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Prototype of backend DSS, ready for integration with the pilot system

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CI	Classified Information (Commission Decision 2015/444/EC)	

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1. Versions History

Version	Date	Author	Comments
0.1	30/8/2022	David Glasspool Alexandra Kogan Ella Barkan Simona Rabinovici-Cohen Szymon Wilk	Initial draft
1.0		David Glasspool Alexandra Kogan Ella Barkan Simona Rabinovici-Cohen Szymon Wilk Roy Leizer	Finished draft for review

2. Executive Summary

This report accompanies the demonstration video available here: D5-6_video.mp4

This deliverable demonstrates that the CAPABLE backend decision support system is ready for integration into the clinical pilot system. The primary deliverable is a video showing a live demonstration of the system responding to five independent clinical scenarios, involving five different patients, which are all presented in parallel to the system by using the CAPABLE simulator utility to inject patient data. The system responds as designed, the various components of the backend DSS communicating with each other and with the CAPABLE infrastructure to manage the five patients and keep track of their different clinical situations.

This report gives an overview of the clinical DSS backend, describes the clinical scenarios used to exercise the system, and gives an overview of the demonstration recording and a summary of the results.

3. Resources

The video recording which forms the primary deliverable is available at the following URL: D5-6_video.mp4

The slides used in the video recording are available here: D5.6 presentation.pptx

The FHIR resources used to configure and test the five different scenarios, along with a summary document for each scenario showing how the resources relate to the clinical scenario, are available here: D5.6 Scenarios

The scenarios all assume that each patient is being treated according to the computer-interpretable guideline (CIG) for diarrhea as a side-effect of cancer treatment. This CIG is based on Bossi et. al (2018) and is available here: Diarrhoea_Physician_tech_dev.pf

4. Scope of the Demonstration

This deliverable aims to demonstrate that the prototype backend decision support system is ready for integration into the clinical pilot system. Specifically, we will demonstrate the following:

- That all components within the backend DSS operate as expected on a set of five different clinical scenarios;
- That the DSS components interact correctly with each other and with the CAPABLE system infrastructure while responding to the scenarios;
- That the system is able to operate correctly when all five clinical scenarios are presented in parallel, so that the components need to keep track of interleaved data and requests for different patients in different clinical situations.

The five clinical scenarios we will use for this demonstration are each relatively simple in themselves, but presenting them all to the system in parallel, so that multiple events happen simultaneously and interactions concerning different patients are interleaved, represents a more realistic and challenging workload compared with the more focussed tests of previous deliverables.

The components included in the demonstration are those which will be in operation to generate live clinical decision support in the clinical pilot studies:

- VC (Virtual Coach)
- PDSS (Physician Decision Support System)
- GoCom (Goal and Co-Morbidity reasoning system)
- KDOM (Knowledge Data Ontology Mapper)

The two core CAPABLE infrastructure components, Data Platform (DP) and Case Manager (CM) will also be incidentally tested due to the heavy reliance on them for data storage and event management during execution of the demonstration.

Due to the regulatory limitations, the remaining component of the CAPABLE DSS system, the Predictive Model Component (PMC), will not be used to generate live clinical decision support in the pilot studies and so will not be included in this demonstration (see D5.4 instead).

5. Overview of the backend DSS

The DSS has been already described in detail in previously published deliverables:

- Deliverable D5.3 (Glasspool et al., 2022): Overview of the DSS backend system.
- Deliverable D5.3: Details of PDSS and GoCom PMC components and their interaction with PMC.
- Deliverable D5.4 (Barkan et al., 2022): Details of PMC component.
- Deliverable D5.5 (Wilk et al., 2022): Details of VC component.

This section provides a brief recap of the main features of each component that are important for the D5.6 demonstration.

Figure 1 shows the main components of the CAPABLE DSS system, with the backend components that will be used in the clinical pilot studies highlighted in orange. The components are not directly connected to each other but interact through message-passing via the Data Platform (DP) as shown by the black arrows in Figure 1. The orange arrows indicate that three components, Physician DSS, Virtual Coach and GoCom, also connect to the Deontics Server which provides a decision support engine that can execute clinical guidelines specified in the PROforma language.

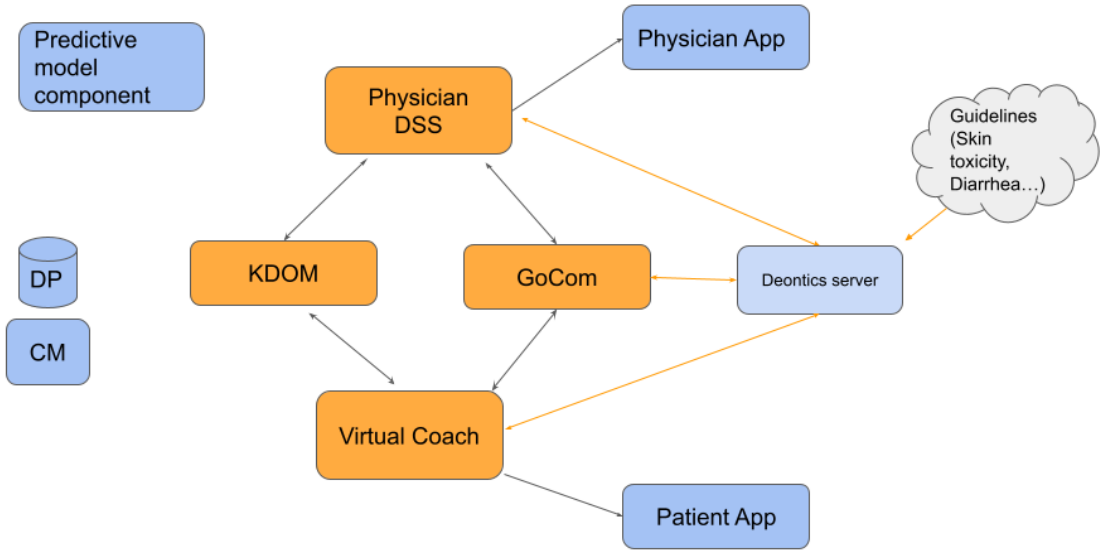

Figure 1: *Conceptual view of the component network surrounding the CAPABLE backend DSS. The DSS components (demonstrated in this deliverable) are shown in orange. All connect to DP (Data Platform) and CM (Case Manager), and the black arrows conceptually indicate interactions that take place via DP. The Predictive Model Component is not involved in the demonstration of this deliverable but current progress is reported in this document.*

The DSS components react to patient data, primarily Observations (such as blood pressure readings, symptom reports etc) and Medication Requests, stored in the DP. For this demonstration data will be sent to the DP not from the physician and patient apps but from the CAPABLE simulator utility, which can automatically send patient data to DP and check that the expected actions are carried out in response by the DSS.

Sub-sections below will provide a short overview of each DSS component, referencing the previous deliverables. For KDOM, which has not recently been described in detail, a wider overview is provided. The PMC component is also included in order to provide an update on progress with model development since month 30.

5.1. PDSS

The Physician Decision Support System (PDSS) is responsible for applying clinician decision support guidelines to patient data in the CAPABLE system. It uses the Deontics engine to execute computer-interpretable guidelines (CIGs) written in the PROforma CIG language; it can deal with multiple patients simultaneously being assessed on multiple CIGs. PDSS interfaces between the CAPABLE component-oriented network architecture (see Figure 1) and FHIR data format, and the specialized CIG execution API and data model of the Deontics engine.

PDSS also implements an assessment-based workflow over the CIGs. This is a workflow that is based on repeated "assessments" of a patient, where assessments may happen at any time but are assumed to be brief - CIG execution is started, the CIG assesses the patient based on current clinical data and immediately returns any recommended actions that are indicated, and then execution stops. Each assessment starts afresh from the beginning of the CIG and is based solely on the current clinical data - no memory is retained in the Engine from one assessment to the next (i.e. the execution model is considered "stateless"). This stateless execution model is a general aim within the CAPABLE project as a means of reducing dependencies between components and increasing robustness, and it also allows more straightforward testing.

Whenever new clinical data arrives for a patient, a single assessment is carried out on each available CIG using the patient's clinical data. Some of these assessments may be very brief, where the CIG is immediately found not to be relevant to the patient, and some may involve more detailed processing.

