ICT Policy Support Programme

Call 3 objective 1.3 ICT for ageing well / independent living

Grant Agreement No. 250505

inCASA

integrated network for Completely Assisted Senior citizen's Autonomy

D6.6 Pilot Evaluation and inCASA Platform Validation and Recommendation

Authors: All Pilots

Project start date: 1st April 2010 Duration: 39 months

Published by the inCASA Consortium

Coordinating Partner: SANTER REPLY Spa 22/07/2013 vDEF

Project co-funded by the European Commission

Within the CIP ICT-PSP Programme

Dissemination Level: Public

Document file: D6.6 Pilot Evaluation and inCASA Platform Validation and Recommendations Report

Work package: WP6 Pilot

Task: D6.6

Document responsible: Jo Fursse CHC

Document history:

Version	Author(s)	Date	Changes made
1.0	Jo Fursse (CHC)	07/04/2013	Expected content and document structure definition
1.0	Trine F. Sørensen (IN-JET)	07/06/2013	Ethical Contribution
1.1	Alexandre Arbaud (INSERM)	21/06/2013	INSERM pilot contribution
1.1	Gianfranco Tarabuzzi (ATC)	21/06/2013	ATC Pilot Contribution
1.1	Alexandre Arbaud (INSERM)	27/06/2013	Updated INSERM pilot contribution
1.1	Gianfranco Tarabuzzi (ATC)	28/06/2013	Updated ATC Pilot Contribution
1.1	Carolina Fernandez (FHC)	28/06/2013	Updated FHC pilot contribution
1.1	S. Patsilinakos, A. Anadiotis, M. Zografou, C. Istikoglou (KGHNI), G. Lamprinakos, K. Papadopoulos, D. Kaklamani, I. Venieris (NTUA)	28/06/2013	Updated KGHNI pilot contribution
1.1	Jo Fursse, Nicky Jones (CHC)	28/06/2013	CHC Contribution, and pilot synthesis
1.1	Fulvio Marchetti (REPLY)	28/06/2013	Contribution to synthesis report
1.1	Jo Fursse (CHC)	29/06/2013	Compiled, formatted and added exec summary
1.2	A. Anadiotis (KGHNI), G. Lamprinakos (NTUA)	09/07/2013	Updated KGHNI pilot contribution
1.2	Gianfranco Tarabuzzi (ATC)	10/07/2013	Updated pilot contribution
1.2	Alexandre Arbaud (INSERM)	14/07/2013	Updated pilot contribution and pilot synthesis
1.2	Carolina Fernandez, Pelayo Benito (FHC)	16/07/2013	Updated pilot contribution
	Helene Udsen (IN-JET)	17/07/2013	Commented on document
1.3	A. Anadiotis (KGHNI), G. Lamprinakos (NTUA)	18/07/2013	Updated KGHNI pilot contribution and pilot synthesis
1.3	Carolina Fernandez, Pelayo Benito (FHC)	18/07/2013	Updated pilot contribution and pilot synthesis
1.3	Gianfranco Tarabuzzi (ATC)	19/07/2013	Updated pilot contribution
1.0	Jo Fursse (CHC)	21/07/2013	Final editing, synthesis chapter, executive summary
2.0	Jo Fursse (CHC) Gianfranco Tarabuzzi (ATC) Carolina Fernandez, Pelayo Benito (FHC) S. Patsilinakos, A. Anadiotis, M. Zografou, C. Istikoglou (KGHNI), G. Lamprinakos, K. Papadopoulos, D. Kaklamani, I. Venieris (NTUA) Alexandre Arbaud (INSERM)	27/10/2013	Updated content based on reviewers comments
3.0/DEF	Jo Fursse	23/12/2013	Updated Executive Summary and Proof Reading

Peer review history:

Reviewed by	Date	Comments
G. Lamprinakos (NTUA)	22/07/2013	
S Galizia (INNOVA)	22/07/2013	
G. Lamprinakos (NTUA)	28/10/2013	
Alexandre Arbaud (INSERM)	28/10/2013	
Fulvio Marchetti (REPLY)	03/02/2013	

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Executive Summary

The inCASA project aimed at developing integrated health and social service models using technology to support the aging or frail population to enable them to stay well in their own homes. Pilots were set up in France, Greece, Italy, Spain and the UK with the specific aim of:

- Investigating populations that could be described as frail or in need.
- Implementing integrated services and tools to support independent living.
- Measuring effect on patient quality of life, clinical and social outcomes, patient and professional perception and organisational delivery.

Between March 2012 and May 2013, 204 participants across the 5 pilot sites were enrolled onto the study. 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 enrolled on to the ATC pilot were deemed to be socially vulnerable. Almost half of those enrolled onto the services were classified (using the Edmonton and G8 Frailty Scales) as being of average frailty or of being very frail. Patients / end users were provided with technology that monitored a combination of physiological and habits measures within their home. Data from the different sensors were transmitted to the inCASA platform and could be accessed via health and social care professionals.

An evaluation methodology was selected to be used for the inCASA pilots that would enable a common set of data to be collected and analysed across all 5 pilots. These common domains included: Patient Perception, Professional Perception, Clinical Outcomes, Organisation / Resource aspects, Economical aspects, Ethical Considerations and Safety.

Within the inCASA project, pilots used technology to develop a profile of a person's behaviour. 5 different habits profiles were developed based on differing patient profiles. These included: COPD, CHF, Cancer, Frail Elderly and users at risk within social housing.

Each profile was tested during the pilot phase and information about suitability and reliability of technology, analysis of data and service response was gathered in order to improve profiles.

- INSERM used actigraphy to determine changes in night time habits for patients who were undergoing chemotherapy.
- KGHNI and CHC used a combination of telehealth and telecare sensors to detect changes from normal patterns of behaviour.
- CHC reported on correlations between health and habits data. As well as presenting examples of where deviations within habits data were earlier predictors of decline in health status.
- ATC were able to use telecare sensors to predict decline in both health and social aspects of their users.

The following provides a summary of the synthesised data as presented in Chapter 7. Individual pilot reports are presented in Chapter 2-6.

Integration

The primary purpose of the inCASA project was to implement the solution in a local context characterized by the growing presence of frailty situations in the population, in line with the local, national and European regulations, recommendations and guidelines. The project was committed to developing a network of homecare services for the frail and elderly, with a specific focus on integrating healthcare and welfare and trying to support these people through the use of ICT in their own homes.

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.

Two distinct service models were developed during the pilot phase. Those services that were aimed at detecting and preventing clinical or social decline of the end users / patients and those services that reorganised existing models of care by moving them into the patients home in order to support clinical and social outcomes.

Prevention and Detection

- 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

In Italy, 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.

Pilots in UK, Greece, France and Spain focused on the management of older people with chronic diseases and the presence of comorbidities, with a closer focus on the disease and their “at home” care and cure, with indirect but demonstrable effects on the social implications.

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.

Despite much effort, the ATC pilot was unable to successfully collaborate with the general practitioners in their pilot. The reasons for this are discussed within the ATC evaluation reporting in section 6. However, the learning from within the ATC pilot and from the evaluation of the other pilots within inCASA has enabled ATC to develop, plan for and present an integrated model to the local municipalities for future development and roll out.

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

- 68% of users reported improved communication within their own organization
- 42% reported improved communication between health and social care

Other benefits reported include:

- The ability to respond quickly to emergencies by receiving immediate alarms and notifications
- 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

However, 63% of professional users reported challenges with other professional groups in relation to the new integrated service. There were a number of suggestions of how to overcome some of the challenges faced with the new service. These included:

- Create a managerial role that would direct cooperating units of the hospital
- Look at using other non-clinical staff to do enrolment, installation and triage
- Development more definitive monitoring protocols
- Enhance the internal promotion of the project

All pilots felt that the services were in their infancy and more work is required to develop these services further.

Patient Perception

A total of 150 patients across the 5 pilot sites completed the SUTAQ patient perception questionnaire.

- Patients felt that access to health care was improved and that it had facilitated improved communication with professionals.
- 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

- Most patients felt that the usage of the inCASA equipment alleviated some of their concerns regarding the management of their condition and that they felt an enhanced sense of security due to the usage of the inCASA services in their homes.
- 56% felt the service had made them more actively involved in their health care.
- While most patients were positive about their experience with being monitored in their own home, none felt it could replace existing care models. However, patients reported that they felt it was very useful as a support to usual service.
- 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.
- Most patients felt that the equipment provided to them was reliable and they reported an overall satisfaction with it.
- Patients felt strongly that the use of the inCASA platform and services should be expanded to include and/or recommended to more people.
- 88% felt that the kits could or should be recommended to others
- 86% felt that the equipment had not invaded their privacy. However some pilots reported patient concerns over being monitored within their home.

Quality of Life

148 patients / end users were asked to complete the SF36 v2 at baseline and end of their time enrolled on to the service.

- Mean scores on all 4 physical and mental health outcome scales show an increase in quality of life when compared to baseline.
- 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 on to the serviceThe FHC and KGHNI pilots both observed increases in quality of life across all of the domains measured. For FHC this was in contrast to results obtained from their control group.

Professional Perception

29 professionals were asked about their experience with the new service and technology. The professional groups included: Health professionals, Social Workers, Community workers, Call Centre workers and Technical Support workers.

- 27% of professional users had used Telehealth technology before and 6% had used Telecare before.
- 72% of professional users rated their overall satisfaction with the new service as satisfactory or very satisfactory.

- 96% of those asked said that they would like to continue using the service.
- 62% of professionals ranked the usability of the technology as very good.
- 96% of professional users rated their satisfaction with the technology as good.
- The integration of services had proved challenging. Some reasons given for the challenges included reorganisation of local services, delays to the start-up of the pilot and cultural differences between organisations.
    - 63% of professional users reported challenges with other professional groups in relation to the new integrated service.
- Failure to decide upon a suitable technical solution (s) within the project consortium led to delays in pilot start up and impacted on the demonstration and evaluation. Reasons for this may have been due to:
    - Unclear user requirements at the start of the project
    - Availability of solutions amongst the pilot partners
    - Competing technical implementation views amongst partners
- Despite the challenges all pilots reported that the integration of services had improved communication between both organisations and professionals.
    - 68% of users reported improved communication within their own organization
    - 42% reported improved communication between health and social care
- All pilots reported that work on defining and refining work flows between services was on-going
- While most professionals reported that they were satisfied with the technology, there had been a number of technical issues reported which had caused difficulties in the delivery of the service.
    - 35% of professional users felt that the technology provided them with the information to manage their patients / end users.

- Improvements to the design of the technology and applications were seen by most professionals as on-going and new requirements to improve functionalities have been developed.

Clinical / Social Effectiveness

CHC, FHC, INSERM and KGHNI all reported clinical outcomes within their evaluation. All 4 pilot sites indicated that use of the inCASA services enabled them to identify patients who were in need of clinical intervention.

INSERM monitored patients at home who were undergoing chrono-modulated chemotherapy for cancer. One chemotherapy course is administrated during four days every three weeks. Because these patients are at high risk of severe toxicity during this treatment, INSERM developed a service that combined the monitoring of body weight, symptoms and night time activity to help support these patients when they are at their most vulnerable and frail. 22 % required a clinical intervention. During the pilot 2 patients were identified as being in immediate need of emergency assistance, a further 7 patients were able to be managed remotely by the nurses for deviations in their weight and symptom scores.

CHC monitored frail elderly patients who had a number of long term conditions. 55 % of patients enrolled onto the CHC service were identified and referred to an intervention during the time that they were being monitored. 44% (17) received some type of intervention. The most common reason for intervention was due to low oxygen levels for patients with COPD. Patients were referred to community pulmonary services quickly which avoided escalation of their condition which may have led to an emergency admission. For those patient who received an intervention over 70% were those that had been rated as average frailty or very frail.

FHC demonstrated clinical outcomes of the in-home tele rehabilitation programme by undertaking comparisons between the COPD patients baseline health status with the health status measured at the end of their training period at home. These were then compared to a control group who received in-hospital training only. The analysis of results offered by the BODE index calculation, using clinical inputs such as MRC, FEV_1 and 6MW test, suggest that making respiratory exercises at home is more efficient than coming to hospital. This was also supported by the outcome of the St. George questionnaire which demonstrated a slight correlation in favour of final health status observed by patients receiving treatment at home.

KGHNI deployed a service monitoring simultaneously health; social and psychological condition via the analysis of a number of clinical and social parameters of patients who had suffered a recent cardiac event. Most interventions were triggered by heart rate alarms helping clinicians identify patients with arrhythmias such as atrial fibrillation. In two of these cases, the inCASA alert was lifesaving as it identified patients at serious risk and resulted in surgical intervention.

A further 6 patients were found to face early depression. This depression was most commonly found in those patients who had recently experienced a recent and serious cardiac episode. Psychologists intervened in each of these cases offering the necessary support.

The ATC pilot, despite not using health monitoring, was able to determine clinical deterioration through the use of other sensors and alert relatives and neighbours in order to obtain clinical intervention.

Organisation / Use of Resources

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 reported time spent on monitoring patients varied between pilots. INSERM reported that it took one hour a day to monitor 10 patients, while KGHNI report 2 hours per patient per week. For CHC, the monitoring time was estimated at 20 minutes per day.

Differences in time taken to monitor patients can be due a number of variables including, reason for monitoring, and the experience of the person doing the monitoring, the information system that is being used and the ease in which the professional can translate the data.

All pilots reported that the introduction of the service was seen as positive by the professionals but the introduction of new services had led to increased workloads for some of the professionals. Much of this additional workload has been due to the following reasons:

- Recruitment of patients / end users
- Installation of equipment
- Monitoring of incoming patient data
- Dealing with support calls from patients and professionals

CHC reviewed case history and service utilisation data for each patient including GP visits, planned and unplanned admissions, ER visits and social service contacts. There was a reported reduction in both planned and unplanned admissions to hospital when comparing data for the time that each patient was enrolled onto the service and compared against the same time period immediately prior to their enrolment. CHC also reported an increase in referrals to social service and community services. This was felt to be an outcome of the study in that patients were being identified to other services.

Economic Reporting

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 presented a hypothesis that a reduction of at least 1 or 2 days of hospitalization 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 hospitalization 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 calculate cost savings based on number of re-hospitalizations averted. The inCASA services contributes to prevention resulting in measurable reduction of the hospitalization needs, a finding that is supported by data made available from the pilot's action log and individual patients' case files; the costs of hospitalizations for CHF patients burden significantly the national health system. For a length of a 5-day admission the cost is 849 euros[1] while for a length of a 10-day admission the cost is 1868 euros[2].

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.

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

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.

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.

Ethical Considerations

Results from the evaluation indicate that overall the project and the pilots did not violate any ethical rights. However a number of issues were raised during the pilot phases which should be considered for the on-going services and development of new:

- Privacy and concern over the use of data
- Use of telecare sensors to monitor continuous activity within a patients home
- The use of the term “frailty” to categories patients
- Reliability and usability of devices and interfaces was felt to be an issue for some professionals.

Conclusions

The inCASA pilots have added to the knowledge base of the potential benefits of developing integrated service delivery for service provider organisations. This provides a concrete starting point for the future development of a more closely integrated healthcare and social care system across Europe.

Pilots have presented outcomes that indicate integrating services can improve the quality of life of patients who are frail and vulnerable. By 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 organizations involved of the importance of joint working between healthcare and social care.

However, there are still many challenges due to the immaturity of a common interoperability model, and the long history of domain-divide between social care and healthcare organisations. In some Pilot countries, such as Italy, this traditional conflict is not well engaged by legislators, and a change would be required to remove first cultural then 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.

1. Introduction

inCASA aimed at developing integrated health and social service models using technology to support the aging population and facilitate them to stay well in their own homes, by means of these specific objectives:

- Providing elderly people with means to profile their habits, while they are at home,
- Providing elderly people (and patients with special needs) with means to monitor their health conditions outside traditional healthcare environments,
- Providing doctors and health professionals with more comprehensive monitoring data for understanding remote user's social/physical conditions and diagnostics.
- Enabling continuity of care through a wider interaction between elderly people and caretakers, especially including not just health specialists but also relatives or people who have close social relations with the user;
- Integrating home automation in a system permitting remote control of electronic devices in the immediate surroundings.

The purpose of the inCASA evaluation is to measure the integrated service models against the aims of the inCASA proposition. The evaluation framework which has been developed for inCASA and is described in Deliverable 6.1, has been based on the MAST Methodology, a validated methodology which has supported the measurement of the evaluation indicators.

1.1 Methods and Design

The study design used for the pilots was a prospective cohort design. This is a longitudinal observational study that follows a group of people over a period of time. The evaluation has assessed the services from the perspective of the stakeholders and organisations involved in the service and have involved multiple data collection methods including interviews, questionnaires and record review.

A minimum of 6 months evaluation data has been collected by each of the pilots.

Overall Evaluation Framework

The following framework describes the minimum data set that was used by all pilots within the evaluation.

Indicator	Stakeholder	Data source / method	Domain
Quality of Life / Wellbeing	End User / Patient / Informal Carer	SF36 Edmonton Frail Scale	Patient Perception
Perception of Service Privacy	End User / Patient / Informal Carer	Questionnaire Interviews	Patient Perception
Perception of Technology	End User / Patient / Informal Carer	Questionnaire Interviews Contact Logs Installation Records	Patient Perception
Clinical Outcomes Degree of change in clinical values	End User / Patient / Informal Carer	Questionnaire Interviews Record / Case Review	Patient Perception
Health and Social Resource Usage Integration	End User / Patient / Informal Carer	Questionnaire Interviews Record / Case Review	Patient Perception

Indicator	Stakeholder	Data source / method	Domain

Perception of Service	Relevant Staff	Questionnaire Interviews Logs Records	Service Provider / Professional Perception
Perception of Technology	Relevant Staff	Questionnaire Interviews Logs Records Training records	Service Provider / Professional Perception
Clinical Outcomes	Relevant Staff	Questionnaire Interviews Record / Case Review	Service Provider / Professional Perception
Health and Social Resource Usage Integration	Relevant Staff	Questionnaire Interviews Record / Case Review	Service Provider / Professional Perception

Indicator	Stakeholder	Data source / method	Domain
Resource Usage	Relevant Staff	Logs Records Interviews Questionnaires	Organisational Change / Service Model Aspects
Service Integration	Relevant Staff	Referrals between organisations Questionnaire Interviews Logs	Organisational Change / Service Model Aspects
Business Models / Pathway Redevelopment	Relevant Staff	Logs Records Interviews Questionnaires	Organisational Change / Service Model Aspects

Indicator	Stakeholder	Data source / method	Domain
Resource Usage	Relevant Staff Patient	Logs Records Interviews Questionnaires	Clinical Effectiveness
Health Interventions	Relevant Staff Patient	Record / Case Review Questionnaires	Clinical Effectiveness
Clinical Change	Relevant Staff Patient	Record Questionnaires	Clinical Effectiveness

Indicator	Stakeholder	Data source / method	Domain
Running costs of delivering the telemedicine service	Relevant Staff Organisations	Logs Records	Economic Aspects
Effects on patients use of health care:	Relevant Staff Organisations	Logs Records	Economic Aspects
Running costs of delivering the telemedicine service	Relevant Staff Organisations	Logs Records	Economic Aspects

Indicator	Stakeholder	Data source / method	Domain
Adverse Effects Service Technical Integration	Relevant Staff End users / Patient	Logs Records Interviews Questionnaires	Safety

Table 1 inCASA Evaluation Framework

End User / Patient / Carer Perception

This will include measures of self-reported quality of life, satisfaction with new health and social service provision, technology and willingness to pay.

Social / Healthcare Professional / Other Provider Perception
This will focus on the impact to the social and health care professional, including satisfaction impact on workload and experience with technology.

Organisational Change / Service Model Aspects
This will focus on the impact of the inCASA solution on health and social organisations including impact on resource utilisation, case management, change in care and organisational pathways. It will also provide information for business models and sustainability of the service model.

Intervention / Clinical Effectiveness
This will cover the types of clinical and social interventions undertaken, who they were taken by and outcomes.

Economic Aspects
This will focus on measuring changes to the cost of providing health and social care within each pilot site as a result of the integrated service model. This will include the costs of changes to resource usage by patients / end users as well as the investment in hardware, software, education and general running costs of delivering the integrated service.

Safety Aspects
Levels of safety and adverse effects

1.2 Purpose and content of this deliverable

Deliverable 6.6 describes the pilot evaluation results. The deliverable is an output from WP6, Pilot Use Cases. This deliverable describes the evaluation data that each pilot site has collected as part of the evaluation. Each pilot site has also described a list of recommendations as an output from the evaluation.

1.3 Outline of this deliverable

Chapters 2 to 6 presents the results of the evaluation data for each pilot site. Chapter 7 provides an overall synthesis report, bringing together the main outcomes from all of the pilots. The annexes contain all of the questionnaires and scales used in the evaluation.

2. KGHNI

Konstantopouleio General Hospital of Nea Ionia (KGHNI) is a public hospital with more than 500 employees (doctors, nurses, physicians, social workers, administrative personnel, etc.) in Athens, Greece. During the last few years, Konstantopouleio General Hospital of Nea Ionia hospital has been carrying out extensive research in to treatment targeted at the elderly and exploiting the technological advances.

2.1 Description of Pilot

The main objective of the KGHNI pilot in the inCASA project is to develop an integrated healthcare service for patients suffering from Chronic Heart Failure (CHF). 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 situations and re-hospitalisation cost reduction. inCASA contributes to delivering new services to patients combining health, psychological and behavioural continuous monitoring and improved quality of life for patients.

The Pilot activities in Greece were primarily motivated by the existing problematic situation as outlined below:

- 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-hospitalization is practically the only way to resolve a heart related issue.
- Health support and Social support exist but their combination is offered in a limited way.
- Healthcare system is based on treatment and not on prevention.

The integrated KGHNI services are designed to complement the established medical services and aim to provide doctors early signs of a patient's deterioration (clinical) and to enhance the patients' quality of life (psychologically, functional-wise in home and in everyday activities). Both components contribute to better CHF patients' prognosis while effectively reducing the risk of re-hospitalization and averting non-required visits to the hospital's out-patient clinic.

In more detail, the specific goals of the inCASA KGHNI Pilot are stated below:

- Improve the speed of delivery and the quality of the provided healthcare services while at the same time reducing costs
- Test and evaluate the organizational cooperation between the involved hospital units in the new inCASA pathway, namely the Cardiology Clinic, the Psychiatric Clinic and the Social Service.
- Reduce the medical risks for the patients due to their continuous monitoring,
- Reduce patients' anxiety about their medical condition

- Understand the health condition of CHF patients in their real life at home by analysing the pilot results
- Discover correlations between the patients' medical condition and everyday habits, thus
- Enable the consolidation of the latter as early indicators of worsening clinical status
- Demonstrate that the active involvement of relatives and the assistance provided by social workers contribute to the patients' overall quality of life
- Prolong elderly patients independence by supporting them in their own home
- Enable early discharge of patients
- Improve medical therapy in order to decrease the risk of hospital readmission

The Pre-Pilot activities began in October 2011 with 2 patients using the inCASA Telehealth solution. After staff training and technical tests, Pilot activities began in March 2012 with daily remote monitoring of the included patients' health status. On September 2012, the inCASA Pilot service was enhanced with the addition the concurrent monitoring of habits and home environment conditions and the depression monitoring via the mediation of expert psychologists. This health and care integrated service run smoothly for 9 months, till the end of June 2013. The staff involved include Cardiologists, Nurses, Psychologists, Social Workers and Technicians. 40 patients were recruited and participated in the inCASA KGHNI pilot for an average monitoring period of two and a half months each. Last but not least, National Technical University of Athens (NTUA) was a supporting hand for KGHNI in the whole Pilot run taking care of all technical issues and having active role in the service design, implementation, deployment and finally evaluation.

In this report, a multi-layered evaluation of the tested service will be reported while further recommendations for future development will be stated too.

2.2 Methods and Design

The evaluation method of the inCASA KGHNI service is based on the MAST methodology. A series of questionnaires were used in order to reveal the outcomes on every single aspect of the inCASA solution. All inCASA common questionnaires can be found at the Appendix A of this document. A multi-perspective evaluation has been conducted, mainly based on the following supporting tools in summary.

- Demographic analysis through an inCASA common template questionnaire.
- Patients' level of frailty categorization using the Edmonton Frail Scale which is included in the inCASA common set of questionnaires.
- Usage of the Kansas City Cardiomyopathy Questionnaire for initial health status evaluation prior to the Pilot inclusion.
- Patients Perception analysis using the SUTAQ questionnaire which is included in the inCASA common set of questionnaires. This analysis was performed with high priority as it was considered crucial to receive feedback from the elderly people concerning their perception of the delivered inCASA service.
- Analysis of the changes in the quality of life, measured using the inCASA common SF-36 v2 questionnaire. Again, this task was treated with a lot of attention as it was the one to reveal the impact that the inCASA monitoring period had on the patients.

- Professional perception evaluation, measured using the relevant inCASA common questionnaire administered to the Professional stakeholders with core participation in the Pilot activities.
- 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's 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 specifications.
- Ethical issues analysis based on the pilot action log and on the continuous monitoring of the feedback both from the patients and the Professionals.

For every type of questionnaire that required a response from the patients, this was done in person at the patients' home. All 40 patients were willing to provide their opinion and no one denied cooperating. KGHNI professionals interviewed the patients and recorded all responses that were later analysed statistically.

Questionnaires that required a response from the Professional stakeholders, they were administered to the professionals via the mediation of NTUA inCASA personnel who conducted the procedure. Obviously, due to their professional nature, no one from the selected KGHNI professionals participating in the interviews posed any objections to answer to any of the questions. 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

2.3 Results

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

- 40 patients included, having as commonality their suffering from Congestive Heart Failure (CHF)
- Their average age is 63 years old
- The recruited patients were 30 men and 10 women
- 34 out of 40 are married
- Half of them have retired

- The majority of them live with their husband. 5/40 live alone
- 6/40 smoke regularly
- 6/40 drink alcohol regularly
- 11/40 had no previous experience with PC usage
- 3/40 had no previous experience even with a cell phone

We can conclude that the majority of patients do not live alone and enjoy the support of the family environment. Meanwhile, it was a considerably challenge that many of them are not familiar at all with the new technologies. We will analyse in the next sections of this report how this challenge was overcome and how the patients felt about using the inCASA interface. We can already provide the information that even the ones having no previous experience with PC usage were finally enthusiastic from their daily usage of the inCASA platform. Finally, taking into consideration the Demographic analysis results, it is worth noting that 15% of the patients follow unhealthy habits, like smoking and drinking alcohol regularly. These habits are mainly followed for psychological reasons, so the role of the inCASA psychologists involved in the process also includes to convince these patients for what is really worthy for their health and life in general, always handling these cases with the appropriate attention required for facing addictions.

Edmonton Frail Scale

The following list summarises the patients' answers regarding their frailty:

- Half of the patients have been in-hospitalized at least once during the previous year.
- Most patients assess their health as moderately good. One third of the patients assess their health as moderately bad or bad. There were two patients that assess their health as excellent.
- One third of the patients can only partially rely on somebody to help them when in need of help.
- Half of the patients receive over five different medications.
- One fourth of the patients forget some times to take their medicines.
- Almost half of the patients frequently feel sad or depressed.
- 6 of the 40 patients face difficulty when they stand-up to walk a few meters.

After scoring the corresponding questionnaire to determine the level of frailty for each patient, we derived the following distribution:

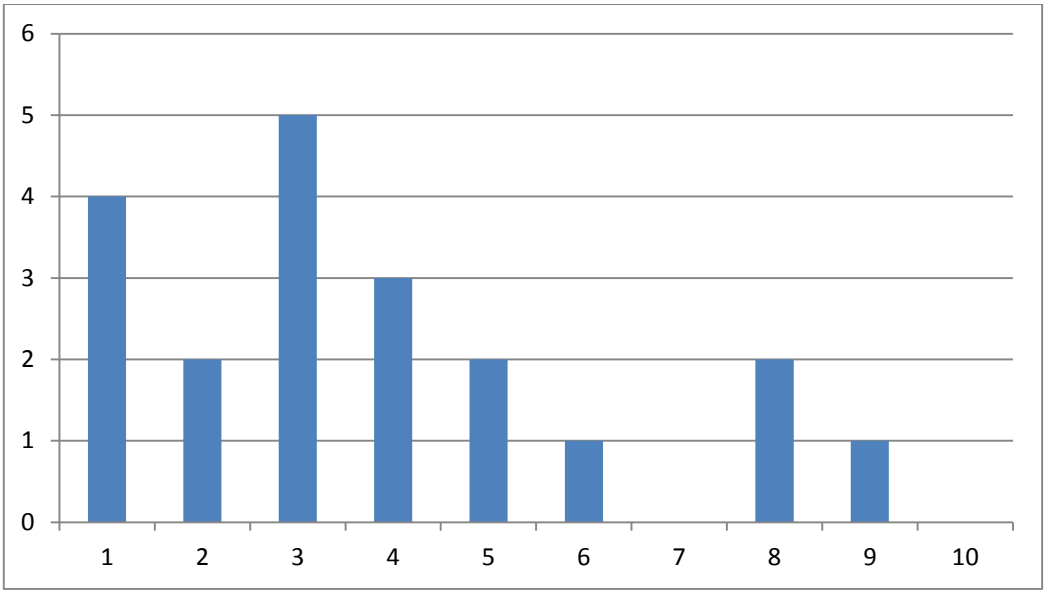


Figure 1 Number of patients categorized from 1-10 according to the Edmonton Frail Scale

From the above result we can determine that 24 of the 40 patients are scored low (from 1 to 3) according to the Edmonton Frail Scale. We can also see that only few of the patients have comparatively scored high in the same scale. The mean score of frailty distribution is 3.58; the patients thus are overall categorized as slightly frail. In conclusion, even if the CHF patients of KGHNI face a considerable health problem, this is not preventing them in most of the cases from being able to perform alone their daily routine activities. Frailty is not therefore the main characteristic of KGHNI CHF patients.

Kansas City Cardiomyopathy Questionnaire

The Kansas City Cardiomyopathy Questionnaire (KCCQ) is a 23-item instrument that quantifies physical function, symptoms (frequency, severity and recent change), social function, self-efficacy and knowledge, and quality of life. The questionnaire was administered to the patients that participated in the Greek pilot by social workers, during the installation of the inCASA equipment in their homes.

The patients' answers to the KCCQ helped build a proper profile over the symptomology, daily functionality and quality of patients' life. The following table summarizes the mean scores of the individual items of the questionnaire over the participating patients' population

	Mean	**Stdev**
Physical Limitation	83.70825	13.36142
Symptom Stability	50	9.805807
Symptom Frequency	83.7495	17.41189
Symptom Burden	80.83425	18.0216
Total Symptom	82.292	17.34541
Self-Efficacy	65.9375	18.55939
Quality of Life	63.12425	18.86124

Social Limitation	79.0105	18.29869
Overall Summary	77.034	13.53601
Clinical Summary	82.2015	14.55876

Table 2 Average KCCQ scores over all participating patients.

The overall mean summary score of 77.034 is mainly mapped according to the literature to NYHA (New York Heart Association) Class II which means that patients are facing slight but not major limitations. According to their KCCQ scoring, almost 20% of the inCASA KGHNI CHF patients are mapped to a NYHA Class III classification which corresponds to a marked limitation while there were really few evidences of severe limitation that is mapped to NYHA Class IV classification.

Patient Perception

KGHNI is using the standard baseline questionnaire agreed among pilot partners to evaluate the patients' perception of the inCASA platform and services. The SUTAQ questionnaire, fully available in the Appendix A, was provided to the patients by social care workers that were also present in the patients' homes while the technicians proceeded with the de-installation of the equipment. All patients were eager to offer their feedback on the inCASA services and in many cases also an informal discussion was initiated by the social workers, while gathering their responses to the questionnaire.

As per SUTAQ analysis**, "**Responses to the questions are measured using a 5 point Likert Scale. The wording of the 22 items (statements) in the Likert scale questionnaire are both positive and negative and this reduces the risk of bias**".**

We have chosen to convert the responses of negatively biased questions in their positive equivalent, in order to be able to add their scores in the respective categories.

For example:

On question No 5. "The kit I received has invaded my privacy." we make the following conversions

1 (Strongly disagree) → 5

2 (Disagree) → 4

3 (Undecided) → 3

4 (Agree) → 2

5 (Strongly agree→ 1

The patient perception is split into various subscales. The average scoring results on each subscale as well as the respective standard deviation are shown below.

Subscale	Average scoring (1-5 scale)	Standard Deviation
Enhanced Care	4.26	1.00
Increased Accessibility	3.90	0.85
Privacy and Discomfort	4.76	0.55
Care Personnel Concerns	4.60	0.55
Kit as Substitution	2.58	1.30
Satisfaction	4.46	0.57

Table 3 Patient Perception subscales

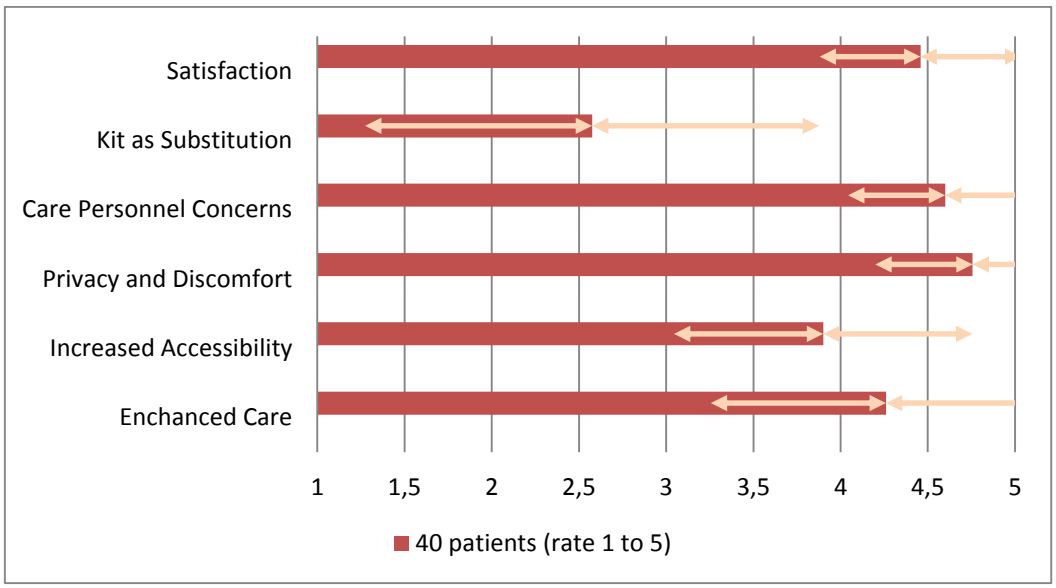


Figure 2 Patient Perception subscales graphical results

Average scoring on each of the 22 SUTAQ questions is shown in the next figure.

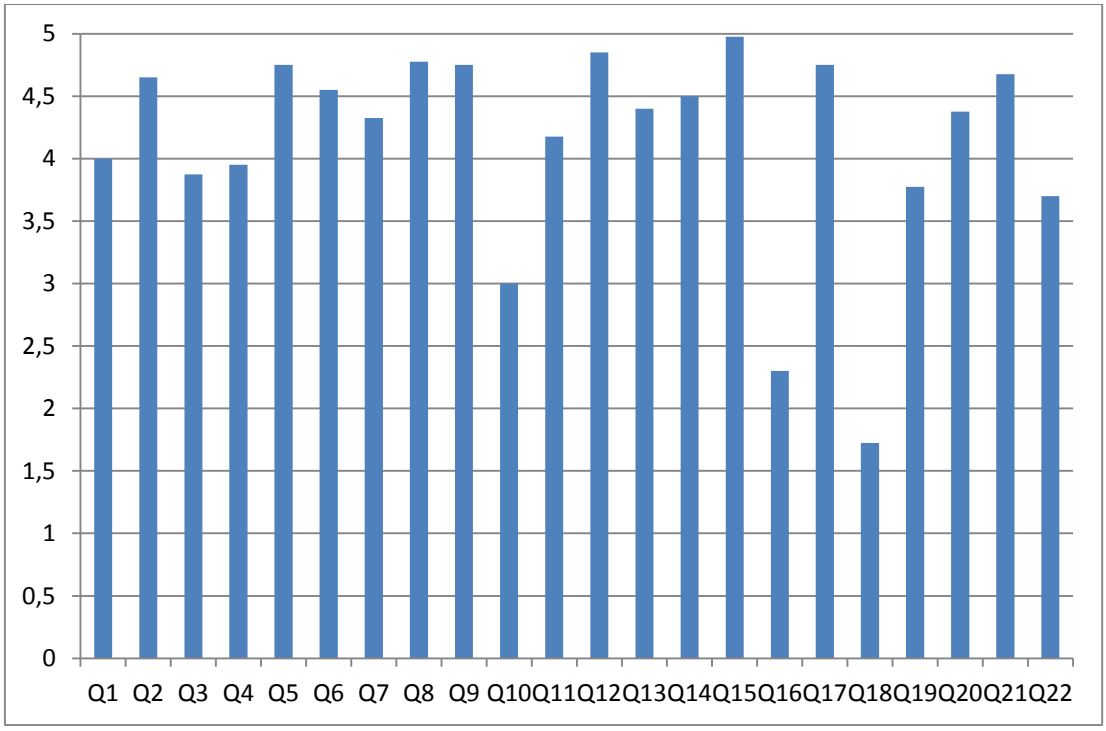


Figure 3 Average scoring (1-5 scale) per SUTAQ question

Here is a summary of the most important conclusions with respect to each of the 22 SUTAQ questions results:

1. 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 premises.
2. Patients emphatically reported that the use of the inCASA platform equipment to conduct medical measurements did not interfere with their daily routines. This result was largely expected since Congestive Heart Failure patients are accustomed to following a strict daily self-care program. Furthermore, the user-friendly design of the inCASA patient's computer interface turned the whole process of conducting measurements into a pleasant action.
3. Regarding the question on whether the usage of the platform facilitated patients in accessing care services, the majority of responses received were positively biased. While patients understood that remote monitoring of their condition by trained medical personnel offered value and helped them to access further medical assistance when required, they were also "culturally-biased" since the usage of Telehealth / Telecare services in major Greek cities (in contrast to selected cases in islands or rural areas) has yet to be adopted on a truly wide base.
4. Patients felt that using the inCASA platform contributed in their well-being medical-wise. This feeling was reinforced by the platform attributes already mentioned. Many of them noted that: "*The inCASA daily schedule is a pleasant routine that helps me not losing control of my health status*"

5. The vast majority of the patients did not think that the inCASA equipment intruded in their private life in any way. Only 2 patients out of 40 were inclined to reject the use of Telecare equipment (i.e. motion sensor) as intrusive to their private life. No one of them considered the Telehealth equipment as intrusive.
6. The majority of patients were satisfied with the provided training on equipment usage. Generally, the user interface of the specialized 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). It is also important to note that installations were conducted by the NTUA personnel who have an excellent knowledge of the provided equipment and of the inCASA platform overall.
7. Patients trusted the provided inCASA equipment to be reliable. Since we are talking about a pilot deployment there were some technical problems but that was largely expected and understood by the patients. They also appreciated that NTUA technicians solved any technical issue in a short time, no more than 3 days.
8. Patients strongly mentioned that no physical or psychological inconvenience incurred by the deployed equipment. Patients were already familiarized with the provided devices that are used by them (blood pressure monitor, weight scale, Oximeter), something totally expected taking into consideration that they are CHF patients.
9. There weren't concerns expressed regarding the personnel assigned to monitoring the patients' condition. Related to this conclusion, we should note that the inCASA patients are followed regularly by the Cardiology Clinic of KGHNI and so there is an already built trustworthy relationship between them and the KGHNI professionals.
10. Patients felt that the usage of the inCASA equipment alleviated some of their concerns regarding provided care, but only at a medium level. This is expected since all patients face important health problems and their concern about the provided care is not easy to be significantly eliminated.
11. The majority of patients thought that the use of inCASA services contributed in making them more actively involved in their personal health. They all noted that the daily monitoring raises their active role.
12. 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 trust the personnel conducting the monitoring and, mainly, they expect from them to use these data in order to help them with their health problem.
13. The majority of patients thought that the use of the platform services allowed professional carers to monitor more closely their condition on a daily basis and more efficiently thanks to the inCASA technology.
14. All patients declared that were satisfied by the provided equipment and quality of services received. Actually, most patients were thrilled to participate in the KGHNI pilot. Some patients proactively wanted to register for future extensions of the programme or related programmes. There was also an exceptional patient case that felt that the inCASA equipment had become a constant part of his life and he was really disappointed when time came for the de-installation. We are determined to continue offering the service to this patient even after the project's end.
15. 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. In

fact, remote monitoring solutions like inCASA are not yet part of the Greek healthcare system's state of the art.

16. Patients were very sceptical on the issue of replacing the current model of care provision with integrated/novel care models like the one promoted by the inCASA programme. They see inCASA as a very important added value to the current model of care provision but not yet as a complete substitution.
17. On the other hand participating patients strongly agree that the inCASA services could constitute a useful addition to the already provided care services.
18. In line with the above expressed views, all patients strongly felt that the inCASA platform cannot in any way replace their personal face to face intercommunication with carers (health or social).
19. Generally there were positive views expressed on the question whether the platform helped them enhance their communication with carers. It is expected that this sentiment will be enhanced with the gradual escalation of the provided socio-health integrated care services.
20. Finally, most patients though that the use of the inCASA services did not intervene in the continuity of care provided. This was largely expected since a major component of the effective treatment of a chronic condition such as congestive heart failure is the development of trust with carers; the Greek pilot was designed carefully not to intervene in any way to the established patient-doctor relationship.
21. Patients did not explicitly express concerns on whether the health carers monitoring their condition through the inCASA platform did not have adequate knowledge on their personal medical history.
22. The daily use of the platform made the patients feel less concerned, but only at a medium level, about their health condition. This outcome is in line with the outcome #10 above.

Quality of Life

Changes in the patient's quality of life were measured through a double completion of the SF36-v2 questionnaire, in the beginning and in the end of the monitoring period.

This is a summary of the results reporting on mean and standard deviation scores across all the patients that have participated in the Greek pilot (*N*=40), results items and summary measures (as defined in the SF-36 v2 questionnaire).

	Start		**End**		**Difference of Mean**	
	Mean	**SD**	**Mean**	**SD**	**in Value**	**as Percentage**
Physical Function (PH)	54.50	16.67	55.90	15.99	1.40	2.56%
Role Physical (RP)	49.45	18.49	53.82	16.32	4.38	**8.85%**
Bodily Pain (BP)	57.89	15.37	60.21	14.57	2.32	4.01%
General Health (GH)	42.26	11.49	45.71	11.46	3.45	8.16%
Vitality (VT)	51.74	9.10	53.25	7.86	1.51	2.91%
Social Functioning (SF)	52.40	13.24	56.25	12.56	3.84	7.33%
Role Emotional (RE)	52.47	21.02	59.06	21.15	6.59	**12.57%**
Mental Health (MH)	48.64	13.22	50.20	12.71	1.57	3.22%

Physical Component Summary (PCS)	46.92	7.59	49.17	7.10	2.25	4.80%
Mental Component Summary (MCS)	46.00	9.15	48.48	7.89	2.48	5.40%

Table 4Synopsis of SF36 results

The differences in the various components compared in the beginning and in the end of the monitored period are depicted in the following graphs.

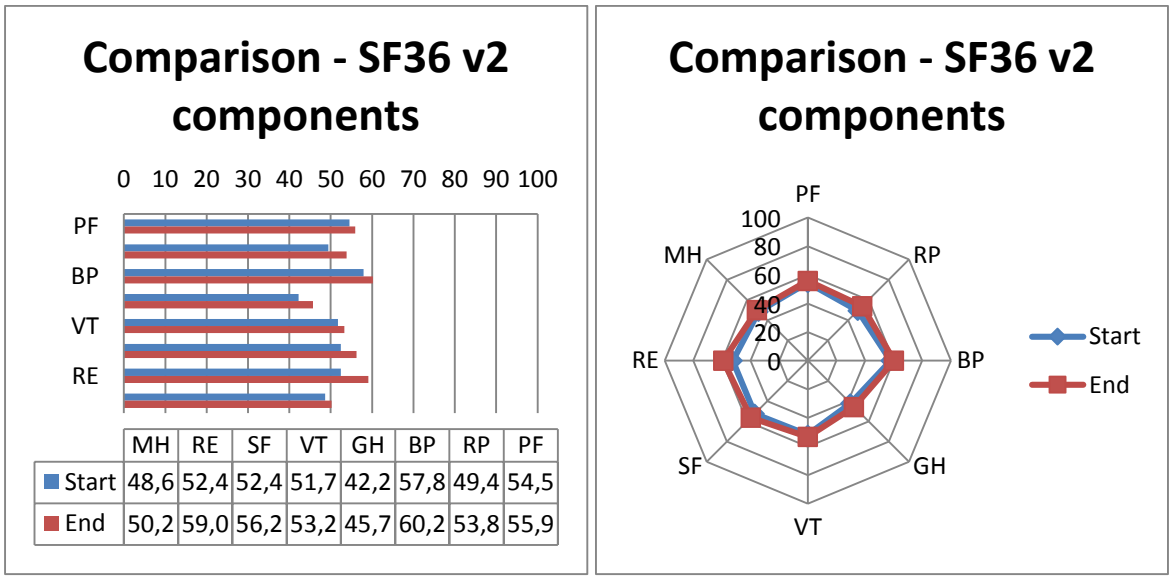


Figure 4 Changes in the quality of life components

It is worth mentioning at a first glance that quality of life was improved in all aspects after the inCASA monitoring, even at a minimum level in most of the cases.

