Learning from integrated eCare practice and promoting deployment in European regions

BeyondSilos

# D3.2 THE BEYONDSILOS SERVICE SPECIFICATION

## WP3 Integration infrastructure and service specification

Version 1.0 / 14th January 2015

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# Document information

**Organisation responsible**

TSB

**Authors**

Naranjo Martínez, Juan-Carlos (TSB)

Valero Ramón, Zoe (TSB)

**Contributing partners**

Piera Jimenez, Jordi (BSA)

Melle, Christian (Gesundes Kinzigtal)

Hobson, Penny (HSCNI)

Kouzmanov, Yanko (CPRH Sofia)

Fernandes, Adriano (Misericordia - Amadora)

Iaccarino, Guido (Campania)

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None

**Filename**

D3.2 v1.0 BeyondSilos Service specification

**Statement of originality**

This deliverable contains original unpublished work except where clearly indicated otherwise. Acknowledgement of previously published material and of the work of others has been made through appropriate citation, quotation or both.

# Executive summary

The aim of the BeyondSilos project is to develop and pilot integrated care services with the help of suitable ICT systems. These services are based on care generic pathways cutting across boundaries which typically separate health from social care. In this case, BeyondSilos will achieve what has frequently been called “horizontal integration” of care delivery, defining and implementing two integrated care pathways that support the provision of integrated care delivery.

Partners at each of the seven pilot sites have the freedom to choose their own ICT infrastructure, reflecting the fact that each pilot site is, to a greater or lesser degree, already working with their own IT systems in place. But this infrastructure has to comply with the BeyondSilos architecture to ensure the correct delivery of integrated care.

The document describes in detail the final BeyondSilos architecture. Each pilot site has made a complete analysis of its infrastructure in order to adapt it to BeyondSilos specifications. This analysis includes a detailed description of the current IT system implemented, mapping them with the BeyondSilos common architecture; this has included an identification of the building blocks implemented and integrated in the pilot site, and as a consequence identified the missing modules and the intention to incorporate some of them into the current pilot sites infrastructure.

The result of this work is the final version of the BeyondSilos integration infrastructure architecture presented in this deliverable, and the current situation of each pilot site regarding IT system integration, together with their intentions as to the way forward in the provision of a better integrated care, incorporating new building blocks and functionalities into their systems.

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# 1 Introduction

## 1.1 Purpose of this document

This document provides the final specification for the BeyondSilos Service, with a final version of the BeyondSilos Architecture and the service specification for the defined pathways in WP1 and services process models of WP2.

The document builds on the previous deliverable D3.1 Pilot Service Specification and its main results, the draft of the BeyondSilos common architecture, and analyses pilot sites' infrastructure in depth. This document concludes the second iteration of WP3, closing the work to be done within WP3.

## 1.2 Background: BeyondSilos: Infrastructure Architecture and Service Specification

The aim of the BeyondSilos project is to develop and pilot integrated care services delivered with the help of suitable ICT systems. These services are to be based on two care pathways cutting across the boundaries which typically separate healthcare from social care. Such boundaries can be defined at both level of service provision and technology.

Delivery of integrated care has to be supported by ICT tools necessary to join up care pathways across participating organisations, from social and health dimensions. The second iteration of WP3 is dedicated to specify the final version of the ICT infrastructure, BeyondSilos architecture, supporting pathways and organisational models developed within the project (WP1 and WP2). There is considerable diversity across the individual BeyondSilos pilot sites when it comes to existing ICT-infrastructure to build on for the service integration, due their cultural and organisational characteristics.

Although all pilot sites have the freedom to choose their own ICT infrastructure, this has to be compliant with the BeyondSilos architecture. An overview of the work done by each pilot site to comply with the architecture, and at a high level to support integrated services and high level care integrated pathways, is given in this deliverable.

## 1.3 Structure of document

The deliverable begins with a revision of the pathways and services from WP1 and WP2, in order to incorporate possible changes and updates to the architecture and service specification. A dedicated section (Section 3) presents the final version of the BeyondSilos architecture, including new building blocks to satisfy new requirements, and a complete description of all building blocks included in the architecture. Section 4 includes a technical analysis for each of the seven pilot sites. This technical analysis reports the current pilot site ICT, the pilot site mapping with the BeyondSilos common architecture, finding what building blocks are implemented in each pilot, and a gap analysis, with the identification of the missing modules and the ones the pilot wants to incorporate into its structure, to fill some of these gaps.

Finally the document incorporates two sections (5 and 6) with the next steps to be arranged and the interaction with other WPs and the corresponding conclusions.

## 1.4 Glossary

| API | Application Programming Interface |
|---|---|
| **BB** | Building Block |
| **BSA** | Badalona Serveis Assistencials |
| **CR** | Care Recipient |
| **DPD** | Data Protection Directive |
| **EC** | European Commission |
| **EH&SR** | Electronic Health & Social Record |
| **EMR** | Electronic Medical Record |
| **EU** | European Union |
| **GP** | General Practitioner |
| **GPS** | Global Positioning System |
| **HIS** | Hospital Information System |
| **HSC** | Health and Social Care |
| **HSCNI** | Health and Social Care North Ireland |
| **I/FC** | Informal/Formal Carer |
| **ICP** | Integrated Care Pathway |
| **ICT** | Information and Communication Technologies |
| **IT** | Information Technology |
| **MI** | Myocardial Infarction |
| **NIECR** | Northern Ireland Electronic Care Record |
| **REST** | Representational State Transfer |
| **SCMA** | Santa Casa Misericórdia Amadora |
| **TNI** | Telemonitoring NI |
| **UK** | United Kingdom |
| **WP** | Work Package |

# 2 Point of departure: Revision

## 2.1 Introduction

The BeyondSilos architecture was considered in the previous document (D3.1 Pilot Service Specification) to be shaped by previous experiences and approaches; these were:

- A set of previous projects implementing infrastructures supporting integrated care: CommonWell[1], INDEPENDENT[2] and SmartCare[3] projects.
- Literature and BeyondSilos pathways and processes.
- Different pilot site implementations and current ICT.

The results of this work was the draft BeyondSilos common architecture, an architecture following a building blocks scheme in a modular manner; these set of building blocks support services which in turn support defined processes and pathways as shown in Figure 1 below.

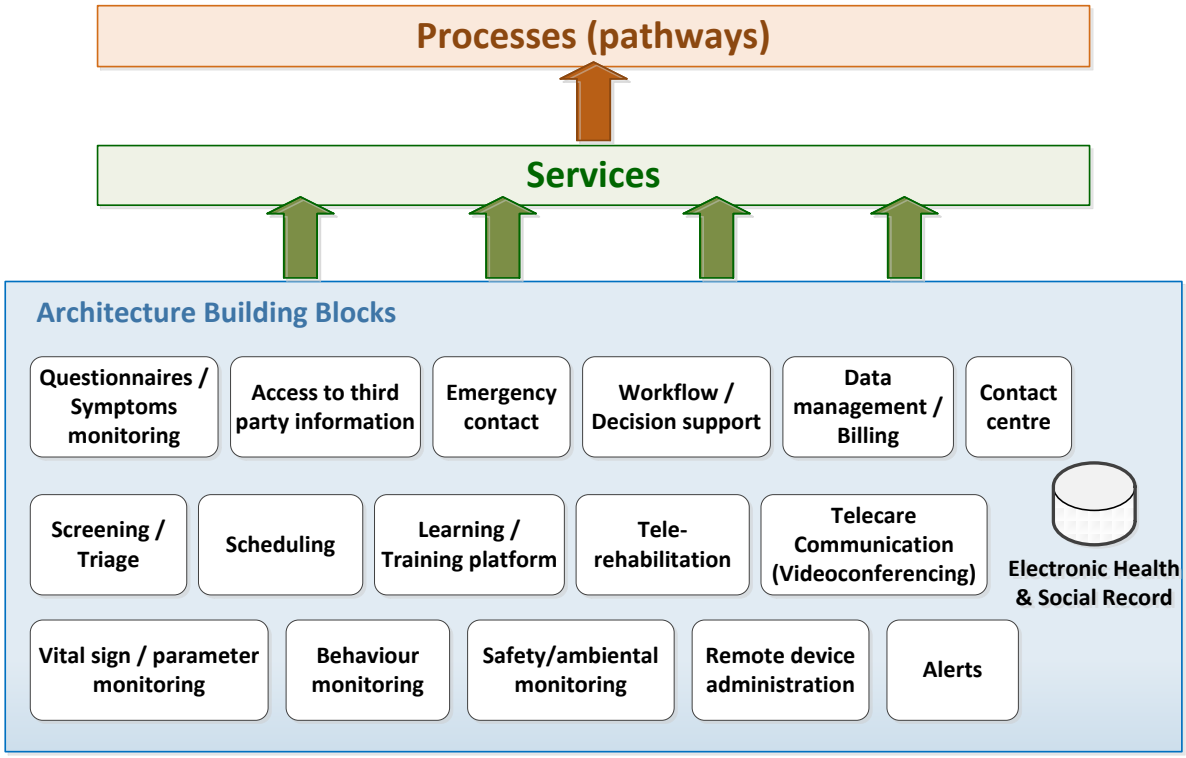


**Figure 1: BeyondSilos draft infrastructure architecture**

This first version of the BeyondSilos architecture is the point of departure for the current document. This architecture needs a revision process before specifying the building block, in order to ensure the final version of the architecture meets the new requirements defined in WP1 for the generic pathways guiding integrated care delivery within BeyondSilos, and new possible needs identified during the deep analysis done by pilot sites.

1 http://commonwell.eu/norm/commonwell-home/
2 http://independent-project.eu/home/
3 http://pilotsmartcare.eu/home/

## 2.2 BeyondSilos Pathways and Processes

Two services were identified in WP1 which hold the potential to deliver significant benefits through better joined-up delivery. These services were presented and briefly explained, for architecture purpose, in deliverable D3.1, but these services and the processes they support underwent modifications during implementation. For that reason, new and final versions of the two generic pathways for integrated care delivery within BeyondSilos are presented below, with their implications for the common architecture.

**Integrated Short-term Home Care Support (Pathway #1 – ICP short)**

This pathway is designed to support people who have experienced a significant "event", such as a stroke, MI, fractured neck of femur, or other injuries and illnesses which impact adversely on the person's ability to live independently. The activities in the pathway focus on delivering time-limited interventions, services, care and support such as rehabilitation, reablement, structured patient education programmes, followed by discharge back to "usual" care, or else moved on to pathway#2. The final version of the BeyondSilos common architecture has to assure the inclusion of this pathway.

**Integrated Long-term Home Care Support (Pathway #2 – ICP LTCare)**

This pathway is designed to support people living with complex needs whose joint care assessment indicates that ongoing health and social care services and wellbeing assistance is required, delivered and/or funded by public sector and/or third sector organisations. As and when the individual experiences an "event" which impacts adversely on their health and wellbeing, the interventions, services, care and support to maintain the person living in their own home will be reviewed and adjusted temporarily. The final version of the BeyondSilos common architecture has to assure the inclusion of this pathway.

Figure 2 and Figure 3 below present graphically the final versions of the two generic pathways for integrated care delivery within BeyondSilos. They are presented as a number of generic steps to be performed when the service is delivered.

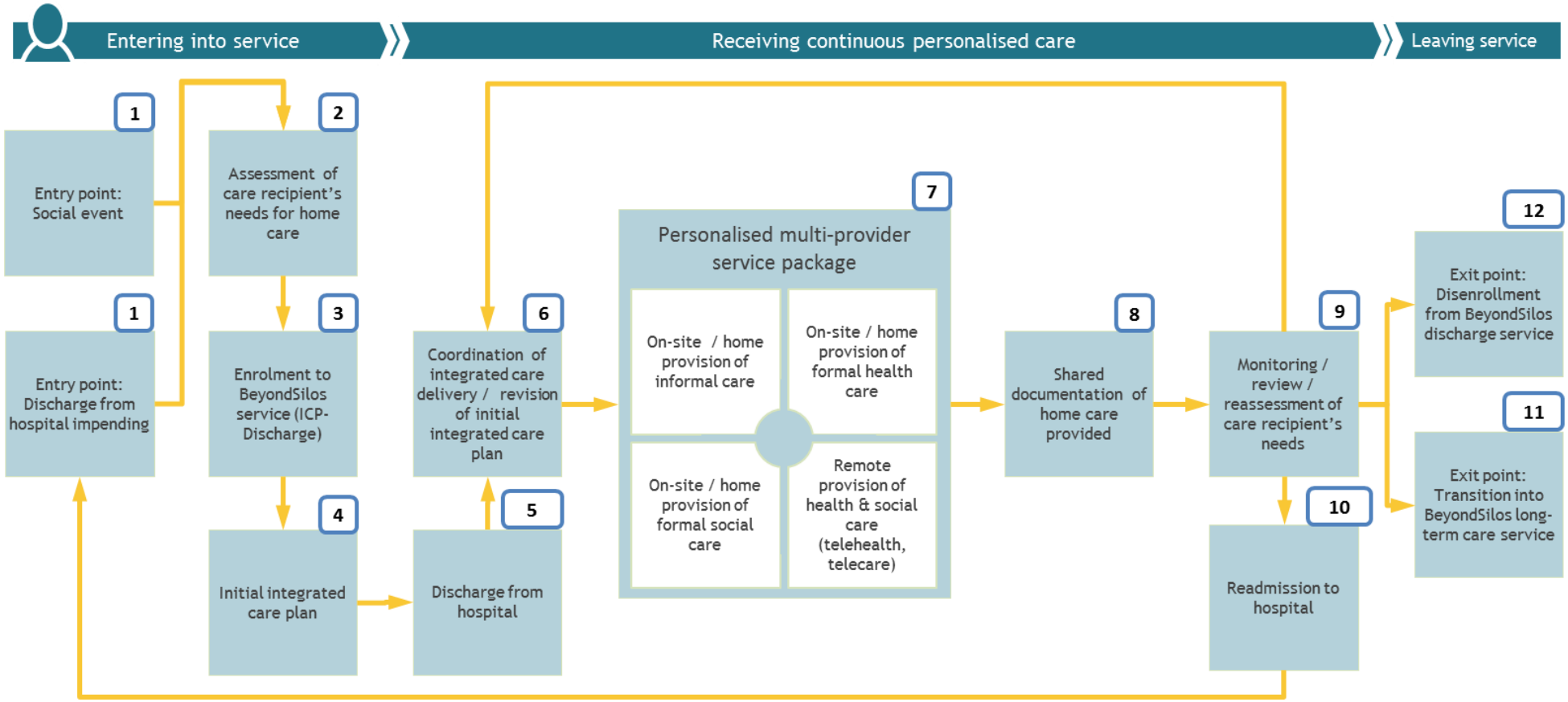


**Figure 2: Integrated Short-term Home Care Support (Pathway #1 – ICP short)**

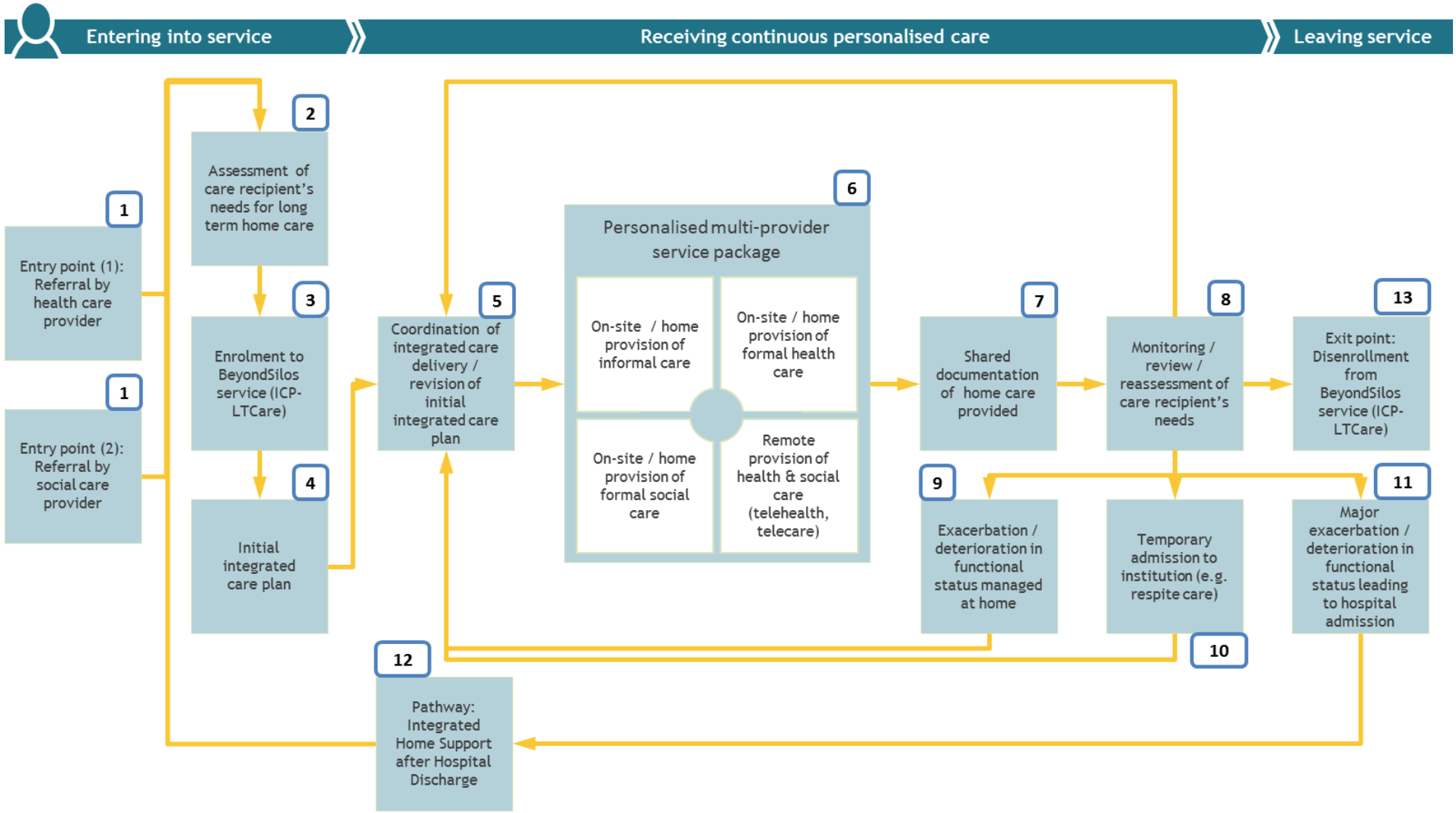


**Figure 3: Integrated Long-term Home Care Support (Pathway #2 – ICP LTCare)**

# 3 Architecture specification

As noted in the previous section, the BeyondSilos architecture has been reviewed in order to include new requirements detected during the deep analysis of pilot site processes carried out to prepare the final generic pathways defined in WP1 and WP2.

The result of this analysis has been the identification of two new building blocks to be included in the common architecture:

- **Predictive Modelling**: ICT tool to predict patient health needs through actionable data of patients living with complex illness conditions, in order to intervene before adverse health events occur.
- **Personal Data Protection**: ICT component that supports personal data management in an efficient and safe manner according to each country's laws.

With the inclusion of these two new building blocks, the final version of the BeyondSilos common architecture is shown in Figure 4 below.

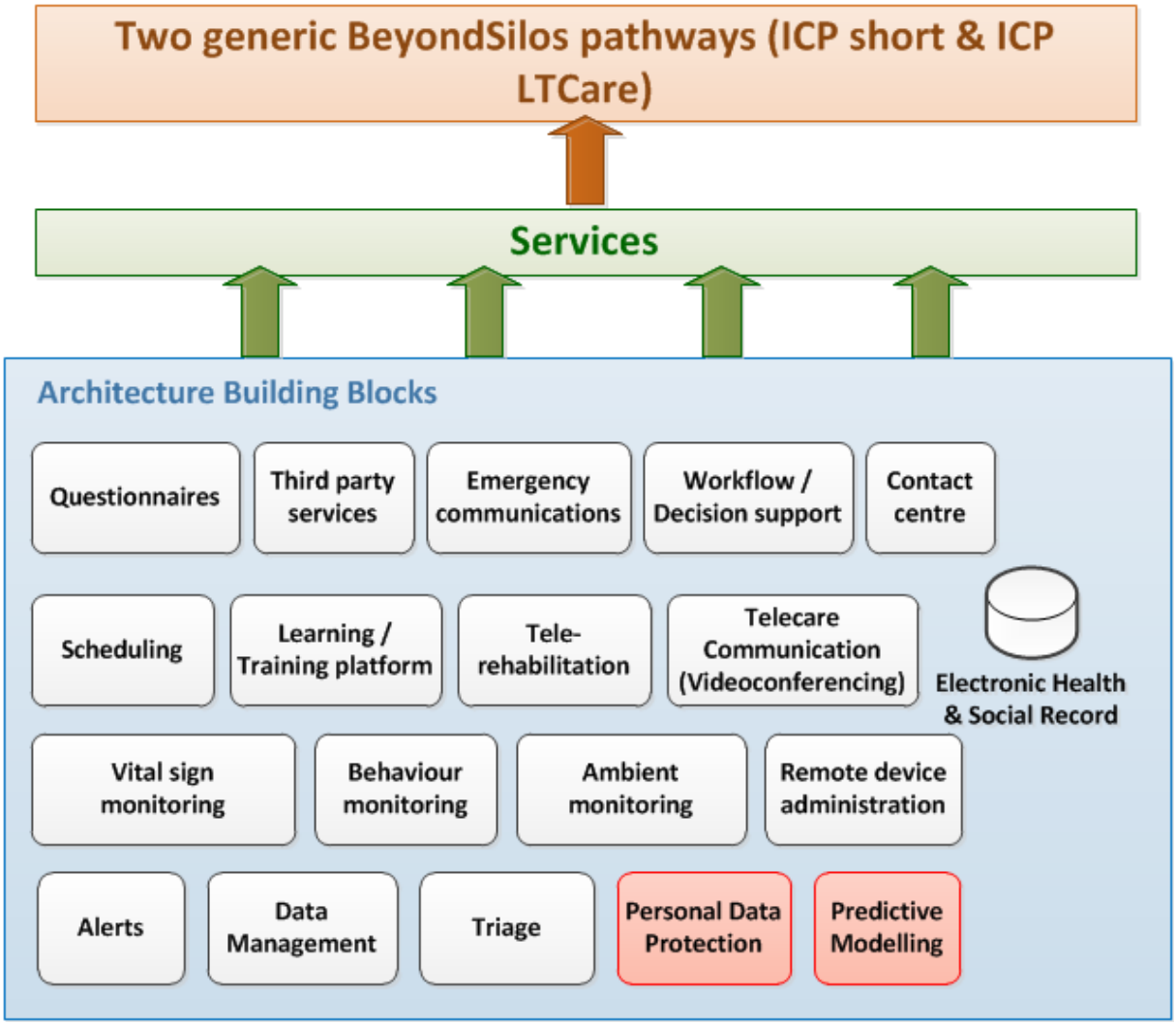


**Figure 4: BeyondSilos final common architecture**

The two generic pathways that guide integrated care delivery are described as a sequence of steps to be performed when the service is delivered making use of one or more building blocks of the architecture. Figure 5 below presents the mapping between the pathway steps and the architecture building blocks, combining the information from Pathway #1 ICP short and Pathway and #2 ICP LTCare.

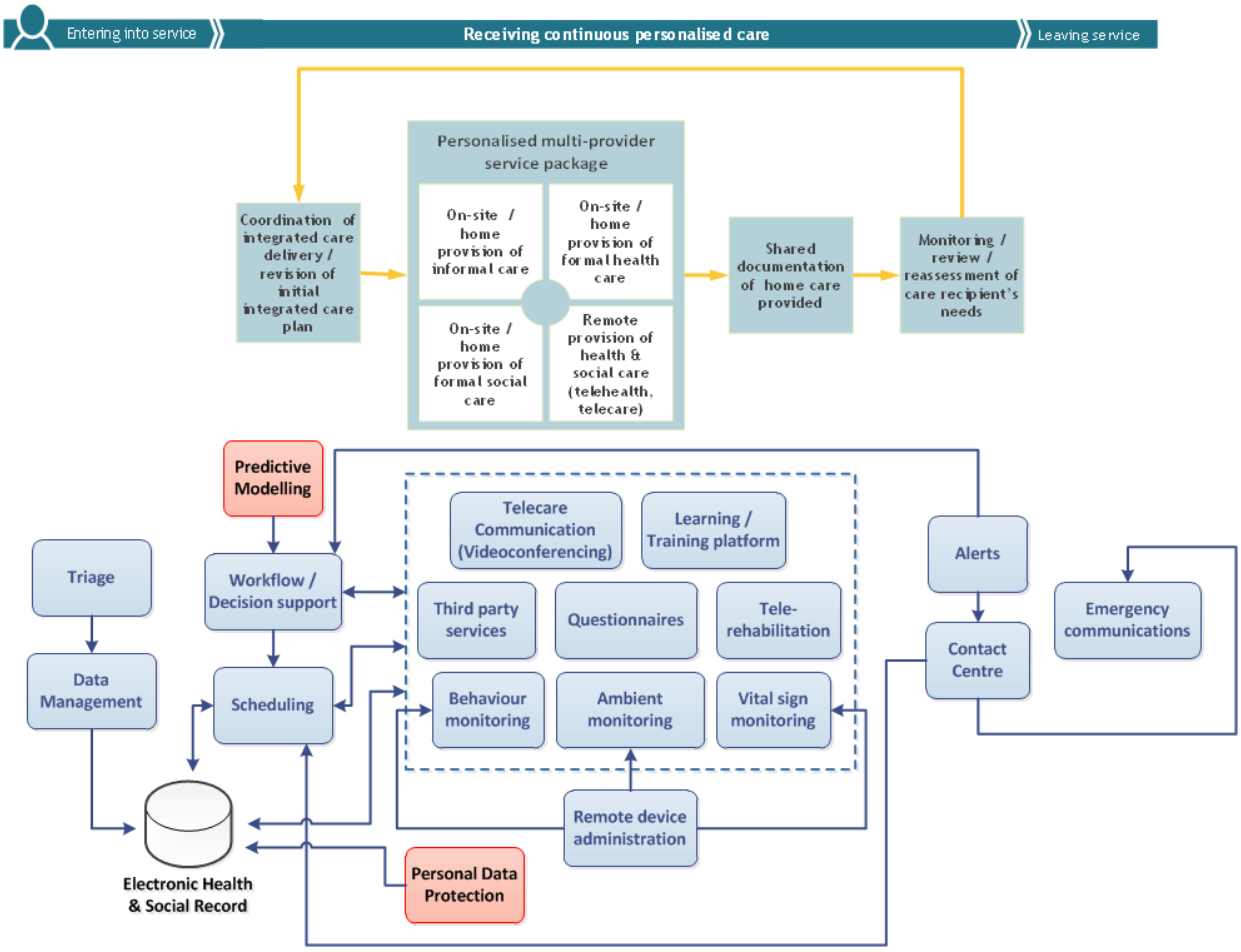


**Figure 5: Pathways architecture mapping**

The building blocks identified in Figure 5 are described in more detail in the following sections.

## 3.1 Triage building block

Triage is the process of determining the priority of patients' treatments based on the severity of their condition. It normally occurs in medical emergencies, including the pre-hospital setting and emergency room treatment, but can also be used when telephoning medical advice systems.

The triage building block is an ICT component with the following objectives:

- Make management of the needs of the patients easier.
- Integrated with the rest of the institution systems and architecture.
- Patient data management.

The health professional will evaluate the patient's condition, as well as any changes, and will determine their priority for admission to the Emergency Room and also for treatment. Normally the triage building block will have the following basic functionality:

- List of patients.
- Search and follow up of patients.
- Triage report.
- Patient form.

- Triage process: vital signs, allergies, injuries, physician in change of the patient, emergency room, etc.

The Triage building block will only interact with the Data Management building block, because once the patient is classified and identified in the emergency department, the patient will enter into the corresponding service / pathway via the standard process, if needed.

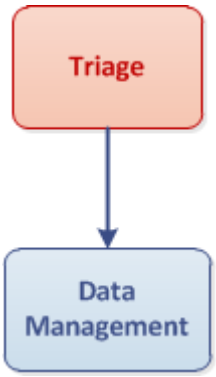


**Figure 6: Triage BB interactions**

## 3.2 Data Management building block

Data management systems are one of the core components of a health institution IT infrastructure, to provide administrative functionality to these organisations. The Data Management building block supports and manages the administrative details of patients; it also supports the management of the hospital or institution to utilise resources, such as clinical staff, rooms, beds and equipment, to provide patient care efficiently and effectively.

Key functions that are normally supported by this block include:

- Patient master index: database used across the organisation to maintain consistent and accurate demographic and essential data on the patients seen and managed within its various departments. Normally the patient is assigned a unique identifier that is used to refer this patient across the enterprise. The objective is to ensure that each patient is represented only once across all the IT systems used within the organisation. The essential data normally includes name, gender, date of birth, ethnicity, social security number, current address and contact information, insurance information, most recent date of hospital admission and discharge (if applicable), etc.
- Admission: admission and discharging management related with the hospital resources: beds, rooms, staff, etc.
- Inpatient management: includes the management of all data related with an inpatient episode, after admission.
- Outpatient management: includes management of all data related to patient discharge: patient's current state, discharge date, redirection to other services, etc.
- Emergency management: data related to emergency services needed by the patient.
- Theatre management: focused on optimising operational efficiency of the operating theatre facility: number of surgical cases, resources, costs, staff, etc.
- Waiting list management: management of the validation process which checks whether patients who are due to have outpatient or inpatient appointments still require them, and the urgency of their requirements.
- Inpatient billing: administrative management of the inpatient billing data.

- Reporting: insurance reporting when applicable.
- Compliance: record and management of all activities related to patient compliance.

The Data Management building block is responsible of managing all the above data, always maintaining the patient's privacy with data protection mechanism. This is reflected in Figure 7 below that shows the different interactions of the Data Management building block with the other blocks defined in the BeyondSilos architecture.

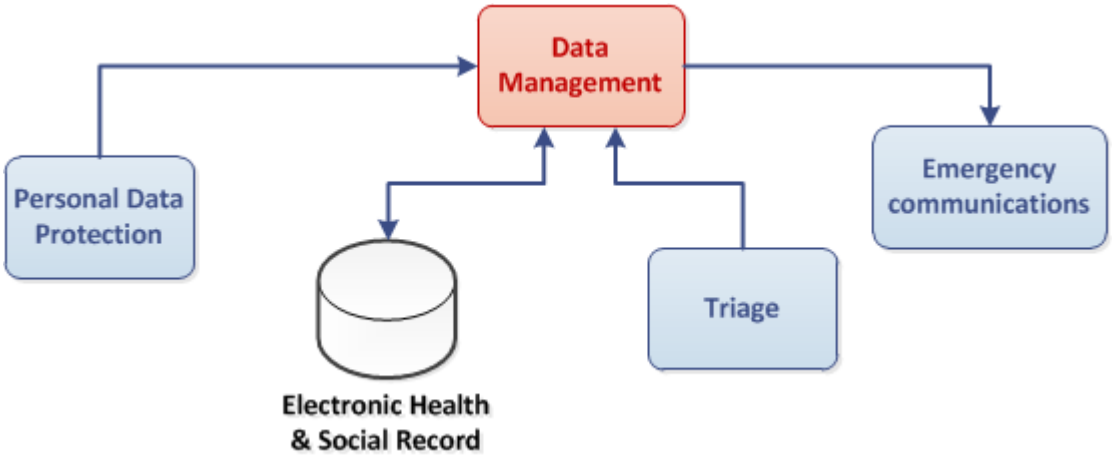


Figure 7: Data Management BB interactions

## 3.3 Workflow / Decision Support building block

A decision support system operates on the basis of a set of personalised rules. Integrated Care pathways require the presence of a workflow management service which activates different resources when needed, interacting with the resources planning services of health and social care providers. The Workflow building block provides clinicians, staff, patients or other individuals with knowledge and person-specific information, intelligently filtered or presented at appropriate times, to enhanced healthcare and social care. The main features of the block include computerised alerts and reminders to care providers and patients, clinical guidelines, condition-specific order sets, focused patient data reports and summaries, documentation templates, diagnostic support, and contextually relevant references to information, among others.

