Co-funded by the Horizon 2020
Framework Programme of the European Union

Deliverable 2.6
Final version of TeNDER Architecture Blueprint, Pilots definition

Work Package 2: Codesign Process

affecTive basEd iNtegrateD carE for betteR Quality of Life: TeNDER Project

Grant Agreement ID: 875325

Start date: 1 November 2019

End date: 31 October 2022

Funded under programme(s): H2020-SC1-DTH-2018-2020/H2020-SC1-DTH-2019

Topic: SC1-DTH-11-2019 Large Scale pilots of personalised & outcome based integrated care

Funding Scheme: IA - Innovation action

Disclaimer

The TeNDER consortium consists of the following Partners.

Table 1 - Consortium Partners List

No	Name	Short name	Country
1	UNIVERSIDAD POLITECNICA DE MADRID	UPM	Spain
2	MAGGIOLI SPA	MAG	Italy
3	DATAWIZARD SRL	DW	Italy
4	UBIWHERE LDA	UBI	Portugal
5	ELGOLINE DOO	ELGO	Slovenia
6	ETHNIKO KENTRO EREVNAS KAI TECHNOLOGIKIS ANAPTYXIS	CERTH	Greece
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13	ASOCIACION PARKINSON MADRID	APM	Spain

Document Information

Project short name and Grant Agreement ID	TeNDER (875325)
Work package	WP2
Deliverable number	D.2.6
Deliverable title	Final version of TeNDER Architecture Blueprint, Pilots definition
Responsible beneficiary	SERMAS
Involved beneficiaries	SPO, SKBA, UNITOV, APM, DW, HOPE, UBI
Type[1]	R
Dissemination level[2]	PU
Contractual date of delivery	31/07/2022
Last update	04/08/2022

[1] **R:** Document, report; **DEM:** Demonstrator, pilot, prototype; **DEC:** Websites, patent fillings, videos, etc.; **OTHER**; ETHICS: Ethics requirement; ORDP: Open Research Data Pilot.
[2] **PU:** Public; **CO:** Confidential, only for members of the consortium (including the Commission Services).

Document History

Version	Date	Status	Authors, Reviewers	Description
v 0.1	15/06/2022	Draft	Domingo Sánchez (SERMAS)	First template
v 0.2	23/06/2022	Draft	Domingo Sánchez (SERMAS)	Small changes and adaptations following the recommendations from End-Users telco
V 0.3	30/06/2022	Draft	Cristina Lozano (SERMAS)	Content to each of the sections, and allocation of tasks
V 0.4	08/07/2022	Draft	Danaja Fabcic (VUB)	Inputs in 3.1 section
V 0.5	11/07/2022	Draft	Martina Steinböck (SKBA)	Inputs in 3.2 section
V 0.6	11/07/2022	Draft	Špela G Krivec, David Krivec (SPO)	Inputs in Section 3.2
V 0.7	13/07/2022	Draft	Cristina Lozano (SERMAS)	Inputs in Section 3.2
V 0.8	15/07/2022	Draft	Camila García (DW)	Inputs in Section
V 0,9	18/07/2022	Draft	Špela G Krivec (SPO)	Inputs in Section 3 and 4
V0.10	18/7/22	Draft	Martina Steinböck (SKBA)	Input in table 4.1.2
V0.11	19/07/2022	Draft	Jennifer Jiménez (APM)	Input in section 3.2 and table 4.1.4
V0.12	26/07/2022	Draft	Juan Mercado Gómez (UPM)	Review
V0.13	29/07/2022	Draft	Špela G Krivec (SPO)	Input in Section 2.3.1.2
V0.14	29/07/2022	Draft	Panos Karkazis (MAG)	Input in Section 2.3.1.4
V0.15	29/07/2022	Draft	Juan Mercado Gómez, Verónica Ruiz, Alberto del Río, Javier Serrano (UPM)	Input in Sections 1.3 and 2.3.1
V0.16	29/07/2022	Draft	Jennifer Jiménez (APM)	Input in Section 2.3.1.2, 2.3.1.7
V0.17	01/08/2022	Draft	Paride Criscio (DW)	Input in section 2
V0.18	01/08/2022	Draft	Cristina Lozano (SERMAS)	Review and template formant

V0.19	03/08/2022	Draft	Cristina Lozano (SERMAS)	Sections: Introduction, KPIs Status and Conclusions
V0.20	03/08/2022	Draft	Špela G Krivec (SPO)	General comments
V0.21	04/08/2022	Draft	Stefan Loureiro (UBI)	Inputs in section 2
V0.22	04/08/2022	Draft	Javier Serrano (UPM)	Inputs in Section 2.3.1 and General Review
V1.0	04/08/2022	Final version for submission	Javier Serrano (UPM)	Final revision and version

Acronyms and Abbreviations

Acronym/Abbreviation	Description
TeNDER	affecTive basEd iNtegrateD carE for betteR Quality of Life
WPx	Work Package
Tx.x	Task
Mx	Month (where x defines a project month e.g. M8)
EU	European Union
IoT	Internet of Things
IoHT	Internet of Healthcare Things
GP	General practitioner, primary care physician
QoL	Quality of Life
Pwd	Person with dementia
AD	Alzheimer’s Disease
PD	Parkinson’s Disease
CD	Cardiovascular Disease

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Executive Summary

TeNDER is developing an integrated care ecosystem using micro-tools based on affection, communication, monitoring of patients with their care ecosystem (involving their carers and social and healthcare professionals). These micro-tools will be aimed at assisting people with Alzheimer's, Parkinson's and chronic cardiovascular disease. They can be adapted to the needs of each person and based on their health situation and degree of affectation. The services created with this approach will create opportunities to facilitate communication between social and healthcare professionals, extending the autonomy of patients who will live more independently. All this while preserving privacy, monitoring ethical principles, providing data protection and security.

This deliverable continues the common research framework advanced in D2.3, which detailed the first version of TeNDER, its first Architecture Plan, and the definition of the Pilots. During M12 to M33, collaborative work has been carried out between the partners involved (MAG, DW, UBI, ELG, CERTH, VUB, SKBA, SPO, APM and SERMAS) to develop the final version of TeNDER, its Architecture Plan, and the definition of the Pilots.

This document details the pilots' definition, connecting end-user's organizations with technical partners, through CERTH's contribution to the Architecture Blueprint, also based on the requirements and needs gathered through research over the first year of its implementation. TeNDER is in the process of development using a co-creation methodology approach through common TeNDER toolbox. This document connects User requirements, Scenarios and System Requirements.

It involves the dedicated contribution from end-user entities and medical bodies in TeNDER to analyse the available technologies, as well as to further collect needs and requirements of each specific category of end-users in terms of services solution characteristics, interface and contents as well as current fields of interaction among the involved actors: health professionals, caregivers and associations, local authorities in the pilot countries. State of the art literature will be analysed, compiled and reported to illustrate and align the needs and constrains for users in the categories defined.

The output of this task is a complete system vision incorporating needs of all actors as well as supported by the medical and social evidence.

1 INTRODUCTION

The development of the TeNDER tool involves a continuous co-creation task to adapt and develop the tool based on the reality revealed by the pilots. To this end, work is coordinated to identify real-world scenarios covering all stages of user activities based on the use cases and user types through which the results of the project will be demonstrated. This is the specific contribution of end-user entities and TeNDER medical bodies to analyse available technologies as well as to gather further information on the implementation of TeNDER.

Co-creation results in a specification of user needs and requirements, as well as the development of user scenarios that have guided the design of the TeNDER system.

The following deliverable collects the results coming from the co-creation taking into account the defined pilot description and the identification of user requirements. It includes the specification of the logical structure of the TeNDER architecture, paying special attention to the data storage and processing layer and to the communication between the discrete parts/components of the system in order to a) ensure the scalability and extensibility of the TeNDER system and the reliability of the service and b) support the continuous integration and deployment to maintain the service during changes. The objective is to analyse the available technologies, as well as to collect the needs and requirements of each specific category of end-users in terms of service solution features, interface and content, as well as the current areas of interaction between the actors involved: health professionals, carers and associations, local authorities in the pilot countries. The state of the art was analysed, compiled and communicated to illustrate and align user needs and constraints in the defined categories.

The outcome is the definition of the system level description for the design of the overall system architecture, as well as the conduct of a survey and the specification of appropriate indicators for the validation of the user scenarios. Providing a global vision of the system that incorporates the needs of all stakeholders and is supported by medical and social evidence.

1.1 Purpose and scope

The TeNDER tool is based on different technological devices. On one hand, the monitoring of patients with the aim of improving their autonomy and facilitating the task of carers and professionals in their care and follow-up. On the other hand, it offers a communication tool between all the actors involved, facilitating the intercommunication of patients and carers with social and health professionals, especially in those cases in which professional care and monitoring is required.

All of this is proposed by combining easy-to-use technologies that are familiar to the population, such as smartphones and devices such as bracelets, movement sensors and other similar tools through which vital signs are monitored, movements are captured and emotional recognition is carried out, among other types of monitoring.

1.2 Contribution to other deliverables

This deliverable aims to monitor the impacts of TeNDER on the requirements identified in WP1 and WP2, as the ICT solutions are integrated, tested and evaluated. The developed scenarios will be the basis for system pilots directly related to WP6 and WP7.