We compared the SF-36 v2 questionnaires scoring when a user started participating to the pilot and when concluding the pilot and we compared over the principal components. For comparison reasons we arbitrarily set a threshold of change to 5% for an individual component to be seen as statistically significant.

Based on the above criteria, we can see significant variation in the following items:

- 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)

These items contributed to improvement both in the Physical Component Summary (PCS) and even more in 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.

From the above findings, we can infer that the inCASA services used by our 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 leaded them to predominately 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 to 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. We can conclude that improved patients' heart failure self-treatment, the improved prevention of incidents due to continuous remote monitoring via the inCASA platform and finally the monitoring of the patients psychological condition constitute a much improved framework for providing care to CHF patients.

Another important form of self-evaluation is the EQ-5D questionnaires answered by the patients when they began and when they ended their participation in the Greek pilot. The patients self-rate their health on the so-called visual analogue scale rating from 0 to 100. Again, an increase in their self-rating scores was observed at an average level of 9.2% which, following the above facts, emphasize the conclusion that patients felt more secure, independent and self-confident through the inCASA monitoring and these emotions, together with the actual improved healthcare service they received, allowed them to have a more optimistic feeling regarding their health status. It is worth noting that the specific support they received from the inCASA KGHNI depression monitoring and psychological support procedure was widely appreciated by the patients and played a major role towards the observed emotional improvement.

Professional Perception

KGHNI is using the standard baseline questionnaires agreed among pilot partners to evaluate the professionals' perception of the platform. This questionnaire is heavily biased towards the integrated aspects of the provided inCASA pilot services. In the KGHNI pilot case the main stakeholders from the carers' perspective that should cooperate to achieve the objectives set forth are the KGHNI cardiology clinic doctors and nurses, the social workers in the respective department of the hospital and the psychologists in charge of monitoring on a weekly basis the patients. It should also be noted that pilot's technical support and installation needs are supported by NTUA personnel.

The following professional members responded to the relevant questionnaires:

- 1 Representative Cardiologist

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

An analysis has been conducted for their answers both in terms of service and technology evaluation. Meanwhile, important recommendations were recorder in the framework of this activity that could be fed as requirements in the future inCASA development process.

Integrated Service

As a general conclusion, all Professionals were enthusiastic with 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.

Here we summarize the most remarkable facts concerning the professional perception of the inCASA Service.

	Cardiologist	Psychologist	Nurse	Social Worker
Overall experience with the integrated service	"Easy to use inCASA clinical portal, first time to see a combination of health with habits and psychological data. This fact was by itself challenging for me. The service was also constantly evaluated both from a professional and a patient perspective and this helped in the continuous monitoring of the results and in the service progressive improvement"	"Even if not familiar with Web Portals, the inCASA system is an easy to use application providing interesting data from various monitoring fields."	"I was quite satisfied to review such wide range patient's data (medical & habitual). This was a motivation for me to get better informed on these domains"	"I am administering the weekly phone conference depression monitoring questionnaire and any other type of direct communication needed with the patient"
Benefits from the service usage	1. Receiving immediate alarms in case of heart failure emergency that require	1. Thorough follow up of the monitored patients 2. Deeper understandi	1. Receiving immediate alarms in case of heart failure emergency	Cooperation with the Doctors and the Psychologists in order to get better informed on

	direct intervention (e.g. heart rate out of normal threshold) 2. Thorough follow up of the monitored patients 3. Deeper understanding of the importance of the psychological monitoring of CHF patients that was obtained thanks to the cooperation with the inCASA KGHNI psychologists. 4. Possibility to correlate medical with habitual data 5. Possibility to correlate medical with environmental data 6. Possibility to correlate	ng of psychological and health status correlation on CHF patients 3. Possibility to correlate medical with psychological data	that require direct intervention (e.g. heart rate out of normal threshold) 2. Thorough follow up of the monitored patients	every patient and contact them in an appropriate way with respect to their personal status.

	medical with psychological data			
Effects on the communication within your own organisation	"Cooperating with different units that we were not used in communicating with prior to the inCASA project. More significant interfacing unit was the Psychiatric / Psychological Clinic and the Social Service of our hospital"	Started multi-disciplinary group sessions with Cardiologists that were not happening in the past	At the beginning of the integrated service testing, communication channels were not fully developed with other professional groups but this was strongly improved in the next phases	
Suggestions for service improvement	"I really count a lot on a mobile inCASA application since this would help me receiving alerts even when I am out of office, something common to Cardiologists"	To make it more personalized, providing the ability to set rules and thresholds regarding the psychological monitoring per case since each monitored person has its own single characteristics. Provide also specific psychological support to relatively young patients who have suffered from an early cardiac episode. This was also an outcome of the SF36 and of depression monitoring questionnaires. Establish a support process from the social workers and psychologists.	Inclusion of specifically educated nurses at home when there is such need.	I propose that our Hospital's social service should inform more on the procedures of the inCASA program and of the suggested daily routine that a CHF patient should follow.

Table 5 Patient Perception Summary

Integrated technology

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 a patient's history graph available when examining the current status

Concerning the problems that were faced in the technical field, Professionals agreed that these were mainly appearing at a sensor level and only concerning the Telecare sensors of temperature, motion detection, TV usage and chair permanence which may not always send accurate values due to their sensitivity. A deeper research in the market of Telecare sensors was thus proposed for the future evolution of the platform. Technical problems with the Telehealth devices were present very rarely, causing no issue in the normal operation of the Pilot service.

Clinical Outcomes

KGHNI is using the common indicators agreed among partners to evaluate the clinical effectiveness of the pilot. One source of information is the pilot action log where all events and subsequent Health and Social interventions are transcribed. Another source is the patients' clinical health records, updated by the KGHNI cardiologists acting as case managers. Health records and case folders contain detailed information on the daily tracking of the clinical measurements contacted remotely via the inCASA platform, alerts raised due to deviations from the habits profile automatically built by the platform and finally all related demographic and questionnaires data.

It is clear that clinical effectiveness has been improved due to the usage of the inCASA solution that gives Professionals the required tools for keeping track of the patient's clinical history and for being notified immediately in case of emerging situations. At the same time, patients feel safer and more secure as they know that there is always a Health Professional that is taking care of them, even remotely, and will react with no delays when their status may be worsening. This emotion is depicted in the analysis of Patient Perception questionnaire and is a positive factor for every human being's health status. At this point, it is important to note that this close follow-up of the patients is assisted by the limited number of included patients in the Pilot and would be more challenging to manage in case of a wide commercial deployment of the solution. Since inCASA technology has proved that can handle at the same way a big amount of data too, the basic challenge in this case of large deployment would be the organizational transformation that would be needed in order to support many patients with the same quality level as during the Pilot life. Another major key point of the clinical effectiveness is considered to be the depression monitoring, performed in a weekly basis via the following tools:

- Zung Self-Rating Depression Scale (SDS): weekly administered to patients via phone conference initiated from a KGHNI social worker or psychologist in order to timely detect any changes in their psychological condition. Analysis and evaluation is performed by psychologists.

- Beck Depression Inventory (BDI): rating scale to assess the severity of depressive symptoms; administered to patients when joining and when leaving a pilot group in order to gather enough evidence for a comparative study. Analysis and evaluation is performed by psychologists.

Depression is a common comorbid condition in heart failure and the two conditions have been shown to share similar underlying physiologic mechanisms. The prevalence of depression in patients increases sharply with the severity of heart failure symptoms, an important consideration when confronting patients with worsening failure. Depression leads to poorer outcomes in patients with heart failure, including increased risk of hospital readmission and death. Moreover, the presence of depressive symptoms has a negative impact on every dimension of health-related quality of life in patients with heart failure, including physical functioning, social functioning, and mental health.

All patients participated in the activity of psychological monitoring willingly. As general outcomes of the procedure, it was recorded that the older patients were more pessimistic about the economic situation of the country and the fate of their children and not for their health. Also, patients who had a good family and supportive framework showed better psychological situation, than those facing family problems. Moreover, due to the need of patients for discussion, there has been applied progressively a change in the monitoring procedure. While in the beginning questions followed the SDS or BDI questionnaires, in the next phase questions retained the same context but became more open, giving to the patients the opportunity to express all their feelings and concerns.

Scheduled periodic meetings took place between the case managers for each patient and the assigned psychologists that monitor patients for signs of depression; they discussed the results of the above questionnaires results that were also made available through the Consumer Applications web-UI (professionals' portal).

Regarding the evaluation of the clinical outcomes, there are a number of cases that the inCASA services helped in the prevention of incidents that would have a negative effect on the health condition of the patients. Overall, the notable interventions by Professionals that were triggered by the inCASA monitored data during the Pilot life are shown in the following table. We have omitted pre-scheduled communication with the patients or informative phone calls.

Sum of Doctors' interventions	Sum of Nurses' interventions	Sum of Psychologists' interventions	Sum of Social Workers' interventions
21	23	6	10

Table 6 Sum of interventions

All interventions are stored in the log file of each patient and included medication change, medication adjustment, communication for important advises and, even, surgical operation as far as the health part is concerned.

From the part of the social monitoring, interventions included on site-visits by the social workers to help a minority subset of the monitored patients that were really frail with their daily activities and encourage them appropriately. Moreover, the psychological/depression monitoring procedure that was normally done through phone conferences triggered 6 interventions due to signs of depression. In these cases, a specific session with the psychologist was arranged and these patients were followed face to face for the needed time frame for which their psychotherapy would be fruitful.

A characteristic example of the clinical effectiveness of the Pilot involving a multi-disciplinary group of Professionals was patient #17, whose case study is analysed below.

At first, his out of threshold measured values of Heart Rate triggered an intervention from the nurse who was alerted by the system. The patient was examined and, taking into consideration his medical history and other tests such as Holter monitoring and cardiac catheterization, cardiologists decided to proceed with a needed surgical operation (Implantable Cardioverter Defibrillator - ICD).

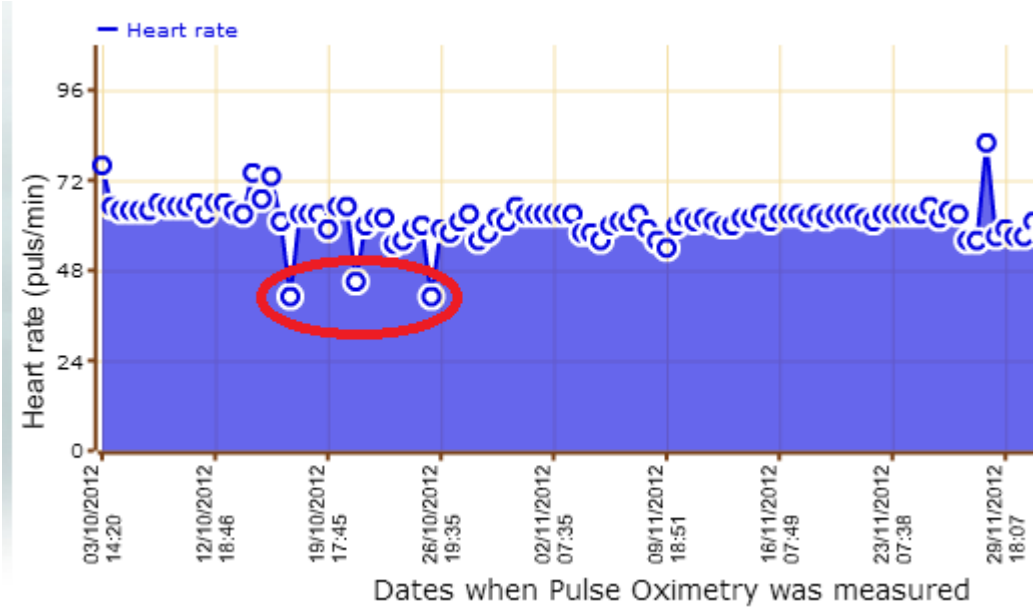


Figure 5 Pulse Oximeter

The operation was quite successful. The patient felt initially discouraged from his health problem since he had not experienced for a long time a cardiac episode. The threshold of light depression was reached in the weekly monitoring questionnaires and this observation triggered the intervention of the responsible psychologist who scheduled a session with the patient. No special medication was given to the patient since 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 the figure below, reveals that the early signs of depression were successfully and immediately managed and the psychological condition of the patient returned to absolute normalcy. It was very important that the Psychologist was aware of the health problem of the patient and had consulted the responsible Cardiologist before organizing the sessions with the patient.

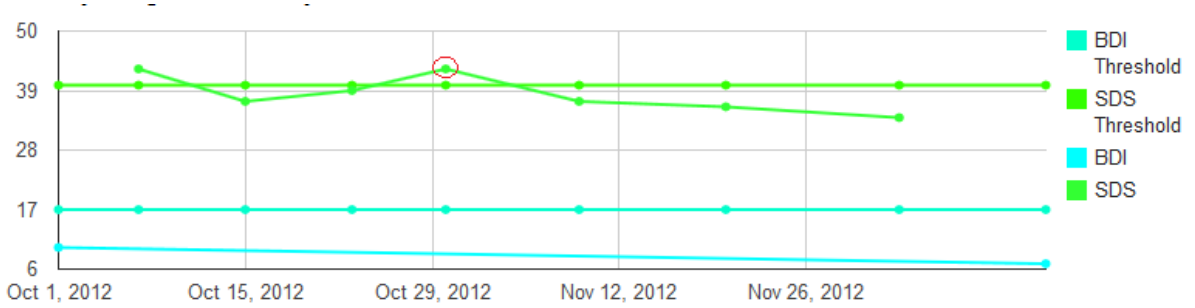


Figure 6 Depression Measure

In the clinical effectiveness domain, it is also important to note the added value by the advanced alerting mechanism implemented in the inCASA SPP component and used in the KGHNI pilot too. The alert functionality supports not only alarm notification but also automatic alert status update throughout the life cycle of the alert. In the next figure, it is shown a case of an alert, generated due to an out of normal thresholds oxygen saturation level measurement, which was automatically updated to inactive when a new measurement inside the specified thresholds was received.

Blood Oxygen alert for patient

Type	Value	Timestamp	Severity/Priority	Phase	State
Blood Oxygen	96	2013-06-06 at 09:57:31	H-PH	end	inactive
Blood Oxygen	89	2013-06-05 at 22:28:03	H-PH	start	active

Figure 7 Clinical alert life cycle example

Alerts

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

- Body Weight
- Blood Pressure
- Pulse Oximetry
- Heart Rate
- Chair Permanence
- TV Usage
- Indoor Movement
- Indoor Temperature
- Psychological parameters which allowed to expert psychologists to derive conclusions with regard to the depression status of the monitored CHF patients

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

One core aspect of the inCASA platform was the ability to reason 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:

1. **Body Weight:** An alarm was generated when an increase of more than 1Kg 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.
2. **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, while the default threshold values were 80 mmHg – 170 mmHg. Alarms of this category should be treated as of high priority and severity from the medical team.
3. **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.
4. **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.
5. **Chair Permanence, 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. In the inCASA KGHNI example, this value was set to 30%. The inCASA platform offers also the possibility to classify the various deviations offering to the operators a quick analysis on the habits change level. Deviation levels from 30% to 50% were characterized as “Away” from the habitual profile, while deviation levels more than 50% were characterized as “Far Away” indicating an even more intense behavioral change. This kind of alarms was analyzed 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 behavioral alteration. After this first level intervention, the whole case manager professional team decided for the next actions if there was proven to be such need.
6. **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. Specific focus is on the high temperature values encountered in Greece during the summer period as this may adversely affect the clinical state of a CHF patient. Thresholds were set in the Celsius scale; <12 °C were characterized by the system as “Very Low”, <15 °C “Low”, >25 °C “High” and >30 °C “Very High”. When such alert appeared, social workers informed accordingly the patients and reminded them the importance of an appropriate indoor environment concerning their well-being.
7. **Zung Self-Rating Depression Scale (SDS) and Beck Depression Inventory (BDI):** The usage of these two well recognized depression monitoring questionnaires 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 emphasized 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, an important volume of 67 alarms was generated which can be divided as shown in table 7. We can note that heart rate alarms were the dominant alerts, following the fact that CHF patients face arrhythmias such as atrial fibrillation. In two of these cases, the inCASA alert was lifesaving as it allowed the on-time performance of the needed surgical operation (Implantable Cardioverter Defibrillator).

Moreover, 6 patients were found to face early depression – especially the ones who had experienced a recent and serious cardiac episode. Psychologists intervened in each of these cases offering a supportive psychotherapy.

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

Certainly, the most challenging interventions were the ones which required integrated case review. We have already presented an integrated case study review above which summarizes the inCASA added value in the framework of the KGHNI Pilot study.

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 7 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. We have already mentioned the importance of the alert's life cycle mechanism which can provide a quick and useful summary to the operators with respect to the evolution of an alert event.

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

Figure 8 Heart Rate alarm example

Type	Value	Timestamp	Severity/Priority	Phase	State
Temperature	30.17	2013-05-25 at 18:30:50	H-PM	end	inactive

Figure 9 Temperature alert example

The above alerts can be also presented in the following **Errore. L'origine riferimento non è stata trovata.** where we summarize 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.

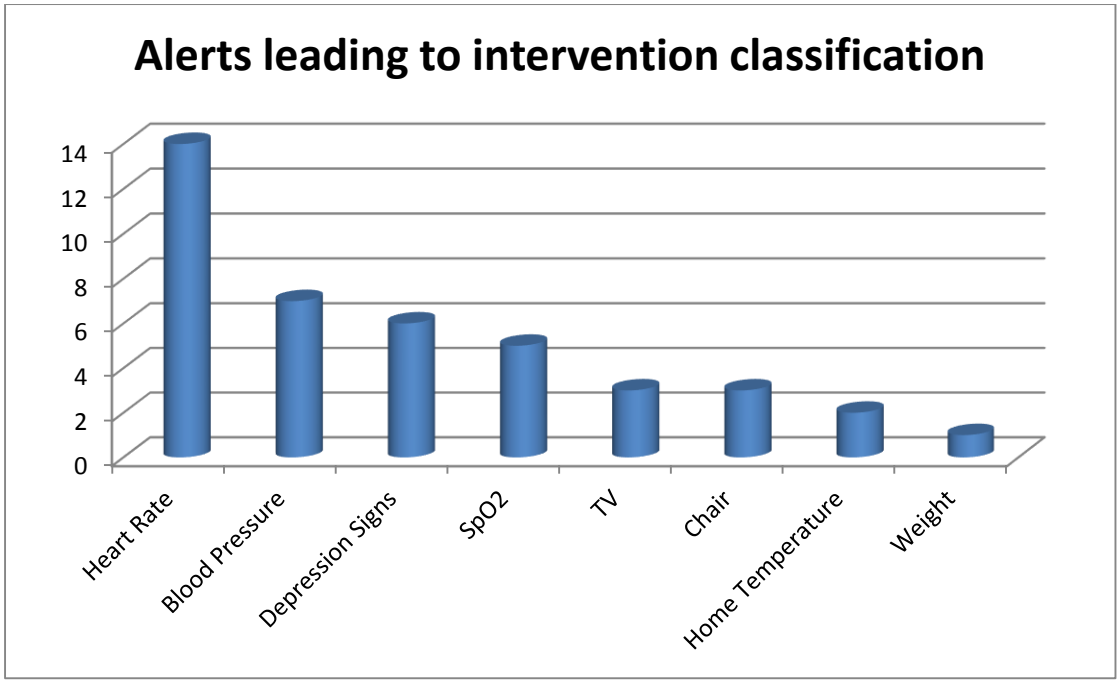


Figure 10 Alerts Classification

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. It should be noted that the vast majority of patients were constantly enthusiastic with their participation and activities in the framework of the inCASA monitoring.
- Psychotherapy sessions set up in case of depression signs. This kind of intervention is considered to be the most time consuming among all, as no immediate solution can be applied. Indeed, three out of the six patients that exceeded the thresholds of depression during the Pilot, are still being consulted by the Psychologists in a weekly basis after the project's end.

Last but not least, we can refer to the changes in the alarms protocol during the Pilot phase based on the respective Lessons Learnt:

- In the first phase, the only upper threshold for heart rate was 100 BPM. Due to its already explained significance, it was decided to create another level of "Very High" heart rate with a threshold of 130 BPM in order to handle appropriately the high emergency episodes.
- In the first phase, Diastolic Blood Pressure (BP) was also included in the alarm generating parameters. KGHNI Cardiologists decided to omit it from this list as it could not lead to safe conclusions according to them. Systolic BP was of course always an alarm generating parameter while the medical team kept observing the trend of the Diastolic BP graph for each patient despite the fact this could not generate an automated alert.

Organisation / Use of Resources

KGHNI Pilot run with respect to the following pathway in which professional actors are shown together with their role and their cooperative activities.

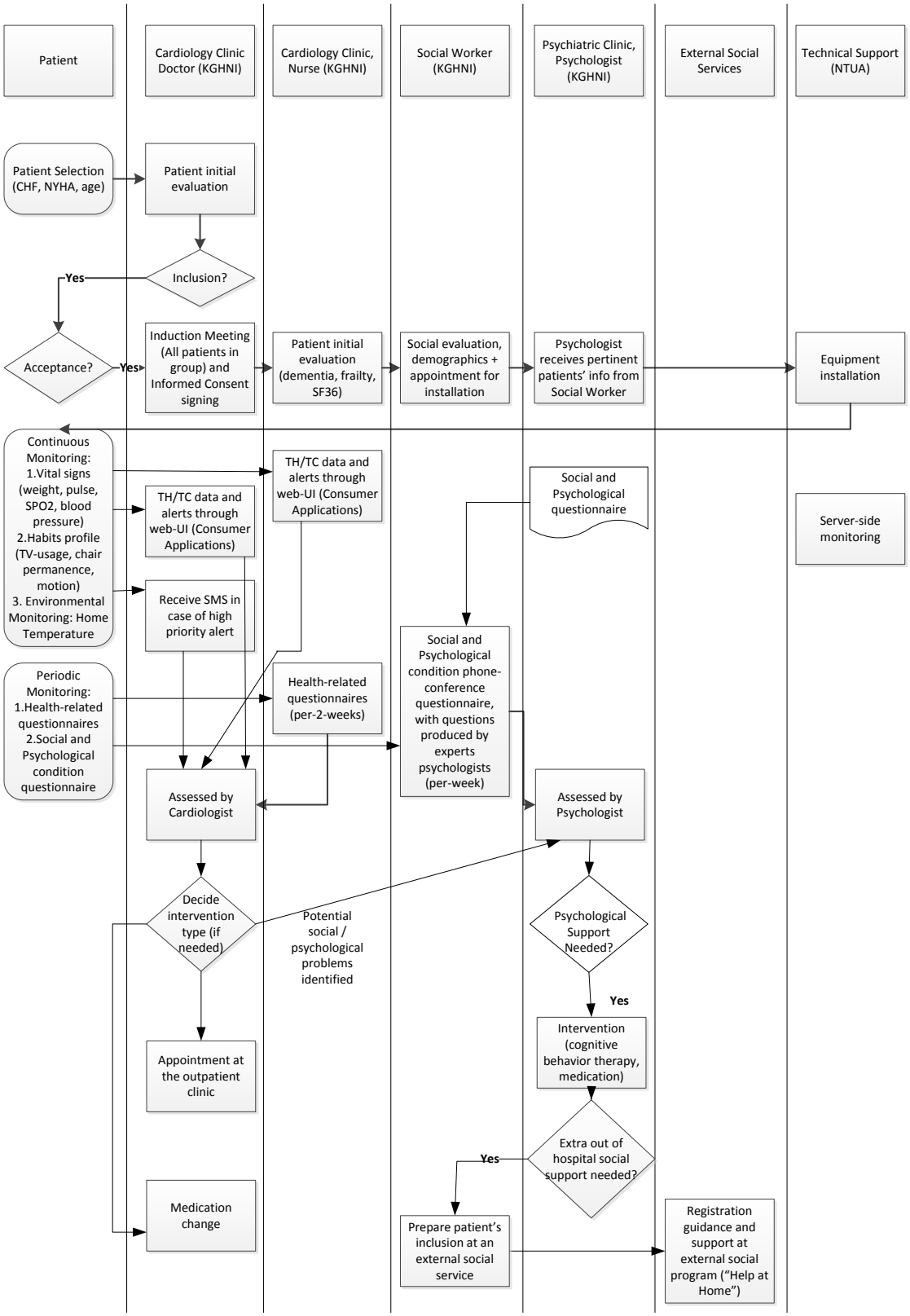


Figure 11 KGHNI pathway

Further analysing the organizational roles, the table below summarizes the duties of each type of professional stakeholder involved.

Job Title	Role summary
KGHNI cardiologists	They coordinate the Pilot activities. Responsible for patient's recruitment, data monitoring, alerts processing, interventions and pilot evaluation. As they coordinate all activities, they should also report any raised ethical issue to the hospital's ethical committee and to the inCASA ethical board too.
KGHNI Social workers	Responsible for the communication with the patients (appointment fixing etc.). Also responsible for carrying out via phone calls with the patients the depression questionnaires
KGHNI Psychologists	Responsible for the psychological status assessment and for the habits change alarms assessment. They are the ones to form the psychological status monitoring questionnaires, like the depression diagnosis questionnaire, and to score them.
NTUA technicians	The NTUA technicians designed the whole KGHNI Pilot architecture and customized the inCASA reference architecture in order to fit KGHNI's needs. Their role includes equipment installation and de-installation, system deployment, administration and technical support.

Table 8 KGHNI professional actors

The other stakeholders involved in the designed pathway are those such as the patient, relatives or external social service. These roles are summarized below.

Role	Role summary
Relatives / Selected Neighbours	Provided with the phone numbers of the case managers and encouraged to directly communicate with them in case they observe any deterioration in the monitored patient's status. Educated also during the installation phase concerning the platform way of usage.
External Social Service	In case the social service team and the psychologists consider that a patient needs extra and direct home assistance, they forward them to an external social service helping them at the same time to prepare their inclusion application. Currently, the external service identified is called "Help at Home", a public home-assistance service offered at a municipality level in Athens.

Table 9 Out of hospital actors participating in the patient cantered KGHNI pathway

The new inCASA pathway introduced an additional workload that will be further analysed in the economic reporting section in terms of additional average working hours.

As a summary quantitative report of the inCASA service's usage and statistics, the following table is provided:

Indicator(s)	Outcome	Timeframe	KGHNI
1. Total number of Alerts Produced by the Platform	Workload	Daily	50 in total (we note that not all alerts triggered an intervention, e.g. if home temperature was slightly out of thresholds no intervention was needed) We also note that the alert workflow could be triggered in some cases even if there was not an alert created by the platform, e.g. in case of observed raw data continuously close to the allowed thresholds)
2. Missing Data	Patient	Daily	4 cases

	Compliance		
3. Partial Missing Data	Patient Compliance	Daily	10 cases
4. Outcome of Alerts	No Contact Patient Contact Emergency Referral Referred to Cardiologist Referral to Social Referral to Case Conference Referral to other Organisation Other	Daily	 25 5 21 6 2 0
5. Professional reported Web User Interface Issues	Usability / Reliability	Daily	5 times in total
6. Clinician reported Device Issues	Usability / Reliability	Daily	2 times in total
7. Clinician Reported Training Issues	Workload	Daily	0
8. Patient Reported Device Fault	Phone Call / In Person / Other	Daily	14 times in total
9. Patient Technical Support Calls	Phone Call / In Person / Other	Daily	15 times in total

Table 10 Quantitative report of the inCASA service's usage and statistics.

Economic Reporting

The costs of the service can be split into various categories including equipment cost and staff costs.

As far as the equipment cost is concerned, it is estimated to be 1.500 euros per patient adding the costs of the devices and of the PC provided to the patient. A cost for the server side should be also taken into account, but it is certainly not a blocking issue. A server machine of 1.000 euros is enough for supporting the operation of the platform, unless a large scale deployment of inCASA takes place with many (>50) concurrently monitored patients.

Concerning staff costs, it was estimated during the Pilot that the average working time needed by the Professionals for each patient per week is 2 hours. Professionals include healthcare staff and technical support engineers.

On the other hand, cost savings are based on the factors listed below:

1. Cost savings based on number of re-hospitalizations averted: the inCASA services contributes to prevention resulting in measurable reduction of the hospitalization needs, a finding that is supported by data made available from the pilot's action log and individual patients' case files; the costs of hospitalizations for CHF patients burden significantly the national health system. For a length of a 5-day admission the cost is 849 euros[3] while for a length of a 10-day admission the cost is 1868 euros[4].
2. Cost savings realized by averting 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 point).
3. Costs savings 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 organizational overhead costs incurred if no effective procedures are already in place to facilitate cooperation between carers of different disciplines and across organizational units (internal/external).

Safety

Regarding the evaluation of the safety aspects of the inCASA platform, no incidents were reported or recorded in the pilot action log. The equipment installed at the patient's house are the activity hub – for tracking Telecare data, the touchscreen PC – for conducting measurements via the SARA client graphical interface, the clinical measurements devices – such as weight scale, blood pressure monitor and Oximeter, and finally the Telecare sensors – such as motion sensor, temperature

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

sensor, chair sensor and TV usage sensor. All above devices are consumer devices and have been approved by EU regarding safety and electromagnetic emissions. The professional users access the Consumer Applications web UI to track remotely the measurements and deviations from the habits profile of the patients on a daily base. Consequently all user interactions with the platform are inherently considered safe.

Ethical Considerations

All patients have signed the informed consent before joining the Pilot. No specific ethical issue was raised during the Pilot. We consider as an ethical issue the fact that one patient was very disappointed when his equipment was de-installed. We are determined to continue offering the service to this patient even after the project's end.

Habits Profile

Habitual data were collected from the chair permanence, the TV usage and the motion sensor. KGHNI goal was to analyse the habits concerning the time spent on chair and the time spent in front of the TV. The automated process of calculating the habitual profile was of 2 weeks duration (initial phase) while in the continuation of the patient's monitoring period the Reasoning part of the inCASA solution compared the daily habits to the ones stored in the habitual profile and generated an alert in case of divergence.

The "obstacles" towards this analysis were the following:

1. Chair permanence sensor was not totally comfortable for the patients. It was though proved that the assumption that elderly people tend to sit in the same unique chair is valid. This fact allowed a successful analysis of chair permanence data, since it was certain that they belonged to the target patient and not to any other family member
2. TV usage sensor cannot provide the information of who is watching TV, but only the fact that the television is open. Even under this assumption, useful results were obtained in the Pilot period.

As an outcome, more than 20 habitual profiles were calculated and this allowed a correlation with the related clinical data.

Healthcare Professionals were mainly seeking at high chair permanence or TV usage daily values as this could indicate possible depression or could be an early sign of health deterioration.

A characteristic paradigm is patient #30 whose habitual profile indicated TV usage 13.31 hours per day and chair permanence 11.42 hours per day:

: Habitual Profile

Description	Value	Unit
AverageTVUsageDuration	13.31	hours per day
AverageOnChair	11.42	hours per day

These high values were observed in the Consumer Applications Web Portal by the nursing team and communicated to the Psychologist. The Psychologist used this information and tried in the next sessions to encourage her going more time out of the home while she also pointed out that a way of life characterized by sedentariness is not helpful for the CHF patients' improvement.

Challenges

Patient

A major challenge identified during the Pilot life till now, is the usual complete lack of PC usage skills from the part of the patients. Taking into consideration their age which is usually more than 60 years, this may sound logical. Of course the inCASA platform is not technology skills demanding and this was one of its main design principles. However, manual actions like restarting the all-in-one PC after a blackout cannot be avoided and some patients have shown difficulties in accomplishing them. It is proven, in fact, that the presence of a familiar younger person is quite useful for the elderly people in order for them to adapt to the new technologies usage; until this moment, the KGHNI inCASA patients that have not complained at all about the platform's usage are the ones that live together with their son(s) or daughter(s).

It is worth mentioning that none of the patients has shown some inconvenience from the daily usage of medical devices, such as the blood pressure monitor. This can be justified by the fact that CHF patients are well familiarized with such devices and know that this monitoring may help them to live more and better.

A challenge identified during the deployment of the integrated Telecare / Telehealth solution has to do with the user acceptance of habits monitoring sensors (motion, chair permanence, TV). In fact, 2 of KGHNI inCASA patients till now have rejected the usage of these sensors in their houses, judging them as non-useful concerning their health problems basically and annoying at a second level. At this point, doctors try to intervene and explain to them again that habits monitoring can help in early detection of heart failure deterioration.

Professional

A challenge identified until now in the KGHNI pilot life, has to do with the nature of the Cardiologist profession. There are some times when the Cardiologist Case Manager has planned to crosscheck the inCASA platform's data but this was not finally manageable due to some external urgency, e.g. a new urgent incident inside the Cardiology Clinic. This challenge is judged as minor and it can be over-passed with better team organization.

Organisational

Organisational challenges are quite important in the framework of the KGHNI pilot. The Pilot requires a close synergy between the Cardiology Clinic, the Social Service and the Psychiatric Clinic. These units were, till now, not much correlated and cooperation between them was more or less non-existent inside the hospital. The inCASA project after the combined Telecare / Telehealth service deployment brought them working together and this is a challenge by itself.

Technical

Current technical challenges may be summarized as follows:

• Challenging to configure the various software programs to run as services in patient's PC in order to manage their automatic start up without any action needed from the end-user patient.

• Manage to resubmit automatically to the server all failed messages due to temporary Internet connection loss from the patient's home side (Client side)

Resource

Obviously, KGHNI, as all other hospitals, has limited resources in terms of human personnel. It is thus challenging to manage to run a project like inCASA which is innovative for the Greek state - so a few previous experiences exists - and demanding as it requires close follow-up, deep and correlated data analysis and not delayed interventions.

2.4 Conclusions

In conclusion, the inCASA Pilot had a great 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 emphasizing the usage of technology, the cooperation between different units of the hospitals and, mainly, put priority on prevention based on patients' continuous monitoring rather than prioritizing treatment.

With regards to the specific goals set by KGHNI pilot, a summary analysis can be presented providing evidences whether each of the single goals was achieved or not and at which 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 organizational schema. The reduction of the costs requires a larger study with more time duration to be proved, but it is estimated that the reduction in the hospitalizations is a major point, taking into account that the costs of hospitalizations for CHF patients significantly burden the national health system, as explained in the Economic section of the KGHNI report.
Test and evaluate the organizational cooperation between the involved hospital units in the new inCASA pathway, namely the Cardiology Clinic, the Psychiatric Clinic and the Social Service	As reported through the document, their cooperation was finally 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 targeting to CHF patients. The monitoring combines health, behavioural and depression monitoring analysis. In this new

	pathway, the organizational cooperation between the involved hospital units was mandatory in order to finally run a successful Pilot.
Reduce the medical risks for the patients due to their continuous monitoring	The number of medical interventions proves that the monitoring was successful and prevented health deterioration or acted timely providing treatment to the patient.
Reduce patients' anxiety about their medical condition	This goal was achieved as it is depicted in the analysis of Patient Perception questionnaires as long as the SF-36 v2 questionnaires.
Understand the health condition of CHF patients in their real life at home by analysing the pilot results	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 offer 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 included medical data, habitual data and frequent psychological monitoring. In this report, examples of medical and psychological status correlations were 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 patients' overall quality of life	The patient's relatives and the 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. For sure, the inCASA social workers and the relatives that were urged to support the monitored patient contributed in this.
Prolong elderly patients independence by supporting them in their own home	In this domain, the overall improvement of the status of the patient that the inCASA service can offer is a very helpful parameter. More specifically, the role of social workers is crucial in this domain helping the patients with their everyday activities. Admittedly, even if KGHNI disposes a Social Service, it cannot be as specialized as social housing companies; therefore there is a lot of room for improvement in this specific target.
Enable early discharge of patients	Early discharge is instigated by the fact that the patient can be successfully monitored remotely as long as the medical team can control the patient's status and being notified immediately in case of an alert. In any case though, it is

	considered 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 occurred during the Pilot life were medication changes, mainly triggered by the Telehealth alerts produced by the inCASA system. The medical team observed constantly the progress of the patient after the medication alteration and proceeded with any other needed action following the medical protocol.

Table 11 KGHNI goals evaluation

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

2.5 Next Steps

KGHNI expresses its will to continue with the business exploitation of the inCASA service after concluding to an agreement with a subset of the inCASA industrial partners. More details on the business approach are currently under investigation while the relevant analysis to date is depicted in the inCASA business plan deliverable.

As a preliminary planning, the following facts are provided:

- KGHNI foresees as first phase target patients to buy the services the ones who could pay the service by themselves (out of pocket payment)

- At a second phase, KGHNI would like to 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 full know-how of the platform, taking care of the installations/de-installations and able to provide 24/7 technical support is required.

In conclusion, the points below have been discussed and defined in order to proceed with a specific cooperation agreement that will define guidelines for the follow-up phase:

1. Set up a business agreement with the required inCASA industrial partners. During this discussion, technical and operational costs should be analysed.

2. Find a Greek IT company as stated above.

3. Sign a contract between the involved partners

4. Run the service, continuing the current KGHNI healthcare integrated inCASA protocol, tested during the project's Pilot life.

2.6 Recommendations

After 15 months of inCASA Pilot life and almost 2 years after the beginning of Pre-Pilot activities, KGHNI has collected valuable feedback and experience from the usage of the inCASA service and is able to provide a list of recommendations towards the fine tuning of the offered solution.

At first, special attention should be paid to the acceptance of the solution by the patients, who are in general not familiarized with the new technologies. The role of relatives or selected neighbours, especially the younger ones, is quite important in order to assist them with the technology usage and that's why they should also be trained during the installation of the equipment. In fact, if the elderly people get familiarized with the inCASA technology, they really like interacting with it and this is something positive and refreshing in their daily routine. The SARA Client helps towards this direction as it is a user friendly software product with an attractive interface.

Moreover, it was seen that some KGHNI inCASA patients rejected the usage of the habitual monitoring sensors in their houses, judging them as non-useful concerning their health problems basically and annoying at a second level. At this point, a process should be better developed in order to convince the patients that habits monitoring can help in early detection of heart failure deterioration. It is also recommended that a deeper research is conducted in the market in order to find less annoying chair permanence sensors compared to the existing ones that caused some inconvenience to the patients.

From the medical monitoring point of view, it is recommended by the Doctors that an inCASA mobile application should be developed in order to help them getting notifications everywhere and not only at their office. This is really important considering that Cardiologists spend a lot of working time out of their office. It is also recommended that the alert notification mechanism is enhanced with SMSs to be sent to a wider patient care network (medical professionals, relatives and selected neighbours). An advanced algorithm analysing the habits of the patient and correlating them with the patient's medical status would also add significant value to the current inCASA service model.

From an organizational point of view, it is recommended to create new managerial roles to coordinate the activities of the cooperating Units of the hospital that offer the inCASA service. This was not needed during the Pilot life, where Cardiologists coordinated the Pilot activities, but it is recommended in the framework of a larger inCASA service deployment.

From a business development point of view, and taking into consideration the outcomes from the Greek national exploitation event, we can describe the framework for developing new e-Health initiatives and services on the regional level. It is highlighted that the limited interoperability of the e-health services developed and often the low level of synergies realized posed the greatest risks to the uptake of the new services. Also, an inhibitive factor is the inadequate training delivered to the health professionals, regarding the use of the new electronic services. The e-health projects currently co-funded by EU and included in the 4th Greek National Strategic Reference Framework are multi-sectorial by design, to overcome the above challenges. Authorities' representatives reported that a new first response to medical emergencies unit will be established, and that it is expected that it will reduce the fragmentation of e-health services delivery on the regional level and will allow for greater synergies to be realized in practice. Additionally, they commented that the new actions target the delivery of novel Telecare services with a lower priority, due to the high cost of the required equipment.

All the involved policy makers' stakeholders characterized the inCASA Greek pilot as a commendable effort that certainly contributes to the establishment of a combined framework to deliver health and social services. They noted that the involvement of the private sector is absolutely crucial to the sustainability of the inCASA services in the long run, due to the currently limited funding opportunities available by the Greek state. In conclusion, a realistic business plan would rely on forming Public–Private Partnerships (PPPs) to deliver the inCASA services to the Greek market. It is also recommended that a niche market for the inCASA services would be the health/social insurance sector.

3. FHC

Fundación Hospital de Calahorra (FHC) is a public non-profit organization which operates within the Spanish national healthcare system (SNS). FHC was funded in 2000 to provide high quality hospitalization services to approximately 70.000 inhabitants living in a rural area at "La Rioja", a Spanish region placed in the northern part of the country.

FHC participates in programs of promotion and protection of healthcare, healthcare training, as well as research projects. Many papers in the biomedical field have been published in international journals by members of FHC –it has been classified as one of the best Spanish hospitals in the areas of Respiratory and Nervous system diseases-. FHC has developed several actions to promote the inclusion of e-health based solutions within its services, too. FHC's workforce includes more than 400 people, including physicians, nurses and other healthcare professionals.

3.1 Description of Pilot

FHC pilot goal was to develop a tele-rehabilitation programme for patients with chronic obstructive pulmonary disease (COPD) aged 65 or more.

Many patients suffering COPD often decrease their physical activity because they feel exercise can aggravate dyspnoea symptoms. The progressive physical deterioration associated with inactivity initiates a vicious cycle, with dyspnoea becoming problematic at increasingly lower physical demands, which finally can provoke an increasing ratio of hospitalization episodes. Patient's clinical condition is also strongly influenced by his/her lifestyle, which is a determinant factor both in the appearance and in the evolution of COPD.

Available scientific evidences point out that exercises specifically designed for upper and lower limbs can maintain their health status for a longer period of time under certain conditions, one of them being that exercises should be made on regular basis for a certain period of time. Nevertheless, some sort of continuous surveillance by health professionals must be done in order to check the evolution of their clinical records. Long distances between patients' homes and hospital facilities, as well as the influence of social determinants, might influence their adherence to treatment. So, e-health solutions such as the one provided by Telefonica (SARA) was considered as an affordable alternative to implement a tele-rehabilitation programme.

Thus, FHC's pilot program aims was to break this vicious cycle by promoting and monitoring rehabilitation exercises made autonomously by COPD patients at their own homes to improve their quality of life in long-term basis.

The specific aims and objectives have been:

- To design a program based upon tele-rehabilitation / in home exercises designed for aged COPD patients to push forward their adherence to treatment through the use of new technologies. It should include a protocol of on-line data transmission from patients 'homes to hospital healthcare professionals by using SARA solution provided by Telefonica (TID), to avoid unnecessary trips for both patients and clinicians.
- To implement a prospective, legatorial and controlled study in order to test the efficiency of this tele-rehabilitation program, including the comparison between each patient's clinical status at the beginning and at the end of the program, as well as checking any significant differences between results got by patients doing exercises at home on their own and patients making exercises at hospital gym –acting as control group-.

To achieve greater patient compliance and at the same time more efficient use of the available resources, it was established that exercises should be conducted into each patient´s own home under the adequate supervision of healthcare professionals. This was considered by FHC as a beneficial alternative to the previous situation, which was characterized by the lack of any reliable alternatives for these patients. This was mainly a result of the availability of skilled personnel and installations needed to complete the activity consistently.

The main issue that arose while designing the tele-rehabilitation programme was the large geographical dispersion of patients within the area in which FHC has to attend (a rural environment with largely scattered populations), including small villages placed 50 kilometres (or more) far from the main hospital building, placed in the suburb of Calahorra, a village with no more than 25.000 inhabitants. Such distances require the use of ambulances to move patients from their homes to the hospital and back (sometimes it can take more than 1 hour for each trip and patient).

3.2 Methods and Design

The evaluation method used by FHC was based on the common Mast Methodology adopted by all pilots. The methods used to collect the data were as follows:

- Demographic: review of clinical records
- SF36 Quality of Life Questionnaire : personal interview carried out by a nurse
- Edmonton Frail Scale : personal interview carried out by a nurse
- Patient Perception – STUAQ : survey on paper by social worker and telephone call by a subcontracting partner (Ingeniería e Innovación)
- Professional Perception: survey on paper at national event
- Clinical Outcomes: clinical outcomes were obtained as a result of statistical analysis of data gathered alongside the pilot by using “SPSS”

The method followed to complete the project had 4 different phases:

Patient evaluation (4 weeks):

It involves the agreement between the Internal Medicine Unit and the Pulmonology Unit with the Rehabilitation Unit regarding patients to be included in the pilot, first medical consultation with the physicians (both pulmonologist and rehabilitation specialist) and other healthcare professionals (nurse, physiotherapist), general information for the patient and informed consent.

Former evaluation by Social Worker was added, too, in order to get relevant inputs related to social determinants affecting each patient (Gijon Scale –a validated questionnaire - was selected for this purpose). Social Worker offered professional advice to patients as well as further assistance if needed (including phone calls and visits if necessary).

Training at the hospital (2 weeks):

It includes specific training in the exercises to be performed and the devices the patient will use at home. This phase was cut down from originally four weeks to a two week period due to advice given

by the colleagues of FHC rehabilitation specialist leading the project at a meeting held in Madrid (Spain) on January 2012 where inCASA project (FHC pilot site) was presented.

SARA evaluation from home (6 weeks):

This phase included transportation and installation of the monitoring devices and, of course, the remote monitoring of exercise for at least 4 weeks, withdrawal of the equipment after finishing the pilot and (very important) patient supervision by home care professionals to guarantee the implementation of activities that ultimately were agreed to according to pilot results. Physiotherapists visited patients every week to solve problems related to the exercises or the use of the involved devices and also to check their status.