Workflow building block should be designed to assist physicians and other health and social professionals on decision making tasks in a transparent way. The decision support system assists the professional to utilize both his/her knowledge, and the decision support analysis of the patient data, making the process better than either human or decision support could make it on their own.

To assists professionals in this process of decision support, the Workflow building block has close interaction with the EH&SR building block in order to gather patient data; its results directly interact with the predictive modelling block and the scheduling of the integrated care plan, as shown in Figure 8 below.

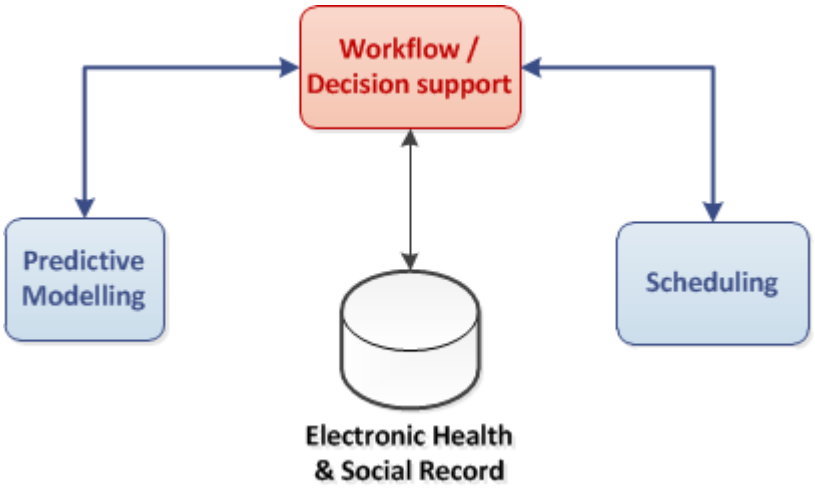


Figure 8: Workflow BB interactions

## 3.4 Scheduling building block

The Scheduling building block is an ICT tool to manage all activities related to the integrated care plan provided, from the point of view of the involved professionals, informal carers and patients; normally the Scheduling building block will be represented by two different implementations, one for professional health and social staff, and one for patients and informal carers (at home).

The scheduling module implemented for professionals will normally contain one or more of the following features:

- Calendar: a calendar showing dates and days of the week.
- Address book: a list of contacts within the organisation with information to enable the user to communicate with them.
- Appointment calendar: list of appointments and the attendees for the appointment.
- Appointment reminders: automatically reminds participants of an upcoming meeting.
- Appointment attachments: allow users to attach a file to an appointment.

The scheduling module implemented for patients will normally contain the previous features, together with ones related to their daily healthcare and social care activities:

- Medication reminder: automatically reminds patient or informal carer of medication due: type of medication, dose, special considerations, etc.
- Monitoring activities reminder: automatically reminds patient or informal carer about integrated care activities programmed: vital signs monitoring (type, device, recommended process, special considerations, etc.), questionnaires, videoconferencing, home visits, etc.

The Scheduling building block is responsible for managing all the above data; this is represented in the following figure that shows the different interactions of the Scheduling building block with the rest of block in the architecture.

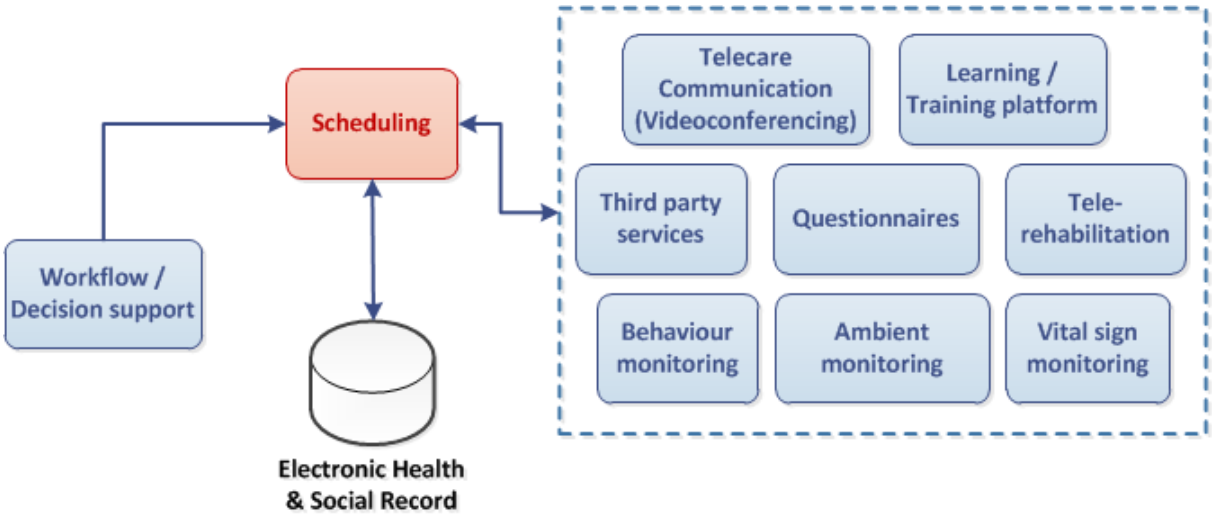


Figure 9: Scheduling BB interactions

## 3.5 Telecare Communication (Videoconferencing) building block

Inside the paradigm of telecare, i.e. offering remote care for elderly persons, providing the care and reassurance needed to allow them to remain living at their own homes, videoconferencing communication may be part of a package which can provide support for this cohort. The idea is to have a video consultation with specialist (and relatives) over ICT. It supposes real-time telecare, as it works as a synchronous interaction.

Videoconferencing can be a very effective tool in the deployment of remote telecare; its uses are many: from monitoring and following up of discharged patients, to facilitating communication to track a patient's recovery, to initial consultation with patients, for keeping contact with relatives, etc.

By using videoconferencing technology when applicable, healthcare and social care professionals and patients can reduce the costs and inconvenience associated with normal office visits. Physicians can be anywhere, monitoring and collecting patient information, while the patient remains in the comfort of his or her home. As well as reducing unnecessary costs and travel times, this can be particularly beneficial for patients with mobility issues or environmental concerns, for whom it would not be ideal to visit a hospital or clinic.

The Videoconferencing building block has to be specifically designed to be used by elderly people and their informal carers, making the system as simple as possible for the user, applying design for all concepts. This building block has to be accessible from both patient and professional workstations.

The teleconferencing building block will interact directly with scheduling module, as it is responsible for the integrated care plan with the different activities, including videoconferencing, to be carried out by patients and professionals. This block will also work with the tele-rehabilitation block as part of the rehabilitation process. The Contact Centre may have the possibility to interact with the videoconferencing module, to start chats with patients when needed.

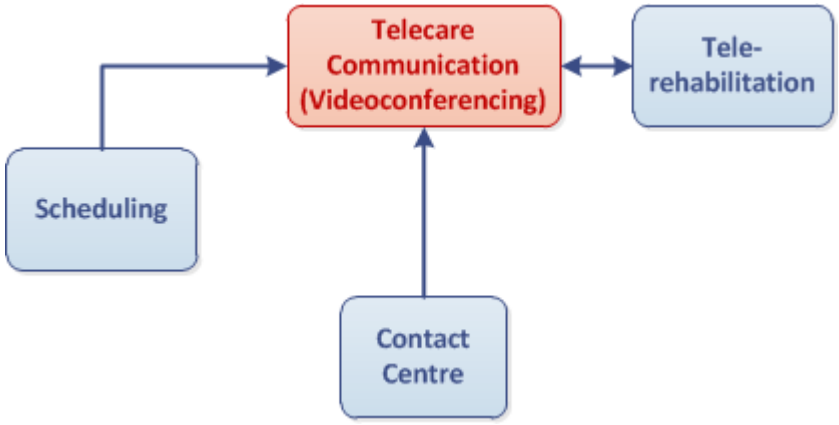


Figure 10: Telecare Communication (videoconferencing) BB interactions

## 3.6 Questionnaires building block

The Questionnaires building block is an ICT tool helping to manage the evolution of the patient via specific and validated questionnaires, relating to the status and progress of the patient. These patient evolution questionnaires can measure different aspects such as general health status, adherence and personal autonomy, environment, informal carer workload, or any other aspect considered important for measuring the patient status and needs.

The block has to be designed to be accessible and understandable for elderly persons and their informal carers, who will complete the patient questionnaires when the patient cannot do so themselves. The results of the questionnaires will be available to professionals.

The Questionnaire building block will interact directly with the scheduling module, which is responsible for the integrated care plan with the different activities, including questionnaires, to be carried out by patients and professionals. This block will also work with Electronic Health and Social Record block, as questionnaires are part of the patient data.

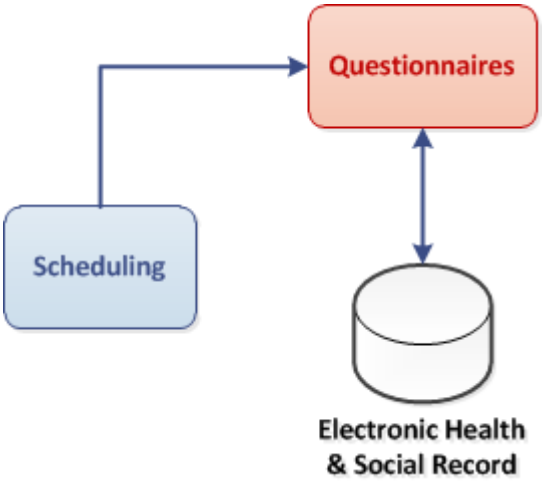


Figure 11: Questionnaires BB interactions

## 3.7 Learning / Training platform building block

Telehealth also provides opportunities for patients and informal carers to receive training related to their illness, needs, care, etc. at their home, giving the system the capacity to empower patients and their self-

care. The Learning / Training platform uses electronic educational technology in learning and training. This platform can be accessed anytime, anywhere.

The Learning / Training building block technology normally includes:

- Videoconferencing module.
- Document reader.

The interdisciplinary team will be responsible for programming in the scheduler the different learning or training activities for the patient and his/her informal carer, with the most appropriate information adapted to their needs. This means that this building block will interact only with the Videoconferencing block, when the session requires video and audio communication, and with the Scheduling block in order to open the corresponding programmed activity. These interactions are shown in the figure below.

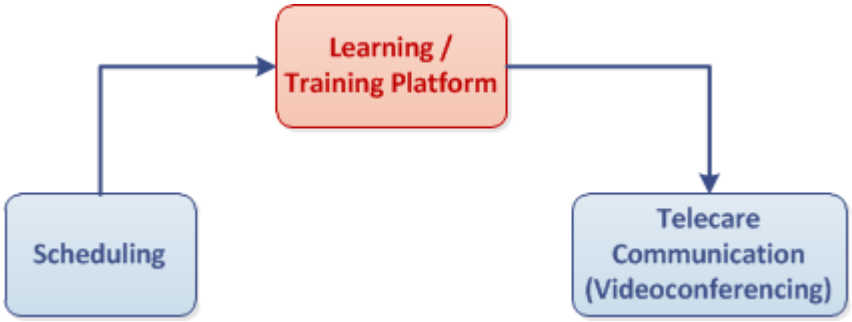


**Figure 12: Learning/Training platform BB interactions**

## 3.8 Tele-rehabilitation building block

The Tele-rehabilitation building block is a tool that manages the delivery of rehabilitation services and activities over telecommunications networks. The goal of this module is twofold: first, to deliver therapy to patients at home, for people who cannot travel to a clinic, and second, to allow experts in rehabilitation to engage in a clinical consultation at a distance.

Online delivery of rehabilitation enables the rehabilitation therapist to optimise the timing, intensity and duration of therapy that is often not possible within the constraints of face-to-face treatment protocols in current health and social systems. The kinds of therapies that can be delivered with tele-rehabilitation block range from physiotherapy, to speech-language therapy or occupational therapy.

The Tele-rehabilitation building block technology normally includes:

- Videoconferencing module.
- Sensors and body monitoring when needed, in order to support and control patient movements.
- Connection with EH&SR, in order to obtain patient characteristics for the therapy and to store possible data from sensors and body monitoring.

Depending on the disease and the characteristics of the patient, the management of the therapy could also include the use of other technology, such as for example Virtual Reality or Artificial Intelligence.

The rehabilitation therapy and related activities will be programmed in the integrated care plan by the interdisciplinary team, and transferred to the Scheduling building block.

The following figure represents the different interactions of the Tele-rehabilitation building block with the Scheduling, Videoconferencing and Electronic Health and Social Record building blocks.

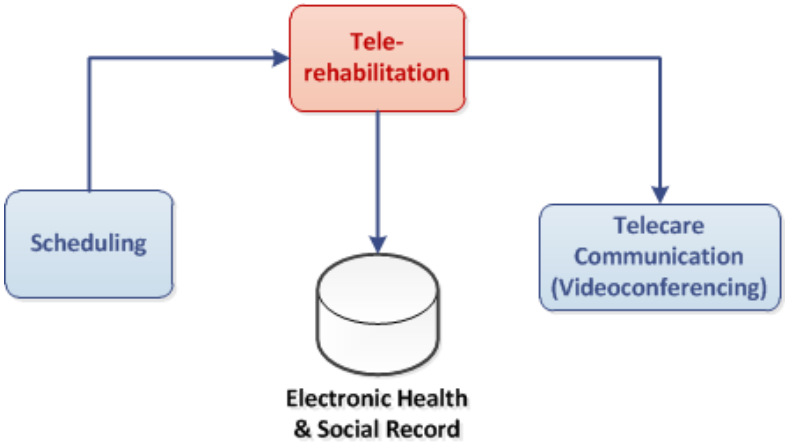


Figure 13: Tele-rehabilitation BB interactions

## 3.9 Behaviour Monitoring building block

Behaviour Monitoring deals with the follow-up system that passively "observes" patient behaviour at home, and automatically records the various patterns of their activity. The goal of this block is to work as a support system to help professionals make decisions, prevent critical situations, and quickly activate assistance when a critical situation occurs (e.g. fall detection).

This building block is based on a sensor network (behavioural movement sensors, cell phone, GPS tracking, etc.) connected to a processing unit. The software follows the patient's behaviour, and collects a number of characteristics such as getting up, going to bed, going to the bathroom, falls, etc. All this data, as with the other monitoring building blocks presented in the architecture, are transmitted to integrated care providers via wireless telecommunication devices, and evaluated for potential problems by the interdisciplinary team and decision support block, in order to detect a problem.

It is very important to highlight that the whole process has to be totally transparent to the patient, in order to be as least intrusive as possible, and not to negative impact on the data collected.

In summary, the Behaviour Monitoring building block directly interacts with the Electronic Health and Social Record module, which stores data collected from behavioural movement sensors, centralising all patients' data,. On the other side, the Scheduling and Remote Device Administration building blocks will respectively manage and programme interventions and actions to be carried out by Behaviour Monitoring block, as shown in Figure 14 below.

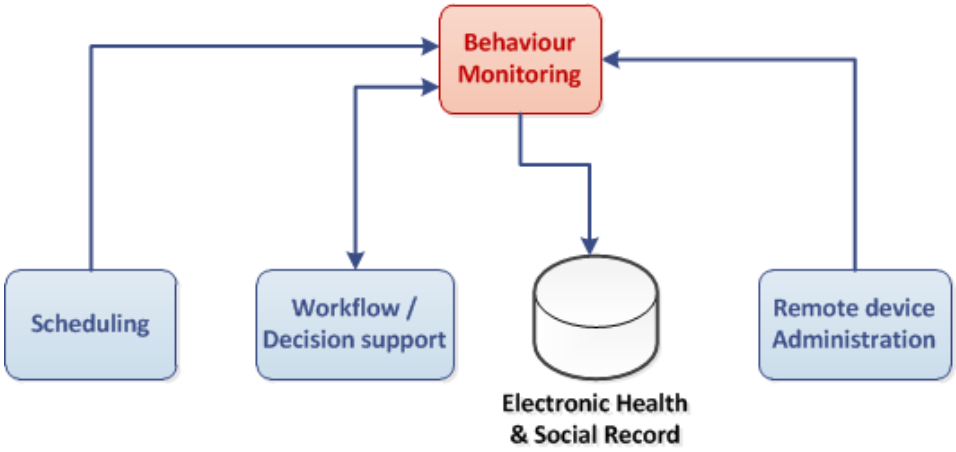


Figure 14: Behaviour Monitoring BB interactions

## 3.10 Vital Sign Monitoring building block

Vital sign or patient monitoring supposes a type of remote patient monitoring, where the patient has a central unit that feeds information from sensors and monitoring equipment (e.g. blood pressure monitors, blood glucose meters, etc.) to an external monitoring centre. This ICT system enables monitoring of patients outside a conventional setting, at their home, which can increase access to care. Data can be transferred either in real time, or it can be stored and then forwarded later.

Vital sign monitoring in chronic diseases can significantly improve an individual's quality of life, preventing complications, and delivering care right to the home. In addition, vital sign monitoring gives patients and their family members reassurance, knowing that they are being monitored and can be supported if a problem arises.

Vital Sign Monitoring building block technology normally includes:

- Sensors and devices that can measure physiological parameters.
- Local data storage at patient's site that interfaces between sensors and a centralised data repository.
- Connection with the centralised EH&SR data repository, to store the data sent from sensors.

Depending on the disease and the parameters to be monitored, different combinations of sensors, storage, and applications may be customised for the patient, in line with the integrated care plan.

Vital sign parameters such as blood pressure or blood glucose are collected by peripheral devices (glucometer, pulse oximeter, etc.). These data are transmitted to an integrated care provider. Data are evaluated for potential problems by integrated care multidisciplinary team; through the clinical Decision Support block, patients, carers, and health and social care providers are immediately alerted if a problem is detected.

Vital sign monitoring building block will need to interact with Electronic Health and Social Record building block that centralises all patient data. Workflow / Decision Support building block will support the integrated care professional using data collected by devices monitoring vital signs, interacting directly with this block. The activities using vital sign sensors will be programmed using the Scheduling building block via the care plan. Finally, Remote Device Administration building block will be in charge of managing all sensors interacting with patients or their environment. These interactions are shown in the following figure.

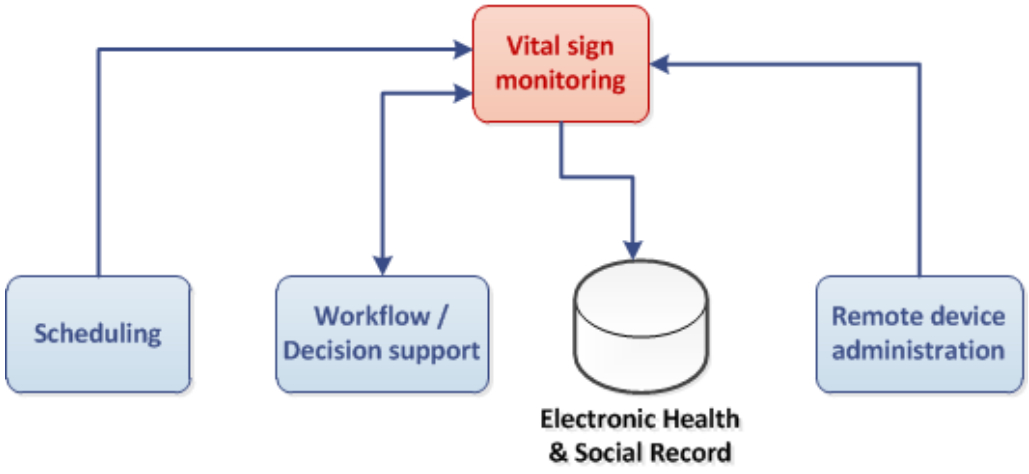


**Figure 15: Vital Sign Monitoring BB interactions**

## 3.11 Ambient Monitoring building block

Ambient monitoring supposes the collection of measurements coming from environmental sensors and home automation actuators in the patient's home, in order to protect him/her from environmental and mechanical risk situations. Environmental sensors monitor variables such as smoke, flooding, gas leaks, temperature, humidity, etc.

Ambient Monitoring building block enables monitoring of these variables in real time via environmental sensors, and stores them for transmission to a central repository for evaluation. When necessary, the block also allows interaction with home automation actuators deployed in the patient's home, to solve the problem detected if possible. So the same building block supports both monitoring and actuating in case of potential risk. To do this, Ambient Monitoring building block normally includes:

- Environmental sensors that measure ambient parameters.
- Home automation actuators that interact with various elements of the house, such as control of lighting, heating, ventilation, air conditioning, security locks of windows and doors, amongst others.
- Local data storage at patient's site that interfaces between the sensors and a centralised data repository.
- Connection with EH&SR, centralising the repository of data sent from sensors.

Depending on the situation of the patient and the environmental variables to be monitored, different combinations of sensors, storage, and applications may be applied through the integrated care plan.

As in the case of behaviour monitoring, the Ambient Monitoring building block must be unobtrusive as possible, and only interfere with the patient in risk situations.

Ambient Monitoring building block will directly interact with Electronic Health and Social Record building block in order to store all the data collected; the Remote Administration and Decision Support building blocks will interact with this module in order to activate home automation when needed.

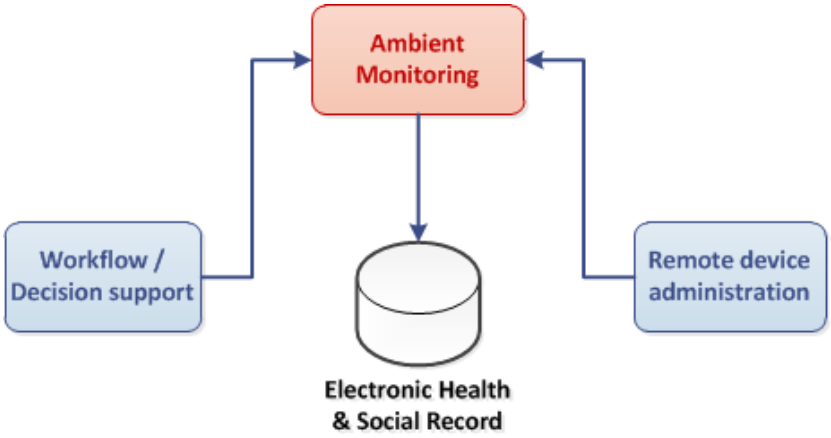


Figure 16: Ambient Monitoring BB interactions

## 3.12 Remote Device Administration building block

The Remote Device Administration building block is in charge of managing all the sensors installed in the patient's home, including environmental sensors, home automation actuators, vital signs sensors, behavioural movement sensors, and any other kind of device monitoring the patient or his/her environment.

The building block can work as a simple manager, redirecting actuation instructions from the Scheduling and Decision Support building blocks, or it can summarise and process raw sensor information before sending it to the central repository. This will depend on the characteristic s of the solution deployed in the patient's home, and the rest of the system and architecture of the pilot site.

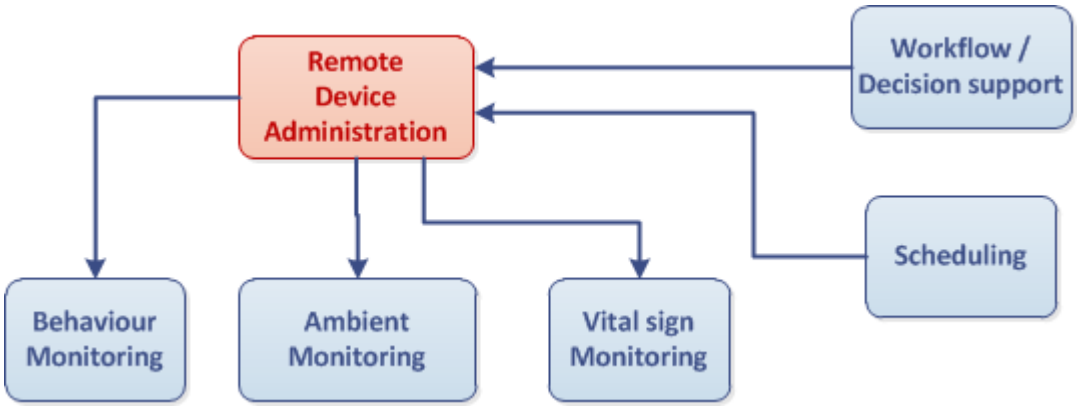


Figure 17: Remote Device Administration BB interactions

## 3.13 Third Party Services building block

Third party services in the project are represented by those organisations in charge of certain aspects of the patient care that are outsourced. These organisations could be NGOs, services addressing social isolation, meal services, information resources, social communities, etc. Sometimes it will be necessary to give these organisations access to some part of the information stored in the system about the patient or his/her environment, or feed the system with the information collected by these third party services, always complying with the principles of personal data protection.

Third party services will therefore have controlled and limited bidirectional access to the Electronic Health and Social Record building block; the Third Party Services building block will be able to both read data from the central repository, and write new data to it.

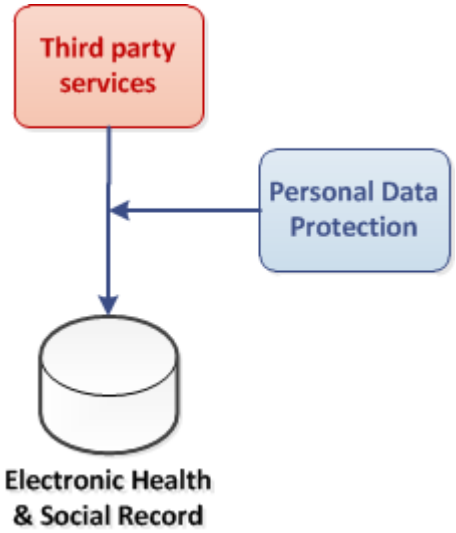


Figure 18: Third party service connection BB interactions

## 3.14 Alerts Management building block

Alert Management building block is responsible for effectively managing and responding to the different alerts detected by the system. Alerts can originate for example from the data collected by sensors, an unattended event or communication, or a situation detected by professionals.

Depending on handling protocols and escalation procedures, the alert may be managed in different ways, always in compliance with the Workflow Decision Support block that stores all the rules and protocols related to the patient.

Normally, actuation of the Alert Management building block will result in interaction with the Workflow Decision Support or the Contact Centre (that will manage the alert in emergency situations).

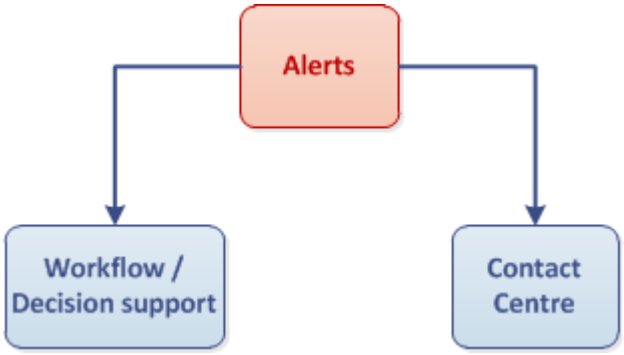


**Figure 19: Alert Management BB interactions**

## 3.15 Contact Centre building block

The Contact Centre building block is the ICT tool that allows contact centre staff to deal with, among others, administration, configuration and network monitoring system. It interacts with almost all of the other blocks of the architecture, in order to ensure the correct management of the different activities. Depending on the role of each professional, he/she will have access to certain blocks and functionalities, determined by the Personal Data Protection building block. The building block will also be responsible for tracking all the actions carried out by the contact centre staff.

The Contact Centre has to be permanently accessible to patients and their carers, responding to patients' requests in an appropriate timeframe.

This building block interfaces with the rest of the building blocks, under the conditions of the personal data protection protocols deployed, see Figure 20 below.

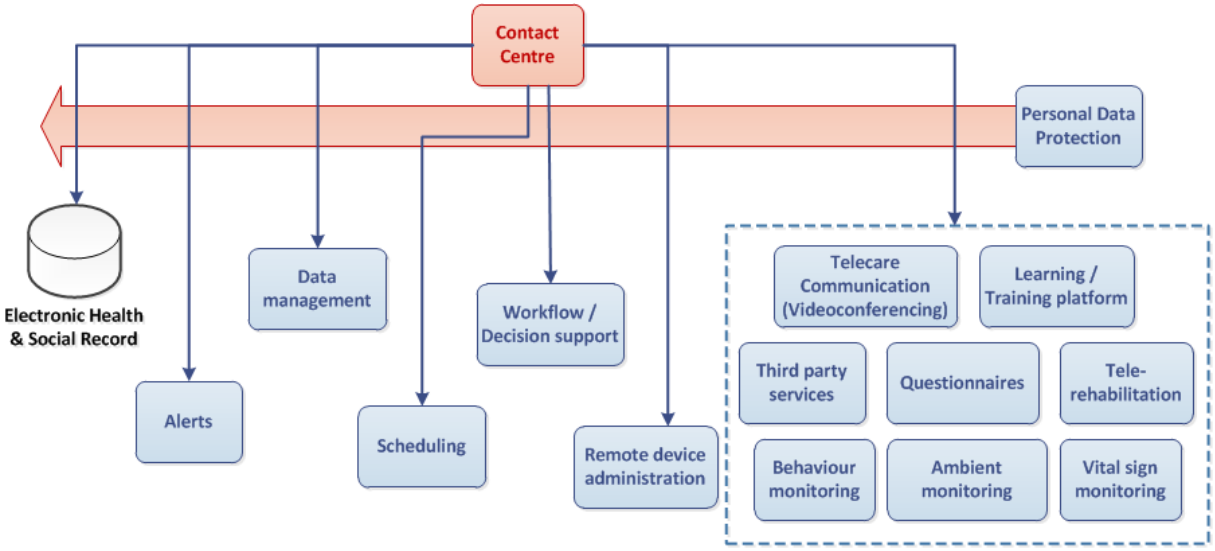


Figure 20: Contact Centre BB interactions

## 3.16 Emergency Communication building block

In emergency situations, the system has to be capable of contacting the emergency services, and tracking the actions carried out, when possible. This building block supports this communication, ensuring that the system has knowledge about what is happening with the emergency contact and activity. The Contact Centre is responsible for this communication, and is the block that interacts with the Emergency Communications building block.

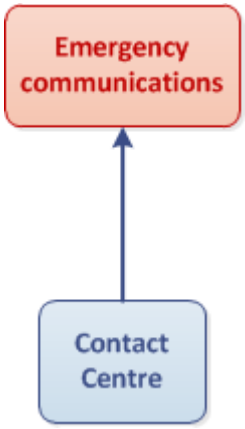


Figure 21: Emergency Communications BB interactions

## 3.17 Electronic Health and Social Record building block

This block supports the systematic collection of electronic health and social information about individuals. The information is recorded in digital format, and can be shared among different care settings. All medical data (including diagnostic tests, images, medications, allergies, vital signs, etc.) and social data (age, family, visits, home needs, personal needs, questionnaires, risk assessments, financial data, evolutions, etc.) is stored under the EH&SR.

The block is designed to present data that accurately captures the state of the patient at all times. It allows for an entire patient history to be viewed without the need to track down the patient's previous medical records, and assists in ensuring that data is accurate, appropriate and legible.

EH&SR is generated and maintained within the institution responsible.

Technical features:

- Digital formatting enables information to be used and shared over secure networks.
- Tracks care (e.g. prescriptions) and outcomes (e.g. blood pressure).
- Triggers warnings and reminders.
- Sends and receives orders, reports and results.

EH&SR can be accessed not only through a workstation, but, depending on the type of system and health and social care settings, may also be accessible through mobile devices, tablets and smartphones.

EH&SR building block has interactions or can be accessible with many of the building blocks of the architecture, because is the central repository of all the data related to the patient, staff, resources, facilities and the rest of management activities. Access to the data stored in the EH&SR block will under personal data protection protocols. These interactions are shown in the figure below.