1.3 Structure of the document

The goal of this document is to define the scenarios, adopting the requirements and constrains in terms of ethics, privacy as well as creating the navigation follows of the envisaged components of TeNDER toolbox. This deliverable aims to describe the TeNDER architecture, its main components and data flow. It will also include the UML diagram and the description of the pilots.

This deliverable has been organised as follows:

First, the Final version of TeNDER Architecture Blueprint is detailed. This section offers a detailed vision of the system, its different levels of development (low-level and high-level), explaining the modules and services that compose them.

Secondly, it describes TeNDER common approach and methodology. Including the strategies carried out to ensure the ethical principles in all the piloting phases. It also provides the co-creation result achieved after the first phases of tool definition.

Thirdly, it presents all the detailed information on the pilots developed and their final definition, offering real examples of scenarios and patients.

Finally, the conclusions of the document are showed.

2 FINAL VERSION OF TENDER ARCHITECTURE BLUEPRINT

This deliverable provides the overall architecture and methods to evaluate feedback. This section goes through all the relevant aspects for the Final version of TeNDER Architecture Blueprint. A top-down methodology has been followed to properly define the most optimal solution from both, logical and technical points of view.

2.1 Technical Architecture Overview

Service Oriented Architecture (SOA) is implemented in the development of the platform. Each element can work individually and interact with other modules as services through interface layers.

TeNDER is divided in six different structures as described in the image below: client's interface – visual independence (example: Home Set, patients TV, Caregivers Mobile, Professionals Web Interface); services; high- and low-level subsystems; and data repositories.

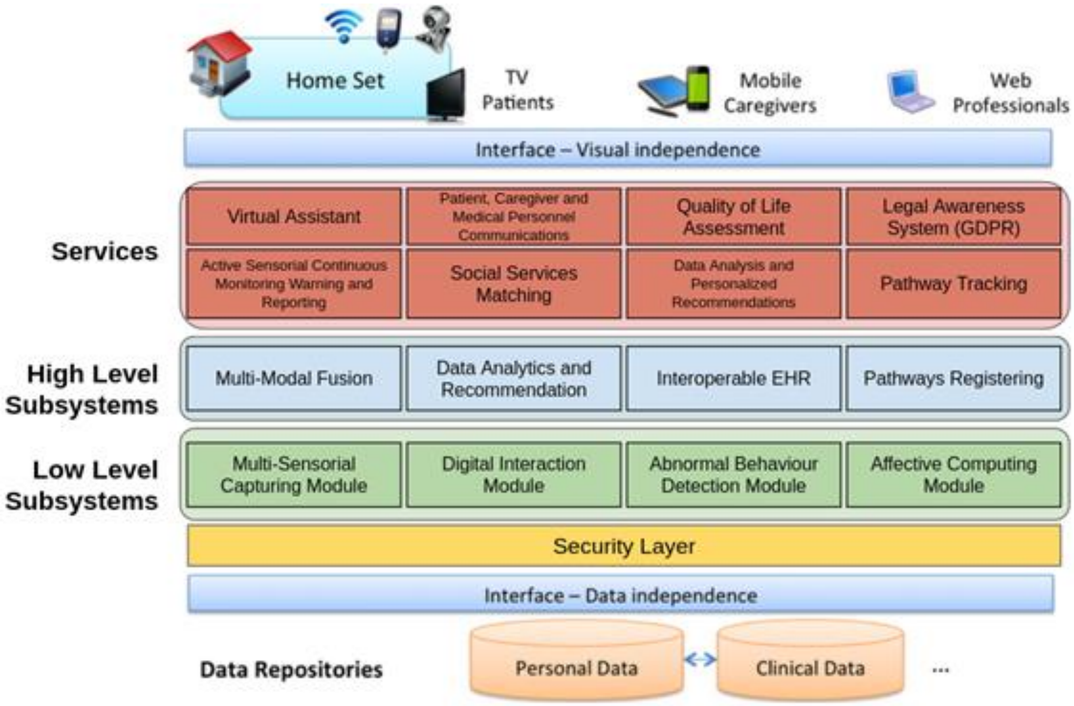

Figure 1- TeNDER Arhitecture

Two servers can be distinguished in Figure 1, with at least two or more databases of different nature (relational or non-relational databases). On the one hand, a server that collects and serves data information related to patients' data-oriented services (represented in the chart as Services). On the other hand, a server that will work with data coming from sensors and will model somehow patients' state (represented in the chart as high- and low-level subsystems).

As stated in the TeNDER Description of Action (DOA) and the previously defined scenarios, there are three main layers to provide the TeNDER services, the Low-Level Subsystems (LLS), the High-Level Subsystems (HLS) and the TeNDER Services.

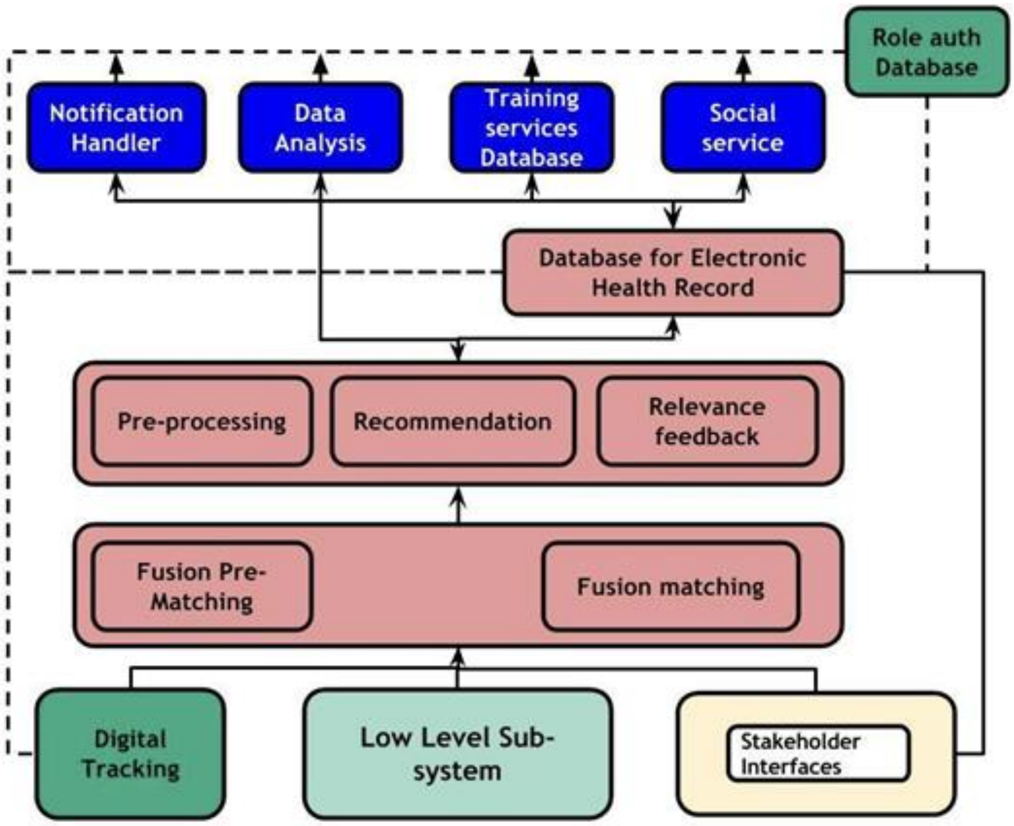

Figure 2- TeNDER System Architecture

The Low-level Subsystem is in charge of gathering information from different sources. his layer is physical based and therefore will be located at the TeNDER aforementioned scenarios. This subsystem will cover the sensor deployment and the communication between different devices. Therefore, a backend management module will handle data collection, health tracking and abnormal event detection.

Both Services and High-level subsystems will be located at different servers than the Low-level Subsystems will be to guarantee optimal data security and comply with the ethical guidelines of the project.

The TeNDER architecture will consider the centralized development of the High-level subsystem and services implementation. This architecture will ensure scalability of the system allowing the integration of future nodes.