PDSS interacts with the DP (pulling patient data when it is told by the CM that a new data is available), KDOM (requesting updated values for any "abstraction" data items that are required by the currently enabled clinical guidelines - these values must be calculated by KDOM dynamically using current patient data values), and GoCom (which must consider any actions recommended by the PDSS clinical guidelines to determine if any unwanted interactions may occur, and if the clinician should consider alternatives).

5.2. GoCom

GoCom (Goal Comorbidities - Multimorbidity Controller) detects interactions among the patient's diseases and treatments and suggests mitigation solutions. GoCom is goal-oriented and mitigates interacting treatments while attempting to provide clinically viable solutions for as many of the patient's diseases as possible. The Physician Decision Support System (PDSS) and Virtual Coach (VC) components forward pharmacological treatments recommended by the guidelines to GoCom for interaction checking in order to prevent adverse events. When GoCom receives a request from the PDSS or VC, the patient's active diagnoses and treatments

are retrieved from the Data Platform (DP) and are re-structured as goals in a hierarchical goal-forest graph. Each disease is a root-goal of a tree in the forest graph, with the treatments as children goals.

After the patient goal-forest is created, it is checked for interactions. Pairs of medication codes are compared for Drug-Drug Interactions (DDIs) and for guideline recommendation interactions. Guideline recommendation interactions are detected by comparing the codes and statuses of medications set in the guideline, where recommendations with opposite statuses (e.g., Active and Stopped) and identical or subsumed medication codes (e.g., The medication group 'Opioids' subsumes the specific medication 'Loperamide') are considered to interact. DDIs are identified using the RxNav API. For medication codes that have the Precise Ingredient (PIN) RxNorm term type, only interactions with that specific code are considered since when the Medication Request provided in the DP has a medication PIN code, this medication has been prescribed for the specific mechanism of action of that variant of medication, thus the interactions should also be considered for that specific variant.

GoCom generates textual explanations for all the recommendations from the clinical practice guidelines and descriptions retrieved from RxNav. GoCom will try to find a replacement treatment in the guideline for medications that were identified as taking part in an interaction. If a replacement is not available, GoCom will suggest a solution without that treatment. This mitigation process can produce multiple alternative (disjoint) solutions referred to as "option-sets", where each option-set is a collection of non-conflicting treatments or suggestions to stop a treatment that the physician should follow in order to adhere to the clinical practice guidelines. The guideline recommendations that have no interactions are displayed to the physician as well with no alternative solutions.

5.3. Virtual Coach

Virtual Coach (VC) is a component of the CAPABLE system that provides active and comprehensive support for patients and their home caregivers. The provided support referred to as *coaching*, involves monitoring reported symptoms and readings obtained from wearable sensors (consumer-grade smartwatches), recommending pharmacological (only if already prescribed by the physicians) and non-pharmacological interventions (so-called well-being capsules), and delivering alerts, reminders and various types of tips (related to prevention, education, and symptom management).

VC employs both knowledge- and data-driven models to control the coaching process. Knowledge-driven models capture clinical knowledge -- guidelines, workflows and rules. They are modeled using the PROforma formalism according to published evidence. Data-driven models capture personalized knowledge related to wellbeing capsules (e.g., preferred notification times, types of motivating messages) and they are derived from data collected automatically by the system (e.g., through wearable sensors) or entered manually by patients (e.g., by evaluating the usefulness of selected wellbeing tips).

VC is designed and implemented following the *actor model* where the functionality of a system is divided into multiple independent entities called *actors*. Actors work in parallel, and communicate asynchronously by exchanging messages. Moreover, they can be created and

deleted dynamically based on the current workload. Such an architecture facilitates parallel operations at various levels -- VC is able to provide support simultaneously to multiple patients, and to run several models (e.g., PROforma guidelines) for a given patient.

More details about VC are provided in the following deliverables:

- D2.1 (Peleg et al., 2020) and D2.2 (Peleg et al., 2021) -- specification of requirements and initial architecture of the component,
- D5.2 (Giloba-Solomon et al., 2021) -- the scheme of major operation performed by the component,
- D5.5 (Wilk et al., 2022) -- description of the prototype, including its revised architecture and operations, and presentation of representative operations in two clinical scenarios.

5.4. KDOM

Knowledge Data Ontology Mapper (KDOM) allows the mapping of abstract medical concepts from Clinical Interpretable Guidelines (CIG) to Electronic Health Record (EHR). CIG execution over a patient's EHR can deliver patient-specific recommendations, supporting clinicians to get better, more accurate results and insights. KDOM delivers this functionality by using design-time (predefined) abstractions (abstractions are similar to queries e.g., 'does patient X has complicated diarrhea?') which are composed by modelers using OWL/XML Editors. KDOM defines four types of mappings: Direct 1:1, Logical, Temporal, and Hierarchical. Once the mappings have been defined, KDOM will automatically generate respective HL7 FHIR queries, those will be executed on the EHR DB and return the related data to complete the abstraction calculation. Once abstraction has been calculated, the results will be stored on the EHR DB (Data Repo) and returned to the caller component (e.g., VC/ PDSS). Moreover, KDOM can return the abstraction results as standard patient data resources – HL7 FHIR Observation and Communication; it also has the ability to listen to triggering events and respond to them; perform reasoning under uncertainty and allow some interpolation of missing data points requesting users to supply missing data points in real-time.
(See Annex 1 for more detail).

5.5. Predictive Models Component

The goal of PMC (Predictive Model Component) is to perform machine learning and statistical data analysis to develop population-based prediction models. These tasks are accomplished using two retrospective datasets described in Section 3.2 of D5.1 (Barkan, et al., 2020), and Section 6.2 of D5.2 (Giloba-Solomon et al., 2021); one of melanoma patients and one of renal cell carcinoma patients.

We apply methods based on neural networks such as MLP as well as methods based on classical classifiers such as XGBoost, Random Forest and Logistic Regression. Statistical data analysis is used to exhibit the characteristics of the processed data, like descriptive statistics, univariate and multivariate analysis. The prediction models are developed using retrospective data, but will also be applied to new prospective patients collected during the pilot. This will enable the provision of insights related to the clinical treatment. According to the

requirements defined in D2.1 (Peleg et al., 2020), the models are developed for the prediction of response to treatment, prediction of survival within given time-span, and prediction of toxicity. The prediction results for both cohorts (retrospective and prospective) will be summarized in a report to the physicians in a statistical manner with no personal advice per patient (see more details on that in D5.4 Section 5.4).

State-of-the-art AI methods suitable for small sets of tabular data are applied for model development, like MLP and ensemble with traditional Machine Learning methods. The developed models are evaluated using ROC AUC with confidence intervals, and compared with well-known prognostic systems, when applicable. Explainability methods are applied on the models in order to provide physicians with insights into the developed models and prioritize the most influencing features. Additionally, large public data sources with clinical data such as UK Biobank are introduced for the development of modern data-intensive models like EHR transformers.

More details about this component can be found in D5.2 (Gilboa-Solomon et al., 2021) sections 7.1.2.1 and 7.1.4.2 respectively; and in D5.4 (Barkan et al., 2022), section 5.

6. Demonstration Scenarios

The demonstration uses five clinical scenarios which are described informally in this section. Each scenario is formally defined as a set of FHIR resources (Medication Requests, Observations and Communications) which the Capable Simulator utility will either insert into the Data Platform to simulate incoming patient data or compare with the actual contents of the Data Platform to assert that the expected actions and recommendations have been made by the system. The resources for each scenario are contained in a separate folder and all are available for inspection at D5.6 Scenarios. Each folder also contains a document that relates specific FHIR resources to each step in the scenario.

All scenarios require the use of a single clinician guideline, the guideline for managing diarrhea as a side effect of cancer treatment, which is available in its CIG form here: Diarrhoea_Physician_tech_dev.pf. For the demo, the PDSS is configured to consider this guideline for all patients.

6.1. Scenario 1 -- Cabozantinib treatment

A patient is prescribed Cabozantinib - a targeted therapy drug. The diarrhea incidence of Cabozantinib is 64%. The threshold above which the patient should be given anti -diarrhea medication to use as needed is 40%. Thus, the PDSS sends a recommendation to the physician app and the patient is prescribed Loperamide as needed.

6.2. Scenario 2 -- Decreased appetite

A patient is enrolled into the system. He is prescribed Bevacizumab - a targeted therapy drug. Since the diarrhea incidence of Bevacizumab is 20% and the threshold for prescribing anti-diarrhea medication to use as needed is 40%, nothing is prescribed at this point.
A week later, the patient enters a new symptom through the patient app and reports he has decreased appetite. He chooses description level 1 which maps to the Common Terminology Criteria for Adverse Events (CTCAE) grade 1: 'Mild decrease of appetite; I eat and/or drink as usual'.