Each patient used a pulse Oximeter that communicated automatically and constantly (every 30 or 60 seconds) via Bluetooth with a tablet PC where both SARA and a Linksmart Client Agent were installed. The monitoring activity was held during the period while the patient is making prescribed exercises.

The use of an actigraph at the FHC pilot site in accordance with INSERM and TID was also used. Its aim was to achieve a better understanding of the activity patterns of those patients who cannot do the in-home treatment initially prescribed due to different reasons (please see below paragraph 7.4).

Then, SARA used specific Web Services to send information to the server, where it was saved through the Telehealth platform services.

Once there, FHC physicians had access to the information by simply going to the Medical Web Portal, which lets them to receive the data directly on their computer, again thanks to specific web services provided by SARA platform.

The global system follows a 3 layer architecture:

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

Rehabilitation physician Evaluation (1 week)

Included the final evaluation by the Rehabilitation physician through standardised and ad hoc questionnaires (SF-36, St. George, BODE index). The Edmonton frailty scale was also included in response to conclusions made at the pilots' meeting held at INSERM on September 2011. A FHC Neumologist specialist was also involved during the monitoring of a post-phase at the end of the inCASA project for patients due to their needs as chronic patients (including the monitoring of FEV1 levels after a period of 6 months).

3.3 Results

In-home tele-rehabilitation treatment has been designed according to available relevant scientist evidences, which show that the implementation of programs for maintenance at home for COPD patients is a positive alternative to the rehabilitation at hospital from the initial stages of the disease (Level of evidence "B") [1,2].

Results obtained at the end of the pilot demonstrates the benefits of in-home treatment oriented for aged COPD patients because it enhances the initial status of their clinical parameters and, so, their quality of life. Nevertheless, it must be pointed out that the number of patients involved is not statistically significant for its general extrapolation for general practice. Main achievement for FHC is that inCASA solution provides a reliable tele-rehabilitation program which allows to analyse in long term basis the evolution of chronic elderly patients and that further treatment based in e-health solutions can be implemented successfully at a larger scale.

Note: when analysing results shown below please take into consideration that "*GR RHB_DOM*" means "In-home tele-rehabilitation treatment group", and "*GR RHB Control*" means "Hospital gym rehabilitation treatment group (no tele-rehabilitation activities)".

Demographics

One major constraint has been the inclusion requirement of patients older than 65 years. A minor constraint was the required level of autonomy of patients to face daily activities. There have been no limits for inclusion related to geographical location, nor level of studies.

The study was initialized with 78 pre-selected patients. However a major constraint was that a significant percentage of pre-selected patients did not want to participate did not want to complete the treatment or did not comply with inclusion criteria due to their clinical or social situation (see figures below):

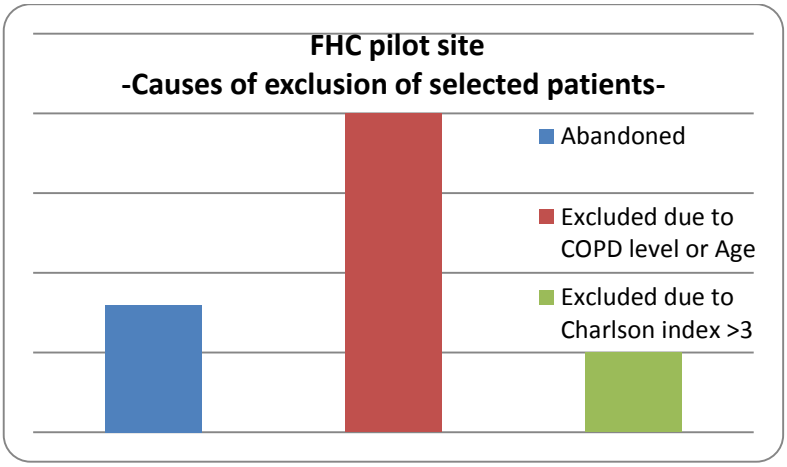


Figure 12 FHC Causes of Exclusion

Note: Charlson's Comorbidity index was used to establish well-based exclusion criteria in the designing process of the tele-relehabiliation programme in order to avoid the confounding influence on the expected outcomes due to patients' comorbidity status (for example, dementia, that can influence the level of expertise to be acquired by the patient in the training period at hospital gym).

Place of residence (geographical distribution):

All the patients that have been included in the GR RHB Control live in Calahorra, that is, the same village where the Hospital is placed. However, the place of residence of patients who have completed the treatment at home is diverse, as it is shown in the following table:

Place of residence	Distance to Hospital	Population
Alfaro	26 km.	9.851
Arnedo	16.4 km.	14.548
Autol	12.8 km.	4.442
Aldeanueva de Ebro	13.5 km	2.815
Calahorra	-	24.897
Cervera del Rio Alhama	48.2 km.	2.636
Herce	22 km.	362
Pradejón	9 km.	4.184
Quel	13.7 km.	2.060
Rincón de Soto	16 km.	3.799

Table 12 Place of residence (geographical distribution)

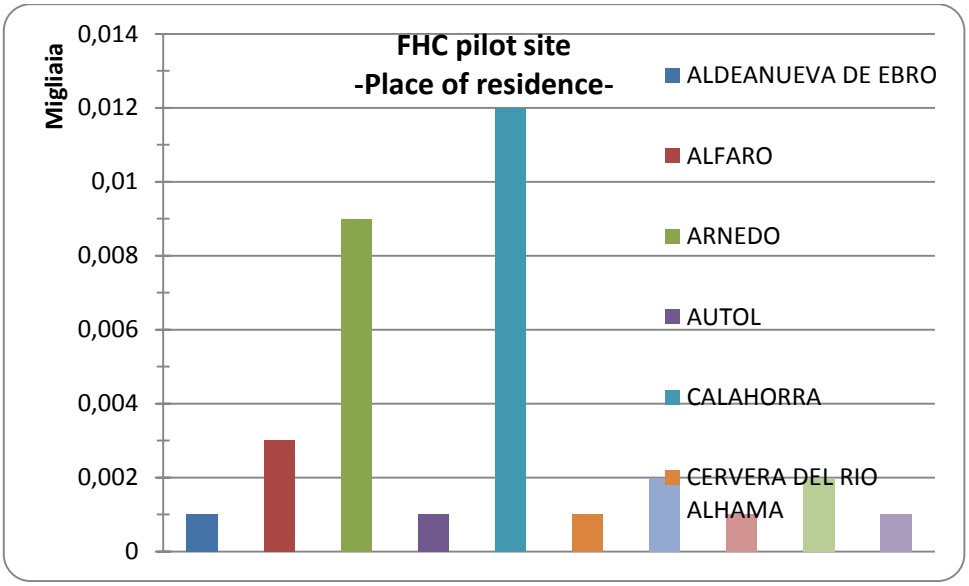


Figure 13 Place of residence - Population

Finally, there are no relevant differences observed due to geographical issues.

Age

The *GR RHB Control* is composed of five patients, each one of them 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 for the *GR RHB_DOM* is 75.6 years old. A majority of them suffer a moderate level of COPD (see figures below):

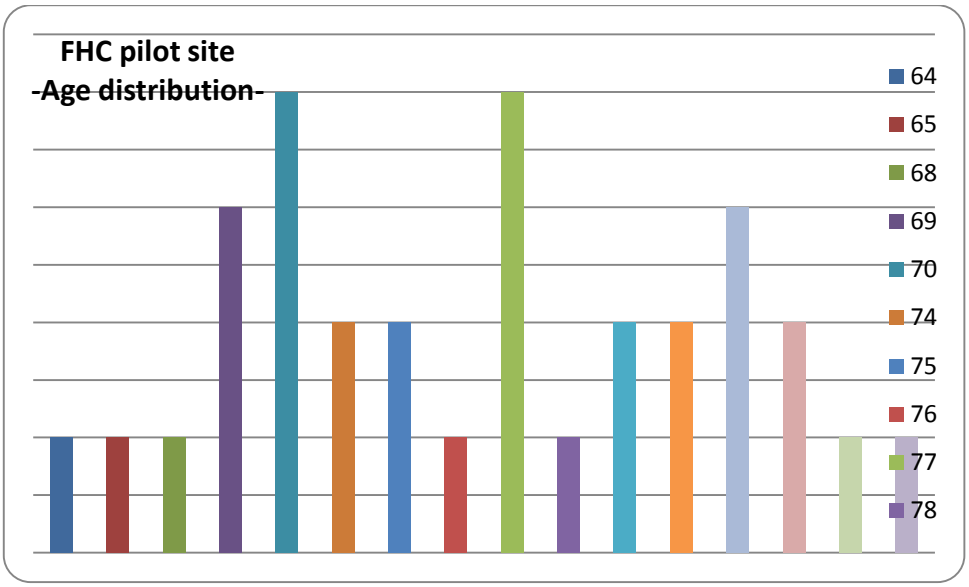


Figure 14 Age Distribution

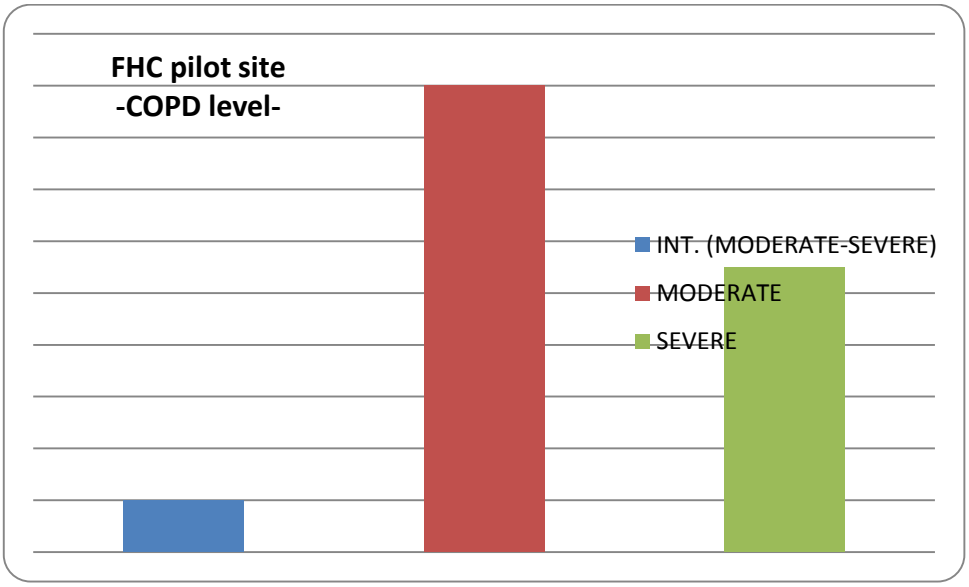


Figure 15 COPD Level

Final conclusion related to age is that there is not any relevant differences, despite the number of pre-selected patients that did not fulfilled this specific requirement (age => 65 years). The elder the patients, the higher level of COPD suffered.

Patient Perception

FHC is using the standard baseline questionnaire agreed among pilot partners to evaluate the patients' perception of the inCASA platform and services.

The patients who participated in the pilot were asked by phone to fill out the Patient`s perception questionnaire translated into Spanish. 26 of the 41 patients completed it. Individual interviews held by phone and ruled by the clinicians belonging to Hospital's Admission Unit with direct knowledge of inCASA project.

Patient perception questionnaires itself can be difficult to be completed accurately by certain patients, as they sometimes get confused about it. For example, 1 patient who has recently finished the in-home training period comes to hospital to pass a social evaluation process by attending a personalized interview to be held with social worker at FHC pilot site; social worker uses a specific evaluation tool named Gijón Evaluation Scale, which includes a predefined set of questions. Then, patient gets an appointment for final quality-of-life self-perception evaluation according to SF-36 questionnaire to be passed by a skilled nurse at hospital facility, too, that is, a second evaluation comprised of 36 additional questions to be answered. Finally, patient receives a phone call referred to his/her perception according to a set of another 22 questions. Thus, some relevant information about real scope of patient's perception can be missed as some misunderstanding related to the whole evaluation process of patient perception regarding inCASA solution has been raised. Some patients get confused because they feel they are passing through the same evaluation again and again –a majority of them are only concern about his/her own health status, not technology nor service-related issues-. Finally, sometimes they can feel anxious about the need to complete the full set of questions, due to their communication skills and both health and social status, especially those most elderly ones.

Although further analysis of gathered data is being developed, preliminary conclusions are:

- A majority of patients agreed that the inCASA services helped them save time in terms of required visits to the outpatient clinic. Some of them are confident it is a good system but at least one patient thinks it is useless. 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 reduce their concern about their health status.
- Interim conclusion is that the majority of patients were satisfied with the provided training on equipment usage, due to previous training at hospital gym plus continuous support by physiotherapist.
- Most patients trusted the provided inCASA equipment to be reliable and did not report any physical or psychological inconvenience incurred by the deployed equipment.
- There weren't any significant concerns expressed regarding the personnel assigned to monitoring the patients' condition. There is an absence of any emergency events due to the nature of patients' clinical status (stabilized COPD patients & focus on upper & lower limbs training).
- No major objections were raised concerning the remote handling of personal data, nor referred to its transmission via the internet.

	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 13 Patient Perception

Quality of Life

Tele-rehabilitation treatment offers a better level of perception by GR RHB_DOM of their quality-of-life situation at the end of the program, in comparison with a lower level of quality-of-life perception by GR RHB Control:

Main conclusion is that statistic analysis demonstrates that there is a relevant increase of item measured by the 8th dimension of SF-36 -General Perception of Health Status- at the end of the training programme, in comparison with the measurement taken at the beginning, which is consistent with the clinical outcomes related to the health status' variation of patients.

Number of column	Aspect
1	Physical Function
2	Physical role
3	Pain
4	Pain-social function
5	Mental health
6	Emotional Problems
7	Vitality
8	General Perception of Health Status
9	Health changes alongside time

Table 14 SF36 Headings

Professional Perception

FHC professionals involved in the project were asked to fill out a specific questionnaire to evaluate the perception of professional users. Finally, five professionals completed it and the results were that 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 to use it.

Clinical Effectiveness

It was stated at the preliminary report that data available at that stage showed a close relationship between health status and in-home rehabilitation treatment. It was also explained that a specific questionnaire designed for patients suffering COPD (St. George questionnaire) has been used to get a specific outcome related to each patient's final health status and, finally, that after a period of six

months at the end of the in-home treatment, a further analysis will be held by pulmonologists in order to check the evolution of the health status of each patients, so that some conclusions related to medium-term-basis can be eventually achieved, too.

As a general conclusion, at this point it can be said that the main clinical outcomes of the in-home tele rehabilitation programme developed at FHC pilot site are related to the observed health status of patients at the end of the training period in comparison with same item for patients integrating the control group (that is, those ones that came to hospital gym instead of staying at home).

The selected outcomes related to clinical effectiveness at FHC pilot site are linked to the following parameters:

- IMC (BMI).
- FEV1.
- MRC.
- 6MW test.
- BODE.
- CAT.

The analysis of results offered by BODE index calculation –which embraces a set of clinical inputs such as MRC, FEV_1 and 6MW test- show the utility of respiratory rehabilitation for COPD patients. Data gathered at FHC pilot site (BODE index) suggest that making respiratory exercises at home is more efficient than coming to hospital to make same type of exercises (see figure below):

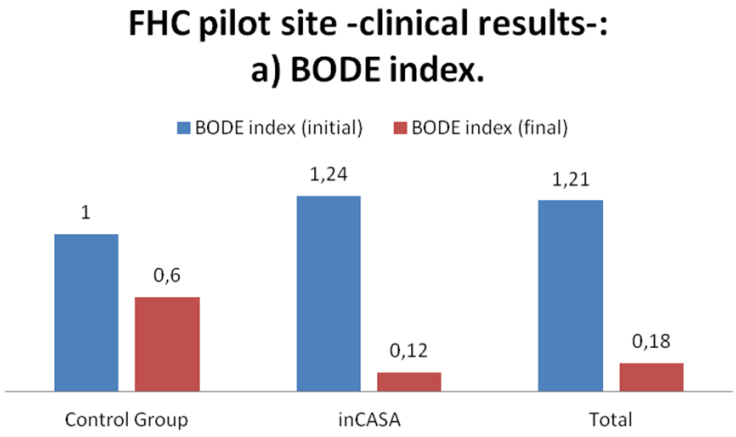


Figure 16 BODE Index

Inputs measured by St. George questionnaire, specifically designed for COPD patients also show a slight correlation in favour of final health status observed at patients belonging to the control group in comparison with final health status reached by COPD patients who were treated at their own homes (see figure below):

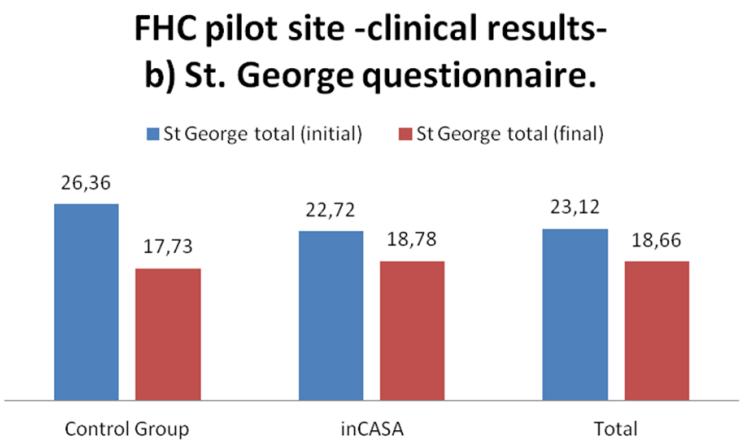


Figure 17 St. George Questionnaire

Explanation may be connected to the COPD level and age (average) of patients for each group, although further analysis is still to be performed.

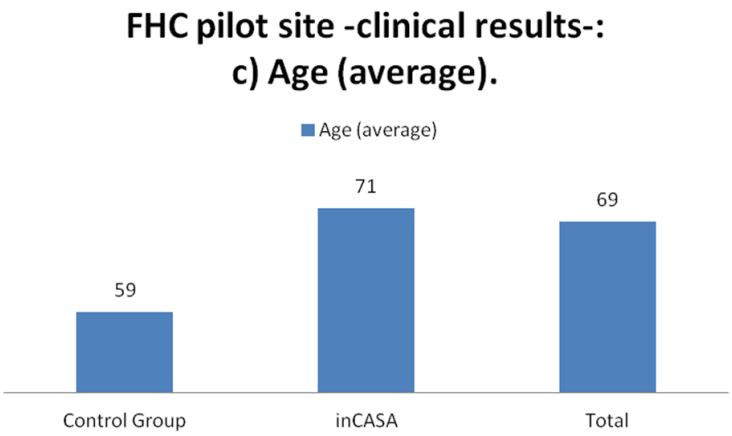


Figure 18 Age

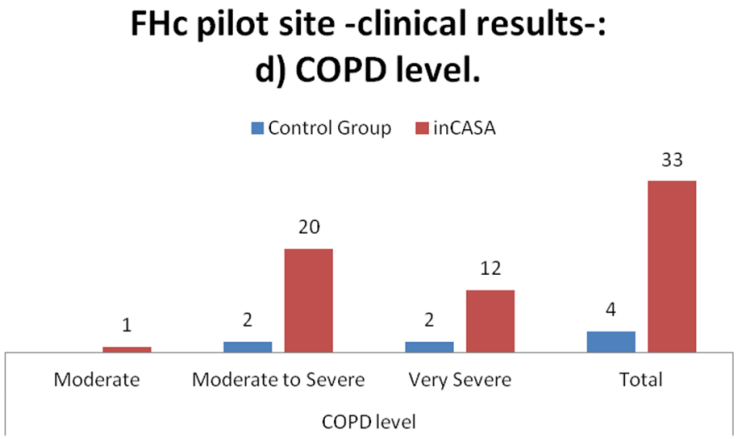


Figure 19 COPD Level

Case Study

Patient W is a 78 year old patient. He is married and lives with his wife in a village with less than 10.000 inhabitants about 10 kilometers away from the Hospital. He is retired but has worked as a professional truck driver for many years in the shoe industry and he is used to having an independent life. Nevertheless, he has told to his doctor that due to his current health status (he suffers COPD, moderate level), he has a very sedentary way of life.

In 1998, he suffered a heart stroke 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 he still smokes 10 cigarettes per day.

He is under regular surveillance and must attend regular appointments with the Pulmonologist specialist at the Hospital. He has no previous hospital stays for the past six months but he is treated with inhalators at home as he suffers symptoms of severe dyspnea.

His physician 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 specialized training in in-home respiratory rehabilitation so that he can get real benefits for his health status in the middle-term, despite the chronic nature of COPD. inCASA offers the best conditions to this patient, as after the completion of the designed intervention he will not need to be worried about any burdensome displacement to 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, dyspnea 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, despite de weekly visit by 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, he was attended at final consultation, held in November 2012. BODE index equal to “1” (Body mass index: 27.7:0, spirometer –FEV1 91:0, dyspnea grade two in MRC scale 1, 6 minutes walking test : 435 m, more than 350:0).

Alongside the whole period of the in-home respiratory rehabilitation programme and beyond, he has not suffered any exacerbation episode nor any hospital stay. For the next period of 12 months his illness status has been stabilized with no signs of clinical deterioration. Nevertheless, due to the chronic nature of COPD, he will continue under regular clinical tracing and, if necessary, he could repeat the in-home respiratory rehabilitation training programme in the future.

Habits Data

Actigraph: During the development of the project at FHC pilot site, a new device (actigraph) was included. The use of actigraph was intended to gather relevant patterns related to social issues

connected to the expected evolution of COPD patients, as actigraph is designed to gather data linked to the physical activity displayed by the patient.

INSERM helped FHC to exploit data gathered by the actigraph to calculate the dichotomy index of some patients' rest-activity rhythm on each period, in order to make some between two different periods of activity for patients who have followed a special program between these two periods. The results indicate that there are not significant evidences of any improvement of the previously detected alteration of circadian disruption of selected patients.

Patients 'ID number	**1st data collection**			**2nd data collection**		
	Inicial date	*Final date*	*Dichotomy index*	*Inicial date*	*Final date*	*Dichotomy index*
27555	20/07/2012	30/07/2012	95,6%	31/10/2012	13/11/2012	96,8%
60717	31/01/2013	07/02/2013	No data recorded	08/03/2013	18/03/2013	No data recorded
70798	20/09/2012	27/09/2012	99,6%	12/12/2012	21/12/2012	99,0%
5621	14/08/2012	15/08/2012	No data recorded	13/11/2012	25/11/2012	91,2%

Table 15 Actigraph Analysis

Alerts

The definition of "Alert" at FHC pilot site is directly related to the type of intervention, which consist 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 'shots' of S_PO_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. 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 physiotherapist could, then, access to data gathered by inCASA kit to secure that exercises were done according to the pathway assigned to each patient. Physiotherapist moved to patient's home on weekly basis to check it personally, too. No alerts were reported maybe as a result of weekly controls by physiotherapist at the patient's home.

Figure 20 FHC Clinical Portal

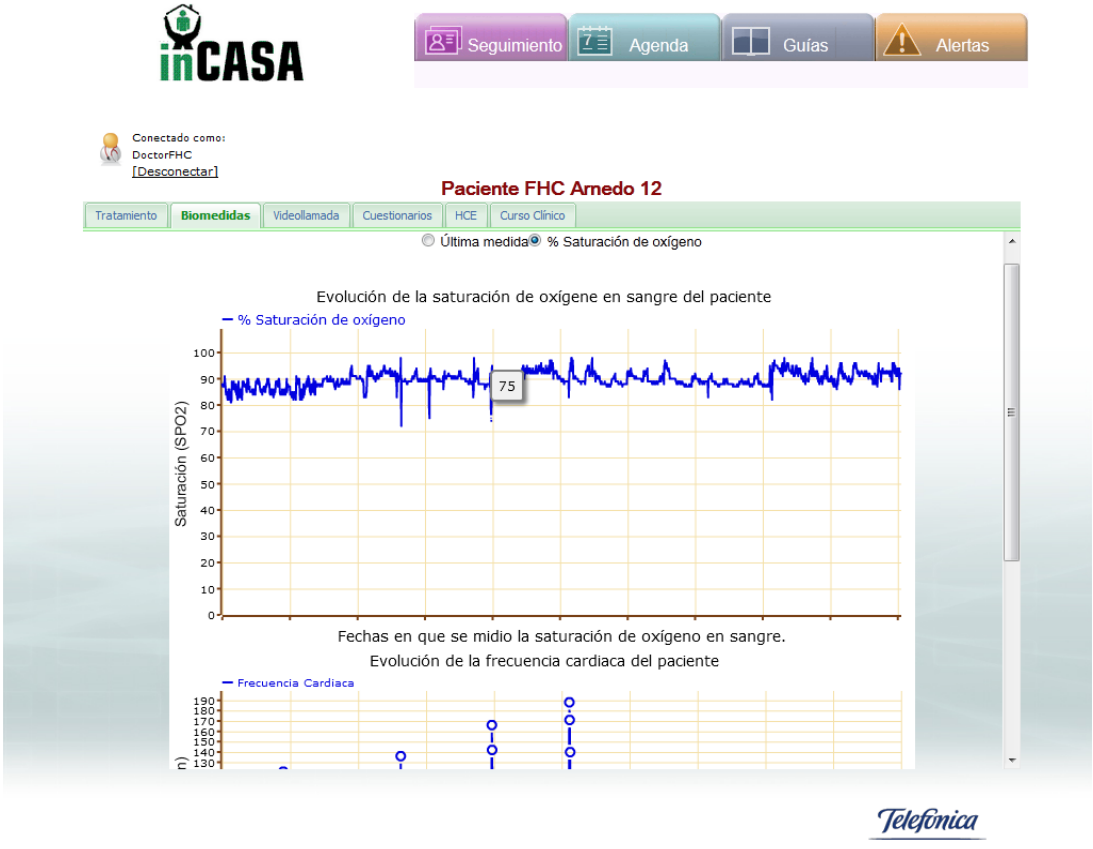


Figure 21 FHC Graphical Representation on Clinical Portal

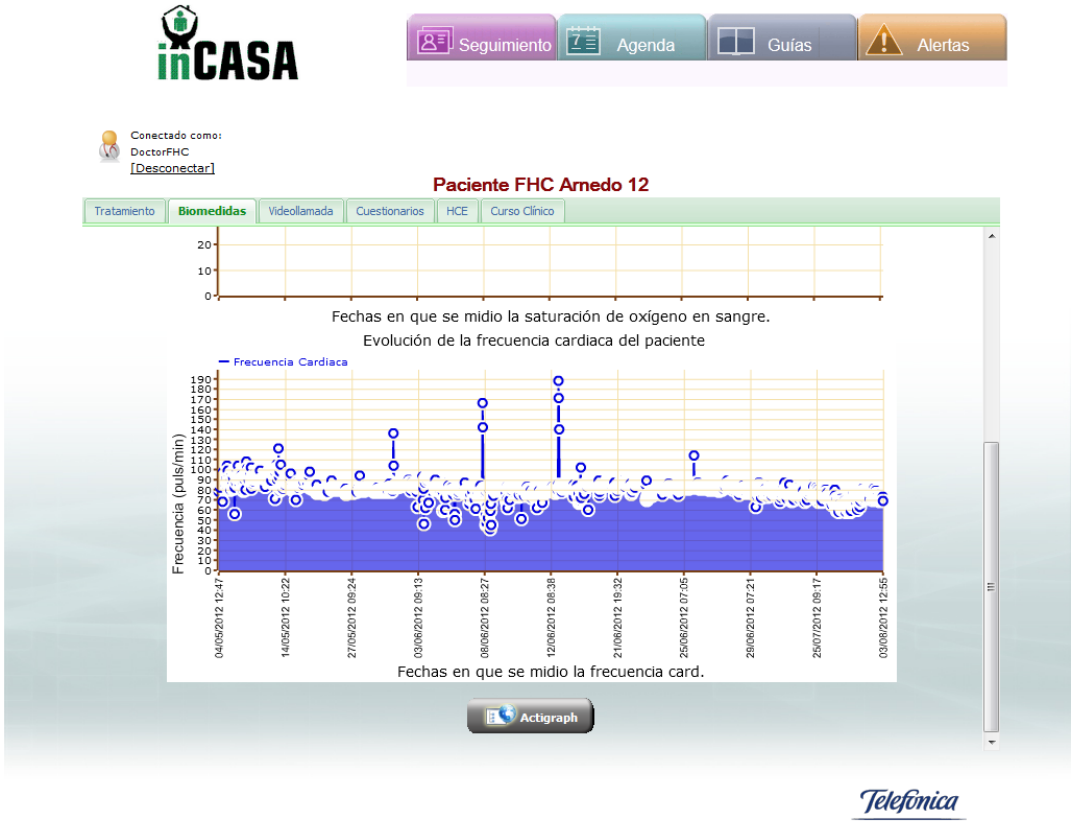


Figure 22 Clinical Portal

Figure 23 FHC Alarms

The remote monitoring system allowed to detect unexpected levels of S_PO_2, that is, patient's oxygen saturation level below the minimum level set for each patient (<90), so that physicians at Hospital could be aware of each patient's evolution alongside the in-home training period. Initial protocol established that whether such an alerts arises, the physiotherapist visits the patient to check patient's clinical status. The physiotherapist, then, can provide personalized advises to the patient. Depending on the type of event, the physiotherapist warns to physicians (health issues) or social worker (social issues) for further actions. For example, due to lack of data gathered, physiotherapist could notify a suspect of dementia suffered by one of the patients that had not been detected during the initial training phase at hospital gym. Nevertheless, it must be said that a great effort was dedicated 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 'Dyspnoea scale' graphic included in SARA solution to be visible while taking measurement during exercises, none significant 'emergency' alarms concerning these issues were reported.

Eventually, a lack of normal activity, that is, the absence of exercising by patient can become itself an "alarm" because it means that there are evidences of unexpected events unknown by hospital services (mainly, deceases). Due to general health status of many aged chronic patients involved in the pilot, some of them died before ending the training period. One patient died after completing the training phase at hospital gym (week one) but just before starting training at home (week two) -installation team noticed it when accessing to patient's home to install the equipment-. This second type of "alarm" caused a revision of the initial protocol in order to secure the updated level of information required to initialize the second phase of the training. If one patient dies outside the hospital, primary care level takes charge of the protocol to inform the system about it and, sometimes, it requires a significant period of time to update files. So, a previous telephone call and clinical record examination were included as previous steps before sending any installation team to patients' home to install the equipment. Furthermore, to avoid problems derived from these types of events, protocol was changed to introduce telephone call by social worker plus displacement by physiotherapist to patient's home to check if everything is all right.

Main outcome of the pilot is the need to extent the definition of alarms to a variety of both health and social events, because it was detected that sometimes malfunction of equipment could be caused by different reasons not necessarily linked to hardware or software problems, but social ones (for example, patient's relative willing to stop the kit because of its lighting alarms by shutting it down forced the installation team to visit patient's home in a hurry; what they discovered there was not any kit malfunction but no expertise when facing minor technical issues). Initial protocol was changed in order to establish that not only clinical or social issues but also technical ones should be reported by phone to physiotherapist, so that the physiotherapist could evaluate the type of resources to be provided to solve the situation as soon as possible.

Finally, clinical alarms were revised at the end of the pilot and it was decided to include clinical measurements at the end of the in-home training period consisting of spirometry to be done at hospital facilities, after a period of six-to-twelve months.

Organisational / Use of Resources

From an operational point of view, the FHC organizational units directly involved in the delivery of the health care and social care integrated inCASA services are the Ambulatory Healthcare Unit, Pulmonology and Rehabilitation Units, and Social Services not only FHC one but both Primary care and Local level too (municipalities).

Economic Outcomes

FHC economic evaluation of its clinical activities is based in “GRD” system, i.e., diagnosis related groups. These consist of a coded variety of hospital activities grouped in terms of complexity and resource needs which are then related to a “UCH” (“unidad de coste hospitalaria”) or “hospital cost unit” (consisting of a fixed amount of money) in order to calculate the total amount and value expressed in € of resources dedicated to any particular process attended by FHC. It can thus be considered whether there is any relevant economic impact of the pilot results according to the evaluation of main indicators based on the described system, such as the reduction of visits to hospital for consultancy, days of hospitalization, etc.

This system is also referred to as "the DRGs", and its intent is to identify the "products" that a hospital provides. In Spain, the Ministry of Health provides an updated version of ICD9CM (Spanish vs.) , titled CIE-9-MC [3]

which contains a classification of diseases and related medical and surgical procedures and it is also used as basic diagnostic code to group and identify diseases.

Cost of each treatment

According to this classification, FHC has selected the total number of patients suffering COPD in 2011 who have been attended at hospital facilities. It means that those patients are the ones whose disease has been codified “COPD” as major diagnosis (number 88 of internal code system). Secondly, FHC has calculated the gross amount of expenditure assigned to each patient to calculate an average cost for the whole treatment received for a period of 12 months.

The theoretical patient, thus, is a person suffering an average length of days of hospitalization of 9.06 days per year, with an average weight of 1.1468 (i.e. associated complexity ratio to clinical procedures applied to the patient based on the number and complexity of those clinical procedures) and a total cost of 1.858,79€ for the whole period of hospitalization, that is, an average cost of 205,11€ per each day of hospitalization –it includes the shared amount of salaries, provisioning, use of equipment and other related costs assigned to each case-. COPD patients are attended not only at emergency unit or at the hospitalization unit, but also at consultancy by physicians on regular basis, as COPD is a chronic disease, so cost assigned to consultation must be also taken into consideration.

FHC’s consultation fees are established by a contract signed with regional authorities on yearly basis: current price is 127€ for first consultation, plus another 76€ for any further consultation. Data can vary depending on each patient’s status, as comorbidity can include any other mayor diseases or disorders that could be treated as major diagnosis for codification purposes instead of COPD, so it has been decided to use code 496 of CIE-9-MC for chronic obstruction of reportorial tract as reference.

Hypothesis

FHC' aim regarding economic impact of InCASA is to establish annual cost of each patient within the project according to data provided by its analytical cost analysing database, based on an ERP by Oracle linked to its Clinical record database. Then, the cost is compared with the cost reported by the system for the period of inclusion within the programme, in order to strengthen the basis for effective analysis when combining this economic data with the clinical data at the end of the project.

As previously stated, the cost for each kit installed in the patient's home for training purposes was expected to avoid worsening the clinical status of a patient suffering from COPD. According to available scientific evidence, this- is about 1.600€ each (it includes pulse Oximeter, tactile screen, portable pedal machine, 3G access to internet and mobile plinth for all the equipment) and it is expected that each patient uses the equipment for an average period of 6 weeks, so each kit could be in active use for a total period of 48 to 50 weeks per year. This is except for those periods of required maintenance and transportation activities, that is, 8 to 9 patients per year. The depreciation rate of each equipment must be calculated for a period of 5 year in accordance with national regulation, that is, an annual cost of approximately 320€. Hypothesis is that a reduction of at least 1 or 2 days of hospitalization 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 hospitalization 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 (see "clinical effectiveness").

Nevertheless, related costs such as those derived from technical issues (software or hardware malfunction, lack of expertise of involved patients in doing prescribed exercises, etc.) could cause sensible level of deviation in expected costs. Therefore, clinical outcomes at the end of the project should demonstrate clearly that patients are improving their health status, so these conclusions referred to cost effectiveness should be treated as preliminary ones.

A real example of the type of information gathered by this system is showed below:

CLINICAL RECORD NUMBER: 122062
Period: January to December 2011

Hospitalization days:		
	Ambulatory unit (in –home treatment) 1 day	716.72€
	Hospitalization unit (Hospital facility, medical consultation) 1 day	68.02€
Pharmaceutical		55.65€
Provisioning		29.70€
Radiology		93.86€
Laboratory (analitical issues):		136.60€

Emergency unit		526.16€
Consultation	Includes spirometry and three visits to hospital to be attended by a physician)	793.21€
	TOTAL (€)	**2660.75€**

Table 16 FHC Hospital Costs

Whether this patient, as a consequence of the in-home treatment programme, suffers in the next future any minor period of hospitalization due to COPD than previously expected, the treatment could be considered cost-effective for FHC as well for the patient, not only in terms of cash but of perceived quality of treatment, too.

Data of each patient participating at InCASA are currently being gathered and they all will become a basis for comparison at the end of the project and on, by making comparisons for both individuals and the whole group of participants. Comparisons for those patients included in the control group, that is, patients who are not doing in-home treatment but only treatment at hospital gym.

Safety Aspects

Regarding the evaluation of the safety aspects of the inCASA platform, no incidents were reported or recorded in the pilot action log. The equipment installed at the patient's house are the touchscreen PC– for conducting measurements via the SARA client graphical interface, the clinical measurements devices – such as Oximeter- and exercising devices –portable pedal machine-,. All above devices are consumer devices and have been approved by EU regarding safety and electromagnetic emissions. The professional users access the Consumer Applications web UI to track remotely the measurements and deviations from the habits profile of the patients on a daily base. Consequently all user interactions with the platform are inherently considered safe.

Challenges

Patient

A major expected challenge identified from the beginning is the usual complete lack of PC usage skills from the part of the patients. Lack of friendly design for clinical purposes is a common feeling for both clinicians and patients involved in the pilot: pc touchable screen does not seems as good solution as it was categorized in the design phase prior to pilot launch, as patients usually do not feel confident to use it in an appropriate way unless there is a previous training period. Even after the training period, some patients feel that equipment does not work as it seems to be expected according to their previous experience at hospital gym, maybe due to conditions under which that training period is develop, that is, continuous presence of professionals who are supervising every issues. Although inCASA platform is not technology skills demanding, it requires a minimum level of expertise required. Moreover, manual actions like restarting the all-in-one PC after a blackout, unexpected light or sound alarms due to hardware malfunction, lower speed of internet connectivity, disruption of Bluetooth connectivity between devices, etc. , are obstacles to be tackled whether a permanent implementation of inCASA solution is to be put in place in long-term conditions.) Regular visits held by health professionals is useful in particular for elderly people in order for them to adapt to the new technologies usage and it is the most valued resource by

patients, direct human interaction seems to remain a necessity for patients, even if it does not consist of skilled people in clinical issues but technical ones in charge of dealing with hardware and software failures.

Some inCASA patients have rejected the in-home training activities not because of lack of confidence in the technical solution but due to their specific health and social status (some of them did not want to do exercises at all, no matter if there is some device involved or not). Other ones have not the required level of self-awareness to be included in the project (Charlson index was used in order to measure this value), as inCASA solution does not fix with their requirements.

Organisational

Organisational challenges has become a thrilling experience as there was not many former links with local social services and clinicians did not have any close relationship with FHC social worker services before. A shared sense of opportunities in this field has arisen alongside the execution of the pilot site, yet to be developed. Some steps have been done, such as the inclusion of social evaluation results within the clinical records of patients involved.

3.4 Conclusions

The inCASA solution has provided to FHC pilot site with a completely developed tele-rehabilitation programme ready to be offered to chronic patients suffering COPD so that they can improve or maintain their health status without any displacement to hospital facilities on regular basis, except for a pre-defined consultations at the end of the training period. It includes not only health outcomes but also social ones, as a social evaluation of each patient is being included, too. Both social and health issues are included into the programme, and a closer relationship between hospital professionals and social ones has become a major outcome of the pilot. The tele-rehabilitation programme provides a tested tool to attend needs of chronic patients suffering COPD and living in rural areas. Patients' satisfaction and self-perception of their health status and quality of life are coherent with previous scientific evidences offered by studies focused on rehabilitation exercises for COPD patients, with the advantage of less resources to be dedicated to build up installations to attend those patients, who can rest at their homes and keep on doing their exercises under remote monitoring when needed. The avoidance of hospitalizations 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, too.

3.5 Next Steps

At FHC pilot site, as a consequence of lessons learned from inCASA, the Management Board is confident that achieving relevant clinical outcomes for chronic patients is a solid reality. Thus, a new program focused on chronic patients (not only frail elderly ones) is currently under discussion. The general approach from a strategic point of view is based on the notion of "managed care", arised in the 90's in the USA. It includes a set of instruments such us:

1. "Programas de Gestión de Enfermedades" (PGE): multidisciplinary teams focused on providing the best clinical assistance based upon documented guidelines.

2. "Programas de Gestión de Casos" (PGC): focused on high risk patients with complex health needs leaded by health professionals with specific expertise in coordinating and integrating care activities. –"Not illnesses but patients"-.

FHC's view is that in the future services provided by the hospital will evolve from "Focus on acute pathologies" to "Focus on chronic pluripathological patients", which should be based on:

- Risk assessment.
- Management based on broad population needs.
- Promotion of higher level of Patient's autonomy.
- Cooperation between different levels of assistance, specifically with Primary care level.

Another key point is current lack of 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.

FHC's Idea is to build up a multidisciplinary team composed by 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 specialized in internal medicine issues, who 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 she/he will be in charge of evaluating patient's needs, 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 practitioners" 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.

Diseases expected to be used as inclusion criteria would be:

1. COPD.
2. Diabetes.
3. Depression (still pendant of final validation).
4. Rheumatoid arthritis.
5. Heart diseases.

Nevertheless, ultimate Inclusion criteria are still pendant, but they will be based on "Kaiser Permanent" approach to chronic patients. More specifically, in accordance with the different levels included in to the "Kaiser pyramid", those ones included into the 3rd level will be those patients to be included within the program, that is, generally speaking "patients with very complex needs that require a specific organizational infrastructure that gives them a highly personalized service". Our prior targets would be those ones related to people with at least two categories as described by Ollero et al., for example one patient with "C" category -COPD clinically stable, Dyspnea level 2 (MRC) or FEV_1 under 65%, or Oxygen saturation under 90%- , plus "A" category - cardiac failure with level 2 of NYHA (New York Hearth Association)-.

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 with at least two clinical

processes classified into level Three of Kaiser Pyramid, in close relationship with primary care level and social units, too.

Tele-health and tele-care innovative approach into this new project would take into considerations lessons learned from inCASA, including recommendations given by other pilots. For example, we expect to use same blue tooth pulse Oximeter used at FHC pilot site to gather clinical relevant information such as heath rate and SPO2 level under remote basis, but we would like also to validate a unique device intended to provide to our clinicians with a full range of clinical parameters on regular basis and remote control, such as glucose, blood pressure, weight, heath rate and rhythm. We have already got in contact with a national company with specific expertise in the field to gain detailed and updated knowledge related to several national providers interested in the development of such a service.

To enhance the integration with additional resources already existing within the region, FHC's aim is to get some relevant partners involved into this project, such us for example a medium-to-long term care hospital (Hospital Virgen del Carmen), which opened its gates in February 2013. Health Professionals working at this Hospital, as well as social professionals belonging to primary care level and local social services are expected to actively participate in the design of an integrated process intended for those patients who have been attended at our hospital due to some sort of acute clinical process (surgical intervention mainly) who also need a moderate level of specialized care for a relevant period of time at the end of the hospitalization phase at FHC, before they can return safely to their own homes.

From a general point of view, beware that a regional strategy focused into chronic patients is currently under consideration. The initial phase, which consisted of a diagnosis led by both regional and external experts as well as health managers, has already been completed. It could affect to the on-going design of this project.

3.6 Recommendations

On June 3rd, 2009 the Spanish National Health System (SNS) approved a new COPD Strategy. The main goal of that strategy was to identify the weaknesses of the healthcare organizations to attend this pathology as well as to establish aims and recommendations agreed upon for the Spanish National Health System.

Among the actions that were considered critical, it was necessary to reach an appropriate level of quality healthcare, which means a group of activities aimed at guaranteeing ideal services. The term includes several aspects, but among them the following stand out:

- To guarantee the accessibility and equity for all the people who suffer from COPD, no matter their zone of residence or their socioeconomic condition.
- To offer an ideal professional supply of services with high scientific and technical quality.
- To streamline the use of available resources attending to cost-effectiveness criteria.
- To ensure the compliance and satisfaction of the user from the attention received.

In year 2013, the results of a survey carried among healthcare professionals involved in COPD healthcare activities at Spain, titled "EPOCCA", whose aim was to analyse their professional

perception related to recommendations oriented to COPD patients, has shown that the existence of home care programmes designed specifically for COPD patients in combination with existing resources can avoid hospitalizations, decrease hospital readmissions and facilitate an appropriate connection between the different levels of care.

According to the results of this survey, home care appears among the three most important indicators for COPD patients' attendance and In-home hospitalization represents a new modality of care for patients with non-acidotic exacerbation but who suffered exacerbations that were attended at hospital. Two possible schemes have been identified for this purpose:

- In-home treatment as an alternative to conventional hospitalization: hospital discharge from the emergency.
- In-home programs as a way of early discharge after a period (usually short) at the hospital.

A meta-analysis included in the study confirms that this approach is safe and, compared to conventional hospitalization, implies a costs reduction at the same time that the period of hospitalization decreases. However, only 26% of people surveyed acknowledged having hospitalization programs at their own health centre.

Home-based care programs for fragile patients are also considered by the majority of participants in the survey a different care alternative. It is not clear if this modality should be attended by the same units as those in charge of in-home hospital units (Secondary level) or supported by the Primary Care Level. According to this survey, this type of initiatives are not yet well established in Spain, and only 22% of participants acknowledged having in-home treatment for COPD.

Another relevant conclusion of this study is that -aware of the importance of the coordination of care for a patient with COPD- 26% of the people surveyed found that consensual common protocols should be made by the professionals who look after these type of patients directly. According to 24% of the participants, rehabilitation programs are also an aspect which needs improvement.

Thus, results offered by "EPOCCA" linked with results gathered at FHC pilot site demonstrates that there is momentum for the deployment of tele-rehabilitation programmes for COPD patients based on e-health solutions but also in a closer relationship between the different levels of healthcare organizations (both Primary Care and Secondary levels), so that a wide range of professionals 8not only healthcare ones but also those ones involved in social issues) can develop new protocols focused on COPD patients treated outside hospitals as a preventive activity to minimize the increasing pressure of costs-structure as well as a better level of living conditions for these chronic patients.