Finally, data will travel between different components of the system in a secure manner by placing in order different security mechanism to provide a transparent and safe transmission of data that can be considered personal such as health data. The main idea behind TeNDER to provide a 100% personal data protection is that personal data will be processed only locally and will never be transmitted as such for further processing on the cloud or in other (of site) premises. An initial TeNDER dataflow can be seen in Figure 3:

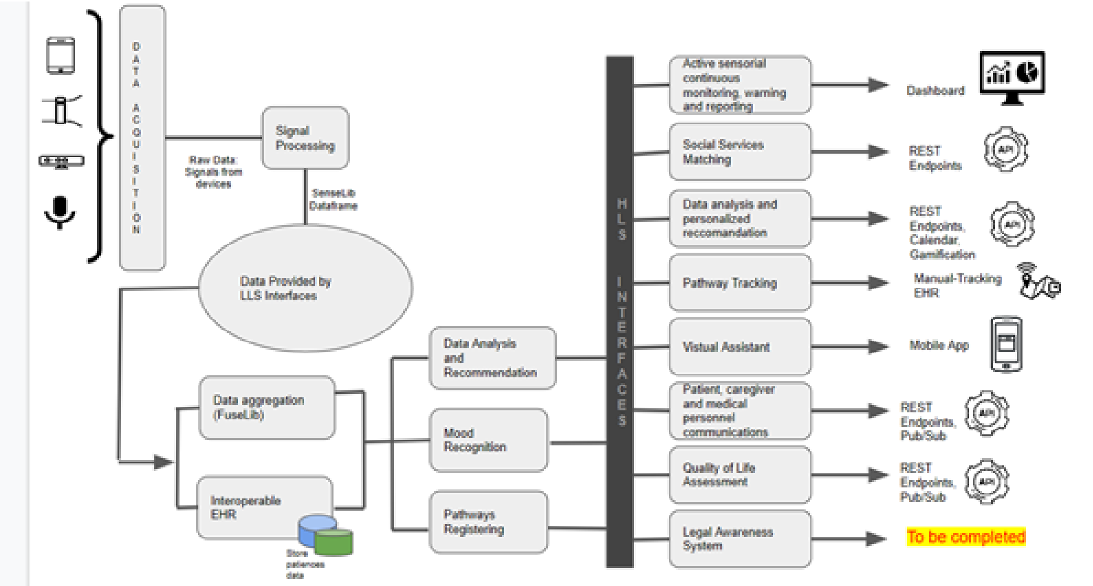

Figure 3- TeNDER First draft of Dataflow

2.2 Low-level Subsystem

The low-level subsystem (LLS) is composed by several sensing modules that will gather information from the patients. These modules are divided into several categories (all the modules will work independently, and the ones desired for the same aim will be able to combine their performance to optimize the results, but also to work on their own). The following is short presentation of the HeTra subsystem and its components, as well as of all the independent modules of the LLS.

HeTra subsystem is the core subsystem that enables tracking patient variables and will offer to the low- and high-level subsystem's modules the functionality to track specific health characteristics, from direct health situation information to periodical test results and feedback from professionals. This subsystem will: 1. Enable users (medical doctors and caregivers) to choose which health characteristics to track and 2. Provide an efficient feedback mechanism that, along with user activity recognition and, through multimodal fusion, will allow for the extraction of valuable conclusions regarding health status.

HeTra will be responsible for the data acquisition from the sensors (Kinect Azure, Wristband, Localization Tracker, Sleep Tracker, Voice Tracker, Pill Dispenser, Binary Sensors). As illustrated in Figure 4, HeTra will deliver the acquired data to the Abnormal Behaviour Detector (ABD) subsystem that is part of TeNDER LLS and to the Multimodal Fusion (MMF) subsystem which is part of the HLS.

HeTra will not just deliver raw data as acquired from the sensors but it will also analyse them to extract features that will be useful for subsequent analysis. This analysis will be performed in SENSELib. This library will include sensor data acquisition tools as well as specific algorithms for an initial data processing (tracking, skeleton smoothing, dimensionality reduction etc.).

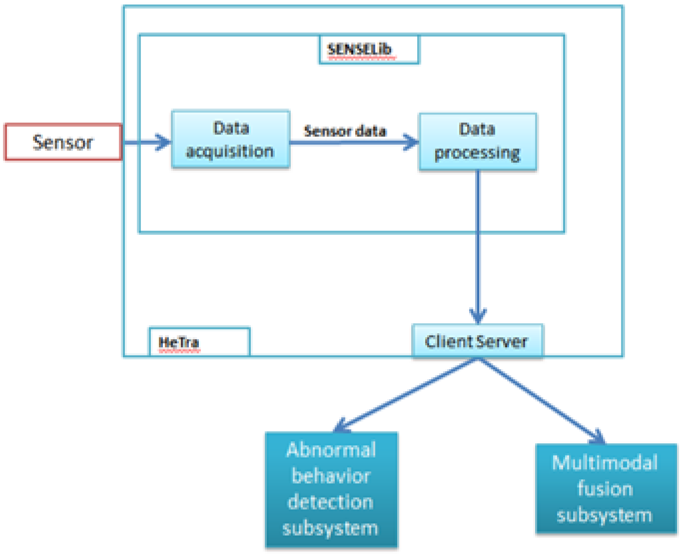

Figure 4- SenseLib schematic description.

A client of HeTra will run on the other subsystems of TeNDER (ABD and MMF subsystems) through which the communication with HeTra will take place.

SENSELib will be part of the TeNDER's open API system and will be used to develop HeTra subsystem. This library will provide two types of functionalities, i.e., acquisition and processing ones (Figure 5). HeTra subsystem will be able to get and deliver both unprocessed and processed data.

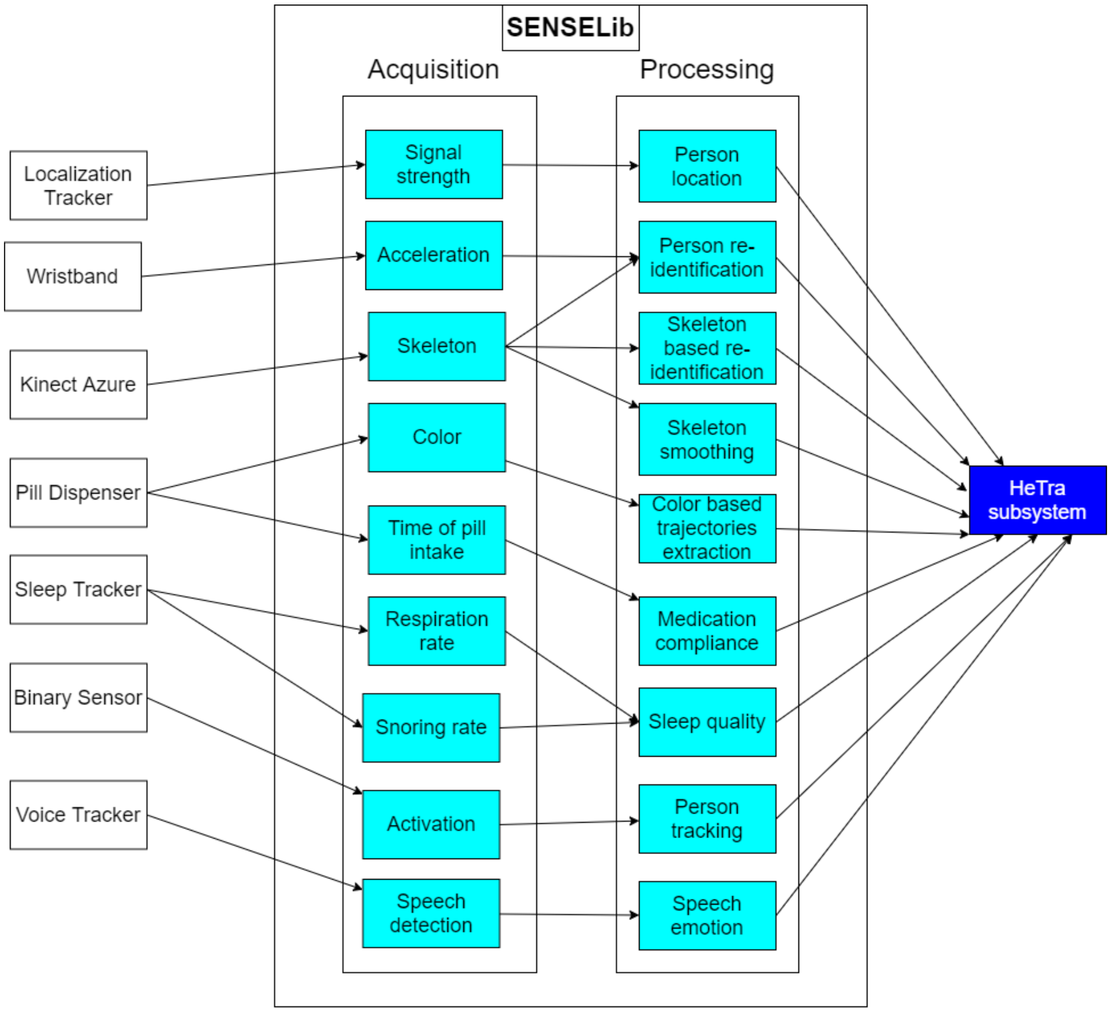

Figure 5- SENSELib Schema workflow

SENSELib modules and their Technical specifications (HW/SW) are presented following.

1. **Multi-Sensorial Capturing module**: Core module to enable tracking patient variables and to offer the service modules the functionality to track specific health characteristics, from direct health situation information to periodical test results and feedback from professionals. Example: Parkinson's patients' daily activities will be correlated to medication they receive and the system should be able to evaluate its impact on their daily routines. Dementia, Alzheimer's, and Parkinson's health plans will be analysed and defined during the project to select the homologated scales to use in the tracking the personal status. There are scales for quality of life, dependence, stress, general health level, etc. that will need to be selected together with the clinical and social team in the first stages of the project.
2. **Digital Interaction Module**: With the objective of having a personalized platform that can adapt its behaviour to patient condition and interaction with the TeNDER platform and its services, TeNDER will design and develop an interaction tracking system that analyses patient access to the different interfaces and their behaviour when using the platform in any of the interfaces. This digital behaviour analysis will help the platform to identify recommendations and help the user (patient, caregiver, professional), by analysing

her/his knowledgeability on her/his condition and the treatment or processes that need to be followed.