The Virtual Coach produces a recommendation with contact level 1 that is sent to the patient app. The patient is instructed to keep monitoring the symptom.

6.3. Scenario 3 -- Diarrhea

A patient is enrolled into the system. He is prescribed Bevacizumab - a targeted therapy drug. The diarrhea incidence of Bevacizumab is 20% and the threshold for prescribing anti-diarrhea medication to use as needed is 40%, thus nothing is prescribed at this point.
A week later, the patient reports the diarrhea symptom through the patient app and chooses description level 2 which maps to CTCAE grade 2: 'Increase of <4 stools per day compared to usual amount of stools per day'.
The Physician DSS sends recommendations to the physician app for initial management of uncomplicated diarrhea that includes dietary modifications, monitoring of the diarrhea and other symptoms that may appear such as fever. Additionally, Loperamide is prescribed to be

taken every 2-4 hours or after every unformed stool, up to 16 mg a day. And the third recommendation produced by the system is oral rehydration.
The physician selects the recommendations for Loperamide and oral rehydration and these recommendations are sent to the patient app as well.

6.4. Scenario 4 -- Diarrhea and Nausea

A patient is enrolled into the system. He is prescribed Bevacizumab - a targeted therapy drug. The diarrhea incidence of Bevacizumab is 20% and the threshold for prescribing anti-diarrhea medication to use as needed is 40%, thus nothing is prescribed at this point. A week later, the patient reports the diarrhea symptom through the patient app and chooses description level 2 which maps to CTCAE grade 2: 'Increase of <4 stools per day compared to usual amount of stools per day'.
Then, the patient also reports another symptom - nausea, with a description that corresponds to CTCAE grade 3:'Mild nausea causing a loss of appetite; I eat and/or drink as usual'. The Virtual Coach recommends through the patient app to contact the doctor.
The Physician DSS produces and sends to the physician app the following recommendations: hospital admission that is advised for patients with mild to moderate diarrhea that is complicated by moderate to severe nausea. And a prescription for Octreotide for intensive management of complicated patients.

6.5. Scenario 5 -- Vomiting

A patient is enrolled into the system. He is prescribed Bevacizumab - a targeted therapy drug. The diarrhea incidence of Bevacizumab is 20% and the threshold for prescribing anti-diarrhea medication to use as needed is 40%, thus nothing is prescribed at this point.
A week later the patient reports a new symptom - vomiting, with a description that matches CTCAE grade 1: '1 - 2 episodes of vomiting (separated by 5 minutes) in 24 hrs'. The Virtual Coach sends a recommendation to the patient app to keep monitoring the symptom and provides hydration tips.

7. The Demonstration

The demonstration is carried out using five separate instances of the Capable Simulator, all configured to address a single DP component running on a virtual machine and connected to single instances of the other DSS components (VC, PDSS, KDOM and GoCom). The five simulator instances are each configured to use a different patient ID, and each runs through the steps of one of the scenarios outlined above.

The result is that a single CAPABLE DSS system must deal effectively with concurrent demands from five different patients, scheduling operations and tracking resources so that each patient is dealt with fully and the system never confuses different patients or looses track of any operation.

The demonstration is presented as a video recording, available here: D5-6_video.mp4

The video runs for 14 minutes and shows the five simulator instances running through their separate scenarios as well as the log output for one of the components, the PDSS, to give an indication of system operation.

Although the commentary of the video notes events occurring in the PDSS log, it should be noted that VP, GoCom and KDOM are all also heavily involved in the activity that is being checked by the simulator instances. (The critical aspect of the system being demonstrated is the testing occurring in the simulator instances, the PDSS log is only included to give an indication of system activity. The PDSS interacts with most of the other components and gives a relatively streamlined indication of the overall system operation. The PDSS log from the demonstration is provided in Annex 2 for reference.)

1.1. Demonstration video walkthrough

Table 1 provides a walkthrough of the demo video (and Annex 2 log) showing what exactly is happening at each step.

Video timestamp	Log timestamp (Annex 2)	Notes
2:12 - 6:09		The five scenarios are outlined and the five simulator instances that will simulate patient data input, and check DSS output, are initialised.
6:09		The five simulator instances are started, and begin to send patient data to the DP
6:15	16:34:11	CM is now sending events to the DSS components to let them know that new patient data has arrived in DP. The PDSS log starts to register new Observations and MedicationRequests arriving for the five demonstration patients. PDSS begins requesting updated values for a number of abstractions for each patient from KDOM.

6:38	16:34:34	PDSS begins to register that it has been informed that new abstraction values are available. Abstraction values for different patients arrive interleaved with each other.
7:15	16:35:09	KDOM has returned all the abstractions that PDSS requires to run the currently configured clinician guideline for the scenario 5 patient, and PDSS carries out an action (sends a communication for the Clinician GUI).
7:49	16:35:45	PDSS has a full set of abstractions for the scenario 4 patient and runs the clinical guidelines for this patient.
8:05	16:36:00	PDSS runs the clinical guidelines for the scenario 1 patient.
8:27	16:36:23	PDSS runs the clinical guidelines for the scenario 3 patient.
8:29	16:36:35	PDSS runs the clinical guidelines for the scenario 2 patient.
9:15-11:02		Each of the simulator instances is asked to check that the actions it expected have been carried out for its patient. The simulations for scenarios 1, 2, 4 and 5 are finished at this point. NB prior to this point it is normal for some simulator instances to display one or more “CKPT FAILED” messages, indicating that checkpoints (when expected resources are checked for in the DP) have been tested and have failed. This is because the checkpoints were tested before all processing in the system had completed. The final check carried out here is the one that counts.
11:02		Simulation for scenario 3 is advanced to its second step.
12:00	16:39:48	Second step of scenario 3 is complete, result is checked in the simulator.
12:10		Simulation for scenario 3 is advanced to its third step.
12:55	16:40:50	Third step of scenario 3 is complete, the result is checked in the simulator.
13:02		All scenarios successfully completed and checked.

Table 1: *Main points of interest in the demonstration video, cross-referenced to the PDSS log of Annex 2.*

8. Summary

In this deliverable we have demonstrated that all components within the CAPABLE backend DSS operate as expected when executing five concurrent clinical scenarios involving different patients; that the components interact with each other and the core CAPABLE infrastructure as expected; that the DSS as a whole is able to keep track of multiple patients where events for different patients may overlap in time, without missing steps or loosing information; and that the system as a whole can operate under a more demanding workload, more representative of the expected workload during pilot testing, compared with previous more focussed demonstrations.

9. Glossary

CIG	Computer-interpretable Guideline
CM	Case Manager
CPG	Clinical Practice Guideline
DE	Deontics Engine
DP	Data Platform
PDSS	Physician Decision Support System
PtApp	Patient App
VC	Virtual Coach

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11. Annexes

11.1. Annex 1: KDOM

KDOM has two sub-components: **Design Time** and **Run-Time**

Design-time components:

- Mapping ontology (1:1, Logical, Hierarchical, Temporal)
- Terminology support – linking to SNOMED-CT, RX-NORM vocabulary concepts.
- Mapping Editor - Ability to compose mapping instances while referring to standard terminology.
- Modelers can define abstractions by specifying the mapping classes, attributes and values using an external editor (e.g., Protégé or XML Editor)
- The abstractions will be stored as OWL/XML files.

KDOM Runtime component:

- Query Generator – translates the mapping instances into queries
- Execute the query and return results to the correct component
- Ability to be invoked by triggers by other components

KDOM is leveraging state-of-the-art technologies, including (i) HL7 FHIR patient data model and the HL7 Search mechanism. (ii) Restful API access which is SSL-Secured to allow other components of complex DSS systems to request abstraction results and Long Polling HTTP connection model (iii) To define the mapping ontology we will use Web Ontology Logic (OWL) accessed via the Protégé editor or XML Editor.

