An Integrated Solution for Sustainable Care for Multimorbid Elderly Patients with Dementia

WP2: User Requirement Definition and Design of CAREPATH System Architecture

D2.2: Scenarios and Use Cases for Integrated Care

Contractual Date of Delivery to the EC: 30 November 2021 (M5)

Actual Date of Delivery to the EC: 25 March 2022

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Type: (P-prototype, R-report, O-other, ORDP-Open Research Data Pilot, DEM-Demonstrator, ET-Ethics): R

Dissemination level: PU

Version: 1v9

Total number of pages: 59

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 945169.

Executive Summary

This deliverable presents the scenarios and use cases developed in Task 2.1, which defines the various application scenarios and use cases for the pilots of CAREPATH. These applications cover the following areas (the list is indicative but not exhaustive): Care Plan creation, Home / Health Monitoring, Data Analysis, Clinical Decision Support, Medication Prescription & Management, Patient Empowerment, Appointment Management, Smart Reminders, etc.

The final application design and characteristics of the CAREPATH platform components will be based upon the user requirements, as refined, and updated from scenario analysis. During this analysis, emphasis is given on CAREPATH target end users' needs and preferences. The set of scenarios presented herein, together with the elicited user requirements, will serve as most important input for the development and deployment of the CAREPATH system and will be evaluated in the pilot studies of WP5.

The presented scenarios and uses cases demonstrate the relevance of CAREPATH for the users' health. They show the envisioned context of use for patients and their informal caregivers as well as for health professionals when using the CAREPATH system. They extend the use cases of the platforms IONIS, C3-Cloud and imergo®-ICP.

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Acronyms and Abbreviations

Term	Definition
CAREPATH	An integrated Solution for Sustainable Care for Multimorbid Elderly Patients with Dementia
AEWSDT	Advanced Early Warning Smart Decision Tools
CDSM	Clinical Decision Support Module
DoA	Description of Action
EHR	Electronic Health Record
H/HMP	Health/Home Monitoring Platform
I.C.	Intrinsic capacity
MCI	Mild Cognitive Impairment
PEP	Patient Empowerment Platform
PROM	Patient Reported Outcome Measures
WP	Work Package

1 Introduction

1.1 Project information

CAREPATH is a Horizon 2020's funded project (Grant agreement ID: 945169), proposing an ICT based solution for the optimization of clinical practice, in the treatment and management of multimorbid older patients with Mild Cognitive Impairment (MCI) or mild dementia. To achieve this, CAREPATH elaborates on a methodology for computer interpretable clinical guidelines and computationally derived best clinical practice, for the best suitable treatment of this patient group. Thereby, a multidisciplinary care approach is considered, with a focus on the very individual needs of these patients to be translated into personalized care plans for increasing their independence and Quality of Life (QoL). CAREPATH will also provide a platform for patients and their informal caregivers to support them in managing their various care tasks arising from such a complex health condition.

The CAREPATH project started on July the 1st, 2021 and will end on June the 30th, 2025.

1.2 Document scope

This deliverable provides the scenarios and use cases developed by the consortium, in order to gain a thorough and common understanding of how the various CAREPATH end users shall interact with the CAREPATH system and the necessities following thereof in regard to CAREPATH use cases and user requirements. The scenarios will also be used to evaluate user requirements to refine or identify missing ones. This way scenarios make a major contribution to the development of CAREPATH applications to ensure that they will meet end users' expectations when deployed in real settings at pilot sites and in patients' homes. Carrying out scenario work for this purpose is a well-established and recommended method when following a human-centred design approach (see ISO 9241-210 'Ergonomics of human-system interaction – Part 210: Human-centred design for interactive systems' [7].

1.3 Document structure

This deliverable is organized as follows:

Chapter 1 – provides information about the project and the scope of this deliverable

Chapter 2 – describes methodology and results of creation of use scenarios for CAREPATH

Chapter 3 – describes derived use cases out of key scenarios and requirements

Chapter 4 – Appendix A: list of key scenarios mapped to requirements

Chapter 5 – Appendix B: Template for definition of key scenarios

Chapter 6 - References

Chapter 7 – Conclusions

2 Scenarios and use cases for integrated care

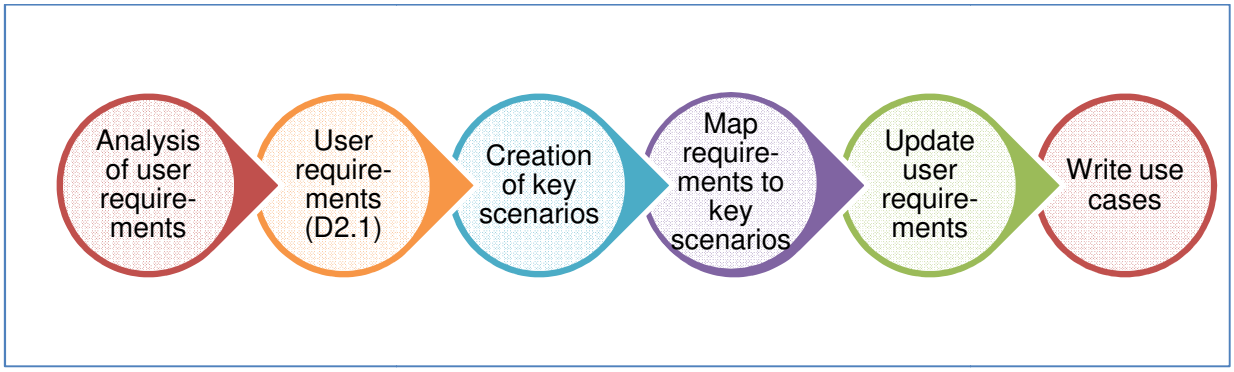

Figure 1: Human-centred design process for eliciting user requirements and establishing use cases

In the following sections, we will describe how scenarios for the CAREPATH system were developed and report the results of this work. The scenarios together with the user requirements defined as part of T2.1 'User requirements analysis'' and whose results are presented in detail in 'D2.1 Initial Requirements Specification User Requirements Analysis', served as main input for the creation of use cases. Updates of the user requirements according to key scenario discussion were also considered (overview of the process see Figure 1). The use cases will be utilised to build the CAREPATH architecture and define the technical specification of CAREPATH applications. Because use cases model requirements, they are highly dynamic by nature. The more we examine a scenario, the more we learn, and the more things change. To further complicate the issue, changes to one use case can lead to changes in others.

2.1 CAREPATH scenarios

In CAREPATH scenarios were captured in form of use scenarios that describe key application use cases of the CAREPATH system. Therefore, they were called key scenarios. This methodology is particularly used in the beginning of a development project to provide a framework for the iterative requirements engineering phase. Key scenarios can also be used later in the project, as the basis for usability evaluations and to identify hazard-related use scenarios. They explicitly deal with the usage of a technical system, the context of use, and the allocation of functions between the technical system and human users. From an overall perspective they describe how a technical system may be used to fulfil its users' tasks and goals. Therefore, key scenarios describe end user activities as well as application functionalities, thus bridging the gap to the creation of use cases and the formulation of technical system requirements [8][9].

It is important to mention that for the development of the CAREPATH system, the consortium builds on experience and existing e-health platforms, namely imergo®-ICP, IONIS and C3-Cloud. Thus, scenario work could concentrate on key application cases, such as the CAREPATH Clinical Decision Support Module (CDSM) its features, interaction with other components etc. In the following a short description of the three aforementioned e-health platforms and which components build the base for the CAREPATH platform.

- imergo®-ICP: Combines the results of many research projects conducted with participation of Fraunhofer. e.g., **PICASO** (A Personalised Integrated Care Approach for Service Organisations and Care Models for Patients with Multi-Morbidity and Chronic Conditions, H2020—689209, 2016—2018). PICASO developed an ICT platform, which supported the coordination of care plans across different sectors for people diagnosed with co-occurring chronic diseases. PICASO addressed three main challenges in Europe's healthcare systems: managing multi-morbidities; coordinating care and treatment across organisational silos and adapting e-health solutions to existing care models and plans. Fraunhofer FIT was the Project Coordinator and developed several innovative prototype components for integrated health care including a Reference Data Server for accessing data through the shared data space and a Care Plan Manager. POLYCARE (POLY-stakeholders for integrated CARE for chronic patients in acute phases, H2020—690367, 2016—2019). POLYCARE provided ICT solutions that fostered real integrated care between health and social care following a new methodology that is defined with a European focus. These ICT solutions were based upon a collaborative environment between health and social care services that helped to share information between them, and a Decision Support System which provided alerts, recommendations, and adverse effects due to drug drug interaction in the case of poly-medicated patients. On the other hand, the project took care of patients by providing devices and personalized apps for being involved at their self-health management and fostered interaction with medical and social care services. The

project was focused on home hospitalization (patient treatment at home as in the hospital). The target patients were chronic patient in acute phases. Fraunhofer FIT's responsibilities were focused on the development of the Decision Support System, together with a Smart Sensor Platform (imergo®-SSP) that provided the integration between the POLYCARE system and the e-health devices. The imergo®-ICP platform will feed the CAREPATH platform with the following components, data and lessons learned 1) imergo®-ICP's drug repositories and their drug-drug interaction subsystem and polypharmacy (STOPP/START); 2) findings about the involvement of patients with dementia in research and development projects will be applied; 3) imergo®-ICP's chronic disease management platform with its related patients' and clinical dashboards; 4) cloud architectures and federated cloud systems.

- IONIS: (https://ionis.eclexys.com/) IONIS built on the AAL NITICS (https:// nitics.eclexys.com/) platform and thus offer fully integrated and validated solutions for health monitoring, home automation, personal agenda with reminders, alerts, caregiver administrative tools (e.g. administrative tools for several users, sensor settings) and profile. The extended platform integrates technologies and services that address dementia specific challenges and offer support to both caretakers and caregivers: wandering detection, sleep monitoring, fall detection, geofencing… The IONIS health monitoring and home automation systems will feed the CAREPATH platform with necessary data about: 1) the health status of patients exploiting the continuous measurements of their physiological parameters (SpO2, temperature, weight, blood pressure, hydration…) and 2) the patient environment parameters: reminder to open the windows / air the room, detection of opened windows; unlocked door; electrical appliances (stove, water heater)…The dementia specific data (trajectory, deviation type and trajectory evolution, based on historical mobility patterns to detect dementia specific behaviour…) will be exploited by the "Advanced Early Warning Smart Decision Tools" (See Section 1.3.1) to establish a dementia profile. Further the parameters that are necessary for the estimation of the intrinsic capacity of the patient will be collected. Both data streams will be input to the AI / Machine Learning Engine in order to correlate its findings with the "CAREPATH Clinical Decision Support Modules" for joint optimal healthcare intervention decisions.

- C3-Cloud: The C3-Cloud project (www.c3-cloud.eu/) has provided an IC platform for the management of multimorbidities including Type 2 diabetes, heart failure, renal failure and mild depression. The platform enables management of personalised care plans by integrating CDS services implementing specific clinical guidelines. Warwick (coordinator of C3-Cloud), SRDC are partners in C3-Cloud project. The CAREPATH Adaptive Integrated Care Platform will be built upon the successful results of C3-Cloud Integrated Care Platform. New CDS services will be implemented by SRDC and WARWICK to automate the decision making to propose personalized care plan goals and activities based on the new evidence-based guidelines targeted by CAREPATH such as Frailty, Sarcopenia, Nutritional risk, Chronic Obstructive Pulmonary Disease (COPD), Stroke, Cardiovascular Disease and Hypertension. In addition to this, integration with Home/Health Monitoring Platform will be achieved by SRDC, to add a new functionality to C3-Cloud IC Platform to adapt the care plan of the patient based on the dementia profile and intrinsic capacity of frail elderly people which had not been tackled in C3-Cloud. The Patient Empowerment platform will be built upon SRDC's Personal Health Record (PHR) Platform and will be extended to support Patient Reported Outcome Measures, and to monitor and reinforce patient adherence to care plans especially for elderly and will provide additional specific tools to support patients with dementia (e.g., memory games, schedulers, reminders). It will also be extended to provide tailored interfaces for elderly population with dementia challenges. CAREPATH will utilize the core Interoperability Features (such as ETL engine and terminology server), on top of this, in CAREPATH Project, new interoperability adapters for the local care sites' existing health IT systems will be developed by WARWICK and SRDC and terminology server will be extended with the mappings to local code systems and new terminology code systems adopted by local care sites.

2.1.1 Methodology

Since domain knowledge is required to develop key scenarios for CAREPATH applications, a list of key scenarios considered crucial for development was compiled in course of T2.1 and clinical partners were asked to create the listed key scenarios as assigned to them (see key scenarios in Appendix A).

For this purpose, a template and of course supported by WP2 providing instructions and help to compile the scenarios were provided. In the following sections, a description of the methodology used for creation of key scenarios, how they were processed to receive a common understanding in the project on how the system shall behave towards the user, what functionalities and features need to be provided, e.g., on the Patient Empowerment Platform (PEP) and the Adaptive Integrated Care Platform (AICP) for health professionals. As mentioned, key scenarios were also used to evaluate user requirements defined until now and see where they need to be refined, enhanced or new ones created.

2.1.1.1 Template for creation of scenarios

There are many formats on how to document scenarios: some suggest a story-like approach, others to conduct a task analysis, or elicit workflow descriptions, etc. In CAREPATH, a combination of all formats was used with a short story-like description of the use scenario, a list of user tasks describing the workflow and in addition to that, clinical partners were asked to provide as much as possible their vision of how CAREPATH applications should be designed to support the user best in fulfilling their tasks and goals. In order to document a key scenario in this form, a template with some instruction was provided to clinical partners (see Appendix B) This approach was considered most useful, because in the e-health domain, established processes are most often underlying the achievement of tasks involving several user roles, e.g., interaction between physician, nurses and dietician. Therefore, it is crucial for development to understand each user role's tasks and needs as well foreseen workflows. So, we received from a design point of view some inputs and how this could be accounted in the best way.

2.1.1.2 Personas

As mentioned above all clinical partners were asked to create key scenarios in order to have a more coherent result, personas were created to be used as representatives of certain user roles. These made the scenarios also more lively and easier to understand. For this purpose, using personas is an established method in scenario writing. The following personas were created for CAREPATH key scenarios:

- Carmen (patient): is a 72-year-old lady who has been living with type 2 diabetes for 10 years. Unfortunately, despite treatment, Carmen is not only developing a heart condition that might lead to heart failure. Even worse, she starts to show signs of memory loss and cognitive impairment leading to the fact that she forgets more and more often to, e.g., take her medication as prescribed and manage her appointments with health professionals.
  Note: in some key scenarios, Carmen is affected by other morbidities or living alone; this is done to illustrate better the purpose of the scenario.

- John (informal caregiver): John is Carmen's 75-year-old husband. He used to own a small bakery where he sold together with Carmen fresh pastries. Since Carmen's health situation is deteriorating, he is helping her with keeping up with her tasks to-do to manage her health condition, e.g., making sure that she takes her medication on time and accompanies her to appointments with health professionals. John has access to Carmen's daily care plan on his tablet and this way can follow-up on tasks Carmen is expected to fulfil to manage her health condition. He has also the possibility to document symptoms Carmen is experiencing, e.g., after medication intake she often feels dizzy; therefore, her geriatrician, Peter, can check on this in the next visit.

- Peter (geriatrician): is 54-year-old physician who is responsible at Smith's Hospital since 20 years for diagnoses and treatment of older adults. Quite often these adults are affected by multimorbidities and cognitive impairments such as MCI (Mild Cognitive Impairment) or dementia. Peter assess older adults, refers them to other health professionals and writes care plans for their treatment.

- Nora (general practitioner): Nora is Carmen's GP that Carmen visits in case she is suffering from everyday diseases such as the flu or gastrointestinal disorders. Nora has access to the care plan Peter has defined for Carmen. She will carry out tasks as prescribed by Peter, e.g., make a blood test every 3 months, uploads the results to the CAREPATH platform and changes Carmen's care plan according to her treatment decisions.

- Diane (nurse): is a 48-year-old nurse working together with Peter in the geriatric's department at Smith's Hospital. She is very experienced with the needs of older adults and manages the department. She has access to the CAREPATH platform to see the care plans of her patients, so

she knows about their medication plans, examinations and may provide comments in regard to symptoms requiring may be a change in medication or about the mood of the patients.

- Emily (occupation therapist): Emily is a 42-year-old occupational therapist at Smith's hospital. She conducts occupational therapy as prescribed by physicians such as Peter. She has access to Carmen's health record and can look at her care plan to be informed about Carmen's overall health status and what Peter wants her to do work on with Carmen. After completion of the prescribed number of occupational therapy sessions, she will report on the CAERPATH platform about Carmen's achievements during the therapy.
- Ellen (dietician): is the 30-year-old dietician at Smith's Hospital. She meets with patients to examine their eating habits and how these may affect their health conditions. She agrees with her patients on goals and writes diet plans which she then uploads to the CAREPATH platform. These plans will become part of her patients' care plans and also be made available for patients on their platform (PEP), so they are aware of their diet plan and are supported in following-up on it.