3. **Abnormal Behaviour Detection module**: This module will focus on analysing sensing information to identify behaviour and inform any interested party (professionals, formal/informal caregivers) about the patient's situation. Exploiting intelligent capabilities of an indoors activity recognition methodology, employing ambient and depth sensors, environmental sensors and mobile based sensors, this core subsystem will provide the TeNDER ecosystem with the capability of assessing on the real deviations from the expected daily conduct of the person (e.g. the senior missed to take a medication dose) and any (previously parameterized) human abnormal behaviour (e.g. for Parkinson's patients need to be controlled if the patient gets blocked or has fallen to help the patient or warn the caregivers)
4. **Affective Computing module:** This module will apply advanced deep learning and Computer Vision techniques to extract relevant features (i.e. general, facial, speech or behavioural) that can allow to estimate the expression and mood of patients. This information will be extracted by using the smartphone devices and will be used as input to up-level services that will support the patient.
5. **Localization tracking module**: This module will combine the information gathered from different sensing devices deployed across the areas to be monitored (For TeNDER purposes, it will be deployed in all scenarios) through a wireless sensor network. Static binary sensors will send information about the interaction with the environment (door open/closed). Wristband device will send health information such as pulse rate and temperature. Moreover, additional information about the position of the participants can be extracted from the wristband looking at the RSSI (Received Signal Strength Indicator). Main technologies that will be employed involve Localization hardware devices. As a result of these techniques a continuous time-real room-level tracking will be reached.
6. **Kinect Azure tracking module**: Kinect Azure sensor will be used for person tracking (to monitor the person's movements and body position). Kinect Azure SDK contains a skeleton tracking based on the fusion between RGB information and depth information, there by more accurate in detecting body joints positions and more robust in difficult conditions like change of lights.
7. **Kinect Azure sensors will be deployed in all the scenarios**: In home scenario and in Daily centre scenario it will be placed in an elevated position (e.g. above a closet) to amplify the recording area. In the rehabilitation centre the sensor will be placed in front of the subject to better register the change of movement during the exercises.

2.2.1 Modules Description

Table 2 - Kinect Tracking module

Kinect Tracking module	Description
Functionalities	Retrieve process and deliver rich sensor data (SENSELib & HeTra low level subsystems). The Kinect tracking module will deliver highly accurate body trajectories, de-noised through a

	novel filtering procedure. Moreover, tracking will provide re-identification functionalities to correlate trajectories to specific patients.
Implemented on	SENSELib
Interfaces Exposed (Outputs)	The HeTra API will enable other subsystems to request and get low level data from sensors. SENSELib will be responsible for the data acquisition from the sensors and their pre-processing to extract features that will be sent through HeTra to Abnormal Behaviour Detection and Multimodal Fusion subsystems.
Interfaces Requested (Inputs)	Wired (USB 3) connection with Kinect as well as the Sensor APIs.
Algorithms employed	Kalman and Kalman/Tobit filtering will be used to filter the acquired skeletons and to decrease the estimation errors.
Instances and Deployment	Depending on each specific use case the hardware deployment will be such, to maximize the possibility to track the patients in their daytime activities.
Programming languages	C#/C++
Libraries	Standard open libraries for video and image processing (e.g., OpenCV)
Issues & Notes	Kinect cameras will operate ~17-19 hours per day. In practice, they will stop working for 5-7 hours every night (in a predefined time interval) in which the patient is sleeping.

Within the TeNDER, it is agreed that Kinect Azure sensors will be used for depth sensing. The specifications for the use of these sensors are the followings:
Each Kinect Azure sensor requires a PC with the following (minimum) specifications:

- Seventh Gen Intel® CoreTM i3 Processor (Dual Core 2.4 GHz with HD620 GPU or faster)
- 4 GB Memory
- Dedicated USB3 port
- Graphics driver support for OpenGL 4.4 or DirectX 11.0
- Windows 8 or 8.1, Windows Embedded 8, or Windows 10

Table 3- Sleep tracking module

Sleep Tracking module	**It collects users' sleep data using a Sleep tracking mat which is located under the user's mattress.**
Functionalities	It monitors the quality of sleep (duration, sleep state, respiratory rate, heart rate, snoring).
Implemented on	SENSELib
Interfaces Exposed (Outputs)	API link: https://rr.intectiv.si:10004/sleep-tracker/?SensorID=20801444
Interfaces Requested (Inputs)	Withing's sleep tracker sensor API link: https://developer.withings.com/oauth2/
Algorithms employed	Averaging the heart rate data on data frames. Other data is as it is obtained from Withing's Cloud.
Instances and Deployment	The sensor will be installed under the user's mattress and connecting it to the local Wi-Fi as described in the sensor manual. After that, the (virtual) user registration on Withing's is required and allowing the TeNDER application to gather the sleep data.
Programming languages	Python, C#
Libraries	Falcon
Issues & Notes	The Withing's API makes data available after the user wakes up.

Table 4- Localisation Tracking module

Localisation Tracking module	**It monitors the strength of the signal from the wristbands or other Bluetooth(r) tags worn by the users and determines the room-level position.**
Functionalities	Identify probable causes of insomnia and check behaviour and position status of the patient.
Implemented on	SENSELib
Interfaces Exposed (Outputs)	API link: https://rr.intectiv.si:10004/position-tracker/?SensorID=30AEA412C380&mac=CAEB0DCFF147

Interfaces Requested (Inputs)	MQTT protocol with JSON
Algorithms employed	Max signal of all the devices that sees the specific device. This represents the room where the user is currently located.
Instances and Deployment	The scanners are positioned in each room we want to localize a user (preferably as far apart as possible to increase accuracy). After plugging the scanner to the wall outlet, it can be connected to the local Wi-Fi.
Programming languages	Python, C#
Libraries	Falcon
Issues & Notes	N/A

Table 5- Voice tracker Module

Voice Tracker module	**Description**
Functionalities	Emotional state detection
Implemented on	SENSELib
Interfaces Exposed (Outputs)	JSON file sharing
Interfaces Requested (Inputs)	Mic Audio flow
Algorithms employed	Deep Learning algorithm that makes use of a convolutional neural network (CNN) composed of three layers: Input layer (Dense layer 256); Hidden layer; Output Layer.
Instances and Deployment	The speaker is connected to a pcbox in local and it is powered through USB. There are no additional requirements for the installation of the system.
Programming languages	Python

Libraries	TensorFlow, end-to-end open source platform for machine learning
Issues & Notes	N/A

2.3 High Level Subsystem

High level subsystem, consists of the following submodule: Notification handler allow to manage notification and alerts, providing a reliable and battery-efficient connection between TeNDER server and devices that allows to deliver and receive messages and notifications on iOS, Android; Data analytics and Recommendation subsystem that provides personalized information to the patients, information to the caregivers and patient information to the professionals; 3) Interoperable EHR (EHR) for proper interoperability and integration in current health systems; 4)tracking service database, to obtain meaningful data about our users and target audience and their behaviors, tracking and collating the metrics that matter most to the TeNDER purpose both accurately and securely. Social service, module devoted to bring the social supply to the patients. The ambition is to integrate medication, medication intake, exercises, nutrition, and non-medical assistance functionalities (daily routines, from cleaning to administration, shopping, occasional travel, or basic finances like paying bills) and related monitoring into connected modules which local caregivers can access and make decisions/provide support services.

2.3.1 Services

TeNDER aims at providing a toolbox of services tackling the main variables (from clinical, social, and quotidian views) that affect patients to improve their QoL and better involve the HealthCare actors:
Services will utilize the information generated through the TeNDER ecosystem to generate information to the related stakeholders as depicted in Figure 7. Specifically, TeNDER has created a set of seven Clusters of Services that, using the core technologies of the system, to serve a plethora of ways in which senior citizens, living on their own, affected by any of several of the Chronic Diseases, are expected to be supported.

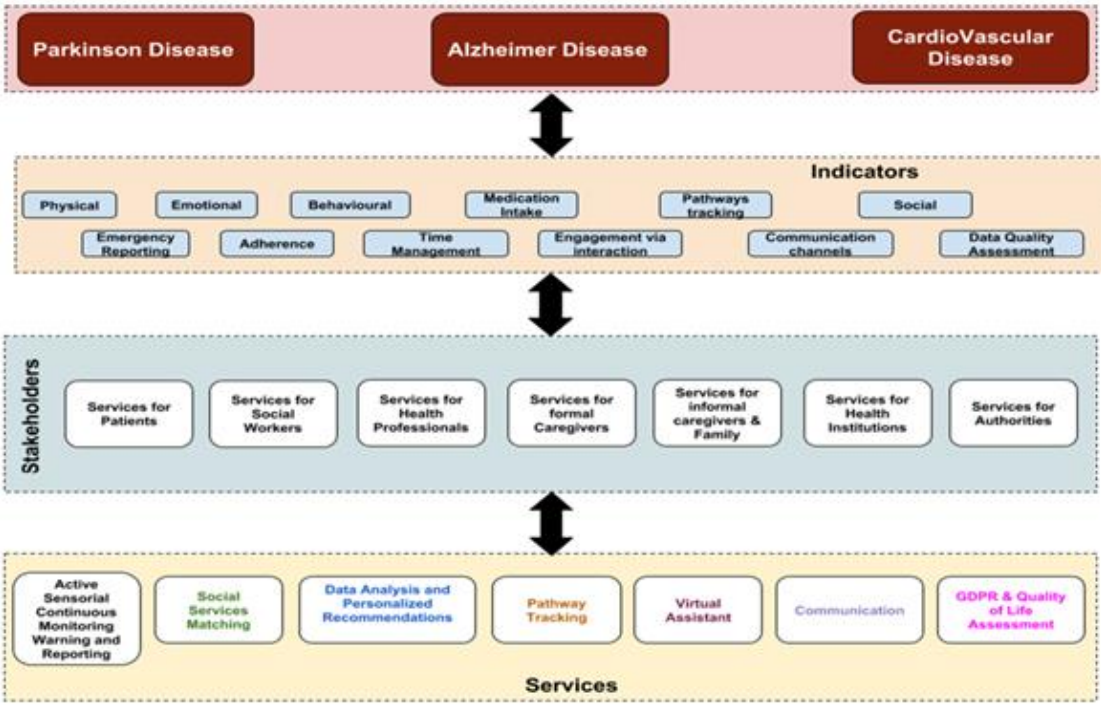

Figure 6- TeNDER Services, Stakeholders, indicators for the Chronic Diseases covered

TeNDER services server has exposed an API that allows users to access to the different modules provided. Access will be provided in a secure way via authorized roles.