KDOM Workflow

KDOM is listening to external abstraction requests using a Rest*Ful* API client which is bound to the Case Manager (**CM**) Service queue. When a CAPABLE Component (e.g., VC/PDSS) wants to send an abstraction request (1) to KDOM, it will use a **Communication resource**. This resource contains important data (e.g., Component Recipient, Patient-ID, Abstraction-Name, EffectiveDate, Terminology type, Values, Units, etc.). The caller component will POST this Communication resource to the DataRepo which will trigger the CM. The CM(Case-Manager) is triggered to this request (2) using a special rule mechanism that creates a new work-order-event for KDOM (3).
After KDOM has received a new work-order event (abstraction calculation request), it starts to process the abstraction (4). The event manager module is parsing the Payload JSON Object to identify the requested data (5). KDOM dynamically loads the respective Abstraction template (6), mapping the data items accordingly, and generates HL7 FHIR Search query (7) to pull the relevant query data (8) from the EHR (Data-Repository). After query results have been received, it's being calculated using a special algorithm defined in the abstraction identifier module to complete the abstraction result (9).
The results can be Boolean, Numeric or Textual. In case of Boolean, there's a additional False reasoning description, since False can be a results from Data Item that not exists (e.g. the patient didn't report blood pressure measurement) or Data Item exists but the abstraction results are False (e.g. Blood

pressure reported is less than 140/90). False reasoning is important to the component caller (VC/DSS) to decide which action to perform, this information is transferred via the Communication resource.
After the Abstraction has been calculated it's being stored in the Data-Repo (DB) using HAPI-Client. There are two resources that are being saved (10): Observation Resource and Communication Resource, both contain the results. The communication resource tigresses the VC rule (via CM) , then VC collects the results.(11)

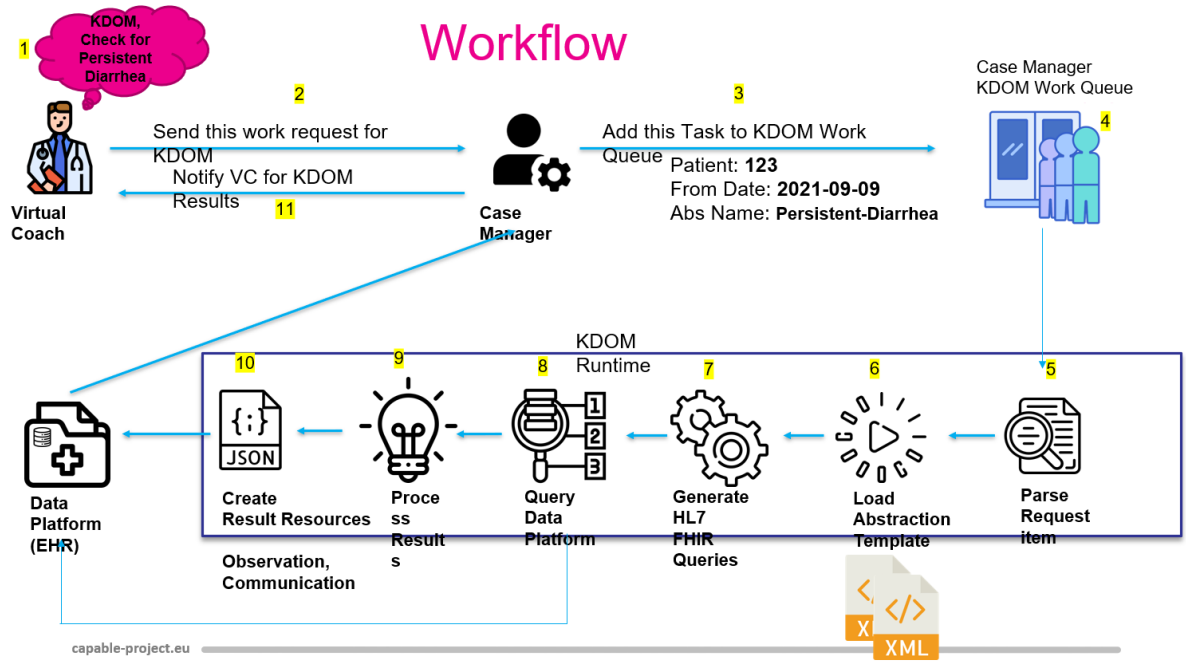

Diagram 1: Abstraction Execution sequence diagram

CAPABLE Architecture

KDOM is connected both to the DR (Data-Repository EHR) and CM (Case-Manager) via Restful API communication protocol.

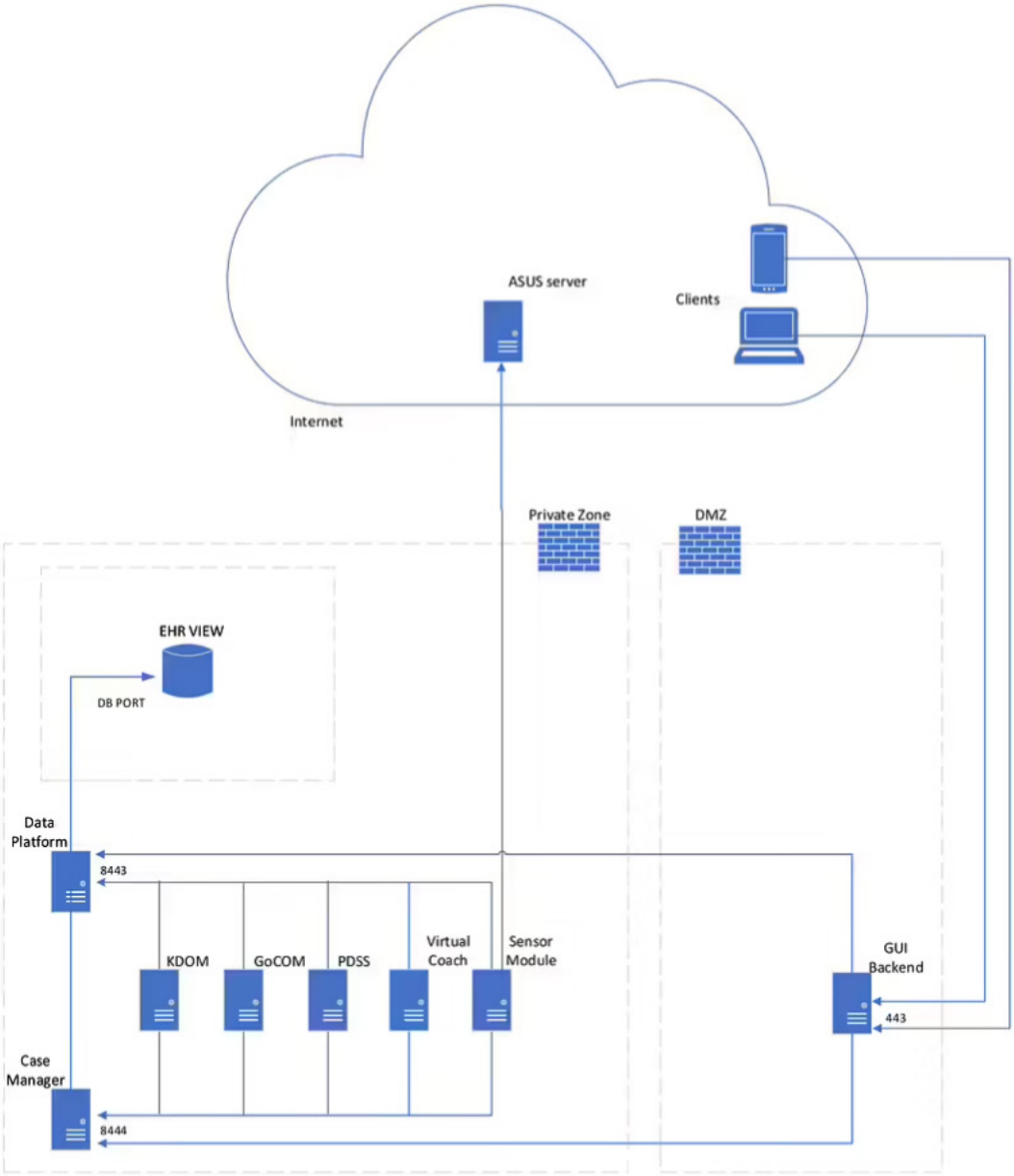

Diagram 2: Capable component connections.

Features

1. **Abstraction-based XML files support** - to compose a new mapping classes (Abstraction) we initially used java code with specified interface and classes, but this approach had some disadvantages such: it requires knowledge of Java coding, KDOM assembly recomplication for each new abstraction, runtime debugging and more. I decided to use easier and more dynamic approach based on XML files to serve those requirements. The XML tag names are readable and convey the meaning of the data. The information structure is easily discerned by both humans and computers as each XML tag immediately precedes the associated data.