2.1.1.3 Results

In total, 20 key scenarios were created by clinical partners, 7 scenarios for AICP and 13 for PEP. As expected, there was overlap among key scenarios revealing a different understanding among partners on how the system should behave or which functionalities are necessary to offer and how. Beyond this, key scenarios were matched with existing user requirements and as it was the purpose of this process, mismatches and missing features were identified in the defined user requirements. To harmonize results and update user requirements so they satisfy partners preferences, a list of open issues was compiled and discussed with the consortium, in particular with clinical partners in two dedicated WP2-key scenario sessions and one individual session with each clinical partner.

After issues were solved user requirements were refined or new ones created to reflect agreed functionalities or features and workflows. For example, clinical partners pointed out the necessity for personalization of how patients will interact with the daily care plan on PEP. Some patients may prefer to be reminded about most to do tasks and only be displayed less important tasks on the daily care plan they will follow-up on by themselves others rather wish to be presented all to do tasks and receive only selected reminders. Therefore, besides that health professionals can define on AICP about which task, e.g., medication intake a patient will be reminded, there will be a configuration page on PEP where patients together with their informal caregiver can configure their preferences in an easy way. During discussion of key scenarios open issues like an escalation scheme for reminders could be agreed on as well. And, country-specific differences became apparent, e.g., in the UK there is a central booking system for appointments with health professionals which clinics can use, whereas in Germany patients/informal caregivers are mainly responsible themselves for making appointments. Missing user requirements were also identified, e.g., it may happen that changes on patients' care plans can also happen, if the patient is not present, because, e.g., an examination result comes in later, to avoid confusion on patients' and/or informal caregivers' side, they need to be informed about this on their daily care plan and be explained what the change is about. Such a user requirement did not exist so far.

In the table below it is documented which user requirements have been updated (14 in total) and which ones were newly defined (7 in total). Full information of a user requirement with, e.g., rationale and fit criterion can be viewed by technical partners on Atlassian Jira where these are documented. The list shows which user requirements have been updated and how as well as newly created ones. In Appendix A all key scenarios created can be viewed with all related user requirements and their update.

User requirement ID	Summary	Updates of user requirements or newly defined ones
CARE-1	Health professionals need to have access to a patient's health data.	
CARE-2	Patients need to be reminded of to-dos as defined in their care plan.	Update: Reminders are configurable by health professionals and patient/informal caregivers, reminders can be dismissed, agreed escalation scheme
CARE-3	Patients need to be able to confirm tasks to do.	Update: - in case confirmation of a task is long overdue, a reminder is generated automatically. - update: system checks off automatically tasks that are achieved on the PEP platform where possible
CARE-4	In CAREPATH personal data are processed according to GDPR as well as national/regional policies and legislations on data protection and security	
CARE-5	User actions can be traced on the CAREPATH platform.	
CARE-6	For data integrity and security reasons, it is necessary to ensure that patient data cannot be interpreted while being transferred.	
CARE-7	The Health/Home Monitoring Platform shall employ minimally intrusive, dementia-friendly and safe devices and technologies	
CARE-8	Patients are provided readily available and dementia-friendly designed materials with instructions on how to use sensors, devices, and the applications provided to them.	
CARE-9	The Health/Home Monitoring Platform monitors proper data collection at patients' homes.	
CARE -10	Patients or informal caregivers should be able to create a ‚leave of absence' message during the clinical study.	
CARE-11	Applications used by patients with MCI/mild dementia shall be designed dementia-friendly.	Update: Content and functionalities on PEP to be presented to patients can be configured according to patients' needs and capabilities
CARE-12	A daily care plan will be presented to patients in a dementia-friendly design	Update: Content and functionalities, e.g., reminders,

User requirement ID	Summary	Updates of user requirements or newly defined ones
		on patients' daily care plans are presented as configured by health professionals and/or patients/informal caregivers
CARE-13	Informal caregivers should have access to all PEP services	Update: PEP should be configurable according to informal caregivers' preferences and be accessible by various end devices, in particular mobile end devices
CARE-14	Results of health measurements and PROMs from H/HMP are presented to patients and informal caregivers	Update: Provide help on what results mean in regard to the patient's (health) status by visualization, e.g., arrow signs (arrow up – has improved, horizontal arrow - is stable, arrow down - has worsened
CARE-15	Patients shall be supported in proper medication intake and documentation thereof	
CARE-16	Patients shall be supported in conducting and recording exercises	
CARE-17	Patients shall be supported in filling out and recording PROMs	
CARE-18	Patients shall be supported in adhering to diet recommendations	
CARE-19	Informal caregivers are sent alerts in case a potentially harmful situation is detected by H/HMP	
CARE-20	Sensors and devices used in the clinical trials shall be removeable without leaving a trace in patients' homes	
CARE-21	Health professionals shall be pointed specifically to alerting risks of their patients (early warnings) and corrupted/lost data from H/HMP	Update: Classification schema for early warnings
CARE-22	Patients shall be able to document drink consumption	
CARE-23	CAREPATH shall allow for easy communication between health professionals and patients/informal caregivers	
CARE-24	Communication with patients and informal caregivers needs to be accessible by all health professionals involved in running the clinical study at	

User requirement ID	Summary	Updates of user requirements or newly defined ones
	pilot sites	
CARE-25	Must be possible to search for misplaced sensors and devices	
CARE-26	Medical doctors need to be provided all medical guidelines relevant for patients' morbidities enrolled in the CAREPATH clinical study	Update: Information needed for monitoring and treatment of multimorbid older patients, e.g., interaction of specific treatments
CARE-27	Health professionals need to be able to overrule system-generated suggestions, adjustments, decisions and the like	
CARE-28	Health professionals need to be able to understand and review the rationale for system-generated suggestions, adjustments, and decisions	
CARE-29	Health professionals need to be able to create a care plan	Update: Patients' health data from patients' EHRs at pilot sites needs to be taken over as much as possible to minimize double documentation efforts to the extent possible
CARE-30	Health professionals need to know who has authored information on the Adaptive Integrated Care Platform	
CARE-31	All results from patient's health data collected on H/HMP and PEP are presented to health professionals	Health professionals need to be able to adapt the thresholds of certain measured parameters to the individual health conditions of a certain patient.
CARE-32	Health professionals need to be supported in analysis and interpretation of results from patient's health data collected on H/HMP and PEP	
CARE-33	Health professionals need to define which information from data collected on H/HMP and PEP shall be visualized to patients and/or informal caregivers	
CARE-34	It needs to be possible for patients/informal caregivers to record symptoms and events	Update: - author of the recording must be clearly indicated on AICP -voice recognition shall be considered with low priority, because not within the scope of the project
CARE-35	Patients shall be able to record medication with same timing all at once	

User requirement ID	Summary	Updates of user requirements or newly defined ones
CARE-36	Health professionals are able to recommend a suitable diet for patients	
CARE-37	Patients and informal caregivers can preview a patient's daily care plan and other documented events	
CARE-38	Health professionals need to be able to create follow-up appointments for patients	Update: Aspect that appointment procedures/system differ among EU-countries, contact details of the health professional the appointment is with needs to be added
CARE-39	Patients/informal caregivers need to be able to document appointments with health professionals and other events	Update: Aspect that appointment procedures/system differ among EU-countries, contact details need to be added
CARE-40	Patients shall be able to confirm follow-up appointments	
CARE-41	Health professionals need to be able to define additional instructions for patients on how to achieve a task properly	Update: Aspect that appointment procedures/system differ among EU-countries
CARE-42	Patients are presented additional instructions as defined by health professionals	
CARE-43	Definitions of care plan activities shall be reusable	
CARE-44	All applications for patients and informal caregivers are available in the pilot sites' national language	
CARE-45	Health professionals need to be informed in case of issues with medication prescriptions	
CARE-46	Patients/informal caregivers shall be able to document intake of non-prescribed medication, phytopharmaceuticals and other supplements in text format. Health professionals should be able to convert them in structured data.	
CARE-47	Health professionals can review information provided by patients/informal caregivers on non-prescribed medications, phytopharmaceuticals and	

User requirement ID	Summary	Updates of user requirements or newly defined ones
	other supplements taken by patients	
CARE-48	Patients are able to play a cognitively stimulating games.	Update: Consortium shall explore whether introducing gamification features such as challenges among patients and online gaming with, e.g., the informal caregiver poses a feasible and motivating option.
CARE-55	CAREPATH services need to be provided in the native language of health professionals	
CARE-56	Information on the CAREPATH platform shall be presented for health professionals according to their personal profile	New user requirement
CARE-57	Patient/informal caregiver needs to be able to document unplanned appointments/visits with health professionals	New user requirement
CARE-58	Patients and their informal caregivers are made aware of changes in the care plan	New user requirement
CARE-59	Health professionals need to be aware of changes to the care plan and new examination results since last visit to the platform	New user requirement
CARE-60	Patients/informal caregivers shall be able to change or cancel appointments – new user requirement	New user requirement
CARE-61	Health professionals need to be supported with the risk assessment of their patients	New user requirement
CARE-62	Health professionals are supported in the adjustment of patients' personal goals	New user requirement

3 Use Cases

The requirements (see D2.1) and key scenarios (see section 3) just give us an outline of what is required. Use Cases are the next step in the design process. In this section we present uses cases that demonstrate the relevance of CAREPATH for patients' health. It shows the envisioned context of use for patients and their informal as well as formal caregivers such as clinicians. These use cases describe the what and not the how of the envisioned CAREPATH components. They are derived from the key scenarios defined by the pilot sites of the CAREPATH project. Use case is a method for modelling and specifying product components. It was first presented by the Swedish computer scientist Ivar Jacobson in 1987. This is 14 years before the Agile Manifesto was published. The idea is that a product can be described using many use cases, which can be depicted in a use case diagram.

A use case is a list of actions or event steps typically defining the interactions between a role (known as an actor) and a system to achieve a goal. A use case diagram is a graphical depiction of a user's possible interactions with a system. A use case diagram shows various use cases and different types of users the system has and will often be accompanied by other types of diagrams as well. The use cases are represented by either circles or ellipses. The actors are often shown as stick figures[1].

In the following sections uses as derived from the key scenarios' analysis will be presented. We will start by detailing the main use cases and then presenting the sub use cases.

3.1 CAREPATH Platform

CAREPATH (see Figure 2) focuses on the enhancement of healthcare interventions for the management of conditions of elderly multimorbid patients. The CAREPATH integrated Care Platform that jointly addresses multimorbidity, dementia and diminished intrinsic capacity and optimally manages healthcare interventions for its users (patients, informal caregiver, healthcare professionals, IT-experts, etc). The integrated treatment of patients managed by clinicians uses standards based EHR, an advanced health & home monitoring and clinical decision support system. The beneficiary of the treatment is the patient herself and her caregiver supported by a smart communication system.

The CAREPATH platform will be deployed, installed, and managed by IT-experts. Appropriate Hardware should be selected and made available beforehand, all required authorisation and security measures will be considered. The Interoperability use case will be responsible for the import of external data mainly from the hospital information system of the respective participating pilot site. The Clinical Decision Support use case is responsible for the data analytics and providing results via the EHR to the clinicians, patients, and informal caregiver. The H/HMP monitors the medical and contextual environment of a patient. The authentication use case will be responsible for all security measures regarding ensuring access to legible users with their respective roles. Finally, the Advanced Early Warning Smart Decision Tolls use case will provide assessments based on the measurements of health parameters form H/HMP, fall detection, drugs taken by the patient and wandering behaviour.

[1] https://wiki2.org/en/Use_case

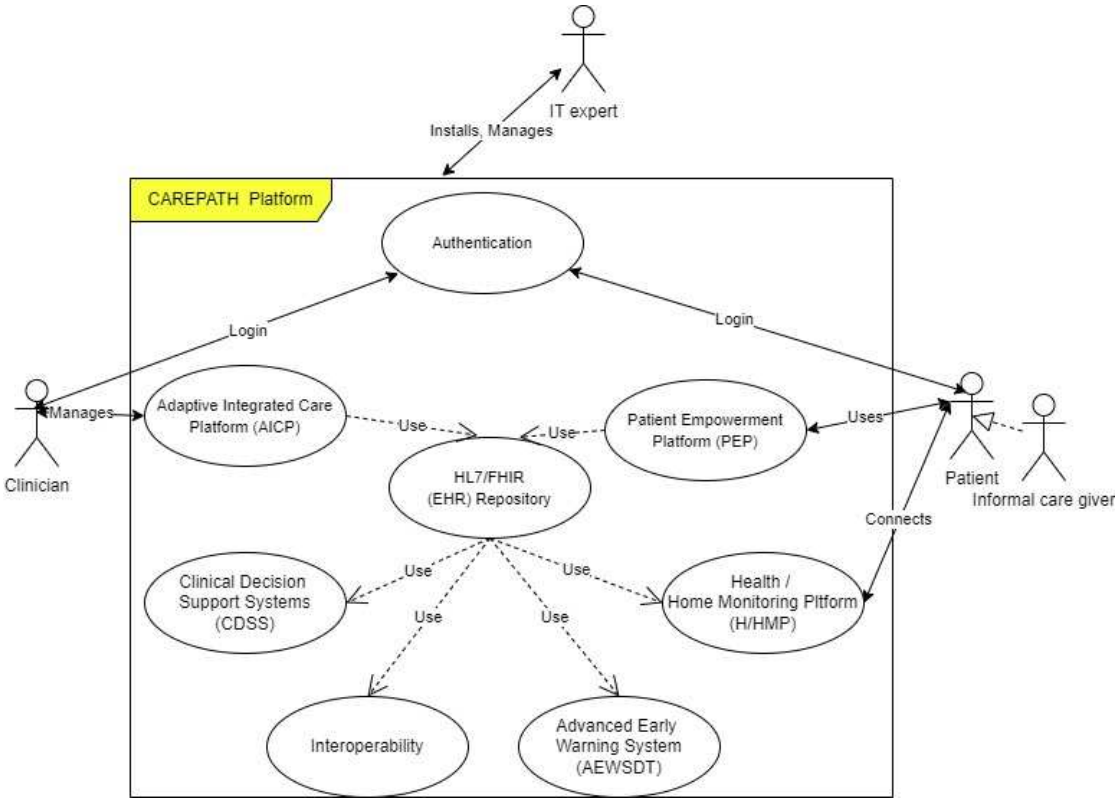

Figure 2: General CAREPATH use case

3.2 Adaptive Integrated Care Platform (AICP)

The Adaptive Integrated Care Platform (AICP) (see Figure 3) interacts with different actors e.g. care team members, for defining, updating, reconciling, sharing care plans, utilization of clinical decision support modules supporting these operations, creating diet and exercise plans as part of care plans, showing the patient data retrieved from local care systems and the Patient Empowerment Platform (PEP) (see section 3.4). It will provide an easy to navigate dashboard for care team members to see patient's medical history along with his/her care plan history, review care plan progress and patient generated data as a dashboard. AICP will be directly connected with the Clinical Decision Support Systems (CDSM) (see section 3.5), Advanced Early Warning Smart Decision Tools (AEWSDT) (see 3.6) and the Patient Data Store which is a FHIR Repository.

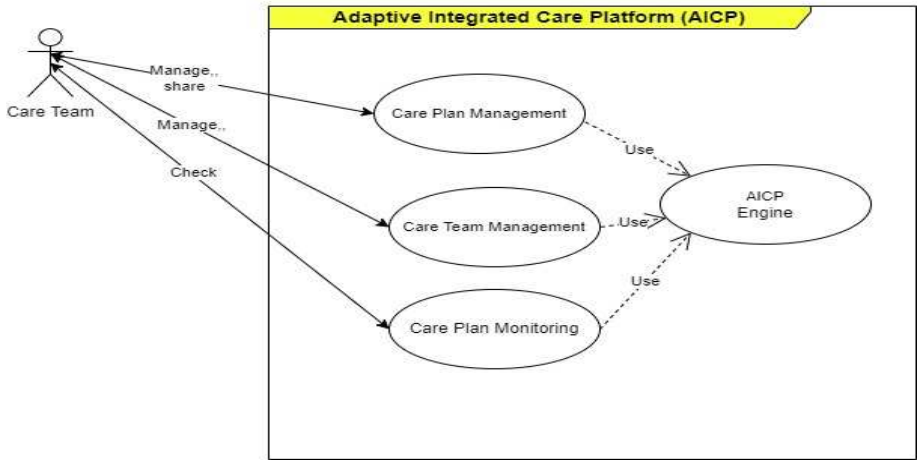

Figure 3: Adaptive Integrated Care Platform (AICP)

The "Care Plan Management" use case will provide the functionalities to create, read, update, and delete care plans. The "Care Team Management" use case will be responsible for the management of the care

team, create, assign to patients, update, and deletion. The “Care Plan Monitoring” use case will provide functionalities for the review of care plans e.g. adherence of the patients to exercises, this use case may include different clinician dashboards allowing them a comprehensive overview and monitoring of the health status and adherence of patients to care plans and assigned tasks.

3.2.1 Clinician Dashboard

The Clinician Dashboard (see Figure 4), as an essential part of the AICP, will be all-in-one portal that revolutionizes remote multimorbid patient monitoring. It will present real-time data from patients' mobile and wearable devices and displays it in an intuitive interface that can be implemented for different outpatient programs. Its tools and analytics help clinicians tackle their administrative tasks and keep up with their outpatients' progress. With the CAREPATH Clinician Dashboard, clinicians will be able to organize and prioritize their day more easily and focus more on caring for their patients.