Despite the previous recommendation, some minor ones can be added, too. Firstly, many problems and glitches were experienced using both in-home equipment and sensors, demonstrating that it is essential that the equipment design be changed and sensor reliability be improved. Additionally, in order to promote the widespread use of such equipment future objectives must be aimed at making software (SARA) affordable.

Secondly, at this time it is uncertain whether or not actigraph data collected throughout the study will be statistically suitable to accurately assess patient improvement. However, in the event that this data should be used as part of the project´s overall data analysis it will provide useful information about the health status of the patient over time.

Final recommendation for inCASA use in future applications would be to broaden the inclusion criteria of patients and increase the number of patients in the study. Several groups of seniors were excluded from the pilot and these groups should be incorporated into later studies. These include persons living in assisted living for seniors (Retirement homes) and persons suffering a high rate of comorbidity. Moreover, in an effort to maintain the continuity of care received by patients involved in the study, hiring social workers not affiliated with participating hospitals is recommended. This way, patients who improve and are released from the study will continue to maintain contact with social workers who can continue to monitor their well-being.

4.0 INSERM

The main objectives of the French pilot in the inCASA project are to develop a service of technologies for cancer patients (with a sufficient level of independence and living at home) focused on their habits in their daily life and the evolution of different physiological parameters that may be affected by the disease and / or treatment (rest-activity rhythm, body weight, symptoms score evaluated by the MDASI scale).

The primary outcomes of the project are:

- A better understanding of the health condition of cancer patients in their real life at home
- The definition of quantitative indices that will enable quick and appropriate intervention in case of alteration of the health condition of the patient staying at home
- The effective implementation of decision procedures in order to treat these frail patients early and adequately, thus minimizing the risk of symptoms worsening, deterioration of general condition and emergency hospitalization.
- The secondary outcome of the project is to develop the area of telemedicine/domomedicine in clinical practice for the follow-up of cancer patients. Indeed, we expect that the quality of life and the health condition of the patients will be improved if the InCASA solution helps avoid hospitalization while reassuring the patient with an effective information system based on relevant health status monitoring.

4.1 Description of Pilot

Cancer is a chronic disease with a high impact on patient's quality of life, health and wellbeing. The treatment proposed by the Chronotherapy Unit of the Paul Brousse Hospital in Villejuif is a chrono-modulated chemotherapy delivered at home. Chronomodulated chemotherapy (chronotherapy) aims at the reduction of treatment-related symptoms through the adjustment of chemotherapy delivery to the circadian timing system which rhythmically regulates cellular metabolism and proliferation. Cancer chronotherapy is delivered at home using programmable pumps, and avoid familial and social disruption. Since cancer is a complex disease associated with co-morbidities, many health and social care providers are involved. This leads to a large burden on the health care system as well as a complex situation for patients and their family. By integrating social and medical care and using telehealth monitoring, patients can be supported on more than one level in efficient ways.

The aims and objectives of the pilot involve:

- Improvement of care for cancer patients, which currently is 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 reduce hospitalization. This approach includes the daily self-rating of the symptoms which reflect impaired behavioural or biological functions, as well as body weight and circadian rest-activity pattern through non-invasive rest-activity monitoring.

This will result in improved quality of life and patient prognosis through facilitating health care coordination, controlling patient symptoms and enhancing circadian robustness.

The telemonitoring system is composed of an electronic platform with the SARA software, a weight scale, an electronic internationally validated symptoms questionnaire and an actigraph watch. This system provides relevant and online daily information about the body weight, the symptoms severity and their interference with daily life, as well as the rest-activity and sleeping patterns of the patients. These data are checked daily by the hospital nurses, with action following when appropriate. The nurses are the primary access point who directly interact with the patient and if necessary signal the health problems at an early stage to the oncologist, the GP, the local nurse, other relevant healthcare professional or the ”helper” relative. Early detection of worsening of cancer or early detection of adverse events on chronotherapy at home followed by immediate appropriate action could prevent health deterioration, hospitalisation and/or death. Pending upon the type of deteriorated item (symptom, body weight, rest-activity...), as indicated with reference to pre-set thresholds eventually completed with patient interview , the nurse refers the patient to the relevant health professional (oncologist, geriatrist, general practitioner, psychologist, dietician, physical therapist or social worker). The patients can then check the appointments with healthcare or social care professional directly on the diary displayed on the electronic platform at his or her home. When a patient has medical questions or needs with arranging social services, the nurses can be contacted by phone during office hours. By integrating healthcare and social care, a network of social and medical professionals is built around the patient resulting in the most appropriate care being delivered in the shortest time with the burden on informal carers (mostly partners or family of the patient) being minimized. The homecare company involved into the coordination of healthcare and social care professionals interventions, the installations and the logistics is ‘LVL Medical’. LVL Medical is composed of 37 agencies in France which allows a follow up of patients living far from the Paul Brousse hospital.

4.2 Methods and Design

After their medical consultation with their oncologist at Paul Brousse hospital in Villejuif, France, patients meeting the inclusion criteria were proposed to participate in the inCASA study. If they gave their oral consent to participate after attending a demonstration of the system and receiving all the information about the terms of the study, an appointment was made for the installation of the equipment at their own home. They were also provided with an information leaflet. The day of the installation, patients were asked to sign a written informed consent. The patients were then interviewed in order to complete demographic questionnaire and frail scale. They were also asked to fulfil one SF36 questionnaire at the beginning of the study (the day of the installation or the day after), one perception and satisfaction questionnaire and one another SF36 questionnaire at the end of the study (6 weeks after the day the equipment was installed). Other specific questionnaires were completed using medical records.

Each patient was enrolled in the study for a minimum monitoring period of 6 weeks. 37 patients completed the study at the end of the project. Some patients didn’t complete the SF36 and SUTAQ questionnaires as they were implemented after the beginning of the pilot phase. Some others never returned back the questionnaires after the end of the study.

Professional perception was evaluated using questionnaires and interviews. Data for economic evaluation were provided by the head nurse of the oncology department of the Paul Brousse hospital.

4.3 Results

Demographics

Age, mean(range)	62.2 (35-91)
BMI (%)	
[18,5-25]	59.5
25-30	40.5
Gender (%)	
Male	57
Female	43.2
Diagnosis	Cancer
Site of Primary Tumour (%)	
Colon	29.7
Rectum	13.5
Pancreas	24.3
Breast	13.5
Other (prostate, ovary, liver...)	18.9
Metastasis (%)	
No	21.6
Liver	55.6
Other (bones, lung, lymph node...)	22.8
Other diseases (%)	
No	81.1
Diabetes	13.5
Hepatitis B	2.7
Heart disease	2.7

Table 17 INSERM Demographics

Regarding the level of education, most of patients (89.1%) completed secondary school. Most of patients were married (59.5%) and retired (51.4%). Almost all patients were non-smokers, 75.7% were familiar with a PC and 86.5% with a mobile phone.

INSERM used G8 Frail Scale (onco-geriatrics) to assess patient's frailty as the Edmonton Frail scale is not validated in French. The G8 scale includes 8 items about health condition and age of patients. A patient is considered frail if the score is lower than 14 over 17. 69% of patients who participated in the study were frail patients. The mean score is 11.6 and the standard deviation is 2.6.

Patient Perception

Patients' 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 in 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 in their positive equivalent). The 22 items have been divided into 6 clusters. Results from the patients' perception questionnaire are presented in the following table:

Subscale	End of Monitoring Period: Mean (SD)
Enhanced care	3.92 (1.11)
Increased accessibility	3.09 (1.15)
Privacy and discomfort	4.24 (1.07)
Care personal concerns	3.72 (1.04)
Kit as substitution	3.11 (1.14)
Satisfaction	4.17 (0.82)

Table 18 Patient Perception

These figures shows that in average patients think that the kit they received can enhance care. But 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 substitution of conventional care. The mean score for privacy and discomfort shows that the kit has generally not interfered with their life. Most of all are concerned about their personal care and the use of their data. Finally, patients are satisfied with the kit they received.

Quality of Life

Patients were provided SF-36 paper questionnaires for quality of life assessment at the beginning of the study and they were asked to complete one questionnaire at the time of inclusion and one another at the end. Answers were then extracted to compute scores of several parameters. The two main parameters are the Physical Component Summary (PCS) and the Mental Component Summary (MCS). PCS provides overall assessment of physical health which includes both functioning and evaluation of one's ability to perform physical activity. Whereas MCS provides overall measurement of mental health as comprised of an assessment of psychological distress and well-being, social and role functioning, and overall vitality.

The following graphs show the changes in PCS and MCS average scores during the study (initial, intermediate, and final). Scores are calibrated so that 50 is the average score or norm

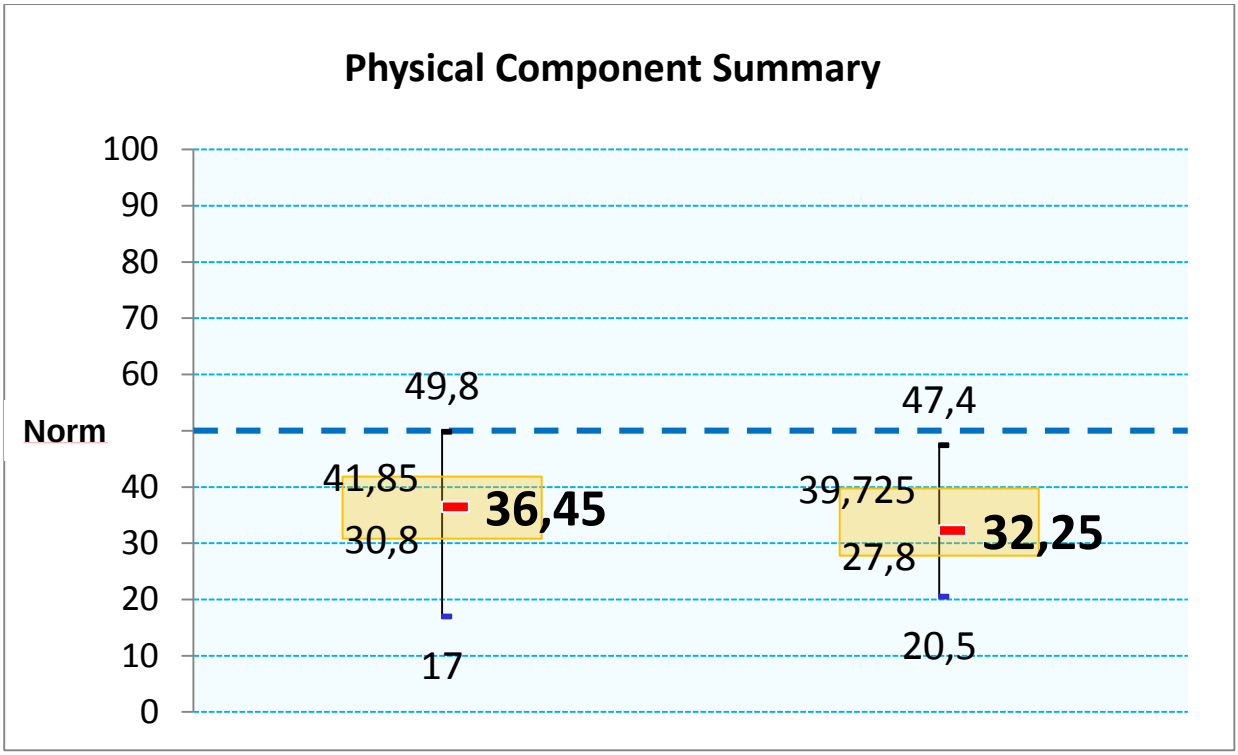


Figure 24 INSERM SF36 - Physical Component

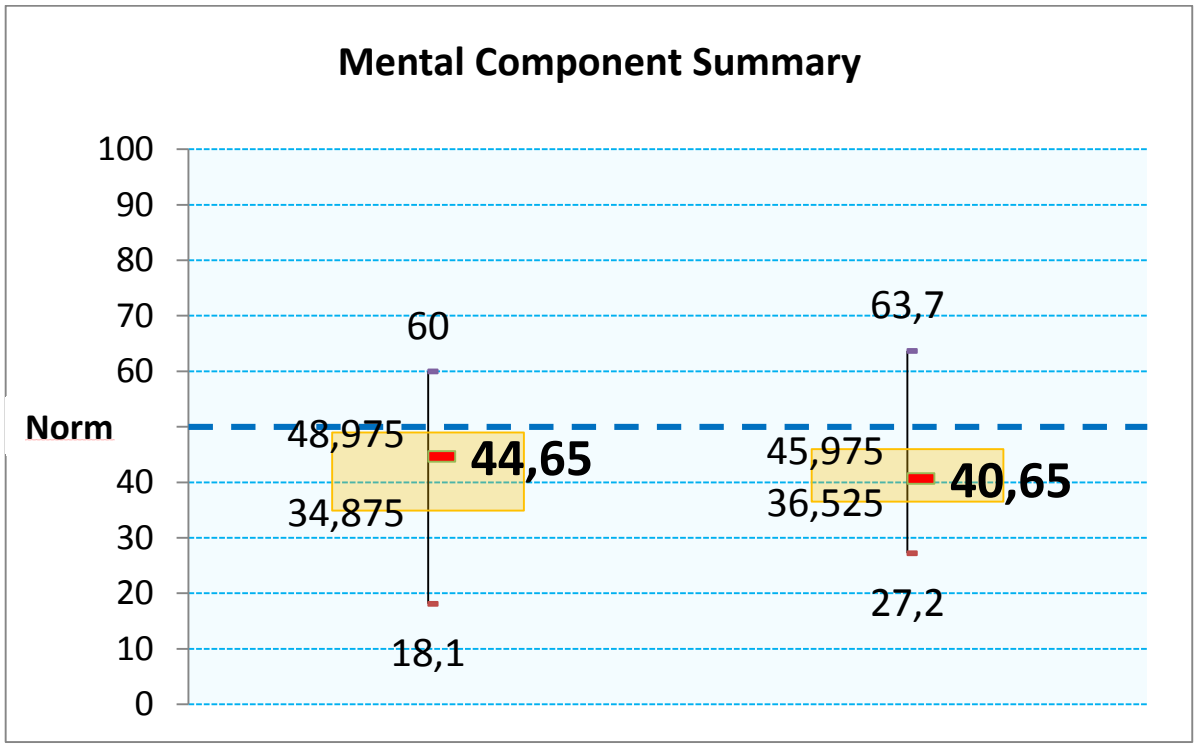


Figure 25 INSERM SF36 - Mental Component

These two main parameters can be split into more detailed components:

Physical Component:

- Physical Function
- Role Physical
- Bodily Pain
- General Health

Mental Component:

- Mental Health
- Emotional health
- Social Functioning
- Vitality

The following graph provides a comparison between the components at the start and at the end.

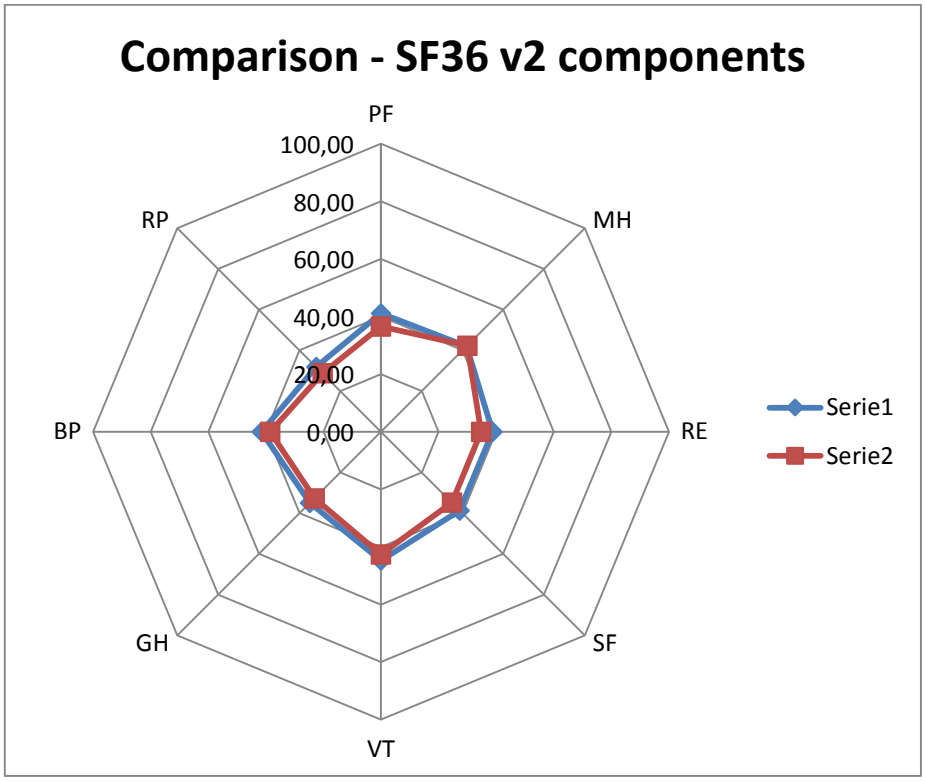


Figure 26 INSERM SF36 components

Results showed a slight decline in PCS and MCS. Even if inCASA services didn't really affected patients, most of patients reported that the system increased their sense of security at home as they knew their weight, symptoms and rest-activity rhythm were monitored and they were less concerned about the risk of alteration of their health condition.

Professional Perception

To evaluate the perception of professional users, they were asked at the end of the pilot phase to fill out the professional perception questionnaire. Three nurses and one technician completed the questionnaire. This questionnaire includes one part related to the integrated service and one another related to the integrated technology.

For the integrated service, results showed a percentage of “yes” of 54% and a percentage of “no” of 46%. For the integrated technology, the percentage of “yes” was 75% whereas the percentage of “yes with some conditions” was 25%.

Regarding the satisfaction questions, scored 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).

To sum up the answers to the other questions, all professional users acknowledge the value of the service and the system for improving the follow up of patients’ health condition and being able to intervene and avoid unplanned hospitalizations but their perception of the service was very altered by technical issues. Especially the nurses had troubles with the web portal to visualize the monitoring data. As some patients had data transmission problems, the nurses had difficulties to perform a close monitoring of patients’ health condition.

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 limits of the technology affected their overall satisfaction.

Clinical Effectiveness

The three monitored parameters were the body weight, the symptoms severity and the rest-activity rhythm. Body weight and symptoms are clinical data that are monitored by comparing the measurements to pre-sets thresholds.

Regarding the body weight monitoring, one alert was generated when 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. The figure 20 shows example of body weight changes before, during and after two chemotherapy courses (periods in blue). In this example the weight decreases between 1 to 2% after each course which is why no alerts were generated.

The symptoms scores, self-assessed by patients using the M.D.A.S.I. questionnaire, are split into five clusters: gastro-intestinal (GI), sleep and activity, emotions, sensations and others. Symptoms scores range from 0 to 10 and the scores of the clusters are a mean value of the symptoms. An alert is generated when one of the clusters scores are higher than 5. In figure 20 **Errore. L'origine riferimento non è stata trovata.**the severity of the gastro-intestinal cluster increase during chemotherapy course but no alerts were generated as the scores remain lower than 5.

Figure 27 Clinical data monitoring

Clinical Case Study

The following case study refers to a cancer patient of the INSERM pilot. This patient is 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.

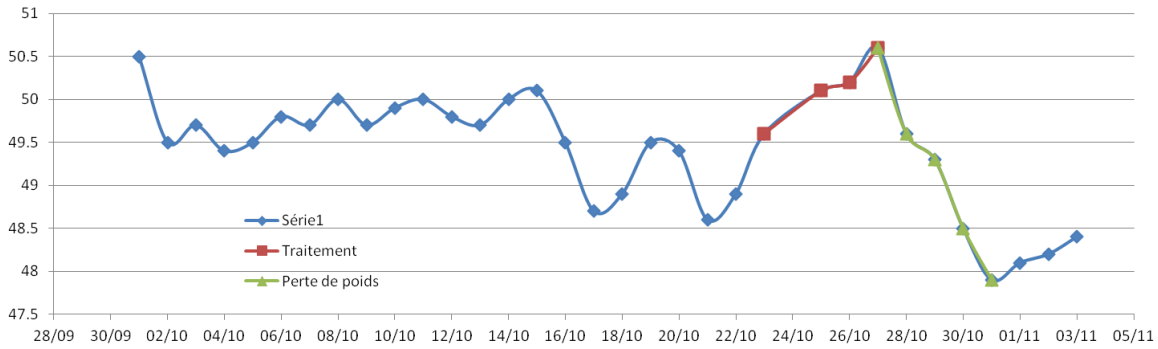


Figure 28 body weight changes during chemotherapy

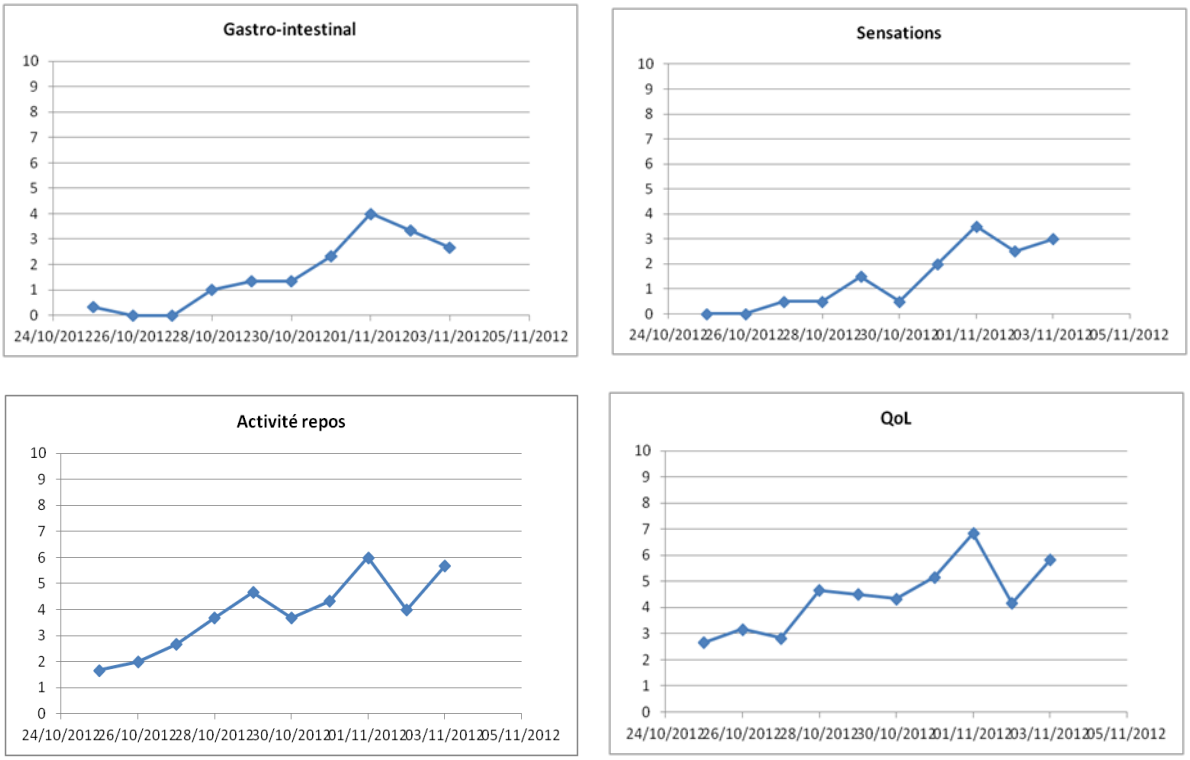


Figure 29 Symptoms clusters during chemotherapy

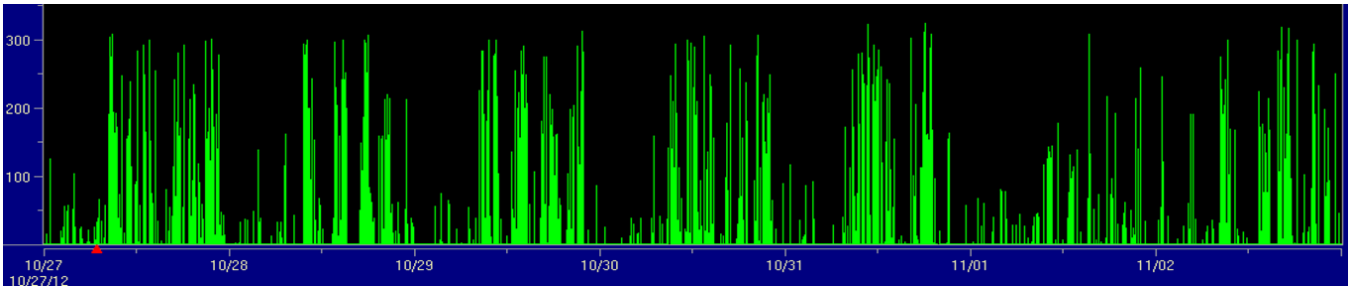


Figure 30 Rest-activity rhythm during chemotherapy

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

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

Alarm Protocol

Four alarms thresholds were defined in order to detect abnormal events:

- body weight monitoring: one alert was generated when 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 alarm was generated when one of the clusters 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 alarm was generated when no data was received during the last 48 hours.

As the alarms were not automatically generated by the system, the nurses checked the data daily. As the dichotomy index was not automatically calculated, the nurses only visualized whether the rhythm was steady (higher activity counts during the day than during the night).

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

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

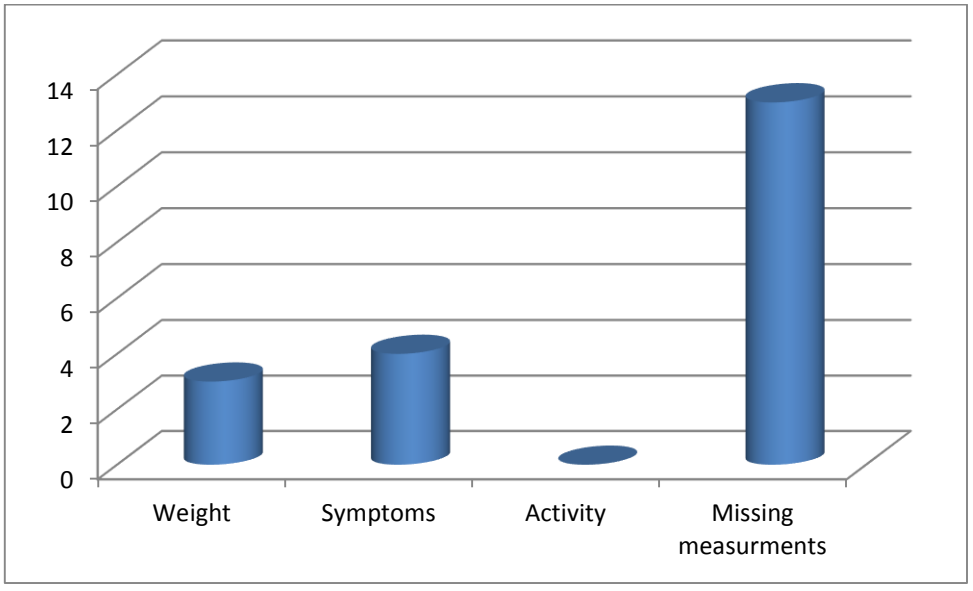


Figure 31 Number of alarms detected by nurses

These alerts resulted in several kinds of interventions:

- 2 hospitalizations for toxicity
- 3 false alerts (patients not at home)
- 9 technical interventions (data transmission problem), including one home visit and seven technical calls
- 6 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 hospitalized in emergency without alarms generated. So it was decided to lower the threshold to 5 instead of 7 which increased the number of generated alarm for symptoms severity.

The alarms were not automatically generated as the thresholds were defined early enough to be implemented in the SARA web portal. So the nurses had to check the data for each patient daily which took about one hour a day. With automatic alarms on body weight, symptoms, activity and missing data they could have save time by looking only patients' data that generated an alarm and detect abnormal events earlier. Each alarm detected by a nurse was followed by a patient call to get more information about the event.

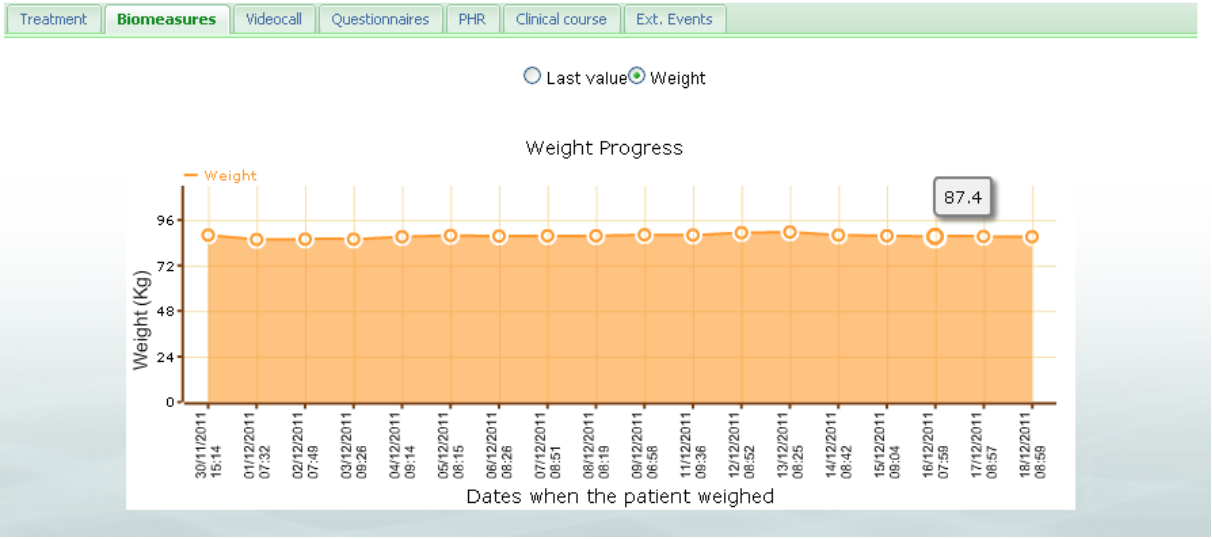


Figure 32 Visualization of body weight changes on web portal

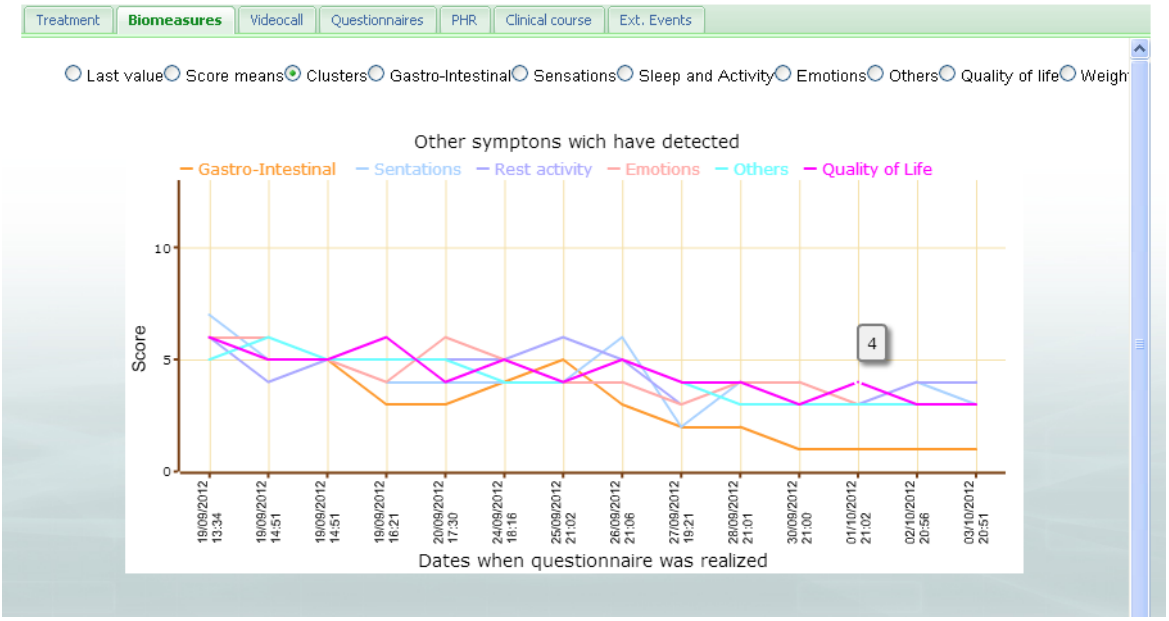


Figure 33 Visualization of symptoms scores changes on web portal

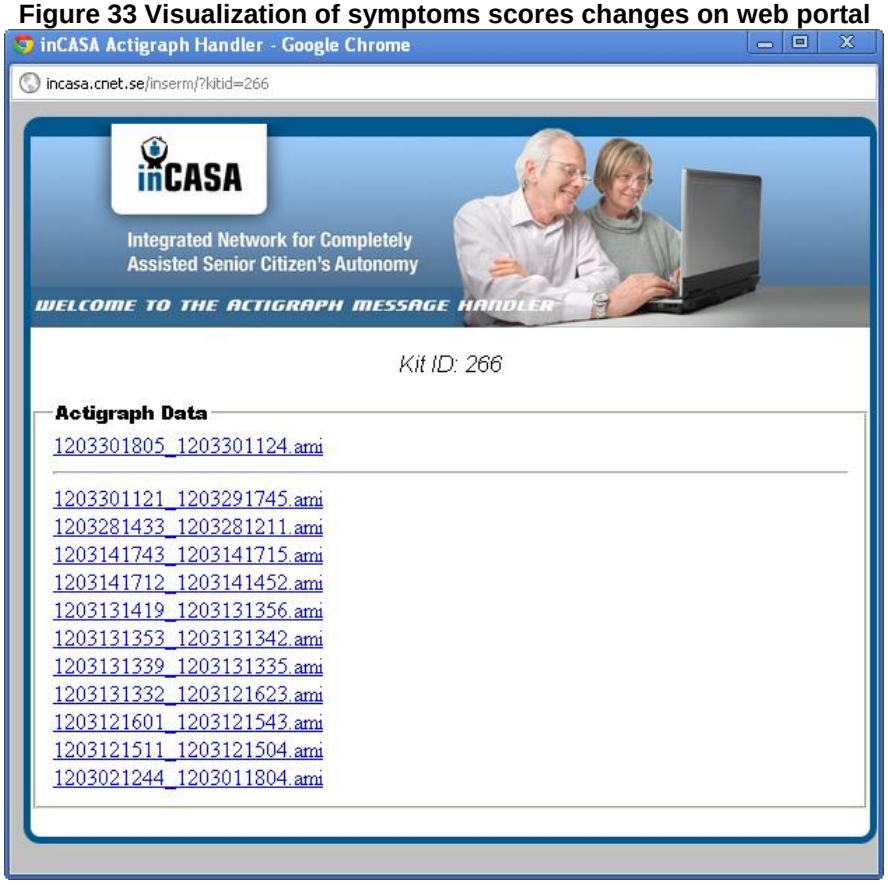


Figure 34 List of Actigraph files on web portal

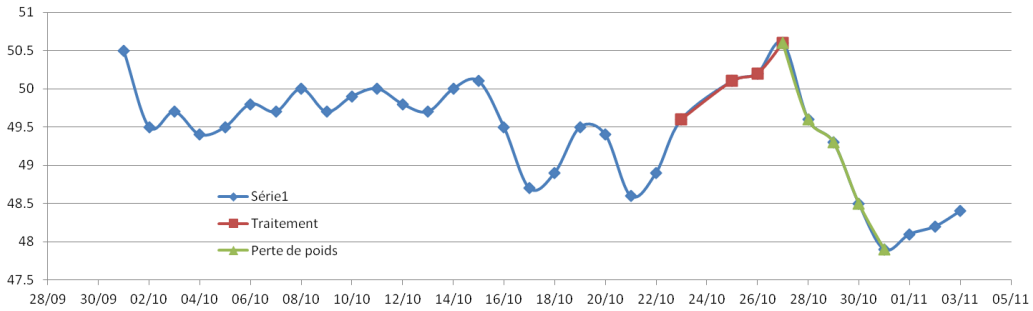


Figure 35 Example of body weight alarm

The figure 35 shows an example of alarm for body weight loss. The part in red corresponds to the weight changes during the chemotherapy course whereas the part in green corresponds to the weight loss. In this case the weight decreased by more than 5% in four days which generated an alert and a clinical intervention.

Organisation / User of Resources

From the beginning of the pilot phase, it was necessary to perform data monitoring daily for an early detection of alteration of patient's health condition. The time required for data monitoring for maximum ten patients was estimated to one hour. So this activity has required some changes in the work organization of nurses and a period of adaptation and training. It was also reported some difficulties for the nurse to contact an oncologist when an alert was raised due to their limited availability.

The cooperation with the homecare company for the installations and the interventions was really good as they were very reactive and well organized. Thanks to their network of agencies throughout the country, several patients who lived very far away from the hospital have been able to participate in the study.

Economic Aspects

In order to evaluate 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). Details are presented in the table below.

Type of costs	Stakeholders	No of hours	Cost Unit	Cost (€)	Total cost (€)
Education of the staff	Nurse	3	24.2	72.6	268.1
	Medical Doctor	1	36.3	36.3	
	Case Manager	4	27.7	110.8	
	Social workers	2	24.2	48.4	
Staff meetings	Nurse	12	24.2	290.4	691.6
	Medical Doctor	8	36.3	290.4	
	Case Manager	4	27.7	110.8	
Installations and logistics	Technician	100	27.1	2710	2710
Monitoring and interventions	Nurse	200	24.2	4840	5618.5
	Medical Doctor	10	36.3	363	

	Case Manager	15	27.7	415.5	

Table 19 Time used by staff

The total cost of time used by staff for running the service (pilot phase) is estimated to 9 288 €. Ten sets of equipment for were purchased for patients at the beginning of the study period. Costs details are presented in the table below.

Equipment name	Cost per equipment	Quantity	Total cost
All in one PC	500	10	5000
Bluetooth weight scale	100	10	1000
Actigraph	1000	10	10000
Total			16000

Table 20 Cost of equipment

The total cost of equipment is estimated to 16 000€. Therefore, the total costs for delivering the service are estimated to 25 288€.

The cost of one chemotherapy course at home with inCASA monitoring was also compared to the cost of one chemotherapy course in conventional care:

- Conventional care (hospitalization in oncology department): 6140 €
    - Five days (drugs, care, staff…): 1228 € per day

- At home with inCASA monitoring: 2099 €
    - Platform installation + training + maintenance: 200 €
    - Course in day hospital: 1479 € (drugs, care, staff…)
    - Data monitoring by nurses: 50 €
    - Homecare by service provider (4 days): 270 €
    - Other drugs: 100€
- According to this comparative study, 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.

Safety Aspects

No safety incidents were reported from patients or professional users. The equipment installed at the patient's homes included the SARA gateway, a Bluetooth weight scale and an Actigraph. These devices are all consumer devices approved by EU regarding safety and electromagnetic emissions. All user interactions with the equipment are considered safe.

Ethical Considerations

No ethical considerations occurred during the pilot.

Habits Profile

The rest-activity rhythm is a parameter which is measured continuously and provides information on habits. That is why it needs to be analysed and interpreted in order to detect changes from normal patterns.

The rest-activity rhythm was recorded using a wrist watch Actigraph. This device measures the frequency of movements which provides information on the patient's level of activity per minute. The goal of this system was to detect an alteration in the patients' rest-activity patterns which indicates a circadian disruption. For this purpose, the dichotomy index (called "I<O") was calculated on two-day periods the ones after the others and compared to a pre-set threshold. The dichotomy index corresponds to the percentage of the activity counts measured when the patient is in bed that are inferior to the median of the activity counts measured when the patient is out of bed. The rest-activity rhythm was considered as altered when the dichotomy index was lower than 97.5%. This method allowed detecting changes from normal pattern and generating alerts and medical or social interventions when necessary.

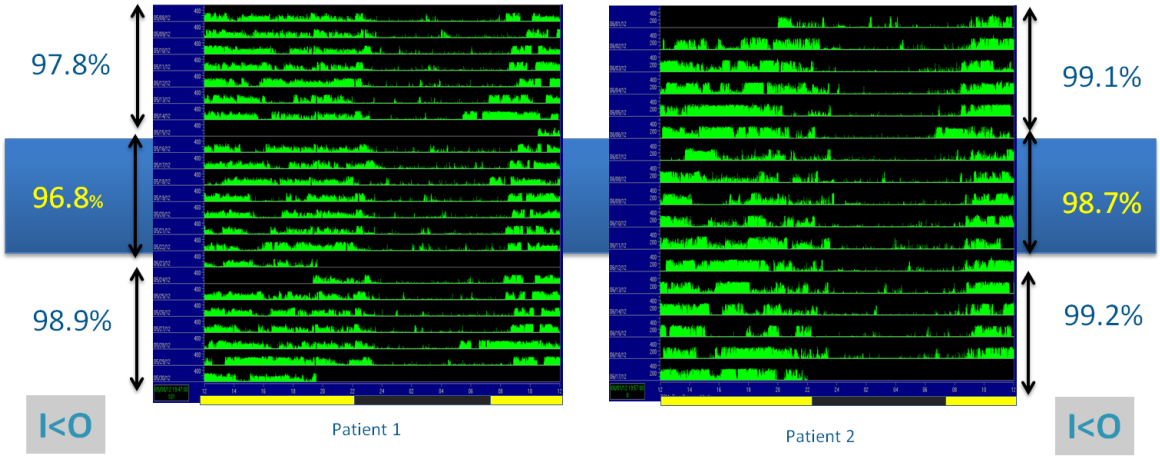


Figure 36 Detection of changes in rest-activity patterns

The above figure presents an example of the rest-activity patterns of two patients receiving chemotherapy at home (period in blue) with Irinotecan, Oxaliplatin and 5 Fluorouracil. The results show that the patient 1's rest-activity rhythm is modestly altered during the treatment as I<O decrease below 97.5% but there is a full recovery after the end of the treatment. In this example, no circadian disruption was detected for patient 2 as the dichotomy index was always higher than 97.5%.

Challenges

Despite the several updates made throughout the duration of the study on the Actigraph data transmission software, most of patients had Actigraph data transmission problems due to the infrared connection, the very limited autonomy of the watch (4 weeks) or the SARA system. But no data were lost as they were saved in the memory of the watch or in the computer. A passive Bluetooth transmission, like initially planned, could have avoided transmission issues while making the process more user-friendly for patients.

The other main technical challenge that the pilot has faced was the data display on the web portal. Sometimes the symptoms scores transmitted by the patients did not appear on the charts which prevented the nurses to make a good follow up of patients' health condition. The changes in body weight over time were also hard to be visualized as the scale of the graph was not adequate and cannot be configured.

The organisational challenges were also quite important as a good cooperation were requested between the nurses, the medical doctors (oncologists and general practitioners), the social care professionals and the technical team. The staff missed a communication tool integrated to the web portal in order to generate alerts, plan interventions and track changes.

4.4 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 are data that were not accessible before and that provided a lot of 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 about the use of the system and the service delivery. Though 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.

4.5 Next steps

INSERM has shown an interest to enlarge the pilot after the end of the project including more patients during six months at least. Collaboration with Telefonica is considered for the support and the web services. In order to increase the duration of the study and the number of the patients INSERM would need to double the number of available equipment's. Then, in order to improve the interactivity of the system, INSERM also would need some technical improvements of the SARA solution : for instance, adjustments on the current data display on the web portal, adding of alerts on weight and symptoms using the pre-set thresholds, improvement of the professional user management on the web portal (for example the ability for the nurses to send a notification to the doctors after detecting an alert and visualization of the decisions), communication with patients through video-call.

Collaboration is also considered with the homecare company 'LVL Medical' which is a service provider, part of the Air liquid group. This company is involved in the French pilot for the end to end management service including installations of the platforms at patient's home and logistics. They also manage when required the intervention of healthcare or social care professionals as their teams are composed of nurses and dieticians.

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.

4.6 Recommendations

The professional users would have liked a more interactive system. For this purpose, the SARA solution could be upgraded: first, adjustments on the current data display on the web portal are necessary for the nurses to perform a more efficiently data monitoring. Then, alerts on weight and symptoms using the presents thresholds should be implemented in order to be automatically warn

in case of abnormal parameters. Also the professional user management on the web portal should be improved, for example the nurses would need sending a notification to the doctors after detecting an alert and visualizing the decisions. Doctors also would like to be able to communicate with patients through video-consultation. This new functionality would avoid some patients who live very far away from the hospital to travel frequently.

5.0 Chorleywood Health Centre

The CHC pilot has developed an integrated service delivery model that combines health and social care services to provide a coordinated response to the needs of frail elderly people with long term conditions. The integrated service is driven by both health and social care. Information about the patient and data from remote monitoring is shared and exchanged between primary care and social services.

The overall objectives are to:

- Develop an integrated health and social service to act on combined data from physiological and environmental monitoring.
- Evaluate the benefit of that service to the frail elderly person
- Evaluate the benefit to and impact on the health and social services
- Understand and measure the impact of such a service on the quality of life of the patient
- Reduce dependency and need of frail patients for social services
- Prevent or reduce the number of unnecessary interventions and hospital admission
- Reduce length of hospital stay and enable early discharge of the frail patient into their own home.