The data structure follows a noticeable and useful pattern, making it easy to manipulate and exchange the data.
The XML schema represents KDOM abstractions. In the table below I specified the Tags needed for constructing the abstractions:

Tag Name	Tag Description
<name>	Abstraction name which will be recognized by KDOM
<description>	Abstraction Description
<mappingType>	Logical/Temporal/1:1
<abstractionResourceList>	Single instance of abstraction (SubAbstraction)
<uriPartsList>	URL parameters: Name, Operator, Value
<parameterName>	HL7 FHIR Search reserved word (e.g., code,date,_count)
<operator>	HL7 FHIR Search reserved word (e.g., eq,ge,le,gt) can be null
<parameterValue>	The parameter requested value (e.g., 250644007,250,ext_date)
<searchable>	Verify a specific value in the XML abstraction (true/false)
<searchableJsonPath>	The value to verify using JSON Path syntax ($..status)
<resourceType>	Resource Type: Observation, MedicationRequest and others.
<logicalOperator>	Logical operator bound between SubAbstractions (AND,OR)
<identifier>	Inner Abstraction identifier
<returnType>	Bool/Numeric/Text

Using those Tags the modeler can compose different abstraction types: **1:1,Logical, Temporal,Hierarchical** with different output types: Boolean,Numeric,Textual,Objects. The abstraction xml files can load in runtime environment, without the need to restart KDOM engine. Below I gave two example of abstractions types 1:1, Logical representation in XML files.

Example	XML Representation
1:1 mapping type abstraction ***Elevated_LDH*** *is composed of:* • *Code: 250644007* • *Value-Quantity: >=250* • *Date: from_external_component* • *Resource Type: Observation* • *Return Type: Boolean*	
Example for Logical abstraction file: ***Elevated_LDH*** **AND** ***Increased S100***	

Elevated LDH	***Increased S100***
Code*: 250644007* ***Value-Quantity****: >=250* ***Date:*** *from_external_component* ***Resource Type:*** *Observation* ***Return Type:*** *Boolean* ***Logical Operator:*** *AND*	***Code****: 115475008* ***Value-Quantity****: >=0.1* ***Date:*** *from_external_component* ***Resource Type:*** *Observation* ***Return Type:*** *Boolean*

XML mechanism workflow architecture:

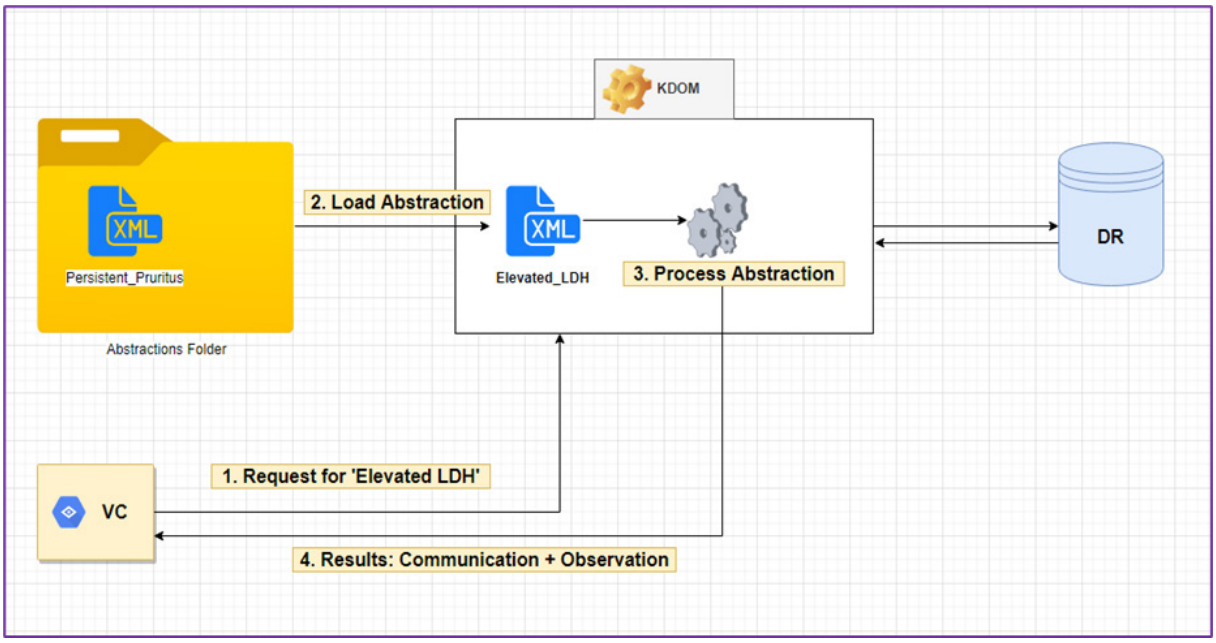

Diagram 3: XML Workflow Architecture

for example (Diagram 3) the Abstractions folder contains Persistent_Pruritus XML file. When the Virtual Coach (VC) component is requesting to calculate Persistent-Pruritus abstraction, KDOM is loading the abstraction file(Persistent_Pruritus.XML) dynamically from the file into the memory, processing the abstraction (getting the requested data from the Data Repository and calculating the abstraction results) and sends back the results (Communication + Observation resources) to the VC.

2. **Multithreading Approach**- Instead of executing abstractions serially (one by one) which might take a longer time when using complex abstractions with many sub-abstractions, KDOM is using a multithreaded approach. Using this approach the abstractions are executed in parallel, each in a different thread. The maximum number of threads is limited to the CPU model. When all threads have completed their execution the abstraction results will be calculated

   The time calculation equation is:
   (Total-Number of Threads/CPU Max Thread count)* Execution time per thread

   Example:
   - **Serial**-time(s) => a Total number of threads * single execution time = 100* 0.5 = **50sec**
   - **Parallel** time(s) => =(100/5)*0.5 = **10sec (x5 times faster)**

Constraints:

The following components are required to be connected to KDOM for standard operation:

- **Case-Manager** – Manage the requests queue for KDOM
- **Data-Repo** – KDOM saves the abstraction results to the Data-Repo.

Risks

No.	Source	Description	Risk
1	**Communication Problems**	Communication Problems can occurs with interaction with Case-Manager,Data-Repository,VC,PDSS.the source can be: No Internet,No network, component down,server down	KDOM won't be able to function. No abstractions calculation will be made at all which will cause a wrong DSS decision in treatment or therapy recommendation.
2	**Wrong abstraction composition**	The abstraction modeler is generating abstraction with mistakes/using wrong concepts/values/units/incorrect guideline	cause a wrong DSS decision in treatment or therapy recommendation.
3	**Wrong data input**	The input data is wrong , which cause by the patient reporting/ by other component who stores data/sensors/wrong value conversion	cause a wrong DSS decision in treatment or therapy recommendation.
4	**Wrong data output**	The output abstraction results wrong because of incorrect algorithm calculation (e.g. False reasoning) , problem with DR/bug	cause a wrong DSS decision in treatment or therapy recommendation.
5	**Problems storing data on DR**	KDOM has generated abstraction results (Observation and Communication) but cannot store the results because of malfunction	Capable systems won't work.

CAPABLE Supported Abstractions:

- M30 [**9** NEW Abstractions]
  - *Ongoing use of chemotherapy (18 data items) - Temporal* ✓
  - *Ongoing use of immunotherapy (6) - Temporal* ✓
  - *Ongoing use of hormonal therapy(4) - Temporal* ✓

- *Ongoing use of radio therapy(1) - Temporal ✓*
- *Ongoing use of targeted therapy(31) - Temporal ✓*
- *Treatment Received For Current Episode Of Diarrhea(41) - Logical ✓*
- *Electrolyte Disturbances(8) - Logical ✓*
- *Bloody Diarrhea(3) – Logical ✓*
- *Complicated Diarrhea(16) – Logical ✓*

- M18 [**1** Abstraction Modification]
  - ***Persistent Diarrhea(1)** – Temporal ✓*
  - *Elevated LDH– Logical ✓*
  - *On Going Symptom – Logical ✓*
  - *Persistent Pruritus – Temporal ✓*
  - *Increased S100 – Logical✓*

- *M12 [**2** Abstractions Modification]*
  - ***Warning Signs(12) – Logical ✓***
  - ***Complicated Diarrhea – Logical** ✓*
  - *On Immunotherapy – Logical ✓*
  - *Additional symptoms – Logical ✓*
  - *Warning signs – Logical ✓*
  - *Persist Diarrhea – Logical ✓*
  - *Elevated LDH– Logical ✓*

Data Representation

KDOM works with multiple types of resources: Observation, Communication and MedicationRequest using JSON object syntax.