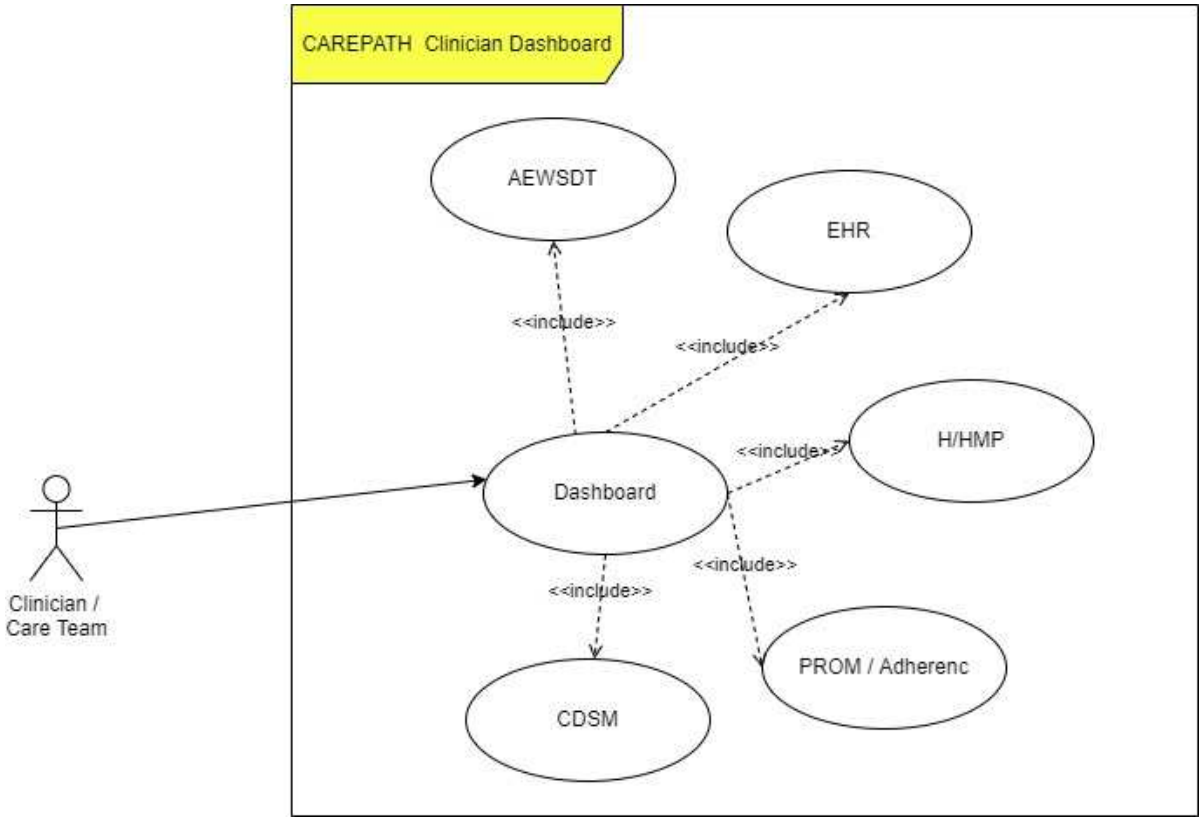

Figure 4: Use Case Clinician Dashboard

The CAREPATH clinician dashboard displays information out of the use cases “AEWSDT”, “EHR”, “H/HMP”, “PROMS and adherence” data and “CDSM”.

3.2.2 Exercises Management

The care team creates appropriate exercises for a patient (see Figure 5), the “Patient Empowerment PEP” presents the exercises and the patient confirms the execution, on the H/HMP platform tracking of the patient will be conducted.

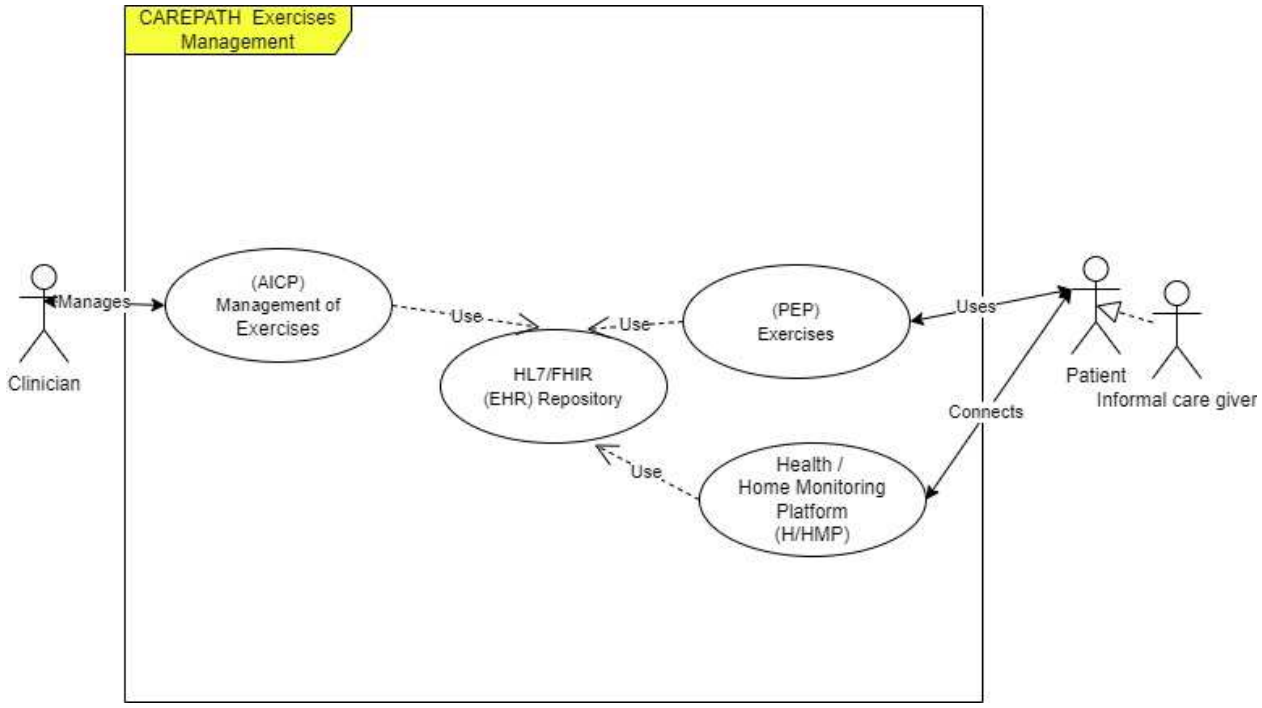

Figure 5: Use case exercises

3.2.3 Diet Management

The care team creates appropriate diet plans for a patient (see Figure 6), the "Patient Empowerment PEP" presents the diet plan and the patient confirms the execution, on the H/HMP platform tracking of the patient will be conducted.

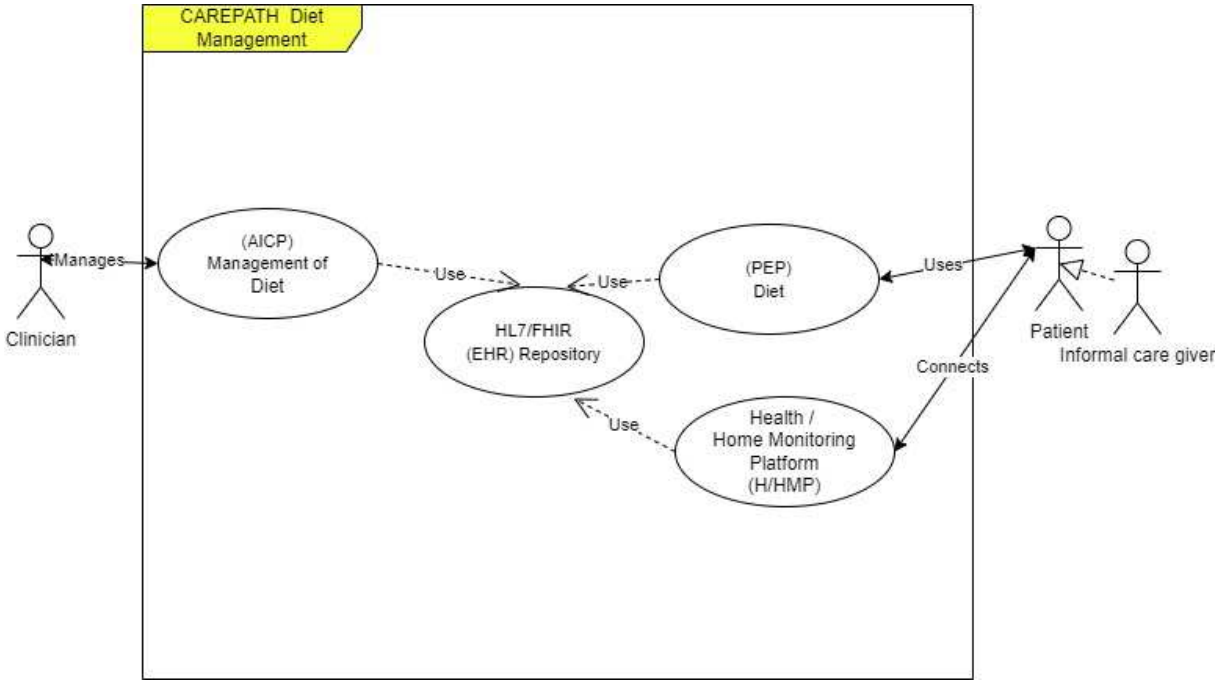

Figure 6: Use case Diet Management

3.2.4 Drug Management

The care team imports prescriptions of a patient (see Figure 7), the “Patient Empowerment PEP” presents the medication plan and the patient confirms the drug intake, on the H/HMP platform tracking of the patient will be conducted.

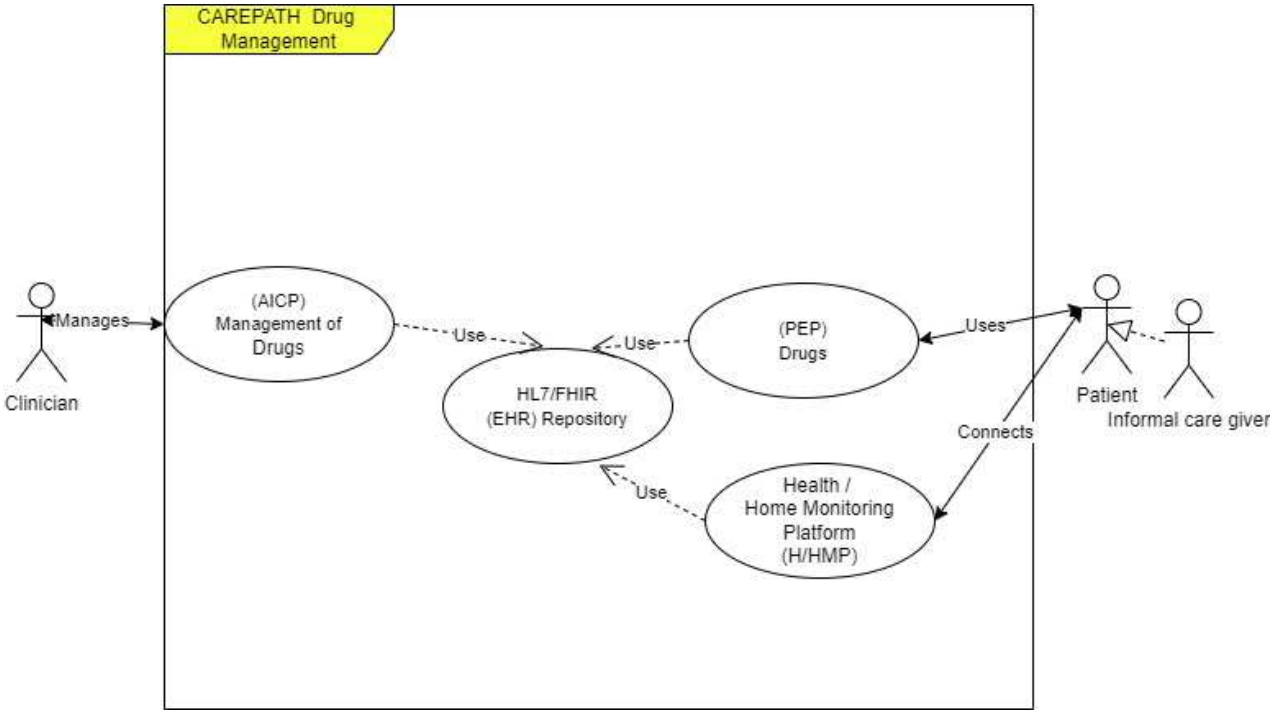

Figure 7: Use case Drug Management

3.2.5 Gaming Management

The care team creates appropriate game plans for a patient (see Figure 9), the “Patient Empowerment PEP” presents the game plan and the patient confirms the execution, on the H/HMP tracking of the patient will be conducted.

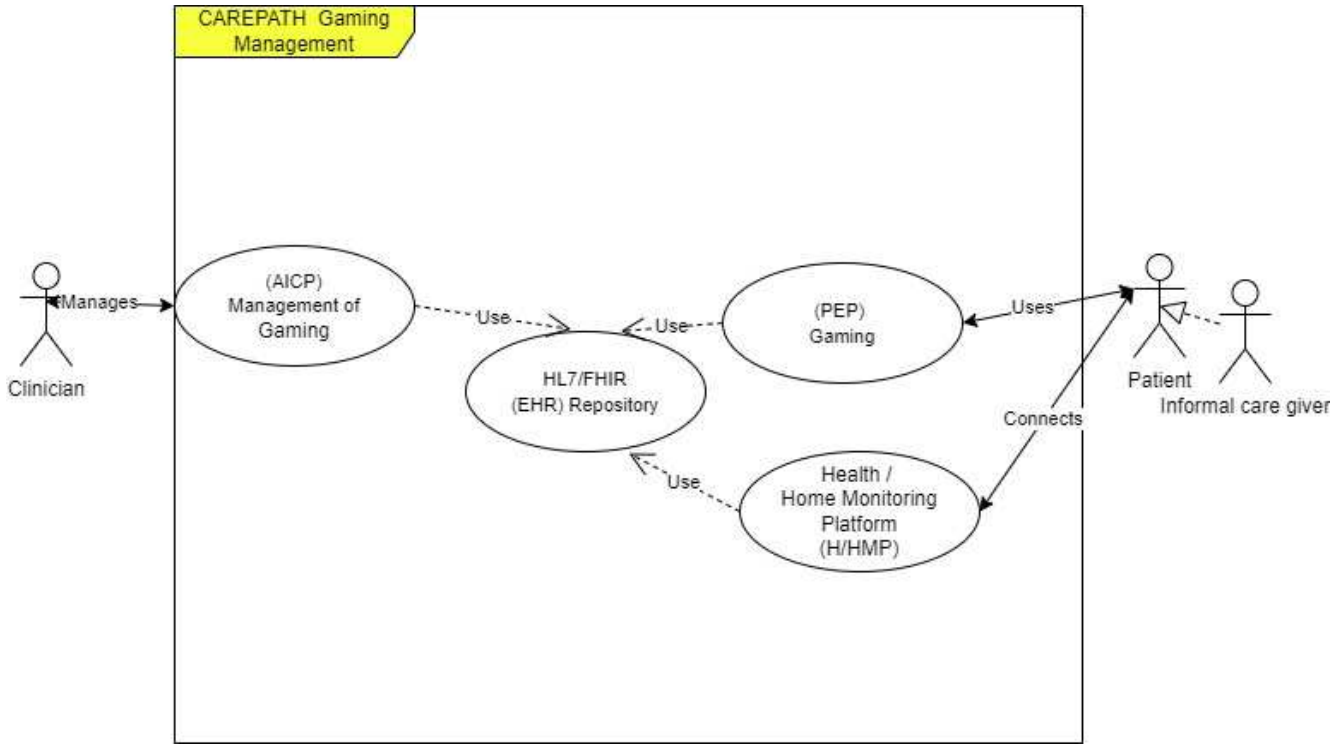

Figure 8: Use case Gaming Management

3.2.6 Daily Tasks Management

The care team creates an appropriate care plan with tasks to do for a patient (see Figure 9), the "Patient Empowerment Platform (PEP)" presents these tasks on a daily care plan and the patient confirms the execution. On the H/HMP tracking of the patient will be conducted.