5.1 Description of pilot

Patients enrolled onto the service were provided with technology to collect both health and habits monitoring data. The devices automatically transmitted the information via a home hub to enable clinicians at Chorleywood Health Centre and social workers at Hertfordshire Adult Social Services to view the data. Each monitoring period began when the equipment had been installed into the patient's home.

Patients were sent a letter inviting them to take part in the service. Clinicians contacted the patients by phone within two weeks of the letter being sent out to discuss the service. Clinicians visited those patients who were interested in taking part and described the purpose of the service. Those patients that agreed to take part completed consent forms and had appointments scheduled for installation. Both the clinician and non-clinical researcher carried out the installations and training was given to the patient.

Each patient had up to 3 of the following devices and a home gateway (The first version of the gateway was only able to pair with up to 3 devices).

- Home Gateway
- Blood Pressure
- Weight Scale
- Spo2
- Bed or Chair Sensor
- PIR, Motion Sensor

Pilot Process

Patients were asked to take a measurement once per day at a time that was convenient to them, this was usually by midday. Some patients were asked to take measurements slightly later dependent on their comorbidity. For example those with COPD were asked to take their measurements at least an hour after they had got up. Data from the habits monitoring devices sent data automatically without any input required from the patient.

Clinicians reviewed incoming data three times a week. Clinicians would carry out initial assessment of the patient data and if necessary would refer the patient for clinical intervention, social services or other community services as required. Clinical intervention was carried out by GP's and nurses. Social service referrals were passed to a named case worked in Hertfordshire Social services.

Clinicians also carried out first line technical triage. This included visiting the patients' homes to diagnose technical faults. Where necessary the clinicians would contact the technical support (provided by Brunel University).

Patients were given support information which described what they should do and who they should contact in the event of a clinical need or technical issue. All actions were recorded in the monitoring system and in the Electronic Patient Record.

5.2 Methods and Design

Methods: Patient Perspective

Study population

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

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

Recruitment

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. The follow up calls were carried out by the clinicians. Patients that were 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. This form ensures that the patient is aware of why they are participating in the service and how their participation will impact on them. A copy of the consent form is given to the patient and recorded in the Electronic Patient Record. Patients were informed at each stage that had the right to withdraw from the demonstration at any time.

Patients were contacted by the clinical team to arrange for the installation and training. Installation was carried out by both clinicians and non-clinical staff. The devices were simple plug and play and did not require hard wiring or other alterations to the patient's home. Devices were sited based on the patient request. Patients were given training during the installation visit and test readings were sent to confirm successful communications

Duration of the Pilot

The pilot phase commenced in October 2012 and data was collected for the evaluation until May 2013. The pilot is continuing past the end of the current funding stream.

Data collection - Patient

Patients were evaluated on clinical health outcomes, frailty, quality of life and patient perception. Data was collected at baseline and at the end of the pilot.

Clinical health outcomes were measured as a mean change in physiological measurements from day 1 to day n (the last day of data collected). The clinical team also documented interventions.

Quality of life was assessed using the SF36 v2 questionnaire which assesses the patient's quality of life over the duration of the time they are enrolled onto the service. The SF36 measures physical and mental health and presents these as two summary scores. Patients were asked to complete the questionnaire at baseline and at the end of the pilot.

A patient's level of frailty was measured using the Edmonton Frail Scale (EFS). The questionnaire measures frailty including cognitive impairment, functional ability and mobility. The maximum score is 17, which represents the highest level of frailty. Patients were asked at baseline to identify the degree of frailty at the time of commencing the study.

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

Patient perception was measured using a questionnaire which was adopted by the Whole System demonstrator program in the UK. It will be used to measure patient's perception of the service and technology. Patients were asked to complete the questionnaire at the end of the pilot.

Data Collection – Staff

The service team were made up of Nurses, General Practitioners, non-clinical researchers, Social Service worker, administrators and technical support.

All staff involved were 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.

In addition to these questionnaires, a small focus group was held once the evaluation data had been collected. Members of the health and social care team were present to make comment and contribute to the overall evaluation deliverable.

Data Collection – Organisation / Resource Usage

Information about service pathway usage was collected including time taken to enrol, install, triage and monitor patients. The number of referrals and outcomes of referrals including clinical, social and to other community services were recorded.

Case history and service utilisation for each patient was recorded including GP visits, planned and unplanned admissions, ER visits and social service contacts.

Data was collected for the time that each patient was enrolled onto the service and compared against the same time period immediately prior to their enrolment.

Data Collection - Economic Reporting

Cost of equipment, set up of service and running the service was recorded.

Data Collection – Safety / Adverse Effect

Any safety and adverse effect was recorded

5.3 Results

105 patients were identified through the registers as meeting the inclusion criteria. Of these 44 patients were recruited on to the service and 36 completed a minimum of 30 days on the service. Most common reason for declining to take part was that they did not want to. Others felt that they were not suitable as they were not "frail".

Baseline Demographics

Male Female	14 (39%) 22 (61%)
Age (SD)	82 (10)
Frailty (SD)	6.6 (2.8)

Table 21 Baseline Demographics

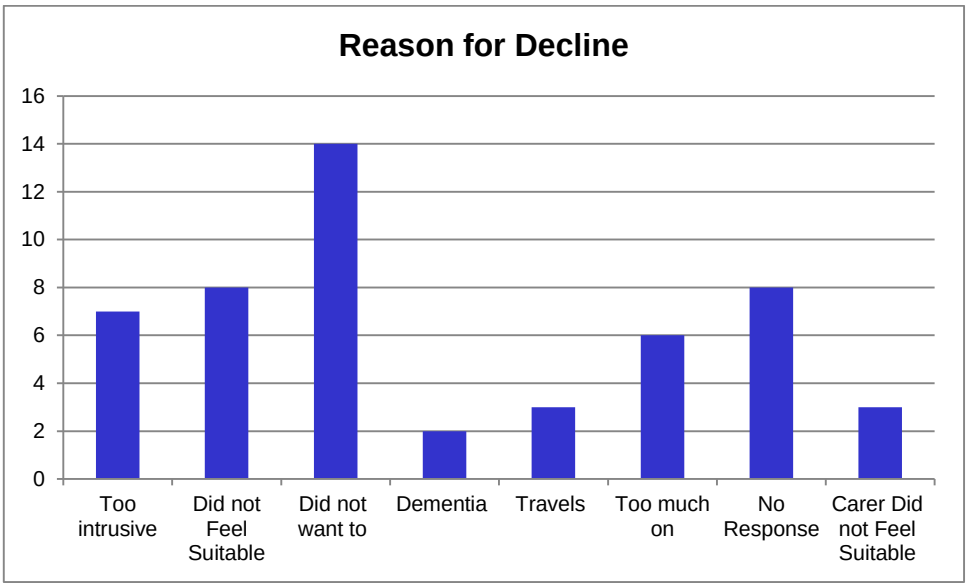


Figure 37 Reason for decline

A number of patients who had originally agreed to participate were not able to complete their time on the service. Most frequent reason was that the patient changed their mind at the time of installation. Poor mobile phone signal reception within the patient homes was another factor which affected patient's ability to take part in the service.

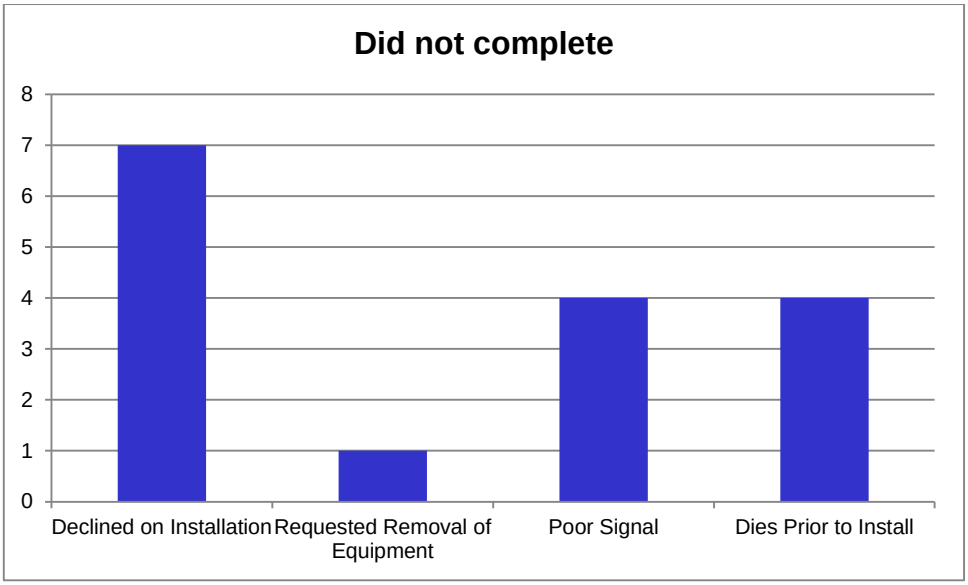


Figure 38 Did not complete

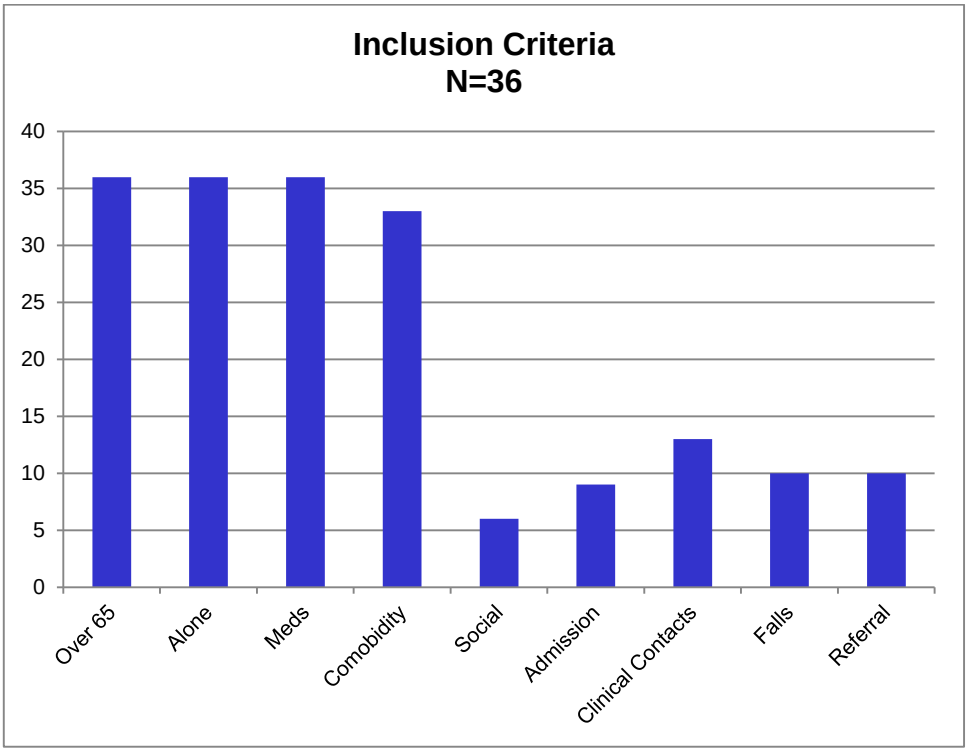


Figure 39 Inclusion Criteria

Edmonton Frail Scores

All patients were asked to complete the Edmonton frail scale to assess the patient's level of frailty. The scale measures from 1 (not Frail) to 17 (very frail). The mean score for frailty was 6. 61 % of patients scores as average frailty or above and 27% scored as very frail.

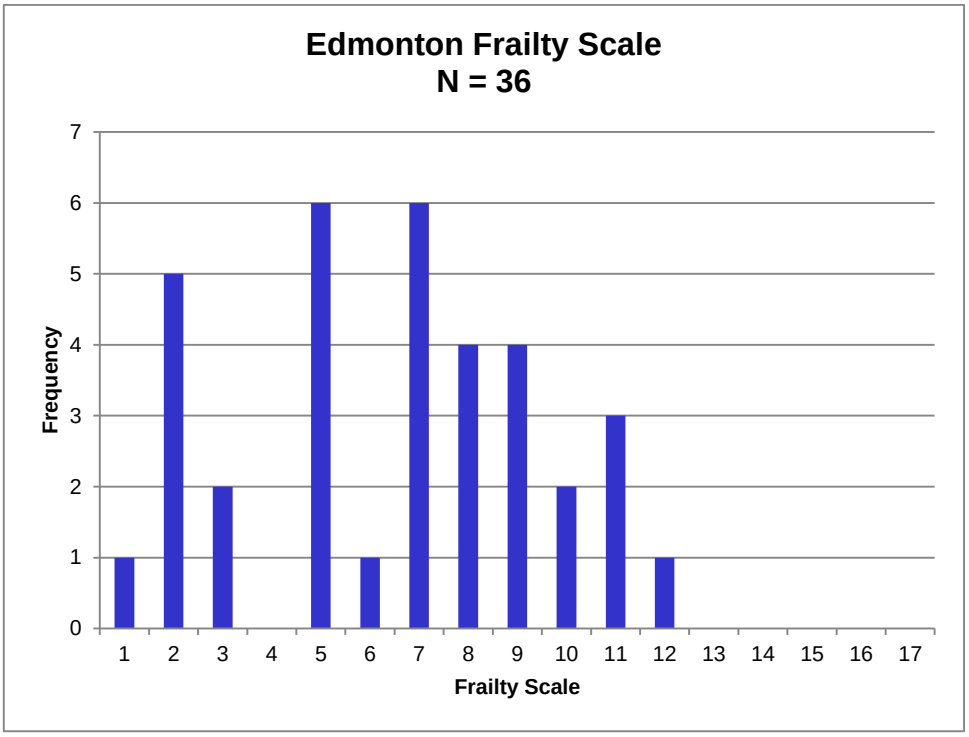


Figure 40 Edmonton Frailty Scores

SF36 – Quality of Life Results

All patients were asked to complete the SF36 at baseline and at the end of their time monitoring. The SF36 v2 provides two summary scores, the Physical Component Score (PCS) and the Mental Component Score (MCS). The SF36 also provides eight dimensions

- Physical Functioning (PF)
- Role Limitations due to physical health (RP)
- Bodily pain (BP)
- General Health Perception (GH)
- Vitality (VT)
- Social Functioning (SF)
- Role Limitations due to emotional problems (RE)
- Mental Health (MH)

The following provides the analysis of 26 patients who have completed both the baseline and end questionnaires.

When looking at the analysis for all of the patients we can see that the score for physical functioning (RP) and for role limitations due to physical health (RP) in table 18 is very low. This is consistent with the elderly group that is being monitored. We see a small increase in the score for General Health Perception.

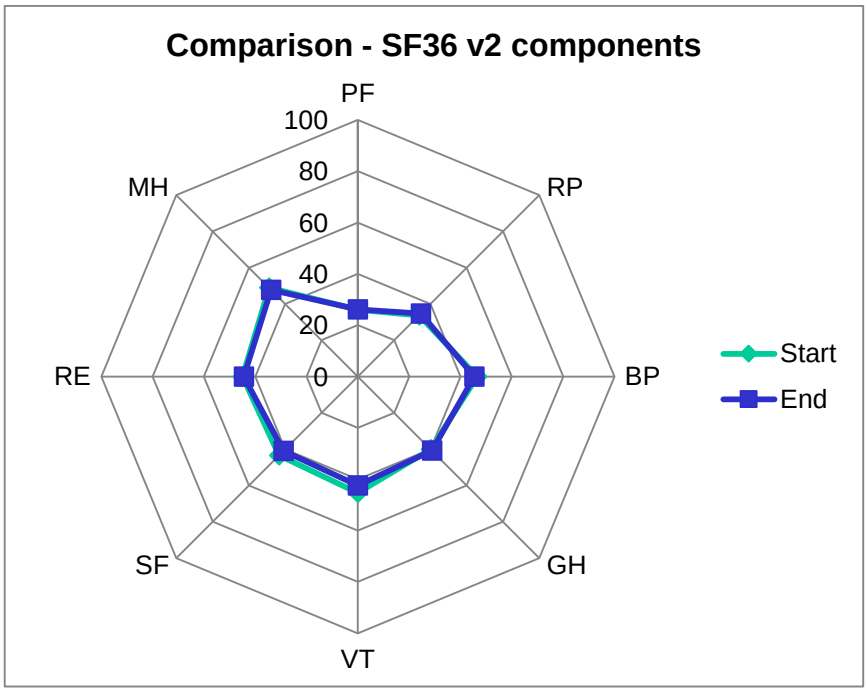
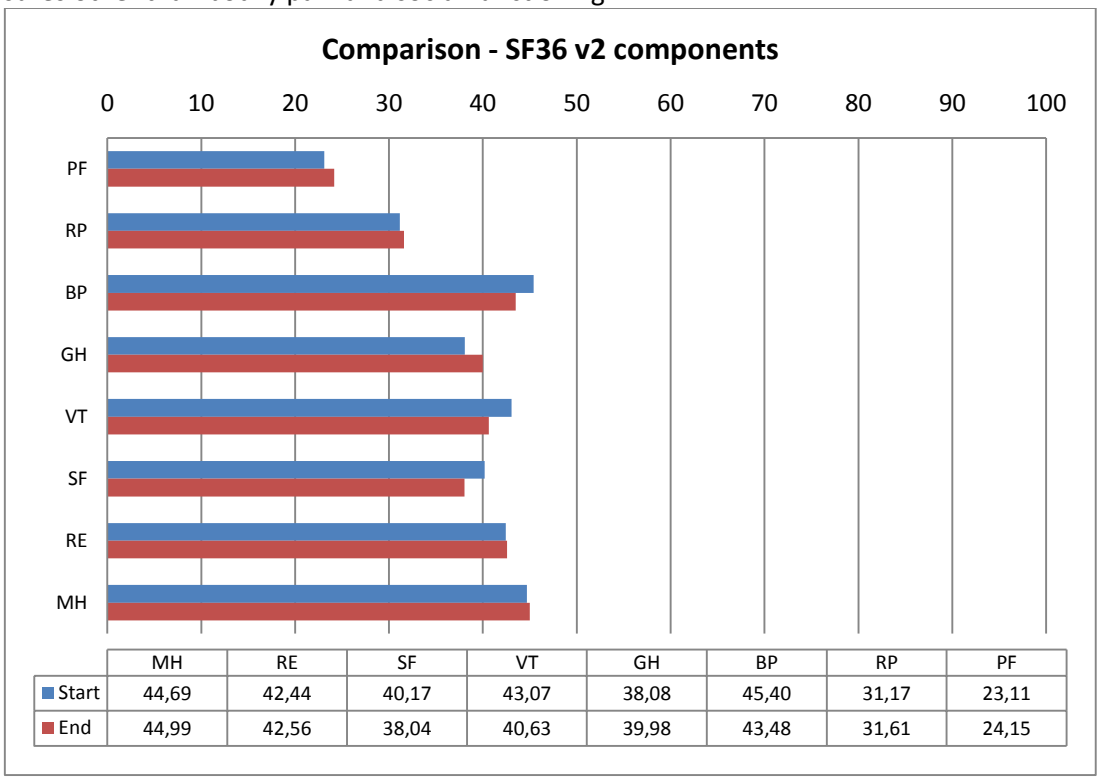


Figure 41 SF36 Spider for all patients

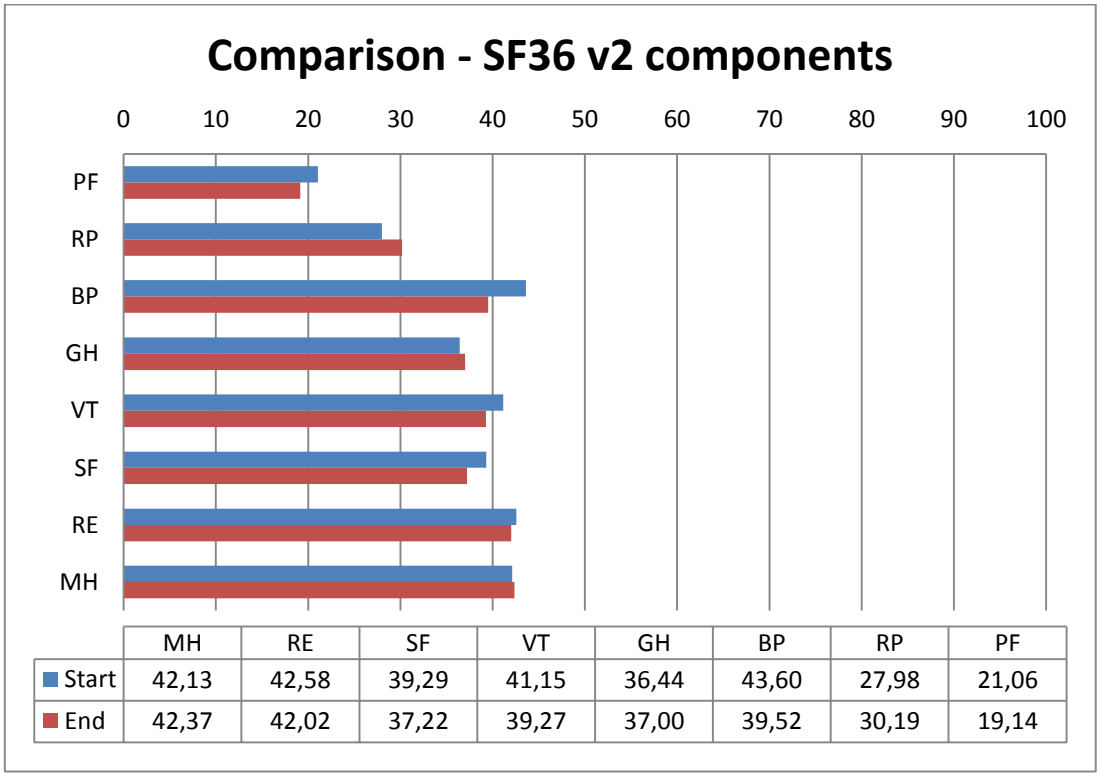
The figure below shows the summary scores for those patients that were scored using the Edmonton Frail Scale as of average frailty. For these patients we can see slight increase in all measures other than bodily pain and social functioning.



	MH	RE	SF	VT	GH	BP	RP	PF
Start	44,69	42,44	40,17	43,07	38,08	45,40	31,17	23,11
End	44,99	42,56	38,04	40,63	39,98	43,48	31,61	24,15

Figure 42 SF36 for patients who scored as average frailty

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	42,13	42,58	39,29	41,15	36,44	43,60	27,98	21,06
End	42,37	42,02	37,22	39,27	37,00	39,52	30,19	19,14

Figure 43 SF36 for patients who scored as very frail

We also measured the SF36 for those patients that received an intervention. 44 % of those that were enrolled onto the service received an intervention. When we analysed the SF36 we can see only a slight improvement in in general health score.

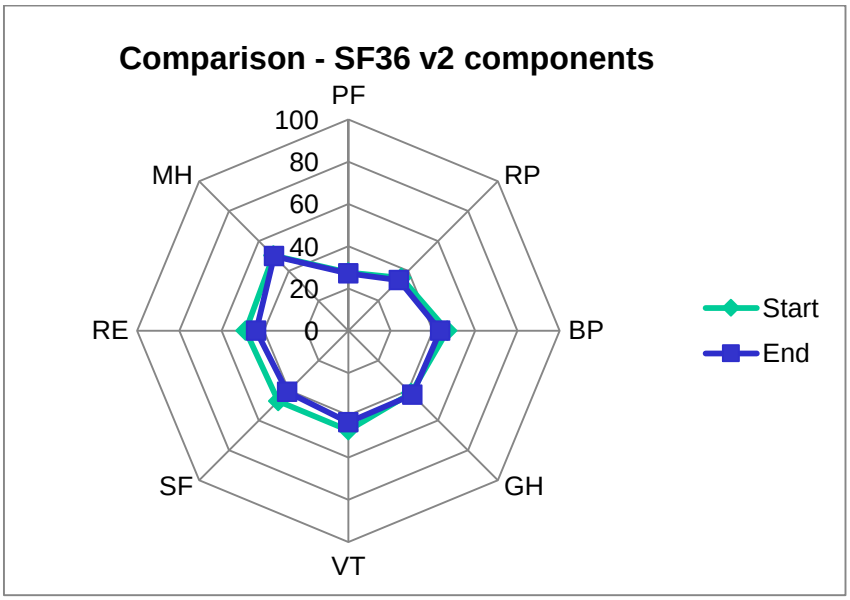


Figure 44 SF36 for those patients that received an intervention

By the nature of the population that we are monitoring a decline in health status is expected over a time. Given the analysis undertaken it could be summarised that for the patients as a whole who were enrolled onto the service did not see an overall decline in quality of life that could be attributed to the service.
However, those patients that scored as average frailty or who were very frail indicated a positive impact on quality of life.

Patient Perception

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

The questionnaire consists of 22 questions that can be grouped under a number of headings. Table 20 provides the descriptive statistics from these groupings.

	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 22 Patient Perception Descriptive Statistics

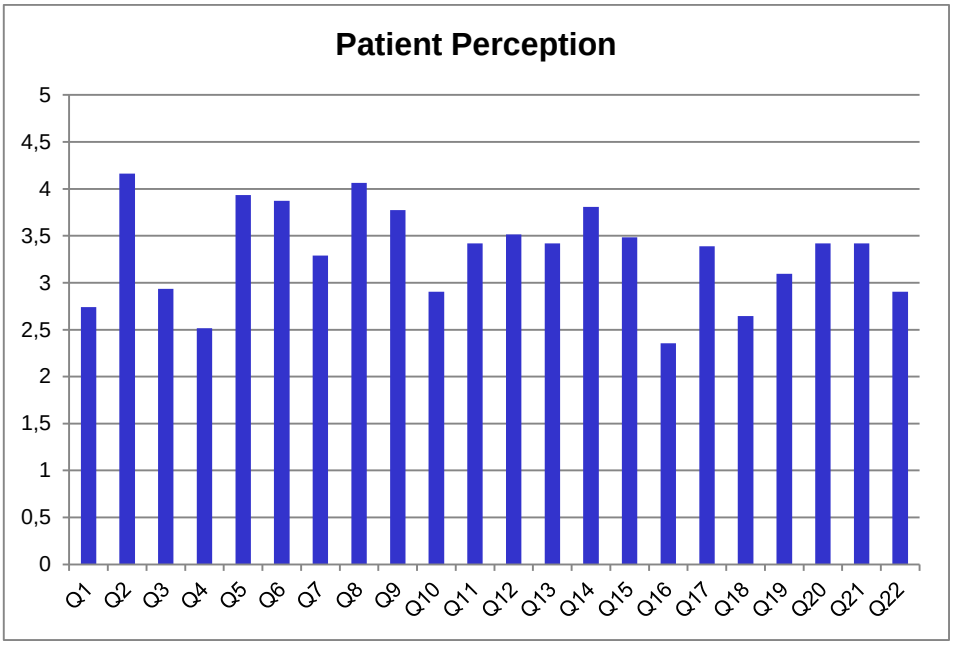


Figure 45 Patient Perception Question Results

Enhanced Care

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 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.

Access to Services

The majority of patients reported that the service had not provided greater access to health and social care services. This is part may be due to the high quality of care and good existing access that patients are already experiencing in this area.

Privacy and discomfort

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.

Personnel care concerns

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. However one patient did report that they were concerned that the health or social care professional may not know their personal health and social history.

Technology as replacement for usual care

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.

Satisfaction

Overall patients reported being satisfied with the technology. However initial technical difficulties that have been encountered are reflected in the patient scores regarding whether the kit can be trusted to work appropriately.

Summary

It should be noted that for many who were enrolled on to their service, their main motivation was one of curiosity rather than they felt that they were “suitable”. Some patients also commented that they did not fully understand what the service was for.

We had a number of concerns raised by patients about the term “frail”, so much so that we removed the term from our documentation entirely. Even those patients that met all of the criteria and who scored highly on the Edmonton frail scale indicated their concern over this.

"good for others but not me"

"I am not frail"

Overall patients were satisfied with the service. Patients in general did not feel that they were getting better access to care. This in part could be due to the high level of care that is currently available within the area and that this patient group is not located within a deprived area. Most patients did not require any social intervention at all and so could not indicate whether there had been any improvement in access to social services.

One patient felt that the equipment itself was like "a companion".

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 substitution for usual face to face care. This may in part by due to the fact that the service is very much clinician driven. The patient was not given any self-management tools. While some of the devices gave feedback of clinical measures, some did not. Interestingly it was observed that patients who had access to their own measurements e.g. blood pressure indicated some concern to the clinicians when they saw their own measurements exceed their expected levels. However for those patients that had the Spo2 device which showed no feedback to the patient, there were no concerns raised.

We also had some feedback from patients concerning the instructional material that was provided initially to patients. The material was very "wordy" and not easy to follow. Especially for those that had visual impairments. We have since updated this material based on the feedback that we received. The instructional material uses more pictures to illustrate the steps needed and has been well received.

Professional Perception

The service team were made up of Nurses, General Practitioners, non-clinical researchers, Social Service worker, administrators and technical support.

All staff involved in the service were 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.

In addition, a focus group which was attended by both health and social care professionals was held on the 28th June 2013. The analysis data generated from the evaluation was presented. A discussion was had about the results and the feedback contributed to the production of the CHC evaluation within this report.

Experience of using the Integrated Service

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's and improvements back into the service design.

One of the clinicians felt that despite the more integrated approach to managing patients there was still a "gap in care".

"I had referred a patient to social services but they had said that the patient did not meet their criteria…. Because the patient had means to pay for services themselves they were not eligible for help from social services. They were told what to do and left to contact help themselves…. But this patient did not understand what to do… there is a gap in care – basic care for those patients that do not have relatives to help them sort these issues out. It's not health and its not social care".

Benefits of the integrated service

When asked about what was working well, 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 clinicians mentioned that one of the key benefits had the ability to get a better idea of how social services work which has improved communication between the organisations.

"Able to provide more information to other professionals such as consultants, district nurses and other community services about a patient's condition".

"Able to see information about what is going on in the home"

"Access to a more complete data set about a patient's habits and health"

"Able to see correlation between habits and health data"

"Been able to provide intervention when otherwise we would not have known"

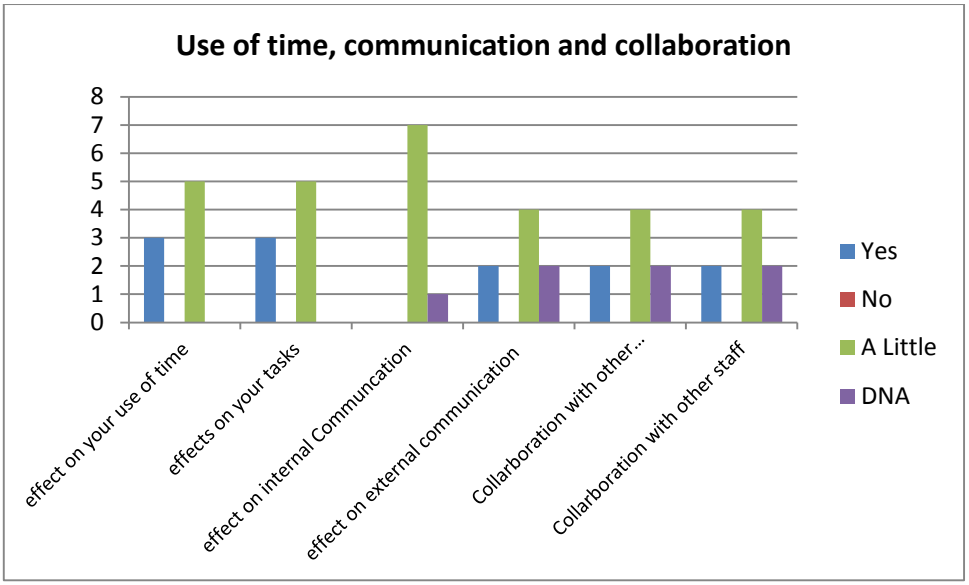


Figure 46 Professional Perception use of time, communication and collaboration

Usability of the Service

It was felt that some aspects of the service worked better than others. In particular the nurses felt that their role within the service was clearly defined. Once they had overcome the initial obstacles and had got used to the technical aspects they felt more confident.

Use of Time

The nurses reported significant effect on their time. This could be split into clinical and non-clinical.

Non-clinical work load comprised of patient enrolment, installation of equipment and technical triage. Due to the complex nature of the inclusion criteria, patient enrolment took a long time. Coupled with having to explain the service to the patient which often took place in the patient's home, meant that a lot of clinical time was spent on this stage.

Following enrolment, the installation of equipment was also carried out mostly by the nurses. While the equipment was relatively easy to install, the whole process took an average of 1 hour to complete.

Triaging technical problems was also cited as having a significant effect on the nurse's time. While many technical visits were undertaken by admin support and the technical team (25), it was estimated that the nurses made a visits to a further 20 patients. Each visit taking an average of an hour. While it was felt that these visits were valuable to also assess the patient in their home it was suggested that technical triage could best be provided by other non-medical staff.

Clinical workload comprised of monitoring of patient data and providing interventions. The monitoring of patient data was estimated to take up to 20 minutes per day for all the patients enrolled. Sometimes this was longer if the data had not been checked the previous day or if there had been a number of patients whose data was outside of range. Trying to get hold of patients to discuss their data was also cited as an additional workload.

An outcome of the service was that a large percentage of patients who were monitored received some type of intervention that otherwise they may not have received. This increased the clinical work load of the nurses as well as the GP's who the patients were referred to.

The GP's reported less of an impact on their use of time. Patients were usually referred to them by the nurses and patients were seen during usual GP surgeries.

Social Services also reported less of an impact on their time as there were few patients that were referred to them.

The technical team reported that during the early stages there was more if an impact in providing technical support. Once the service had been underway for a few months, attention turned to making improvements based on the updated requirements of the clinicians.

Communication

Overall, the introduction of the service was deemed to have had an effect on communication within the organisation. It was reported that this was due to the discussion around the patient data and understanding the habits monitoring data that was new for the clinicians and the health data that was new for the social team.

The biggest impact was the increased communication between social and health services. This started prior to the introduction of the service during the set up and has continued. Prior to the start of the project there had been little direct involvement between health and social services. Sharing of experience of patients, knowledge of telecare and telehealth are being shared across the organisations.

When asked about the challenges with the integrated services, it was felt that it had been very difficult for social services to understand the overall picture of what was trying to be achieved. Challenges remain, including the feeling that it is not their role, and that they consider that they already have a heavy workload and this is an addition. Innovation is seen as extra. The seasonal extra workload has been an added challenge as people already have a greater workload.

Even amongst clinicians at Chorleywood Health Centre it was felt that sometimes to be challenging to engage the clinicians with the service.

"sometimes communications was slightly disjointed. "some people are more interested in the developing the service than others"

Collaboration

The clinicians felt that it had been a good "learning curve" about how best to work with social services. It had also improved their understanding with why certain actions had not been taken. For example when social services had not intervened with a patient.

Clinicians….

“it has given me a better understanding of what social services can and cannot do”.

“but has identified this gap in care, when it is not seen as a social services issue or a medical one”.

Also there had been some collaboration issues with the technical team. Understanding technical issues has been a challenge and sometimes communication with those providing technical triage has been difficult.

Clinicians….

“technical people had fixed ideas of what was needed, but now it is improving… They have been very supportive if things have gone wrong”.

“some issues with admin who were reluctant to do some of the form filling.

“difficult to get hold of GP’s in a timely manner”.

When asked about how to overcome some of the challenges, it was mentioned that there is a need to persevere with the project and continue to champion the usefulness as well try to encourage local engagement.

- Look at using other non-clinical staff to do enrolment, installation and triage.
- Develop more definitive monitoring protocol
- Understand better what it is that social services want from the service so that they are able to become more engaged.

It was also felt that the current inclusion criteria could be amended.. “it is difficult to know who is frail and who is not. The current inclusion criteria do not always match with what the patient thinks. The Edmonton scale works well and perhaps we should use this more than the other criteria”.

“Need ways to better identify those patients who are.. on their own, want help, approaching them at the right time. Focus less on the number of commodities etc”.

Overall the staff rated their overall satisfaction as average. And all indicted that wanted to continue developing and enhancing the service delivery model.

Professional Perception of the Technology

The overall perception of the technology is that it is seen as being very useful but that there have been many difficulties with the reliability of some of the devices as well as the communications gateway.

Previous Experience of Telehealth and Telecare

Most of the clinicians have previous experience of using telehealth. Clinicians were aware of telecare and some had seen it in use. On the converse, social services had a great deal of experience in using telecare devices but none in using telehealth.

Access to Information

It was felt that the system provided the telehealth information as needed. However the visualisation of the habits data has been difficult to understand. And the system as yet did not automatically identify any correlations between the health and habits data yet.

Over the pilot period there have been updated user requirements for the visualisation of data within the portal as well as more basic administrative tasks.

Suggestions for improvement have included:

- Change the time periods for grouping the activity data
- Ability to identify when a sensor was not working as expected
- Ability to view different levels of analysis of the data

There have also been requests for improvements in the referral information between health and social. None of the professionals expressed concerns over the safety of the technology.

Professional reported Web User Interface Issues	Usability / Reliability	66
Clinician reported Device Issues	Usability / Reliability	47
Clinician Reported Training Issues	Workload	13
Patient Technical Support Calls	Phone Call / In Person / Other	65

Table 23 CHC Reported Issues

Safety

When asked about how safe they felt about using the information being gathered by the telehealth and telecare devices there was a mixed response which was dependent on the devices that were being used. Overall the Health Monitoring devices were deemed to be very reliable and safe. The PIR was felt to be safe but the bed / chair sensor was felt to be unsafe as it did not work reliably or as expected.

Benefits

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.

Technical difficulties

A number of technical challenges were reported from mainly the clinical teams. All of those that were directly involved in managing the technical triage had experienced problems. These included:

- Gateway positioning and signal strength
- Patient ability to use the equipment
- Reliability of bed / chair sensor

- Reliability of data on the clinical portal
- The weight scale is not suited for older patients
- Unable to determine who is moving about the home

Suggested improvements

The following summarises the suggested improvements to the system

- Improved signal strength within the gateway
- Use of repeaters in the home
- Find an alternative bed / chair sensor
- Investigate the use of a wearable sensor to track activity and location within a house.
- Use a different weight scale
- Improved visualization of data on the clinical portal
- Check user instructions to help patients better understand how to use the equipment

Satisfaction

Over satisfaction ratings were spread from average to very satisfied, indicating that overall there was a general feeling of satisfaction with the technology despite some of the challenges.

Figure 47 Professional Perception - Technical Satisfaction

Clinical Effectiveness

The clinical team at Chorleywood Health centre provided 1st line clinical triage for the monitoring of incoming patient data. Patient data was viewed three times a week to determine if intervention was required. Clinicians used information from the patients EPR to help with their decision. If immediate intervention was required they contacted the patient directly, otherwise patients were referred to GP's or asked to make an appointment at the health centre for a clinical review.

The following clinical data was collected via the monitoring devices. Patients were monitored for deviation from their personalised targets. These were adjusted based on the patient's current clinical status. Patients were not monitored for acute events.

Parameter	Reason	Monitoring for	Outcome Measure
Blood Pressure	Hypertension	Trend – variance from defined targets - 140/80	Stability / Change from Day 1 to Day N / Improvement
Spo2	COPD	Trend – variance from defined targets - < 85%	Stability / Improvement
Weight	CHF	Change of >1kg in 24 hours or 1.4kg over 3 days	Stability
Blood Glucose		Within targets	Stability / Improvement

Table 24 Clinical Data Capture

Interventions

55 % patients were referred to an intervention during the time that they were being monitored. 44% (17) received some type of intervention. Interventions are described in the figure below.

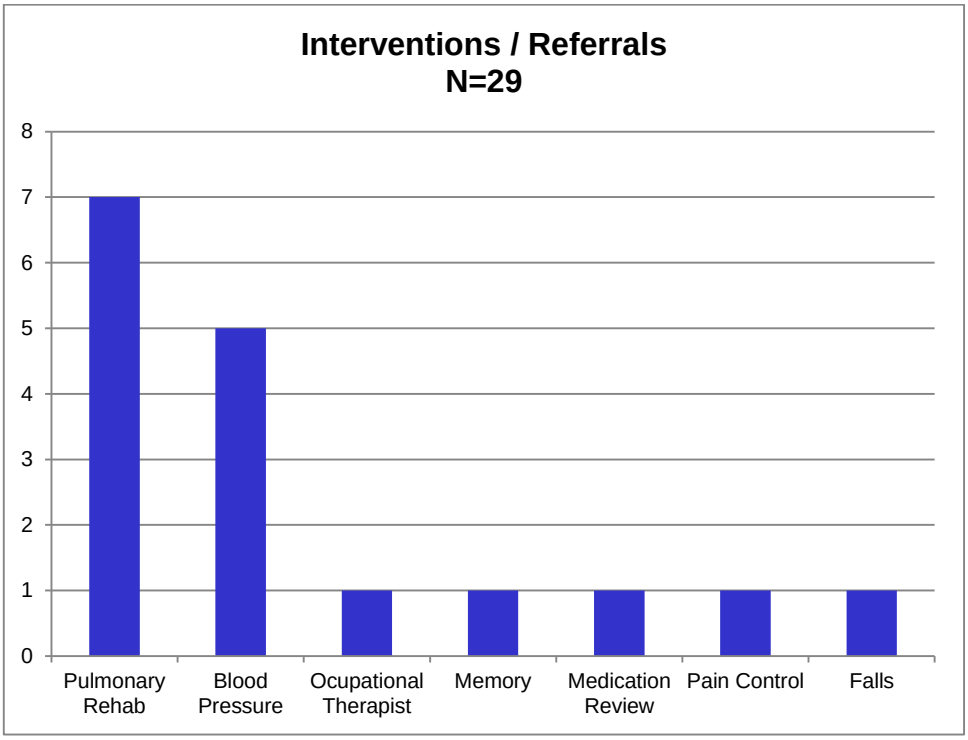


Figure 48 Interventions

The most common reason for intervention was due to low oxygen levels for patients with COPD. Patients were referred to community pulmonary services.

For those patient who received an intervention over 70% were those that had been rated as average frailty or very frail.

We investigated impact on SF36 and satisfaction scores but we saw no recognisable correlation.

Habits Monitoring Data

A major challenge within the CHC pilot has been concerned with understanding the analysis of the data being received via the habits monitoring devices and presenting this to the professionals in a useful and manageable way. One of the outcomes from the pilot was to develop habits profiles and resulting rules to notify professionals when there is a deviation from normal patterns. The development of this pattern recognition is in its early stages but the following describes the first stages of this process.

Motion Sensor	Habits Monitoring	Trend Movement	Stability and change from "normal"
Chair Sensor	Habits Monitoring	Avg time spent sitting	Stability and change from "normal"
Chair Sensor	Habits Monitoring	Avg time spent sitting	Stability and change from "normal"

Table 25 Habits monitoring data capture

The aim of the data analysis was to determine the correlation between change in habits behaviour, change in physiological data and deterioration in the condition of the patient. The habits data were processed in order to establish a normal pattern for each participant, detect deviations from the normal pattern and observe long term trends in their habits.

Trends in Subject's habits – Clinical and Habits data correlation

One of the outcomes from the pilot is to develop habits profiles and reasoning rules to notify professionals when there is a deviation from normal patterns. In order to so, we use two approaches: (1) look for trends in the data, (2) in the case of an event, analyse the data retrospectively. Results from these and strategies suggested by health professionals will be used for improving decision rules.

We wanted to answer following questions:

- is there a trend in habits data, i.e. increasing, decreasing, a cyclic change that lasts for several days or weeks, or change in local mean and standard deviations?
- if there is a cyclic change, is there one or more cycles?
- how do the trends in habits data and clinical data compare?
- can we get important clues from habits data in terms of subject's well-being?

In the case of an event, e.g. an intervention, we retrospectively analysed the data (habits and clinical data) for possible trends or correlation.

Case Study 1: a CHF patient

If we use the same example given above (Figure 1), it is easy to see a decreasing trend in patient's daily PIR activities after day 45. The patient said that they stayed in bed longer after a fall incidence (~ day 65), which is why their activity rate stayed low. The same patient had a medication change on

day 74 (dashed, magenta line in figure 2). It can be seen that their blood pressure levels dropped after the intervention.