At the same time, it will expose another secure API where sensors and remote computers will be connected to a central server (TeNDER cloud). All requests will have a valid token previously generated by the login services. A task is in charge of gathering all the services available in the platform. A set of sub-models will be defined to achieve all users' requirements.

Here follows an initial approach of two UML use case diagrams that correspond to two examples of the User Stories in Section 2 [document TeNDER_All_User_Story].

For example, in Figure # a UML use case diagram is depicted according to the use case scenario (as described in the Section 2 [document TeNDER_All_User_Story Table 2)], in which a patient who suffers from Parkinson's Disease is monitored in his/her house.

Another instance of a UML use case diagram is shown in Figure #. In this case, the patient suffers from Alzheimer and he/she is located in Day-Care Centre (as described in the Section 2 [uploaded document TeNDER_All_User_Story, Table #)].

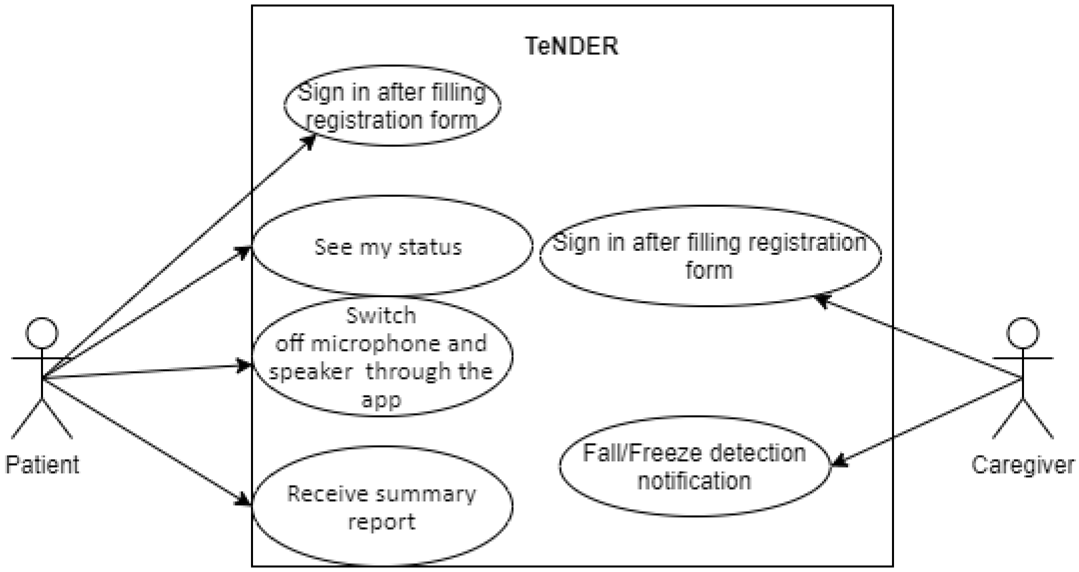

Figure 7- TeNDER UML Table 2 HOME SET Parkinson Disease

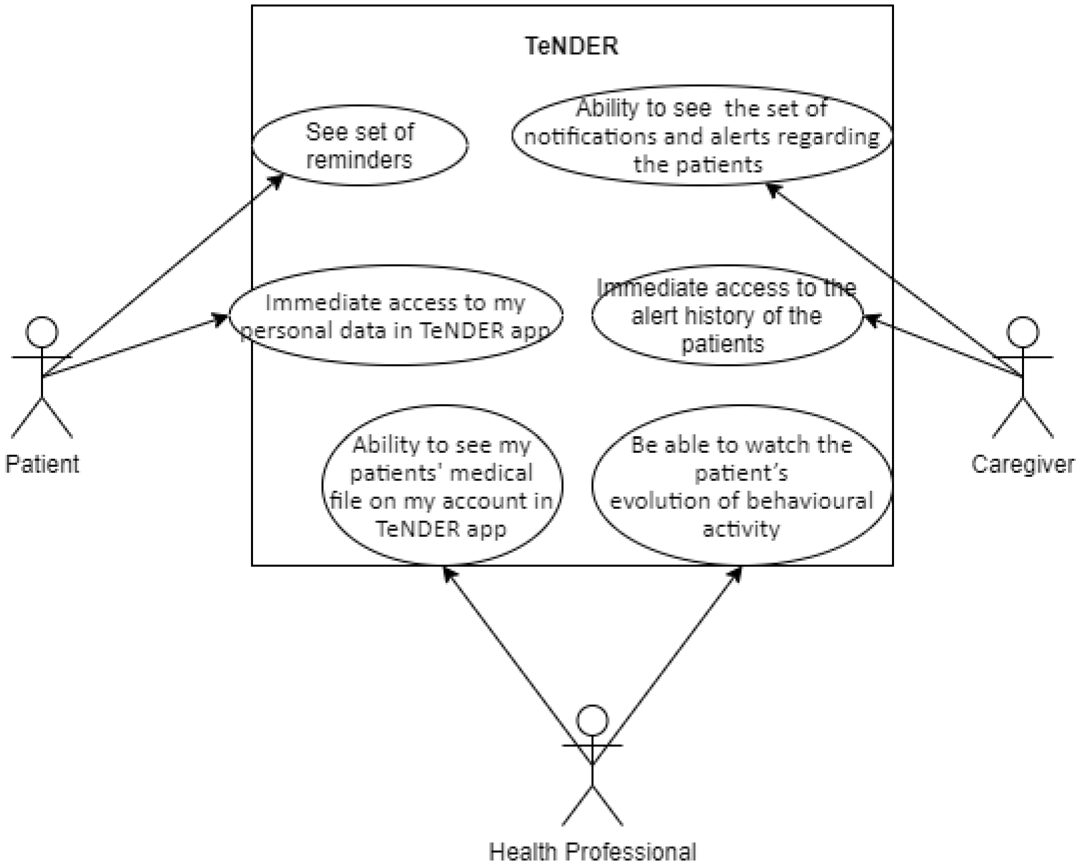

Figure 8- TeNDER UML Table 4 Day-Care CENTER Alzheimer or related

All the services are mostly provided to our users in the form of specific features and sections on our app and platform in general.

2.3.1.1 **Service Cluster 1:** Active Sensorial Continuous Monitoring, Warning and Reporting

This system takes advantage of the use of multi-sensorial infrastructure to provide patients with:

- **Health tracking service:** This service will offer patients the monitoring of patient biological, behavioural variables such as blood pressure, weight; reaction to stimulus; Social behaviour (among others). The service will be in charge of capturing relevant data from the patient and his/her environment to detect abnormal situations.
- **Emotional/affective detection service:** this service will be end-user oriented and intends to detect the patient's mood to support their status enabling services that might help him in case of negative feelings (i.e. sadness, depression-like).
- **Warning and reporting service:** this service will be in charge of controlling the patient variables and report any special/abnormal event to the adequate stakeholder (caregiver, informal caregiver, and family) according to the type of event, the relevancy and the action required (i.e. to call emergency services).

Table 6- Service Cluster 1

Service Cluster 1	**Description**
Functionalities	Services responsible of providing to patients and caregivers, health professionals with Health Tracking, Emotional/Affective detection of patients and providing reports and input for triggering warning Both on the App and web platform.
Implemented on	TeNDER Services
Interfaces Exposed (Outputs)	Health tracking service Emotional/affective detection service User interfaces bo in the in TeNDER APP and Web APP within specify section called safety and wellbeing Warning and reporting service: ▪ Fitbit's Tender app ▪ User interfaces both in TeNDER APP and Web APP providing emergency notification, common notification, alerts.
Interfaces Requested (Inputs)	**Health tracking service** ▪ Input form Recommendation System. ▪ Input form related TeNDER sensors, wristband, position sleep tracker. **Emotional/affective detection service** ▪ Input form Recommendation System.