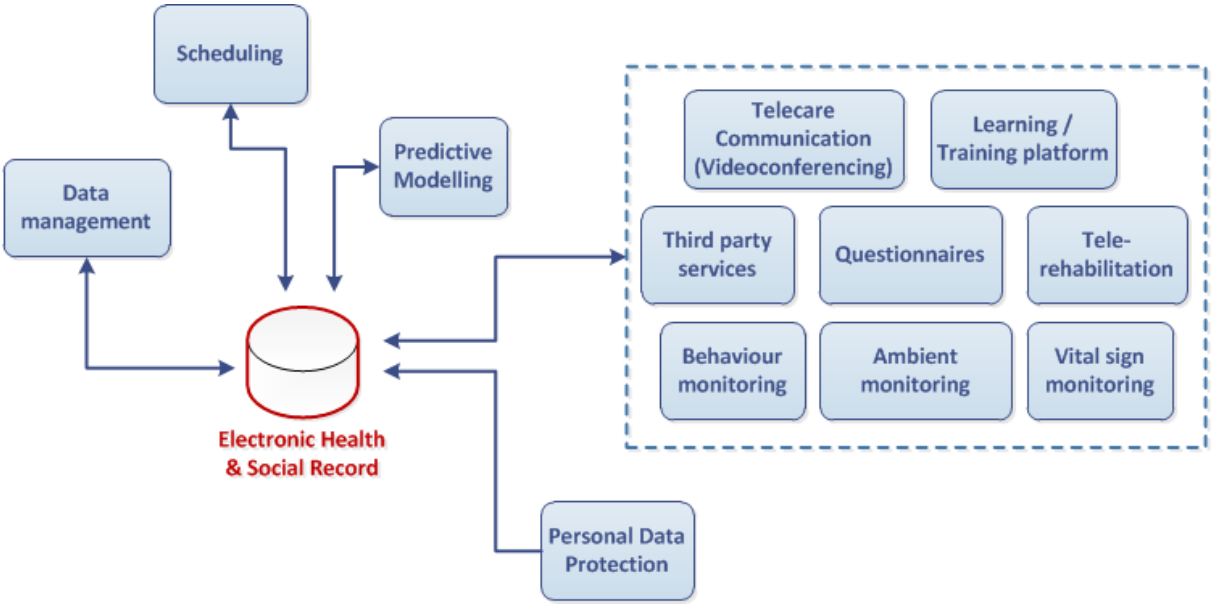


**Figure 22: EH&SR BB interactions**

## 3.18 Predictive Modelling building block

Predictive modelling in health and social care is an analytical process involving assessment and adjustment of risk behaviour, as applied to a given population based upon available data, for the purpose of stratifying that population by their future probability of incurring a given outcome or behaviour. Predictive modelling is essentially a way to take specific data sets from EH&SR implementation, and use them to predict future trends. The objective is to identify individual opportunities for intervention or action before the projected outcome has occurred, and in this way to mediate hospital (re)admissions.

One ambitious way in which integrated care could benefit from predictive modelling is in the improvement of patient outcomes. Models which are capable of doing this will make use of Big Data, EH&SR and workflow implementations. Predictive modelling for clinical outcomes will essentially allow integrated care providers to monitor patient outcomes by taking into account specific patient factors; for example, a patient population can be examined based on a chronic condition. Predictive modelling can take into account patient factors such as age, severity, gender, primary diagnosis, etc. and see what correlation there is with the onset, worsening, or development of the disease. Going a step further,

predictive modelling can provide statistics on what has worked most effectively to treat a specific disease from a care perspective, and can indicate optimal care for specific patient groups based on their historic data to provide the optimal outcome. Predictive modelling can allow institutions to impact on integrated care through:

- Creation of best practices based on historic data and outcomes.
- Integrated care planning and coordination based on predictive modelling analysis.
- Allocation of care resources to achieve best results.

In order for predictive analytics to be effective, it is very important to understand the type of available data, the organisation workflow, the target audience, and what action will result from knowing the prediction. Full clinical utility of prediction or risk stratification is only possible in a data-rich enterprise warehouse environment; and the predictor-intervention sets can be best monitored and measured within the same data environment, so the block has to be fully integrated with the EH&SR and Workflow Decision Support building blocks in order to be effective.

In summary, predictive modelling could be an effective tool to identify patients who are likely candidates for interventions to prevent disease, better manage their health and social conditions outside the institution (hospital…), and prevent future hospitalisations; all of which could save insurers and the system money.

This building block interacts directly with the Electronic Health & Social Record as a source of data, with the Workflow / Decision Support building block to monitor and programme interventions, and with Alerts building block to manage outcomes. These interactions can be seen in Figure 23 below.

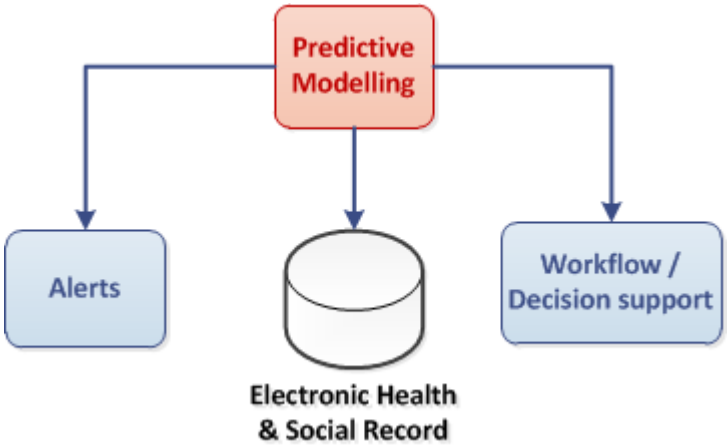


Figure 23: Predictive Modelling interactions

## 3.19 Personal Data Protection building block

The ICT components that allow integration of services, and hence sharing of health and social care related data of older European citizens, must comply with local, national and European regulations regarding many issues, first of all privacy.

While in general many elements of the BeyondSilos architecture are pre-existing in a large majority of the deployment sites, and hence are expected to comply with data protection best practice and regulations, integrating these elements could introduce additional requirements with regard to shared data access and communication data.

Sharing data across a wide range of care disciplines may require: review of registration of databases with Data Protection Registrars; review of authentication of personnel accessing the shared data; and analysis of any other legal issue arising from national legislation and regulations. In the same way, the security of the communications infrastructure should be reviewed to ensure that the new paths over which patient / service user identifiable healthcare or social care data are transferred meet the requirements of local and national data protection legislation.

Deployment sites may include the laws governing data protection through this module; in general, data protection provision tends to describe personal information as data that are afforded protection at every step from collection to storage and dissemination and finally to destruction:

- Personal data are obtained fairly and lawfully.
- They are used for the originally specified purpose.
- They are adequate, relevant and not excessive with regard to purpose.
- They are accurate and up-to-date, as well as accessible to the subject.
- They are kept secure, and destroyed after their purpose is completed.

The module implemented may guarantee the following objectives:

- Safe and efficient management of the identities of the different actors who have access to data and information (health information, medical records, etc.), in order to ensure control over the person or entity that accesses information at any time, as well as that this person has the required permissions and privileges to do so.
- Ensure the security of stored and exchanged data among the different actors involved in healthcare and social care scenarios, once they have been identified (doctors and health personnel, management, suppliers and/or consumers of health and social services, etc.). This security is required because of the sensitive nature of the information exchanged.
- Establish guidelines, criteria and best practices for the proper management of risks and threats to the security of the information and communications systems in health and social care scenarios, including both preventive (audit) and reactive (monitoring and incident management) actions.

With regard to the above objectives, the Personal Data Protection building block deployed should implement the relevant security mechanisms to provide integrated care scenarios that meet safety requirements and guarantee the access and exchange of reliable information of a sensitive nature, endorsing the following aspects:

- **True identification** of the person who accesses the system: it is necessary to identify, without doubt, the person who tries to gain access to sensitive information. This could be achieve through identification processes (presentation of credentials) and authorisation processes (allowing validation of the authenticity of the submitted credentials).
- **Secure access**: once the person trying to access data has been identified, permission may be granted (or not) for the execution of certain tasks; it has to be guarantee that the person only has access to the information they are authorised to see, and only for the use for which they are accredited. This is achieved through authorisation processes (access control and allocations of roles and profiles).
- **Confidentiality**: sensitive information is encrypted so the content can only be read by the legitimate recipient of the same.
- **Integrity**: ensure the information has not been transformed, either accidentally or intentionally during storage or exchange.
- **Availability**: guarantee the information can be accessed and used when necessary.

- **Non-repudiation**: whoever accesses or takes part in information management may not deny having done.
- **Audit**: health or social organisation can check who has accessed information and which transactions have been made, as well as detect possible security incidents that violate policies.
- **Legal provisions** in the field of security, confidentiality, computerised medical records, as well as other technical and organisational aspects.

Legislation and regulation concerning the protection of personal data is of central relevance for the provision of the services to be developed and piloted within the project. Sections 3.19.2 and 3.19.3 include the regulations and legislation at European and national level respectively that are potentially relevant to pilot sites, and that should be implemented through this module in each pilot site.

### 3.19.1 Building block interactions

Personal Data Protection building block will directly interact with the Electronic Health & Social Record in order to guarantee the access and exchange of reliable information of a sensitive nature that is stored in the EH&SR, endorsing: true identification, secure access, confidentiality, integrity, availability, non-repudiation, audit and legal prevision. This building block will also directly act over the communications and information exchange between EH&SR block and the rest of building blocks accessing its information and data. The protocols and mechanism to be applied in order to achieve the above objectives are fixed by European and national regulation and legislation; this means each pilot site will integrate this building block following the rules relevant for each one.

The interactions with the rest of the building blocks that integrate the architecture can be seen in the following figure.

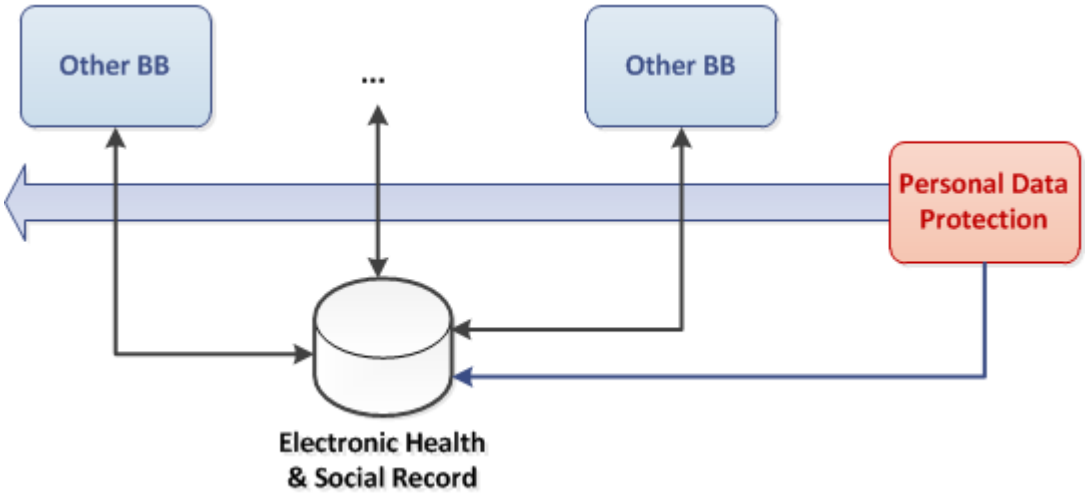


**Figure 24: Personal Data Protection BB interactions**

### 3.19.2 European level regulation/legislation

**The European Data Protection Directive**

The EU Data Protection Directive 95/46/EC (DPD) complements fundamental rights in the area of personal data protection. Personal data are defined as "any information relating to an identified or identifiable natural person ("data subject"); an identifiable person is one who can be identified, directly or indirectly, in particular by reference to an identification number or to one or more factors specific to his physical, physiological, mental, economic, cultural or social identity;" (Art. 2 a).

By adopting the Data Protection Directive of 1995 (Directive 95/46/EC), the European Union set legally binding rules for the protection of individuals with regard to the processing of personal data. Through this regulation, basic principles for processing personal data have been stipulated to be followed in all Member States:

**Transparency:** The data subject has the right to be informed when his or her personal data are being processed. The controller must provide his or her name and address, the purpose of processing, the recipients of the data and all other information required to ensure the processing is fair (Art. 10 and 11). Data may be processed only under the following circumstances (Art. 7):

- when the data subject has given his or her consent;
- when the processing is necessary for the performance of or the entering into a contract;
- when processing is necessary for compliance with a legal obligation;
- when processing is necessary in order to protect the vital interests of the data subject; when processing is necessary for the performance of a task carried out in the public interest or in the exercise of official authority vested in the controller or in a third party to whom the data are disclosed;
- when processing is necessary for the purposes of the legitimate interests pursued by the controller or by the third party or parties to whom the data are disclosed, except where such interests are overridden by the interests for fundamental rights and freedoms of the data subject.

The data subject has the right to access all data processed about him or her. The data subject even has the right to demand the rectification, deletion or blocking of data that is incomplete, inaccurate or is not being processed in compliance with the data protection rules (Art. 12).

**Legitimate purpose:** Personal data can only be processed for specified explicit and legitimate purposes, and may not be processed further in a way incompatible with those purposes (Art. 6 b).

**Proportionality:** Personal data may be processed only insofar as it is adequate, relevant and not excessive in relation to the purposes for which they are collected and/or further processed. The data must be accurate and, where necessary, kept up to date. Every reasonable step must be taken to ensure that data which are inaccurate or incomplete, having regard to the purposes for which they were collected or for which they are further processed, are erased or rectified. The data should not be kept in a form which permits identification of data subjects for longer than is necessary for the purposes for which the data were collected or for which they are further processed. Member States shall lay down appropriate safeguards for personal data stored for longer periods for historical, statistical or scientific use. (Art.6). When sensitive personal data (including religious beliefs, political opinions, health, sexual orientation, race, membership of past organisations) are being processed, extra restrictions apply (Art. 8).

**Directive 2002/58/EC concerning the processing of personal data and the protection of privacy in the electronic communications sector**

The Data Protection Directive of 1995 was complemented in 2002 (Directive 2002/58/EC), with particular respect to the processing of personal data in the electronic communication sector. It applies to all matters which are not specifically covered by the 1995 Directive. The main provision made in the 2002 Directive concerns the duty of electronic communication providers to ensure security of services (Art. 4). This obligation also includes the duty to inform subscribers whenever there is a particular risk, such as a virus or other malware attack (Art. 4.2). Another provision concerns maintenance of confidentiality of information. Here the addressees are Member States, who should prohibit listening, tapping, storage or other kinds of interception or surveillance of communication and related traffic unless the users have given their consent or specific conditions (Art. 15.1) have been fulfilled.

### 3.19.3 National level regulation/legislation

#### 3.19.3.1 Italy

**Article 32 of Italian Constitution**

A fundamental principle relating to privacy is ratified in section 32 of the Italian Constitution. The Constitution of Italy (Italian: Costituzione della Repubblica Italiana) is the supreme law of Italy that states fundamental rights.

**Legislative Decree 196/2003, 30th June**

Legislative Decree 196/2003 is also called “Privacy Code” or “Data Protection Code”. The new code came into force on 1st January 2004. The code does not distinguish clearly between privacy and security, but it treats both topics in depth.

This decree lays down important rules to protect the data subject. It recognises the right of the person to safeguard his/her personal data, and regulates the different ways of processing data, with regard to the collection, processing, deletion, modification, communication or diffusion of data, and also the responsibility and sanctions in case of damages.

The Code is unique in that it brings together all the various laws, codes and regulations relating to data protection since 1996. There are three key guiding principles behind the code, which are:

- Simplification.
- Harmonisation.
- Effectiveness.

**Legge 28 marzo 2001, n. 145**

This law accepts within the Italian legislation the so called Declaration of Oviedo, which includes the right to be informed when a healthcare intervention is performed on somebody.

**Medical and professional ethics code**

Clinicians and other professionals (nurses, social workers, etc.) have specific rights and duties that are described in specific Medical Professional Ethics Code. These codes set out the principles and rules that doctors must respect in the exercise of their specific profession.

With regard to the processing of sensitive and personal data, sections 9, 10, 11 and 30 and seq. enunciate clinicians’ duties.

#### 3.19.3.2 UK

**The Data Protection Act of 1998**

The EU Data Protection Directive (DPD) was transposed into national legislation by the Data Protection Act of 1998. The Act stipulates general rules for processing of information relating to individuals, including the obtaining, holding, use or disclosure of such information. In part IV, section 30, the rules around personal data consisting of information as to the physical or mental health of the subject are set.

Vital signs data is classified as "sensitive personal data" (section 1). "Data protection principles" are set out in Schedule 1 (section 4). As in DPD, "Processing" includes any storage ("holding") or transmission; the data do not have to be manipulated for their use to qualify as "processing". Schedule 1 specifies the first such data protection principle, for the case of sensitive personal data, such as "1 Personal data ... shall not

be processed unless ... at least one of the conditions in Schedule 2 is met, and ... at least one of the conditions in Schedule 3 is also met."

Schedule 2 allows processing under at least three circumstances relevant to BeyondSilos; processing is allowed if:

- The data subject has given his/her consent to the processing.
- The processing is necessary ... for the performance of a contract to which the data subject is a party, or ... in order to protect the vital interests of the data subject.

Schedule 3 allows processing if consent is obtained i.e. if "1 The data subject has given his explicit consent to the processing of the personal data" but also where "8 (1) The processing is necessary for medical purposes and is undertaken by (a) a health professional, or (b) a person who in the circumstances owes a duty of confidentiality which is equivalent to that which would arise if that person were a health professional". Medical purposes include the purposes of preventative medicine, medical diagnosis, medical research, the provision of care and treatment and the management of healthcare services.

So in summary, the Act allows transmission and storage of vital signs and therefore vital signs triage by anyone, given the client's consent (Schedule 2 paragraph 1 and Schedule 3 paragraph 1). It seems also possible (but probably no advantage) to have a contract with a client which includes care for medical purposes and to apply Schedule 2 paragraph 2 and Schedule 3 paragraph 8.

Schedule 2 also allows processing if "6 (1) ... necessary for ... legitimate interests pursued by the data controller ... except where the processing is unwarranted" and allows the Secretary of State to specify what this means. Also, though section 57 seems to outlaw (a contract of) consent to use any health record or extract of this, this applies only when the client himself has obtained the data from elsewhere, and so is not relevant here.

**Code of Practice on Protecting the Confidentiality of Service User Information**

This Code of Practice on Protecting the Confidentiality of Service User Information[4] was communicated throughout HSCNI in March 2012. The revised Code is aimed at supporting staff in making good decisions about the protection, use and disclosure of service user information. The original Code was issued in 2009. The Code of Practice should be the reference point for all staff.

**Good Management Good Records**

Good Management Good Records is the Department's advice and guidance on records management. It includes a retention and disposal schedule, prepared in accordance with the Public Records Act (NI) 1923 and the Disposal of Documents Order 1925.

It covers all records created by the Department, Public Safety and HSC Organisations, as well as those working under contract to the HSC.

**Freedom of Information Act 2000**

The Freedom of Information Act 2000[5] provides public access to information held by public authorities. The Act covers any recorded information that is held by a public authority in England, Wales and Northern Ireland, and by UK-wide public authorities based in Scotland.

[4] http://www.dhsspsni.gov.uk/confidentiality-code-of-practice0109.pdf
[5] www.legislation.gov.uk/ukpga/2000/36/contents

Public authorities are obliged to publish certain information about their activities, and members of the public are entitled to request information from public authorities. Public authorities include government departments, local authorities, the NHS, state schools and police forces. Recorded information includes printed documents, computer files, letters, emails, photographs, and sound or video recordings.

The Act does not give people access to their own personal data (information about themselves) such as their health records or credit reference file. If a member of the public wants to see information that a public authority holds about them, they should make a subject access request under the Data Protection Act 1998.

#### 3.19.3.3 Spain

**Personal Data Protection Law (1999) Organic Law 15/1999 of 13th December on the Protection of Personal Data (Organic law 15/99)**

The protection of personal data is enshrined in the Spanish Constitution through Article 18.4, which requires that the law shall restrict the use of informatics in order to protect the honour and the personal and family privacy of Spanish citizens, as well as the full exercise of their rights. This provision was further developed by Organic Law 5/1992 on the Regulation of the Automatic Processing of Personal Data, as amended by Organic Law 15/1999 on the Protection of Personal Data. This law corresponds to European legislation. Article 7 deals with data related to information on testing of health in particular. In the Royal Decree 1720/2007, the Rule Development of Personal Data Protection Law is approved. This Decree aims at regulating possible risks of Personal Data treatment.

**Safety of medical information 41/2002**

In Law 41/2002, the safety of medical information is set out. It states that: “Health Centres must establish an active and diligent mechanism to safeguard medical records”.

**Royal Decree 994/199**

This law might also be relevant as legislation dealing with safety and security of medical and personal data. It states that databases that contain medical and personal data must be given maximum security.

**RD 1720/2007**

This develops Organic Law with respect to some aspects related to privacy.

**RD 3/2010, of 8th January**

This develops security requirements of electronic administration.

**Other**

Organic Law implements European Directive 95/46/CE related to the protection of personal data management. The right of personal data protection is ratified in article 18 of the Spanish Constitution.

It is important to highlight the right to the protection of health recognised in article 43 of the Spanish Constitution of 1978. In addition, Spanish law recognises the right to clinical information and the individual autonomy of the patient regarding his/her health (Law 14/1986 of 25th April).

Resolución de 15 de diciembre de 2009 del Secretario Autonómico de Sanidad sobre solicitud, tratamiento y cesión de datos de los sistemas de información de la Conselleria de Sanidad Valenciana:

Regional regulation in the Valencia Region for treatment and cession of data from health information systems, 15th December, 2009.

#### 3.19.3.4 Portugal

**Article 35 of the Portuguese Constitution**

A fundamental principle relating to privacy and data protection is ratified in article 35 of the Portuguese Constitution. The Constitution of the Portuguese Republic is the supreme law of Portugal that states fundamental rights. This article defines the ways to access personal data, protection of personal data, and use of personal data in computerised systems.

**Law nº 67/98. DR 247/98 Série I-A 1998-10-26 – Law of data protection:** This Act transposes into national law the Directive 95/46/EC of the European Parliament and of the Council of 24 October 1995 on the protection of Individuals with regard to processing of personal data and on the free movement of such data.

**Law 43/ 2004 – Law of organisation and functioning of National Commission for Data Protection (CNPD):** CNPD is the national entity with authority and responsibility for managing and controlling personal data protection, in its various forms of use.

#### 3.19.3.5 Germany

In the German federal Data Protection Act (BDSG) of 1990 together with the data protection act of the different states in Germany, the use of personal data through ICT systems is regulated. It protects infringing the right of personality, which is enshrined in the German constitution (article 1).

Most important are the following articles:

- Article 4 relating to private and public authorities, which are allowed to collect personal data. It regulates in which cases personal data may be used, stored and transferred without consent, and in which cases any consent from the person is needed.
- Article 5 relating to data secrecy of employees who are working with confidential personal data.
- Article 9 relating to organisational and technical requirements of data used, stored and changed.
- Article 34 relating to the right of the person to have access to the data.
- Article relating to obligation to erase incorrect or unnecessary data. It also regulates how long data has to be stored.

German signature act of 16th May 2001 relating to the safety of e-commerce or e government: It regulates the requirements for quality certificates and electronic signature. In the health sector, it is relevant for e-services such as e prescriptions.

For the end 2014, the Ministry of Health plans an e-health act to regulate the requirements for the use of electronic health card in Germany.

Professional code of conduct for physicians (Musterberufsordnung der Ärzte) (MBO-Ä), especially Article 9 on medical confidentiality. In an electronic patient record, it must be determined which actors may get access to which type of information. Article 10 regulates the obligation requirements of medical data documentation, especially electronic documentation.

#### 3.19.3.6 Bulgaria

Constitution of Republic of Bulgaria (1991): Guarantees the rights of citizens for private life, freedom and secrecy of correspondence, and personal data. Art. 32 Every citizen has the right for protection against illegal interference in his private life. No one shall be followed, photographed, or recorded without his knowledge or approval. Art. 33 guarantees the inviolability of the home.

Data Protection Act (2002): Art. 1(2) guarantees inviolability of personal data.

Electronic Communications Act (2007): Art. 4(1)a ensures opportunities for consumers, including people with disabilities, the elderly and persons with special social needs to derive maximum benefit from the choice, price and quality of electronic communications; Art. 248-253 regulate the protection of data of users of electronic services.

Health Act (2005): Art. 28b patient has the right to protection of personal data concerning health status; Art.84-98 regulate in detail the rights and obligations of patients.

Health Insurance Act.

National Framework Contract.

# 4 Technical analysis

## 4.1 Amadora pilot site

Social intervention in the municipality is ruled by the principles of the Local Social Network. Its main hubs are the CLAS (Local Council of Social Action) and the CSF (Parish Social Commissions), which represents all the key actors in this area (particularly in social care and health care areas), so it will be possible to work in partnership to share information and resources from various entities and define integrated strategies to be part of the Integrated Care Programme. Amadora Municipality Assessment Unit will be the central point for the management of the pilot and direct interaction with end users and care givers. Santa Casa da Misericórdia is the provider of the integrated Home Care Service, with the final objective of setting up the basis for an integration of workflows and actors involved in the care service delivery. Currently, local services already perform these services, but separately from each other. The Amadora pilot will also comprise a vertical integration component pursuing integration between primary and secondary care. Primary and secondary care professionals will be provided by Santa Casa Misericórdia, by the local Health Care Centre, and/or by the hospital. The integration and sharing of patient's medical information through the BeyondSilos infrastructure will enable the achievement of this goal.

The ICT provider, Portugal Telecom, besides the contribution to improve the efficiency of the institutional members with technology, aims to achieve these main benefits for the various actors at the Amadora deployment site:

- **End Users/Clients**
  - Improvement of self-confidence and security;
  - Enhancement of the QoL;
  - Improved satisfaction with service delivery;
  - Perception of service-specific impacts such as safety and security, improved physical status, improved communication with care providers, reduced social isolation, etc.
- **Informal/Formal Carers**
  - Training in health & social care;
  - Improvement of self-confidence and security.
- **Social Care Providers**
  - Training in health & social care;
  - Improved feeling of quality of service provision;
  - Reduction of the average time per case, when the CR, I/FC are sufficiently trained;
  - Reduction in the number of visits (because of the empowerment of the I/FC or the use of telehealth tools), when the CR, I/FC are sufficiently trained.

  Service Providers and local government will have gains of scale in terms of cost saving and income boosting due to the following:
  - More efficiency means less time spent with each client;
  - More efficiency means more quality of services provided, and consequently more interest from potential clients to request the services;
  - More time and the same resources to reach more clients.
- **Health Care Providers**
  - Improved feeling of quality of service provision;
  - Reduction of the average time per case;

- Reduction in the number of visits, because of the empowerment of the I/FC or the use of telehealth tools;
- Reduction in the number of hospitalisations.

- **3rd Sector Care Providers**

  SCMA will also monitor relatives and volunteers from SCMA and Amadora Municipality that actively participate in the daily activities of the CRs through the following services:
  - Training on care providing (alongside Amadora Municipality and Portugal Telecom);
  - Supervision (alongside Amadora Municipality and Portugal Telecom);
  - Planning/monitoring/evaluation of activities.

### 4.1.1 Pilot IT Infrastructure

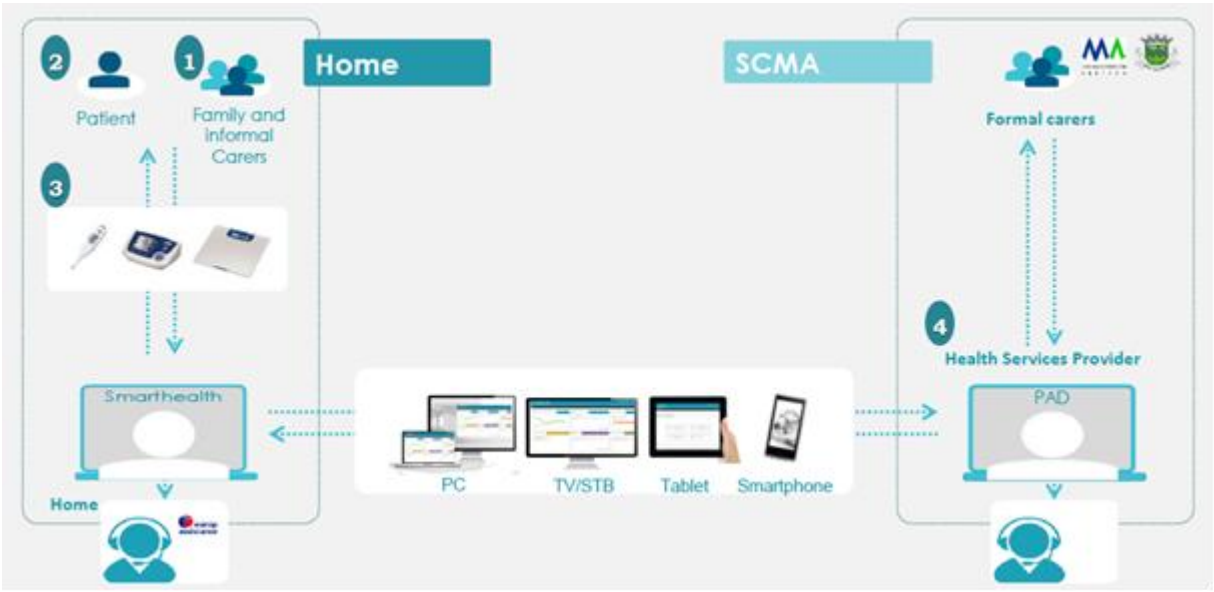


**Figure 25: Amadora IT infrastructure**

The pilot IT Infrastructure is represented in Figure 25 above. Each component of the pilot solution is described next.

- eLearning integrated solution:
  - Administrative management: training event management in eLearning and bLearning.
  - Pedagogical management: self-learning and collaborative learning management.
  - Communication and interaction: synchronous communication with text or video chat and collaborative work.
  - Content availability: creation, import, availability, normalisation and content management on LMS.
  - Evaluation: pedagogical evaluation, surrounding and effective training evaluation.

**Figure 26: Amadora: eLearning integrated solution**

- Tele-assistance and telemonitoring solution:
  - Teleassistência – Patients with fixed line PT:
    - Works like a normal phone, easy to connect and use.
    - It has keys and larger display.

- It has an SOS (emergency) button and has an associated wireless pendant, also with SOS button.
- The pendant has a range up to 30 meters.
- Allows hands free / speakerphone communication.

- True Kare – Patients with mobile line PT:
  - It is an innovative service aimed at 65+ with health monitoring needs.
  - The service includes a web portal where all the user information is entered, and a mobile phone that interacts with the platform.


**Figure 27: Amadora: Tele-assistance and telemonitoring solution**

- SmartHealth:
  - Vital signals acquisition at patient home: blood sugar, blood pressure, etc.
  - Measurements for each patient are stored on SmartHealth platform.
  - Data collected can be viewed by date, by vital signal, etc.
  - The data is sent to the portal, and notifications can be done by text messages or by alerts on the portal.

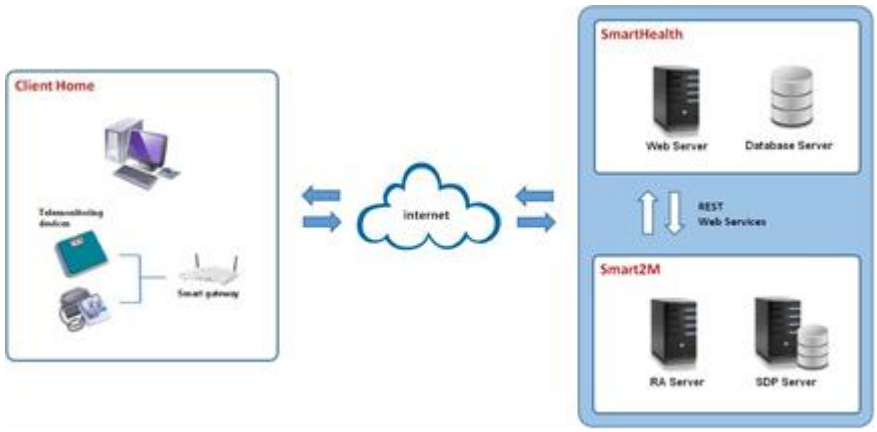


**Figure 28: Amadora:SmartHealth**

Examples of client's and carer's mobile view are shown in Figure 29 and Figure 30 respectively, with examples of back office views in Figure 31.