- **Observation** - contains information about test measurements results / patient report data/ symptoms/ diseases /treatment /meds/ abstractions results.
- **MedicationRequest -** contains information about medications requests for patients.
- **Communication -** contains abstraction request name, abstraction results reference, patient information and more is a way to communicate with other CAPABLE components(e.g., VC/PDSS).

Elevated LDH Observation example
This resource is pulled from the EHR (DR) by KDOM for the abstraction calculation.


```
{
 "resourceType": "Observation",
 "id": "1614171",
 "meta": {
  "versionId": "1",
  "lastUpdated": "2021-04-01T12:10:00.765+00:00",
  "source": "#TPG3dc3914lsPpBn"
 },
 "identifier": [ {
  "value": "obs_1"
 } ],
 "status": "final",
 "code": {
  "coding": [ {
   "system": "http://snomed.info/sct",
   "code": "250644007",
   "display": "LDH blood level"
  } ]
 },
 "subject": {
  "reference": "Patient/32"
 },
 "effectiveDateTime": "2021-04-01T09:00:00",
 "valueQuantity": {
  "value": 140,
  "unit": "unit per liter",
  "system": "http://snomed.info/sct",
  "code": "8645"
 }
}
```


Elevated LDH Communication Request
This resource is posted by the caller component (e.g CDSS) to request for abstraction calculation to the DR.


```
{
 "resourceType": "Communication",
 "identifier": [ {
  "value": "absReq"
 } ],
 "status": "in-progress",
 "category": [ {
  "coding": [ {
   "system": "http://capable-project.eu/data/dict/comm",
   "code": "KDOM"
  } ]
 } ],
 "subject": {
  "reference": "Patient/229"
 },
 "payload": [ {
  "contentString":
"{\"code\":{\"code\":\"250644007\",\"system\":\"http:\\/\\/snomed.info\\/sct\"},\"sender\":{\"code\":\"CDSS\",\"system\":\"http:\\/\\/capable-project.eu\\/data\\/dict\\/comm\"},\"effectiveDateTime\":\"2021-04-03T15:33:09.028029100+02:00\",\"absName\":\"elevated_ldh\"}"
 } ]
}
```


Elevated LDH Observation Results This resource contains an abstraction result which was generated by KDOM .It's stored in the EHR (DR).	**Elevated LDH Communication Result** This resource contains abstraction related data which was generated by KDOM. It's stored in the EHR (DR).

```
{
  "resourceType": "Observation",
  "id": "#absobs5",
  "status": "final",
  "code": {
    "coding": [ {
      "system": "http://snomed.info/sct",
      "code": "250644007",
      "display": "LDH blood measurement"
    } ]
  },
  "subject": {
    "reference": "Patient/229"
  },
  "effectiveDateTime": "2021-04-03T15:33:09+03:00",
  "valueCodeableConcept": {
    "coding": [ {
      "system": "http://snomed.info/sct",
      "code": "35105006",
      "display": "Increased"
    } ]
  }
}
```

```
{
  "resourceType": "Communication",
  "identifier": [ {
    "value": "ABS_LDH"
  } ],
  "status": "in-progress",
  "category": [ {
    "coding": [ {
      "system": "http://capable-project.eu/data/dict/comm",
      "code": "CDSS"
    } ]
  } ],
  "subject": {
    "reference": "Patient/229"
  },
  "payload": [ {
    "contentString":
"{\"code\":{\"code\":\"250644007\",\"system\":\"http:\\/\\/snomed.info\\/sct\"},\"sender\":{\"code\":\"KDOM\",\"system\":\"http:\\/\\/capable-project.eu\\/data\\/dict\\/comm\"},\"effectiveDateTime\":\"2021-04-03T15:33:09\",\"resultReference\":\"Observation\\/1461\"}"
  } ]
}
```