	▪ Input form related TeNDER sensors, like: microphone, deep camera. **Warning and reporting service:** ▪ Input form Recommendation System. ▪ Input form related available TeNDER sensors, like: microphone.
Algorithms employed	**Health tracking service** • N/A **Emotional/affective detection service** • Sound recognition through a deep learning algorithm using a pre-trained model of predetermined sounds (crying, laughter, falling). **Warning and reporting service:** • Deep Learning algorithms for fall detection • Machine Learning algorithms for freezing detection
Instances and Deployment	**Warning and reporting service:** ▪ Dockerized Abnormal Behaviour Detection (ABD) system
Programming languages	**Health tracking service:** • C# **Warning and reporting service:** ▪ Python (for the ABD general modules) ▪ Javascript (for the Fitbit's Tender app) ▪ CSS (for the Fitbit's Tender app)
Libraries	**Health tracking service:** • SenseLib: Opun source library for sensors information collection. **Emotional/affective detection service:** ▪ NumPy array with the vectors of the extracted features from the analyzed sound frames **Warning and reporting service:** ▪ Numpy ▪ Keras.Tensorflow ▪ Mqtt
Issues & Notes	▪ No relevant issues

2.3.1.2 **Service Cluster 2:** Social Services Matching

This set of services is devoted to bring the social supply to the patients. The ambition is to integrate medication, medication intake, exercises, nutrition, and non-medical assistance functionalities (daily routines, from cleaning to administration, shopping, occasional travel, or basic finances like paying bills) and related monitoring into connected modules which local caregivers can access and make decisions/provide support services.

- Patients can answer the questions (e.i. in regards to companionship, loneliness, financial status, care service support need/instrumental activity) provided through the TeNDER system and select/obtain services and type of assistance from communication channel with the social professionals or through the system recommendation service (a list available locally or have information about the type of assistance provided or available). They can follow their own status and wellbeing, getting suggestions/instructions about wellbeing (daily activity, nutrition or exercise).

- Caregivers can use monitoring data and user requirement information to analyse situation and start/adjust the level of support and select trained staff to provide assistance. They can monitor patients' TeNDER Sections 1-3 Page 12 of 70 adherence to previously agreed activities (from exercises to medication or taking adequate nutrients, vitamins, etc.). They can also obtain information on available social support for carers (like support group, help with grocery etc.).
- Feedback from monitoring or change in available services may lead to modification of level of support.
- Medical information (from other subsystems) may also assist to set the adequate level and combination of support services.
- The services will be provided to users, caregivers (formal or informal), family and social worker (and institutions).

Table 7- Service Cluster 2

Service Cluster 2	**Description**
Functionalities	This cluster of services is in charge of bringing social supply to the patients and provide resources to use and adapt the support services available.
Implemented on	TeNDER Services
Interfaces Exposed (Outputs)	TeNDER services Rest Endpoint ▪ User interfaces within fot TeNDER APP with specific section called questionnaire
Interfaces Requested (Inputs)	Questionnaire on the patient and carers status and need for social support, Recommendation System, Monitoring, Medical Information from other subsystems
Algorithms employed	N/A
Issues & Notes	No relevant issues

2.3.1.3 **Service Cluster 3:** Data Analysis and Personalized Recommendations

Professional oriented service to offer value on the patient data gathered through different services and through the analysis of the interaction amongst all the involved parties. The objective will be to generate knowledge by a continuous data analysis focus on all patients' information identifying patterns and models of best practices in coordination, treatment, recommendations offered, gamification integration, interaction design, etc. Knowledge will be offered to medical and social professionals while using platform services with information on alternatives used by other professionals of the platform in the actions they are taking.

- Follow-up protocols: Chronic conditions need follow up protocols to understand their evolution and patient's specific needs at all stages. This service will automatically recommend forms and questionnaires to identify patient situation, while recommendations will also be targeted to caregivers that take care of patients on a daily basis. The service will include different protocols depending on the disease of the patient and will be open to new protocols when future targets are incorporated into the platform.

Table 8- Service Cluster 3

Service Cluster 3	**Description**
Functionalities	Knowledge generation and sharing with medical and social professionals
Implemented on	TeNDER Services
Interfaces Exposed (Outputs)	TeNDER Services: Rest Endpoint, Calendar User interfaces both in TeNDER APP and Web APP within section called "recommendations/ suggestions"
Interfaces Requested (Inputs)	TeNDER Services: Training, Calendar TeNDER EHR
Algorithms employed	▪ ▪ API calls ▪ Deep Learning techniques ▪ Clustering techniques ▪ Classification algorithms
Instances and Deployment	▪ Dockerized container: Recommendation module
Programming languages	▪ Python ▪ HTML

Libraries	▪ ▪ Tensorflow ▪ Numpy ▪ Sklearn ▪ NLTK
Issues & Notes	No relevant issues

2.3.1.4 Service Cluster 4: Pathway Tracking

This service employs all data flow across the System and will analyse the patient non-clinical activity, providing all stakeholders with relevant information to optimize time management in the patient healthcare chain.

- Clerical Pathway: using all information available, this service will register the entire repository of events associated to healthcare attention to the patient. This service has been implemented by the TeNDER EHR server which supports interoperability using the HL7 communication protocol for easier connection with external systems. In this server, all the patients' activities and data are stored. TeNDER ecosystem provides also its own user interfaces (web and mobile applications) that offer all the necessary information to users (patients, doctors, caregivers, etc).
- Quality of data provided: This service enables TeNDER to improve continuously in the manner that information is retrieved and presented to health professionals. This service continuously monitors the quality of the offering information (i.e. recommendations, graphs, evolutions, sensor readings, etc), and the optimal efficiency of the system.

This service is based on two different approaches, in the first one, we collect feedback directly from the users of the system. Secondly, we have developed a separate monitoring framework that observes the operation of the TeNDER ecosystem and in case of an abnormal detection informs the administrator of each health organization. As abnormal events, we consider issues like the unexpected shut down of a user's PC, the failure of the data storage in the cloud due to a network disconnection, sensor disconnection, etc. In every case, an email alert notification is generated with all the necessary information and sent to the appropriate person in order to evaluate and solve the issue.

Table 9- Service Cluster 4

Service Cluster 4	Description
Functionalities	Employ all data flow across the System, analyse the patient non-clinical activity and provide stakeholders with information relevant with optimising time management in the patient healthcare chain. Check that all patients' data are stored properly to the TeNDER EHR.
Implemented on	TeNDER Services

Interfaces Exposed (Outputs)	▪ TeNDER Services: Manual-Tracking ▪ TeNDER EHR ▪ TeNDER Monitoring service ▪ TeNDER Web and Mobile application
Interfaces Requested (Inputs)	▪ TeNDER Services: Rest Endpoint (HTTPS) ▪ Publish/Subscribe (AMQPs) Input form related TeNDER sensors, like: microphone
Algorithms employed	N/A
Instances and Deployment	Web Application developed (Spring Java framework), Mobile Application developed (Android, iOS), Message broker (RabbitMQ), TeNDER EHR (Tomcat), Databases (PostgreSQL, MongoDB), TeNDER Remote DB (Django).
Programming languages	Java, SQL, Python, Spring.
Libraries	>= Java 1.7, Spring Core, Spring MVC, Spring Data, Python, Django, RabbitMQ, prometheus-client, fhirclient, python-keycloak.
Issues & Notes	No relevant issues

2.3.1.5 Service Cluster 5: Virtual Assistant

The behaviour and capabilities of the virtual assistant (VA) module is based on the availability of peripherical devices in the tender ecosystem. The first version of the VA depends on the interaction between the speaker and the mini-PC. The mini-PC reads the text of a Tender app reminder aloud using its speaker.
The second and final version of the virtual assistant communicates with the speaker and microphone connected to the mini pc, so the mobile app is not detecting any voice input from the user or playing any output. Using a trigger keyword, the system can determine when the software has listened to a user request or command. The system collects information from the users via specific questions and it can obey to commands like "call my urgent phone number".

Table 10- Service Cluster 5

Service Cluster 5	Description
Functionalities	This service cluster is in charge of collecting general information and provide an easier user experience for patients with serious illness

Implemented on	TeNDER Services
Interfaces Exposed (Outputs)	TeNDER Services: Rest Endpoint
Interfaces Requested (Inputs)	Audio stream
Algorithms employed	Speech-to-text and text-to-speech algorithms and machine understanding technologies.
Instances and Deployment	Web Application developed with Spring Java framework and python module deployed into Web server
Programming languages	Java, SQL, python
Libraries	>= Java 1.7, Spring Core, Spring MVC, Spring Data, Flask, GTTS, idna, Jinja2, MarkupSafe, Mutagen, Numpy, Pocketsphinx, PyAudio, python-vlc, Pyttsx3, Requests, Scipy, SpeechRecognition Urllib3, Werkzeug
Issues & Notes	No relevant issues

2.3.1.6 **Service Cluster 6:** Patient, Caregiver and Medical personnel Communications

Service to offer social communication among users of the Platform at different privacy levels and with different objectives:

- Family Support: Communication among family members, caregivers, and patients to reduce patient loneliness and to offer personal services for the patient.
- Social Interaction: Among patients with similar situations to motivate patients with socialization.
- Care Support: Communication between professionals and caregivers or patients.
- Coordination: Foster coordination among medical and social professionals.
- Share Knowledge: Communication among professionals to share treatment knowledge and best practices.