Figure 29: Amadora: client's mobile view

Figure 30: Amadora: carer's mobile view

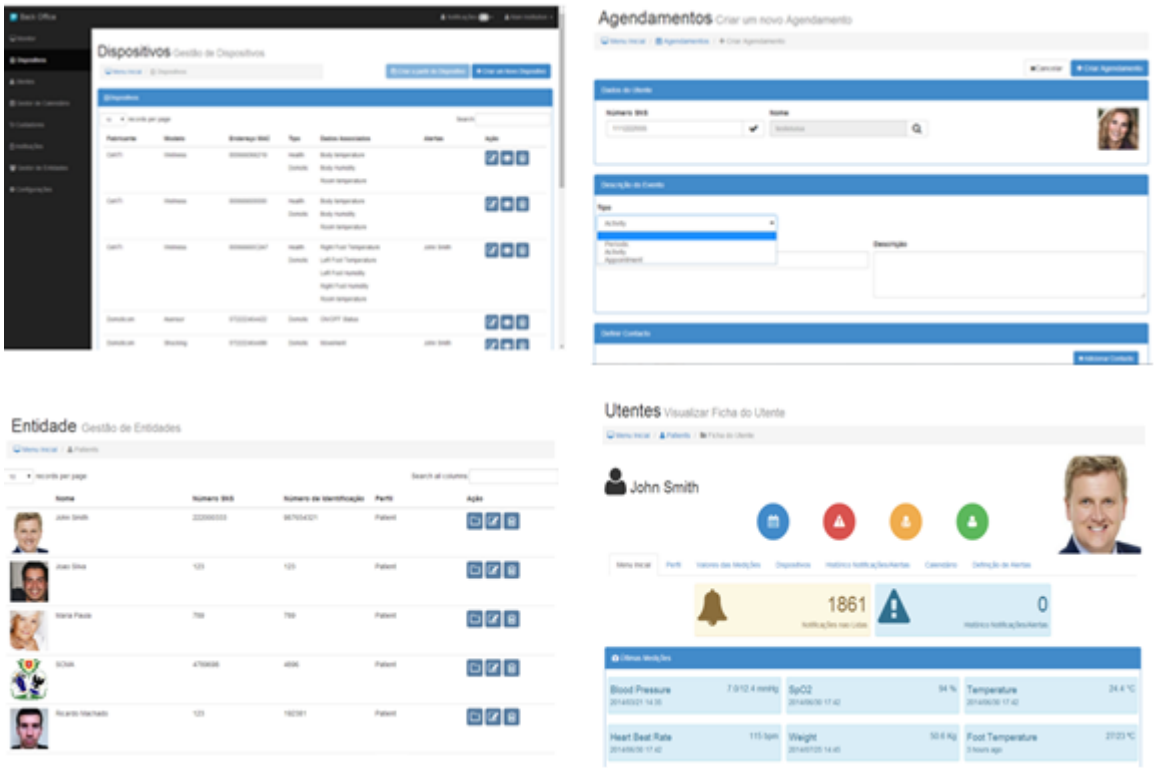


Figure 31: Amadora: back office's view

- Portal – PAD (Portal de Assistência Domiciliária)
  - Activities Management.
  - Patient Management.
  - Vital signals data control.
  - Alerts management.
  - Possible integration with a call centre

Figure 32: Amadora: Portal – PAD

#### 4.1.1.1 Specific technical requirements

- SmartHealth infrastructure's layers and requirements:
  - Application server:
    - CPU: 2 Core;
    - RAM: 16GB;
    - HDD: 100GB;
    - SO: Windows Server 2008 R2 x64 Standard Edition;
    - Outro: IIS 7 com .NET Framework 4.5.
  - Data base server:
    - CPU: 4 Core;
    - RAM: 16GB;
    - HDD: 500GB;
    - SO: Windows Server 2008 R2 x64 Enterprise Edition;
    - SGBD: SQL Server 2008 R2 x64 Enterprise Edition.
- SmartM2M infrastructure's layers and requirements:
  - RA server:
    - CPU: 2 Core (Intel E5-2680 @ 2.7GHz);
    - RAM: 4GB;
    - HDD: 100GB;
    - SO: RedHat Enterprise Linux 6.
  - SDP server:
    - CPU: 2 (Intel E5-2680 @ 2.7GHz);
    - RAM: 4GB;
    - HDD: 500GB;
    - SO: RedHat Enterprise Linux 6;
    - SGBD: PostgreSQL 9.2.
- Client's machines network requirements:
  - Connection / internet: minimum of 1Mbps.
- Infrastructure "backend" (servers) network requirements:
  - Connection: minimum of 100Mbps.
- Computer / tablet client's infrastructure:
  - Browser: IE9+, Chrome, Firefox or Safari.

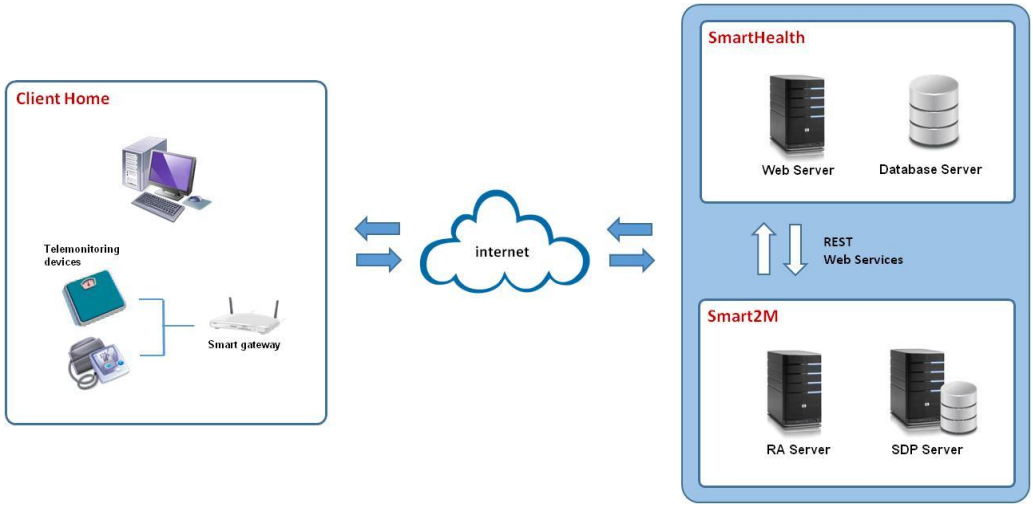


Figure 33: Amadora: SmartHealth technical requirements

#### 4.1.1.2 Client's data integration on SmartHealth

PAD is the master of client information. Every time a new client is registered or updated, PAD uses a web service to send that data to SmartHealth.

The client has a unique identification code for login on SmartHealth and for data exchange and information update.

Data considered in this service to send to SmartHealth:

Ficha Utente

| ATRIBUTO | TIPO DADOS | DESCRIÇÃO |
|---|---|---|
| **PatientID** | String | Identificador do utente no sistema de integração (exemplo: U00000001) |
| **Name** | String | Nome |
| **BirthDate** | DateTime | Data de nascimento |
| **Sex** | Char | Sexo (M/F) |
| **Nationality** | String | Nacionalidade |
| **BirthCity** | String | Naturalidade |
| **Identification** | String | Nº Identificação (BI) |
| **Address** | String | Morada de residência |
| **PostalCode** | String | Código Postal da residência |
| **City** | String | Localidade de residencia |
| **Region** | String | Distrito de residência |
| **Country** | String | País de residência |

Figure 34: Data to send to SmartHealth by Pad – client information

Lista de Sistemas de Saúde do utente

| ATRIBUTO | TIPO DADOS | DESCRIÇÃO |
|---|---|---|
| **PatientID** | String | Identificador do utente no sistema de integração (exemplo: U00000001) |
| **HealthSystem** | String | Nome do sistema/seguro de saúde |
| **HealthSystemNumber** | String | Nº de beneficiário |

Figure 35: Data to send to SmartHealth by Pad – client's health system

Lista de contactos do Utente

| ATRIBUTO | TIPO DADOS | DESCRIÇÃO |
|---|---|---|
| **PatientID** | String | Identificador do utente no sistema de integração (exemplo: U00000001) |
| **ContactName** | String | Nome da pessoa de contacto |
| **Contact** | String | Contacto |
| **Kinship** | String | Tipo de parentesco |

Figure 36: Data to send to SmartHealth by Pad – client's contacts

#### 4.1.1.3 Integration of measured data on PAD

PAD offers a web service to record the SmartHealth measurements. This service is activated every time a measurement is recorded on SmartHealth for a specific client, independently of whether the measurement is confirmed or not, although PAD will only provide the confirmed measurements.

Data considered in this service to send to PAD:

| Lista de medições a enviar | | |
|---|---|---|
| **ATRIBUTO** | TIPO DADOS | DESCRIÇÃO |
| **PatientID** | String | Identificador do utente no sistema de integração (exemplo: U00000001) |
| **Código do device** | String | Código do device |
| **Designação do device** | String | Designação do device |
| **Capability do device** | String | Capability do device |
| **Datas (inclusive data da medição)** | String | |
| **Valor** | String | Valor da medição |
| **Código da medição** | String | |
| **Estado da medição** | String | Confirmada ou não |

Figure 37: Data to send to SmartHealth by Pad – measurements list to send

#### 4.1.1.4 Consulting measurements data on PAD

PAD provides a table with a list of all the measurements on the user record previously sent by SmartHealth. It can be searched by: data range; type of measurement; measurement status (by omission, it only shows the confirmed measurements).

#### 4.1.1.5 Measurements data alerts on PAD

After receiving a measurement for a specific client from SmartHealth, PAD will check whether that measurement is above or below the normal range of the recorded data for that client, for that type of measurement. If the received measurement data is out of that range, the system will send two types of alerts for the health professional users with the profile “profissional de saúde”:

- Alert on PAD (this alert will be shown on the entry page of the portal): after authentication, and it should consider a filter of the client and the type of measurement.
- SMS alert (via GlobalChannel): the alert/SMS must show the client, type of measurement, the measurement value and the max and min registered values for the client / type of measurement.

#### 4.1.1.6 Create a new “Profissional de Saúde” user profile on PAD

If needed, PAD will provide a new “Profissional de Saúde” profile that allows them to consult the user’s records, including the measurement alerts and the measurements themselves.

The other application profiles will not have access to the client’s measurements or alerts.

### 4.1.2 Pilot mapping

The solutions are totally aligned with the BeyondSilos Building Blocks planned for Amadora pilot’s site.

**Data sharing and coordination**

- Integrated data access for care providers in different agencies and informal carers:
  - Integrated Care Record.
  - Input from health and social care actors / interfaces to different ICT tools.
  - Web-based portal.
  - Integration of vital sign / health monitoring data into care planning and management processes.

- Design and execution of pre-planned care pathways enabling coordination between steps taken by care providers in different agencies, informal carers and cared for people:
  - Training delivery / learning pathways / plans for professional and/or patient self-care training support tools.
- Access to the home: home based systems (telemonitoring and/or telecare (TM/TC)) by care providers in different agencies and informal carers:
  - Automated self-care and (older people wellness and informal carers) promotional / educational / training / planning tools.

Summarising, the solutions to be implemented will focus on the needs of BeyondSilos Amadora's pilot. The eLearning integrated solution and tele-assistance and telemonitoring solution combined with the two integrated portals "Smarthealth" and "PAD", described below, will cover all the needs:

**Smarthealth**

- Patient data file received from the portal (PAD).
- Acquiring vital signals from monitoring devices and store.
- Health indicators.
- Alerts based on patient vital signals.
- Portal notifications and text messages to the healthcare providers.

**PAD – Portal de Assistência Domiciliária (Home Assistance Portal)**

- Monitoring patient health profile.
- Receives the vital signals measurements from patient home with SmartHealth.
- Alerts defined by user profile.
- Allows integration with a call centre.

The integration of the two portals will allow immediate control of the health of the patient, with improvements in the efficiency of the management processes and scheduling of treatments, improving the user experience.

Each of the components explained has its own role when identifying what is covered with regard to the ICT building blocks of the BeyondSilos architecture, Figure 38 maps the Amadora ICT systems to the different BeyondSilos building blocks.

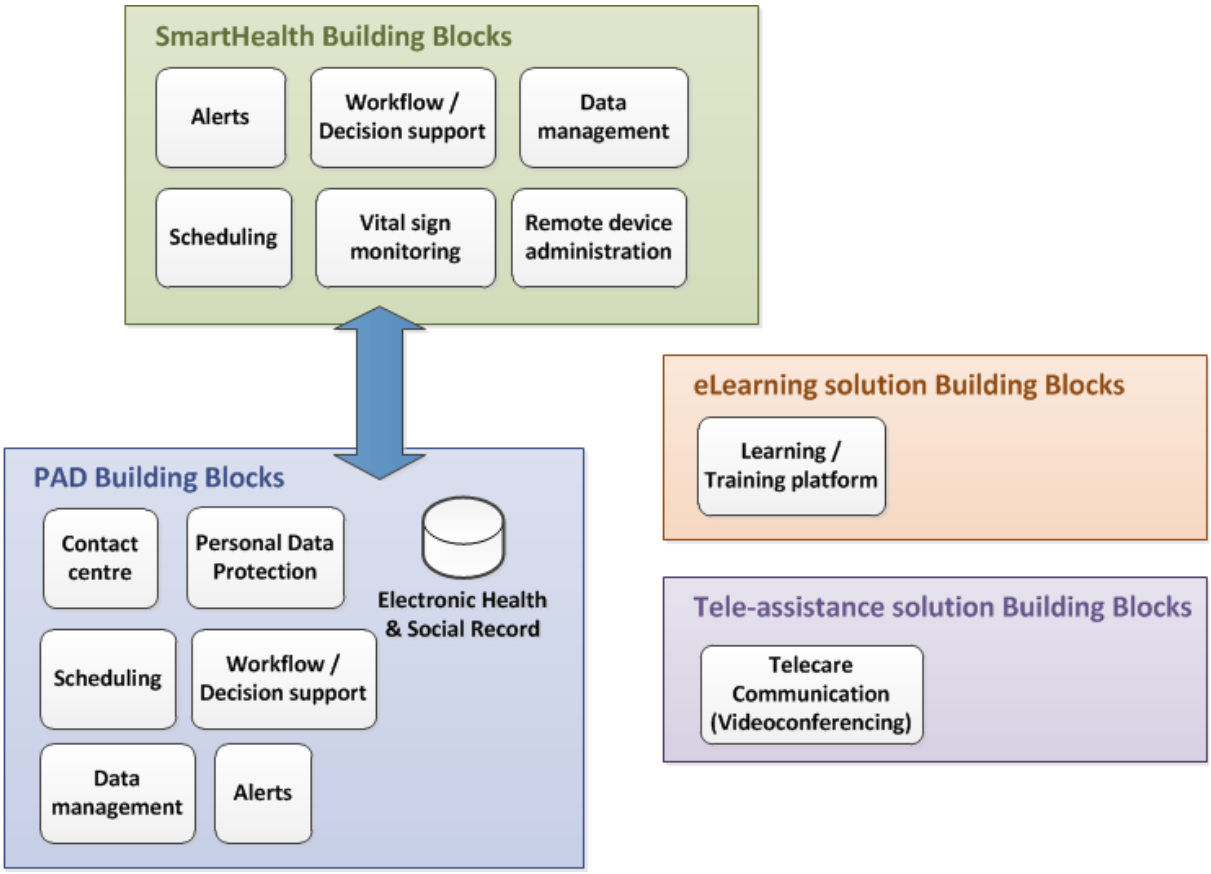


**Figure 38 Amadora Prototype mapped with BeyondSilos Architecture**

### 4.1.3 Identifying gaps

Not applicable so far.

## 4.2 Badalona pilot site

Badalona Serveis Assistencials (BSA) is an integrated private health and social care organisation with entirely public capital that manages the Hospital Municipal de Badalona, the Homecare Integrated service, the socio health centre El Carme, seven primary care centres, and the Centre for Sexual and Reproductive Health. It provides care to a total population of 419,797 inhabitants in a very populated suburban area of Barcelona.

BSA has a special characteristic that distinguishes it from all the other healthcare providers in Catalonia: it also provides social care services for the region of Badalona and three other towns surrounding it. Originally in our country, a separation between the Department of Social Welfare and Family and the Department of Healthcare has existed. In terms of welfare, this separation has not proven to be the most suitable to provide effective and quality care to the patient who receives both types of care simultaneously. Because of that, from BSA and with the support of Badalona's Council, it was decided in 2000 to change the conceptual model, focusing it on the patient. This model was carried out at the operating level by transferring social services to BSA, a company originally dedicated to the provision of health services, thus obtained the perfect fusion between the conceptual and operational level.

The union of the older healthcare-oriented infrastructure (the Geriatric Department) dealing with all kinds of elderly typologies ranging from the healthy, the frail, ill, dependent or those in a late stage of life, along with a public Social Service department, renders BSA able to complement health-related interventions

with social assistance on a level of almost unprecedented process consolidation. This situation, as a whole, effectively makes BSA work as an integrated care organisation, not only taking into account the transversality among assistance levels, but also being able to deal with and manage the complete social welfare situation among the whole reference population. The structure of the organisation is formed by a Primary Care unit, administering a reference population of 114.347; the Hospitalisation unit, located at the Hospital Municipal de Badalona; the Socio-Health Care unit and a Home Care Service; and all supported by state-of-the-art technology.

BSA is involved in a number of research and innovation projects, both national and European, dealing with the development of new services for their target population with the support of ICT, including all types of telemedicine and e-health solutions. BSA is constantly aiming to improve the services offered to the population that it is responsible for. In the last five years, the complexity of wellbeing related problems has greatly increased, especially in the social care area. The geriatrics, psycho geriatrics, neuropsychiatry, convalescence, rehabilitation and palliative care specialties are currently being complemented by several programmes that have been put in place in order to improve the services provided.

BSA has been providing social and health care services in an integrated way for quite a long time now, but there is still a long way to go. With BeyondSilos, BSA aims to better integrate the measurements that patients are taking at home with the corporate electronic medical record (EMR). Another challenge that BSA would like to achieve during the project timeframe is opening specific subsets of its EMR to the third sector organisations surrounding it, in order to increase the effectiveness of the integration beyond current levels.

### 4.2.1 Pilot IT Infrastructure

BSA implements the following ICT components in its system:

- **Social Care Record (SCR):** Which is a self-development meant to manage all the social data.
- **Electronic Health Record (EHR):** Presented by three commercial products used in each of the healthcare levels (OMI-AP for Primary Care, Gesdohc for Specialised Care and TESIS-HCE for Residence) and another commercial product used as a telemonitoring solution (HIS platform).
- **Integrated Care Record (ICR):** Which is a self-development meant to manage the Homecare Department.

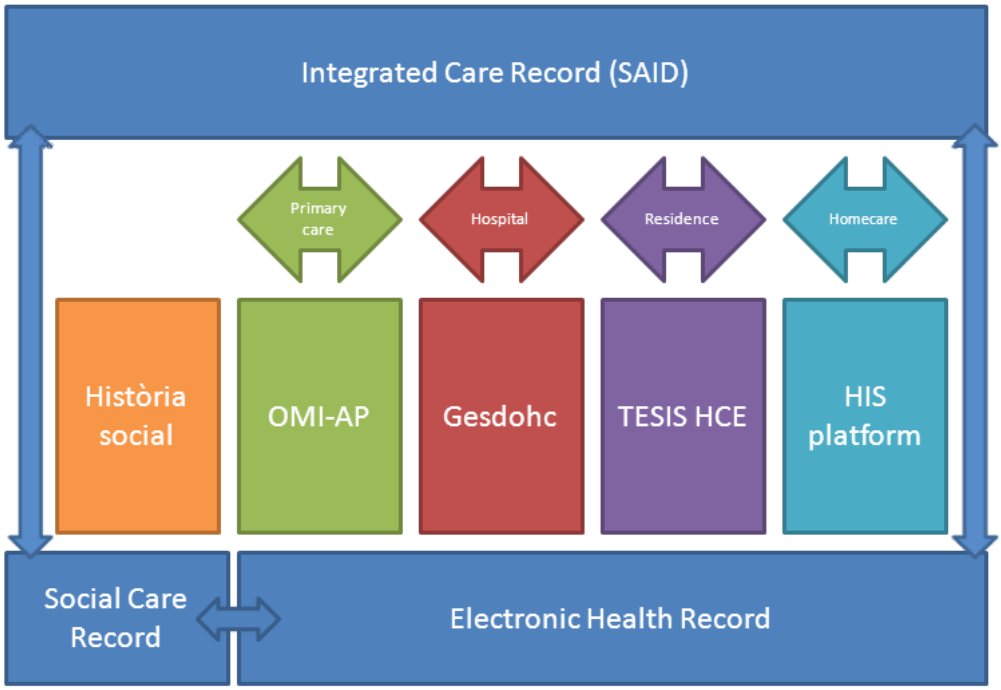


Figure 39: BSA ICT components

**Social Care Record: Integral management tool for the social-related data**

The Social Care Record was developed by the ICT Department of BSA in 2000, when the City Council decided to entrust to it the management of the social services, following the strategy to convert BSA into a paper-less organisation, while up to that point all the social-related documentation was hold by the City Council in paper.

Social Care Record has the main objective to be the central point to hold all the social-related information from patients in BSA's sphere, accessible from any workstation within the organisation.

The system includes the following functionalities:

- **Administrative module: Demographics and economical information**

  This module holds all the demographics information from the user and caregivers. Furthermore, it includes all the economic data from the family unit, which is really important when evaluating the level of dependency and frailty of a single user.

- **Administrative module: Management and agenda**

  The different enabled services are managed within this module. In addition, it includes the scheduling of the different activities to be delivered, and the teams involved within the process.

- **Care module: Social Record**

  This is the central point where the social and family workers do the follow up of the different activities related to a given user through evolution reports.

- **Evaluation module: Zarit Index (reduced version)**

  This functionality allows the social workers and case managers to calculate the Zarit index.

- **Evaluation module: Socio-Familiar evaluation (Gijón Index)**

  This module evaluates the level of support that the family unit has amongst all the people who live in the same household through the Gijón Index.

**Electronic Health Record: OMI-AP, Gesdohc, TESIS-HCE and HIS Platform**

OMI-AP, Gesdohc, TESIS-HCE

Those first three components are the central repository for all the health-related information about each individual patient regarding the three levels of healthcare. They contain all the clinical data, but not the administrative data (including diaries & schedules) which is hold by the corporate ERP (SAP). They are all interconnected with the different ancillary systems (such as pharmacy, surgery, digital imaging, emergency triage, etc.) through the integration of SAP-PI (formerly SAP-XI).

The three software platforms are fully integrated with each other, and track all the activities done by the different care professionals interacting with them in order to guarantee continuity of care. This integration process is also done through SAP-PI. The architecture is really complex, see Figure 40: BSA Architecture.

The different ancillary systems cover:

- Diagnostic imaging.
- Laboratory.
- Pharmacy.
- Anaesthesiology and recovery.
- Surgery.
- Emergencies triage.
- Nursing management.

Through this comprehensive set of systems, all the needs of the different care professionals are covered; everything works in a paperless environment, which has significantly reduced the costs in terms of time and materials, while improving access to data.

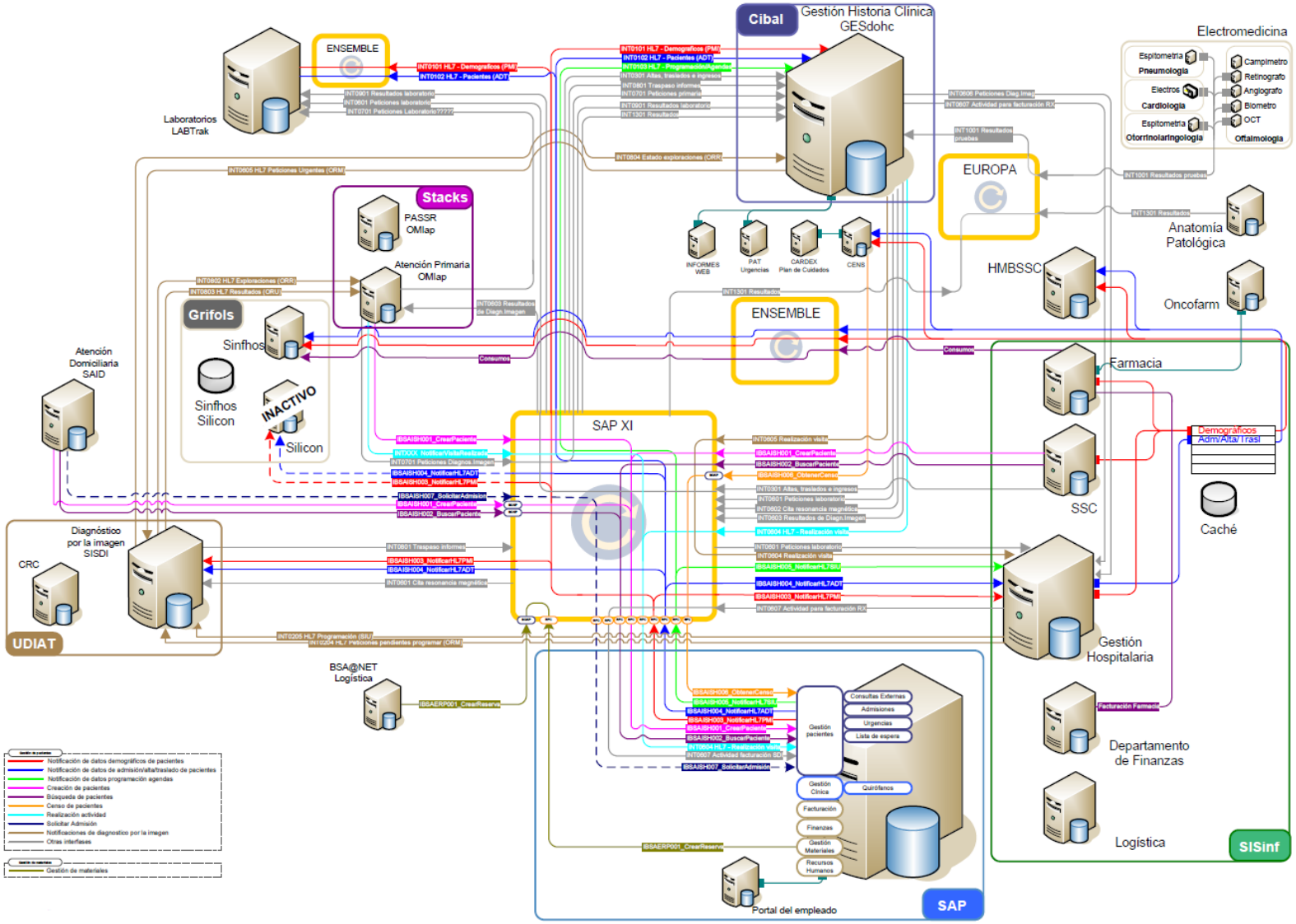


**Figure 40: BSA Architecture**

HIS Platform (HIS Portal)

This software supplies the medical and social service organisations with the necessary monitoring data, analytical tools, and communication procedures that enable the efficient planning, coordination and delivery of their services in the home environment.

All solutions can be integrated into the overall system, and can be managed and controlled from the role-model based HIS Portal.

The web-based HIS Portal is a tool that supports medical practitioners, care providers, administrators and technical staff. It receives the measurement data from the different HIS Gateways. The patients' data is stored for further consultation by authorised users, and can equally be used for analysis.

Notification threshold, trend alarms and communication channels can be adjusted individually for each citizen or each group of citizens. This feature allows preventative medical provision at the very moment that the monitored individual's state of health requires it. Individualised measurement schedules can also be set.

Automatic pdf reports can be sent to a predefined email or fax on a daily, weekly or monthly basis, e.g. to the doctor, to give a summarised overview of the measurement data.

The HIS Portal can also be used to enter notes that are visible to the other carers, or to attach documents, e.g. X-rays.

Multiple definable user and access authorisations safeguard sensitive data. It is possible to interface the HIS Portal to other systems such as Electronic Health Records.

The HIS Portal provides the following features:

- Administration management: management of users, patients, mobile devices, etc.
- Patient management: management of patient information, medical data, etc.
- Role model management: set up of access rights.
- Warning management: set up of warnings, conditions, transmissions, notifications etc.
- Monitoring data management: overview of data received by the HIS Portal.
- Report management: creation of reports with medical data or environmental data from patients.
- Configuration, set-up and device management: configuration mobile solution etc.
- Application management: reminder settings, videoconference, questionnaires etc.

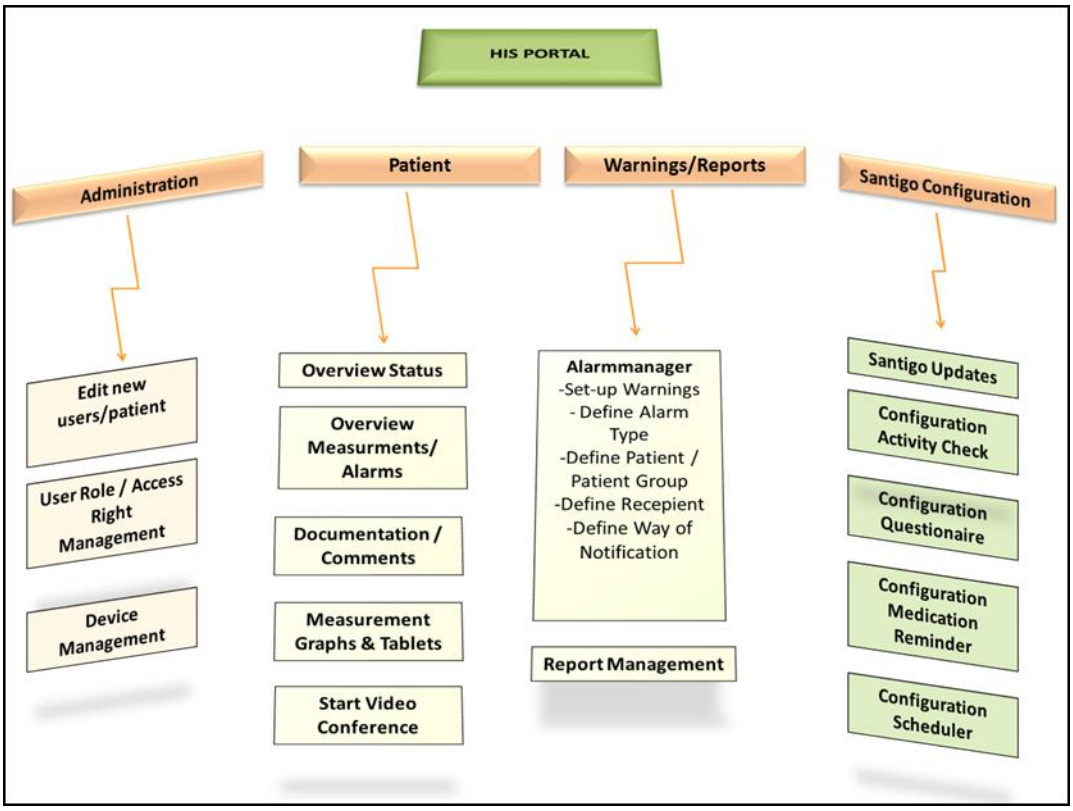


**Figure 41: HIS Portal: functionalities overview**

The most interesting features to define in more depth are the following:

- **Administration Management**

  "Administration Management" is an important tool in the organisation of the HIS Portal and the connected tablets / mobiles and vital monitors.

  - An overview of all patients, users and tablets / mobiles;
  - An overview of the existing user roles;
  - An overview of the registered users;
  - An overview of all patients;
  - An overview of all connected gateways;
  - System information;
  - Mobile Option configuration tool.