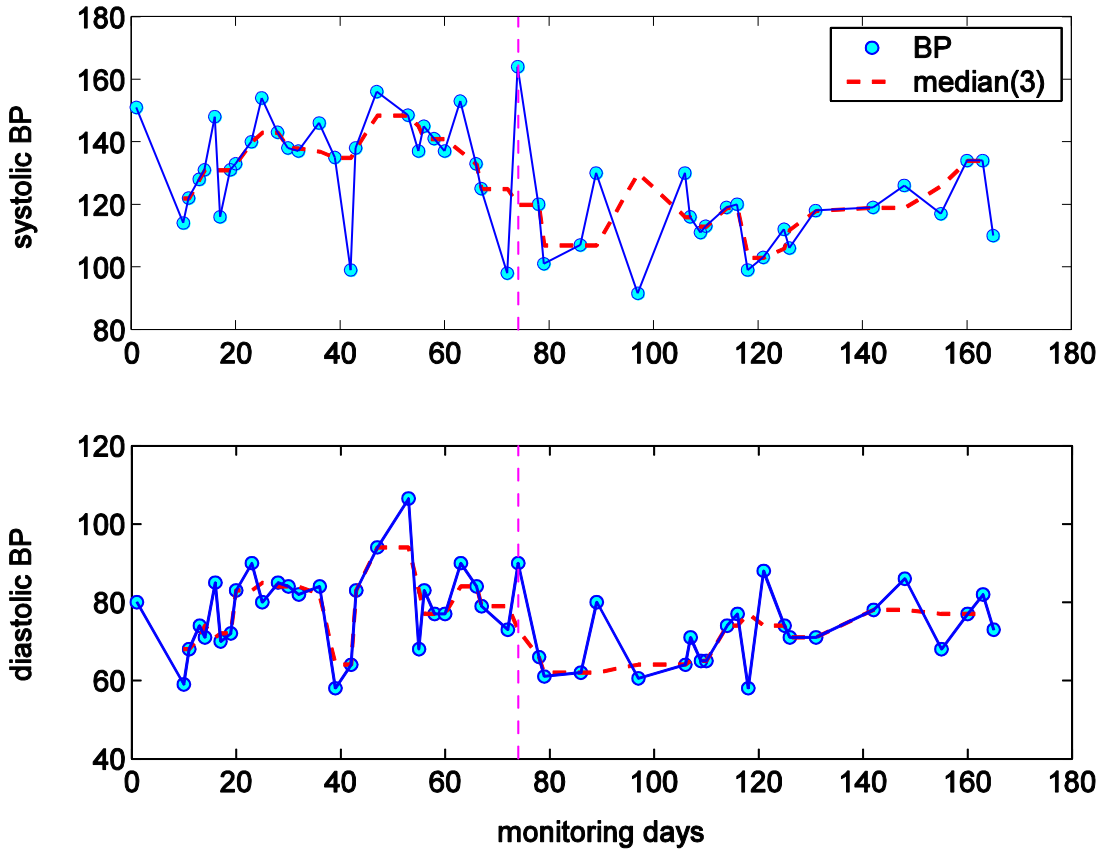


Figure 49 Blood pressure levels; intervention day (magenta line)

Case Study 2: a COPD patient:

This patient started to get up slightly earlier after day 80. This increased their PIR event counts for time slot 1 (Figure 28). For monitoring day 90 onwards, they had more PIR events than usual for time slot 3.This change in habits behaviour correlated to an observed change in the frequency of low Spo2 levels for the patient. An outcome of the identification of habits change was that the patient was referred to pulmonary rehab and was given oxygen therapy.

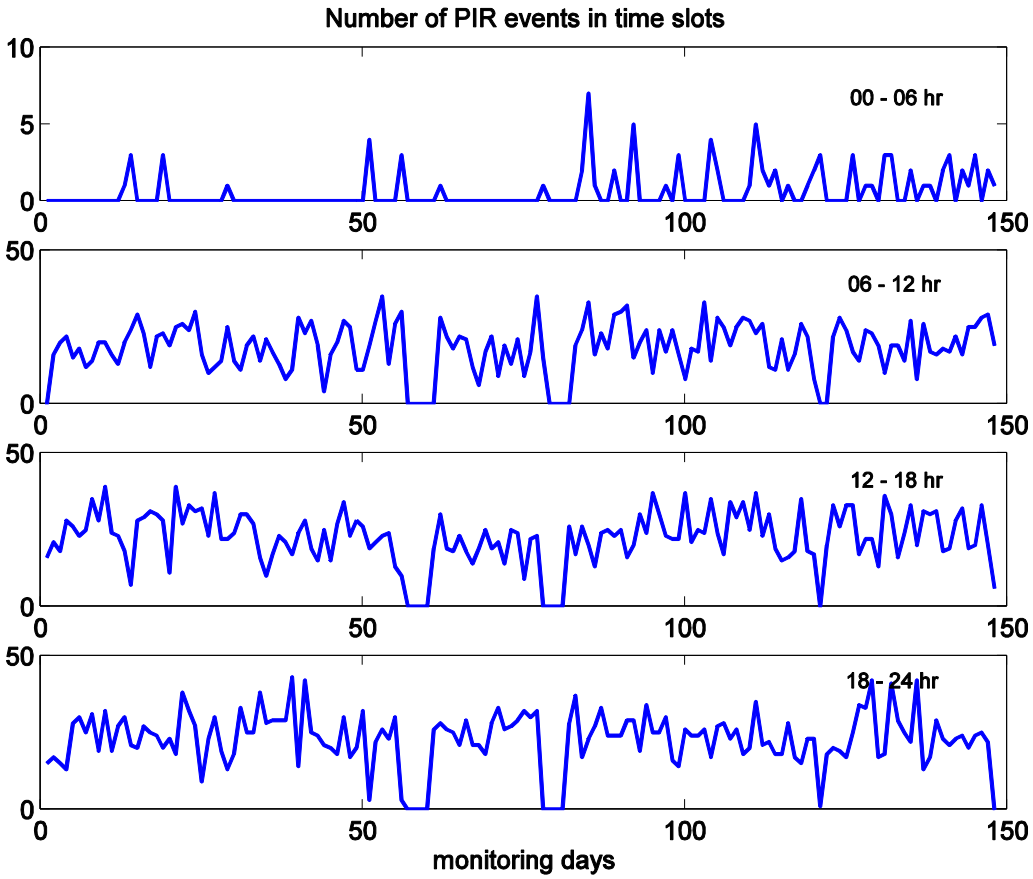


Figure 50 Number of PIR events in time slots

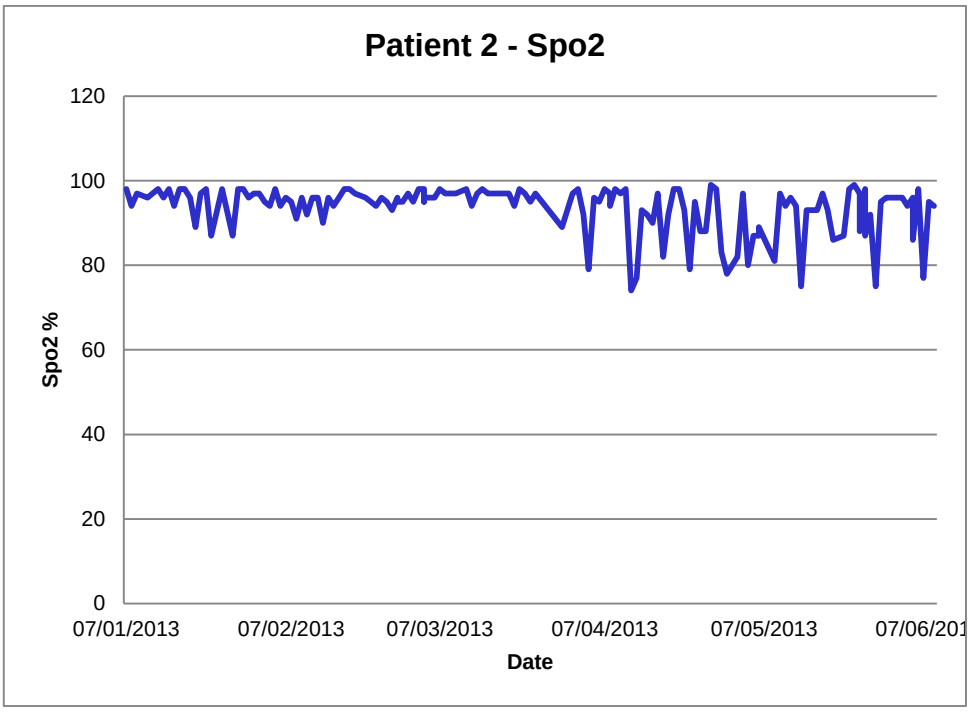


Figure 51 Patient 2 Sp02 Measurements

Alarm / Notification Protocol

The 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 a patient's trend data over a period of time and not for sudden deterioration or acute exacerbations. Data from Telecare devices is also handled differently to that of telehealth data which requires a patient to actively do something in order for data to be transmitted. The volume of data from some telecare devices is also very different to that of telecare. A motion sensor can send a huge amount of data in a short period of time, as opposed to a single blood pressure reading

The alarm / notification system within the clinical portal had to manage the different types of data within a single platform and visualise that 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 patient's physiological parameter that is outside of pre-defined thresholds over a period of time.
2. Highlight to the clinician a change in patients "normal" habits behaviour as gathered from different telehealth devices.

Physiological Alert Rule Protocol

Upper and Lower thresholds could be set for each of the following physiological measurements:

- Systolic
- Diastolic
- Spo2
- Weight
- Blood Glucose

The clinician could also specify a change over a period of days. For example, is the physiological data outside of parameters for three days? The system allowed for a number of rules to be set for a patient which enabled more intelligent filtering of data. If a measurement falls outside of rule, the measurement(s) in question is highlighted on the clinical portal. Alert thresholds can be changed when necessary.

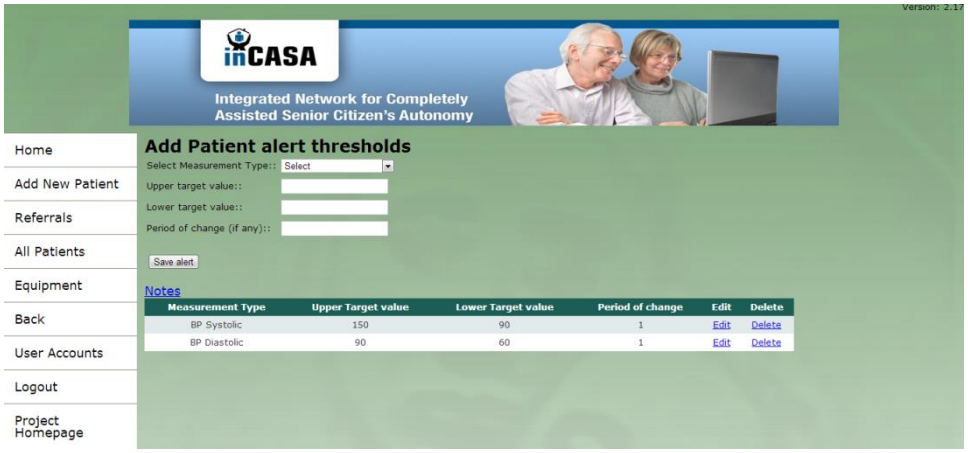


Figure 52 Setting Alert Thresholds

The protocol determines that no thresholds are set for patient's 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.

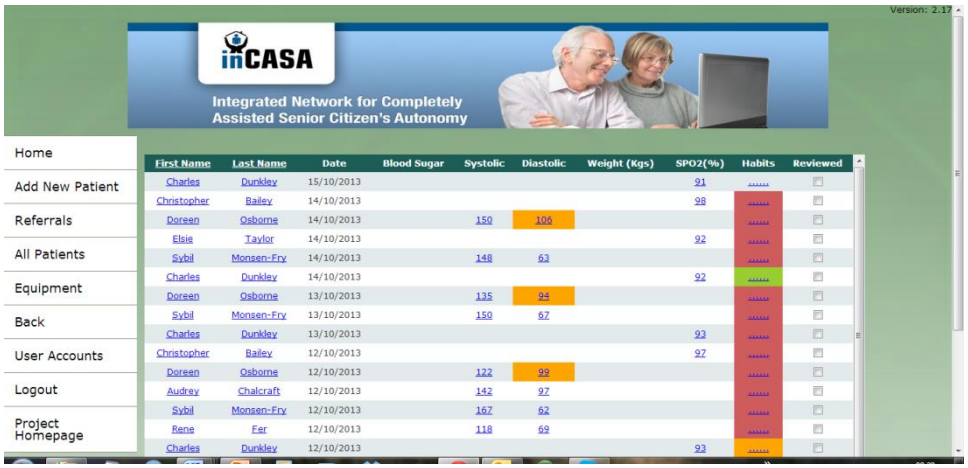


Figure 53 Alert Notification Screen

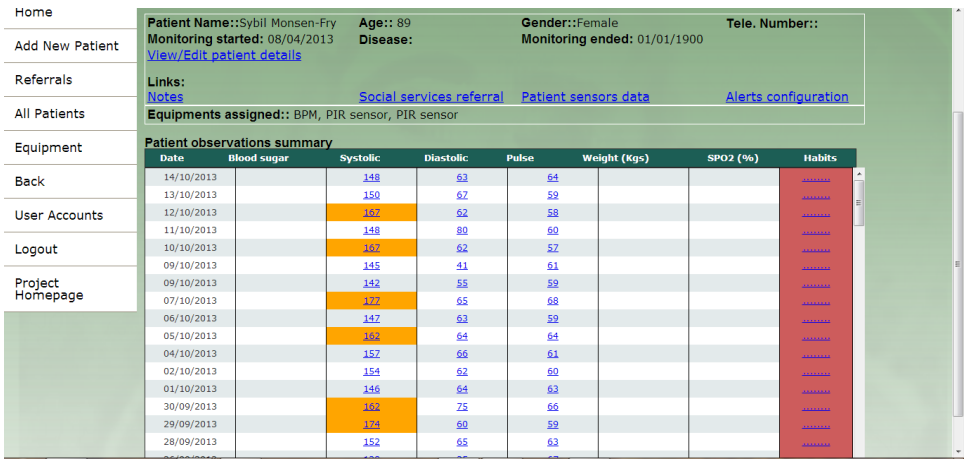


Figure 54 Patient Screen

Habits Data Alert Protocol

We extracted the following parameters 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

Detecting deviations from normal pattern

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, 18:00-24:00. The number of sensor events for each of these periods and for all-day (from midnight to midnight) were counted, and the average and standard deviations (SD) over 15-20 days were calucalted. The threshold values are calculated as the mean of 2 x Standard Deviation for under-activity and mean +2 x Standard deviations for over-activity. Deviation from the norm is then detected by comparing the number of movements in a period with the threshold values for that period.

Both under- and over-activity can convey important information about subjects’ well-being. 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 sign of discomfort, onset of dementia, or due to a visitor.

The figure below displays daily PIR event counts (blue line), a trend line (red) and circles highlighting areas where we had over-activity alerts (magenta) and under-activity alerts (cyan). We used 7-term moving median filter for the trend line. We preferred to use moving median filter instead of moving average filter in order to avoid the impact of extreme values on the mean:

- The patient had frequent health visits during the first 40 days, giving rise to frequent over-activity alerts
- several under activity alerts around day 65 is because of a fall incidence
- Over-activity after the fall incident on day 74 was due to carers

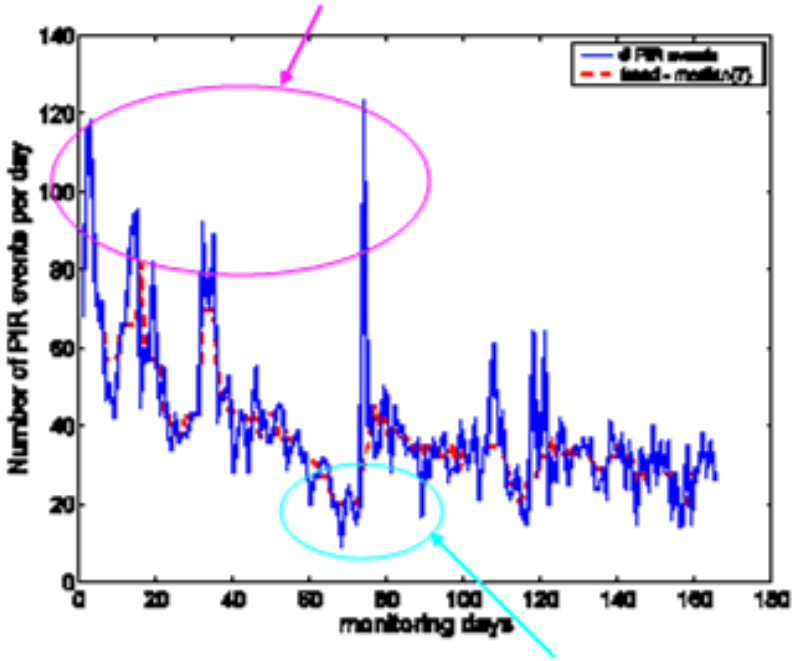


Figure 55 number of PIR events per day over 165 monitoring days

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

Number

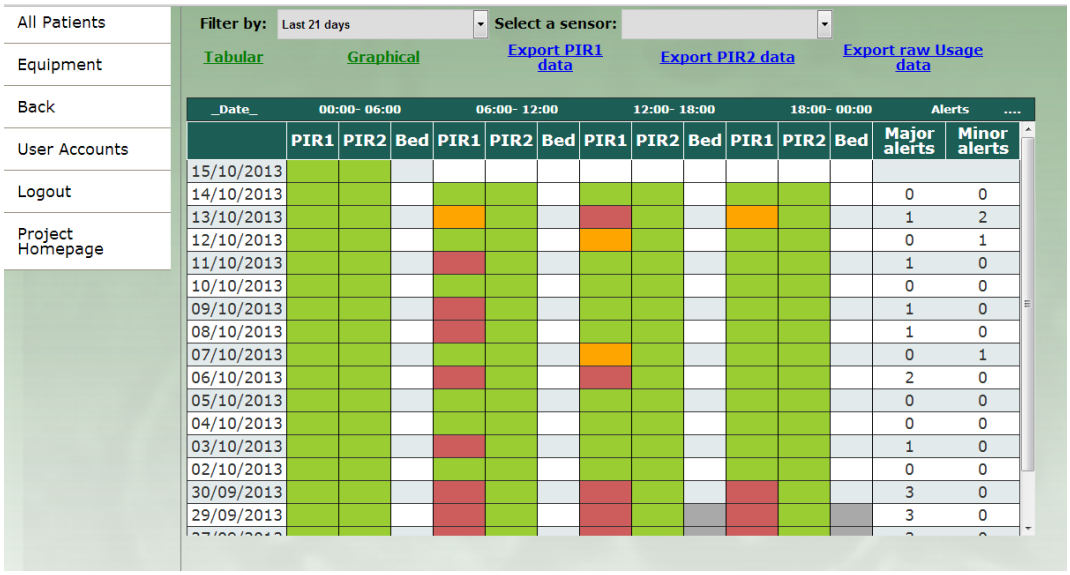


Figure 56 Habits Alert Screen

Numbers and Types of Alerts

Over the average 123 monitoring days that the patients were enrolled onto the study there was an average of 18 alerts a day. Only 4% of the total number of alerts led to a clinical or social intervention. The majority of alerts that were generated were due to the bed / chair sensors. It became apparent early on that there were some technical difficulties with these devices that were triggering alerts for over and under activity. As a result we began to remove these and replaced them with additional PIR's while further testing was carried out on the devices.

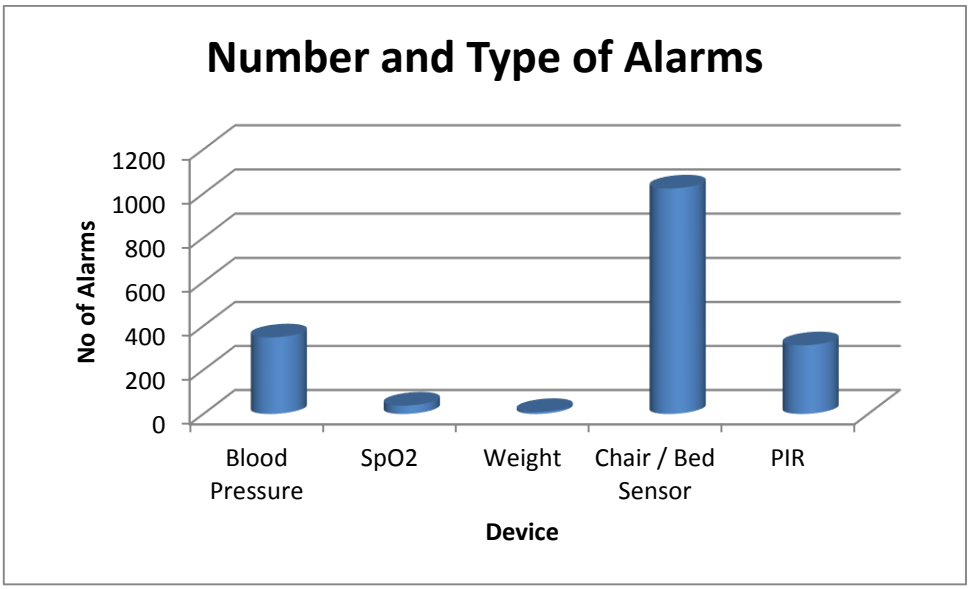


Figure 57 Number and Type of Alerts

8% of the missing data alerts were attributed to patient difficulty using the physiological devices. Mostly this resulted in a call to patients and a reminder of how to use the device in question. 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 Thresholds	7
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 26 Alerts and Interventions

Improvements to Physiological Protocol

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

Improvement to analysis of habits data

We are considering using a moving training period instead of fixed training period at the beginning. This will reduce the false alert rates especially when a subject's habits changes significantly from the beginning of the monitoring, i.e. significant change in mean and standard deviation values.

From our experience and discussion with the clinical team, 3 time-slots were found to be more relevant to subjects' well-being: all-day (mid-night to mid-night), night-time (from 00:00 to 06:00 am) and morning (from 06:00 to 10:00 am). Instead of presenting alerts for four time slots, we will raise alerts for these time slots.

Future Work

Future work that we are planning to do can be listed as follows:

- Reduce the number of false alerts by
    - Discriminating presence of visitor(s) to avoid unnecessary over-activity alerts
    - Discriminating patient's absence (out/away) from fall/feeling-unwell incidences
- Derive one alert for habits by applying combined decision rules on data/parameters from PIR and bed/chair sensors
- Search for more useful dimensions in order to get further useful information

Organisational / Use of Resources Data

Information about service pathway usage was collected including time taken to enrol, install, triage and time taken to monitor patients. The number of referrals and outcomes of referrals including clinical, social and to other community services were recorded.

Organisation Pathway

A new pathway was implemented to support the service. Patients were identified using a combination of health, acute and primary care data sets. Those that agreed to take part were enrolled onto the service by clinicians. Home visits were carried out and installations were undertaken by nurses and non-clinical researchers.

1st line technical and clinical triage was carried out by clinicians and interventions were carried out by Nurse and GPs. Clinicians used the information from the patients EPR to help with their decision. If immediate intervention was required the patient was contacted directly. If necessary they referred the patient directly to social services using an online referral form accessed via the inCASA portal. The social service team contacted the patient directly if required or referred for further assessment. The patient may also so be referred to an integrated case conference which is attended by both social and health teams.

The integrated case conference was attended when possible by both health and social teams, otherwise individual phone calls were made. Both monitoring data and data from the patients EPR and social records were viewed side by side although as yet they are not linked. Decision to intervene was determined through joint discussion.

Outcome of the case conference was recorded in the inCASA portal, EPR and social record. The patient was contacted by either the health and or social team dependent on the patient need.

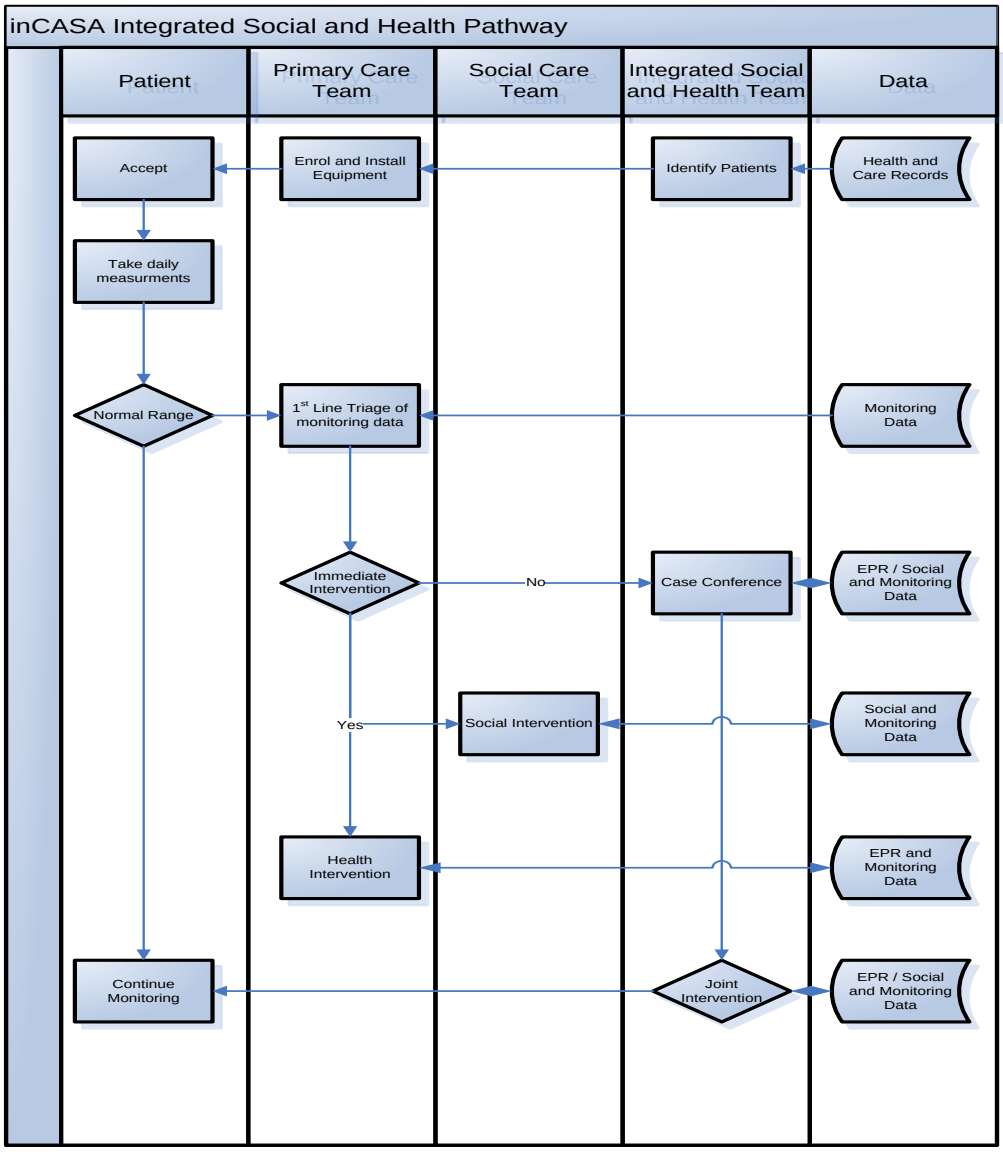


Figure 58 inCASA Pathway

Monitoring Period

The average length of monitoring was 123 days.

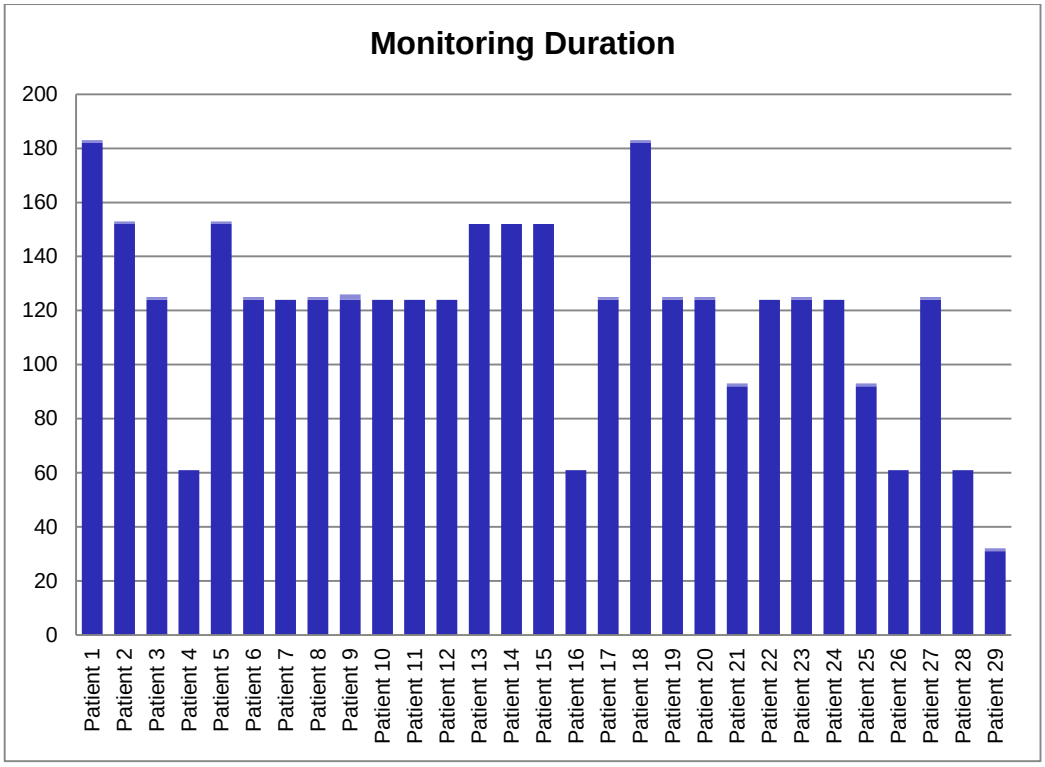


Figure 59 Monitoring Period

Effect on Organisation Usage

The following indicators were collected in order to assess the impact on professional and organisational use of resources. Data was collected for each patient. The table below shows the mean number of contacts.

Indicator(s)	Outcome	Time frame	Mean
Days Monitored	General	Daily	123
No of Alerts	Workload	Daily	457
Missing Data	Patient Compliance	Daily	250
Partial Missing Data	Patient Compliance	Daily	203
Outcome of Alerts	No Contact Patient Contact Emergency Referred to GP Referral to Social Referral to Community	Daily	 106 0 5 4 11

Table 27 CHC Resource Usage Data

Category	Measure
Patient Enrolment	82 hours
Installation	44 hours
Technical Triage	42 hours

Monitoring	20 mins per day
Meetings / Training	21 hours

Table 28 Time to run the service

Patient Resource Usage

Case history and service utilisation data for each patient was recorded including GP visits, planned and unplanned admissions, ER visits and social service contacts.

Data was collected for the time that each patient was enrolled onto the service and compared against the same time period immediately prior to their enrolment.

From the figure below we can see that there was a reduction in both planned and unplanned admissions to hospital. However this data is skewed as one patient who had an unplanned admission had a hospital stay of 27 days.

We do see an increase in referrals to social service and community services. This was felt to be an outcome of the study in that patients were being identified to other services.

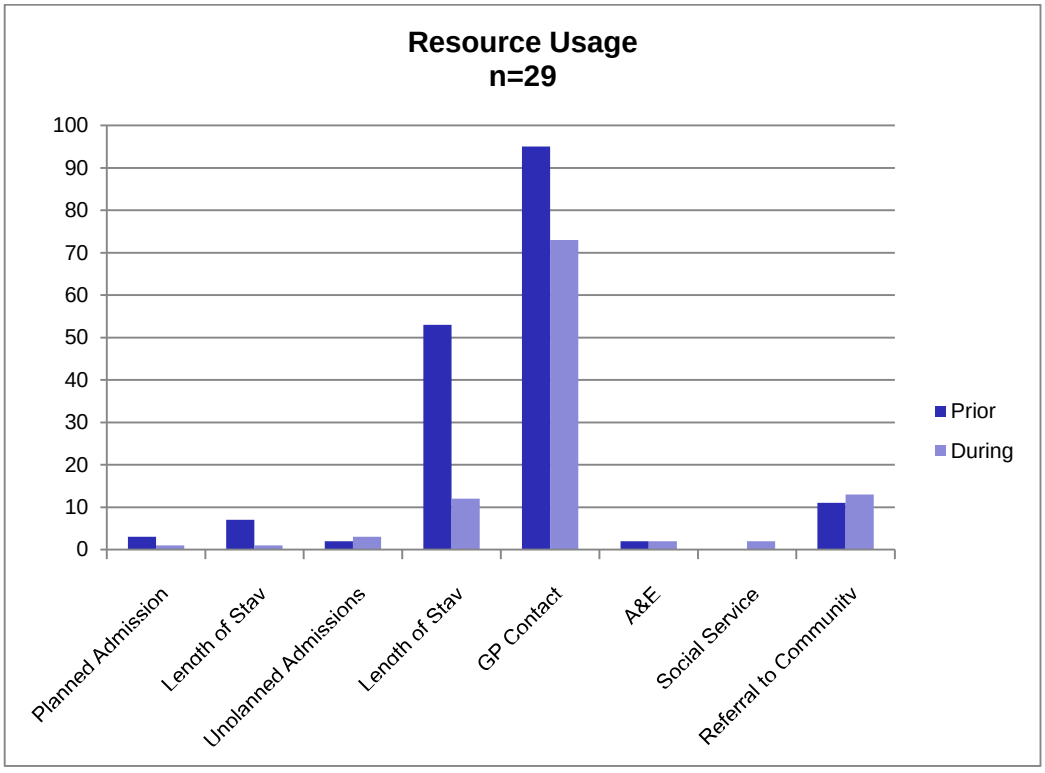


Figure 60 Resource Usage

Economic Data

We collected economic data based on the resource usage cost reported in the previous table and on the cost of the integrated service as described below.

Resource	Cost	Prior	During	Var
A&E Usage	£75.00 per attendance	2	2	0.00
Admission	£640 per night	53	23	(19,200)
GP Contact	£25.00 per visit	95	73	(550.00)
Walk in Visit	£63.00 per attendance	0	0	0.00
Social Service Referral	£25.16 per hour	0	2	50.32
Community Referral	£24.00 per visit	11	13	48.00
Total				(19,651)

Table 29 Resource Costing's

Overall we see a reduction in admission costs and in GP contact costs.

Cost of Equipment

Patients were provided with a gateway and a combination of up to 3 of the other sensors. These products are not in commercial use currently so the costs indicated are based on development costs. The price of the devices will reduce once they are in commercial production.

Equipment	Cost	Number Used	Total
Gateway	£325	40	£13.000
Blood Pressure	£135	20	£2,700
Weight Scale	£157	5	£785.00
Spo2	£200	15	£3,000
Bed / Chair Sensor	£245	20	£4,900
PIR	£106	30	£3,180
Total			£27,565

Table 30 Equipment Costs

Personnel Costs of Running the Service

Category	Time	*Cost	Total
Patient Enrolment	82 hours	20.06	1,646
Installation	44 hours	20.06	882
Technical Triage	42 hours	20.06	842
Monitoring	**20 mins per day (60 hours total)	20.06	1,203
Meetings / Training	21 hours	20.06	421
Total			4,994

Table 31 Staff Costs

***average hourly personnel cost**

**** calculated 180 days (6 months)**

Return on Investment

A simple return on investment calculation was used to evaluate the efficiency of the service. To calculate the ROI, we divided the difference in patient resource usage to the cost of equipment and the personnel costs of running the service for the 6 months.

The return on investment formula:

$$\text{ROI} = \frac{(\text{Gain from Investment} - \text{Cost of Investment})}{\text{Cost of Investment}}$$

$$\frac{(19{,}651 - 32{,}559)}{32{,}559} = -39\%$$

Summary

We can see that the figures as reported above indicate some savings due to changes in resource usage of patients enrolled on to the service. However when comparing the cost of the service with these savings we see that this saving was absorbed by the cost of equipment and the running of the service. Overall this has resulted in a negative ROI during the first 6 months of the service. It would be expected that reuse of equipment would improve the cost ratios.

There are a number of points to note with our economic reporting.

- The cost of equipment has not had any amortisation calculations applied, so the figure is still quite high despite the fact that it is cheaper than most comparative systems on the market.
- The personnel costs include start-up costs e.g. training and meetings which would otherwise not necessarily be as high.
- Creating the frailty register was costly – the EPR and other registers did not have data able to create frailty scores and the time taken to create the register was costed.
- In addition personnel costs have been calculated using an "average" hourly rate for all staff involved.
- Resource usage data was collected using data from the electronic patient record. Data about hospital admissions and use of other services may be missing or incomplete due to the nature of the different information systems used.
- Resource usage has been calculated using average cost of an encounter. This does not necessarily reflect the actual time used which may be substantially higher e.g. social service referral which may contain a number of steps involving different stakeholders.
- We also did not take into account seasonal effect on resource usage
- The re-use of equipment would reduce the cost at least ten fold over five years but was not accounted for.

Safety

There have been no reported incidents from either patient or professional users.

Ethical Considerations

During the project a number of ethical issues arose. These are summarised as follows:

- Privacy –13% of those who gave a reason for declining to take part said that they felt the equipment was too intrusive. "Big Brother"
- Labelling – A number of patients who were very upset by the term "frailty".
- Frailty – 16% of patients felt that they were not suitable to take part.
- Social Service - Stigmatisation

5.4 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 with 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	In conjunction with Brunel University we

whether environmental monitoring can aid and even predict clinical events and care	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 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.

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.

5.5 Next Steps

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.

Results from the evaluation are being fed back into the existing service and changes and recommendations as described in the next section will be implemented.

5.6 Recommendations

Local Implementation

- Target services towards a more tightly defined population in order to maximize both patient and professional outcomes.
- Review use of resources in order to reduce costs and unnecessary impact on clinical time
- Continue working with Hertfordshire Social Services to better define integrated working partnerships and pathways
- Continue work with Brunel University to enhance user requirements for the information management system
- Continue to investigate alternative monitoring devices that support patients / end user within their home
- Expand the service to include unpaid carers in the monitoring of their relatives by means of information exchange and accessibility
- Investigate integrating patient information system with Electronic Patient Record
- Use inCASA to support wider local adoption of the inCASA service

National Implementation

- Work with commissioning groups at a strategic level to support the wider adoption of integrated services. In particular focusing on pathway redesign, economic outcomes and patient / informal carer benefits

- We are seeking partners to apply for further funding in order to use the outcomes of inCASA to continue developing services and technology to support older people who are in need.
- Continue to disseminate and promote the outcomes of inCASA. We will be publishing two papers within the end of the year.

6.0 ATC

ATC Torino (whose full name is 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, to manage its own real estate. Furthermore, ATC undertakes the refurbishing and conservation of the patrimony of public housing and the related services.

In other words, ATC Torino supplies and manages public and private real estate; proposes and outlines programmes and strategies for urban and territorial planning; supplies and manages the relative networks and services.

6.1 Description of Pilot

ATC pilot sought to incorporate the concepts, values and standards of inCASA solution into the organizational structure and culture of the local environment, improving the quality of life of Italian frail elderly people and the quality of work of social services' professionals, actively cooperating with the social care community.

The service implemented has profiled user habits in order to automatically identify anomalous situations and send alerts to the users, carers and service providers. ATC has monitored the behavioural parameters, e.g. movement, contact and home environment parameters, e.g. gas/water leaks and room temperature in order to establish an alert system. The service has also profiled user habits. Any significant deviations from the Habits Model generated an alert that required defined action by a designated person (e.g. case manager to social worker).

The objectives for the ATC pilot are:

- improving elderly people's quality of life
- promote remote health monitoring
- implement home automation services
- improve relations with neighbours

6.2 Methods and Design

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 was composed by 25 women and 15 men. They all live alone. Their average age is 72.

Their dwellings are located in the central area of Turin. This is not a deprived area of the town, but the houses where the users are living have been built in the 1920s and 1930s, so usually they don't have courtyards or elevators, because located in narrow streets where it was necessary to maximize the available spaces. Considering the age of construction, it is easy to understand that into those buildings it's very difficult to realize energy savings measures in order to have, at the same time, a better comfort inside the dwellings and less expenses. For these reasons, the rents are low and affordable to elderly people.

Due to the main features of the houses where they are living, the elderly people must face problems of sociability, stressed by their motion difficulties.

So their most important needs, supported by the social workers, are about daily activities as doing their shopping, cooking the meals, cleaning the apartments etc.

The targeted groups of tenants living in ATC's 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.

After staff training and technical tests, the pre-pilot started in October 2011. During the first phase some incidents were detected, especially from a technical point of view. These incidents have been listed, analysed and solved.

The staff involved in the pilot needed some time adapt to the new procedures. In general, co-operation between ATC and Social Services of the Turin Municipality staffs was quite good, and communication was very fluent.
After five months of pre-pilot, in March 2012, the pilot was running with 20 users involved.
In October 2012, other 20 users have been recruited and inserted in the pilot, reaching the total number of 40 final users.
During the pilot several meetings were arranged between ATC and Municipality of Turin in order to discuss how the pilot was running and if there was any kind of problems coming from the persons recruited.
The staff involved in the project at ATC include: supervisor, call centre operators; at Municipality of Turin: social workers of Social Services Department.
The number of emergency situation cases managed through inCASA during all the pilot is an average of 43/month, so for the total of the pilot there were 898 alarms.

The usual number of alarms, with an average of 28/month, has been the "door open" alarm. When the call centre operator received on the P.C. the alarm, he/she called as the first the user involved. Except a 10% of alarms caused by malfunctions of the door locks with the sensors, they were originated by the users that wanted to speak for a while with the operators in order to fight their loneliness.

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

1. SF36 – asked at baseline and end of data collection period
2. Edmonton – 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 end users own home person at a pre-arranged time. The questionnaire response rate was 95%, with 38 out of the 40 patients completing all of the questionnaires. Reasons for non-completion are not known.

6.3 Results

Demographics

In collaboration with Social Services of Municipality of Turin, 40 patients have been recruited following the inclusion criteria for the participants:

- Living in social house managed by ATC
- Be in charge of Social Services
- Have more than 65 years old
- Living alone

Edmonton Frail Scale

All patients were asked to complete the Edmonton frail scale to assess the patient's level of frailty. The scale measures from 1 (not Frail) to 17 (very frail).

These are the results:

Low Frailty	11	27,5%
Moderate Frailty	14	35,0%
Medium Frailty	8	20,0%
High Frailty	7	17,5%
Total	40	100,0%

Table 32 ATC Frailty Score

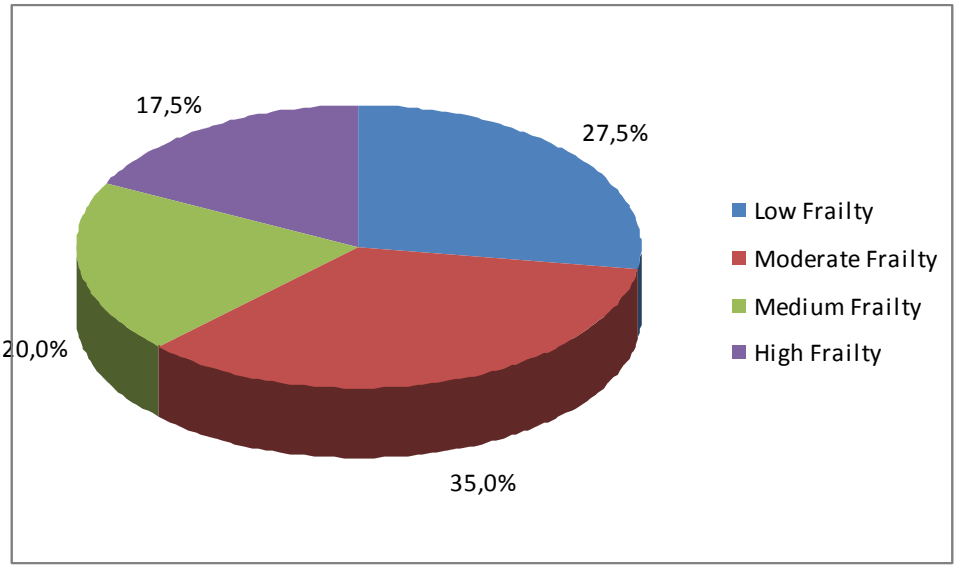


Figure 61 ATC Frailty

Patient Perception

The Service User Technology Acceptability Questionnaire (SUTAQ) was submitted to all the participants in person and the results obtained were then grouped in six different categories:

- Enhanced care
- Increased accessibility
- Privacy and discomfort scale
- Care personnel concerns
- Kit as substitution
- Satisfaction

The table below provides an overview on 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)

Figure 62 ATC Patient Perception

As illustrated in in the figure above the results are very interesting. 75% of users think that the services provided enhanced the level of care and there is an 80% satisfaction rating of the proposed Kit. This numbers fits with the feedback provided by the users:

- The Lady D.C. has seen this project thanks to a neighbour (user of the Project inCASA) and has taken steps to benefit of the services provided by the inCASA solution. She founds interesting to be monitored at a distance and without violation of her private life, h24. This has ensured 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 his fears related to the possibility that someone might break into her apartment, forcing the door. This increased feeling of safety is consequential to sensors installation.

Moreover, this feedback is consistent with the very low level of concernments regarding the privacy and discomfort scale also.

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

Il the pre-pilot and pilot phases, the users had only one worry concerning the sensors'. This was around energy consumption. ATC made the calculation and then communicated to the users that the cost was of few € centimes for each day, so the users accepted their installation without any problem.

Already in 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.

In fact, one of the pre-pilot users talked about the project with one of her neighbours, that has been so positively surprised by the sensors' functioning and, more in general, by the project's aims, that she wanted to be involved in the pilot at every cost, and so it happened.

Answering to the questionnaires, 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 the payment of the rent and the other expenses, but finally an institution that realized something in order to help them and increase their welfare in their own homes.

Their satisfaction is so high that now, at the end of the project, their worries are about the fact they don't have any more the possibility to be monitored in their daily life.

So, in order to satisfy this request, ATC decided to maintain the sensors' activity in the 40 users' homes at least until the end of September 2013.

Summarizing, the Project inCASA has increased the sense of security of the users and, consequently, increased the feeling of trust in public institutions because they feel, by the same, more secure.