Table 11- Service Cluster 6

Service Cluster 6	Description
Functionalities	Offers social communication among platform users at various privacy levels and with different objectives
Implemented on	TeNDER Services
Interfaces Exposed (Outputs)	Translations Server: 195.251.117.117:8080 Users Server: https://social-stage-tender.maggiolicloud.it/
Interfaces Requested (Inputs)	N/A
Algorithms employed	N/A
Instances and Deployment	Open source rapid development framework for web applications where users need to login and share information. Standalone version for translations, dockerized version for users.
Programming languages	PHP, MySQL
Libraries	Apache 2.4 PHP 7.4.25 MariaDB (formerly MySQL)
Issues & Notes	Elgg 3.3. does not support PHP8, although any PHP7 version will do. The current installed version of Apache is Apache 2.4.52. Be sure to perform an update as soon as it comes out for security reasons. Dockerized version is configured to work with the TeNDER Keycloak Authentication service.

2.3.1.7 Service Cluster 7: Quality of Life Assessment

This service will allow users to measure and know the impact of their interactions with the different functionalities of the TeNDER system. Additionally, this service will allow to match questionnaires related to QoL (i.e. SF-36, SF-12, OP-QoL, PDQ8, PDQ39 or QoL-AD) in an interactive manner by using interface dynamic tools and serious games.

Table 12- Service Cluster 7

Service Cluster 7	Description
Functionalities	TeNDER will try to encourage users in the user of the application using games throughout the system experience. This service will record actions rules to calculate points, achievements, and rewards.
Implemented on	TeNDER Services
Interfaces Exposed (Outputs)	TeNDER Services: Rest Endpoint, Pub/Sub, Notification via Pub/sub. User interfaces within specify section called questionnaire. Ckan interface to visualise monthly reports for each organization registered in the HAPI FHIR server. Each report, generated as an excel file, contains several sheets with data that corresponds to patients, caregivers, practitioners and several metrics regarding their disease and devices.
Interfaces Requested (Inputs)	TeNDER Services: Documents Calendar, Training, Manual-Tracking, and Person. TeNDER EHR
Algorithms employed	N/A
Instances and Deployment	Web Application developed with NodeJS with RabbitMQ deployed into TeNDER and acceded with Load Balancer for Rest API and Pub/Sub for RabbitMQ. Neo4j Graph database
Programming languages	Node JS, JavaScript, CypherQL, Python
Libraries	>= Node JS 4.4.4, Rabbit MQ 3.6.2, Neo4j Community 3.0.1
Issues & Notes	No relevant issues

3 TeNDER COMMON APPROACH AND METHODOLOGY

To define the final version of TeNDER applied to the pilots, preliminary development work has been carried out on the adoption of the requirements and constraints in terms of ethics and privacy. In parallel, the definition of the scenarios in the final design approach of TeNDER has been carried out.

3.1 Ethical and legal management

Legal and ethical aspects have been continuously addressed in TeNDER, starting with D1.1 Fundamental Rights, Ethical and Legal Implications and Assessment, which defined the framework and principles applicable to technical works. Further details were reported on in the first impact assessment (delivered in M22), namely data protection, privacy, ethics and safety aspects of the development process. In order to avoid replication of already submitted work, we will here summarise the most pertinent points.

In TeNDER technical work, the data of patients and caregivers are processed in order to develop an integrated care model. These data are considered personal data in the sense of the GDPR, insofar they fall under its scope of application.

The GDPR applies to processing of personal data. These notions are defined in Art. 4(1) and (2), respectively as: 'personal data' means any information relating to an identified or identifiable natural person ('data subject'). 'Processing' means any operation or set of operations which is performed on personal data or on sets of personal data, whether or not by automated means, such as collection, recording, organisation, structuring, storage, adaptation or alteration, retrieval, consultation, use, disclosure by transmission, dissemination or otherwise making available, alignment or combination, restriction, erasure or destruction.

Since TeNDER is concerned with health and aging technology, the data that will be processed falls under the regime of special categories of data (art. 9 of the GDPR). This article specifies that health data can only be processed if specific criteria are met, such as processing with the explicit consent of the patient. '**Health data'** under the GDPR mean personal data related to the physical or mental health of a natural person, including the provision of health care services, which reveal information about their health status.

The partners involved in the pilots will be acting as either data controllers or data processors. **'Controller'** means the natural or legal person, public authority, agency or other body which, alone or jointly with others, determines the purposes and means of the processing of personal data; **'processor'** is defined as a natural or legal person, public authority, agency or other body which processes personal data on behalf of the controller.

In TeNDER, the user partners are acting as controllers and the technical partners as processors; therefore, they have signed respective data sharing agreements, which in accordance with art. 28(3) of the GDPR, set out the subject-matter and duration of the processing, the nature and purpose of the processing, the type of personal data and categories of data subjects and the obligations and rights of the controller.

We are aiming to operationalise the privacy by design approach from art. 25 of the GDPR, which states that controller is required to implement appropriate technical and organisational measures, such as pseudonymisation, which are designed to implement data-protection principles, such as data minimisation, in an effective manner and to integrate the necessary safeguards into the processing in order to meet the requirements of the GDPR and protect the rights of data subjects. While doing so, the controller must take into account the state of the art, the cost of implementation and the nature, scope, context and purposes of processing as well as the risks of varying likelihood and severity for rights and freedoms of natural persons posed by the processing. In TeNDER, the legal, user and tech team collaborate through serial impact assessments through which we strive to follow the principle of data protection by design.

The consortium has taken specific steps to respect applicable legal and ethical frameworks, and several measures regarding the treatment of personal data have been adopted by the consortium partners. More specifically, our approach rests on ex ante and ex post legal analyses

1. **Definition of applicable framework in D1.1 Fundamental Rights, Ethical and Legal Implications and Assessment** (First Version): applicable legal and ethical frameworks, such as the GDPR, elemental principles of biomedical ethics, and regulation of medical devices. Based on our analysis, we defined the fundamental obligations of pilot partners vis-à-vis patients on protection of personal data, involvement of participants in pilots, ethical and social aspects, and safety requirements of medical devices deployed. Further ethics compliance was demonstrated by our work in WP10.
2. **Impact assessment and continuous legal and ethical monitoring:** in the impact assessment, we take into account the nature, scope, context and purposes of the processing in the development process in order to ascertain risks to the fundamental rights and freedoms of patients involved. Our initial findings were be reported in the D1.4 First legal/ethical monitoring report, submitted in M22, and will be revisited in D1.5 Final legal/ethical monitoring report (due M42)
3. **Final legal evaluation of the technical development and project research:** D1.6 Final version of Fundamental rights, ethical and legal implications and assessment (also due M42).

3.2 TeNDER approach

TeNDER is developed in two parts:

1. The first part (Phase 1) was dedicated to study the provisions flow (Deliverable 2.1), scenarios proposed (Deliverable 2.3) and the relevant evidence from the literature (Deliverable 2.4), but also the real experiences from potential participants by an observational study that was conducted with surveys and interviews. Therefore, different potential TeNDER end-users (patients, caregivers, and professionals) were involved in co-design process already in pre-piloting phase of TeNDER. The user requirements, usability, and acceptance of the technology was investigated, and Persona cards (Personas, models) were created (Deliverable 2.4). This way, we were able to visualize the needs of the TeNDER users, to define and confirm requirements of various patients with different abilities, people that surround them, and furthermore, with different types of professionals that are included in patients` care pathway. The aim is to develop a technological tool adapted to their preferences and needs.

2. The second part of the co-design process (Phase 2, 3 & 4) has been carried on throughout the Mock-Up testing and also thorough the piloting phase in all 5 pilot sites of TeNDER. This intended to be a large-scale intervention phase to be carried out in a total of 5 institutions in different countries. During this pilot phase, feedback has been continuously received from the users through the interviews and observations. Every user is invited to reflect and comment his/her own views on the tool to incorporate the

modifications and improvements detected. With this, we continue with the collaborative work with the beneficiaries of the tool.

The following tables list the actors involved in the collection of user requirements in each of the pilots. It can be seen that in each of the phases the actors directly involved in TeNDER have collaborated, offering their opinions, needs and experiences of use through different data collection tools, combining qualitative and quantitative methodology. This feedback has made the co-creation of the TeNDER tool possible.

Table 13- Actors involved in Pilot 1

ACTORS INVOLVED IN PILOT 1 (SERMAS)									
		PATIENTS			CAREGIVERS	PROFESIONALS		
		AD	PD	CVD		HP	SW	Other
Phase 1	Survey requeriments	2	8	10	21	13	-	2
	Interview requeriments	1	-	1	2	1	1	-
Phase 2	FIRST WAVE	-	-	33	10	31	-	8
	Testing Lab 1	-	-	14	10	13	-	-
	SECOND WAVE	5	2	62	11	26	-	6
Additional user requirements		2	1	-	3	-	2	-
TOTAL		**10**	**11**	**120**	**57**	**84**	**3**	**14**

Table 14 - Actors involved in Pilot 2

ACTORS INVOLVED IN PILOT 2 (APM)								
		PATIENTS			CAREGIVERS	PROFESIONALS		
		AD	PD	CVD		HP	SW	Other
Phase 1	Survey requeriments	-	20	-	20	9	-	-
	Interview requeriments	-	3	-	3	3	-	-
Phase 2	FIRST WAVE	-	32	-	16	8	-	-
	Testing Lab 1	-	11	-	-	4	-	-
	SECOND WAVE	-	48	-	28	8	1	1
Additional user requirements		-	-	-	-	-	1	-
TOTAL			114		67	32	2	1