  The main features of the administration section are the possibility to:

  - Add / edit / delete patients;
  - Add / edit / delete users / administrators, their access and their passwords;
  - Add / change / delete users' rights and role models;
  - Assign gateways to users;
  - Add / delete folders and patient links.

- **Patient management**

  The patient management section of the HIS Portal is designed to organise information about the patient; it contains all measurement data.

  An overview chart in the patient sections displays the latest measurements with a time stamp, and the connected vital monitors. It also shows if the last measurements were in range or if they triggered an alarm. All active alarms are displayed as well.

The HIS Portal offers different administration tools which support and help to structure, administer and manage the Santigo Solution, patients, devices and incoming data.

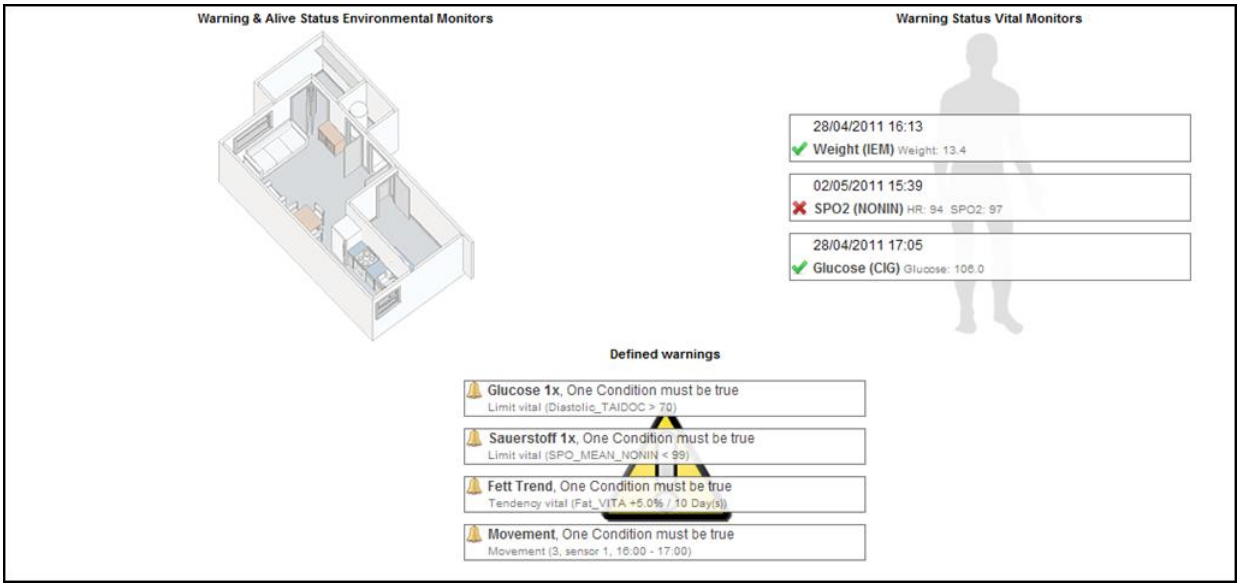


Figure 42: HIS Portal: alarms overview

- **Behavioural analysis**

  The innovative Behavioural Analysis of the HIS Portal is based on different data which is collected by the different sensors. This could be a powerful tool help to minimise risk and optimise the service an elderly person needs.

  The in-house observation of movements is performed by collecting motion events using motion detectors in different rooms of the living environment. Every motion detector sends detected motion to the HIS HomeBox. The HIS HomeBox collects the single events, and sends them to the portal on an hourly basis. In the portal, a rules engine compares the movement pattern. If there is an irregularity out of the predefined range, a notification is generated and an alarm is triggered.

  In a first step, the software will identify and learn the standard motion pattern of movement in the home. This “learning step” will be done for every person individually, to identify the pattern. In the so-called "recall phase", the identification of a specific pattern is done automatically. For a better granularity in defining rules to trigger alert messages, it is possible to set parameters that control the sensitivity of the detection.

  The movement pattern can be also combined with other data which is collected by the monitoring system. For example, vital measurements done in a predefined timeframe, reaction times of cognitive training games, results of door open/close monitors, etc. Every single parameter will be added to the analysis, and will help to refine the prediction.

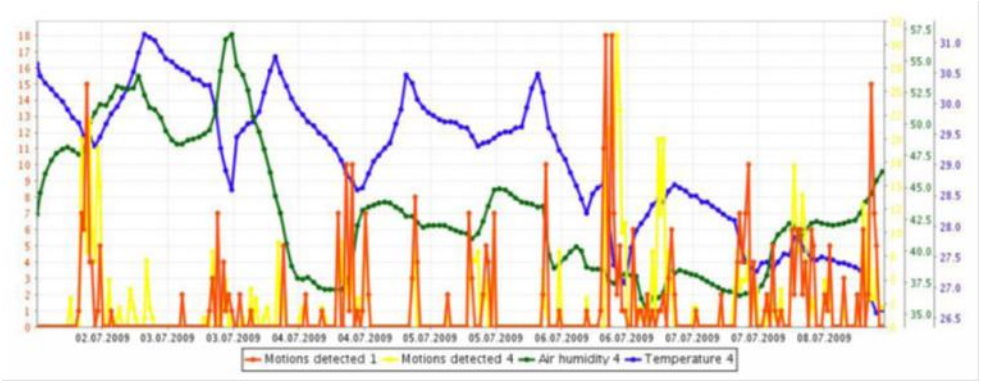


Figure 43: HIS Portal: behavioural analysis

The general overview of the architecture of the HIS Portal is shown in Figure 44.

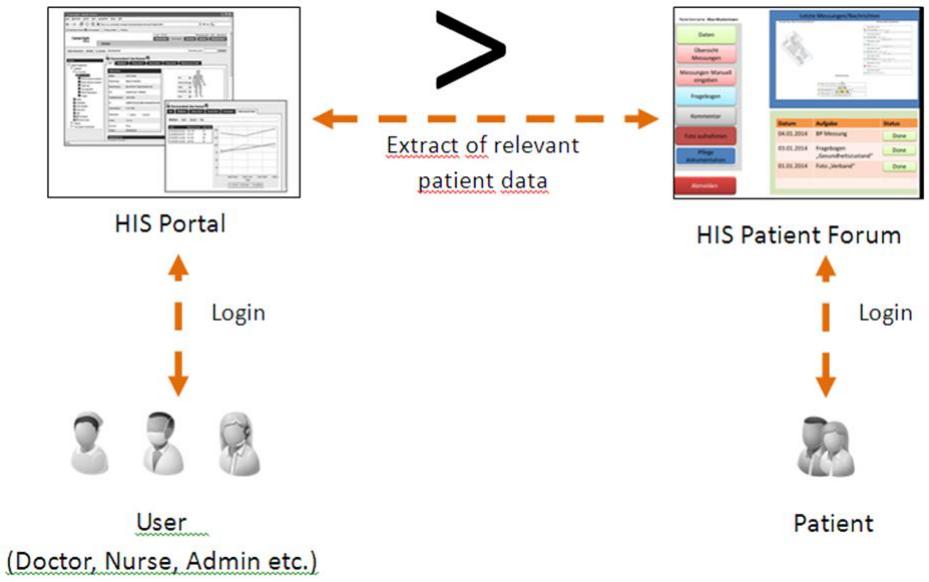


Figure 44: HIS Portal: general architecture

**HIS Santigo**

Up to this point, only the back-office of the solution has been shown; this is the one used by professionals. For patients, the proposed solution to interact with the HIS Portal is HIS Santigo.

With the HIS Santigo application, Health Insight Solutions provides a telehealth solution based on Android technology which can be run on Android based tablets or mobile phones.

It was developed specifically for citizens with chronic diseases, older people, and patients in rehabilitation.

In combination with the HIS Portal, the Santigo application provides the following care function modules, which can be combined depending on the requirements of the care process:

- Vital Measurements.
- Measurement History.
- Videoconference (optional).
- Medication reminder (optional).
- Activity check (optional).
- Questionnaires (optional).

HIS will provide a downloadable application, which can easily be installed on the tablets which fulfil the technical minimum requirements (e.g. Android 2.2 or higher, and Bluetooth 2.0 and higher). All tablets / mobiles will be set-up automatically in the HIS Portal, and can then easily be linked to a patient.

The user-friendly administration of the solution, the easy to handle management of patients and devices, and the scalability as far as roll out is concerned, allows a successful integration into the health infrastructure.

Last but not least, the HIS Santigo solution and the HIS Portal allow to combine the single patient solution with a multi patient solution (Santigo Care) which was especially developed for caregivers. This flexibility

enables institutions to meet their requirements regarding different roles of caregivers and citizens within a project, as shown below.

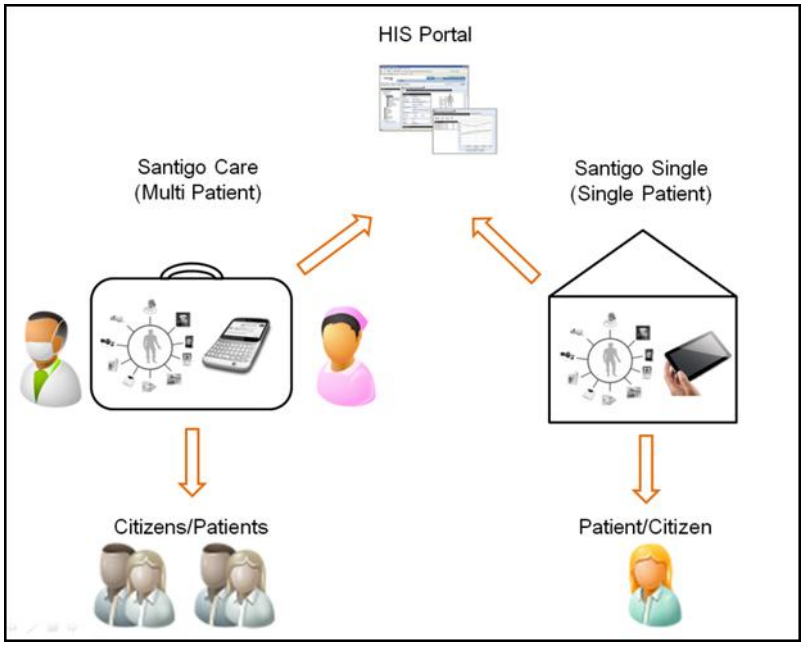


**Figure 45: HIS Portal**

Figure 46 below shows the technical architecture of the HIS Santigo Solution based on a tablet application.

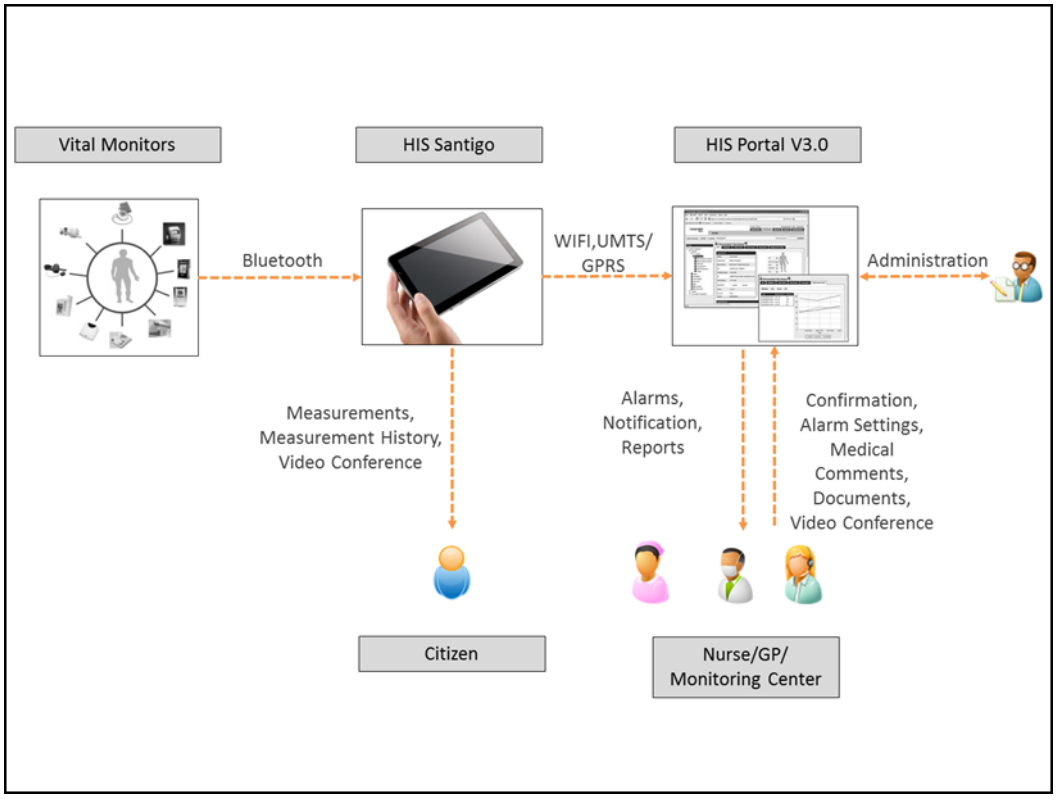


**Figure 46: HIS Santiago Solution: technical architecture**

**Integrated Care Record (SAID Software)**

The Integrated Care Record is the most important software ICT component required to achieve the integration between social and health services. It is a self-developed web-based software layer that sits in between the Electronic Health Record and the Social Care Record; it acts as the single point of access for all the homecare related activities, providing a comprehensive tool which is managed by all the professionals within BSA, but also giving access to external providers depending on access permission by roles. One can say that the Electronic Health Record and the Social Care Record feed this software layer with all the information already available, which is enriched with new information related to the homecare provision in the Integrated Care Record.

From BSA, all professionals are able to access it through links within the three Electronic Health Records, and also from the Social Care Record, and for external providers directly through the public website accessible from outside the organisation.

The functionalities of the platform include:

- Patient management: admission, discharge, temporal discharge, etc.
- Patient assessment and evaluation: through Integral Geriatric Evaluation deployed by Case Managers.
- Patient scheduling and interventions: according to enabled services and homecare teams.
- Billing module: according to provider when applicable.
- Pre-defined integrated pathways and programs.
- Comprehensive access to shared care plan: depending on permissions by role, and including all the involved stakeholders in the process of care giving from health and social professionals to third party organisations and even the City Council.

In addition, the services that can be requested to be enabled are:

- Dependency care.
- Chronic processes: represented by different programs and pathways.
- Acute processes: represented by different programs and pathways.
- Geriatric patient care.
- Palliative care.
- Health promotion.
- Information and access.
- Social services: including panic button, meals at home, integral home help, laundry at home, home fixings and repairs, emotional guidance provided by third sector care professionals, cleaning at home, and GPS tracking for patients impaired by dementia.

Finally, Figure 47 shows the inclusion, assessment (through the Case Managers) and enrolment process of a patient into any of the homecare services which are available.

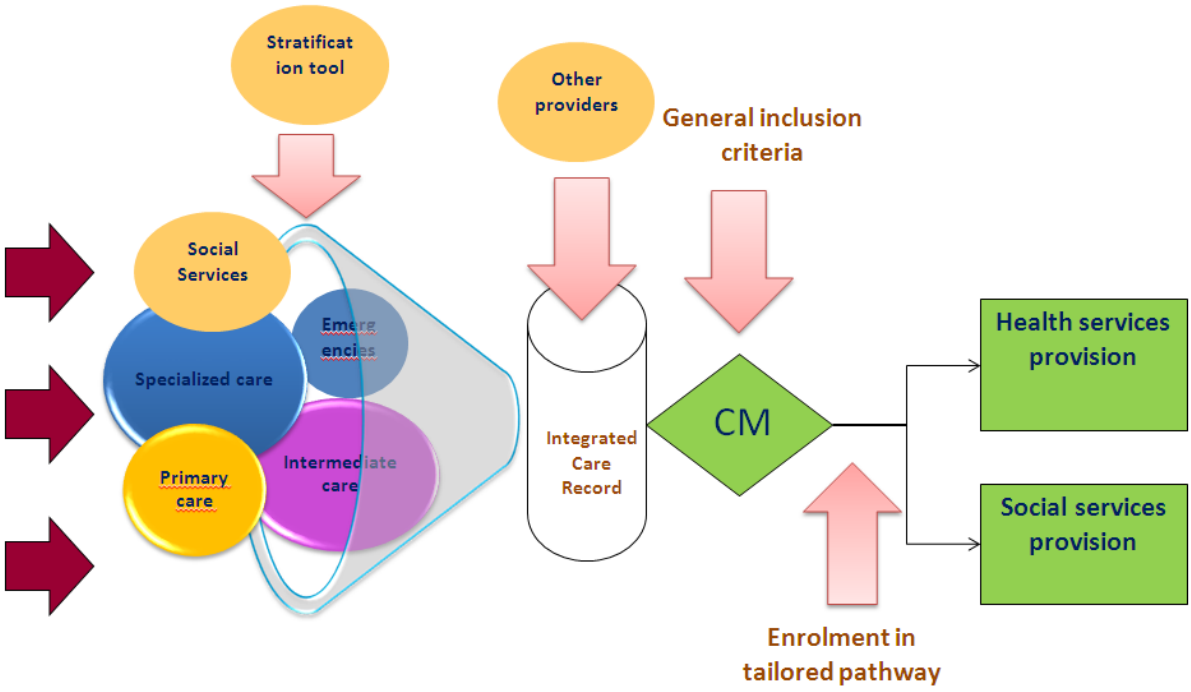


Figure 47: Integrated Care Record (SAID): inclusion, assessment and enrolment process

### 4.2.2 Pilot mapping

Each of the components that have been explained in the previous section has its own role when identifying what is covered with regard to the ICT building blocks of the BeyondSilos architecture. Note that the Integrated Care Record plays a central role in such an environment. Figure 48 maps the BSA ICT systems to the different BeyondSilos building blocks.

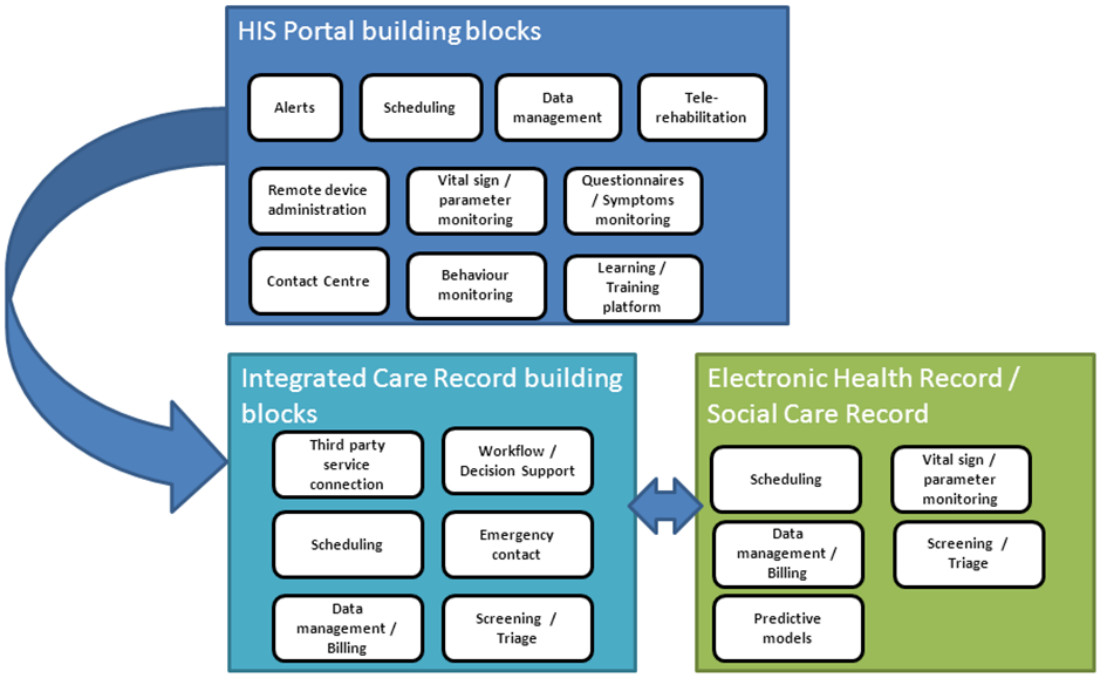


Figure 48: BSA prototype mapped with BeyondSilos architecture

The BeyondSilos building blocks, and the BSA system components that meet / comprise the building blocks, are as follows:

- **Electronic Health and Social Record**: as already mentioned, the ICR is a central point for the Badalona pilot site.
- **Triage:** the triage methodology is implemented at two levels: the Electronic Health Record has a specific component for triage in emergencies, and the Integrated Care Record has a component used by the Case Managers to enable or disable certain services according to patients' conditions.
- **Data management:** the central repository for demographic data is SAP (which is not shown in the figure), while the other three systems take it from there and replicate it when necessary. The EHRs contain billing information which is sent to SAP regarding the financing of the Catalonian National Health Service, while the ICR contains billing information for the third party organisations participating in the process of care, and for the patients having any co-payment according to their specific conditions for the social services they receive (this billing is sent to the City Council which is the one which receives the payments). Finally, the HIS Portal has only administrative data to make the platform work.
- **Predictive models:** the EHR implements a predictive model which is able to detect one year in advance those users who will become large consumers of resources. The system is a self-developed software tool, including chronic conditions, pharmacy consumption, hospital admissions, gender issues, and frailty criteria (including social aspects), which is able to classify the population in advance in order that the homecare teams can start to deal with them in advance.
- **Third party service connection:** the ICT component is designed to allow third party organisations collaborating in the provision of care to access some sub-sets of the ICR, including health and social related data. In addition, the different stakeholders can access the shared care plan through the ICR, and see the provision of care through a comprehensive picture of the activities being carried out for a single user. Finally, the involved third party organisations, which have some billing associated with the services they provide, can see the activity on a monthly basis and the costs associated with it.
- **Scheduling:** this tool is available in the three systems shown above, with the following particular characteristics:
  - **EHR / SCR:** appointments at outpatient consultations with specialist physicians and nurses. Also the visits with GPs at the Primary Care centres. In addition, all the different diagnostic tests (including laboratory and X-ray imaging test) are managed through the scheduling tools of the three EHR systems.
  - **ICR:** in this system, the scheduling is related to the interventions being done for a single patient. A shared care plan is provided, including all the information on the time and the interventions deployed by the different homecare teams (either social or health), plus the activities carried by third party organisations, such as third sector care organisations or private companies.
  - **HIS Portal:** in the telemonitoring solution, there is an ICT component which proposes a schedule for the different activities that the patient should be carrying out. Those activities may be recommendations made by the physician or the social worker, but may also include reminders about appointments set by the informal caregivers.
- **Workflow / Decision Support:** even if the EHR incorporates plenty of clinical decision support software tools (CDSS), none of them is applicable within the BeyondSilos architecture. On the other hand, within the ICR, once a user is admitted into a specific programme, a workflow engine is triggered which enables the specific services predefined for such a situation. For example, a patient who has gone under a hip fracture will be discharged in three days from the hospital; once admitted into the homecare setting, the short term pathway will be enabled, activating social resources (a family worker to help at home) and the nursing teams (to do the care). Later on, a rehabilitation team (formed by physiotherapists) will be enabled to finish the intervention.
- **Tele-rehabilitation**: HIS Portal component has a specific module for this purpose, where physical or cognitive exercises and status-related questionnaires are prescribed to patients, and could be monitored through the module with the objective of providing remote rehabilitation services.

- **Learning / Training platform**: evolution of the healthcare systems put a great emphasis on patient empowerment and self-care. One may consider that this module is very slightly implemented within the HIS platform.
- **Behaviour monitoring**: this module has been already used in BSA in another pilot with the HIS platform. In the case of BeyondSilos, there will be a "softer" behaviour monitoring through the use of pedometers.
- **Vital sign monitoring**: this building block is implemented by the HIS Portal and the EHR component:
  - **HIS Portal:** this component provides an interface for the communication of data between devices and HIS Santigo (tablet PC at patients' home with the medical devices attached). These interfaces meet the requirements for medical devices to be able to be connected. Data is collected to be used to evaluate alerts in the HIS Portal.
  - **EHR:** in this case, the component is only a link within the HIS Portal and the three Electronic Health Record systems available at home. The integration is soft, and allows checking vital data by just clicking once on the patient who is already selected.
- **Emergency contact**: this building block is implemented by the ICR, which contains all the contacts to be enabled when something goes wrong.
- **Questionnaires / Patient evolution**: ICT tool helping to manage the evolution of the patient, from a professional perspective with validated questionnaires, and from informal care givers perspective with subjective evaluation questionnaires. These patient evolution questionnaires should measure different aspects such as general health status, adherence and personal autonomy, and health.
- **Remote device administration**: management of medical devices, home automatic actuators, environmental sensors, and any kind of device monitoring parameters of the patient or his/her environment. The HIS Portal is capable of managing all of these, but there will only be interaction with medical devices within the context of the BeyondSilos project.
- **Safety / ambient monitoring**: this module is not implemented in the Badalona pilot.
- **Alerts**: the Alerts building block is implemented in the component HIS Portal. Depending on pre-set conditions for each patient in their alerts plan, the alert function in the HIS Portal component is responsible for determining if the newly received data generates an alarm that should be checked by a professional. The module stores raw data (vital signs, questionnaires, etc.) and once stored, proceeds with the calculation of complex indicators. In addition, the HIS Portal is also able to pop up alerts when the batteries of the medical devices are not working.
- **Contact centre**: contact centre building block is implemented by the HIS Portal component. This module offers a complete contact centre to manage all patient data (administrative, health and social) and offers a contact point for home monitored patients.

### 4.2.3 Identifying gaps

The missing ICT building blocks are mainly two:

- **Third party service connection:** this configures and deploys within the ICR the access for the Third Sector Care organisations that have agreed to participate in the BeyondSilos project. Two organisations were already participating with BSA, but in an informal way; only some professionals took advantage of their services. In the context of the project, their service will be made available through the ICR to every professional.
- **Vital sign / parameter monitoring:** the HIS Portal is a solution that was already used in another pilot project in BSA. In the BeyondSilos project, the interfaces will be improved, achieving a better integration with the EHRs. Even so, the vital sign / parameter monitoring building block it will cover everything for the telemonitoring solution.

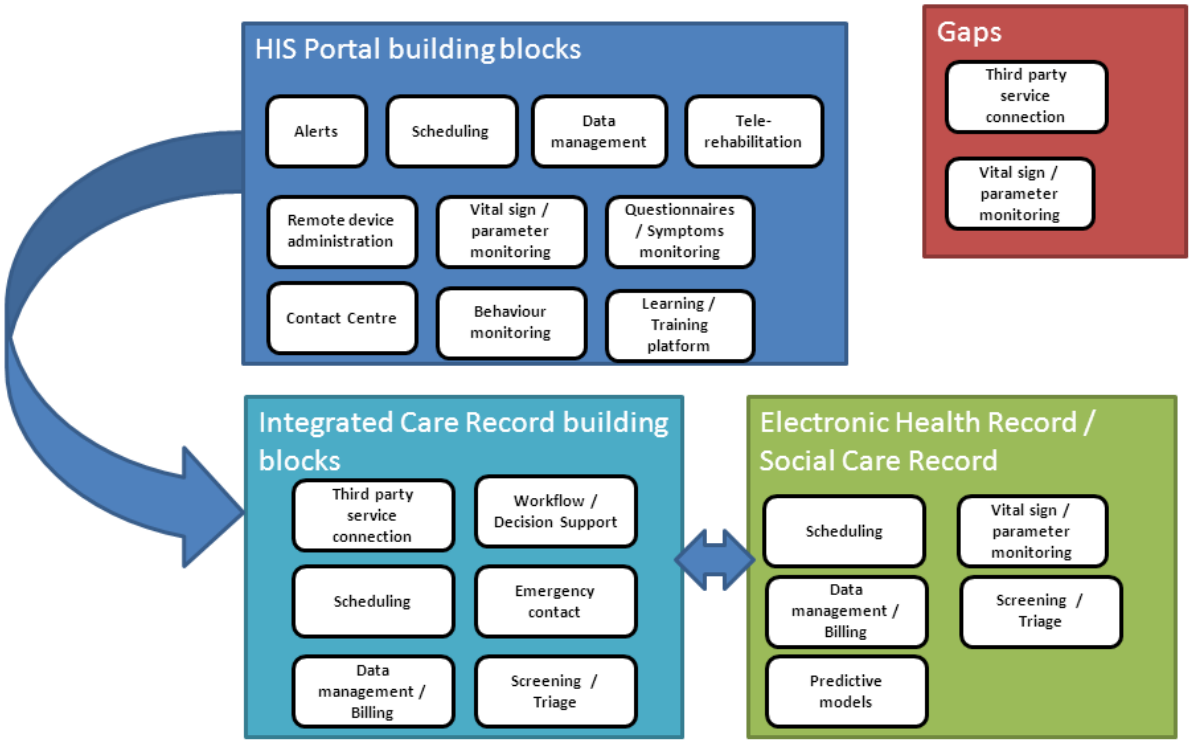


Figure 49: BSA prototype GAP analysis

That would end with a picture like the following one:

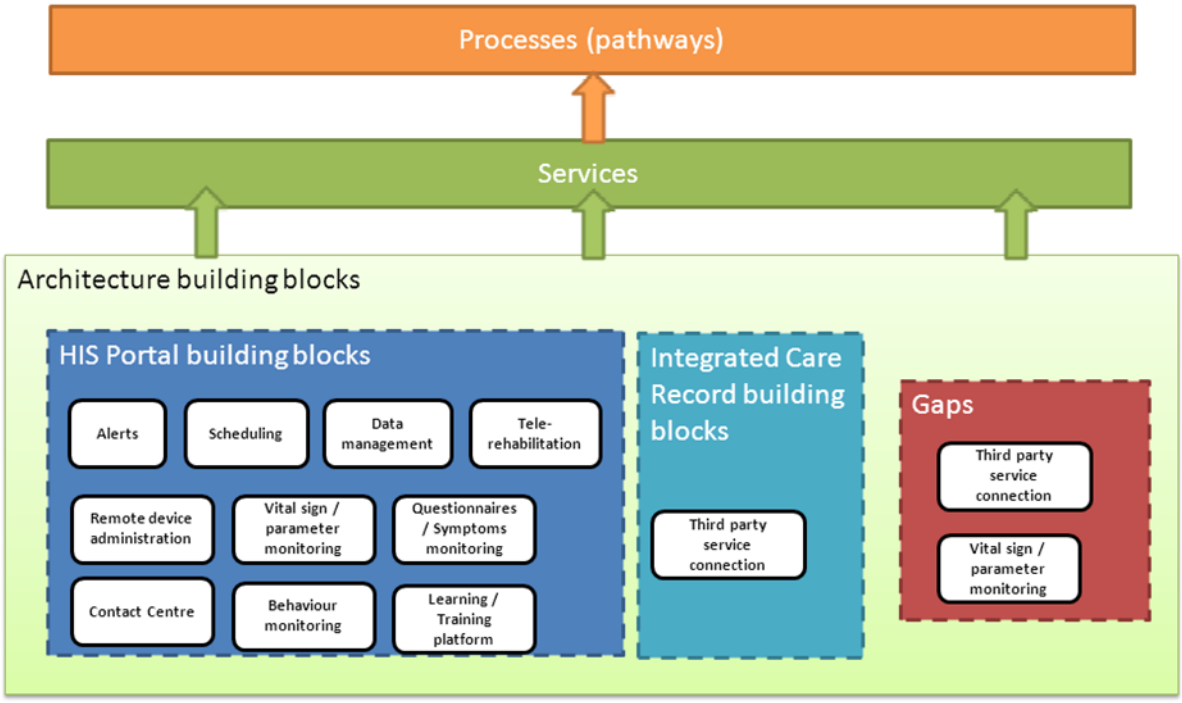


Figure 50: BSA Prototype: GAP analysis and pathway identification

## 4.3 Campania pilot site

Campania Pilot site is organised around two specific areas of the Campania region, Naples and Salerno. Its specific aim is prevention of cardiovascular diseases, such as stroke and myocardial infarction, by the use

of ICT to collect and monitor patients' data and health. This site is located in two specific centres hosted by Federico II University of Naples and University of Salerno, where it coordinates GPs, secondary and tertiary care, hospitals and specialised healthcare centres. Specifically, this site provides the CampaniaSalute system, whose backbone ICT infrastructure is Wincare, the infrastructure that is present in the hospital, and Webcare, a web based application that allows remote access to patients' data in the hospital. Wincare and Webcare represent an integrated environment , which uses computer technology as a web access system to a container of clinical data, and the Internet as a network connection between the various centres and between the centres and GPs, with software Wincare (TSD -Projects) as a system of integrated medical records. The system connects the Centres for Diagnosis and Treatment of Hypertension located in Naples and Salerno with the other specialist centres located in the Campania region, as well as GPs. The Centre inserts into the electronic archive the clinical data on all types of services provided (mainly visits, monitoring 24 hours to blood pressure and ECG, laboratory examinations, specialist examinations, laboratory tests, including also ultrasound images and electrocardiograms performed, allowing an electronic health record for each patient. Each centre can have complete access to patients' data, and uses a specific access code (PIN), through which patients can be identified throughout the system, allowing viewing and updating of their clinical data. In addition, the patient can also have access to the different centres included in the network.