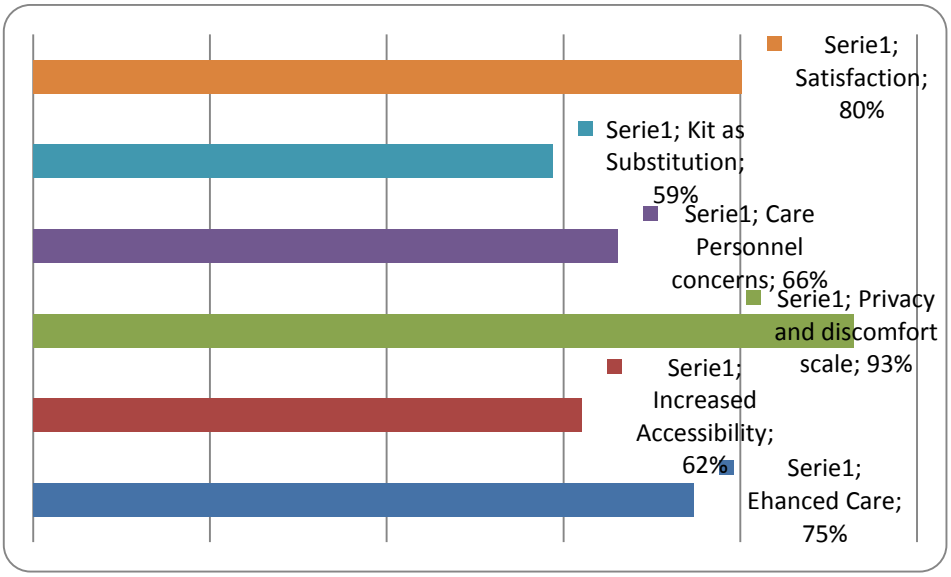
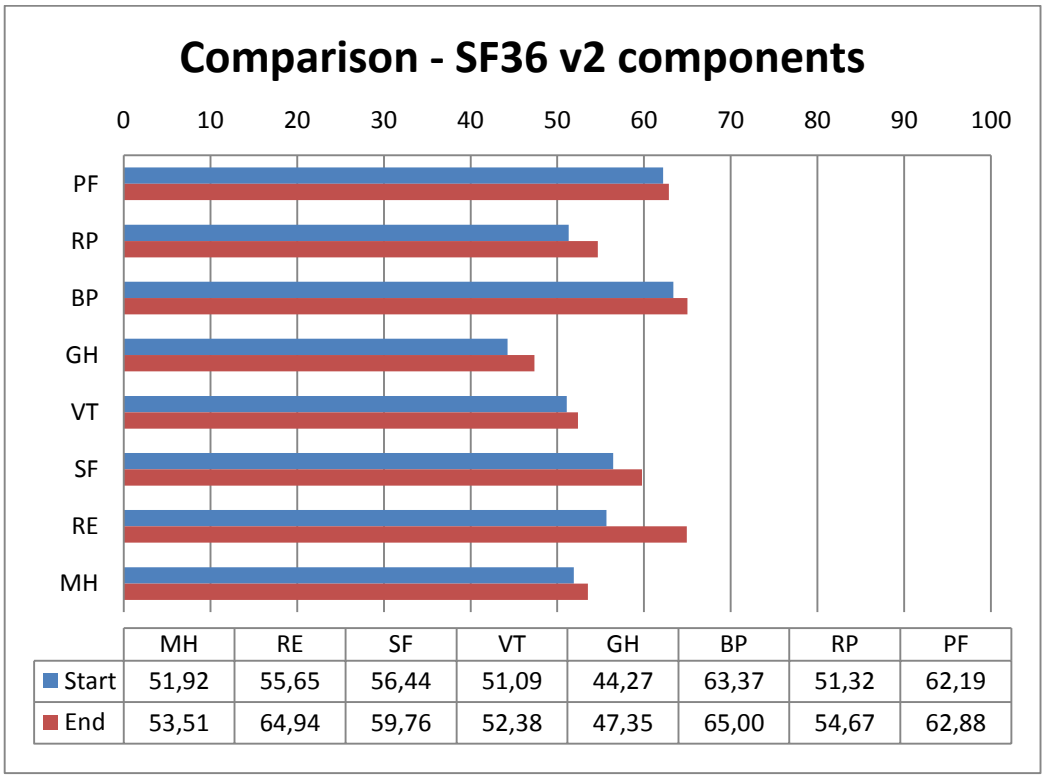


Figure 63 ATC Patient Perception Chart

Quality of Life

These questionnaires were submitted in person to all the users involved in the process; the results were then grouped in the following category:



	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 64 SF36 ATC Results

It is possible to notice from the figure how the overall level of the users at the end of the monitoring period, was substantially higher in some specific sub-category.

The results are coherent with the services provided in the Italian Pilot where only the Tele-Care services were active. The overall Mental Status, identified with MCS (Mental Component Summary) had an increase, starting with a Mean value of 47, 68 and growing to the end of period to 51,16 with an increase of 7,30%. The MCS value is given by the collection of the values of the Sub-Category related. It is possible, therefore, to find this increment also in this Sub-Category, as shown in figure 35.

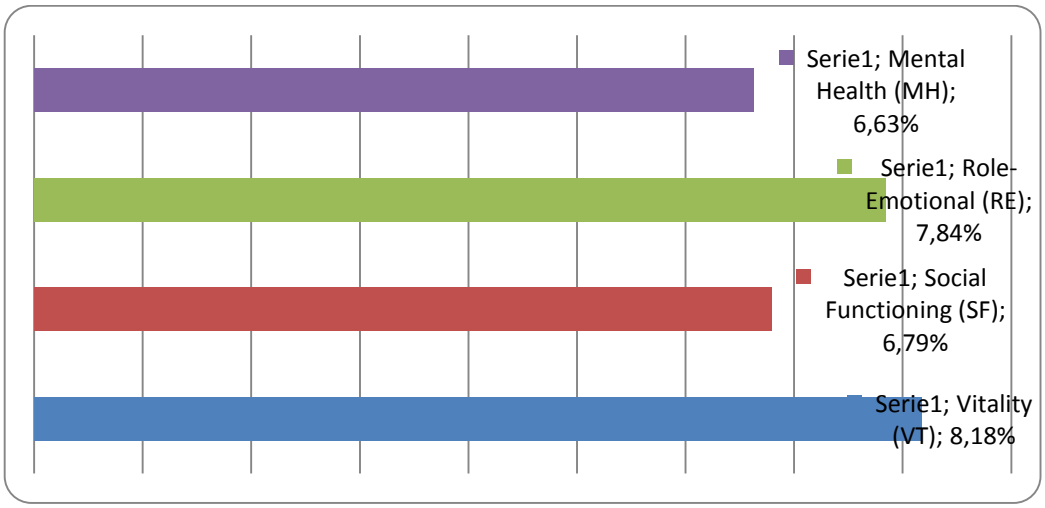


Figure 65 MCS Direct Sub Category

The increased value is present not only in the MCS status of the users, strictly correlated to the Tele-Care services provided to the users, but even in the PCS (Physical Component Summary) value, representing the Physical health status of the user. At the starting period the mean level of PCS was at 45,05 while at the end there was a slightly increase to 46,63 (+3,50%). From figure 43 it is possible to notice 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 even the right part of the Radar Graph (PCS parameters) shows a slightly 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.

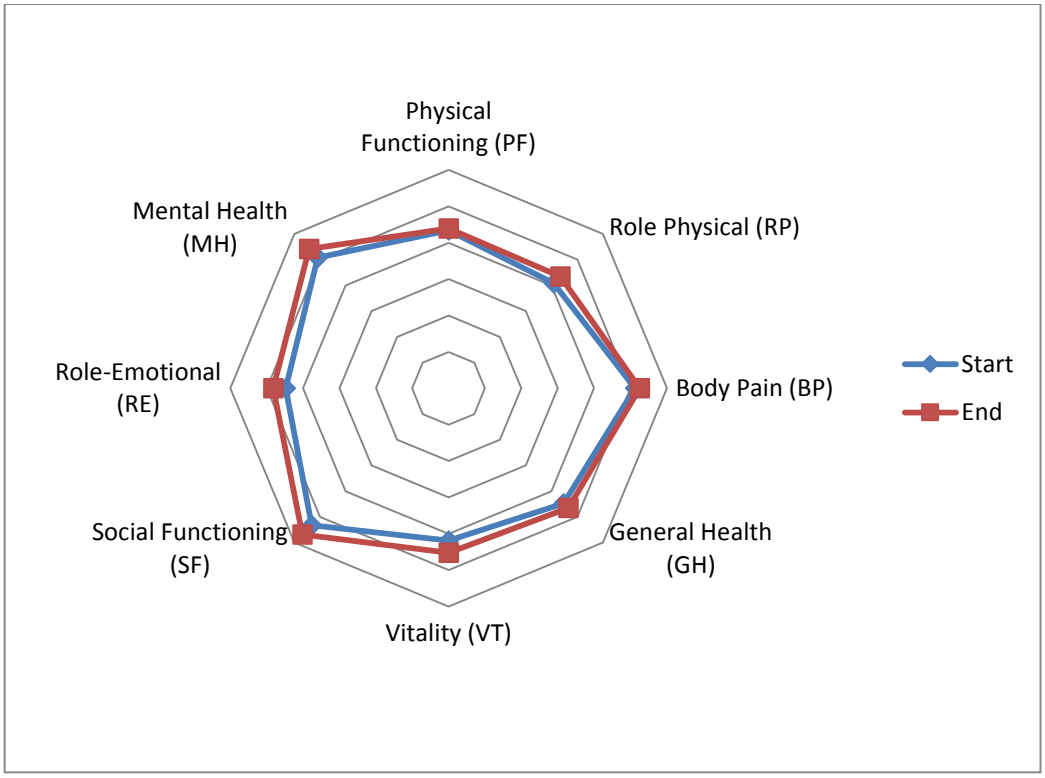


Figure 66 Italian SF36 Summary

Hypothesis: As reported, the services provided by the inCASA pilot were all relative to the Tele-Care part of the inCASA project, so the expected results were relative at an increase only in the MCS status of the users. However, the results obtained, even if with this slight increase in the PCS, representing the physical status of the users, open the way to a hypothesis. The users taking advantage of the benefits provided by the Tele-Care solution, jointly with the high level of acceptance of the technology provided, as proved above, show an improvement of their physical status as effect of their effective improvement in the Mental Status. Therefore, as on the figure above, the enhancement in the parameter in the right part of the Radar Graph, Physical Status is a reflection of the Mental Parameters on the left side of the Radar Graph. Summarizing, the hypothesis is that the users are getting better in their Physical status, with a minor increase, as a reflection of their effective improvement in the mental one.

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

Professional Perception

The two groups of professionals involved in the Italian pilot are formed of 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 to all the phases of the project. First of all, they choose the users to be involved in the pilot; they participated to all the meetings where it was planned how to organize the work:

- Installation of the sensors into the users' homes
- Definition of the alarms
- Ethical aspects concerning the level of knowledge about the users' health
- What persons had to be contacted in case of alarms: relatives, neighbours, social workers, etc?)

From their answers to the questionnaires, they declare that their involvement in the project has been very positive; the already knew the possibility to use sensors for remote control monitoring, but they never used them before InCASA. They are very satisfied about the pilot experience, because they had to do home visits only in case of real difficulties of the users. They are convinced that the integration of telecare and telehealth services could be the logical prosecution of 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 an important experience, since more than ten years, answering to the requests that the tenants asked to ATC calling the free toll number 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 to the meetings where the alarms have been decided, what must be the persons to be contacted, and so on.

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 be learnt and used.

5 professional users, 2 social services, 3 call centre operators were asked about their perception of the social service and the technology that was being used. The following provides a summary of the results.

Experience of using the Integrated Service

1. Can you describe your experience with using the INTEGRATED service?

All felt that this experience has been a big training, very satisfying and enriching, because they had the possibility to work in a different dimension that gave a new work perspective especially to the Social Services.

2. **What benefits have you found using the integrated service?**

"An optimization of my working time".

"Able to see information about what is going on in the home"

"Been able to provide intervention when otherwise we would not have known"

3. **How would you describe the usability of the INTEGRATED service for you?**

	Very Poor	Poor	Average	Very Good	Excellent
ID1				4	
ID2				4	

ID3				4	
ID4			3		
ID5			3		

4. Has the use of the INTEGRATED service had any effect on your use of time?

	Yes	No	A little
ID1			x
ID2	x		
ID3			x
ID4			x
ID5			x

5. Has the use of the INTEGRATED service had any effects on your tasks?

	Yes	No	A little
ID1		x	
ID2		x	
ID3			X
ID4			X
ID5			x

6. Has the use of the INTEGRATED service had any effects on the communication within your own organisation?

	Yes	No	A little
ID1			x
ID2	x		
ID3			x
ID4			x
ID5			x

Some meetings have been organized in order to explain the project and to identify the right users for the pilot. In some cases the operators have been involved also when the sensors have been installed. During the pilot, especially the social workers discussed together some feedbacks of the project.

7. Has the use of the INTEGRATED service had effects on the communication between health and social organisations

	Yes	No	A little
ID1		X	
ID2		X	
ID3		X	
ID4		X	

ID5		X	

8. **Have you experienced challenges in your collaboration with other professional groups in relation to the INTEGRATED service**

	Yes	No	A little
ID1		x	
ID2		x	
ID3		X	
ID4		X	
ID5		x	

9. **Have you experienced challenges in your collaboration with the staff at the other organisations in relation to the INTEGRATED service?**

	Yes	No	A little
ID1		x	
ID2		X	
ID3		X	
ID4		X	
ID5		X	

10. **Do you have suggestions on how to overcome some of the challenges?**

When asked about how to overcome some of the challenges, the answers of the social workers were concentrated on the need to continue with the project integrating the social and the healthcare services.

11. **What suggestions do you have to improve the service?**

Add health sensors to those that have been used in the pilot. The Edmonton scale is a very good tool and perhaps we should use this more than the other criteria.

12. **Would you like to continue to use the INTEGRATED service?**

	Yes	No	Other
ID1	x		
ID2	x		
ID3	x		
ID4	x		
ID5	x		

13. How would you describe your overall satisfaction with the use of the integrated service

	Very Unsatisfied	Unsatisfied	Average	satisfied	Very satisfied
ID1				4	
ID2				4	
ID3				4	
ID4				4	
ID5				4	

Professional Perception of the Technology

1. **Can you describe your experience with using the technology?**

The overall perception of the technology is that it has been being very useful and it wasn't matched with any difficulty.

2. **What experience did you have with telecare / telehealth technology prior to the project?**

Telehealth

	Used in a lot	Have used it a little	Have seen it used but not used yourself	Had heard about it but not used	Had not heard of it
ID1				4	
ID2				4	
ID3				4	
ID4				4	
ID5				4	

Telecare

	Very Poor	Poor	Average	Very Good	Excellent
ID1					5
ID2					5
ID3				4	
ID4				4	
ID5				4	

Social services had a great deal of experience in using telecare devices but none in using telehealth, also if they know how it could be used.

3. **Did the technology provide you will the information you required to manage the end users/patients?**

	Strongly Disagree	Disagree	No Opinion	Agree	Strongly Agree
ID1				4	
ID2				4	
ID3			3		
ID4			3		
ID5			3		

- The visualisation of the habits data has been easy to understand.

4. How safe do you feel monitoring the end users / patients using the technology

	Not Safe	Somewhat safe	No Opinion	Safe	Very Safe
ID1		2			
ID2		2			
ID3			3		
ID4			3		
ID5			3		

5. **What benefits have you found using the technology? – Please describe**

The main benefits cited were that the technology was that it was easy to install and unobtrusive for the patients. The technology enabled the professional users to monitor and view data over a period of time.

6. **How would you describe the usability of the technology for you?**

	Very Poor	Poor	Average	Very Good	Excellent
ID1				4	
ID2			3		
ID3				4	
ID4					
ID5				4	

7. **Have you experienced technical challenges which may affect the quality of care delivered by the integrated service?**

    - With the exception that in the first phase of the pre-pilot, sometimes the hubs were not working correctly, no technical challenges were reported.

8. **Do you have suggestions on how to overcome some of the challenges?**

    - Add health sensors
    - Improved visualisation of data on the portal
    - help patients to better understand how to use the sensors

9. **What suggestions do you have to improve the technology?**

As above

10. **Would you like to continue to use the technology?**

All who answered said that they would like to continue using the technology.

11. **How would you rate the quality of the support you have received using the equipment?**

	Very Satisfied	Satisfied	Average	Somewhat Unsatisfied	Very Unsatisfied
ID1		2			
ID2		2			
ID3			3		
ID4			3		
ID5			3		

12. **How would you describe your overall satisfaction with the using the technology?**

	Very Satisfied	Satisfied	Average	Somewhat Unsatisfied	Very Unsatisfied
ID1	1				
ID2	1				
ID3		2			
ID4		2			
ID5		2			

Organisation / Use of Resources

ATC pilot had the following pathway and architecture:

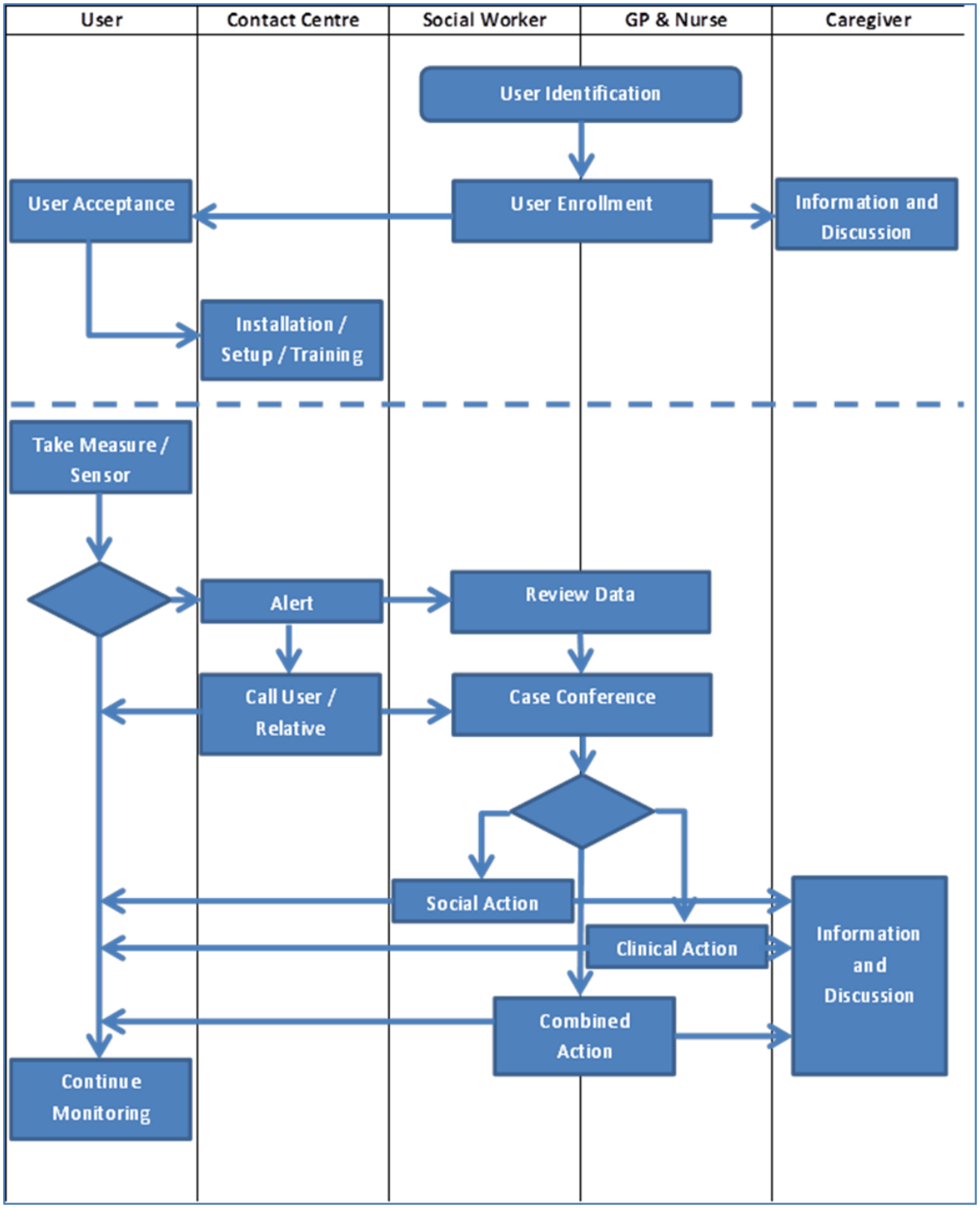


Figure 67 ATC Pathway

The table below summarizes the duties of the professional stakeholders involved.

Job Title	Role summary
Municipality of Turin **Social workers**	Responsible for the communication with the users (appointment fixing etc.). Also responsible for carrying out with the patients the questionnaires
ATC call centre's operators	Responsible for the monitoring of alarms and the consequential calls to users, relatives, neighbours, social workers, etc.
REPLY technicians	The Reply technicians designed the whole ATC Pilot architecture and customized the inCASA reference architecture in order to fit ATC's needs. Their role includes: system deployment, administration and technical support, training on the Consumer Applications for the operators of the Call Centre and Social Services.

Table 33 ATC Professional Stakeholders

As a summary quantitative report of the inCASA service's usage and statistics, the following tables are provided*:*

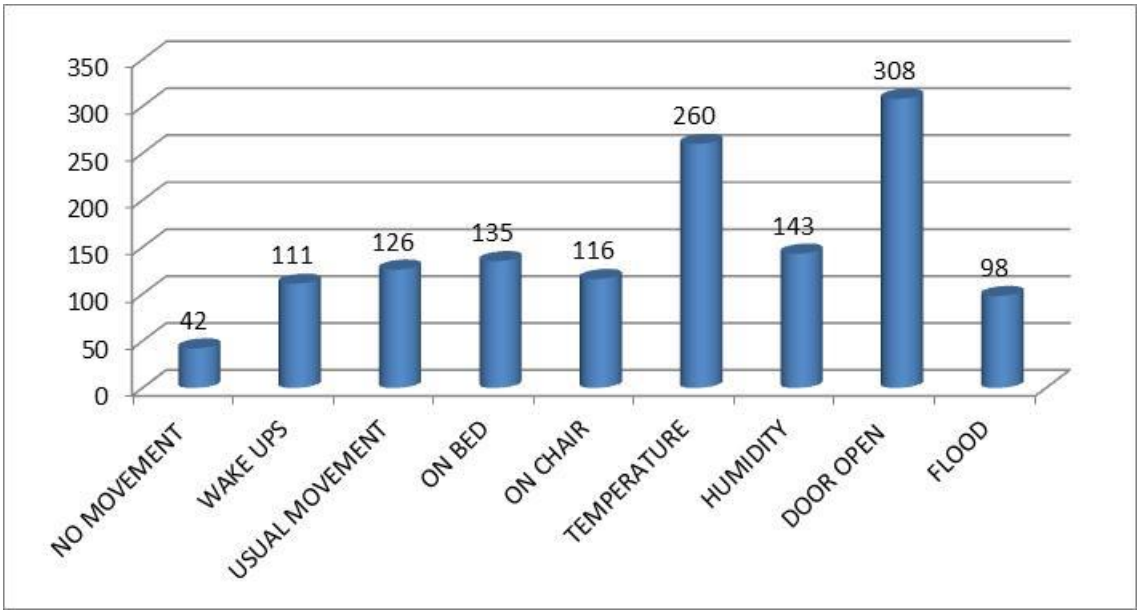


Figure 68 Percentage of alerts per sensor managed by ATC Call Centre operators

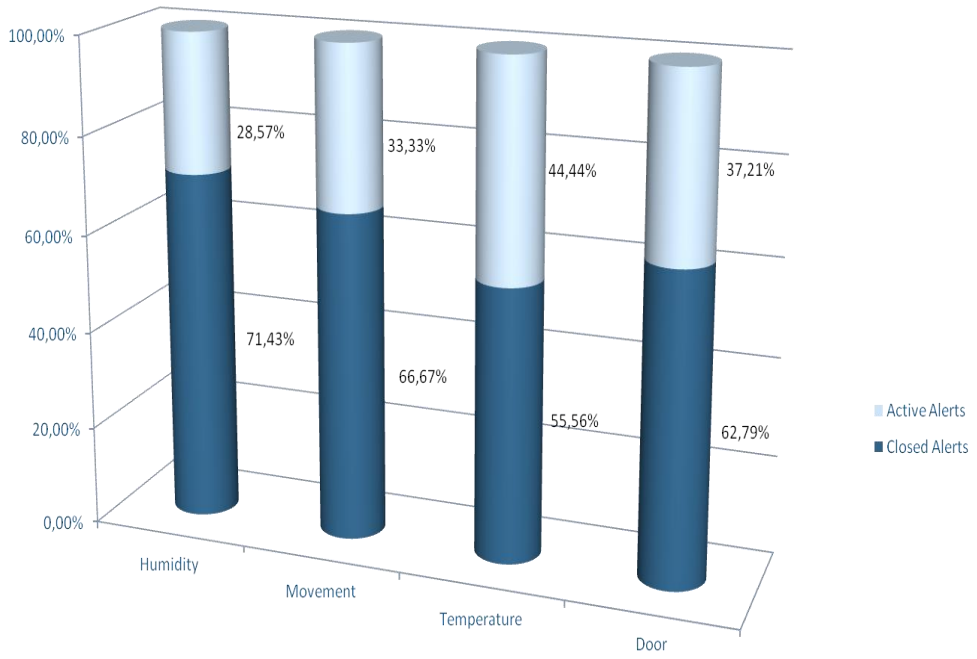


Figure 69 Percentage of active and closed alerts per sensor managed by ATC Call Centre operators

Every "Alert" is based on the "Normal Habits Model", that has been defined as the repeating of a single or complex action (like sitting on a chair or going out of home) or a pathway (a sequence of actions like going out of bedroom to 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.
Monitoring, aiming at triggering alerts to notify about abnormal behaviour, has been on a daily basis and monitored behaviour has been compared to the normal habits profile. Actions/behaviours indicators observed during a period of no less than 1 day have been compared with reference normal habits profile.

For example, if the user didn't close the door, after other 30 minutes inCASA platform sent an alert update (e.g. higher priority) to NTUA Consumer App, that explicitly showed the alert to ATC Call Centre.

Generically the protocol to handle an alarm is the following:

- Measure Taken: in case an Alarm is triggered;
- Alert: the contact center 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, following this pathway is possible to identify some main scenarios; for a generic sensor the protocol will be as follow.

A generic sensor monitoring a situation in charge of ATC Contact Center (e.g. temperature / humidity sensor, indoor movement sensor, etc) detects an anomalous event.

inCasa platform sends an alert to NTUA Consumer App, that shows the alert to an operator of ATC Contact Center. The operator calls the user (and a relative, a neighbour or the social services if the user doesn't answer).

The operator can write a note associated to the alert, and marks it as "handled" (or "forwarded to" in case the alert is given in charge to social services). The modified alert will be sent from NTUA Consumer App to EPR for storing.

When the situation comes back to normality as per sensor's measurements, inCasa platform communicates the alert update (e.g. alert definitively closed) to NTUA Consumer App, that shows it to the operator of ATC Contact Center.

Following the same principle there is a specific protocol in case of Habit Changes Alarm.

A generic sensor monitoring habit changes (e.g. changes in bed staying, in TV watching, etc), detects over a given report time period (a week or a month) significant habit changes.

inCasa platform, through weekly/monthly reports, sends an alert to NTUA Consumer App, that shows the alert to the ATC operator. The operator can call the user (and a relative, a 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 to inCasa platform to update the habits model of the user.

In the subsequent report, inCASA platform verifies if the alert still holds, or if the user behaviour is aligned to the habits model. In this last case, inCasa platform communicates the alert closure to NTUA Consumer App, that shows it to the operator of ATC Contact Center.

Moreover it is possible to identify a specific pathway in case of door alarms.

If the user didn't close the door, after other 30 minutes inCASA platform sends an alert update (e.g. higher priority) to NTUA Consumer App, that explicitly showed the alert to ATC Call Centre.

First of all, the operator makes a call to the user, to understand directly from him/her if there is some problem. If the user doesn't answer on mobile or home phone, the operator calls one of the neighbours that communicated to the social workers, before the beginning of the project, their availability in case of problems. If also this call fails, the third attempt is to call a relative of the user. If all the three calls don't reach anybody, the operator alerts the social worker that goes directly to the user's home or in some of the places that the user usually frequents (gardens, cafés, clubs, or other meeting places).

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 of social workers	90

Table 34 ATC Pathway Escalation figures

During the pre-pilot and pilot phases, the Call Centre operators didn't observe any particular situation of danger or regarding users' serious health problems.
Before inCASA, the users received the home visits of the social workers, but between one visit and the other, they felt to be completely alone. During inCASA they understood that each deviation from their daily habits was continually monitored, so this awareness increased their self-confidence and their feeling of loneliness fell off.

The operator could write a note associated to the alert, and mark it as "handled" (or "forwarded to" in case the alert was given in charge to social services); in such a case, the modified alert has been sent from NTUA Consumer App to EPR for storing.

When the door has been closed, inCASA platform sent an alert update (e.g. alert definitively closed) to the ATC Call Centre (through NTUA Consumer App), so that the operator was aware that the situation came back to normality.

If the door was not closed after a given time (e.g. 3-5 hours), inCASA platform sent an alert update (e.g. higher priority) to the ATC Call Centre (through NTUA Consumer App), so that the operator had to decide the best action to perform.

The last scenario is to be referred in case of technical emergency. The pathway is pretty much similar.
An alert from Hydra middleware (e.g. from the water sensor) will be sent to the inCASA Platform, that will pass it to the NTUA Consumer App, that in turn will show the emergency situation to the ATC Contact Centre.

An ATC Contact Centre operator will call the user. If the user doesn't answer to the phone, the ATC Contact Centre's operator will call a relative, a neighbor or the Social Services to check the situation and user's conditions.

When no further alert from Hydra middleware will be sent for the water sensor, NTUA Consumer App will show to the ATC Contact Center that the situation has come back to normality.

Social Interventions

During the winter months there were a number of low temperature alerts. Four of the end users who had alerts triggered were subsequently referred by the call centre to social workers. It was identified that the end users were concerned over the expense of heating their homes. Most of the interventions were focused on "education". However, for one end user economic support was requested in order to enable them to heat their home.

The call centre also had a large number of alerts from a user in relation to flooding. The end user was identified as using too much water when washing the floor which was causing the flood alarm to be triggered. Intervention of the social workers was focused on "training" on how to correctly clean the floor, reducing risks of flooding and electric shock.

Another user was particularly hard to manage because he was an alcoholic. On one occasion, while he was drunk, he destroyed the sensors' set. The user was identified as being a high risk of violence and suicide; as such the user was continuously jointly monitored by the local police department and the call centre in order to respond to any situations.

The bed sensor alerts usually indicated minor changes in user habits. In a number of cases it was identified that the end users were unwell. In these instances the call centre directed the patient to contact their GP or contacted the relatives of the users and informed them of the situation..

Something has to be highlighted is that the small number of alerts related to the chair permanence suggests that this use case is not so relevant for the "basic" habits monitoring considered within in CASA. Probably if a more complex model of habits analysis would be implemented (e.g. kitchen use at lunch or dinner, sitting before or after physical activities and so on) this alert could gain more significance.

Alarms

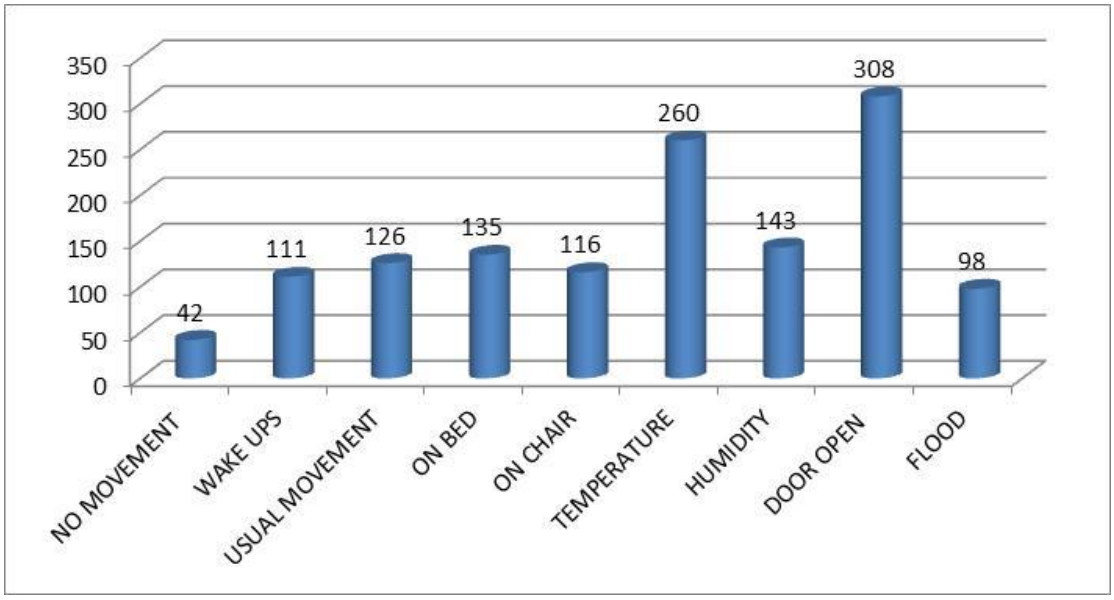


Figure 70 Percentage of alerts per sensor managed by ATC Call Centre operators

From a numerical point of view the most activated sensor that triggered an alarm was the door one, with 308 occurrence. All alarms have had a favorable outcome through direct contact with the user or with a relative. In one case, for a total of 43 occurrences for the same user, it was found a continuous and unjustified alarm port as a result of a defect in the sensor mounting, as showed in the **Errore. L'origine riferimento non è stata trovata.**. The alarm, in this specific case, was returned after the intervention of a technician who solved the problem.

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 71 Alarm Notifcation Screen

For the same sensor there is another user that presented the same kind of problem (36 occurrences); initially the idea, as reported in the comments note of the contact center operator in **Errore. L'origine riferimento non è stata trovata.**, was that the sensor was broken or not well operative. After some initial investigation by the technical team and social workers, it was clear that the user intentionally was leaving the door open just to be contacted by the operator. In this case it was necessary an escalation for a psychological intervention.

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 72 Door Alarm Intentionally Triggered

For the alarm "water" (98 messages) it was found a re-operation on a single user. The alarms were triggered because of two main elements: the bad habit of the user in using the kitchen sink and some practical problem to the water pipes in the kitchen.

Alarms "temperature" (260 messages) and " Humidity " (143 reports) have seen the involvement of social services in order to monitor the health of users and their possible need for help but no further intervention was necessary.

The “No Movement” alarm (42 occurrences) was handled as the normal flow with a first call from the contact center and in a very few cases with an escalation on the Social Workers.

The other kind of alarms have not resulted in particular problems or the need for intervention; they were all handled via the contact center through the phone call to the user or to his/her relatives.

During the pilot phase there were substantially no changes in the Alarm protocol; as reported the majority of alarms were handled through the contact center and in some cases with the escalation on Social Workers just to check the status of the user. Even the case of intentionally triggering the alarm was well handled with the current alarms protocol.

Economic Outcomes

The costs of the service can be split into two categories: equipment costs and staff costs.

For each installation of a complete set of sensors ATC sustained an expense around 1.450 € per user. ATC didn’t have cost for the server, because the company’s server farm has been used for the data storage.

Concerning staff costs, it was estimated during the Pilot that the average working time needed by the Professionals for each patient per week is 2 hours. Professionals include social services staff and call centre operators.

On the other hand, cost savings are based on the factors listed below:

- Cost savings realized by averting unnecessary visits to the user.
- Considering that the social workers usually visit the patients twice for each month, the possibility to monitor at distance their daily habits gives them the opportunity to make only one visit face to face for each month. Each visit at patient's home entails 2 hours of work, so it means 80 hours/month for 40 patients. The hour cost of the social worker of Turin Municipality is around € 30,00, so the total monthly cost that can be saved is around € 2.400,00.

This means that the saving for each patient is about 60/euro month. On this basis, the average cost suggested for this kind of service is about 2/euro a day.

Safety

Regarding the evaluation of the safety aspects of the inCASA platform, no incidents were reported or recorded in the pilot action log. The equipment installed at the patient's house is the activity hub – for tracking Telecare data, and the TC sensors. All above devices are consumer devices and have been approved by EU regarding safety and electromagnetic emissions. The professional users access the Consumer Applications web UI to track remotely the deviations from the habits profile of the patients on a daily base. Consequently all user interactions with the platform are inherently considered safe.

Ethical Considerations

All patients have signed the informed consent before joining the Pilot. No specific ethical issue was raised during the Pilot. We consider as an ethical issue the fact that some of the users are very afraid knowing that the devices will be de-installed at the end of the project. So ATC decided to continue the monitoring until the end of September 2013.

6.4 Conclusions

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

But the most important aim of inCASA is to improve the quality of life of elderly people, reducing the time of hospitalization, allowing, thanks to technology, to spend more time in their own homes.

This objective is pursued with the creation of integrated services/solutions that allow the monitoring inside home and of the patient's vital signs through the collection and analysis of a significant quantity of data, in order to profile the users' customs and to identify possible gaps that require an approach of integrated socio-health services.

The Italian pilot didn't have the possibility to realize the integration of telecare/telehealth services, but the experimental service realized 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.

For this reason, in May 2013, ATC and Reply presented the project's results to the Department of Social Services and Politics for the Family of Piedmont Region.

It is well known that frail people for age, chronic diseases and economic and social disadvantage, is more and more numerous and, at the same time, the resources of the Regional Health System are decreasing for home and long-range assistance.

Politics of real prevention of the risk events that provoke the not self-sufficiency on this sample group of people could be really important. Therefore, to invest on a segment of population that is already monitored by the Social Services would activate scale economies in terms of knowledge and sharing of data of the persons involved and of use of only one service central. The presence into ATC of a Call Centre h/24, equipped to supply telecare services and to collect alerts profiles, could become a resource for all the territory.

The main interest of Piedmont Region is to develop a solution as inCASA in a territory with increasing frail people, and according with 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, it has been developed a new model in order to supply integrated social and health services, involving general practitioners, nurses, specialist doctors, social workers.

The new kind of organization is based on the daily competence of social and health professionals, and the definition of guidelines and integrated protocols, for which the inCASA experience could be source of ideas and concrete proposals.

Since this new organization has begun only during 2013, unfortunately the inCASA project didn't benefit from this model that would have permitted to realize completely the field test integrating the social environment with the clinic one (GPs). As a consequence the integrated model has been analysed only from a theoretical point of view, highlighting the project's potentialities.

So, considering the interest of Piedmont Region to go ahead in this direction, its implementation will be realized during the post-project phase, inside the initiative called OPLON.

OPLON (Opportunities for active and healthy Longevity), is a proposal born inside the project “Smart Cities and Communities and Social Innovation” of the Italian Ministry for Education, University and Research (Ministero dell’Istruzione, Università e Ricerca - MIUR).
Piedmont Region, with Emilia Romagna, Puglia and Lombardy Regions, under the supervision of the Health Ministry, will develop the inCASA project on the subject of frail persons in order to show the potentialities and features of socio-health integration through the frailty classification deduced from the "European Innovation Partnership on Active and Healthy Ageing”. Inside this project it will be given a complete fulfilment to the integration with the part of territorial medicine that unfortunately has been missed inside inCASA.

Since some years, the local welfare is supported, especially for the test of innovative models, by the two local Bank Foundations: Compagnia di San Paolo and Fondazione CRT.

Concerning the welfare, Compagnia di San Paolo has financed many projects about home hospitalization, using telemonitoring devices and advanced telehelp, including fall and presence sensors. Fondazione CRT has financed research programmes about lifestyles, especially finalized on the arrangement of systems of prevention and information about correct lifestyles.

So, on the regional territory, there is a positive background to propose the continuation of the service on a larger sample group of population (400 tenants over 65 living alone in apartments managed by the provincial ATCs), applying also methodologies of analysis in order to identify precisely the possible benefits of the service in relation to the decrease of improper hospital admissions.

6.5 Recommendations

Regional/National Implementation

- Reorganization of territorial services has to take in account the frailty model, both in terms of services adoption than on terms of process design. Reduction of resources needs to rationalize efforts, to be addressed according the “frailty urgency”.
- Target services defined according the Frailty model towards a more tightly defined population in order to maximize both patient and professional outcomes.
- Reinforce the position of remote supporting organizations, like the contact center, as key role enabler of the process
- Health and social integration are expected, both by users than by institutions. The availability of shared tools (patient profile) and common supporting organizations (contact center), is not enough the involve professionals, especially in the health sector (GPs).

Local Implementation

- Investigate on expanding services to external organizations. ATC is suffering the decrease of public resources, inCASA project helped us to think in terms of openness to the market
- Continue working with Municipality Social Services and newly defined health territorial health services to better define integrated working partnerships and pathways
- Review use of technology in order to reduce costs. Some devices were not useful
- Continue work with Reply to enhance user requirements for the information management system
- Expand the service to include unpaid carers in the monitoring of their relatives by means of information exchange and accessibility

7.0 Synthesis Report

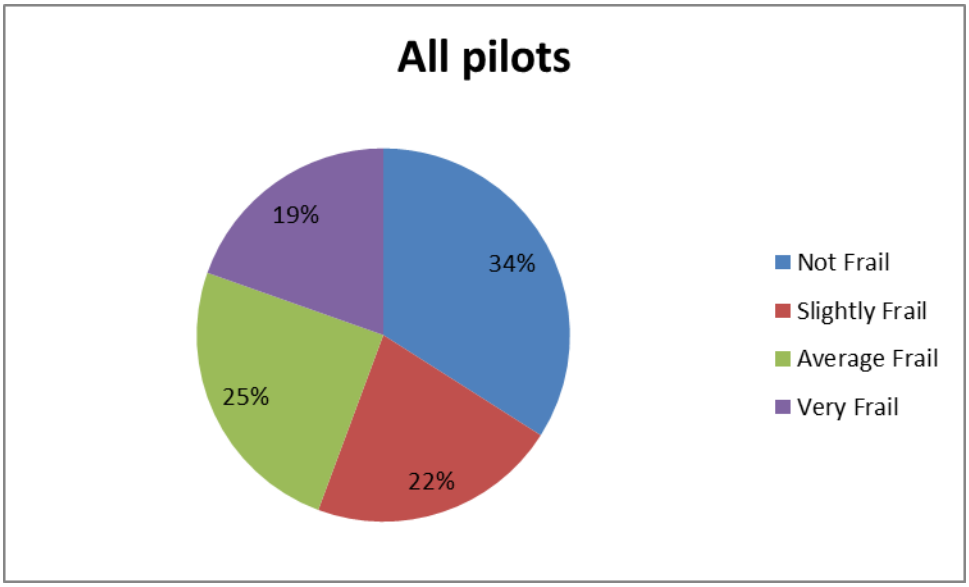
7.1 Main Results

Study Population

Between March 2012 and May 2013, 204 patients across the 5 pilot sites were enrolled onto the study. 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, users from the ATC 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 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.



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 date. 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 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

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.

Enhanced 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 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.

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 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.

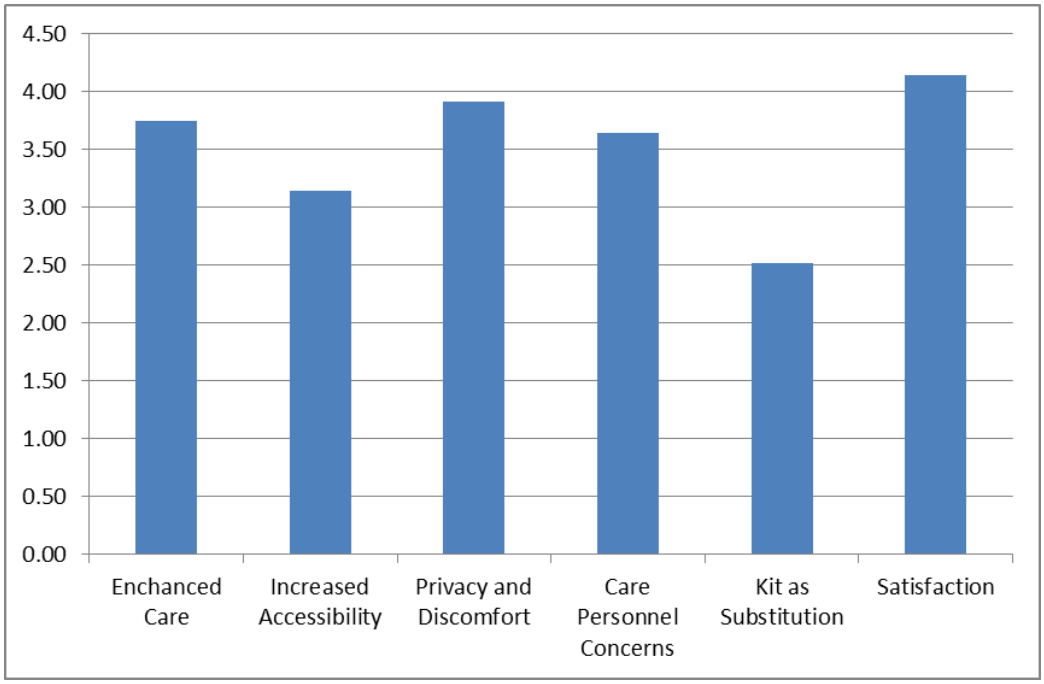


Figure 73 Patient Perception results for all pilots

Access to Services

While patients within FHC and KGHNI reported increased access to services, both CHC and INSERM reported that patients did not perceive that they had greater access to health and social care services. The CHC pilot felt that this may be to the high quality of care and good existing access that patients are already experiencing in this area.

Privacy and discomfort

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.

Personnel care concerns

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.

Patients within the KGHNI pilot reported a greater sense of security due to the usage of the inCASA services in their premises. FHC patients also reported that using the inCASA platform contributed to a reduction in their concern about their health status.