Table 15- Actors involved in Pilot 3

ACTORS INVOLVED IN PILOT 3 (UNITOV)								
		PATIENTS			CAREGIVERS	PROFESIONALS		
		AD	PD	CVD		HP	SW	Other

Phase 1	Survey requeriments	2	2	-	2	2	1	-
	Interview requeriments	1	-	-	2	1	1	-
Phase 2	FIRST WAVE	10	9	-	2	3	-	-
	Testing Lab 1	-	1	-	-	1	-	-
	SECOND WAVE	10	9	-	2	3	-	-
Additional user requirements		-	-	-	-	-	-	-
Total		**23**	**21**		**8**	**10**	**2**	

Table 16- Actors involved in Pilot 4

ACTORS INVOLVED IN PILOT 4 (SKBA)								
		PATIENTS			CAREGIVERS	PROFESIONALS		
		AD	PD	CVD		Health	Social	others
Phase 1	Survey requirements	-	-		-	4	-	-
	Interview requirements	5	-	5	5	4	-	-

Phase 2	FIRST WAVE	13	1	8	13	7	-	-
	Testing Lab 1	-	1	1	-	7	-	-
	SECOND WAVE	17	-	23	16	6	-	1
Additional user requirements		-	-	-	-		-	-
TOTAL		35	2	37	34	32	-	1

Table 17- Actors involved in Pilot 5

ACTORS INVOLVED IN PILOT 5 (SPO)								
		PATIENTS			CAREGIVERS	PROFESIONALS		
		AD	PD	CVD				
Phase 1	Survey requirements	20	-	-	20	7	1	2
	Interview requirements	3	-	-	3	1	2	
Phase 2	FIRST WAVE	25	-	-	15	2	2	2

	Testing Lab 1	-	-	-	-	-	-	-
	SECOND WAVE	44	-	-	25	4	1	2
Additional user requirements		2	-	-	8	7	2	3
TOTAL		94	-	-	71	21	8	9

The final design of the TeNDER tool is the result of the study of user needs and requirements, which have been collected through different tools detailed in WP2 Deliverbales and the outcome of which has served to provide feedback and evaluation to guide the design of the TeNDER system requirements.

4 PILOTS DEFINITION

The output of this section will be a complete system vision incorporating needs of all actors as well as supported by the medical and social evidence.

4.1 Final version of scenarios and use cases

Under this subsection the final version of the multiple scenarios defined within TeNDER framework and the services and user cases associated with them is provided.

4.1.1 HOME SET Scenario

Home set scenarios include users from the 3 groups: AD, CVD, PD

Table 18- HOME SET Scenario

HOME SET Scenario			
Disease	AD	CVD	PD
EPIC	**Primary:** User (Patient) **Secondary:** Caregivers (Family)	**Primary:** User (Patient) **Secondary:** Caregivers (Family)	**Primary:** User (Patient) **Secondary:** Caregivers (Family)

	Health Professionals, Social workers and other professionals	Health Professionals and other professionals	Health Professionals and other professionals
Required functionalities	Physical activity (steps and heart rate) Fall detection Sleep quality Humidity and temperature detection Confusion and disorientation Room localization	Physical activity (steps and heart rate) Fall detection Sleep quality	Physical activity (steps and heart rate) Fall detection Sleep quality Humidity and temperature detection Confusion and disorientation
Modules:	Activity /Acceleration Tracking module, Sleep Tracking module	Activity /Acceleration Tracking module, Sleep Tracking module	Activity /Acceleration Tracking module, Sleep Tracking module
Devices:	▪ Fitbit Versa 2 ▪ Smartphone ▪ Withings Sleep Sensor ▪ Binary sensor (implemented in June 2022) ▪ Temperature sensor (implemented in June 2022) ▪ Localization sensor (implemented june 2022)	▪ Fitbit Versa 2 ▪ Smartphone ▪ Withings Sleep Sensor	▪ Fitbit Versa 2 ▪ Smartphone ▪ Withings Sleep Sensor ▪ Binary sensor (implemented in June 2022) ▪ Temperature sensor (implemented in June 2022) ▪ Localization sensor (implemented june 2022)
Services:	Main out of 7 Service Clusters: **S3**: Data analysis & Personalised Recommendations **S5**: Virtual Assistance **S6**: Communication	Main out of 7 Service Clusters: **S3**: Data analysis & Personalised Recommendations **S5**: Virtual Assistance **S6**: Communication	Main out of 7 Service Clusters: **S3**: Data analysis & Personalised Recommendations **S5**: Virtual Assistance **S6**: Communication
Outcomes System Requirement:	Primary & secondary: Activity during day and night; quality of sleep, safety and wellbeing; vital signs; fall detection	Primary & secondary: Activity during day and night; quality of sleep and wellbeing; vital signs; fall detection	Primary & secondary: Activity during day and night; quality of sleep and wellbeing; vital signs; fall detection

4.1.2 HOSPITAL Scenario

Hospital scenarios are tailored for users among AD and CVD groups.

Table 19- HOSPITAL Scenario

HOSPITAL Scenario		
Disease	AD	CVD
EPIC	**Primary:** User (Patient) **Secondary:** Caregivers (Family) Health Professionals,	**Primary:** User (Patient) **Secondary:** Caregivers (Family) Health Professionals
Required functionalities	Tracking the activity and wellbeeing during day and night; information goes from user to caregiver, health professional and others.	Tracking the activity and wellbeeing during day and night; information goes from user to caregiver, health professional and others.
Modules:	Activity /Acceleration Tracking module, Sleep Tracking module, Kinect Tracking module	Activity /Acceleration Tracking module, Sleep Tracking module, Kinect Tracking module
Devices:	▪ Withings Sleep sensor, ▪ Fitbit versa 2 smartband ▪ (Kinect Azure) ▪ Smartphone /Tablet	▪ Withings Sleep sensor, ▪ Fitbit versa 2 smartband ▪ (Kinect Azure) ▪ Smartphone /Tablet
Services:	Main out of 7 Service Clusters: **S3**: Data analysis & Personalised Recommendations **S5**: Virtual Assistance **S6**: Communication	Main out of 7 Service Clusters: **S3**: Data analysis & Personalised Recommendations **S5**: Virtual Assistance **S6**: Communication
Outcomes System Requirement:	Primary & secondary: Activity during day and night; vital signs; quality of sleep and well beeing; fall detection	Primary & secondary: Activity during day and night; vital signs; quality of sleep and well beeing; fall detection

4.1.3 DAY CARE CENTRE Scenario

Day care centre scenarios are tailored for users among AD group.

Table 20-DAY CARE CENTRE Scenario

DAY CARE CENTRE Scenario	
Disease	AD
EPIC	**Primary:** User (Patient)

	Secondary: Caregivers (Family) Health Professionals, social worker, other professionals
Required functionalities	Tracking the activity at the centre, location within the centre and possible function if a person leaves the area; fall detection
Modules:	Activity Localization module Door opened/closed module Notification module
Devices:	▪ Writband ▪ and Localization sensors ▪ Binary sensor for the door ▪ Smartphone/tablet
Services:	**S3**: Data analysis & Personalised Recommendations **S5**: Virtual Assistance **S6**: Communication
Outcomes System Requirement:	Monitoring of activities, safety and wellbeing

4.1.4 REHABILITATION ROOM Scenario

Rehabilitation room scenarios are being implemented for users among PD group.

Table 21 - REHABILITATION ROOM Scenario

	REHABILITATION ROOM Scenario
Disease	PD
EPIC	**Primary:** User (Patient) **Secondary:** Caregivers (Family) Health Professionals, Social workers, Other professionals
Required functionalities	Physical activity (steps and heart rate) Fall detection Rehabilitation tool
Modules:	▪ Activity ▪ Rehabilitation ▪ Recommender ▪ Notifications
Devices:	▪ Fitbit versa 2 smartband ▪ Kinect 2 ▪ Smartphones ▪ Speaker
Services:	SC1 SC2

	SC3 SC4 SC5 SC6 SC/
Outcomes System Requirement:	Activity Fall detection Vital signs Feedback for rhb

5 KPIs STATUS

Table 22 – KPI Status

KPIs	STATUS
Co-design TeNDER content, producing more than 10 intervention programs.	**ACHIEVED**
Include over 3 different types of stakeholders and service users across the various co-design phases	**ACHIEVED**
Involve at least 20 end-users (elders, carers, doctors) during the TeNDER co-design process	**ACHIEVED**
100% coverage of end-user requirements through functional validation during TeNDER's test phases	ONGOING
Recommendations for information sharing, communication among different entities involved, based on the organisational and collaboration model selected for the pilots (>10).	ONGOING
Number of real-life experiments (at least 4)	**ACHIEVED**
Stakeholders from different backgrounds (doctors, caregivers, policy makers) will be involved through targeted events	ONGOING

6 CONCLUSIONS

In the more technical aspect of the deliverable, this document shows the progress made in the development of the final version of TeNDER. On the one hand, it provides the general architecture and the relevant aspects for the final version of the TeNDER architecture project. A Service Oriented Architecture (SOA) has been created in which each element can work individually and interact with other modules as services through interface layers. On the other hand, the development of the low-level subsystem and the high-level subsystem achieve the correct functioning of the TeNDER architecture.

With regard to the development of the scenarios, it can be seen how the co-creation has given rise to concrete scenarios of daily life in which each of the functionalities offered by the TeNDER system is adapted both to the scenario itself and to the needs of the patient and the people in charge of their care, taking into account the disease they are living with.