At the same time, patients can update their clinical data (symptoms, blood pressure, cardiac frequency, etc.) and biochemical parameters in order to achieve a self- empowerment, and allowing doctors to adjust the medical prescriptions. With BeyondSilos, Campania pilot site wants to implement the CampaniaSalute Wincare / Webcare system with home monitoring devices, and electronic health and social care records, both in primary care and hospital; in particular, for those people with a high probability to incur major health problems, including those in need of social assistance. The Italian welfare system provides a system of interventions and health services offered at home (ADI), which is characterised by the integration of the services offered, related to the nature and the needs it addresses; it is also based on the combinations of interventions designed and managed by multidisciplinary professionals. Continuity of care offered by the several professionals involved (health, social workers, physical therapists, pharmacists, psychologists, etc.) ensures the sharing of objectives and responsibilities, and establishes the means and resources needed to achieve results. This home care thus comprises different types of assistance that are divided into different levels, distinguished according to their degree of care intensity, the number and specific professional competence of the operators involved, to profile the person to whom they are addressed, the method of work of the operators, and finally at the operational level the integrated territory involved.

Campania pilot site has recently made agreements with the local ADI of Salerno and Naples in order to identify people who can benefit from the integrated care (health and social) monitoring service.

### 4.3.1 Pilot IT infrastructure

Campania pilot site has implemented its ICT components with the collaboration of HIM SA (Health Information Management S.A.) for a tele-monitoring solution. The different components implemented are shown in Figure 51 below.

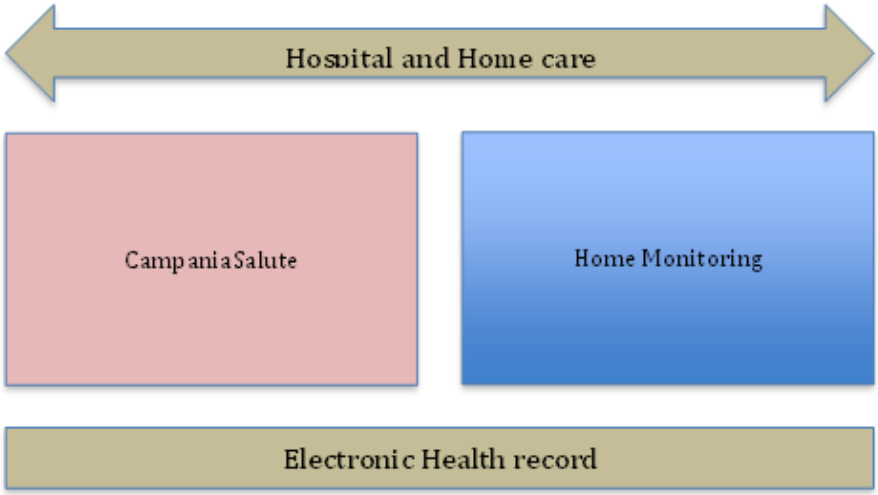


**Figure 51: Campania: ICT components**

#### 4.3.1.1 CampaniaSalute

This is the central repository for health information about each individual patient regarding primary care activities. It contains all the clinical data of the primary care system for each patient.

The software tracks all the activities carried out by professionals; it is also the single point of access for all the stakeholders involved (internal and external, with different access roles).

CampaniaSalute has as its main objective to interconnect centres with primary and specialised care Information Systems in an integrated manner, providing administrative functions (appointments, agenda, etc.) and management of the assistance process.

All the clinic and administrative information is centralised and available from any point of the assistance network (surgery, primary care centres, specialised centres and hospitals), through the Electronic Health Record.

**Administrative modules**

CampaniaSalute component incorporates five sections for the administrative management of the patient's data: patient file, patient admission in the system, suspensions, reactivations and discharge at the end of the attention.

Patient's data

User can upload patient's data into the system including:

- Personnel data: name, surname, age, gender, associated image.
- Contact data: address, phone number, and other data.
- Health information related to the patient and care centre: health identifications, national insurance number, etc.
- Other data: allows adding other interesting data of the patient.

Admission

Once the patient has been admitted into the system, this section allows assigning the patient to the professionals in charge of him/her, and indicating the diagnosis and risk factors. It also allows association of devices and first appointments.

Discharge

When the attention and follow-up of the patient has concluded, the user will discharge the patient from the system through this section, indicating the reason.

**Repository of patient care plan templates**

The system allows storing templates with a specific configuration of care plans. These templates are specifically defined for each scenario of use of the system, and are usually prepared in collaboration with qualified health professionals. These templates include protocols for patients monitoring based on their pathologies, configuration of personalised alerts for each patient profile, and interventions associated with each of the states which can be an alert.

#### 4.3.1.2 Home Monitoring

The development status of the telemonitoring platform (called Home Monitoring) to be used by Campania site in the BeyondSilos project is ongoing. It includes:

- Professional workstation.
- Patient's workstation.

It allows measurement monitoring (weight scale, blood pressure meter, pulseoximeter, amongst others), questionnaires, education contents and empowerment tools, diaries, appointments, medication, etc.

The telemonitoring platform (Home Monitoring) consists of different components that work in a coordinated manner:

- List of work.
- Patient summary.
- Care plan configuration module.
- Care plan planning modules: monitoring, medication, appointments and physical exercise.
- Actuation module.
- Alert assessment.
- Communication interfaces.
- Administrative modules: income, admissions, patient data, discharge, re-admissions.
- Workflow engine.
- Repository of patient care planes templates.

**List of work**

This element includes a list of work for health personnel supervision and management of patients. This list shows users all assigned patients for their management, and prioritises them according to the alert status that has been generated from data received from patient devices (monitoring different vital signs).

The patient pathologies are listed in this section, represented by a set of descriptive icons and colours based on the seriousness of the data.

**Patient summary**

This module presents all historical data related to monitoring, questionnaires, medication, etc. that are collected from the patient via devices (monitoring different vital signs) or directly by a professional. Data that can be reviewed (in different formats, graphics, tables, …) in this module are vital signs related to alerts, symptoms from questionnaires, indicators calculated from basic or compound vital signs, and a

summary of the patient medication. The module is configurable depending on the interests of the end user and the scenarios raised; the final user can remove and add those modules interesting for him/her.

**Care plan configuration module**

This component allows the user to configure the range of indicators, templates for decompensation phases in the monitoring plan, alerts and variables to be displayed in the "patient data" section; in other words, this component supports configuring the care plan for the patient.

**Care plan planning module**

This module holds prescribed care plan activities; the activities are categorised as monitoring (measurements and questionnaires), appointments, medication and physical exercise.

The monitoring module sets the frequency at which the patient must perform measurements and questionnaires, and which ones. Appointments allow professional have a scheme of control for contacts with patient. The medication module records the pharmacological treatment that the patient receives, and which serves as additional information for health professionals, reminders to take the medication in patient's home, and compliance with the treatment checklist. The physical exercise module sets which exercise should be done by the patient, and at what frequency and intensity.

**Workflow engine**

The workflow engine is responsible for updating the patient status at all times; below is a description of these states:

- New: the administrative information of the patient is available, but the patient has not been admitted into the programme.
- In practice: the patient has been admitted into the programme and is in testing period.
- Suspend: the patient is going to be out of the programme for a specific period: hospitalisation, vacations, lack of caregiver, etc.
- Pending reactivation: the patient is suspended and has received a new alert indicating that the patient is becoming active (the reactivation should be performed by a professional).
- Out: the patient is not participating in the programme any more.
- Active: the patient has passed the internship period and is included in the programme. This state consists of the following sub-states:
  - Pending: the patient has an interaction, but this has still not been reviewed by any professional.
  - Under observation: the patient is stable, and has received a warning for which an automatic response protocol exists.
  - Scheduled: the patient does not have any interaction, and has an appointment scheduled with some professional.
  - Management: the patient has an interaction that has already been reviewed by a professional, but not today.
  - Reviewed: professional has reviewed the interaction for today.
  - Stable: the patient has no interactions.

**Alert Assessment**

Depending on a pre-set action for each patient in his/her alert plan, the alert assessment module is responsible for determining if the newly received data generates an alarm that should be checked by a health professional.

Data received are stored in a raw format, without processing; once stored, it is processed with the calculation of complex indicators from one or more data received or stored previously. An example of this is the receipt of new data on systolic and diastolic blood pressure. If it was defined as necessary, the system would calculate an indicator for obtaining some alert, then it would proceed to calculate, for example, the pressure balance, calculated as the differences between two pressures. The calculated data is also saved, associated to the patient.

When the patient is in the state "under observation", and has not produced any critical warning, the output rules are validated, and will determine if the patient is marked as stable or should remain in the current state. If the patient state is modified, the system will determine the guidelines to apply.

Once the alerts are evaluated, they are implemented: alerts are stored, automatic ones are run, the type of interaction is updated, guidelines are stored, and the patient status is updated. Last, the colour of the affected icons is recalculated.

**Communication interfaces**

This module provides an interface for communication between devices and Home Monitoring platform. These interfaces provide the requirements for those external devices to be able to be connected to the system. These devices can be connected directly, or through a hub. One of the supported communication protocols is Continua Health Alliance.

**Actuation module**

Depending on patient needs, this module allows users to perform actions during the course of the following-up, and to see any historical interventions.

The professional has to fill in the evolution field in order to select the interventions to carry out. There are two types of interventions: generic interventions, available regardless of the interaction and the patient state; and specific interventions which will depend on the current interaction alert.

Through interventions, the user can indicate the actions carried out, such as phone contacts, professional consultations, contacts with the patient, etc., or make modifications to the patient prescriptions. In this module, the professional can also notify the results of measurements and questionnaires to the patient.

### 4.3.2 Pilot mapping

Each of the components above covers a set of BeyondSilos architecture building blocks, to ensure processes via pathways. Each of the building blocks is listed below, identifying the existing Campania ICT systems which meet the requirements for the block; Figure 52 maps the Campania ICT systems to the different BeyondSilos building blocks.

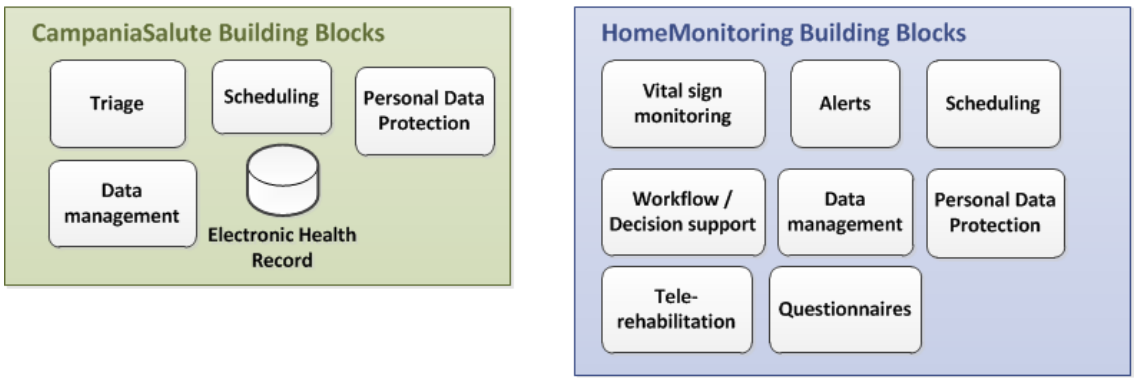


**Figure 52: Campania Prototype mapped with BeyondSilos Architecture**

- **Triage**: this building block is implemented through CampaniaSalute component as a complete tool for triage in hospital emergency.
- **Data management**: management of all patients' administrative data, financial information, human resources, billing, etc. by CampaniaSalute.
- **Workflow / Decision support**: Integrated care pathways require the presence of a workflow management service which activates the different resources when they are needed, interacting with the resources planning services of health and social care providers. It is implemented through Home Monitoring module.
- **Scheduling**: this ICT block is implemented through CampaniaSalute and Home Monitoring modules.
- **Questionnaires**: Home Monitoring module includes this building block.
- **Learning / Training platform**: this module is not implemented in the Campania pilot site.
- **Tele-rehabilitation**: Home Monitoring component has a specific module for this purpose under the functionality “Care Plan”, where physical or cognitive exercises and questionnaires are prescribed to patients, and could be monitored through the module with the objective of providing remote rehabilitation services.
- **Behaviour monitoring**: this module is not implemented in the Campania pilot.
- **Vital sign monitoring**: this building block is implemented in Campania pilot through Home Monitoring component.
- **Ambient monitoring**: this module is not implemented in the Campania pilot.
- **Remote device administration**: Home Monitoring component implements this module to control vital sign monitoring devices; this control could be done directly or via hub.
- **Third party services**: this module is not implemented in the Campania pilot.
- **Alerts**: The Alerts building block is implemented in the Campania pilot through Home Monitoring module.
- **Contact centre**: this module is not implemented in the Campania pilot.
- **Emergency contact**: this module is not implemented in the Campania pilot.
- **Electronic Health and Social Record**: CampaniaSalute is currently implemented with health record but not social records.

### 4.3.3 Identifying gaps

Gap Analysis identifies the following missing modules that the Campania pilot site wants to incorporate in order to obtain a better integration between social and health dimensions:

- Access to third party information.
- Learning / training platform.
- Behaviour monitoring.
- Safety / ambient monitoring.
- Electronic social records.

## 4.4 Kinzigtal pilot site

In 2013, the electronic patient record system named CGM net was implemented of for GPs and specialists in Gesundes Kinzigtal in cooperation with Compugroup medical. The opportunity for a physician to receive adequate information, instead of asking the same questions about patient´s health status and

treatments a second or third time, will rise. Not only for the physician (thus saving valuable time), but also for the patient and social care institutions. This is an important aspect in terms of obtaining a confidential relationship, relief of staff, and more transparency between the stakeholders in the care system and a higher level of quality of care. The idea for BeyondSilos project is to expand the electronic information and communications system by adding social care institutions of Gesundes Kinzigtal. Till now a linked documentation system between those two sectors has not existed. The social care provider owns a documentation database system which holds the patient's data referring to social attention, but this has no access to the patient's medical records or information that may be useful and in some cases important for decision making. In the same way, social providers and healthcare providers maintain separate records of the assistance procured and services consumed by patients, without access or data sharing between them; therefore, there is no horizontal inter-organisation integration, making the coordination of activities more difficult. Against this background, the contextualised implementation of the BeyondSilos pilot service aims to provide a common framework that allows the coordination of health and social professionals, along with a common patient data set that supports an integrated type of care, not only for discharge cases but also patients in long term at home.

The technical part will be realised by medical networks in cooperation with Gesundes Kinzigtal GmbH to link the social care documentation system called AscleonCare with the electronic patient record called CGM net.

### 4.4.1 Pilot IT Infrastructure

**CGM net**

CGM net is standardised and full integrated software for physicians, with the aim of real integrated care and improved communication and information flow in the healthcare system. CGM net contains care pathways which were developed by Gesundes Kinzigtal, a technical link between the physicians' practices (electronic patient record) as well the managed care institution, central net management with tools for billing and analysis, and online services such as online scheduling, electronic prescription, and electronic consultation for patients. CGM net is fully integrated with the physician information systems of Compugroup Medical Germany AG, which nearly every second physician uses. From the physician information system, there is access to CGM net. The functionality of the physician information system also contains enrolment procedures for patients, diagnosis documentation, billing system, and labour data. But users who do not own software components of Compugroup Medical are also able to use CGM net in a restricted framework. For this, client software (DocAccess) is needed, which is the part to be developed to connect to AcleonCare.

**AscleonCare**

This is electronic documentation software for the social care provider in residential homes or the outpatient sector for caring for people living at home. Mobile end user devices are allowed to connect and make changes in real time; it contains tour planning, service documentation, personnel planning, assessment documentation, and billing. AscleonCare is a web based cloud platform for external users such as hospitals, GPs, etc. to log in. Data access depends on the user profile login in.

**DocAccess**

To connect the social care documentation software AscleonCare and the Electronic patient record CGM net of Gesundes Kinzigtal, a special interface is needed. This interface will be via client software DocAccess. Doc Access provides a protocol through which the relevant data of the social care sector is written and translated. This data package can be seen by GPs in the electronic patient record. On the other hand, the social carers have access via Doc access to the electronic patient record, and are able to

see specific GP information. On the AcleonCare platform, a special button is created to start the DocAccess interface.

### 4.4.2 Pilot mapping

Each of the modules above covers a set of BeyondSilos architecture building blocks. Figure 53 maps the Kinzigtal ICT systems to the different BeyondSilos building blocks; after that, each of the building blocks is listed and explained.

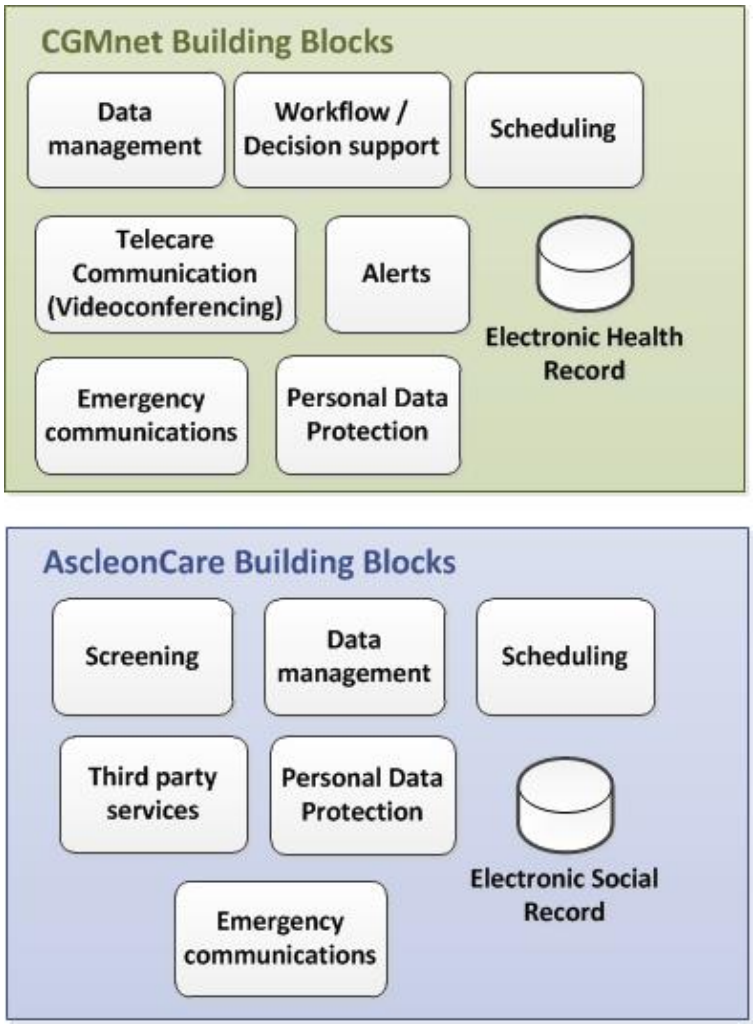


**Figure 53: Kinzigtal Prototype mapped with BeyondSilos Architecture**

ICT components to identify diseases and classify possible CRs:

- **Triage building block:** this building block is not part of the ICT components.
- **Screening:** AscleonCare as well as CGM net provides a set of assessment tools to identify certain risks, for example risk of falling or chronic back pain.
- **Data management building block**: this building block is part of AscleonCare as well as CGM net. AscleonCare contains data management for social care section, CGM net for GPs and specialists in term of administrative data.
- **Workflow / Decision support building block**: AscleonCare does not contain this kind of functionality, but CGM net does. During the enrolment process of patients into Gesundes Kinzigtal services, the system recommends which care programmes may be necessary and useful for an enrolled patient on the basis of documented vital signs. The GP is more or less able to follow a care pathway.

- **Scheduling building block**: AscleonCare contains a scheduling block as described. CGM net has the functionality of patient consultation and online scheduling for patients. In addition, CGM net is able to set dates for certain actions to be taken by GPs and specialists such as next consultation or appointment.
- **Telecare communication (Videoconferencing) building block**: for both AscleonCare and CGM net, it is possible to send photo documentation, for example for wound management. ICT infrastructure for videoconferencing is implemented in CGM net, but not yet rolled out.
- **Questionnaires building block**: AscleonCare and CGM net contain such a building block in their systems.
- **Learning / Training platform building block**: neither AscleonCare nor CGM net has implemented such a building block.
- **Tele-rehabilitation building block**: neither AscleonCare nor CGM net has implemented such a building block.
- **Behaviour monitoring building block**: neither AscleonCare nor CGM net has implemented such a building block.
- **Vital sign monitoring building block**: neither AscleonCare nor CGM net has implemented such a building block. This module is planned for CGM net in 2016.
- **Ambient monitoring building block**: neither AscleonCare nor CGM net has implemented such a building block.
- **Remote device administration building block**: neither AscleonCare nor CGM net has implemented such a building block.
- **Third party service connection building block**: in AscleonCare, internal documentation of third party service provision is implemented for social care institution. But there is no connectivity to the third party services.
- **Alerts management building block**: in AscleonCare, such a building block is not implemented. For CGM net, an internal alert pops up when patient health data is documented by healthcare staff.
- **Contact centre building block**: neither AscleonCare nor CGM net has implemented such a building block. In AscleonCare, such a building block is not implemented. In CGM net, the ICT infrastructure exists to connect hospitals, pharmacies etc.
- **Emergency communication building block**: for AscleonCare, it is possible to generate an emergency data set with the most relevant information about the patient. In case of an emergency, it can be printed out. A similar module exists in CGM net.
- **Electronic Health and Social Record building block**: the implemented ICT infrastructure contains two separate databases. One electronic social care record in AscleonCare, and one electronic patient record in CGM net. There is no sharing of data between these two systems. The ICT infrastructure exists in CGM net to connect hospitals, pharmacies, etc. But it is not yet rolled out.
- **Predictive Models**: neither AscleonCare nor CGM net has implemented such a building block.
- **Personal Data Protection**: CGM net, as an electronic patient record system, fulfils the requirements of German federal data protection act (BDSG), especially §4 (requirements for data use, §1 (self-determination of data, data secrecy) and §11. There is an official contract between Gesundes Kinzigtal and service provider Compugroup for handling data in the network. The data protection framework of AscleoCare is also part of the signed contract, and fulfils the same requirements. Employees are obligated to be educated in data protection regulations of BSDG. Furthermore the data management workflow is accompanied by our responsible data protection company Privcom GmbH.

### 4.4.3 Identifying gaps

The missing building block is a common Electronic Health and Social Record for access to each other to see relevant data for social care and health care section. To connect the social care documentation software AscleonCare and the Electronic patient record CGM net of Gesundes Kinzigtal, a special interface is needed. This interface will be done via client software DocAccess. Doc Access provides a protocol in which the relevant data of the social care sector is written and translated. This data package can be seen by GPs in the electronic patient record. On the other hand, social carers have access via DocAccess to the electronic patient record, and are able to see specific GP information. On the AcleonCare platform, a special button is created to start the DocAccess interface.

## 4.5 North Ireland pilot site

The Northern Ireland Electronic Care Record (NIECR) sits on top of the Health & Social Care (HSC) information systems to give health and social care professionals a single window into the key information that a patient expects the different professionals involved in their care to have about them.

HSCNI wish to use the BeyondSilos project to better integrate the care of elderly people in Northern Ireland by further utilising the NIECR to enable information sharing between health and social care professionals.

The Telemonitoring NI (TNI) service operating in Northern Ireland provides an end-to-end managed service for remote monitoring of patients in their own homes. The service encompasses both Telehealth (vital signs monitoring) and Telecare, and operates across all five Health and Social Care Trusts. We wish to build on the TNI service and integrate it with the NIECR, thereby providing health and social care teams with common access to patient and client data.

The Northern Ireland Single Assessment Tool (NISAT) is designed to capture information required for holistic, person-centred assessment of the older person. It is available in an electronic format - eNISAT.

Interfacing the eNISAT with the NIECR will enable the transfer of information, including risk assessments, between professionals, and will facilitate a smoother journey for the service user along the care pathway.

We also wish to incorporate an Integrated/Shared Care Plan into the NIECR, enabling all care providers to see easily what is included in a specific patient's care plan and where they fit in; this should facilitate a more holistic view of patient care and enable any gaps / omissions to be more easily identified.

### 4.5.1 Pilot IT Infrastructure

**NIECR**

The NIECR system has the following functionality:

- Common Portal:
  - Homepage dependent on users role e.g. Consultant/ED Consultant/GP, etc.
  - Messages.
  - Work lists.
  - Recently viewed patients.
  - Dynamic patient Summary.
- Patient Administration System / ED System:
  - Patient demographics.
  - Combined encounters.

    - ED views (encounters, allergies, etc.).
    - My inpatients.
    - My outpatients.
    - Identifier search.
    - Demographic search.
    - Medications.
    - Diagnoses and procedures.
    - Clinical alerts & allergies.
- Labs/Radiology Information System (RIS):
    - Document tree (Lab / RIS).
    - Numeric Lab.
    - Cumulative.
    - Textual Lab / RIS.
    - PACS (Picture Archiving System for Radiology).
- Administration functions.
- Document Tree (DOCS).

These currently Interface with a number of HSC information systems, for example:

- Laboratory systems from acute hospitals.
- Radiology Information Systems from different hospitals.
- PACS from different hospitals.
- Accident & Emergency Systems (A&E) from different hospital EDs.
- Clinical documents from different sites.
- Referral letters.

**Telemonitoring NI (TNI) system**

The TNI system has the following functionality:

- **Telehealth service:**
    - On-line gateway
        - Access to activity and service level reporting.
        - On-line training manuals.
        - Copies of contractor procedures and protocols.
    - Triage Manager:
        - On-line referral.
        - Demographic information.
        - GP information.
        - Details of condition being monitored.
        - For Triaged patients – parameters set.
        - Details of data upload schedule.
        - Telehealth Key Worker details.
        - Escalation protocol.
        - Clinical reporting functionality.
        - Review.
        - Discharge.

- **Telecare service:**
  - On-line gateway
    - Access to activity and service level reporting.
    - On-line training manuals.
    - Copies of contractor procedures and protocols.
    - On-line referral.
    - Demographic information.
    - Details of responders.
    - Telecare Key Worker details.
    - Details of risks being mitigated.
    - Alert protocols.
    - Client level reports.
    - Discharge.

**The electronic Northern Ireland Single Assessment Tool (eNISAT):**

The tool comes in seven sections:

- Core screening.
- Core assessment.
- Complex assessment.
- Carer needs assessment.
- Specialist referral.
- Specialist summary.
- GP report.

### 4.5.2 Pilot mapping

This section identifies how each building block present in the architecture is implemented or is going to be implemented in the Northern Ireland pilot, considering that not all the modules of the BeyondSilos architecture have to be implemented, as each site has different needs.

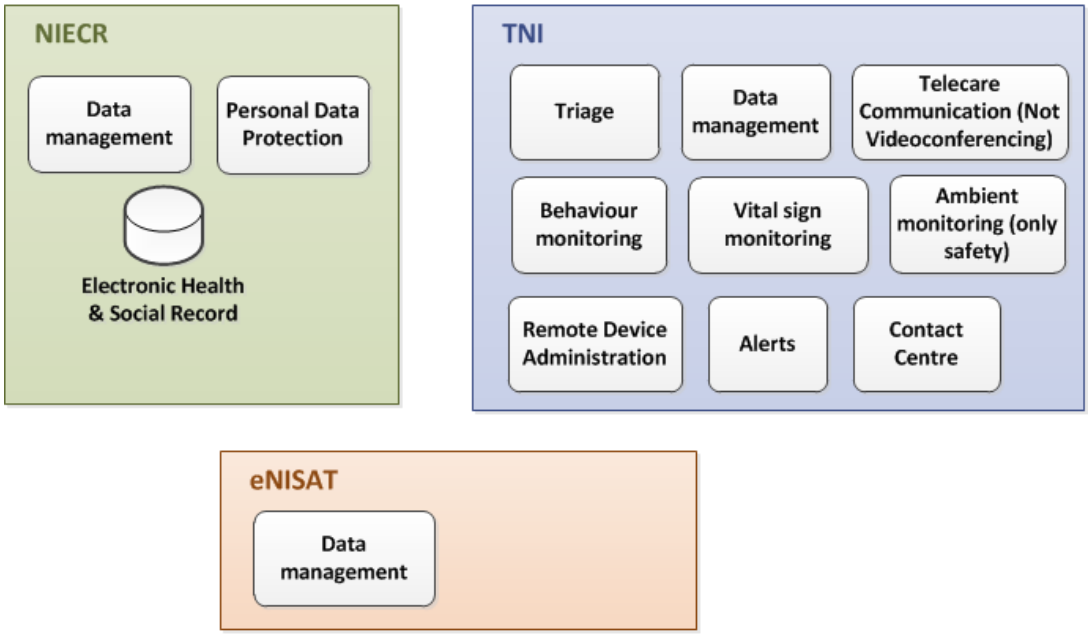


**Figure 54: North Ireland Prototype mapped with BeyondSilos Architecture**

- **Triage:** this block exists within the TNI system for those patients who have been referred for triage; alerts are generated when vital sign parameters are breached.
- **Data management:** patient demographic data only exists in TNI, eNISAT and NIECR.
- **Workflow / Decision support**: this is not being implemented in Northern Ireland pilot.
- **Scheduling**: this is not being implemented in Northern Ireland pilot.
- **Telecare communication**: telecare exists in the TNI service, but there is no intention to implement video-conferencing.
- **Questionnaires / Patient evolution**: this is not being implemented in Northern Ireland pilot.
- **Learning / Training platform**: training is currently provided by the TNI contractor; online platform is not being implemented in Northern Ireland pilot.
- **Tele-rehabilitation**: this is not being implemented in Northern Ireland pilot.
- **Behaviour monitoring**: this exists as part of the TNI telecare system.
- **Vital sign monitoring**: this exists in the TNI Telehealth service.
- **Safety / ambient monitoring**: safety alarms exist in TNI Telecare service, but there is no intention to implement domotic actuators in NI.
- **Remote device administration**: TNI service already has a level of checking, e.g. battery life for peripheral devices used in telehealth and telecare.
- **Third party services**: this is not being implemented in Northern Ireland pilot.
- **Alerts**: alert / alarm system already exists in TNI telehealth and telecare services.
- **Contact centre**: already exists for TNI service.
- **Emergency contact**: this is not being implemented in Northern Ireland pilot.
- **Electronic Health and Social Record**: this already exists in the NIECR. TNI and eNISAT will be interfaced through the BeyondSilos NI pilot, and a shared care plan will be incorporated into it to give fuller visibility of personal care plans to users.

### 4.5.3 Identifying gaps

As indicated above, all the required blocks currently exist in Northern Ireland. The gap to be filled by the BeyondSilos pilot is the integration of TNI and eNISAT with the NIECR, and the incorporation of an online shared care plan into the NIECR to pull available information together at a patient level, and enable easy access to details in the plan that are held in other systems that integrate with the ECR.