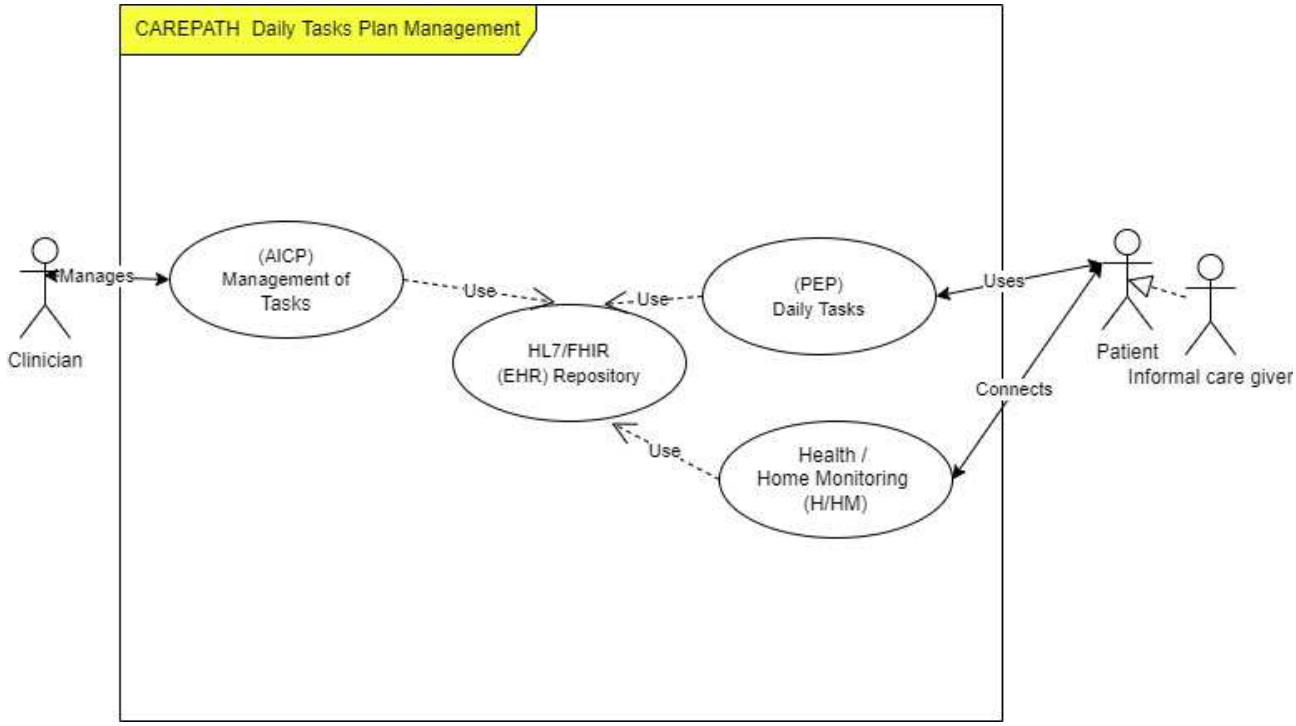

Figure 9: Use case Tasks Management

3.2.7 Appointments Management

The care team creates a list of appointments for a patient (see Figure 9), the "Patient Empowerment Platform (PEP)" presents these appointments, and the patient confirms the execution. On the H/HMP platform tracking of the patient will be conducted.

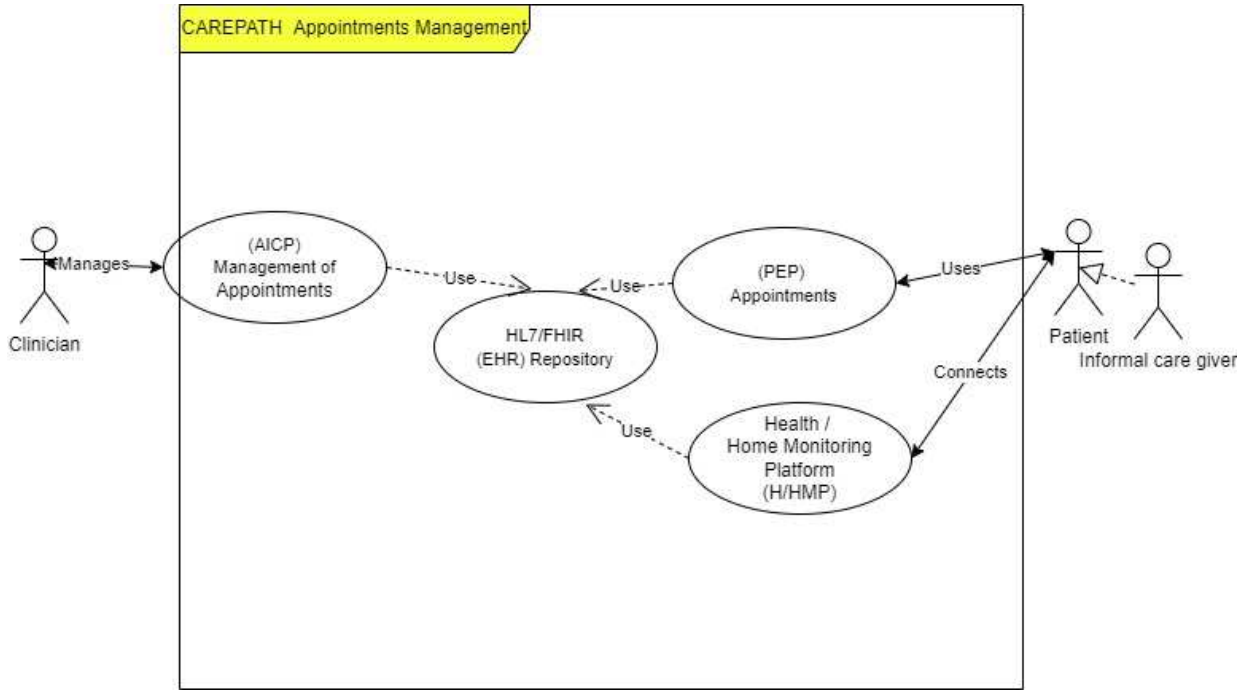

Figure 10: Use case Appointments Management

3.3 Health / Home Monitoring platform (H/HMP)

The diverse applications of H/HMP lead to numerous variations of H/HM technology architecture (see Figure 11). However, most H/HMP technologies follow a general architecture that consists of four components [3]. Sensors on a device that is enabled by wireless communications to measure physiological parameters. Sensors can connect back to a central database by Wi-Fi or cellular communication protocols depending on the manufacturer. Local data storage at patients' site that interfaces between sensors and other centralized data repository and/or healthcare providers. Centralized repository to store data sent from sensors, local data storage, diagnostic applications, and/or healthcare providers. Diagnostic application software that develops treatment recommendations and intervention alerts based on the analysis of collected data. Depending on the disease and the parameters that are monitored, different combinations of sensors, storage, and applications may be deployed [4]. For patients with dementia that are at risk for falls, H/HMP technology promotes safety and prevents harm through continuous surveillance [3]. H/HMP sensors can be affixed to the individual or their assistive mobility devices such as canes and walkers [3]. The sensors monitor an individual's location, gait, linear acceleration and angular velocity, and utilize a mathematical algorithm to predict the likelihood for falls, detect movement changes, and alert caregivers if the individual has fallen. Furthermore, tracking capabilities via Wi-Fi, global positioning system (GPS) or radio frequency enables caregivers to locate wandering elders. Diabetes management requires control of multiple parameters: blood pressure, weight, and blood glucose. The real-time delivery of blood glucose and blood pressure readings enables immediate alerts for patient and healthcare providers to intervene when needed. There is evidence to show that daily diabetes management involving RPM is just as effective as usual clinic visit every 3 months [6].

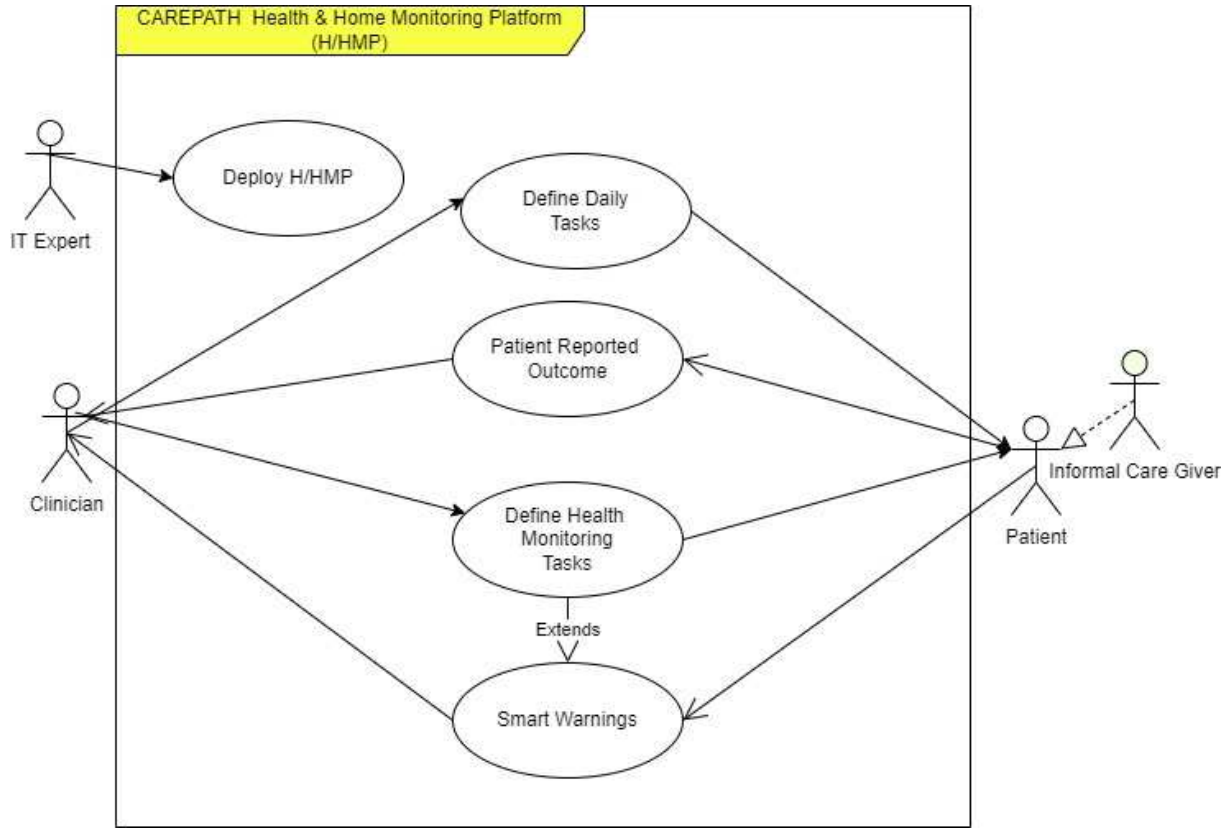

Figure 11: General CAREPATH H/HMP

3.4 Patient Empowerment Platform (PEP)

The term chosen to engage and involve patients will depend on what is appropriate for the specific culture of a region or community. Patient empowerment might be the preferred term from a patient advocacy point of view. However, the less emotionally charged and challenging term patient participation might be a term more acceptable to many patients, and cultures. For the purpose of these guidelines, the word empowerment is used. “WHO” defines empowerment as “a process through which people gain greater control over decisions and actions affecting their health” and should be seen as both an individual and a community process.

Four components have been reported as being fundamental to the process of patient empowerment:

- understanding by the patient of his/her role
- acquisition by patients of sufficient knowledge to be able to engage with their healthcare provider
- patient skills; and
- the presence of a facilitating environment. Based on these four components, empowerment can be defined as a process in which patients:
    - understand their role,
    - are given the knowledge and skills by their healthcare provider to perform a task in an environment that recognizes community and cultural differences and encourages patient participation.

In CAREPATH PEP encompasses mainly a health management system customized to the needs of multimorbid patients with MCI/mild dementia and their informal caregivers (see Figure 12).

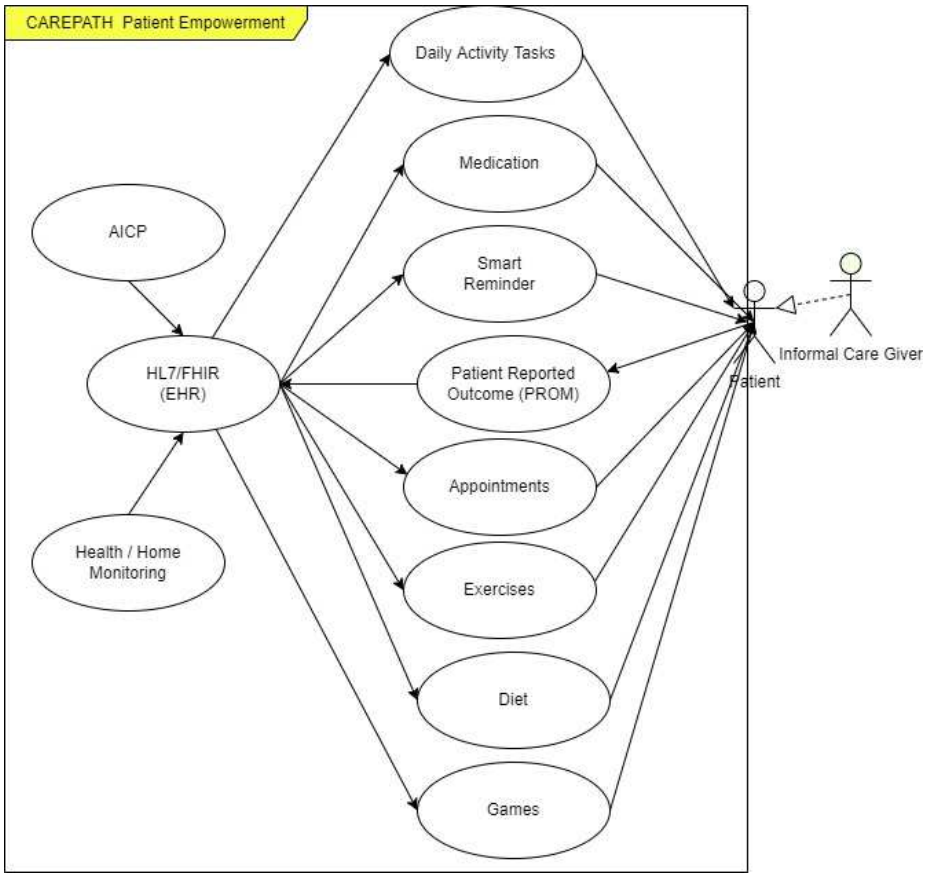

Figure 12: Use Case Patient Empowerment

Patient SMART Reminder

Alert key staff to messages with critical health information. As healthcare providers, we should remove as many barriers to patient access as we can (see Figure 13).

Rather being told to come to the appointment without getting a say in the matter, the patient can be asked to confirm the appointment, and given the option to cancel and reschedule. Not only does this empower the patient with the choices that drive patient engagement, but it helps clinics maximize business results. If patients are not given the option to reschedule appointments, or if they forget about the appointment in the first place, the risk is high of the patient not showing up.

No-shows and cancellations continue to plague practices, and they cause wasting of efforts and material.

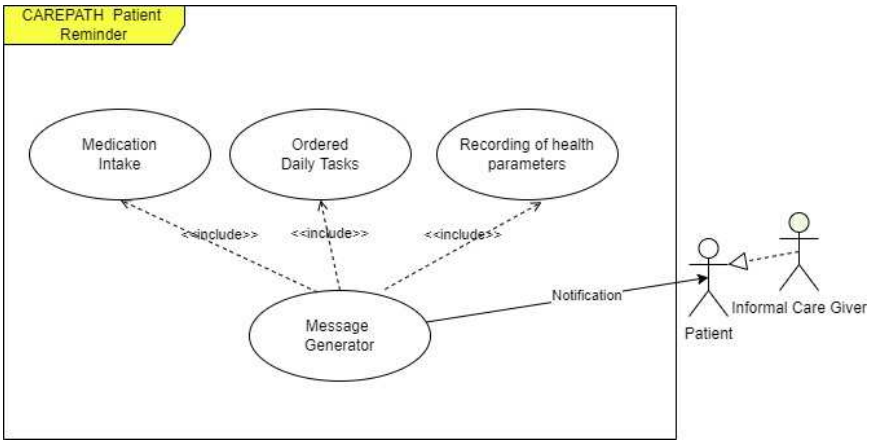

Figure 13: Use Case Patient Reminder

3.5 Clinical Decision Support Module (CDSM)

Clinical Decision Support Systems (CDSM) (see Figure 14) will provide decision support aids to provide clinical guideline-based treatment suggestions, to carry out risk assessments and to provide guidance about polypharmacy management and being utilized by AICP during the creation and update of care plans. This also includes an Advanced Early Warning Smart Decision Tools (AEWSDT), utilising algorithms built using machine learning techniques to identify potentially preventable situations.

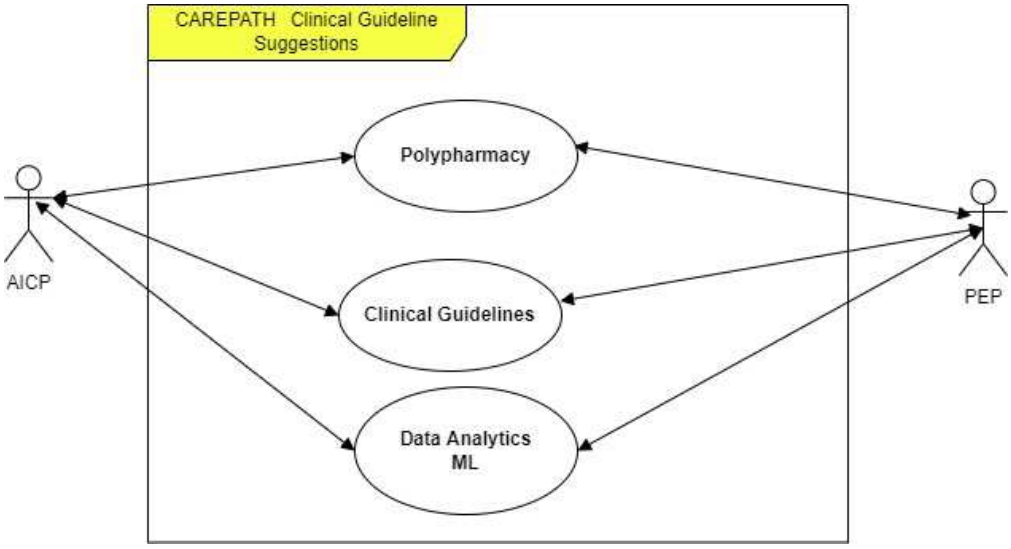

Figure 14: Use case CDSM

The use case “Polypharmacy” provides the functionality to minimize inappropriate prescribing for multimorbid elderly patients.