Users within ATC highlighted how much the monitoring has increased their feeling of safety and protection. For ATC this has had a number of benefits

“Perhaps for the first time, they [end users] saw the local institutions in a very different way: in particular, ATC has been viewed not only as the institution that asks them the payment of the rent

and the other expenses, but finally an institution that realized something in order to help them and increase their welfare in their own homes".

However one patient within the CHC pilot did report that they were concerned that the health or social care professional may not know their personal health and social history.

Technology as replacement for usual care

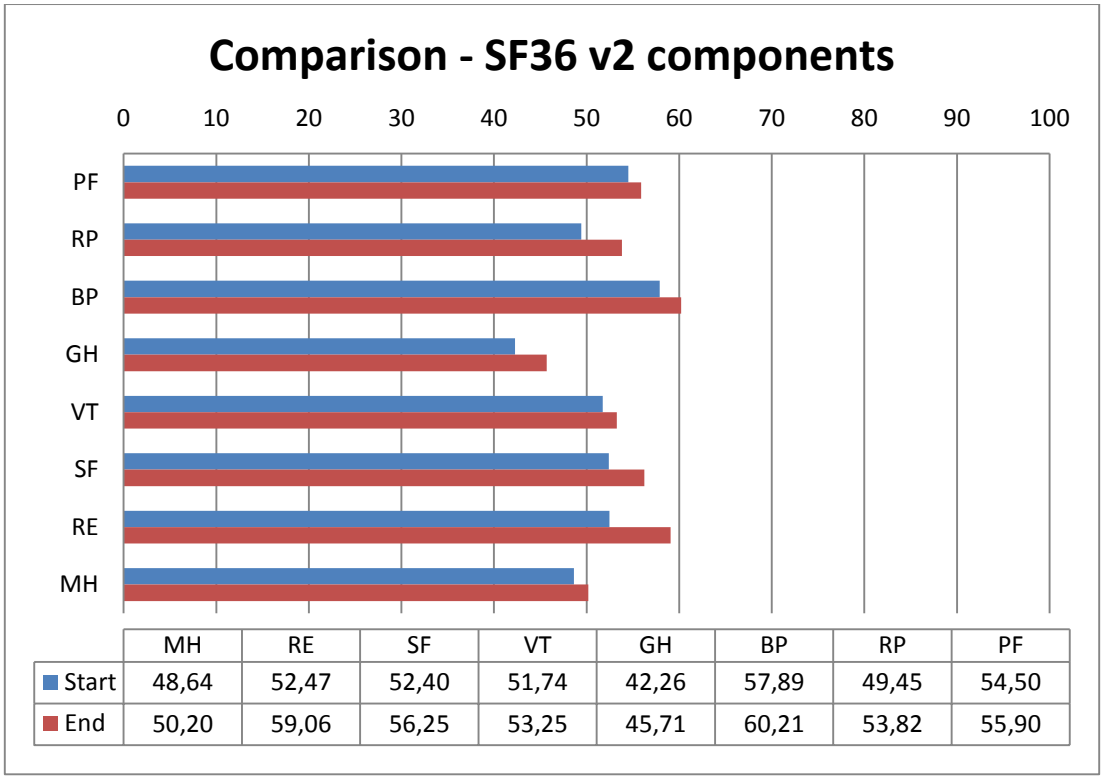
The majority of patients within the pilots felt that the technology provided to them as part of inCASA, could not replace their regular health or social care, although some patients felt that the technology was as suitable as a regular face to face consultation.

Satisfaction

The overall scoring of patient's satisfaction with the inCASA pilots is very high. However, for CHC, initial technical difficulties that have been encountered are reflected in the patient scores regarding whether the kit can be trusted to work appropriately.
ATC, KGHNI and CHC pilots have all reported that patients currently enrolled on to their service wish to continue being monitored.

Quality of Life

All pilots assessed changes to Quality of Life using the SF36 v2 questionnaire. This approach used a descriptive analysis to examine changes in responses to individual items on the SF-36v2 to provide interpretative meaning to any potential improvements during the time the patient was enrolled onto the new service. A total of 148 patients completed the questionnaires at baseline and at the end of their time enrolled onto the study.



	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 74 Comparison - SF36 v2 Components

The comparison of mean values of each component at baseline and endpoint are presented in figure 71 compared to baseline.

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 on to the service

For the KGHNI pilot, it was felt that the pilot had contributed to improved heart failure treatment by facilitating improvements in the patient's own emotional handling of their chronic condition.

KGHNI also used an EQ-5D questionnaire which also provided evidence of how, with the help of the inCASA service, patients felt more secure, independent and self-confident and that the inCASA KGHNI depression monitoring and psychological support procedure was widely appreciated by the patients and played a major role towards the observed emotional improvement.

The FHC pilot had 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 by

within the control group. In particular they found significant increases within the general perception of health domain which is consistent with the clinical outcomes as related to the health status of the patients.

In the INSERM pilot, the results showed only a slight decline in PCS and MCS. Despite this most patients reported that the system increased their sense of security at home as they knew their weight, symptoms and rest-activity rhythm were monitored and they were less concerned about the risk of alteration of their health condition.

The majority of patients within the CHC pilot did not see a great change (either positive or negatively) in the SF36 scores over the time that they were enrolled onto the service. However, those patients that scored as average frailty and above indicated a positive impact on quality of life. CHC argued that by the nature of the population being monitored, a decline in quality of life could be expected over a period of time as a result of their disease and frailty.

It can be observed that the pilot sites who were primarily medically led saw improvements in perception of health related scores over the time that their patients were enrolled onto the service. By contrast the ATC, pilot which was led by social housing saw improvements in the more social aspects of the scale.

Professional Perception

29 professionals were asked about their experience with the new service and technology across the 5 pilot sites. All pilots used the same questionnaire so that data could be aggregated and compared. The professional groups included: Health professionals, Social Workers, Community workers, Call Centre workers and Technical Support workers.

Experience of using the Integrated Service

As a general conclusion, 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.

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

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

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.

Unfortunately despite much effort, ATC were unable to successfully collaborate with the general practitioners in their pilot. The reasons for this are discussed within the ATC evaluation reporting. However, the learning from within the ATC pilot and from the evaluation of the other pilots within inCASA has enabled ATC to develop, plan for and present an integrated model to the local municipalities for future development and roll out.

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.

All pilots felt that the services are in their infancy. More work is required to develop these services further.

Benefits of the integrated 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 optimization of my work time
- Being able to instantaneously identify health problems and adverse effects and being able to address them promptly

Usability of the Service

The majority of professional users within the pilots rated the usability of the service as average (60%). 8% felt that the usability was poor.

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

Use of Time

All pilots reported that the introduction of the service had impacted on their use of time in some way. 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.

Some pilots (CHC and KGHNI), reported increased workload as a result of identifying interventions that would have otherwise gone unnoticed over the short term.

Communication and Collaboration

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

- 68% of users reported improved communication within their own organisation
- 42% reported improved communication between health and social care

For ATC, even though there were no formal links with other organisations, the call centre would share information gathered via the inCASA platform with other services in order to provide the needed response to that data. An example of this was when data was shared with the local police department about an end user who was in need of police monitoring. Data was also shared with end users relatives who would then take further action if required.

CHC reported that the introduction of the service had improved understanding between the health and social organisations with regard to existing pathways and ways of working. This had led to the identification of a "gap in care" for some patients that was neither covered by health or social services.

Some pilots reported communication difficulties within their own organisations.

- 63% of professional users reported challenges with other professional groups in relation to the new integrated service.

Physicians in KGHNI have found that they were not able to access information on their patients always at the time or place when they needed it. They have since requested the ability to be notified by SMS and email when a patient has been identified as being in need.

As previously mentioned, the nurses within the CHC pilot who were charged with the daily monitoring of patients did not always feel that the General Practitioners responded to referrals or requests for information in a timely manner as possible. It was reported that this may have been to an already busy workload as well as the general level of personal interest in the project.

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

- Create a managerial role that would direct cooperating units of the hospital
- Look at using other non-clinical staff to do enrolment, installation and triage

- Development more definitive monitoring protocols
- Enhance the internal promotion of the project

The following are a summary of the suggestions captured by the staff about 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 associated with the devices used
- Communication improvements for the medical devices used
- Understand if some aspects of the service can be outsourced or whether they can be developed in house
- Facilitate better management of the services
- Extend this service to other areas of the organization
- 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 personalized (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

Integrated technology

The inCASA project was never designed to be a technical development pilot. However, it took a long time for a solution or various solutions to be agreed upon. Indeed, it took almost 18 months for a consensus to be agreed and pre-pilot implementation to begin. There are many reasons for this. Some of which are summarised below:

1. Unclear user requirements
2. Availability of solutions amongst the pilot partners
3. Competing technical implementation views amongst partners

Once agreement was made, pilots encountered further delays while technology and software was developed and tested. For the ATC pilot this resulted in one solution having to be replaced with another.

For the most part this meant that pilots commenced using technology that was still being developed. Updated user requirements were feedback to technical partners and improvements were made on an on-going basis.

As such, the evaluation of technology and the user's perception to it should be viewed in a slightly different way to that of a pilot that is using pre-existing and developed technology. A person's perception may change over time dependent on changes and improvements made and this is reflected in the results from the pilots.

Professional Perception of the Technology

Only 27% of professional users had used Telehealth technology before and only 6% had used Telecare before. 62% of patients ranked the usability of the technology as very good.

96% of professional users rated their satisfaction with the technology as good.

35% of professional users felt that the technology provided them with the information to manage their patients / end users.

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. INSERM experienced difficulties in particular with the integration of Actigraph data and visualisation of that data so that it could be interpreted in a meaningful way by the nurses.

CHC also reported issues with interpretation of habits data as well as accuracy of the incoming data specifically from the bed/chair data.

The following summarises some of the difficulties experienced by the pilots:

- Sensor temperature, motion detection, TV usage and chair permanence 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

Only 32% reported that they were completely satisfied with the level of information they were receiving to manage a patient. This was mainly targeted at the information being generated by the Habits devices. CHC suggested the following improvements

- Change the time periods for grouping the activity data
- Ability to identify when a sensor was not working as expected
- Ability to view different levels of analysis of the data

Safety

Despite this, the majority of users felt safe about monitoring patients using the technology (safe, 57%, very safe, 10%). Both CHC and KGHNI reported concerns over the interpretation and accuracy of data being received from the bed / chair sensor and felt that this was not reliable in its current form. KGHNI also expressed concerns over whether the TV usage monitor was applicable for the pilot group.

Benefits of the Technology

Despite the difficulties there were many benefits that were reported. The following summarises the reported benefits of the technology

- 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. New knowledge of other European projects with similar aims.
- 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 ability to visualize, interpret and correlate to other sensors in the home (including telehealth). KGHNI suggested that more research should focus on the Telecare sensors that will be used in the future evolution of the platform. The following provides some suggestions as reported by the pilots.

- Further research into telecare sensors
- Improve the signal strength within the gateway
- Use of repeaters in the home
- Investigate the use of a wearable sensor to track activity and location within a house
- Improve visualization of data on the clinical portal
- Review user instructions so patients better understand how to use the equipment

Organisational Impact / Resource Usage

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.

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

Much of this additional workload has been due to the following reasons:

- Recruitment of patients / end users
- Installation of equipment
- Monitoring of incoming patient data
- Dealing with support calls from patients and professionals

The reported time spent on monitoring patients has varied between pilots. INSERM report that it takes one hour a day to monitor 10 patients, while KGHNI report 2 hours per patient per week. For CHC, the monitoring time was estimated at 20 minutes per day.

Differences in time taken to monitor patients can be due a number of variables including, reason for monitoring, the experience of the person doing the monitoring, the information system that is being used and the ease in which the professional can translate the data.

It has previously been reported that many pilots have experienced difficulties with interpreting some data received from the devices, especially the habits data. This may have contributed to the difference in time taken to review the data.

KGHNI have stated that while the time taken at present to monitor patients is manageable for the numbers involved within the existing pilot, in order to increase the numbers, the existing pathway would need to be modified and developed further.

Only CHC looked at comparing patient resource usage for patients enrolled into the study. Resource usage data was collected for hospital admissions, GP contacts, ER contacts, Social contacts and Community contacts for the period that the patient was enrolled into the study compared to the same time period immediately prior to the enrolment. A reported reduction in both planned and unplanned admissions to hospital was observed however, this was felt to have been skewed by a single patient. CHC did report an increase in referrals to social service and community services. This was felt to be an outcome of the study in that patients were being identified to other services.

While ATC was not able to fully integrate with other services it did collaborate closely with other services in order to respond to incoming data. For example, these included calls to social workers, other community services including the police, relatives and neighbours in order to respond appropriately to an event.

Clinical / Social Services Effectiveness

CHC, FHC, INSERM and KGHNI all reported clinical outcomes within their evaluation. All 4 pilot sites indicated that the use of the inCASA service enabled them to identify patients who were in need of clinical intervention.

KGHNI deployed a service monitoring simultaneously health; social and psychological condition via the analysis of a number of clinical and social parameters of patients who had suffered a recent cardiac event. Most interventions were triggered by heart rate alarms helping clinicians identify patients with arrhythmias such as atrial fibrillation. In two of these cases, the inCASA alert was lifesaving as it identified patients at serious risk and resulted in surgical intervention.

A further 6 patients were found to face early depression. This depression was most commonly found in those patients who had recently experienced a recent and serious cardiac episode. Psychologists intervened in each of these cases offering the necessary support.

FHC demonstrated clinical outcomes of the in-home tele rehabilitation programme by undertaking comparisons between the COPD patients baseline health status with the health status measured at the end of their training period at home. These were then compared to a control group who

received in-hospital training only. The analysis of results offered by the BODE index calculation, using clinical inputs such as MRC, FEV_1 and 6MW test, suggest that making respiratory exercises at home is more efficient than coming to hospital. This was also supported by the outcome of the St. George questionnaire which demonstrated a slight correlation in favour of final health status observed by patients receiving treatment at home.

INSERM monitored patients at home who were undergoing chrono-modulated chemotherapy for cancer. One chemotherapy course is administrated during four days every three weeks. Because these patients are at high risk of severe toxicity during this treatment, INSERM developed a service that combined the monitoring of body weight, symptoms and night time activity to help support these patients when they are at their most vulnerable and frail. 22 % required a clinical intervention. During the pilot 2 patients were identified as being in immediate need of emergency assistance, a further 7 patients were able to be managed remotely by the nurses for deviations in their weight and symptom scores.

CHC monitored frail elderly patients who had a number of long term conditions. 55 % of patients enrolled onto the CHC service were identified and referred to an intervention during the time that they were being monitored. 44% (17) received some type of intervention. The most common reason for intervention was due to low oxygen levels for patients with COPD. Patients were referred to community pulmonary services quickly which avoided escalation of their condition which may have led to an emergency admission. For those patient who received an intervention over 70% were those that had been rated as average frailty or very frail.

For the ATC pilot who was not able to integrate a health response within the timeframe of the pilot, they were able to report on a number of occasions where alerts generated within the home did lead to them contacting health services indirectly and through relatives or neighbours. This has provided ATC further evidences to present to the local general practitioners to encourage future collaboration.

Economic Reporting

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 begin to make determination about future costs for the service.

The cost models are different as they are based on different funding streams and outcomes. As such it is difficult to present a common model within this section. The following is a summary of those models. The actual cost of the service is presented within the individual pilot evaluation.

FHC presents a hypothesis that a reduction of at least 1 or 2 days of hospitalization 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 hospitalization 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 calculate cost savings based on number of re-hospitalizations averted. The inCASA services contributes to prevention resulting in measurable reduction of the hospitalization needs, a finding

that is supported by data made available from the pilot's action log and individual patients' case files; the costs of hospitalizations 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 realized by averting 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 point).
- 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 organizational overhead costs incurred if no effective procedures are already in place to facilitate cooperation between carers of different disciplines and across organizational units (internal/external).

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 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.

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.

Safety

None of the pilots presented any concerns from either the patients or professionals involved in the pilots.

[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)

7.2 Ethical Considerations

The inCASA project has been committed to ensure that the project and the pilots were ethically sound. In order to achieve this, a project ethical policy was defined, an Ethical Board established, and ethical guidelines to the pilots were defined. The pilots used the latter to assess if any ethical issues requiring action were present in the pilot. The results, which showed that the pilots reported only minor ethical issues, were described in the deliverable D6.4 Pilots Ethical Report (January 2012).

The ethical issues raised in D6.4 Pilots Ethical Report were subsequently discussed at the Ethical Board Meeting held in in Chorleywood, UK, on 2 February 2012. The Ethical Board's remarks and proposed solutions were documented in the deliverable D2.3 Annex - National Country Policies and Ethical Package Update (April 2012). The inCASA pilots have not reported any ethical issues or concerns since.

For this final Pilot Evaluation Report, we have analysed two of the evaluation questionnaires: the Patient Perception Questionnaire - Service User Technology Acceptability Questionnaire (SUTAQ) and the Professional Perception Questionnaire (see Appendix A). These two 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 two questionnaires show that overall the project and the pilots did not violate any ethical rights. However, some patients expressed concerns in relation to privacy and data protection and autonomy.

A number of patient's did initially express some concerns related to privacy and protection of data, but this concern was alleviated as the security measures in the system and with regards to the transmission and handling of data were explained in more detail. Some pilots have also remarked that a concern about privacy was a likely factor why some patients declined to take part in the pilots. This concern was particularly related to Telecare data, i.e. data collected via movement sensors (motion, chair permanence, TV usage); not fully understanding the rationale for collecting this type of data was most likely a factor for their expression of concern.

Another patient felt that the technology had interfered with their daily routine which relates to the issue of autonomy; although the technology per se did not constrain the person or curtail their freedom of movement or association having to use the technology was perceived by the patient as an inconvenience.

The CHC pilot found that using the term "frail" in relation to its targeted population was found to be objectionable. Patients reported feeling stigmatised and did not feel that it was a suitable term to be used. The CHC pilot removed the term from all of its patient information.

With respect to the results from the Professional Perception Questionnaires, no ethical problems were raised. However, an issue related to inclusion is worth mentioning here, namely that some patients and healthcare professionals felt that the user interfaces could be made more user-friendly. Secondly, the reliability of some of the devices and of the communications gateway was not considered as fully satisfactory and is thus an area for improvement through further research, development and testing.

7.3 Habits Profile

Within the inCASA project, pilots used technology to develop a profile of a person's behaviour. Different disease groups including cancer, COPD and CHF were targeted by three of the pilots. One pilot focused specifically on the older frail patient and another focused on individuals at risk in their home environment. Pilots chose technology which they determined to be most relevant in monitoring for specific indicators based on their patient profile

5 different habits profiles were developed based on these patient profiles. Each was tested during the pilot phase. These are summarised below.

The ATC pilot used a combination of telecare devices in the home including movement, contact and home environment parameters, e.g. gas/water leaks and room temperature to monitor patients within a social housing scheme who were determined to be at risk and vulnerable in order to automatically identify anomalous situations. Any significant deviations from the Habits Model generated an alert that required defined actions by a designated person (e.g. case manager to social worker).

The CHC pilot used a combination of telehealth and telecare sensors including blood pressure, weight, spo2, bed / chair sensor and motion sensors to monitor frail older people within their home. Information was collected from each of the devices to build up normal patterns of behaviour for each of the patient. Data was analysed to detect deviations from "normal". Deviations from these patterns automatically triggered notifications which were sent to health and social workers. The CHC pilot also analysed the data for correlations between health and habits data to detect if a change in a person's usual habits could give an early indication of decline in health.

The FHC pilot used a combination of telehealth and activity monitors e.g. spo2, actigraph and exercise bike to monitor patients with COPD. Unlike the other pilots who were monitoring change in usual patterns of behaviour, the FHC pilot used the information gathered to encourage increased levels of activity in order to improve its patient's health.

The INSERM pilot used a combination of telehealth, activity monitors and symptom questionnaires e.g. weight, actigraph and depression scoring for patients who were undergoing chemotherapy within the home. The actigraph was used to monitor activity levels of sleep during the night. Change in expected values was identified and clinicians notified.

The KGHNI pilot focused on the monitoring of CHF patients. A combination of telehealth and telecare sensors was used including Blood Pressure, Weight, Pulse Oximetry, chair sensor, TV usage and motion. The KGHNI pilot also used depression scoring to monitor for changes in a person's mental and psychological health. Changes in patient's usual activity levels or clinical parameters were monitored and alerts sent to the Professionals via the Web Clinician Portal when a deviation from normal patterns was identified.

7.4 Conclusions

The primary purpose of the inCASA project was to implement the solution in a local context characterized by the growing presence of frailty situations in the population, in line with the local, national and European regulations, recommendations and guidelines. The project was committed to developing 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.

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.

Two distinct service models were developed during the pilot phase. Those services that were aimed at detecting and preventing clinical or social decline of the end users / patients and those services that reorganised existing models of care by moving them into the patients home in order to support clinical and social outcomes.

Prevention and Detection

- 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

In Italy, 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.

Pilots in UK, Greece, France and Spain focused on the management of older people with chronic diseases and the presence of comorbidities, with a closer focus on the disease and their “at home” care and cure, with indirect but demonstrable effects on the social implications.

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.

The inCASA pilots have added to the knowledge base of the potential benefits of developing integrated service delivery for service provider organisations. This provides a concrete starting point for the future development of a more closely integrated healthcare and social care system across Europe.

Pilots have presented outcomes that indicate integrating services can improve the quality of life of patients who are frail and vulnerable. By 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 organizations involved of the importance of joint working between healthcare and social care.

However, there are still many challenges due to the immaturity of a common interoperability model, and the long history of domain-divide between social care and healthcare organisations. In some Pilot countries, such as Italy, this traditional conflict is not well engaged by legislators, and a change would be required to remove first cultural then 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.

Definitely, all contributors to this project were in agreement that much more needs to be done in making integration, in terms of joint services and data sharing. This is possible to be achieved only with the strong intervention of the legislators and a strong cultural change.

7.5 Recommendations

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

In particular, it is well recognised, that especially in the practice of primary care, it is necessary that healthcare aspects are well integrated with the more social aspects to enable a multidimensional assessment of resources.

In this context, the cooperation of the various actors involved 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 an effective total patient care of the individuals whose risk profile is associated with the implementation of measured and personalized 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 or extension of illness.

The majority of inCASA users were not familiar with the new technologies, and in some cases user acceptance of habits monitoring sensors was low. There is a need to focus on the design of such systems so that they are unobtrusive and "inclusive". End uses should be involved in order to understand how these systems can be developed and reach a level of maturity and acceptance by those that they are designed for.

The process illustrated by the project and partially 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, hospitalizations, 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.

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 himself by implementing available technological tools to support learning/informative activities for healthcare and social care operators and to support their interaction among them and with the patient.

Another recommendation would be to test the benefits of the system in different social and healthcare situations and in both metropolitan and more rural contexts. This might help to better verify its actual extensibility to the entire population.

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[3] ICD9CM (Spanish vs.) , titled CIE-9-MC
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Appendix A – Questionnaires

Demographic Data

In order to have a common description of the patients participating in the intervention and control group in the pilots, all pilots must collect the following demographic data for each patient:

Demographic data on each end user / patient	
Date of birth	DD-MM-YYYY
Gender	1 = Male 2 = Female 9 = Missing answer
What is the highest level of education you have completed?	1 = No formal schooling 2 = Less than primary school 3 = Primary school completed 4 = Secondary school completed 5 = High school completed 6 = College/University completed 7 = Post graduate degree 88 = Refused 99 = missing answer
What is your present marital status?	1 = Never married 2 = Currently married 3 = Separated 4 = Divorced 5 = Widowed 6 = Cohabitating 88 = refused 99 = missing answer
Which of the following best describes your **main work** status over the past 12 months?	1 = Government employee 2 = Non-government employee 3 = Self-employed 4 = Non-paid 5 = Student 6 = Homemaker 7 = Retired 8 = Unemployed (able to work) 9 = Unemployed (unable to work) 88 = refused 99 = Missing answer
How many people older than 18 years, including yourself, live in your household	Number of people _ _ 88 = Refused 99 = Missing answer

OTHER MEASURES	
Do you currently smoke tobacco products **daily**?	1 = yes 2 = No 8 = Refuse 9 = Missing answer
During the past 12 months **how frequently** have you had at least one alcoholic drink?	1 =Daily 2 = 5-6 days per week 3 = 1-4 days per week 4 = 1-3 days per month 5 = Less than once a months 88 = Refuse 99 = Missing answer
Your height is?	In centimetres (cm) _ _ _ 888 = Refuse 999 = Missing answer
Your weight is?	In kilograms (kg) _ _ _ 888 = Refuse 999 = Missing answer
Have you been diagnosed with other diseases?	1 = Heart diseases 2 = Cerebrovascular disease 3 = Dementia 4 = Chronic pulmonary disease, incl. COPD 5 = Connective tissue disease or rheumatic disease 6 = Ulcer disease 7 = Liver disease 8 = Diabetes 9 = Hemiplegia 10 = Renal disease 11 = Cancer 12 = AIDS 13 = Other 88 = Refuse 99 = Missing answer
Do you receive support from social services?	1 = Home help 2. Accommodations and Housing

	3. Adapting Your Home 4 = Meals 5 = Telecare 6 = Other 9 = Missing answer
Are you familiar with using a personal computer (PC)?	1 = yes 2 = No 8 = Refuse 9 = Missing answer
Are you familiar with using a mobile telephone?	1 = yes 2 = No 8 = Refuse 9 = Missing answer

SF 36 Quality of Life Questionnaire

SF-36 can be self-administered, or administered by an interviewer. The following questions are answered by selection of a single choice:

Reporting

When reporting the results, the following should be included in the description.

- How the study was done:
  - The research method (e.g. mailed questionnaire survey, in person)
  - The sample selection and data collection incl.:
- Identification of potential subjects
- How many and what type of attempts were made to contact subjects
- Who approached potential subjects
- Where were potential subjects approached
- How was informed consent obtained
- How many agreed to participate
- How did those who agreed differ from those who did not agree
- What was the response rate

Analysis

Analysis will be conducted using the QualityMetrics Scoring Software. A licence will be purchased for 1 desktop. A template will be sent to all sites to complete for each end user. At the end of the monitoring period, results will be collected for analysis individually per pilot and across all pilots.

Each The QM Certified Scoring (Software) is provided via email, **installed on a single desktop**, and activated with a key supplied by QualityMetric. Data can be imported via a .CSV file, entered through a data grid, or obtained by allowing patients to complete the survey on-screen. Once data is entered, a variety of comprehensive reports can be obtained.

1. In general, would you say your health is:

    1. Excellent

    2. Very Good

    3. Good

    4. Fair

    5. Poor

2. Compared to one year ago, how would you rate your health in general now?

    1. Much better now than one year ago

2. Somewhat better now than one year ago

3. About the same as one year ago

4. Somewhat worse now than one year ago

5. Much worse than one year ago

3. Does your health now limit you in this activity? If so, how much?Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports.

1. Yes, limited a lot

2. Yes, limited a little

3. No, not limited at all

4. Does your health now limit you in this activity? If so, how much?Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling or playing golf.

1. Yes, limited a lot

2. Yes, limited a little

3. No, not limited at all

5. Does your health now limit you in this activity? If so, how much?Lifting or carrying groceries.

1. Yes, limited a lot

2. Yes, limited a little

3. No, not limited at all

6. Does your health now limit you in this activity? If so, how much?Climbing several flights of stairs.

1. Yes, limited a lot

2. Yes, limited a little

3. No, not limited at all

7. Does your health now limit you in this activity? If so, how much?Climbing one flight of stairs.

1. Yes, limited a lot

2. Yes, limited a little

8. Does your health now limit you in this activity? If so, how much? Bending, kneeling, or stooping.

1. Yes, limited a lot

2. Yes, limited a little

3. No, not limited at all

9. Does your health now limit you in this activity? If so, how much?Walking more than a mile.

1. Yes, limited a lot

2. Yes, limited a little

3. No, not limited at all

10. Does your health now limit you in this activity? If so, how much?Walking several blocks.

1. Yes, limited a lot

2. Yes, limited a little

3. No, not limited at all

11. Does your health now limit you in this activity? If so, how much?Walking one block.

1. Yes, limited a lot

2. Yes, limited a little

3. No, not limited at all

12. Does your health now limit you in this activity? If so, how much?Bathing or dressing yourself.

1. Yes, limited a lot

2. Yes, limited a little

3. No, not limited at all

13. During the past 4 weeks, have you had the following problem with your work or other regular daily activities as a result of your physical health? Cut down the amount of time you spent on work or other activities.

1. Yes

2. No

14. During the past 4 weeks, have you had the following problem with your work or other regular daily activities as a result of your physical health? Accomplished less than you would like.

1. Yes

2. No

15. During the past 4 weeks, have you had the following problem with your work or other regular daily activities as a result of your physical health? Were limited in the kind of work or other activities.

1. Yes

2. No

16. During the past 4 weeks, have you had the following problem with your work or other regular daily activities as a result of your physical health? Had difficulty performing the work or other activities (for example, it took extra effort).

1. Yes

2. No

17. During the past 4 weeks, have you had the following problem with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)? Cut down the amount of time you spent on work or other activities.

1. Yes

2. No

18. During the past 4 weeks, have you had the following problem with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)? Accomplished less than you would like.

1. Yes

2. No

19. During the past 4 weeks, have you had the following problem with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)? Didn't do work or other activities as carefully as usual.

1. Yes

2. No

20. During the past 4 weeks, to what extent has your physical health OR emotional problems interfered with your normal social activities with family, friends, neighbours, or groups?

1. Not at all

2. Slightly

3. Moderately

4. Quite a bit

5. Extremely

21. How much bodily pain have you had during the past 4 weeks?

1. None

2. Very mild

3. Mild

4. Moderate

5. Severe

6. Very severe

22. During the past 4 weeks how much did pain interfere with your normal work (including both work outside the home and housework)?

1. Not at all

2. A little bit

3. Moderately

4. Quite a bit

5. Extremely

23. How much of the time during the past 4 weeks: Did you feel full of pep?

1. All of the time

2. Most of the time

3. A good bit of the time

4. Some of the time

5. A little of the time

6. None of the time

24. How much of the time during the past 4 weeks: Have you been a very nervous person?

1. All of the time

2. Most of the time

3. A good bit of the time

4. Some of the time

5. A little of the time

6. None of the time

25. How much of the time during the past 4 weeks: Have you felt so down in the dumps that nothing could cheer you up?

1. All of the time

2. Most of the time

3. A good bit of the time

4. Some of the time

5. A little of the time

6. None of the time

26. How much of the time during the past 4 weeks: Have you felt calm and peaceful?

1. All of the time

2. Most of the time

3. A good bit of the time

4. Some of the time

5. A little of the time

6. None of the time

27. How much of the time during the past 4 weeks: Did you have a lot of energy?

1. All of the time

2. Most of the time

3. A good bit of the time

4. Some of the time

5. A little of the time

6. None of the time

28. How much of the time during the past 4 weeks: Have you felt downhearted and blue?

1. All of the time

2. Most of the time

3. A good bit of the time

4. Some of the time

5. A little of the time

6. None of the time

29. How much of the time during the past 4 weeks: Did you feel worn out?

1. All of the time

2. Most of the time

3. A good bit of the time

4. Some of the time

5. A little of the time

6. None of the time

30. How much of the time during the past 4 weeks: Have you been a happy person?

1. All of the time

2. Most of the time

3. A good bit of the time

4. Some of the time

5. A little of the time

6. None of the time

31. How much of the time during the past 4 weeks: Did you feel tired?

1. All of the time

2. Most of the time

3. A good bit of the time

4. Some of the time

5. A little of the time

6. None of the time

32. During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting with friends or relatives)

1. All of the time

2. Most of the time

3. Some of the time

4. A little of the time

5. None of the time

33. How true or false is the following statement? I seem to get sick a little easier than other people.

1. Definitely true
2. Mostly true
3. Don't know
4. Mostly false
5. Definitely false

34. How true or false is the following statement? I am as healthy as anybody I know.

1. Definitely true
2. Mostly true
3. Don't know
4. Mostly false
5. Definitely false

35. How true or false is the following statement? I expect my health to get worse.

1. Definitely true
2. Mostly true
3. Don't know
4. Mostly false
5. Definitely false

36. How true or false is the following statement? My health is excellent.

1. Definitely true
2. Mostly true
3. Don't know
4. Mostly false
5. Definitely

Patient Perception Questionnaire - Service User Technology Acceptability Questionnaire (SUTAQ)

Reporting

When reporting the results, the following should be included in the description.

- How the study was done:
  - The research method (e.g. mailed questionnaire survey, in person)
  - The sample selection and data collection incl.:
- Identification of potential subjects
- How many and what type of attempts were made to contact subjects
- Who approached potential subjects
- Where were potential subjects approached
- How was informed consent obtained
- How many agreed to participate
- How did those who agreed differ from those who did not agree
- What was the response rate

Analysis

Responses to the questions are measured using a 5 point Likert Scale. The wording of the 22 items (statements) in the Likert scale questionnaire are both positive and negative and this reduces the risk of bias.

The responses can be grouped into subscales. The following describes those subscales and the questions which relate to each.

- Enhanced care (based on questions: 17, 15, 10, 11, 13)
- Increased accessibility (based on questions: 1, 3, 4, 19)
- Privacy and discomfort scale (based on questions 5, 2, 8, 12)
- Care personnel concerns (based on questions: 9, 21, 20)
- Kit as substitution (based on questions: 18, 22, 16)
- Satisfaction (based on questions: 7, 6, 14)

Based on the estimated subscales a table similar to the table below should be produced for each pilot (SD is standard deviation).

Subscale	End of Monitoring Period
Enhanced care	Mean (SD)
Increased accessibility	Mean (SD)
Privacy and discomfort	Mean (SD)
Care personal concerns	Mean (SD)
Kit as substitution	Mean (SD)
Satisfaction	Mean (SD)

1. The kit I received has saved me time in that I did not have to visit my GP clinic or other health/social care professional as often.

1 = strongly disagree

2 = disagree

3 = undecided

4 = agree

5 = strongly agree

2. The kit I received has interfered with my everyday routine.

1 = strongly disagree

2 = disagree

3 = undecided

4 = agree

5 = strongly agree

3. The kit I received has increased my access to care (health and/or social care professionals).

1 = strongly disagree

2 = disagree

3 = undecided

4 = agree

5 = strongly agree

4. The kit I received has helped me to improve my health.

1 = strongly disagree

2 = disagree

3 = undecided

4 = agree

5 = strongly agree

5. The kit I received has invaded my privacy.

1 = strongly disagree

2 = disagree

3 = undecided

4 = agree

5 = strongly agree

6. The kit has been explained to me sufficiently.

1 = strongly disagree

2 = disagree

3 = undecided

4 = agree

5 = strongly agree

7. The kit can be trusted to work appropriately.

1 = strongly disagree

2 = disagree

3 = undecided

4 = agree

5 = strongly agree

8. The kit has made me feel uncomfortable, e.g. physically or emotionally.

1 = strongly disagree

2 = disagree

3 = undecided

4 = agree

5 = strongly agree

9. I am concerned about the level of expertise of the individuals who monitor my status via the kit.

1 = strongly disagree

2 = disagree

3 = undecided

4 = agree

5 = strongly agree

10. The kit has allowed me to be less concerned about my health and/or social care.

1 = strongly disagree

2 = disagree

3 = undecided

4 = agree

5 = strongly agree

11. The kit has made me more actively involved in my health.

1 = strongly disagree

2 = disagree

3 = undecided

4 = agree

5 = strongly agree

12. The kit makes me worried about the confidentiality of the private information being exchanged through it.

13. The kit allows the people looking after me, to better monitor me and my condition.

1 = strongly disagree

2 = disagree

3 = undecided

4 = agree

5 = strongly agree

14. I am satisfied with the kit I received.

1 = strongly disagree

2 = disagree

3 = undecided

4 = agree

5 = strongly agree

15. The kit can be/should be recommended to people in a similar condition to mine.

1 = strongly disagree

2 = disagree

3 = undecided

4 = agree

5 = strongly agree

16. The kit can be a replacement for my regular health or social care.

1 = strongly disagree

2 = disagree

3 = undecided

4 = agree

5 = strongly agree

17. The kit can certainly be a good addition to my regular health or social care.

1 = strongly disagree

2 = disagree

3 = undecided

4 = agree

5 = strongly agree

18. The kit is not as suitable as regular face to face consultations with the people looking after me.

1 = strongly disagree

2 = disagree

3 = undecided

4 = agree

5 = strongly agree

19. The kit has made it easier to get in touch with health and social care professionals.

1 = strongly disagree

2 = disagree

3 = undecided

4 = agree

5 = strongly agree

20. The kit interferes with the continuity of the care I receive (i.e. I do not see the same care professional each time).

1 = strongly disagree

2 = disagree

3 = undecided

4 = agree

5 = strongly agree

21. I am concerned that the person who monitors my status, through the kit, does not know my personal health/social care history.

1 = strongly disagree

2 = disagree

3 = undecided

4 = agree

5 = strongly agree

22. The kit has allowed me to be less concerned about my health status.

1 = strongly disagree

2 = disagree

3 = undecided

4 = agree

5 = strongly agree

Professional Perception Questionnaire

Reporting

When reporting the results, the following should be included in the description.

- How the study was done:
    - The research method (e.g. mailed questionnaire survey, in person)
    - The sample selection and data collection incl.:
- Identification of potential subjects
- How many and what type of attempts were made to contact subjects
- Who approached potential subjects
- Where were potential subjects approached
- How was informed consent obtained
- How many agreed to participate
- How did those who agreed differ from those who did not agree
- What was the response rate

Analysis

A summary of responses to each question should be presented. Percentage of yes / no / a little should be produced. Please include quotes where pertinent.

Questions – Integrated Service	End of Monitoring Period
1,2,4,5,6,7,8,9,10,11,12	% of yes / no / a little Written summary of answers Quotes

Questions – Integrated Technology	End of Monitoring Period
1,5,7,8,9,10,11	% of yes / no / a little Written summary of answers Quotes

The mean and SD should be reported for questions:

Questions – Integrated Service	End of Monitoring Period
3, 13	Mean (SD)

Questions – Integrated Technology	End of Monitoring Period
2,3,4,6,11,12	Mean (SD)

Integrated Service Questionnaire

1. Can you describe your experience with using the INTEGRATED service?

2. What benefits have you found using the integrated service?

    a. What has worked well

3. How would you describe the usability of the INTEGRATED service for you?

Very Poor	Poor	Average	Very Good	Excellent
1	2	3	4	5

4. Has the use of the INTEGRATED service had any effect on your use of time?

    Yes – Please explain
    No
    A little

5. Has the use of the INTEGRATED service had any effects on your tasks?

    Yes – Please explain
    No
    A little

6. Has the use of the INTEGRATED service had any effects on the communication within your own organisation?

    Yes – Please explain
    No
    A little

7. Has the use of the INTEGRATED service had effects on the communication between health and social organisations

    Yes – Please explain
    No
    A little

8. Have you experienced challenges in your collaboration with other professional groups in relation to the INTEGRATED service?

    Yes – Please explain
    No
    A little

9. Have you experienced challenges in your collaboration with the staff at the other organisations in relation to the INTEGRATED service?

    Yes – Please explain
    No
    A little

10. Do you have suggestions on how to overcome some of the challenges?

11. What suggestions do you have to improve the service?

12. Would you like to continue to use the INTEGRATED service?

    Yes
    No
    Other

13. How would you describe your overall satisfaction with the use of the integrated service?

Very Unsatisfied	Unsatisfied	Average	Satisfied	Very Satisfied
1	2	3	4	5

Integrated Technology

1. Can you describe your experience with using the technology?

2. What experience did you have with telecare / telehealth technology prior to the project?

   Telehealth

Used in a lot	Have used it a little	Have seen it used but not used yourself	Had heard about it but not used	Had not heard of it
1	2	3	4	5

   Telecare

Used in a lot	Have used it a little	Have seen it used but not used yourself	Had heard about it but not used	Had not heard of it
1	2	3	4	5

3. Did the technology provide you will the information you required to manage the end users/patients?

Strongly Disagree	Disagree	No Opinion	Agree	Strongly
1	2	3	4	5

4. How safe do you feel monitoring the end users / patients using the technology

Not at all safe	Somewhat safe	No Opinion	Safe	Very Safe
1	2	3	4	5

5. What benefits have you found using the technology? – Please describe

6. How would you describe the usability of the technology for you?

Very Poor	Poor	Average	Very Good	Excellent
1	2	3	4	5

7. Have you experienced technical challenges which may affect the quality of care delivered by the integrated service?

8. Do you have suggestions on how to overcome some of the challenges?

9. What suggestions do you have to improve the technology?

10. Would you like to continue to use the technology?

11. How would you rate the quality of the support you have received using the equipment?

Very Satisfied	Satisfied	Average	Somewhat Unsatisfied	Very Unsatisfied
1	2	3	4	5

12. How would you describe your overall satisfaction with the using the technology?

Very Unsatisfied	Somewhat Unsatisfied	Average	Satisfied	Very Satisfied
1	2	3	4	5

G8 Frail Scale

INSERM use G8 Frail Scale to assess patients fraility as the Edmonton Frail scale is not validated in French. The G8 scale includes 8 items about health condition and age of patients. A patient is considered frail if the score is lower than 14 over 17. All patients who participated in the study were frail patients.

	Items	**Score**
A	Le patient présente-t-il une perte d'appétit ? A-t-il mangé moins ces 3 derniers mois par manque d'appétit, problèmes digestifs, difficultés de mastication ou de déglutition ?	0 : anorexie sévère 1 : anorexie modérée 2 : pas d'anorexie
B	Perte récente de poids (< 3 mois)	0 : perte de poids > 3 kg 1 : ne sait pas 2 : perte de poids entre 1 et 3 kg 3 : pas de perte de poids
C	Motricité	0 : du lit au fauteuil 1 : autonome à l'intérieur 2 : sort du domicile
E	Problèmes neuropsychologiques	0 : démence ou dépression sévère 1 : démence ou dépression modérée 2 : pas de problème
F	Indice de masse corporelle	0 : IMC < 18,5 1 : 18,5 < IMC ≤ 21 2 : 21 < IMC < 23 3 : IMC ≥ 23
H	Le patient prend plus de 3 médicaments	0 : oui 1 : non
P	Le patient se sent-il en meilleure ou moins bonne santé que la plupart des personnes de son âge ?	0 : moins bonne 1 : ne sait pas 2 : aussi bonne 3 : meilleure
	Age	0 : > 85 ans

		1 : entre 80 et 85 ans 2 : < 80 ans
	SCORE TOTAL	**0 – 17**

The mean score is 9.86 and the standard deviation is 2.61.

Clinical Baseline Characteristics

The following form is used to collect data on clinical baseline characteristics which include information about the disease, the treatment and the health history. These data are collected on a paper form at the end of the study for each patient using the medical record. Data are then reported on an electronic database.

Primary Tumor (PT):

Date of 1st diagnosis: |__|__| |__|__| |__|__|__|__| Site of PT*: |__|
DD MM YYYY

Histological type: ……;

Date of 1st Metastasis: |__|__| |__|__| |__|__|__|__| Site*: |__|
DD MM YYYY

<u>Treatment before inCASA study</u>:

Prior adjuvant chemotherapy: ❑ Yes ❑ No

Prior radiotherapy: ❑ Yes ❑ No

Prior chemotherapy (CT) for Metastasis: ❑ Yes ❑ No

If yes, starts date of the 1st course: |__|__| |__|__| |__|__|__|__|
DD MM YYYY

End date of the last course: |__|__| |__|__| |__|__|__|__|
DD MM YYYY

Number of prior chemotherapy lines: |_____|

Type of chemotherapy received before inCASA study:❑ Chrono ❑Flat ❑ No CT

Drugs given: ……

Prior surgery of primary tumor: ❑ Yes ❑ No. If yes, date: |__|__| |__|__| |__|__|__|__|
DD MM YYYY

Prior surgery of metastasis: ❑ Yes ❑ No. If yes, date: |__|__| |__|__| |__|__|__|__| Site*: |__|
DD MM YYYY

Clinical symptoms (Grade) at inclusion: (according to NCI CTCAE v. 3.0)

Nausea	Vomiting	Sensory neuropathy	Anorexia	Fatigue	Diarrhea	Constipation	Pain
|___|	|___|	|___|	|___|	|___|	|___|	|___|	|___|

* 1 = Colon ; 2 = Rectum ; 3 = Liver ; 4 = Bones ; 5 = Lymphnode ; 6 = Peritonium ; 7 = Skin ; 8 = Brain ; 9 = Pelvis ; 10 = Other ; 99 = Missing answer

Treatment during inCASA study:

Chemotherapy (CT):

Cycle: |__|

CT protocol: |_____|; Chronomodulated: ❑ Yes ❑ No.

Targeted agent: ❑ Yes ❑ No. If Yes, specify: ……..

Drugs given: ……

Date of course: Beginning: |__|__| |__|__| |__|__|__|__| (DD MM YYYY) End: |__|__| |__|__| |__|__|__|__| (DD MM YYYY)

Where: ❑ Hospital; ❑ Home

Toxicity: Date of assessment: |__|__| |__|__| |__|__|__|__| (DD MM YYYY)

Grades according to NCI CTCAE v. 3.0:

Hemoglobin	Leucocytes	Neutrophils	Platelets	Nausea	Vomiting	Diarrhea
|___|	|___|	|___|	|___|	|___|	|___|	|___|
Mucositis	Skin	Fatigue	Motor neuropathy	Sensory neuopathy	Anorexia	
|___|	|___|	|___|	|___|	|___|	|___|	