11.2. Annex 2: PDSS demonstration log

This is the log captured from PDSS during the demonstration shown in the video.

```
16:34:11 [INFO   ] New Observation for patient Scenario-2_0, Observation/48319 Mood anorexia
16:34:11 [INFO   ] Scheduling a request to KDOM for current abstractions for patient Scenario-2_0
16:34:11 [INFO   ] New MedicationRequest for patient Scenario-1_0, MedicationRequest/13359 cabozantinib
16:34:11 [INFO   ] Scheduling a request to KDOM for current abstractions for patient Scenario-1_0
16:34:12 [INFO   ] New Observation for patient Scenario-3_0, Observation/48322 Diarrhea
16:34:12 [INFO   ] Scheduling a request to KDOM for current abstractions for patient Scenario-3_0
16:34:12 [INFO   ] New Observation for patient Scenario-4_0, Observation/48324 Diarrhea
16:34:12 [INFO   ] Scheduling a request to KDOM for current abstractions for patient Scenario-4_0
16:34:12 [INFO   ] New Observation for patient Scenario-5_0, Observation/48326 Vomiting
16:34:12 [INFO   ] Scheduling a request to KDOM for current abstractions for patient Scenario-5_0
16:34:13 [INFO   ] New Observation for patient Scenario-4_0, Observation/48325 Nausea
16:34:13 [INFO   ] Scheduling a request to KDOM for current abstractions for patient Scenario-4_0
16:34:22 [INFO   ] Scheduling a request to KDOM for current abstractions for patient Scenario-1_0
16:34:25 [INFO   ] Scheduling a request to KDOM for current abstractions for patient Scenario-3_0
16:34:34 [INFO   ] Recieved new abstraction ABS_onRadiotherapy for patient Scenario-2_0, observation ref
Observation/48340
16:34:34 [INFO   ] Recieved new abstraction ABS_onChemotherapy for patient Scenario-2_0, observation ref
Observation/48338
16:34:41 [INFO   ] Recieved new abstraction ABS_diarrhoeaDuration for patient Scenario-3_0, observation ref
Observation/48345
16:34:41 [INFO   ] Recieved new abstraction ABS_onHormonalTherapy for patient Scenario-3_0, observation ref
Observation/48346
16:34:46 [INFO   ] Recieved new abstraction ABS_complicatedDiarrhoea for patient Scenario-5_0, observation
ref Observation/48347
16:34:50 [INFO   ] Recieved new abstraction ABS_onTargetedTherapy for patient Scenario-5_0, observation ref
Observation/48348
16:34:51 [INFO   ] Recieved new abstraction ABS_persistentDiarrhoea for patient Scenario-5_0, observation
ref Observation/48349
16:34:53 [INFO   ] Recieved new abstraction ABS_bloodyDiarrhoea for patient Scenario-5_0, observation ref
Observation/48350
```

```
16:34:56 [INFO   ] Recieved new abstraction ABS_onImmunotherapy for patient Scenario-2_0, observation ref
Observation/48352
16:34:56 [INFO   ] Recieved new abstraction ABS_onChemotherapy for patient Scenario-5_0, observation ref
Observation/48351
16:34:56 [INFO   ] Recieved new abstraction ABS_onRadiotherapy for patient Scenario-5_0, observation ref
Observation/48353
16:34:57 [INFO   ] Recieved new abstraction ABS_warningSigns for patient Scenario-2_0, observation ref
Observation/48354
16:34:59 [INFO   ] Recieved new abstraction ABS_onImmunotherapy for patient Scenario-5_0, observation ref
Observation/48355
16:35:00 [INFO   ] Recieved new abstraction ABS_diarrhoeaDuration for patient Scenario-2_0, observation ref
Observation/48356
16:35:01 [INFO   ] Recieved new abstraction ABS_warningSigns for patient Scenario-5_0, observation ref
Observation/48357
16:35:02 [INFO   ] Recieved new abstraction ABS_onHormonalTherapy for patient Scenario-2_0, observation ref
Observation/48358
16:35:09 [INFO   ] Recieved new abstraction ABS_diarrhoeaDuration for patient Scenario-5_0, observation ref
Observation/48364
16:35:09 [INFO   ] Recieved new abstraction ABS_onHormonalTherapy for patient Scenario-5_0, observation ref
Observation/48365
16:35:09 [INFO   ] KDOM request completed for patient Scenario-5_0
16:35:09 [INFO   ] ****** Running assessment for patient Scenario-5_0 on pathway
Diarrhoea_Physician_tech_dev ******
16:35:11 [INFO   ] ACTION: Execute Communication action for patient 2354, destination: CPB:GUIS, content:
Please contact the patient. No updates in the last 72 hours
16:35:11 [INFO   ] Sent communication Communication/95704
16:35:13 [INFO   ] Recieved new abstraction ABS_complicatedDiarrhoea for patient Scenario-4_0, observation
ref Observation/48366
16:35:19 [INFO   ] Recieved new abstraction ABS_onTargetedTherapy for patient Scenario-4_0, observation ref
Observation/48367
16:35:19 [INFO   ] Recieved new abstraction ABS_persistentDiarrhoea for patient Scenario-4_0, observation
ref Observation/48368
16:35:21 [INFO   ] Recieved new abstraction ABS_bloodyDiarrhoea for patient Scenario-4_0, observation ref
Observation/48369
16:35:24 [INFO   ] Recieved new abstraction ABS_onChemotherapy for patient Scenario-4_0, observation ref
Observation/48370
16:35:24 [INFO   ] Recieved new abstraction ABS_onRadiotherapy for patient Scenario-4_0, observation ref
Observation/48371
16:35:26 [INFO   ] Recieved new abstraction ABS_onImmunotherapy for patient Scenario-4_0, observation ref
Observation/48372
16:35:26 [INFO   ] Recieved new abstraction ABS_warningSigns for patient Scenario-4_0, observation ref
Observation/48373
16:35:33 [INFO   ] Recieved new abstraction ABS_complicatedDiarrhoea for patient Scenario-1_0, observation
ref Observation/48375
16:35:37 [INFO   ] Recieved new abstraction ABS_onTargetedTherapy for patient Scenario-1_0, observation ref
Observation/48376
16:35:37 [INFO   ] Recieved new abstraction ABS_persistentDiarrhoea for patient Scenario-1_0, observation
ref Observation/48377
16:35:40 [INFO   ] Recieved new abstraction ABS_bloodyDiarrhoea for patient Scenario-1_0, observation ref
Observation/48378
16:35:44 [INFO   ] Recieved new abstraction ABS_diarrhoeaDuration for patient Scenario-4_0, observation ref
Observation/48383
16:35:44 [INFO   ] Recieved new abstraction ABS_onHormonalTherapy for patient Scenario-4_0, observation ref
Observation/48384
16:35:44 [INFO   ] KDOM request completed for patient Scenario-4_0
16:35:45 [INFO   ] ****** Running assessment for patient Scenario-4_0 on pathway
Diarrhoea_Physician_tech_dev ******
16:35:46 [INFO   ] ACTION: Execute Communication action for patient 2353, destination: CPB:GUIS, content:
Please contact the patient. No updates in the last 72 hours
16:35:46 [INFO   ] Sent communication Communication/95726
16:35:46 [INFO   ] ACTION: Execute Medication action for patient 2353, med Oral rehydration therapy for
Action Diarrhoea_Physician_tech_Oral_Rehydration
16:35:46 [INFO   ] ACTION: Execute Medication action for patient 2353, med octreotide for Action
Diarrhoea_Physician_tech_Octeriotide
16:35:46 [INFO   ] ACTION: Execute Communication action for patient 2353, destination: CPB:GUIS, content:
Outpatient management could be appropriate. If the patient is unwell, consider hospitalisation.
16:35:46 [INFO   ] Sent communication Communication/95727
16:35:46 [INFO   ] Sending a message to GoCom
16:35:46 [INFO   ] Sent communication Communication/95729
16:35:47 [INFO   ] Recieved new abstraction ABS_onChemotherapy for patient Scenario-1_0, observation ref
Observation/48385
16:35:49 [INFO   ] Recieved new abstraction ABS_onRadiotherapy for patient Scenario-1_0, observation ref
Observation/48386
```

```
16:35:52 [INFO   ] Recieved new abstraction ABS_onImmunotherapy for patient Scenario-1_0, observation ref
Observation/48388
16:35:52 [INFO   ] New Option Set for patient Scenario-4_0 with type: medication-proposal and goal ref:
Goal/1250
16:35:52 [INFO   ] Sending goal reference Goal/1250 to Physician GUI
16:35:52 [INFO   ] Sent communication Communication/95736
16:35:55 [INFO   ] Recieved new abstraction ABS_warningSigns for patient Scenario-1_0, observation ref
Observation/48390
16:35:57 [INFO   ] Recieved new abstraction ABS_diarrhoeaDuration for patient Scenario-1_0, observation ref
Observation/48394
16:35:59 [INFO   ] Recieved new abstraction ABS_onHormonalTherapy for patient Scenario-1_0, observation ref
Observation/48396
16:35:59 [INFO   ] KDOM request completed for patient Scenario-1_0
16:36:00 [INFO   ] ****** Running assessment for patient Scenario-1_0 on pathway
Diarrhoea_Physician_tech_dev ******
16:36:05 [INFO   ] ACTION: Execute Communication action for patient 2350, destination: CPB:GUIS, content:
Please contact the patient. No updates in the last 72 hours
16:36:05 [INFO   ] Sent communication Communication/95744
16:36:05 [INFO   ] ACTION: Execute Medication action for patient 2350, med loperamide for Action
Diarrhoea_Physician_tech_Loperamide_as_needed
16:36:05 [INFO   ] Sending a message to GoCom
16:36:05 [INFO   ] Sent communication Communication/95745
16:36:05 [INFO   ] Recieved new abstraction ABS_complicatedDiarrhoea for patient Scenario-3_0, observation
ref Observation/48397
16:36:08 [INFO   ] Recieved new abstraction ABS_onTargetedTherapy for patient Scenario-3_0, observation ref
Observation/48398
16:36:10 [INFO   ] Recieved new abstraction ABS_persistentDiarrhoea for patient Scenario-3_0, observation
ref Observation/48399
16:36:10 [INFO   ] New Option Set for patient Scenario-1_0 with type: medication-proposal and goal ref:
Goal/1251
16:36:10 [INFO   ] Sending goal reference Goal/1251 to Physician GUI
16:36:10 [INFO   ] Sent communication Communication/95750
16:36:10 [INFO   ] Recieved new abstraction ABS_bloodyDiarrhoea for patient Scenario-3_0, observation ref
Observation/48400
16:36:12 [INFO   ] Recieved new abstraction ABS_onChemotherapy for patient Scenario-3_0, observation ref
Observation/48401
16:36:16 [INFO   ] Recieved new abstraction ABS_onRadiotherapy for patient Scenario-3_0, observation ref
Observation/48403
16:36:21 [INFO   ] Recieved new abstraction ABS_complicatedDiarrhoea for patient Scenario-2_0, observation