The use case “clinical guidelines” will provide the management and processing of clinical guidelines as described in WP06 (D6.2) that are responsible for building clinical decision support services to deliver personalized guidance to healthcare professionals about the goals and interventions (treatment actions, patient monitoring activities and lifestyle management activities) that can be put into the active care plan of the patient. These suggestions will be built upon the recommendations of the clinical guidelines to achieve patient-centred and customised care.

The use case “Data Analytics/ML” will be responsible for processing of data in CAREPATH and providing appropriate recommendations.

3.6 Advanced Early Warning Smart Decision Tools (AEWSDT)

The Advanced Early Warning Smart Decision Tools (AEWSDT) (see Figure 15) will incorporate advanced technologies such as artificial intelligence and machine learning, to provide dynamic early warning about the development of the condition as well as the suitability of the treatment, namely:

1) effectiveness of medication and detection of side-effects.
2) development of a risk stratification model in collaboration with WP6 and definition of how the risk categories will be monitored by the various tools.
3) continuous monitoring of trajectories of intrinsic capacity and dementia profile by integrating patient data collected both passively and actively from home/health monitoring platform.

The Advanced Early Warning Smart Decision Tools gets inputs from the following components:

- Patient Empowerment Platform
- Home/Health Monitoring Platform

- Interoperability Framework
- Clinical Decision Support Modules

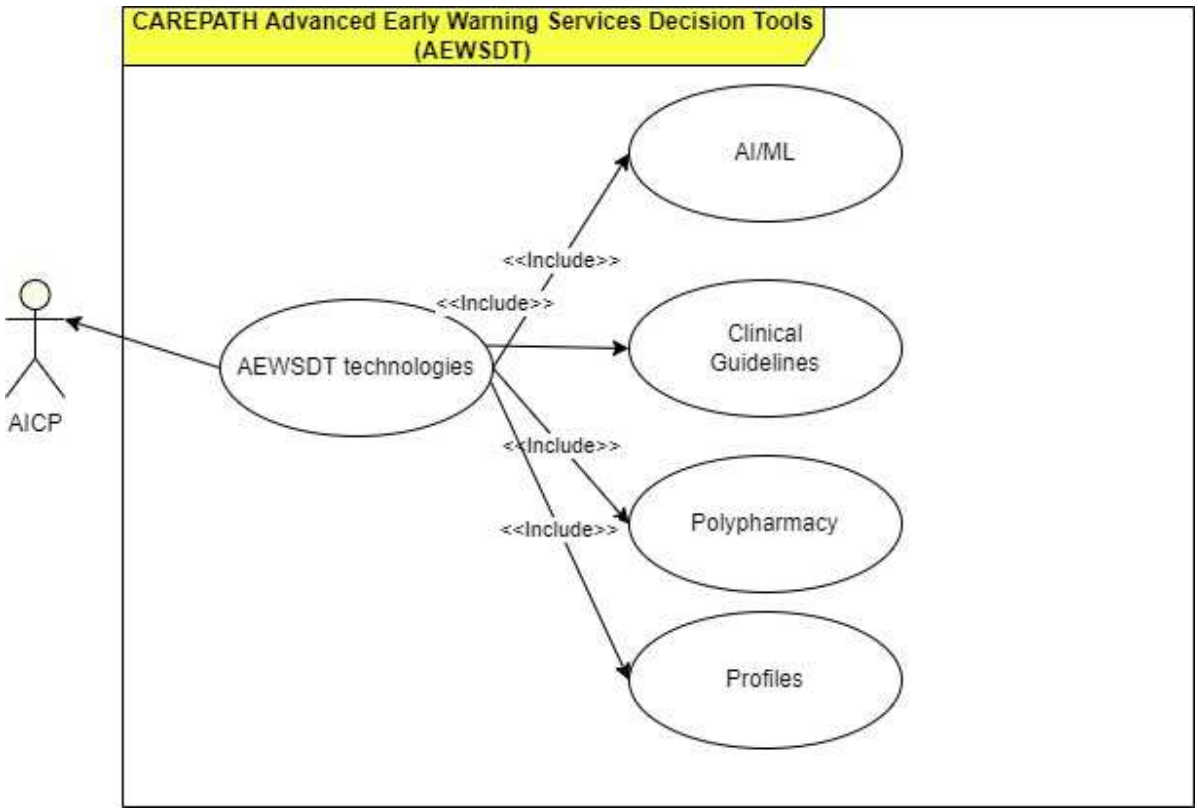

Figure 15: AEWSDT use case

Drug Guidelines

Electronic prescription is the use of information and communication technologies (ICT) and tools to acquire, examine, re-examine, modify, and electronically transmit prescription information about pharmaceutical products by legally and professionally qualified and registered healthcare practitioners to registered pharmacies (or dispensing systems). The main prescribing practice in majority of the world countries- the paper method, offers weakness in the delivery of high-quality medical care. In general, medical prescription errors are caused primarily by communication of prescriptions, illegible handwriting, unclear abbreviations, dose errors, unclear oral orders, ambiguous orders and fax clarity.

In CAREPATH the medication list of each patient will be imported from the hospital information system (see Figure 16), it will be reviewed according to completeness, allergies, drug-drug interaction, and polypharmacy adapted guidelines for multimorbid elderly with mild dementia.

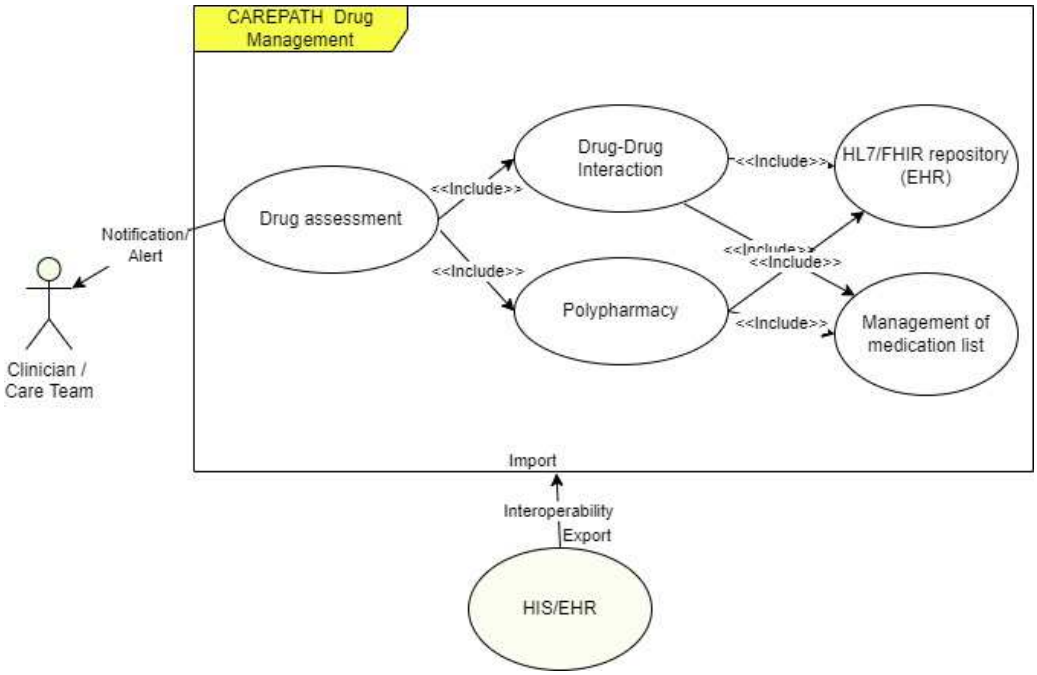

Figure 16: Drug Management use case

The use case "Drug assessment" allows clinicians to review the medication list of a patient for appropriateness, this use case will collect its information from the "drug-drug interaction" and polypharmacy use cases. Both use cases require information from the use cases "EHR" and "Management of medication list". The initial data will be imported via the interoperability from the hospital information system (HIS).

3.7 Interoperability

Technical Interoperability Suite (TIS) will provide interoperability interfaces to enable seamless data exchange between the CAREPATH solution and the systems external to the project (see Figure 17), such as local care systems. The TIS component aims to allow data exchange while handling the heterogeneous protocols and clinical data representation formats which may be in use across the IT systems in local care sites. TIS will provide a **standard based data exchange protocol**. The following requirements have been identified as being relevant for defining the functionality/architecture of the interoperability tools:

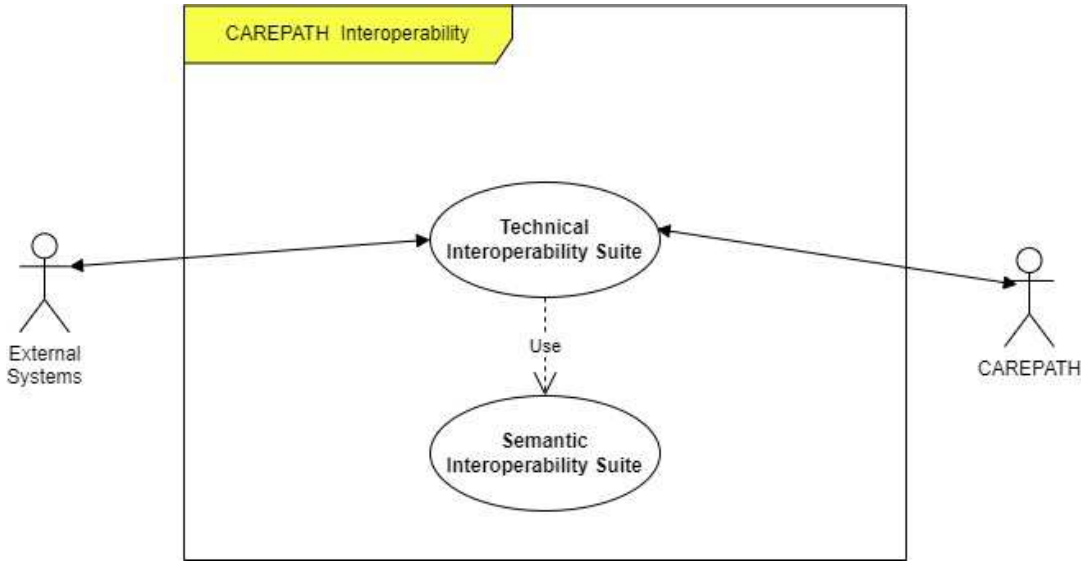

Figure 17: Use Case Interoperability

Additionally, based on the architecture of existing components within CAREPATH at the time of this deliverable, the following assumptions regarding the constraints/functionality of the interoperability services are made:

- FHIR will be adopted as the standard for data storage, representation, and exchange between CAREPATH components.
- TIS will import patient data and/or clinical documents from local care system into CAREPATH via pull/query-based mechanisms but should also support importing of data through manual upload.
- TIS will utilize the structural mapping and terminology mapping services provided by Semantic Interoperability Suite (SIS) to transform data into FHIR format and terminology codes which can be interpreted and used by the CDS services.
- TIS will push data into CAREPATH FHIR repository (provided as part of Personalised Care Plan Management Platform) through its FHIR RESTful API;

It is important to note at this stage the specific structure of the FHIR resources applicable for the CAREPATH data model has been finalised and the actual data that will be made available by pilot sites still needs to be confirmed, through investigation of external APIs, identification of items in relevant clinical guidelines and development of the research protocol/needs of the CAREPATH tools.

Semantic Interoperability Suite (SIS) will be developed to both handle structural mappings among different information models and resolve semantic mismatches due to use of different terminology systems and different compositional aggregations to represent the same clinical concept.

In general, the SIS module will run in the background and so the effects of its use will not be immediately visible to users. As such, specific requirements will not be extracted through user engagement, such as the clinical scenario storyboards being developed by pilot sites. Instead, the functionality of SIS will be inferred based on what is needed to support the requirements of user facing components.

4 Conclusions

This deliverable describes the key scenarios and use cases created within Task 2.1 of WP2. Key scenarios were created by clinical partners as assigned and issues arising from mismatches among each other or with user requirements described in D2.1 were solved by several clarification meetings. As a result of discussion in these meetings existing user requirements could be updated and missing ones created. The use cases were depicted based on a thorough analysis of the key scenarios and user requirements they form a starting point and basis for future work. The key scenarios and the use cases will build the source and the boundaries of the envisioned CAREPATH system.

The results of this deliverable will serve as important inputs to the work in upcoming tasks of WP2 especially the specifications of all components and customisation requirements. These results will be reported in Deliverable D2.5. It should be noted that although initial key scenarios and use cases have been defined, their documentation is to be considered a living document, so key scenarios and use cases will change throughout the lifecycle of the CAREPATH project.

5 Appendix A

In the following key scenarios created by clinical partners for AICP and PEP are presented.

5.1 Key scenarios Adaptive Integrated Care Platform (AICP)

Key scenario: doctor's appointment - quick overview on patient´s current health situation

Scenario	A patient comes to the hospital for a routine check-up and the medical doctor wants to receive a quick overview on the patient's current health status.
User roles involved	GP □ Geriatrician X □ Nurse X□ PT/OT □ Dietician □ Social worker □ Patient X Informal caregiver X□ Other (specify) □ ……
User tasks	Diane: 1. Measuring blood pressure and weight, venipuncture for routine lab investigation 2. Checks, if all current letters from all medical specialists, the GP or from labs are updated and included into the database on the CAREPATH platform Peter: Compares status of Carmen between the current status and the status when she has been seen at last doctor´s appointment on Adaptive Integrated Care platform (AICP): 1. Searches for patient record on the CAREPATH platform 2. Checks, if there are new alerts noticed by the early warning tools and documented on AICP, e.g., Carmen forgot to turn off the gas stove, the smoke detector went on, because she burnt her meal, former alerts are listed also and can be compared 3. Looks at EHR, diagnoses (diabetes, Parkinson, multimorbidity…) 4. Checks lab results from the last visit 5. Checks reports from medical specialists and Nora, also from Emily and Ellen 6. Looks at medication plan and medication intake recordings on AICP: Did the patient take the medication regularly? Does time between two receipts (and doctor´s appointments) fit to the prescribed daily dose? Does Carmen tolerate the medication or does she feel dizzy or sick after taking the pills? Does she have any other sensations? 7. Looks at plan for occupational therapy: Did the patient do the exercises? Did Emily include any comment/message on AICP? Did the patient have any progress/stagnation/ worsening? 8. Looks at patient's health measurements from last 3 months and if there is an indication of measurements out of expected range, e.g.,: a. Blood pressure measurements b. Weight measurements: in case there is an unusual weight gain or loss, there should be an alert c. Movement patterns: Did the patient fall? Did s/he walk less inside or

	outside of the apartment? Did s/he get disoriented outside? d. Looks at self-recordings on PEP of informal caregivers and patients: e.g. feeling dizzy, tired, vomiting 9. Looks at self-recordings on PEP of informal caregivers and patients: e.g. feeling dizzy, tired, vomiting 10. Physical examination including asking for symptoms, neurologic tests and test for sarcopenia, balancing, did vision and hearing change? In case John is accompanying Carmen: he is asked also about Carmen`s symptoms, behavior etc. 11. Prescription of medication or special diet, referral to a medical specialist, prescription of physio-/ergo-/ speech therapy 12. Instruction which lab parameters should be examined 13. Documentation of findings in clinical documentation system. This information will be updated on AICP automatically by data export from clinical documentation system 14. Adaptation of personalized care plan, giving advice for warnings to professional and informal caregivers according to worsening of certain symptoms. Diane 1. Documentation on AICP completed? 2. Forward information according to adaptation of personalized care plan, giving advice for warnings to professional and informal caregivers according to worsening of certain symptoms
Design in-/output of CAREPATH services	General function: Automatic update of all patient data included in the clinical study. This means that all patient data are automatically retrieved from the different computer systems (sources) of the hospital and are presented on AICP (patients health data, reports from internal doctors, lab-results) and from the Health/Home Monitoring Platform. Task 1 Output: Clearly arranged alphabetical sorted list of patient names List should be able to be filtered also by - patients with early warnings - list all patients with the same professional caregiver - last seen patient - diagnosis (like diabetes, COPD…) Input: If the doctor/study nurse wants to include an important note for early warnings into the Personal Care Plan this should be easy to do and, if applicable, should trigger a new message on the Patient Empowerment Platform, so that informal caregivers get informed. Task 2 Output: Actual and history of early warnings with clear hint by what reason the alert was triggered. Input: a) Check off early warning as ‘seen’ b) Classification of alert with boxes to be ticked by Peter or Diane:

	- life threatening - severe - not severe - false alarm There should be an individual threshold adaption possible for certain parameters of early warnings on AICP. And, field on the screen for short comments about the alert. c) Action/procedure taken: Field on the screen to make notes: What needs to be done? d) Outcome: Field on the screen to make notes In some cases this can only be done retrospectively. Task 3: Output: EHR should be presented in clearly defined sequence Input: New medical reports from specialists or GP should be integrated (Dianes task as nurse) Task 4: Output: lab results, new one should be highlighted and also measurements which are out of normal range should be highlighted Automatic comparison of the actual lab results with the former ones should be done automatically e.g. Blood glucose level and HbA1c are worse Input: new lab results should be imported into the AICP automatically Field on the screen should be available to put down notes, e.g. increase of diabetes medication because of certain lab parameter Task 5: Output: medical reports from specialists, New ones should be highlighted Input: Peter or Diane should have a field on the screen to put in their interpretation/conclusion derived from the information of consultation of medical specialist, e.g. cardiologist gave advice for other medication. Then Peter or Diane can select the medication plan on AICP and put in a comment concerning new medication But the prescription should be updated automatically in AICP from clinic data management system. Task 6: Output. information of the polypharmacy tool: Alert or everything ok? Input: New medication, all prescriptions with automatic check of the amount needed for the following period until the next doctor`s appointment Task 7 Output: report or messages from therapist to doctor Input: response to therapist or information of new prescription But the prescription should be updated automatically in AICP from clinic data management system. Task 8 Output: Clear graphic presentation of measurements from period of time with

	indication lines concerning normal thresholds of highest or lowest measurements of parameter. Combined graphic of blood pressure and heart rate of the same period of time. Extra function: The formal caregiver can zoom into a certain period of time in order to see the measurements of for example when the heart rate and the blood pressure were extremely high. Input: Doctor needs a place on the screen to write his/her findings concerning the measurements. Task 9 Output: Clearly to be distinguished messages: Who wrote this message? The patient her/himself or an informal caregiver Responses to three questions to be answered by the patients by estimation of a scale between 0 and 10 (PROMs): How do you feel over all today/ during this week? Do you have any pain? Can you do your normal daily activities? Input: Information from doctor to patient and informal caregiver about new prescriptions (this is not replacing a doctor´s appointment!) Also the doctor or study nurse can enter advices concerning the questions of a patient or informal caregiver. For example: If a patient complains about dizziness the health professional can give the advice to take medication regularly and drink more. Task 10: Output: Findings of last doctor´s appointments These data should be updated automatically from clinic data management system. Input: Findings of this doctor´s appointment: These data should be updated automatically from clinic data management system. Doctors or study nurses should not have extra efforts of double documentation tasks! Task 11 Output: last prescribed medications and therapies shown in clearly arranged form These data should be updated automatically from clinic data management system. Doctors or study nurses should not have extra efforts of double documentation tasks! Input: new prescriptions with automatic check of the amount needed for the following period until the next doctor`s appointment Task 12 Output: lab parameters including date presented with the thresholds of normal/abnormal range These data from the last lab results should be updated automatically from clinic data management system. The graphic course/trend of the lab parameters of a period of e.g. 3 months should be shown in AICP Input: Doctor gives advice which parameters should be determined in the lab. These data should be updated automatically from clinic data management system. Doctors or study nurses should not have extra efforts of double documentation tasks!

	Task 13: Already included in the previous tasks Task 14 Output: Personal care plan for the patient in a clearly arranged way Input: Adjustments of personal care plan. Field on the screen for each item, e.g., diet plan
Related user requirements	CARE-21 Health professionals shall be pointed specifically to alerting risks of their patients (early warnings) and corrupted/lost data from H/HMP – update: classification schema for early warnings CARE-29 Health professionals need to be able to create a care plan – update: patients' health data from patients' EHRs at pilot sites needs to be taken over as much as possible to minimize double documentation efforts to the extent possible CARE-30 Health professionals need to know who has authored information on the Adaptive Integrated Care Platform CARE-31 All results from patient's health data collected on H/HMP and PEP are presented to health professionals CARE-32 Health professionals need to be supported in analysis and interpretation of results from patient's health data collected on H/HMP and PEP CARE-36 Health professionals are able to recommend a suitable diet for patients CARE-38 Health professionals need to be able to create follow-up appointments for patients CARE-41 Health professionals need to be able to define additional instructions for patients on how to achieve a task properly

5.2 Key scenario: polypharmacy evaluation by CAREPATH Clinical Decision Support Modules (CDSM)

<table>
<tr><td>Scenario</td><td colspan="3">Carmen is a CAREPATH patient; Peter is her geriatrician, and in her initial interview he is reviewing her medical history and regular medication.
Carmen's medical history includes the following conditions: hypertension, chronic kidney disease, diabetes, ostheoarthritis, and peripheral artery disease; she also presented mild depression 3 years ago, and has received a recent diagnosis of mild cognitive impairment.
Different specialists (cardiologist, nephrologist, neurologist, endocrinologist and general practitioner) have been prescribing Carmen the following medication:
Enalapril 10 mg/24h; long-acting insulin 12 IU/24h; vitamin DI 0.266 mg every 15 days; spironolactone 25 mg/24h; amitriptylin 25 mg/24h; diazepam 5 mg/24h; ibuprofen 400 mg/24 h, and paracetamol 1 g/ 24 h if needed for pain.</td></tr>
<tr><td>User roles involved</td><td colspan="3">GP x Specialist x Nurse x PT/OT/Sport □ Dietist Social worker □ Patient x Informal caregiver x Other (specify) □ ……</td></tr>
<tr><td>User tasks</td><td colspan="3">List of user tasks, depicting the workflow:</td></tr>
<tr><td></td><td>Health professional</td><td>Patient</td><td>Informal Caregiver</td></tr>
<tr><td></td><td>• Medical history (eHR)
- Pharmacological prescriptions
- Diagnoses</td><td>• Medication reminder
• Comments</td><td>• Medication reminder
• Comments</td></tr>
</table>

	- Laboratory tests]		
	• Review of alerts and early warnings		
Design in-/output of CAREPATH services	Through the CDSM, Peter has received an alert (red bell) about several drugs that Carmen has been prescribed; these are shown in red and with a legend (text box) indicating the reasons and risks of that drug). Peter will review the appropriateness of these prescriptions in addition to reviewing the STOPP-START criteria, and decides to realize a lab test to Carmen including vitamin D levels and Glomerular filtration rate, and an electrocardiogram to detect arrhythmia. Peter will also access the H/HMP to review Carmen blood pressure and glucose levels. (According to STOPP criteria): - Diazepam 5 mg/24h: 1.Risk of exacerbation of respiratory failure (reason for admission). 2. Risk of falls in elderly people 3. Duration of more than 4 weeks (risk of prolonged sedation, confusion, etc.). - Vitamin D 0.266 mg every 15 days: Risk of overdosage and hypercalcaemia due to erroneous administration of Vitamin D analogues. (He does not have a diagnosis related to this drug in his history). - Spironolactone 25 mg/24h: 1. Dose > 25-50 mg/day in HF NYHA III-IV (Safety Information Note AEMPS-2011). 2. Concomitant prescription with drugs that increase K+ levels. - Ibuprofen: NSAID (risk of renal function impairment with GFR <50 ml/m.) - Amitriptylin 25 mg: Tricyclic antidepressants in patients with dementia (According to START criteria): - AAS 100 mg: Peripheral artery disease in sinus rhythm Peter reviews these prescriptions as well as Carmen's most recent blood work to assess Vitamin D deficiency to justify taking this medication as there is no associated diagnosis and also glomerular filtration rate levels. Peter verified that Carmen did indeed require treatment with vitamin D, as she had a deficiency that needed to be corrected; the corresponding update was made to her medical history, adding this diagnosis. As an analgesic regimen, it is recommended to eliminate the ibuprofen and increase the regimen with paracetamol 1g/ 8 hours if necessary due to pain. As for the diazepam, the regimen will be progressively reduced (with a reminder of the exact dose) to be withdrawn. Peter decides to withdraw spironolactone as it has no indication according to Carmen's pathology and is interfering with enalapril. Amitriptyline is also suppressed progressively because of cognitive impairment that can be exacerbated by anticholinergic drugs. According to the START criteria, there is evidence for the introduction of AAS 100 mg/day for peripheral artery disease. Peter will assess the intensity of depressive symptoms to evaluate prescribing sertraline 50 mg/24h in a progressive pattern.		

	After the appropriate modifications Carmen and her caregiver will be informed of all these changes through her personal profile with a red bell that will open the new treatment plan (the appropriate reminders will be activated automatically).
Related user requirement	CARE-45 Health professionals need to be informed in case of issues with medication prescriptions CARE-58 Patients and their informal caregivers are made aware of changes in the care plan – new

5.3 Key scenario: CSDM- prescribe medication with non-pharmacological intervention evaluation

Scenario	Carmen is a 71-year-old patient with obesity (BMI >30), diabetes, hypertension, sarcopenia, frailty and mild cognitive impairment. In accordance with her state of health, she was given the corresponding diet and exercise instructions at her initial visit. No changes were made to her medication initially prescribed by her family doctor for the control of her pathologies, but great emphasis was placed on compliance with these recommendations to improve her state of health. After several weeks in the CAREPATH program, the fourth visit was made.
User roles involved	**GP x Specialist x Nurse x PT/OT/Sport x Dietist x Social worker □ Patient x Informal caregiver x Other (specify) □ ……**
User tasks	*List of user tasks, depicting the workflow:*

Health professional	**Patient**	**Informal Caregiver**
• View eMH/	PEP	2] PEP
• AICP	Comments	Comments
• CDSS/E. Warnings	To do view	To do view

Design in-/output of CAREPATH services	Peter reviewed her medical history, latest clinical analyses, visits to other specialists, current medication and all the data collected through the H/HMP. There is also a review of her interaction with PEP, visualization of the recommendations made for diet and exercise. The CDSS gives Peter a suggestion based on the Diabetes clinical guideline. The patient maintains a high BMI (in her HMP weight control chart there has been improvement but not enough to improve her obesity BMI) and she is only prescribed metformin by her general practitioner for glycaemic control. Peter has been able to verify through AICP that exercise monitoring has been irregular and his glucose figures have worsened in the last laboratory analysis Carmen has undergone. Based on these data and the suggested recommendations, it was decided to start treatment with arGLP-1 to try to reach the weight target, which would also improve her glycaemic control, weight and mobility for exercise. Carmen and her informal caregiver (red bell) will be informed of this change and a reminder will be activated to take this new daily drug.
Related user requirements	CARE-20 Health professionals need to be able to create a care plan CARE-26 Medical doctors need to be provided all medical guidelines relevant for patients' morbidities enrolled in the CAREPATH clinical study CARE-32 Health professionals need to be supported in analysis and interpretation of results from patient's health data collected on H/HMP and PEP

	CARE-58 Patients and their informal caregivers are made aware of changes in the care plan - new user requirement

5.4 Key scenario: change of personal goals with CDSM support (health professional perspective)

Scenario	The Clinical Decision Support system provides a list of personal goals to the patient, which are linked to their underlying medical conditions and how these interact. These may need to be adapted and changed by the healthcare professional over time.
User tasks	List of user tasks, depicting the workflow: • Can see current personal goals within CDSM and these are presented at each consultation for review. (Maximum 3 monthly with the same Speciality). • User can review patient "compliance" against each goal • User can review each goal and either make no change, change the goal or delete the goal. • User can prioritise goals that are most important to focus on
User roles involved	Healthcare professional, patient, informal caregiver
Design in-/output of CAREPATH services	• On review of the system, CAREPATH presents a list of the current goals set for the patient. • The system shows completion against these goals • The system allows goals to be deleted if no longer relevant • The system allows the "target" of different goals to be changed where relevant • The system shows other potentially relevant goals for the patients underlying medical condition, which can be added • The system communicates the changed goals to the patient and the informal care giver.
Related user requirements	CARE-27 Health professionals need to be able to overrule system-generated suggestions, adjustments, decisions and the like CARE-62 Health professionals are supported in the adjustment of patients' personal goals – new user requirement

5.5 Key scenario: applying Best Practice CAREPATH guideline (health professional perspective)

Scenario	Dr Peter is caring for Carmen who has multiple medical problems, he is caring specifically for her diabetes, but she also has heart failure and COPD. When he sees the patient (or reviews her virtually) he needs to understand how these different features interact and what the CAREPATH consensus guideline recommends in key areas. The two key areas that the guideline focuses on are*: 1) Monitoring 2) Treatment *To be confirmed
User tasks	List of user tasks, depicting the workflow:

	• Can see from the CAREPATH workflow what conditions and stage of conditions the patient has. • When requesting or recommending monitoring, can see what would be recommended in terms of the specific combination of co-existing medical conditions. • When requesting or recommending treatment can see what would be recommended in terms of the specific combination of co-existing medical conditions. • When selecting a treatment can see how this would interact with other conditions or other therapies that the system records that the patient is on
User roles involved	Healthcare professional
Design in-/output of CAREPATH services	• The CAREPATH system records what conditions a patient has and what treatment classes they are on. • For that specific combination of condition, the system presents a recommendation for monitoring. • For that specific combination of treatments, the system presents a recommendation for treatment and how they interact • When a treatment is selected the system provides advice on how that treatment may interact with other medical conditions. • The system provides the option for these to be reviewed, possibly with alerts where they are not followed GUIDELINE IN DEVELOPMENT: The development of a multimorbidity guideline of this nature has not previously been attempted and is therefore a work in progress and the content of the guideline may change over time
Related user requirements	CARE-26 - Medical doctors need to be provided all medical guidelines relevant for patients' morbidities enrolled in the CAREPATH clinical study – updated: information needed for monitoring and treatment of multimorbid older patients, e.g., interaction of specific treatments

5.6 Key scenario: risk assessment (health professional perspective)

Scenario	Dr Peter is caring for Carmen who has multiple medical problems, he is caring specifically for her diabetes, but she also has heart failure and COPD. He needs to complete a risk assessment for the patient on the first appointment and review this at subsequent appointments or virtual reviews. **To be confirmed*
User tasks	List of user tasks, depicting the workflow: • Can see from CAREPATH a list of potential risks relevant to the specific combination of medical conditions that the patient has. • Can select individual risks as to whether they are valid and grade the severity of the risk on first consultation. • Can review risks on subsequent consultations as to whether there are new risks to add or whether the level of the risk has changed • Recommendations are provided based on those risks and these can be accepted or rejected
User roles involved	Healthcare professional
Design in-/output of CAREPATH services	• The CAREPATH system records what conditions a patient has and what treatment classes they are on. • For that specific combination of condition, the system presents a list of potential risks on first consultation.

	• The system allows the caregiver to rate those risks and the system then provides recommendations as to how to minimize those risks. • The system presents these risks at a subsequent consultation (perhaps maximum 3 monthly) for review.
Related user requirements	CARE-28 Health professionals need to be able to understand and review the rationale for system-generated suggestions, adjustments and decisions CARE-61 Health professionals need to be supported with the risk assessment of their patients – new user requirement

5.7 Key scenario: early warnings (health professional view)

Scenario	Carmen is a 71-year-old patient with obesity (BMI >30), diabetes, hypertension, sarcopenia, frailty and mild cognitive impairment. She has been included in the CAREPATH program for a few weeks. The H/HMP has been recording data correctly. Several Early Warnings have been triggered in the last 24 hours: - Risk of insomnia, and other sleep/circadian rhythms disturbances - Risk of hyper/hypoglycemia In addition, the H/HMP has recorded a fever of 38ºC; in addition to changes in the movement pattern with nocturnal wandering, which has also been reflected in the sleep recording. The comments of his informal caregiver are also noted, who refers to an episode of disorientation at home. In the last two days Carmen has reported a "bad mood".		
User roles involved	**GP x Specialist x Nurse x PT/OT/Sport □ Dietist Social worker □ Patient x Informal caregiver x Other (specify) □ ……**		
User tasks	*List of user tasks, depicting the workflow*		
	Health professional	**Patient**	**Informal caregiver**
	• View eMH	• Comments	• Comments
	• AICP/EW	PEP	PEP
	• CDSS		
Design in-/output of CAREPATH services	Based on these data Peter reviews all the records and decides to order a urine and blood test to rule out urine infection or other organic condition that could be altering Carmen. Carmen and her informal caregiver are alerted to the need for these tests. *Information on alerting conditions is presented to health professional* *Out-of expected range results are highlighted*		
Related user requirements	CARE-21 Health professionals shall be pointed specifically to alerting risks of their patients (early warnings) and corrupted/lost data from H/HMP CARE-31 All results from patient's health data collected on H/HMP and PEP are presented to health professionals CARE-32 Health professionals need to be supported in analysis and interpretation of results from patient's health data collected on H/HMP and PEP		

5.8 Key scenarios Patient Empowerment Platform (PEP)

Key scenario: view on the daily care plan (patient and informal caregiver perspective)