## 4.6 Sofia pilot site

Centre for Protection of the Rights in the Healthcare (CPRH) is an independent non-governmental and non-profit organisation working for public benefit. For seven years now, CPRH has worked exclusively in the field of protection of the rights in healthcare. Besides providing information, consulting and legal assistance to individuals and organisations, CPRH has organised and implemented breast cancer screening programmes.

In the context of BeyondSilos, note that according to the Bulgarian legislation CPRH cannot provide social and health services and assistance; therefore CPRH will subcontract these activities alongside the development of the electronic integrated CR record.

Currently there is no electronic health record system installed in Bulgaria. A prototype system will be set up for piloting purpose in the project, and will be filled with data and shared between health and social partners.

The objective is to validate that the provision of integrated social and health care through ICT innovation to the elderly population improves quality of life and is more efficient than the traditional way of service provision.

In Sofia region (as well as in the whole of the country), social services and social assistance are provided by governmental agencies or municipalities funded by the State budget. Social services are divided into two parts: institutional services (homes for elderly, homes for disabled), and community based services, especially personal assistant, social assistant, home helper. The only service financed by municipalities is home social patronage, providing mainly meals and home cleaning. People pay for institutional services, 70% from their incomes of the price of home social patronage.

Health services are provided at three levels: GPs, outpatient specialised healthcare, and hospital care. Healthcare is funded by the National Health Insurance Fund (NHIF). All medical establishments for hospital care in Bulgaria are registered as commercial companies.

At the moment, there is no system to integrate social and health care for the elderly population in Bulgaria. This situation poses a great challenge to our pilot site, because besides implementation, we will have to advocate for legislative changes to ensure wider deployment of the integrated services in the future.

The software product for Sofia is not built around legacy software, but is developed from scratch. The pilot is built around a modern web infrastructure as a presentation layer, and mobile devices for health and social care measurements and actions receivers.

The new pilot site is developed with the following modules in mind:

- **GP Portal:** a place for the GP medical providers to follow their assigned patients, make exams, and record activities.
- **Social Care Portal:** a place for the social care providers to follow their assigned patients, and record activities.
- **Patient Observer Portal**: a module built for the call centre operators who will monitor the patients 24/7.
- **Administrator Portal:** a module that takes care of patients' administration, users' administration, etc.
- **Authentication:** an authentication provider. Sofia's pilot site is using Google as an authentication provider.

### 4.6.1 Pilot IT Infrastructure

The application is designed so that every component is modular, though the base functionalities are operated through centralised APIs.

Each logical component of the software infrastructure is scaled in a logical module, and can be horizontally scaled as much as needed.

The centralised information repository and API is REST (Representational State Transfer) based, and can be horizontally scaled as much as needed.

Database infrastructure for now is only vertically scalable (for the scope of this project).

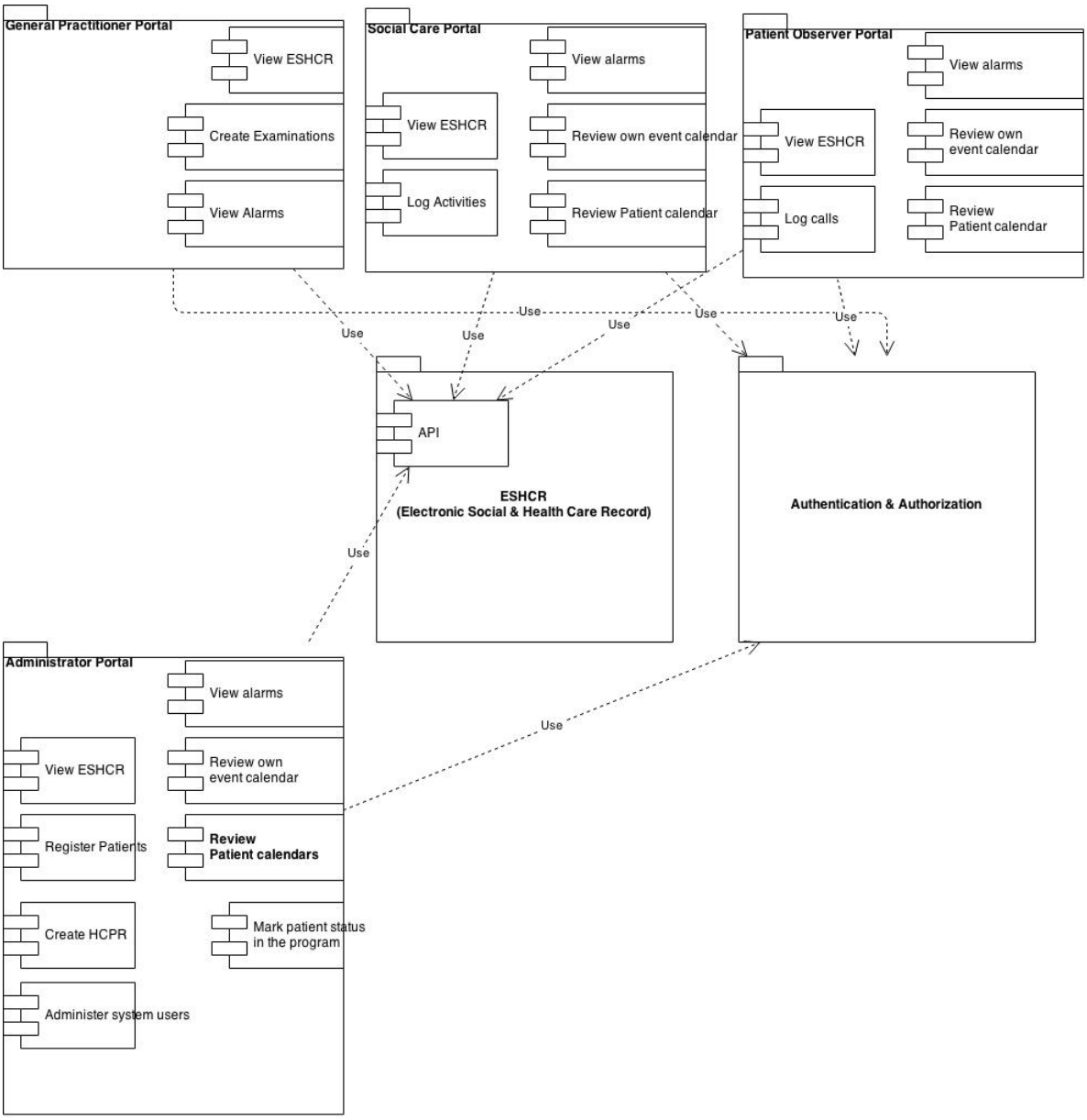


Figure 55: Sofia Pilot site infrastructure

**Application logical modules**

Each client functionality is described as a separate portal with included modules as needed by the client requirements.

They are as follows.

#### 4.6.1.1 GP Portal

The GP portal is the centralised end point for every operation that a GP will execute:

- View ESHCR, including:
  - Vital signs history.
  - Patient history.
  - Patient alarms, past and present.
  - Patient call centre calls, etc.

- Create patient examination records: a patient examination record is a set of data recorded for a patient visit to the GP office, for example: patient examination outcomes adding / removing accompanying diseases.
- View own and patient calendars.
- View current patient alarms.

#### 4.6.1.2 Social Care Portal

The SC portal is the centralised end point for every operation that a social care working will be executing:

- View ESHCR, including:
  - Vital signs history.
  - Patient history.
  - Patient alarms, past and present.
  - Patient call centre calls, etc.
- Create patient activity logs: for example: patient has been visited, depression has been diagnosed, food has been provided, etc.
- View own and patient calendars.
- View current patient alarms and log respective actions taken.

#### 4.6.1.3 Patient Observer Portal

The PO portal is the centralised end point for every operation that a patient observer (call centre operator) will be performing.

- View ESHCR, including:
  - Vital signs history.
  - Throughout patient history.
  - Patient alarms in the present and past.
  - Patient call centre calls, etc.
- Log patient calls and respective actions taken.
- View current patient alarms and log respective actions taken.

#### 4.6.1.4 Administrator Portal

The Administrator portal is the centralized end point for data and user management:

- View ESHCR, including:
  - Vital signs history.
  - Patient history.
  - Patient alarms, past and present.
  - Patient call centre calls, etc.
- Log patient calls and respective actions taken.
- View own and patient calendars.
- View current patient alarms and log respective actions taken.
- Administer system users.
- Create an Integrated Health & Social Care Plan.

- Mark patients as:
  - Discarded from the care programme.
  - Deceased.
  - Hospitalised.

#### 4.6.1.5 Authentication

The authentication module will serve as a centralised OAUTH & OAUTH2 provider and federation service.

Thinktecture server is a prime candidate for this.

#### 4.6.1.6 Electronic Social & Health Care Record

The ESHCR is a centralised database containing all the vital ESHCR information.

On top of the database there is a thin REST API layer that will be responsible for all ESHCR operations.

REST API will be secured via SSL and Access Token Bearer OAUTH implementation.

ESHCR will take care of receiving patient alarms and vital signs.

### 4.6.2 Pilot mapping

All modules are designed to be fully mapped to short and long term care pathways. The Figure 56 shows the different building blocks implemented in each module of the pilot infrastructure.

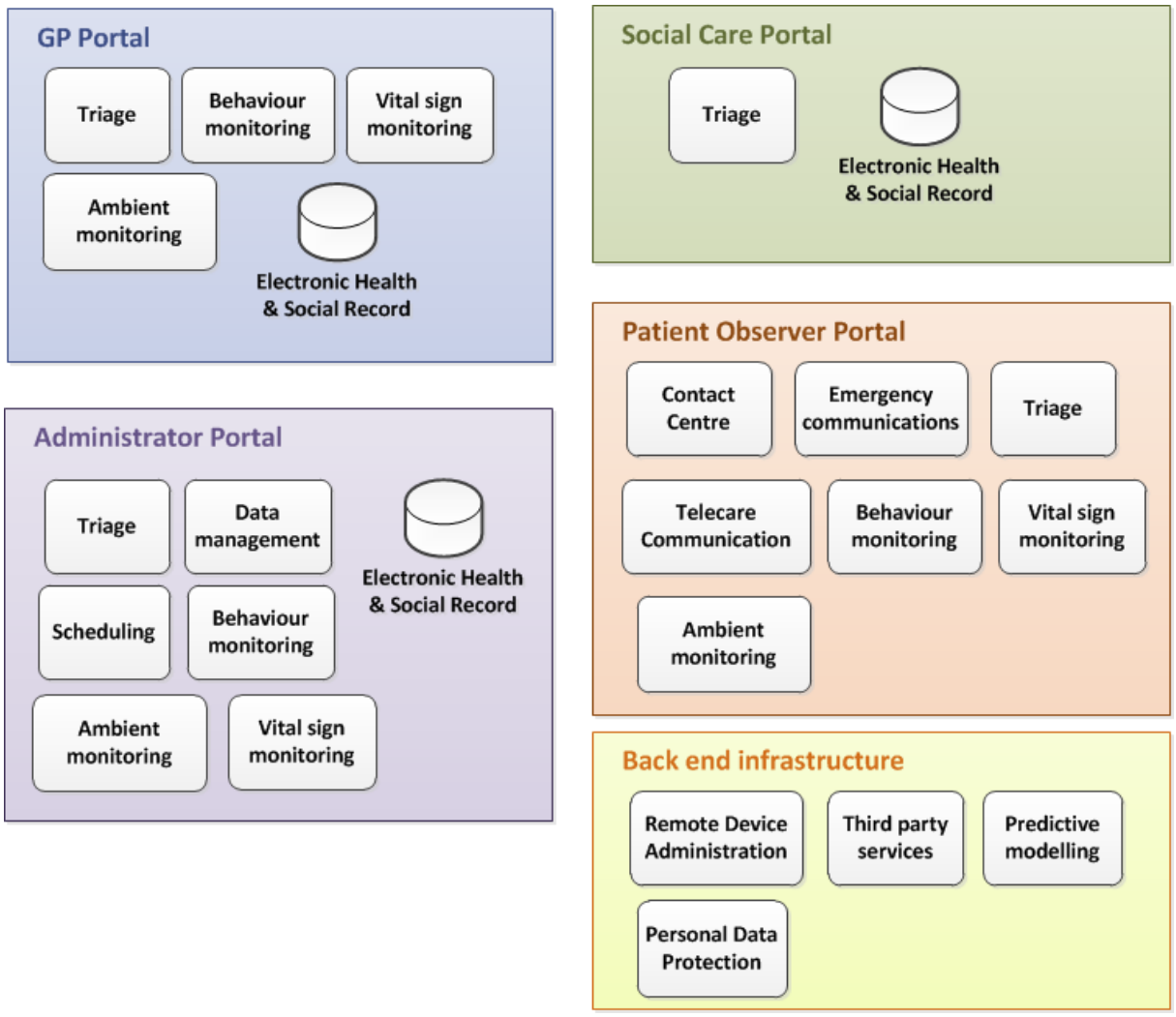


Figure 56: Sofia Prototype mapped with BeyondSilos Architecture

Each building block present in the BeyondSilos architecture is listed below, indicating how each is implemented or not in the Sofia pilot site.

- **Triage:** this block exists within the Sofia system provided by GP Portal, Social Care portal, Administrator Portal and Patient Observer Portal.
- **Data management:** patient data only exists in Administrator Portal.
- **Workflow / Decision support**: this is not being implemented in Sofia pilot.
- **Scheduling**: this building block is implemented through the Administrator Portal.
- **Telecare communication**: this exists in the Patient Observer Portal.
- **Questionnaires**: this is not being implemented in Sofia pilot.
- **Learning / Training platform**: this is not being implemented in Sofia pilot.
- **Tele-rehabilitation**: this is not being implemented in Sofia pilot.
- **Behaviour monitoring**: this block exists as part of the GP Portal, Administrator Portal and Patient Observer Portal systems.
- **Vital sign monitoring**: this exists in the GP Portal, Administrator Portal and Patient Observer Portal services.

- **Ambient monitoring**: this block exists as part of the GP Portal, Administrator Portal and Patient Observer Portal systems.
- **Remote device administration**: back end infrastructure implements the functionality of this block.
- **Third party services**: this block is implemented in the back end infrastructure system.
- **Alerts**: this is not being implemented in Sofia pilot.
- **Contact centre**: this is not being implemented in Sofia pilot.
- **Emergency communications**: this exists in the Patient Observer Portal module.
- **Electronic Health and Social Record**: this exists in the Sofia pilot through the GP Portal, Social Care Portal and Administrator Portal systems.
- **Predictive modelling:** Sofia pilot implements this block in the back end infrastructure module.
- **Personal Data Protection:** this block is present in the back end infrastructure module.

### 4.6.3 Identifying gaps

The following modules will not be implemented in this site:

- Questionnaires building block: there will be patient questionnaires, but they will be based on an open source SAAS solution, and will not be directly incorporated in the pilot.
- Learning / Training platform building block.
- Tele-rehabilitation building block.

## 4.7 Valencia pilot site

Valencia Pilot is organised around the Health Department Valencia-La Fe, belonging to the Comunidad Valenciana Regional Healthcare System. This Health Department covers a geographical area located in the city of Valencia, and coordinates all the healthcare services provided in the territory, for all health levels (including primary care, GPs, secondary and tertiary care, hospitals and specialised healthcare centres). The health department is coordinated by a big hospital that manages all the care delivery in the geographical area. Primary care is directly managed by a primary care manager who belongs to the management structure of the Health Department.

The health services in the Spanish public health system are free at the point of delivery for those citizens with coverage (basically all the population), with the exception of drugs prescribed outside hospitals, which must be co-paid by citizens, with different percentages depending on their income. There is no reimbursement scheme, as the system directly covers the costs of healthcare, and no direct payment is made by users.

The integrated care at home programme (which exists already today) provides patients and informal care givers with comprehensive care at home, supporting transition from hospitalisation to home care. The programme includes several services particularly valuable for the older population: specific home based training for patients and caregivers, to empower patient's self-management and increase adherence to treatment; a specific score for the stratification of the risk of falls, and a set of intervention guidelines to prevent the occurrence of falls; mental health and cognitive decline assessment test for early diagnosis and prevention; multidisciplinary integrated care teams supporting patients and informal care givers at home. The service includes specific ICT support: home monitoring devices, electronic health and social care records both in primary care and hospital, and mobility support for professionals while doing home visits.

The programme is coordinated by the home hospitalisation unit (UHD) of the Hospital La Fe of Valencia, but includes health and social care professionals in the team, thus providing a combination of health and social services within an integrated care path for citizens.

With BeyondSilos, Valencia pilot site wants easier technological deployment with fewer burdens for the actors involved, to achieve better reliability of ICT systems, to implement a full technological integration between information systems, and to integrate more specialised technological for social care.

### 4.7.1 Pilot IT Infrastructure

Health Department Valencia-La Fe Pilot site implements the following ICT components in its system:

- Abucasis;
- Orion Clinic; and
- NOMHAD.

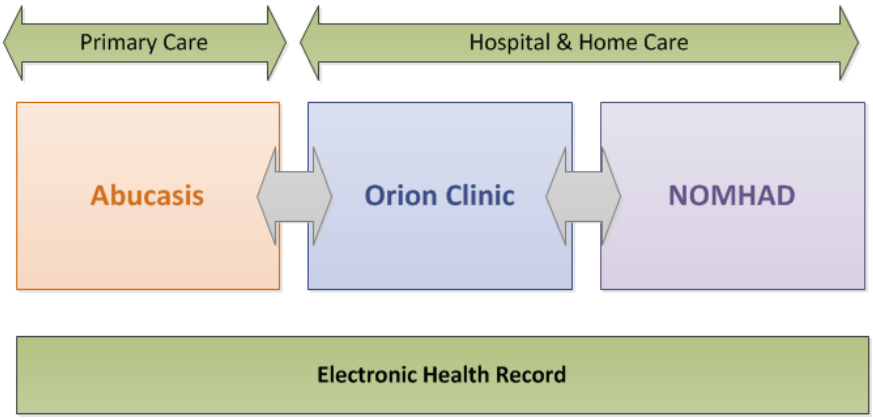


Figure 57: La Fe ICT components

#### 4.7.1.1 ABUCASIS: the outpatient clinical management system

This component is the central repository for health information about each individual patient regarding primary care activities. It contains all the administrative and clinical data of the primary care system for each patient.

The software tracks all the activities done by the professionals, the administrative activities surrounding it (for example, billing to external providers), and is also the single point of access for all the stakeholders involved (internal and external, with different access roles).

Abucasis has as its main objective to interconnect centres with primary and specialised care Information Systems in an integral and integrated manner, giving administrative functions (appointments, schedules, etc.) and the management of the assistance process.

All the clinical and administrative information is centralised and available from any point in the assistance network (surgery, primary care centres, specialised centres and hospitals), through the Electronic Health Record. This system encompasses the following modules.

**Administrative module**

This is based on the scheduling management by the administrative staff in order to facilitate the Access of the population to the consultations of different health professional, by appointment.

**Care module / Clinical Record**

Clinic management of patients: this module helps medical personnel in their daily consultation and allows them to obtain required data for their own clinical management based on the care process administration.

**Pharmaceutical prescription module**

Central information system for pharmaceutical provision connected to primary care centres that assists in prescribing.

**Nominal Vaccine Register**

Information system for the registration, tracking and management of vaccination activities carried out in the regional centres of Consellería de Sanitat (local Ministry of Health agency).

**Corporate Resources Catalogue**

Management system based on an Integrated Health System that supports the maintenance of a catalogue of corporate resources, from which are stored the data centres and services, human and material resources, etc.

**Indicators**

Indicators such as health, activity, quality indicators, epidemiologic or economic indicators.

**Integration with other Health Information Systems**

This module allows the exchange of information with other systems such as specialised care and billing.

#### 4.7.1.2 Orion Clinic: the inpatient clinical management system

This component is the central repository for health information about each individual patient regarding hospital La Fe activity. It contains all the administrative and clinical data for each patient in the hospital.

The software tracks all the activities done by the professionals, the administrative activities surrounding it (for example, billing to external providers), and is also the single point of access for all the stakeholders involved (internal and external, with different access roles).

The component supports the management of patients through: patient information, patient history, vital signs, alerts, drugs prescription / validation / administration, EHR interface, reports, scales and integration with other information systems present in the public national health system. The component can also organise lists of work (extractions, sent requests, appointments), beds and rooms, notifications, etc. Finally, the tool acts as a request manager, allowing control of all hospital request activities: laboratory, consultations, radiology, administrative activities (admissions, discharges, transport).

Orion Clinic consists of different sections that work in a coordinated manner, completing the entire central repository for health information in the hospital environment. These sections are.

**Emergency**

This module includes all activities related to the emergency department: patient management, triage, diagnosis, treatment, laboratory techniques, access to EH&SR, protocols, etc. This module can be accessed by nurses, medical doctors and administrative staff roles.

**Hospitalisation**

This part of Orion Clinic allows professionals to manage patients, work, appointments, resources, techniques, discharges, diagnoses, etc.; in other words, all the work related to hospitalisations from the point of view of health professionals and management. This module can be accessed by nurses, medical doctors, administrative staff, physiotherapist, speech therapist and occupational therapist roles.

**Consultations and techniques**

Specific module to manage consultations and techniques: request, follow-up, results, history, reports, patient management, etc. in the hospital environment. This module can be accessed by nurses, medical doctors, administrative staff, radiologist, technician, physiotherapist, speech therapist and occupational therapist roles.

**Pharmacy**

This module allows management of patients' treatment, medication, medical doctor in charge of the patient and treatment, formulation of pharmaceutical products, etc. in the hospital environment. This module can only be accessed by pharmaceutical role.

**Admission**

This module manages health transportation (hospital - home) and admission orders. This module can only be accessed by medical doctors from the Admission and Clinic Documentation Unit.

**Social Care Module**

This module consist of two sections that work in a coordinated and integrated manner in order to evaluate, follow up and manage health and social conditions of home hospitalised patients in two different situations: patients that are in a critical situation (corresponding with Pathway #1 – ICP short); and patients that are in a stable situation (corresponding with Pathway #2 – ICP LTCare). The first situation corresponds to the section called Home Hospitalisation Unit, and the second one with the section called Case Management, explained below. The main difference between the two components is the initial assessment of the patient's needs and conditions, and the frequency and intensity of the patient's follow up.

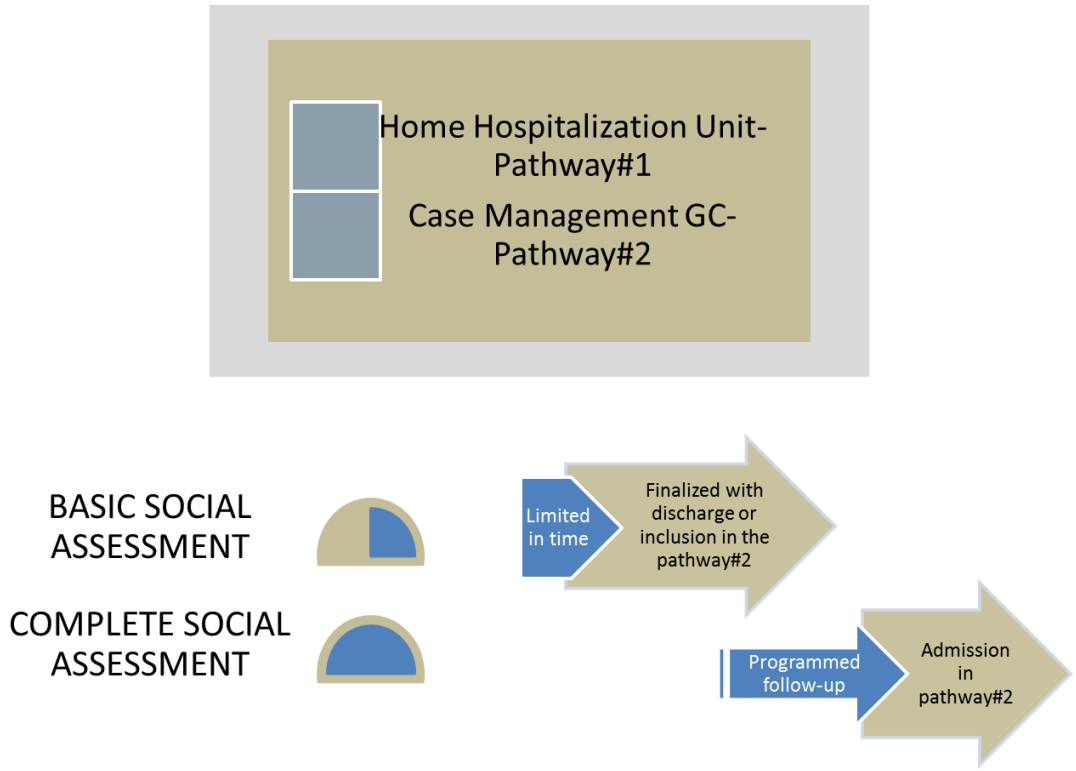


**Figure 58: Social Care implementation**

- Home Hospitalisation Unit

  This component can be accessed by nurses, medical doctors, physiotherapist, and social worker roles The Home Hospitalisation Unit supports the initial assessment of the social needs and situation of a home hospitalised patient in risk situation (Pathway#1): socio-economic situation, family environment, social relationships, available resources and diverse validated questionnaires (Zarit, Gijón). This initial social assessment will have as a result a potential social risk to be carried out by the hospital once the patient is discharged and in his/her home. The initial assessment carried out by social worker at patient's home consists of the aspects in Figure 59 below.

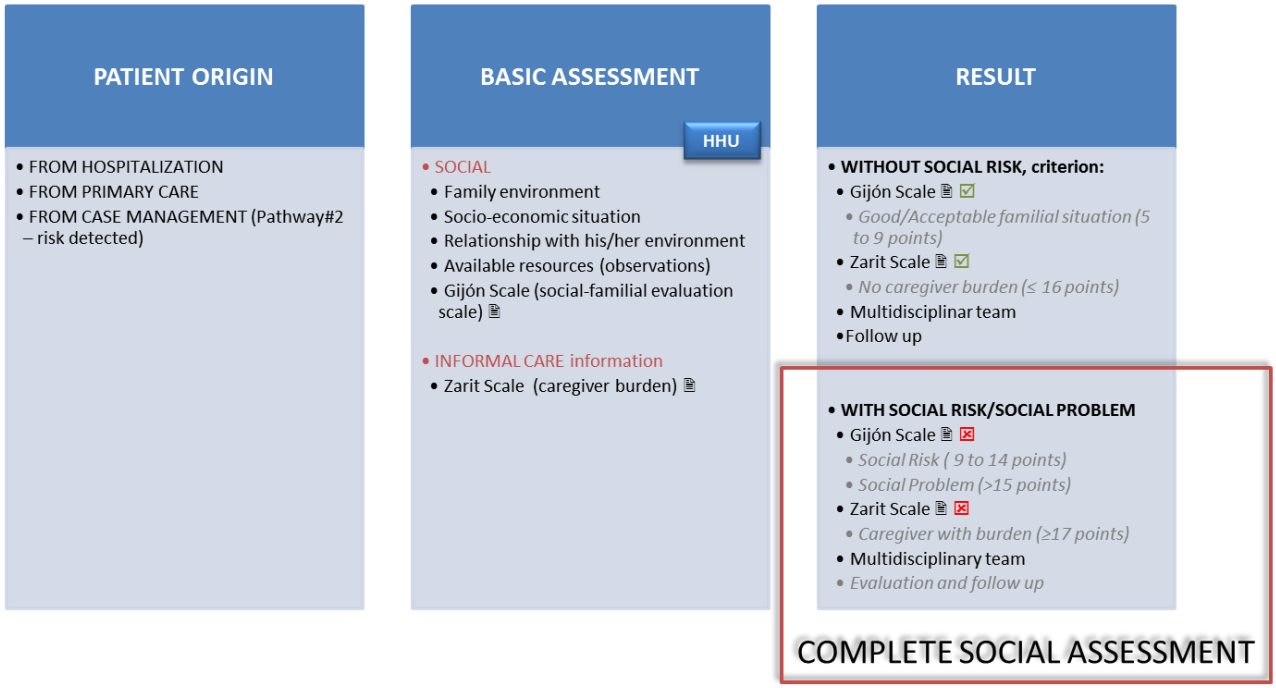


**Figure 59: Home Hospitalisation Unit initial assessment**

The follow up of the social intervention for these patients can be seen in Figure 60 below

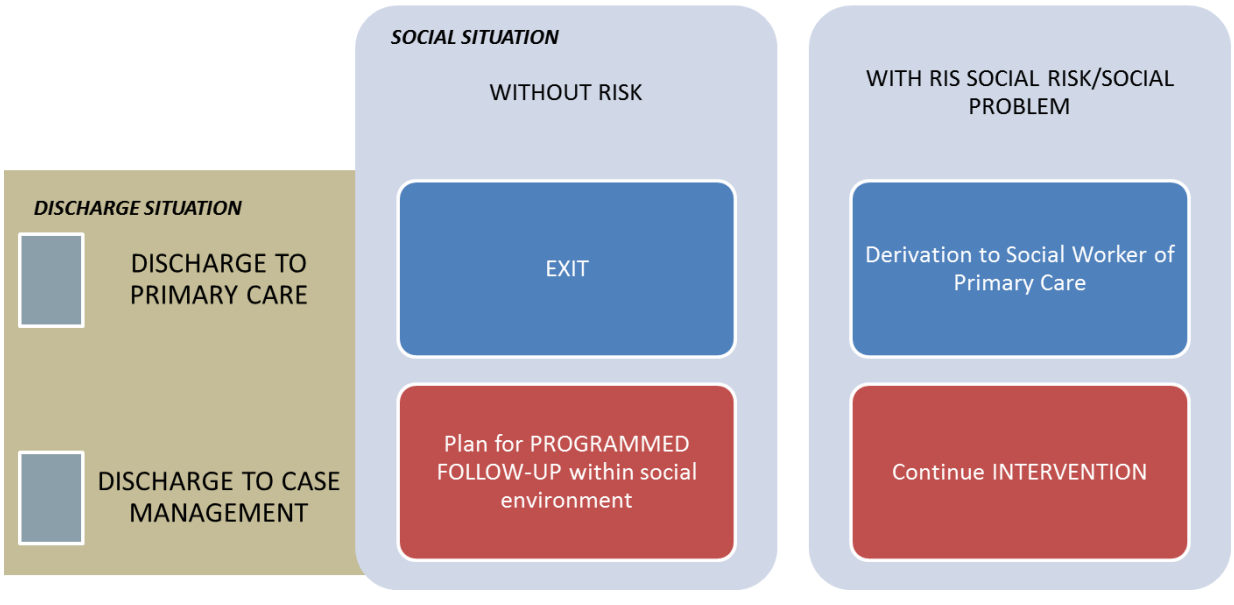


**Figure 60: Social intervention follow-up**

The plan for programmed follow-up intervention within the social environment generally specifies a basic assessment every six months, and on-demand attention whenever the patient needs it.

- Case Management

This component can only be accessed by social worker role. The component allows doing an initial assessment of the social needs and situation of a home hospitalised patient in a stable situation (Pathway#2); for these cases, a more complete assessment is made, as shown in Figure 61.