ref Observation/48404
16:36:21 [INFO   ] Recieved new abstraction ABS_onImmunotherapy for patient Scenario-3_0, observation ref
Observation/48405
16:36:23 [INFO   ] Recieved new abstraction ABS_warningSigns for patient Scenario-3_0, observation ref
Observation/48407
16:36:23 [INFO   ] KDOM request completed for patient Scenario-3_0
16:36:23 [INFO   ] ****** Running assessment for patient Scenario-3_0 on pathway
Diarrhoea_Physician_tech_dev ******
16:36:24 [INFO   ] ACTION: Execute Communication action for patient 2352, destination: CPB:GUIS, content:
Please contact the patient. No updates in the last 72 hours
16:36:24 [INFO   ] Sent communication Communication/95758
16:36:24 [INFO   ] ACTION: Execute Communication action for patient 2352, destination: CPB:GUIS, content:
The following recommendations, suitably rephrased, have been sent to the patient by the CAPABLE system:
Initial management of mild to moderate diarrhoea should include dietary modifications (e.g. eliminating all
lactose-containing products and high-osmolar dietary supplements) and the patient should be instructed to
record the number of stools and report symptoms of life-threatening sequelae (e.g. fever or dizziness on
standing). Special attention should be given to patients who are incontinent of stool due to the risk of
pressure ulcer formation. Skin barriers should be used to prevent skin irritation caused by faecal
material. Spices and beverages such as coffee and alcohol should be avoided and reduction of insoluble
fibre intake may also be useful [V, C]. Diluted fruit juices and flavoured soft drinks along with saltine
crackers and broths or soups may meet the fluid and salt needs in patients with mild illness.
16:36:24 [INFO   ] Sent communication Communication/95759
16:36:25 [INFO   ] ACTION: Execute Medication action for patient 2352, med loperamide for Action
Diarrhoea_Physician_tech_Loperamide_if_required
16:36:25 [INFO   ] ACTION: Execute Medication action for patient 2352, med Oral rehydration therapy for
Action Diarrhoea_Physician_tech_Oral_Rehydration
16:36:25 [INFO   ] ACTION: Execute Communication action for patient 2352, destination: CPB:GUIS, content:
Loperamide should have been prescribed at the enrollment as a drug to be taken "as needed".  If that
prescription has been done, the patient has already received the recommendation to take loperamide. If not,
consider that: Loperamide can be started at an initial dose of 4mg followed by 2mg every 2–4 hours or after
every unformed stool [II, B]. The maximum daily dose of loperamide is 16 mg. One should pay attention to
the risk of causing paralytic ileus and, even if rare, these patients need to be monitored while using
high-dose loperamide. After 48 hours, in case of absence of efficacy of loperamide, administration of other
drugs should be considered.
16:36:25 [INFO   ] Sent communication Communication/95760
```

```
16:36:25 [INFO   ] Sending a message to GoCom
16:36:25 [INFO   ] Sent communication Communication/95761
16:36:28 [INFO   ] Recieved new abstraction ABS_onTargetedTherapy for patient Scenario-2_0, observation ref
Observation/48408
16:36:32 [INFO   ] New Option Set for patient Scenario-3_0 with type: medication-proposal and goal ref:
Goal/1252
16:36:32 [INFO   ] Sending goal reference Goal/1252 to Physician GUI
16:36:32 [INFO   ] Sent communication Communication/95769
16:36:32 [INFO   ] Recieved new abstraction ABS_persistentDiarrhoea for patient Scenario-2_0, observation
ref Observation/48412
16:36:35 [INFO   ] Recieved new abstraction ABS_bloodyDiarrhoea for patient Scenario-2_0, observation ref
Observation/48414
16:36:35 [INFO   ] KDOM request completed for patient Scenario-2_0
16:36:35 [INFO   ] ****** Running assessment for patient Scenario-2_0 on pathway
Diarrhoea_Physician_tech_dev ******
16:36:36 [INFO   ] ACTION: Execute Communication action for patient 2351, destination: CPB:GUIS, content:
Please contact the patient. No updates in the last 72 hours
16:36:36 [INFO   ] Sent communication Communication/95776
16:39:10 [INFO   ] New MedicationRequest for patient Scenario-3_1, MedicationRequest/13372 loperamide
16:39:10 [INFO   ] Scheduling a request to KDOM for current abstractions for patient Scenario-3_1
16:39:21 [INFO   ] Scheduling a request to KDOM for current abstractions for patient Scenario-3_1
16:39:31 [INFO   ] Recieved new abstraction ABS_complicatedDiarrhoea for patient Scenario-3_1, observation
ref Observation/48440
16:39:36 [INFO   ] Recieved new abstraction ABS_onTargetedTherapy for patient Scenario-3_1, observation ref
Observation/48441
16:39:36 [INFO   ] Recieved new abstraction ABS_persistentDiarrhoea for patient Scenario-3_1, observation
ref Observation/48442
16:39:39 [INFO   ] Recieved new abstraction ABS_bloodyDiarrhoea for patient Scenario-3_1, observation ref
Observation/48443
16:39:42 [INFO   ] Recieved new abstraction ABS_onChemotherapy for patient Scenario-3_1, observation ref
Observation/48444
16:39:42 [INFO   ] Recieved new abstraction ABS_onRadiotherapy for patient Scenario-3_1, observation ref
Observation/48445
16:39:44 [INFO   ] Recieved new abstraction ABS_onImmunotherapy for patient Scenario-3_1, observation ref
Observation/48446
16:39:44 [INFO   ] Recieved new abstraction ABS_warningSigns for patient Scenario-3_1, observation ref
Observation/48447
16:39:46 [INFO   ] Recieved new abstraction ABS_diarrhoeaDuration for patient Scenario-3_1, observation ref
Observation/48448
16:39:46 [INFO   ] Recieved new abstraction ABS_onHormonalTherapy for patient Scenario-3_1, observation ref
Observation/48449
16:39:46 [INFO   ] KDOM request completed for patient Scenario-3_1
16:39:47 [INFO   ] ****** Running assessment for patient Scenario-3_1 on pathway
Diarrhoea_Physician_tech_dev ******
16:39:48 [INFO   ] ACTION: Execute Communication action for patient 2355, destination: CPB:GUIS, content:
Please contact the patient. No updates in the last 72 hours
16:39:48 [INFO   ] Sent communication Communication/95846
16:39:48 [INFO   ] ACTION: Execute Communication action for patient 2355, destination: CPB:GUIS, content:
Loperamide should have been prescribed at the enrollment as a drug to be taken "as needed".  If that
prescription has been done, the patient has already received the recommendation to take loperamide. If not,
consider that: Loperamide can be started at an initial dose of 4mg followed by 2mg every 2–4 hours or after
every unformed stool [II, B]. The maximum daily dose of loperamide is 16 mg. One should pay attention to
the risk of causing paralytic ileus and, even if rare, these patients need to be monitored while using
high-dose loperamide. After 48 hours, in case of absence of efficacy of loperamide, administration of other
drugs should be considered.
16:39:48 [INFO   ] Sent communication Communication/95847
16:40:12 [INFO   ] New MedicationRequest for patient Scenario-3_2, MedicationRequest/13377 Oral rehydration
therapy
16:40:12 [INFO   ] Scheduling a request to KDOM for current abstractions for patient Scenario-3_2
16:40:32 [INFO   ] Recieved new abstraction ABS_complicatedDiarrhoea for patient Scenario-3_2, observation
ref Observation/48474
16:40:38 [INFO   ] Recieved new abstraction ABS_onTargetedTherapy for patient Scenario-3_2, observation ref
Observation/48475
16:40:38 [INFO   ] Recieved new abstraction ABS_persistentDiarrhoea for patient Scenario-3_2, observation
ref Observation/48476
16:40:40 [INFO   ] Recieved new abstraction ABS_bloodyDiarrhoea for patient Scenario-3_2, observation ref
Observation/48477
16:40:44 [INFO   ] Recieved new abstraction ABS_onChemotherapy for patient Scenario-3_2, observation ref
Observation/48478
16:40:44 [INFO   ] Recieved new abstraction ABS_onRadiotherapy for patient Scenario-3_2, observation ref
Observation/48479
16:40:46 [INFO   ] Recieved new abstraction ABS_onImmunotherapy for patient Scenario-3_2, observation ref
Observation/48480
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16:40:46 [INFO   ] Recieved new abstraction ABS_warningSigns for patient Scenario-3_2, observation ref
Observation/48481
16:40:48 [INFO   ] Recieved new abstraction ABS_diarrhoeaDuration for patient Scenario-3_2, observation ref
Observation/48482
16:40:48 [INFO   ] Recieved new abstraction ABS_onHormonalTherapy for patient Scenario-3_2, observation ref
Observation/48483
16:40:48 [INFO   ] KDOM request completed for patient Scenario-3_2
16:40:48 [INFO   ] ****** Running assessment for patient Scenario-3_2 on pathway
Diarrhoea_Physician_tech_dev ******
16:40:49 [INFO   ] ACTION: Execute Communication action for patient 2356, destination: CPB:GUIS, content:
Please contact the patient. No updates in the last 72 hours
16:40:49 [INFO   ] Sent communication Communication/95916
16:40:50 [INFO   ] ACTION: Execute Communication action for patient 2356, destination: CPB:GUIS, content:
Loperamide should have been prescribed at the enrollment as a drug to be taken "as needed".  If that
prescription has been done, the patient has already received the recommendation to take loperamide. If not,
consider that: Loperamide can be started at an initial dose of 4mg followed by 2mg every 2–4 hours or after
every unformed stool [II, B]. The maximum daily dose of loperamide is 16 mg. One should pay attention to
the risk of causing paralytic ileus and, even if rare, these patients need to be monitored while using
high-dose loperamide. After 48 hours, in case of absence of efficacy of loperamide, administration of other
drugs should be considered.
16:40:50 [INFO   ] Sent communication Communication/95917
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