Scenario	It is a regular day for Carmen who wakes up, because she heard a couple of beeps and her smartwatch had vibrated on her hand wrist. She knows that this is a sign that a reminder was sent from her daily care plan about a task Carmen should react on. So, Carmen takes the tablet next to her bed with the Patient Empowerment Platform (PEP) installed on it and sees the reminder about her blood thinning medication. This is important and she cannot skip it. So, she quickly takes her medication and confirms that she has taken it. Her son John will be pleased with her, because he can view Carmen's daily care plan as well and see the status of tasks to-do. Now, he knows that she has taken her medication and he does not have to worry about her. John has selected in his configuration of the daily care plan that he does not want to receive reminders as Carmen does, because Carmen can handle medication intake usually herself, if reminded, and this would disturb him when he is at work. He prefers to check the status of Carmen's daily tasks a couple of times during the day on his smartphone, in particular the medication intake. This makes him feel safer with handling the care situation. When checking further on her daily care plan, Carmen notices that John is supposed to visit her after work. Carmen herself does not remember for sure. But she feels happy when reading this, because she enjoys having visitors, in particular if this is John who is looking after her.
User tasks	List of user tasks, depicting the workflow: Patient: • Checks tasks to-do on her daily care plan • Looks at the reminder issued on her daily care plan • Confirms the reminder • Browses other tasks and events on the daily care plan Informal caregiver: • Checks status of tasks to-do on the daily care plan
User roles involved	Patient, informal caregiver
Design in-/output of CAREPATH services	• A daily care plan should be accessible on PEP • Tasks to-do should be presented to patients with clear task description and time when due • A reminder about tasks should appear on the interface accompanied by a sound and a text message, if scheduled as such • The user should be presented with the option of confirming or declining a task • The status of the task should be made available to the informal caregiver • Reminders are only presented to the patient, not to the informal caregiver, if configured as such
Related user requirements	CARE-2 Patients need to be reminded of to-dos as defined in their care plan – update: reminders are configurable by health professionals and patient/informal caregivers, reminders can be dismissed, agreed escalation scheme CARE-11 Applications used by patients with MCI/mild dementia shall be designed dementia-friendly – update: content and functionalities on PEP to be presented to

	patients can be configured according to patients' needs and capabilities CARE-12 A daily care plan will be presented to patients in a dementia-friendly design – update: content and functionalities, e.g., reminders, on patients' daily care plans are presented as configured by health professionals and/or patients/informal caregivers CARE-13 Informal caregivers should have access to all PEP services – update: PEP should be configurable according to informal caregivers' preferences and be accessible by various end devices, in particular mobile end devices

5.9 Key scenario: document health measurements and self-recordings (patient/informal caregiver perspective)

<table>
<tr><td>Scenario</td><td colspan="2">Carmen was seen by her geriatrician, Peter, for her routine quarterly review. He has updated her care plan according to examination results. Back at home Carmen and her informal caregiver John are presented Carmen's new daily care plan on her tablet which Carmen follows up on.</td></tr>
<tr><td>User roles involved</td><td colspan="2">GP □ Specialist □ Nurse □ PT/OT/Sport □ Dietist □ Social worker □ Patient X Informal caregiver X Other (specify) □ ……</td></tr>
<tr><td>User tasks</td><td colspan="2">List of user tasks, depicting the workflow:

Note: Comments by patients or informal caregivers are always optional and a predefined list with possible response options as well as a field for free text input is provided.
<table>
<tr><td>Patient (Carmen)</td><td>Informal caregiver (John)</td></tr>
<tr><td>Record weight: absolute measurement, tendency indicated by an arrow (loss, steady state or gain of weight)

Aim in personal care plan e.g. 70 kg

Record comment: obstipation</td><td>Record weight: absolute measurement, tendency indicated by an arrow (loss or gain of weight)

Aim in personal care plan e.g. 70 kg

Record comment: obstipation</td></tr>
<tr><td>Record appetite:

Comments: I (Carmen) didn´t like to eat much. I only ate a banana.</td><td>Record appetite: Comments from John: Carmen eats less if she needs to eat alone without my company. She also has some difficulties with her denture.</td></tr>
<tr><td>Record blood pressure: absolute measurement from that day

Record comments?</td><td>Record blood pressure: absolute measurement from that day

Record comment: Carmen felt dizzy and weak today. The whole day there were difficult weather conditions and, in the evening, there was a thunderstorm.</td></tr>
<tr><td>Record medication:

Output: Reminder to take the medication at a certain time with additional information to take it before or after the meal

Input: After taking the medication Carmen can tick off the reminder

Record comments: I feel dizzy after taking this medication</td><td>Record medication:

Output: Reminder to take the medication at a certain time with additional information to take it before or after the meal

Input: Check medication intake of care-dependent: John can check if Carmen has taken her medication and can tick off the reminder either together with Carmen or let her know.

Records comment: Carmen felt dizzy</td></tr>
</table></td></tr>
</table>

		after taking this medication, so she decided not to take it anymore at the following days. Please take care of this at the next doctor´s appointment
	Record drink consumption Record a comment, if applicable	Record drink consumption Record a comment, if applicable
	Record falls: I tripped over the carpet/ I slipped on the wet floor in the bathroom	Record falls and message to health professionals: Carmen tripped over the carpet/slipped on the wet floor in the bathroom I found her lying on the floor and had to help her to get up. She would not have managed by her own. She has several bruises at her right arm and at the forehead. She had to take a longer rest afterwards.
	Record overall health status: Output: Emoticons happy, neutral, sad Input: Carmen or John can check which emoticon is the right one Record comments: it needs to be clear who is the author of this comment, John or Carmen	Record overall health status: Carmen has a good/bad day today because… Record comment: There was the special event today that Carmen´s grandson came for a visit. So she got very excited and got prepared for his visit by taking a shower and getting dressed nicely. She also wanted to bake muffins although she didn´t bake for a long time. She forgot to turn off the oven in time. She had a great time talking to her grandson and remembering the old times.
	Confirm motion (exercises, walk etc.) on the daily care plan Record comment (if applicable)	Record comment: less compared to last month. Carmen is moving unstable after she fell in the bathroom. Comments to health professionals: Carmen gets slower and unstable in motion. She needs to hold on to the furniture while walking.
	…	
Design in-/output of CAREPATH services	Output: Carmen is asked to check her weight on the daily care plan: Present analysis of weight result by an arrow: Weight has risen Arrow pointing upwards Weight stayed stable: horizontal arrow Weight loss: Arrow pointing downwards Aim e.g. 70 kg This is a specification which is transferred from the care plan the doctor is specifying for the individual patient on AICP Input: weight is measured by H/HMP integrated scale. If this scale is a smart one which diminishes between fat tissue and other tissue, this would be great. So here is a possibility to check on the hydration status of the patient: If Carmen is	

	dehydrated or storing fluid (water) in her tissues because of e.g. heart insufficiency this could be measured here. Field for comments: Carmen or John can put in here e.g. obstipation or vomiting Appetite Output: Drink 6 glasses of water Input: Carmen could check here, if she drank enough Output: Diet plan Input field for comments, e.g., “I felt so sick today. I was vomiting.” Blood pressure (see weight measurement) Output: Absolute measurement and arrow showing tendency Input field for Carmen´s or John´s comments Medication Output: One screen only for medication plan including times or indications like “take thyroid hormone pill 30 Minutes before breakfast” Parkinson medication needs to be taken independently from meals Some antibiotics need to be taken explicitly before or after the meal So, all these special instructions for the medication needs to be automatically transferred from the care plan the doctor is specifying for the individual patient on AICP Input: Carmen and/or John can check when medication was taken Detection of fall: Output: Fall detection This causes an early earning on AICP Input field to give feedback to the doctor, it´s necessary to be able to distinguish who made the comments: Carmen herself or John So Carmen or John can put in: “Carmen just dropped her smart watch, no fall” Or “John writes: I had to help Carmen to get up after she slipped in the bathroom, she would not have managed by her own. She has bruises, but no fracture” State of health: Output: Emoticons happy, neutral, sad Input: Carmen or John can check which emoticon is the right one Comment field: comments to be distinguished between Carmen or John Motion: Output: In my opinion it´s an overload of information if the number of counted steps is shown. Input: Field for comment to be distinguished who put in the comments
Related user requirements	CARE-11: Applications used by patients with MCI/mild dementia shall be designed dementia-friendly - update: content and functionalities on PEP to be presented to patients can be configured according to patients’ needs and capabilities CARE-13: Informal caregivers should have access to all PEP services - update: PEP should be configurable according to informal caregivers’ preferences and be accessible by various end devices, in particular mobile end devices CARE-14: Results of health measurements and PROMs from H/HMP are presented to patients and informal caregivers – update: provide help on what results mean in regard to the patient’s (health) status by visualization, e.g., arrow signs (arrow up – has improved, horizontal arrow – is stable, arrow down – has worsened CARE-15: Patients shall be supported in proper medication intake and documentation thereof CARE-16: Patients shall be supported in conducting and recording exercises CARE-17: Patients shall be supported in filling out and recording PROMs CARE-18: Patients shall be supported in adhering to diet recommendations

	CARE-22: Patients shall be able to document drink consumption CARE-34: It needs to be possible for patients/informal caregivers to record symptoms and events – update: author of documentation must be clear, patient or informal caregiver CARE-35: Patients shall be able to record medication with same timing all at once CARE-42: Patients are presented additional instructions as defined by health professionals

5.10 Key scenario: patient and informal caregiver look at health recordings on PEP

Scenario	As Carmen is taking every day her weight, blood pressure and glucose level she and John are interested in the results and the development over the past 2 weeks.
User roles involved	**GP** □ **Geriatrician** □ **Nurse** □ **PT/OT** □ **Dietician** □ **Social worker** □ **Patient X Informal caregiver X Other (specify)** □ **……**
User tasks	Patient/informal caregiver: • View health measurements in retrospective (2 weeks)
Design in-/output of CAREPATH services	**Input:** On the PEP is a button which can be pushed in order to reveal the measurements of health recording for the past two weeks **Output:** PEP shows an easy graphic for Weight: arrow up/horizontal or down indicating the change over the past two weeks and also the actual weight and the aimed weight of e.g. 70 kg Blood pressure: arrow up/horizontal or down indicating the change over the past two weeks and also the actual blood pressure and the aimed value Glucose level (only for patients with Diabetes): arrow up/horizontal or down indicating the change over the past two weeks and the aimed value
Relating user requirements	CARE-14 Results of health measurements and PROMs from H/HMP are presented to patients and informal caregivers - update: provide help on what results mean in regard to the patient's (health) status by visualization, e.g., arrow signs (arrow up – has improved, horizontal arrow - is stable, arrow down - has worsened

5.11 Key scenario: document symptoms (patient perspective)

Scenario	Carmen accesses her CAREPATH profile on a daily basis and listens to the various alerts that remind her of the routines and recommendations. For a few days now, she has started to notice less appetite, so she notes this in her PEP.		
User roles involved	**GP x Specialist x Nurse x PT/OT/Sport x Dietist x Social worker x Patient x Informal caregiver x Other (specify)** □ **……**		
User tasks	*List of user tasks, depicting the workflow:*		
	Health professional	**Patient**	**Informal Caregiver**
	• View AICP	• To do view	• Caregiver comments/Patient comments

	• Medical history review 3]	Patient Comments	
	• Review of alerts and early warnings		
Design in-/output of CAREPATH services	Carmen will have the possibility to refer her symptoms in a free text field where she can express in a more extensive or direct way how she feels (we think that it is also possible to send an audio message since for the profile of our patients it can be more direct to use spoken language as opposed to written language). You will also have the possibility to review a checklist with the most frequent signs and symptoms if it is easier for you. This space will be connected to AICP where all professionals involved in the management of your case will be able to see. *(It would also be possible to send a reminder at the end of the day to fill in something about how your day went or how you felt: How did you feel today? Is there anything important you want to tell us?)*		
Related user requirements	CARE-34 It needs to be possible for patients/informal caregivers to record symptoms and events – update: voice recognition shall be considered with low priority, because out of scope of the project		

5.12 Key scenario: follow an exercise plan (patient perspective)

Scenario	Following Carmen's initial assessment for CAREPATH; a home exercise plan has been recommended based on her health status. Carmen is a person with no walking difficulties and has been assessed as "robust" (not frail), so she has been recommended an exercise plan to follow with weekly targets.		
User roles involved	**GP x Specialist x Nurse x PT/OT/Sport x Dietist x Social worker □ Patient x Informal caregiver x Other (specify) □ ……**		
User tasks	*List of user tasks, depicting the workflow:*		
	Health professional	**Patient**	**Informal Caregiver**
	• View AICP	• PEP • To do view • Follow list of exercises	• Caregiver comments/Patient comments
	• Medical history review		
	• Review of alerts and early warnings		
Design in-/output of CAREPATH services	Carmen receives a notification on her platform that a daily training plan is available. She "clicks" on the notification and is linked to the list of exercises. She works through the exercises one-by-one and checks off when done. After 3 exercises she wants to take a break and goes back to her daily care plan. On the daily care plan, it is indicated that Carmen has done 3 of the 5 assigned exercises, so she knows that there are 2 more exercise to-do. She finishes these 1 hour later and this task I checked-off on her platform to indicate that this task has been completed.		
Relating user requirements	CARE-16 Patients shall be supported in conducting and recording exercises		

5.13 Key scenario: reminders for tasks to-do

Scenario	Carmen is connecting in the morning to the CAREPATH PEP on the tablet to check

	her daily care plan. There were no tasks assigned before breakfast. However, after breakfast she got a reminder on her smartwatch and the tablet via a long beeping sound which she could hear even from the kitchen. She knew already that she had to take her Metformin pill, but she will confirm the reminder anyway such that her daughter stopped worrying. So, Carmen pressed the YES button. Her next reminder is an appointment with her GP, but Carmen is feeling low on energy and does not know what to do. While pondering she receives a second reminder and this time the sound is louder and does not stop for several tens of seconds. She really needs to take a decision. She is not feeling great and decides to cancel the appointment, but she does not know how to do it from the PEP interface (see suggestion by UHCW in open appointments scenario). So, she 'clicks' on the reminder and the 'Appointment'-page opens with the details of the appointment including a phone number which she can use to call her GP's practice. She is able to reach someone at the reception desk of her GP and cancels the appointment. On the 'Appointment' page on PEP, she records the appointment as 'cancelled'. She is asked whether she would like to provide a reason why she cancelled the appointment, and a predefined list of possible reasons is presented to her. From this list she selects 'I feel tired'. With this explanation her son John will for sure contact her later, but oh well, at least they will chat a bit, so it's not so bad.
User tasks	List of user tasks, depicting the workflow: • Patient confirms or dismisses a reminder by pressing the YES or the NO button • Patient is selecting from a predefined list of reasons to justify a NO decision • Patient cancels and appointment with details provided on PEP
User roles involved	Patient, informal caregiver
Design in-/output of CAREPATH services	• It should be configurable on PEP by patients/informal caregivers that for specific types of tasks a reminder is presented in case a task has not been confirmed by the patient even though this was not configured as such by health professionals on AICP. All 3 actors can transform a task into a reminder. However, tasks selected as reminder by the caregivers or clinicians should not be reversable by the patient. • Reminders should be triggered on patient's smartwatch and accompanied on the tablet by a pop-up, sound and possibly SMS. The alerting level should gradually increase if the reminder is not acknowledged. • Safety controls should be implemented for some reminders such as medication. For example, after pressing the YES button the patient should be asked if the medication was taken as prescribed. A help menu should be available for the patient in case she/he does need to be reminded about how the medication has to be taken. • If the reminder is dismissed by pressing NO then the patient should be prompted to provide an explanation by either selecting a predefined one or by typing one. • Informal caregivers will be informed on their tablet about reminders not reacted upon.
Related user requirements	CARE-2 Patients need to be reminded of to-dos as defined in their care plan. – updated: reminders are configurable by health professionals and patient/informal caregivers, reminders can be dismissed, escalation scheme

5.14 Key scenario: confirm tasks to-dos

Scenario	Carmen is connecting in the morning to the CAREPATH PEP on the tablet to check her daily care plan. Her first task is to measure the blood glucose level before breakfast. Carmen performs the measurement and the task is automatically checked-off by the platform. Her blood glucose level is pretty low, so she hurries to

	have her breakfast. She will have more carbs than her recommended diet plan. Therefore, she will later mark this on the Diet Plan on the PEP. She also needs to write an explanation although the system should already know that she ate more, because her values were low. Her next task is to meet her cardiologist in the afternoon. But she still has some hours until then so she checks her unscheduled tasks. She opens the exercise tab and checks her daily exercise task. She decides to do only leg stretching. Once she was done, she marks it on the exercise tab and returns to the main page of the PEP. Now her exercise task shows 1 out of 6.
User tasks	List of user tasks, depicting the workflow: • Looks at the daily care plan on the PEP • Performs the tasks which are assigned • Checks also unscheduled tasks [4]
User roles involved	Patient, informal caregiver
Design in-/output of CAREPATH services	• A list of all daily tasks should appear on the PEP • Once a task is performed it should be checked-off by the platform automatically, if possible, e.g., in case a measurement was performed, so the system 'knows' whether a task was done or not, for other tasks this needs to be done by the user
Relating user requirements	CARE-3 Patients need to be able to confirm tasks to do. – update: system checks off automatically tasks that are achieved on the PEP platform where possible