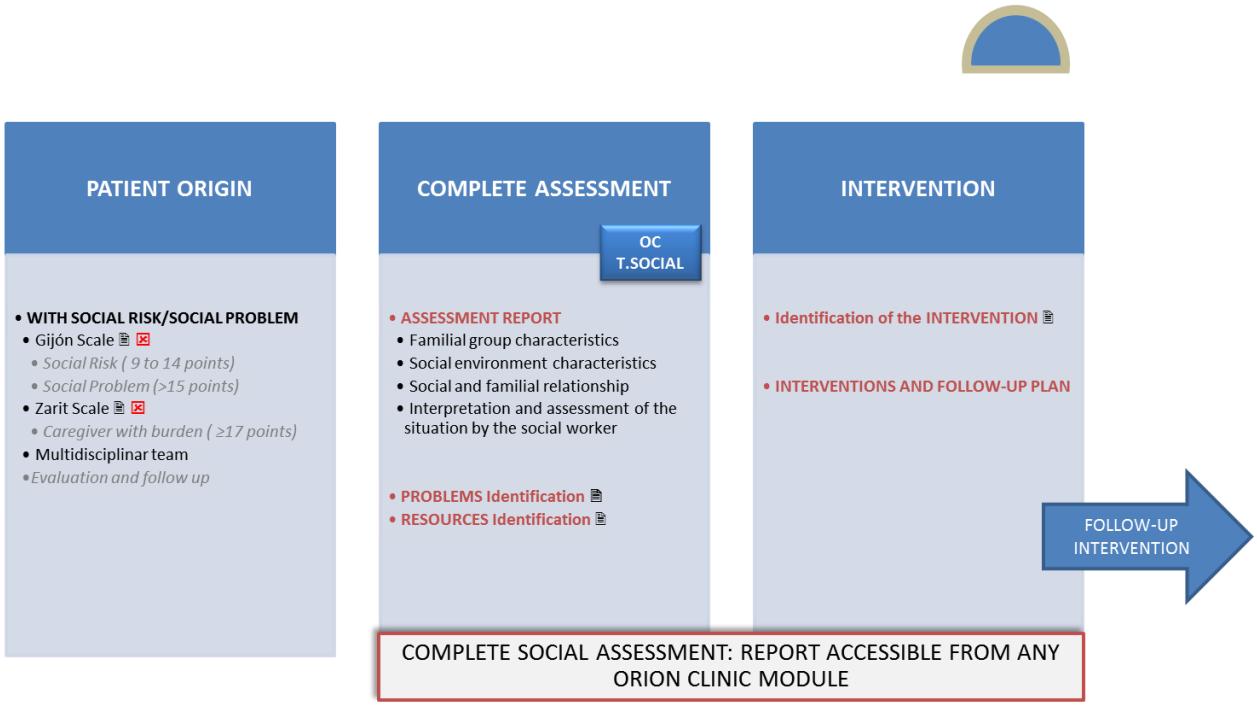


Figure 61: Case Management assessment

**Obstetrician block**

This part of Orion Clinic system allows the follow up of pregnant women and births: techniques, treatment, patients' record, etc. This module can be accessed by obstetrics and midwife roles.

**Surgical block**

This part of Orion Clinic system includes functionalities related with the management and work in a surgical environment, such as waiting list management; interventions carried out, access to patient EHR, surgical report, possible incidents, patient evolution, instruments, patient allergies, vital signs, techniques, etc. This module can be accessed by nurses, medical doctors and anaesthetist roles.

**Mobility**

Module of the system running on a tablet to assist professional in their daily activities within the hospital visiting patients at their rooms. It includes functionalities such as patient identification, access to EHR, treatment, care plans, monitoring of vital signs, etc. This module can be accessed by nurses and medical doctors.

**Configuration**

This part allows the complete management and configuration of Orion Clinic users, functionalities, menus, etc. It can be accessed by administrator, pharmaceutical, section responsible and nurse supervisor roles.

#### 4.7.1.3 NOMHAD

This component is the telemonitoring platform that will be used by Hospital La Fe in the BeyondSilos project; its development status is ongoing. At this moment, NOMHAD has implemented health

monitoring, but it has no monitoring for social purposes, so social care monitoring is being implemented to add the social perspective to the current patient management in order to implement Integrated Care. It is planned that NOMHAD can connect with Orion Clinic in order to share health and social data with the rest of the system. It is a very complete solution with the following components:

- Professional workstation.
- Patient workstation.

It allows measurement monitoring (weight scale, blood pressure meter, pulseoximeter, amongst others), questionnaires, education contents and empowerment tools, diaries, appointments, medication, etc.

NOMHAD consists of different components that work in a coordinated manner, and complete all the workflow of health care and clinical management of chronic patients. These modules are:

- List of work.
- Patient summary.
- Care plan configuration module.
- Care planning modules: monitoring, medication, appointments and physical exercise.
- Actuation module.
- Alert assessment.
- Communication interfaces.
- Administrative modules: income, admissions, patient data, discharge, re-admissions.
- Workflow engine.
- Repository of patient care plan templates.

Figure 62 shows the components schema of NOMHAD.

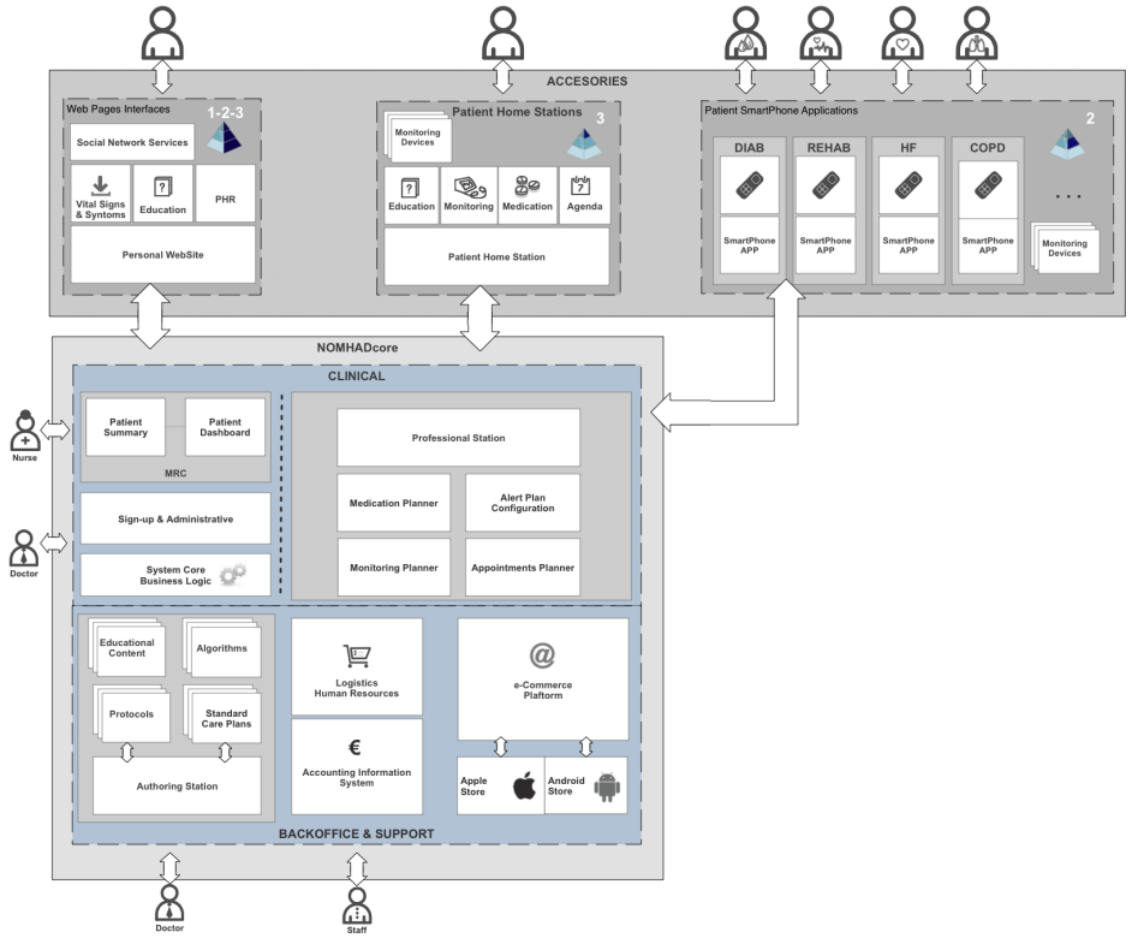


Figure 62: NOMHAD blocks

**List of work**

This element includes a list of work for health personnel supervision and management of patients. This list shows to the user all assigned patients for their management, and prioritises them according to the alert status that has been generated from data received from patient devices (monitoring different vital signs).

The patient pathologies are listed in this section, represented by a set of descriptive icons and colours based on the severity of the data.

**Patient summary**

This module presents all historical data related to monitoring, questionnaires, medication, etc. that are collected from the patient via devices (monitoring different vital signs) or directly by a professional. Data that can be reviewed (in different formats, graphs, tables, etc.) in this module are vital signs related to alerts, symptoms from questionnaires, indicators calculated from basic or compound vital signs, and a summary of the patient medication. These modules are configurable depending on the interests of the end user and the scenarios raised; the user can remove and add those modules interesting for him/her.

**Care plan configuration module**

This component allows the user to configure the range of indicators, templates for decompensation phases in the monitoring plan, alerts and variables to be displayed in the “patient data” section; in other words, this component allows configuring the care plan for the patient.

**Care plan planning module**

This module prescribes the care plan activities. The activities are categorised by monitoring (measurement and questionnaires), appointments, medication and physical exercise.

The monitoring module sets the frequency at which the patient must perform measurements and questionnaires, and which ones. Appointments allow the professional to have a scheme to control contacts with the patient. The medication module records the pharmacological treatment that the patient is receiving, and which serves as additional information for the health professional, and provides reminders to take the medication in patient's home, and compliance with the treatment checklist. Physical exercise module sets the exercises that should be done by the patient, and with what frequency and intensity.

**Workflow engine**

Workflow engine is responsible for updating the patient status at all times; below is a description of these states:

- New: administrative information of the patient is available, but the patient has not been admitted into the programme.
- In practice: the patient has been admitted into the programme, and is in testing period.
- Suspend: the patient is going to be out of the programme for a specific period because of: hospitalisation, vacations, lack of caregiver, etc.
- Pending reactivation: the patient is suspended, but has received a new alert indicating that the patient is becoming active (the reactivation should be performed by a professional).
- Out: the patient is not participating in the programme any more.
- Active: the patient has passed the internship period and is included in the programme. This state consists of the following sub-states:
  - Pending: the patient has an interaction, but this has still not been reviewed by any professional.
  - Under observation: the patient was stable and has received a warning for which an automatic response protocol exists.
  - Scheduled: the patient does not have any interaction, and has an appointment scheduled with a professional.
  - Management: the patient has an interaction that has been already reviewed by a professional, but not today.
  - Reviewed: professional has reviewed the interaction for today.
  - Stable: the patient has no interactions.

**Alert Assessment**

Depending on the pre-set for each patient on his/her alert plan, the Alert Assessment module is responsible for determining if the new data received generates an alarm that should be checked by a health professional.

Data received are stored in a raw format, without processing; once stored, it is processed with the calculation of complex indicators from one or more data received or stored previously. An example of this is the receipt of new data on systolic and diastolic blood pressure; the system will store this, and, if it was defined as necessary, calculate an indicator to obtain an alert. The calculated data is saved to the patient.

If the patient is in the state "under observation" and has not produced any critical warning, the output rules are validated and will determine if the patient is marked as stable or should remain in the current state. If the patient state is modified, the guidelines to apply will be determined.

Once the alerts are evaluated, they are implemented. Alerts are stored, the automatic ones are run, type of interaction is updated, guidelines are also stored, and the patient status is updated. Last, the colour of the affected icons is recalculated.

**Communication interfaces**

This module provides an interface for communication between devices and NOMHAD. These interfaces provide the requirements for the external devices to be able to connect to the system. The devices can be connected directly, or through a hub. One of the supported communication protocols is Continua Health Alliance.

**Actuation module**

This module allows the user to perform actions according to patient needs during the course of the following-up, and to see the historic interventions of the performed actuations.

The professional has to fill in the evolution field in order to be able to select the interventions to carry out. There are two types of interventions: generic interventions, available regardless of the interaction and the patient state; and specific interventions, which will depend on the current interaction alert.

Through interventions, the user can indicate the actions to be carried out, such as phone contacts, professional consultations, contacts with the patient, etc., or make modifications to the patient prescription. In this module, the professional can also notify the result of measurements and questionnaires of the patient.

**Administrative modules**

NOMHAD component incorporates five sections for the administrative management of the patient's data: patient file, patient admission in the system, suspensions, reactivations and discharge at the end of the attention.

Patient's data

User can upload patient's data into the system, including:

- Personnel data: name, surname, age, gender, associated image.
- Contact data: address, phone number, and other data.
- Health information related to the patient and care centre: health identifications, national insurance number, etc.
- Other data: allows adding other patient data.

Admission

Once the patient has been admitted, this section allows assigning the patient to the professional in charge of him/her, indicating the diagnosis and risk factors. It also associates devices and first appointments.

Discharge

When the attention and follow-up of the patient has concluded, the user will discharge the patient through this section, indicating the reason.

**Repository of patient care plan templates**

The system stores templates for care plans. These templates are specifically defined for each scenario of use of the system, and are usually prepared in collaboration with qualified health professionals. These templates include protocols for monitoring patients based on their pathologies, configuration of personalised alerts for each patient profile, and interventions associated with each of the states which can be an alert.

### 4.7.2 Pilot mapping

Each of these three components covers the building blocks identified in the BeyondSilos architecture, to support pathway processes. Figure 63 identifies the building blocks covered by each ICT system.

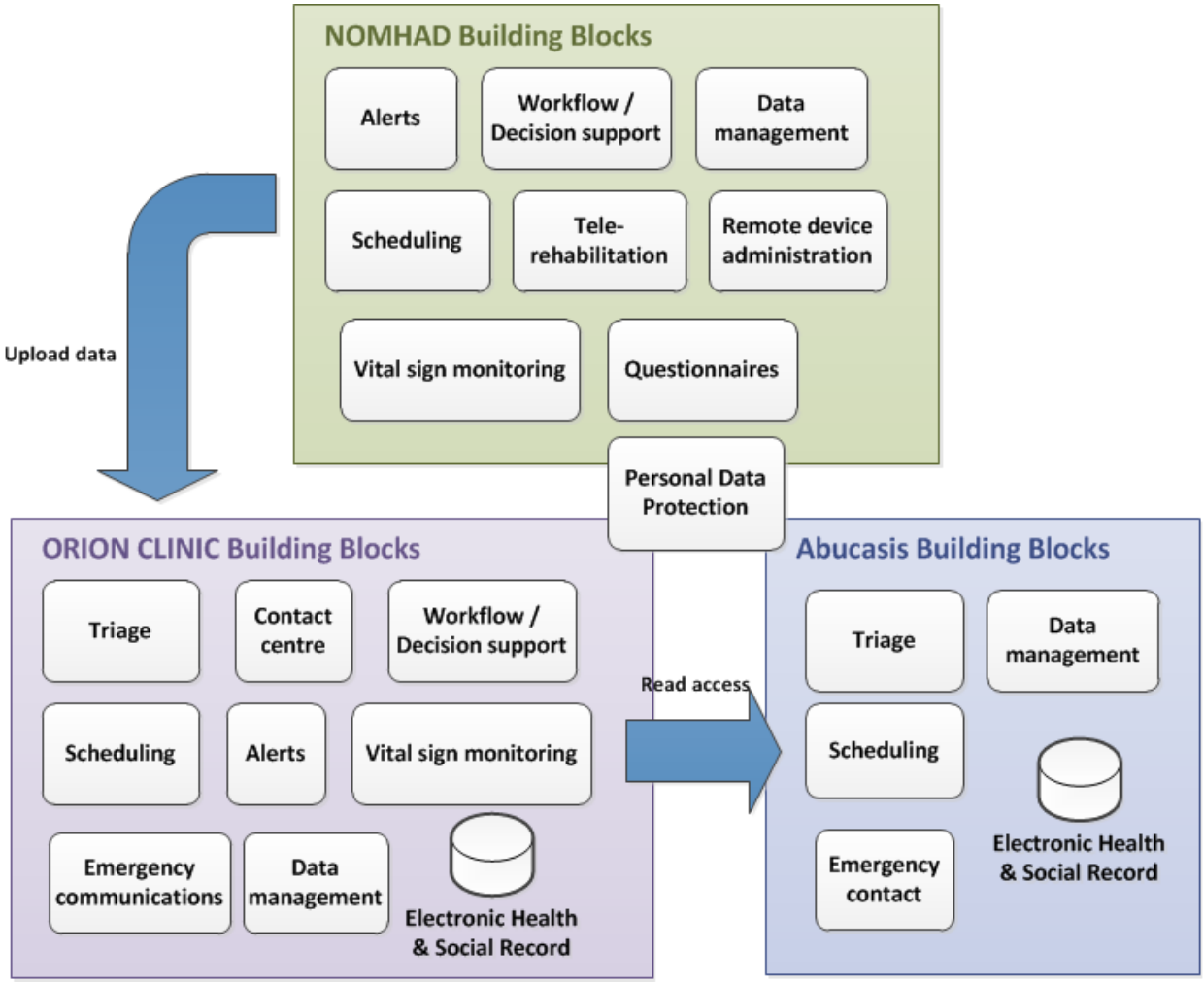


**Figure 63: La Fe Prototype mapped with BeyondSilos Architecture**

Each building block present in the BeyondSilos architecture is shown below, indicating how each is implemented or is going to be implemented in the Valencia pilot. Note that not all the modules of the architecture have to be implemented at each site, as each has different needs.

- **Triage**: this building block is implemented through Orion Clinic as a complete tool for triage in hospital emergency and by Abucasis for emergencies in primary care.
- **Data management**: this module is implemented in the three components present in Valencia pilot, depending on the scenario; hospital data are managed with Orion Clinic, primary care data are managed with Abucasis and NOMHAD for telemonitoring patients. All patients active in NOMHAD will be also active in Orion Clinic.

- **Workflow / Decision support**: NOMHAD implements a workflow engine to update the status of the patient at any time. Orion Clinic also implements a complex workflow engine for the stratification of the risk of hospital re-admissions of chronic patients.
- **Scheduling**: this module is implemented through the three components of the pilot: Abucasis, Orion Clinic and NOMHAD depending on the type of information to be stored in the scheduler: primary care, hospital, or home hospitalisation. Each environment uses its own scheduling system, although they are connected.
  - NOMHAD scheduling: care plan activities, categorised as monitoring (measurements and questionnaires), appointments, medication and physical exercise.
  - Orion Clinic scheduling: professional requests (laboratory, consultations, appointments, different medical tests, etc.), patient appointments (at patient's home or by telephone), and the professional's schedule.
  - Abucasis scheduling: professional requests (laboratory, consultations, appointments, different medical tests, etc.) and the professional's schedule.
- **Telecare communication**: this module is not implemented in the Valencia pilot.
- **Questionnaires / Patient evolution**: NOMHAD component has a specific module for this purpose under the "Care Plan" functionality, where detailed questionnaires could be prescribed to patients and carers.
- **Learning / Training platform**: this module is not implemented in the Valencia pilot.
- **Tele-rehabilitation**: NOMHAD component has a specific module for this purpose under the "Care Plan" functionality, where physical or cognitive exercises and questionnaires are prescribed to patients, and could be monitored through the module with the objective of providing remote rehabilitation services.
- **Behaviour monitoring**: this module is not implemented in the Valencia pilot.
- **Vital sign monitoring**: this building block is implemented by Orion Clinic and NOMHAD components.
  - NOMHAD: this provides an interface for the communication of data between devices and NOMHAD, allowing setting the frequency of the monitoring activities and vital signs to be monitored. Data collected is used to evaluate alerts and is sent to Orion Clinic.
  - Orion Clinic: the component offers an interface to manually register vital signs in the system. The professional collects these data and records them by this module. This also offers vital sign viewing functionalities such as graphs, logs, percentiles, etc.
- **Safety / ambient monitoring**: this module is not implemented in the Valencia pilot.
- **Remote device administration**: NOMHAD implements this module to control vital sign monitoring devices.
- **Third party services**: this module is not implemented in the Valencia pilot.
- **Alerts**: this is implemented in Orion Clinic and NOMHAD:
  - NOMHAD: based on personalised user alert plan, it determines the actions to be given.
  - Orion Clinic: this manages the decompensation risk probability (the probability of being chronic) and probability of re-hospitalisation based on the vital sign stored, the different health episodes suffered by patient and the lasts hospitalisations. With these variables, the module manages alerts and tries to predict future decompensation episodes.
- **Contact centre**: this is implemented by Orion Clinic, which offers a complete contact centre to manage all patient data (administrative, health and social), and a contact point for home monitored patients.
- **Emergency contact**: this building block is implemented by Orion Clinic as well as by Abucasis. Both these have direct contact with emergency services.

- **Electronic Health and Social Record**: Valencia pilot has implemented two different Electronic Health and Social Records, one for hospital environment with Orion Clinic and one for primary care environment with Abucasis. Orion Clinic is able to read the EH&SR of Abucasis, but cannot modify registers, while Abucasis has no access to Orion Clinic.
- **Personal Data Protection**: this block is implemented by the three systems, Orion Clinic, NOMHAD and Abucasis, following the Spanish legislation.

### 4.7.3 Identifying gaps

Figure 64 below represents the building blocks implemented in the pilot site of Valencia, and the missing modules, mapping with the common architecture.

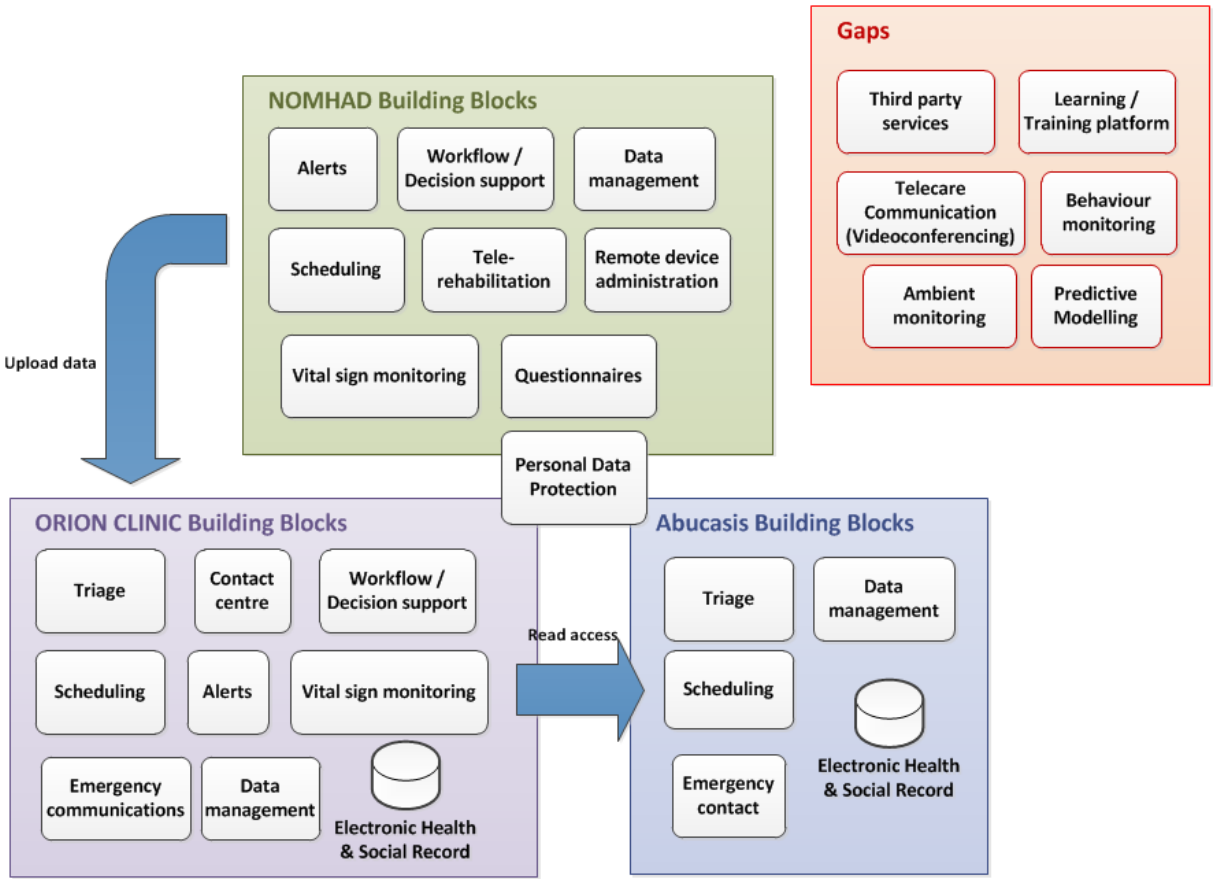


Figure 64: Gap Analysis: Valencia pilot site

In the same way, Figure 65 below includes the pathway identification and where the pilot site wants to incorporate new developments. In the case of Valencia pilot site, its intention is to incorporate the new building block Predictive Modelling, and go a step further and better integrate deployed systems and the social dimension in the reality of the pilot site.

To achieve the above objectives, the pilot wants to incorporate new social parameters for the social dimension, and improve the plan for programmed follow-up intervention actually carried out. This plan will include new monitoring parameters from the patient and caregiver, such as caregiver burden, patient intake, home cleaning, etc., and the frequency to report these data.

On the other side, and with the objective of improving the integration among systems, NOMHAD component will have access to the social assessment done in Orion Clinic, so the initial assessment is made with Orion Clinic, and the continuous assessment, interventions and follow-up are collected in NOMHAD at patient's home or by telephone by social workers.

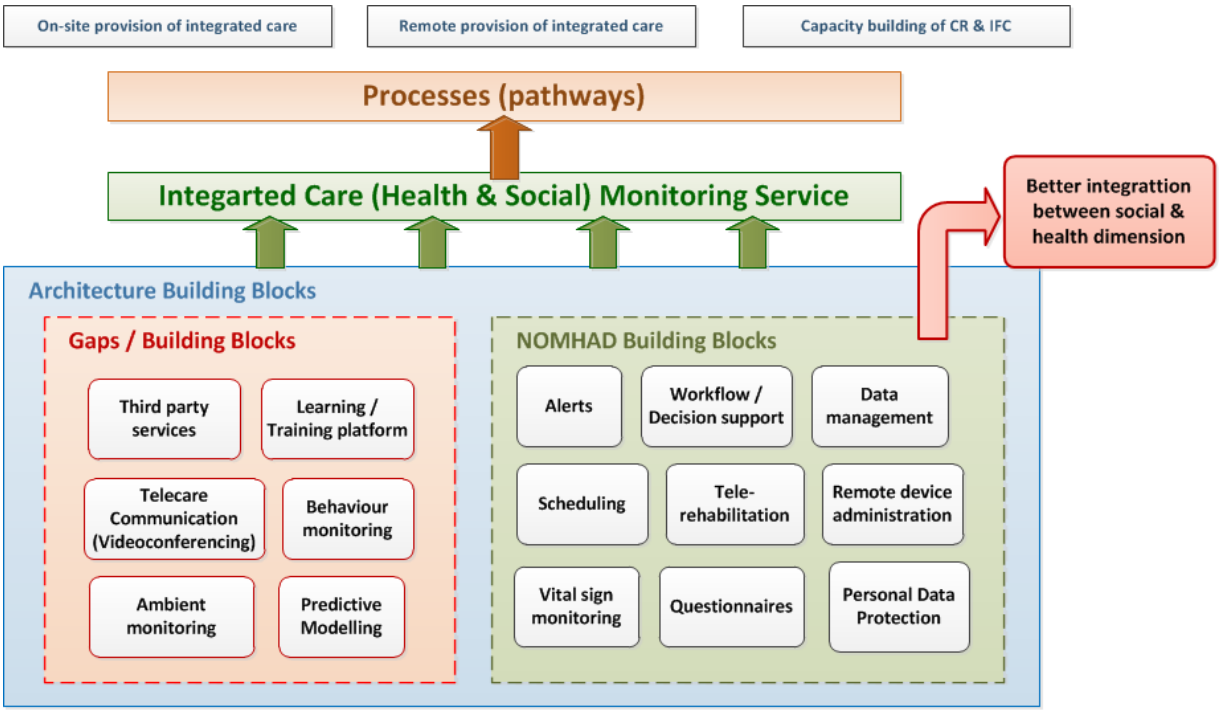


Figure 65: Valencia pilot site: Gap analysis and pathway identification

# 5 Next Steps

This deliverable has presented the final common BeyondSilos architecture to be follow by all pilot sites in order to correctly deliver integrated care, together with a detailed analysis of the component deployed in each pilot site. This detailed analysis has included a description of the current IT systems mapped against the BeyondSilos common architecture in order to detect missing building blocks, and the intention of each pilot site to fill the gaps identified, in other words, their intention to incorporate them into their infrastructure, and the improvement that they want to integrate.

This analysis represents the conclusion of the second iteration of the architecture included in the WP3, and supports the point of departure for deliverable D4.2 BeyondSilos Prototype System, where pilot sites will describe the new IT developed, as shown in Figure 66 below.

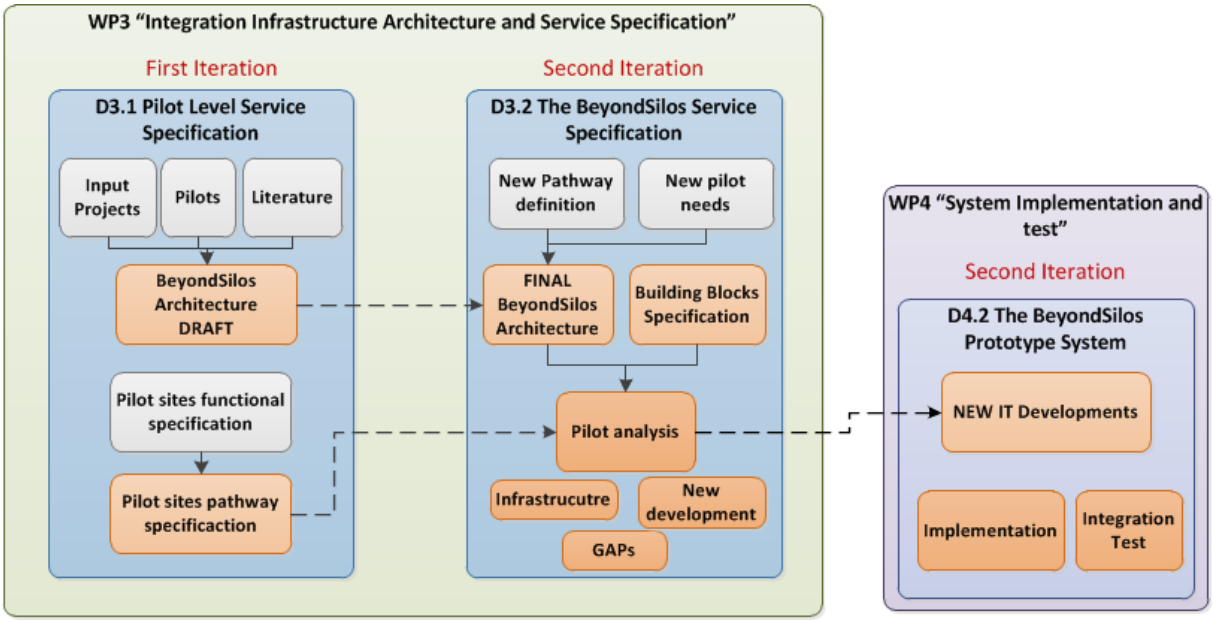


**Figure 66: WP3 alignment with other WPs**

In deliverable D4.2 BeyondSilos Prototype System, pilot sites will describe the gaps filled and the improvements integrated into their infrastructures, and the result of the integration with the rest of the components and building block described in the present document.

# 6 Conclusions

This document has presented the final common BeyondSilos architecture. This has been based on the draft elaborated in the first iteration of the WP3 that proposed an ICT infrastructure based on building blocks, which has been reviewed in order to include the new needs detected in the pilot sites and to accomplish the final generic pathways defined within BeyondSilos.

Although the pilot sites had the freedom to choose their own ICT infrastructure, their implementation should comply with the architecture defined; as has explained throughout this deliverable, all pilot sites follow the BeyondSilos architecture supporting the processes defined in the generic pathways.

Each pilot site has made a complete analysis of its ICT infrastructure, including a detailed description of their current IT systems mapped with the BeyondSilos architecture in order to demonstrate their compliance, and detect missing building blocks. In order to go a step further in the provision of better integrated care, pilot sites have included their intention to fill gaps encountered in the mapping process, and to incorporate improvements to their infrastructure.

The pilot sites infrastructure analysis and the definition of the final BeyondSilos architecture close the second step of WP3, and the WP itself.

The analysis will be completed in the second iteration of the WP4, where pilots will describe the gaps filled and the improvements integrated into their infrastructures, and the results of the integration with the rest of the components and building blocks described in the present document.