5.15 Key scenario: view diet plan (informal caregiver perspective)

Scenario	John and his mother are going shopping together, because Carmen was not feeling very well and asked him if he could help today. They have just arrived at the food section and John asks his mother if she wants to eat sausages. Carmen would love to eat some sausages, but she has a vague impression she is not allowed to. She doesn't remember why, though. At that moment, John asks his mother if she has dietary restrictions set by her doctor. She doesn't remember that, either, but she says she is usually using the PEP to see what she can eat and what not. So as not to do more harm than good, John unlocks his smartphone and opens the caregiver interface of the CAREPATH platform, via his web browser. He goes to the diet plan and checks if his mother has any dietary restrictions or recommendations. John is astonished by the volume of dietary restrictions his mother has. He knew the doctor recommended to Carmen to avoid the consumption of refined sugars, but he had no idea she also has to cut on salt and salty products. Despite this, he sees that his mother regularly checked that she respects the diet. Thus, sausages, and processed meats in general, are salty products which Carmen must avoid. Her doctor recommended fresh fruits and vegetables and wholegrain cereals. He also recommended the use of spices instead of salt. John is already having ideas about the meals Carmen could prepare with these ingredients. He proposes them to his mother, and they start talking about which of them she would rather eat. He then makes a list of ingredients and products in his head, and they start searching for them.
User tasks	List of user tasks, depicting the workflow: • Open the caregiver interface of the CAREPATH platform, via a web browser • Go to the diet plan section of the CAREPATH platform • Check senior's dietary restrictions and recommendations given by their doctor • Buy ingredients and products according to the dietary restrictions and recommendations
User roles	Informal caregiver, patient

involved	
Design in-/output of CAREPATH services	The caregiver interface of the CAREPATH platform is designed so that the caregiver can access it from any web browser. Furthermore, the diet plan panel shows the senior's dietary restrictions and recommendations given by their doctor, but also if they respected their restrictions. If they did not, their reasons are shown.
Relating user requirements	CARE-13 Informal caregivers should have access to all PEP services – update: PEP should be configurable according to informal caregivers' preferences and be accessible by various end devices, in particular mobile end devices CARE-18 Patients shall be supported in adhering to diet recommendations

5.16 Key scenario: define appointments on PEP and view daily care plan (informal caregiver perspective)

Scenario	Carmen is not feeling well today and she called her son, John, to let him know. She is dizzy, her head hurts and she feels tired, symptoms that worry John. He calls the GP to let her know how his mother is feeling and asks her for advice. Nora schedules an appointment for Friday, two days from now, and tells John not to worry, it is probably a side effect of changing medication. John thanks her and hangs up. John opens the PEP with the intention of adding a task for the medical appointment on Friday. He navigates to reminders, clicks on add new task, inputs the date and the time, selects the activity from the available list and saves the task. He also checks off that an additional reminder shall be presented to Carmen about the appointment in the morning. He then checks if the appointment was saved in the daily care plan. He navigates to Friday and finds the reminder there. He then goes back to the present day and checks what his mother has to do today. Besides taking medication and exercising, there is not much to do. The daily plan is well organised, the letters are big and the contrast is visible.
User tasks	List of user tasks: • Open the caregiver interface of the CAREPATH platform via a web browser • Go to 'Add tasks' • Add a task • Save the task • Add a reminder • Check if task is there
User roles involved	Informal caregiver, patient, GP
Design in-/output of CAREPATH services	Tasks should be easy to add, by both senior and caregiver. The daily care plan should be easy to read for the seniors. The consortium may explore an option to allow for turning text into speech for seniors with visual impairments.
Related user requirements	CARE-11 Applications used by patients with MCI/mild dementia shall be designed dementia-friendly- update: content and functionalities on PEP to be presented to patients can be configured according to patients' needs and capabilities CARE-12 A daily care plan will be presented to patients in a dementia-friendly design - update: content and functionalities, e.g., reminders, on patients' daily care plans are presented as configured by health professionals and/or patients/informal caregivers CARE-39 Patients/informal caregivers need to be able to document appointments with health professionals and other events– update: aspect that appointment procedures/system differ among EU-countries, contact details need to be added

5.17 Key scenario: define appointments on PEP (patient perspective)

Scenario	Carmen has multiple medical conditions including diabetes, chronic obstructive pulmonary disease and heart failure. She sees multiple teams for these different conditions at different sites, this includes doctors, allied health professionals and nurses. Some of these are at the specialist hospital, others are at community sites. It can be confusing keeping track of all these appointments. It is important to ensure appointments are not forgotten, do not clash and are optimized to try to reduce travelling time. As Carmen has cognitive impairment deteriorates her interaction with the appointments reduces as time goes on.
User tasks	List of user tasks, depicting the workflow: Patient: • Looks at appointments of the day on the daily care plan function on PEP • Looks at appointment details on dedicated 'Appointment-page' on PEP • Views which appointments are upcoming, what condition they are for, who they are with, when they are and where they are • Can see if there are any clashes in appointments Informal caregiver: • All information on appointments can be viewed as well by informal caregivers • Informal caregiver can create a 'task' for the patient about pick-up time for the appointment etc. This task will appear on patient's daily care plan. Informal caregiver can select that the patient shall receive a reminder about this task.
User roles involved	Patient
Design in-/output of CAREPATH services	• A daily care plan showing appointments of the day should be accessible on the CAREPATH interface (PEP) • A reminder should appear on the daily care plan accompanied by a sound when there is an appointment that day, if scheduled as such • The preview function of the daily care plan should be modifiable such that it shows the current day or a week or a full month • The preview function of the daily care plan and the Appointment-page on PEP present which appointments are upcoming, what condition they are for, who they are with, when they are and where they are. They also show the number to call if there is a need to change or cancel the appointment. • Informal caregivers can view all information provided about appointments on PEP • On the 'Appointment-page' it is documented when an appointment has been changed or cancelled, if documented by the patient/informal caregiver or this information can be taken over from patients' EHR at pilot sites. • If an appointment is missed the patient has the option to record why it was missed • Any notes from the informal caregiver for the appointment can be seen, for example pick up time for the appointment, transport plan for the appointment, who will accompany the patient.

	OUT OF SCOPE: • To avoid complexities of interactions with booking systems I would suggest we do not include the functionality to cancel or change appointments, but these pull through if they are changed. • Ideally the calendar should coordinate with both Apple and Android calendar functionalities. • The calendar creates and alert if appointments are too close to each other to allow travel between
Related user requirements	CARE-38 Health professionals need to be able to create follow-up appointments for patients – update: aspect that appointment procedures/system differ among EU-countries, contact details of the health professional the appointment is with needs to be added CARE-39 Patients/informal caregivers need to be able to document appointments with health professionals and other events – update: aspect that appointment procedures/system differ among EU-countries, contact details need to be added CARE-40 Patients shall be able to complete information about follow-up appointments – update: aspect that appointment procedures/system differ among EU-countries CARE-60 Patients/informal caregivers shall be able to change or cancel appointments – new user requirement

5.18 Key scenario: follow up on exercising (informal caregiver perspective)

Scenario	John is on his way to work, and he is thinking about his mother. It is the beginning of autumn and the weather already began to get chilly. He has observed lately that Carmen doesn't go out as much as she used to, which makes him worry about the amount of physical exercise she is doing. In order to stop worrying, John unlocks his smartphone and opens the caregiver interface of the CAREPATH platform, via his web browser. He goes to the exercise panel and checks if his mother has done her exercises in the last 2 weeks. He sees that his mother is regularly doing her exercises and rarely skips them. He then goes to check the recordings of the fitness bracelet Carmen wears permanently, to see if the exercises are overburdening her. He sees that his mother's heart rate is a bit higher than usual right after the reminder of the care plan for physical exercises. He does not observe any worrying changes in her heart rate, besides the normal increase determined by a moderate session of exercises. John is no longer concerned about his mother. Even though the weather outside stops Carmen from walking in the park, she is doing her exercises at home, every day.
User tasks	List of user tasks, depicting the workflow: • Open the caregiver interface of the CAREPATH platform, via a web browser • Go to the exercise section of the CAREPATH platform • Check the regularity of the exercises, by day • Go to the recordings of the fitness bracelet the elderly is wearing, to see if the exercises determine a higher heart rate than they should (if the senior is overburdened by exercises). [5]
User roles involved	Informal caregiver, patient
Design in-/output	The caregiver interface of the CAREPATH platform is designed so that the caregiver

of CAREPATH services	can access it from any device connected to the Internet. Furthermore, the exercise panel shows the exercises the senior has done, organised by day. It also shows what types of exercises the senior has done, as they are checking them when they are done. A very important thing to mention is that the senior should be able to confirm when they begin the exercises, so that the platform won't alert the caregiver/doctor if it detects an increase in heart rate (early warning systems).
Relating user requirements	CARE-13 Informal caregivers should have access to all PEP services – update: PEP should be configurable according to informal caregivers' preferences and be accessible by various end devices, in particular mobile end devices CARE-16 Patients shall be supported in conducting and recording exercises

5.19 Key scenario: gaming with informal caregiver

Scenario	John has some serious problems with his car. It refuses to start and the engine flashes red in the car's dashboard. The mechanic he called said the issue will probably take some time to fix and he hopes John hasn't had any plans with the car in the near future. Unfortunately for him, John had a very important visit to make, but he will not be able to make it. He lives on the outskirts of town and a journey with the public transport will take him too long. He calls his mother to let her know that he won't show up today. Carmen is very disappointed; she lets her son know that she was looking forward to spending time with him today. Oh, well, they won't be able to, possibly for another week. He hangs up and a wave of guilt passes over him. He loves his mother and he feels sorry about the whole situation. Later that evening, his phone rings; it's his mother. In order for Carmen to engage her brain and lift her mood, she tried playing some of the games on the PEP. While playing, she discovered that the multiplayer version of the game she played can also be played remotely. Carmen asks her son if he would like to play together. This is great news! Of course, John would like to play! It the least he could do, after the car situation. He opens the caregiver interface of the CAREPATH platform, via his web browser. He then clicks on the games and chooses the game his mother told him to. He clicks on multiplayer and selects his mother. The game begins. Even though they are far away, Carmen and John are able to spend time together via the CAREPATH platform. John is grateful that his mother can share games with him and feels less alone.
User tasks	List of user tasks: • Open the caregiver interface of the CAREPATH platform via a web browser • Go to the games section of the CAREPATH platform • Select the game and click on multiplayer • Select the person you want to play with (your senior/caregiver should be available right away)
User roles involved	Informal caregiver, patient
Design in-/output of CAREPATH services	The games are easy to find for both senior and caregiver, some reminders of the existence of this functionality of the PEP should be shown from time to time to the senior (e.g.: game of the day). The multiplayer feature of the games should show the caregiver the possibility of playing with the elderly relative they have in their care. Similarly, the multiplayer feature should show the senior the possibility of playing with their informal caregiver. This should be automatic, so that the senior or the caregiver won't have to search for

	each other.
Relating user requirements	CARE-48 Patients are able to play a cognitively stimulating game – update: consortium shall explore whether online gaming with, e.g., the informal caregiver poses a feasible and motivating option.

5.20 Key scenario: gaming (patient perspective)

Scenario	Carmen can't go out for a walk but she is feeling restless. So, she decided to play a bit on the CAREPATH platform. She opened the PEP and the game of the day popped up. She could choose another game but the game of the day was usually the one where she could play with other users of the CAREPATH platform. Some socializing while gaming was fun. So, she started to play and also share her score with another user. She was ahead and this improved her mood. After a while she quit the game and chose another one. Here she played alone but it was still fun. She felt that it helped improve her memory. It was a simple game of matching cards but she had was now able to play it pretty fast with 16 cards. In the beginning she played only with 8 and even then pretty slow. Her best time or score where always shown in the end of the game next to her current one. John, her son, has also noticed her progress. Sometimes, when he had time, they played together, either physically or remotely like now with the game of the day.
User tasks	List of user tasks, depicting the workflow: • Patient plays the game of the day and compares performance with other users of the platform • Patient is playing a memory or cognitive stimulating game • Patient is able to compare current and past score • Patient is playing a game remotely with the caregiver
User roles involved	Patient, informal caregiver
Design in-/output of CAREPATH services	• Game of the day is suggested when accessing the gaming tab from the PEP • The game of the day has other players playing simultaneously and the score can be shared. • Optional, users can chat or exchange emoticons while playing. • Several games are available • Games have increasing levels of difficulty • Scores are calculated in the end of a game and displayed along with best values obtained by a user • Performance can be seen by the informal caregiver • Caregivers can choose to play remotely with the patients
Relating user requirements	CARE-48 Patients are able to play a cognitively stimulating game – update: the consortium may explore to include gamification features such as introducing challenges among patients to motivate patients to play.

6 Appendix B

Template for definition of key scenarios

Title key scenario

<table>
<tr><td>Scenario
(S1)</td><td>Short description of the scenario, so workflow and context-of-use become alive for partners, e.g., what shall happen on the CAREPATH platform, if a patient comes to the hospital for a routine check-up and the medical doctor wants to receive a quick overview on the patient's current health status.</td></tr>
<tr><td>User roles involved</td><td>GP □ Geriatrician □ Nurse □ PT/OT □ Dietician □ Social worker □ Patient □ Informal caregiver □ Other (specify) □ ……</td></tr>
<tr><td>User tasks</td><td>List of user tasks, depicting the workflow:

You may do this either in form of a list in case only one user role is involved otherwise you may make a table preferable with a dedicated column per user role. In case several health professionals are involved in the scenario, the table may become too big. In that case you may summarize all health professionals involved in the scenario in one column, however, please be sure to indicate always which role is doing which task. E.g.:

…
<table>
<tr><th>Health professionals</th><th>Patient</th><th>Informal caregiver</th></tr>
<tr><td>Geriatrician:
• View H/HMP data
o Weight recordings
o Patient/informal caregiver comments
o Carmen's self-reports on diet adherence and reasons</td><td>• Records weight
• Provides comments</td><td>• Records weight with patient
• Provides comments</td></tr>
<tr><td>Geriatrician:
• Medical history review
• Previous STEP1+STEP2 review</td><td></td><td></td></tr>
<tr><td>Geriatrician:
• Review of alerts and early warnings</td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>Design in-/output of CAREPATH services</td><td>Describe here whatever is important to mention in regard to what and how CAREPATH services should be presented to users enabling them to fulfil their tasks. For example, if input is required from a user, how shall the system be designed to collect this input. If the system provides output such as an early warning, analysis of a patient's health measurements, how shall this information be presented to the user. You may refer to user requirements for this task, but do not forget to describe the</td></tr>
</table>

	context. You may do this in form of a list showing the workflow, e.g.: … • The patient should be presented with the option of confirming or declining the task • In case the task is declined, the patient is provided the option to give reasons for this. For this purpose, a list of predefined reasons is offered which the patient may choose from, however, there is also an option to provide free text input

7 References

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[8] Rosson, M.B., Carroll, J. M. (2001). Usability Engineering: Scenario-Based Development of Human-Computer Interaction. Morgan Kaufmann

[9] Shannon, E.T. (20020). The Practical Guide to Experience Design: A Guidebook for Passionate, Curious, and Intentional People who Enjoy Designing for Humans. Artificial Publishing

8 Review status

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9 Document History

Date	Changes	Version	Authors
2021-10-07	Initiation of Deliverable Table of Content (ToC) and first draft	1v0	Yehya Mohamad (Fraunhofer)
2021-11-04	Initial draft key scenario template	1v1	Henrike Gappa
2021-11-15	Initial draft methodology	1v2	Henrike Gappa
2021-11-22	Initial draft after methodology meetings	1v3	Henrike Gappa, Yehya Mohamad, Pedro Abizanda Soler, Timothy Robbins, Wolfgang Schmidt-Barzynski, Antje Steinhoff, Cristiana Ciobanu, Oana Cramariuc, Gokce Banu Laleci Erturkmen, Theo Arvanitis, Jaouhar Ayadi, Angelo Consoli, Lionello Ferrazzini
2022-01-15	Finalization methodology key scenarios / use cases	1v4	Henrike Gappa, Yehya Mohamad
2022-03-03	Finalization key scenarios	1v5	Henrike Gappa, Yehya Mohamad, Carlos Velasco, Pedro Abizanda Soler, Timothy Robbins, Wolfgang Schmidt-Barzynski, Antje Steinhoff, Cristiana Ciobanu, Oana Cramariuc, Gokce Banu Laleci Erturkmen, Theo Arvanitis, Jaouhar Ayadi, Angelo Consoli, Lionello Ferrazzini
2022-03-15	Results key scenarios analysis / use cases	1v7	Henrike Gappa, Yehya Mohamad, Carlos Velasco, Pedro Abizanda Soler, Timothy Robbins, Wolfgang Schmidt-Barzynski, Antje Steinhoff, Cristiana Ciobanu, Oana Cramariuc, Gokce Banu Laleci Erturkmen, Theo Arvanitis, Jaouhar Ayadi, Angelo Consoli, Lionello

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2022-03-22	Pre-final version to be submitted to the internal reviewers	1v8	Henrike Gappa, Yehya Mohamad, Carlos Velasco, Pedro Abizanda Soler, Timothy Robbins, Wolfgang Schmidt-Barzynski, Antje Steinhoff, Cristiana Ciobanu, Oana Cramariuc, Gokce Banu Laleci Erturkmen, Theo Arvanitis, Jaouhar Ayadi, Angelo Consoli, Lionello Ferrazzini
2022-03-24	Updated according to reviewer comments and deliverable final version.	1v9	Henrike Gappa, Yehya Mohamad, Jaouhar Ayadi, Angelo Consoli

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