



# CrowdHEALTH

**Collective Wisdom Driving Public Health Policies**

## **Del. no. – D3.1 Health Record Structure: Design and Open Specification v1**

**Project Deliverable**



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**D3.1 Health Record Structure: Design and Open Specification v1**

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## List of acronyms

AMA	American Medical Association
ANSI	American National Standards Institute
API	Application Programming Interface
BMI	Body Mass Index
CAS	Chemical Abstracts Service
CMD	Common Data Model
CPT	Current Procedural Terminology
CRC	Clinical Research Chart or Data Repository Cell
DOID	Human Disease Ontology
EHR	Electronic Health Record
ER	Entity Relationship
EuroFIR	European Food Information Resource
FAO	Food and Agriculture Organization of the United Nations
FHIR	Fast Healthcare Interoperability Resources
FOKB	Food Ontology Knowledge Base
FOOD	FOod in Open Data
HHR	Holistic Health Records
HL7	Health Level 7
ICD	International Classification of Diseases
ICF	International Classification of Functioning, Disability and Health
IT	Information Technology
JSON	JavaScript Object Notation
LOD	Linked Open Data
LOINC	Logical Observation Identifiers Names and Codes
MeSH	Medical Subject Headings
NCIT	National Cancer Institute Thesaurus
NHS	National Health Service
NLM	National Library of Medicine
NoSQL	Not Only Structured Query Language
OBO	Open Biomedical Ontologies
OMOP	Observational Medical Outcomes Partnership
OWL	Web Ontology Language
RIM	Reference Information Model
SMASH	Semantic Mining of Activity, Social, and Health data
SNOMED CT	Systematized Nomenclature of Medicine Clinical Terms
SNOMED RT	Systematized Nomenclature of Medicine Reference Terminology
SNOP	Systematized Nomenclature of Pathology
SPARQL	Simple Protocol and RDF (Resource Description Framework) Query Language
SQL	Structured Query Language
Turtle	Terse RDF (Resource Description Framework) Triple Language
UML	Unified Modeling Language
USDA	United States Department of Agriculture
WHO	World Health Organization
WOF	World Obesity Federation
XML	eXtensible Markup Language

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## 1. Executive Summary

Holistic Health Records (HHRs) are structured health records that may include several types of information that are relevant to a patient's health status, such as laboratory medical data; clinical data; lifestyle data collected by the patient or related people; social care data; physiological and environment data collected by medical devices and sensors. Currently, many data models have been specified for representing the aforementioned data (section 3 State of the Art), but there is no single model that covers in an integrated way all the needs of CrowdHEALTH use cases. This deliverable presents a first version of such an integrated HHR model.

In order to have a strong foundation, the model is mainly based on the new emerging FHIR standard. FHIR is considered easier to implement than previous standards, covers very well the clinical aspects of human health and has a good extension mechanism that allows adding information models for aspects not yet covered by the model.

The HHR model has been obtained by first producing a separate conceptual data model for each use case, then clarifying their semantics with a preliminary mapping to the FHIR standard (annex B1 to B5, which comply to the template reported in annex B) and finally merging the separate models in a unique HHR conceptual model. A coherent mapping to FHIR has therefore been defined with respect to the merged conceptual model, in order to guarantee that different teams adopt the same FHIR representation (as FHIR allows different representations for the same information). The conceptual HHR model is specified in UML, with the adoption of specific constraints and stereotypes, while the mapping is expressed using structured tables and the FHIRPath language (section 4.3 UML conceptual model).

Although based on FHIR, the HHR model is designed at a higher conceptual level, making explicit several concepts that are implicit in the FHIR standard, other than extending it by adding missing concepts. By maintaining a double view, the HHR model aims on one hand to guarantee the interoperability and the possibility to implement it on top of existing FHIR libraries, and on the other hand it is also intended to be usable independently from FHIR (and its future evolutions) and applicable also for different purposes than the exchange of health data. For example, it can be more suitable than FHIR as data schema for Object Oriented local APIs.

The current HHR model aims to represent the information enabling the execution of the first cycle of use case demonstrations, expected for the first year of the project. In particular, the current release of the HHR model fully covers CareAcross and SLOfit datasets and partially covers HULAFE and BIOASSIST datasets. During the second year, the HHR model will be extended to satisfy new requirements, to complete the coverage of HULAFE and BIOASSIST datasets and to include the DFKI and KI datasets.

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## 2. Introduction

One of the pillars of the CrowdHEALTH project is the development and exploitation of the so called Holistic Health Records (HHRs). HHRs are intended to provide an integrated view of the patient including all health determinants. Such data may be produced by different human actors or systems, in different moments of the patient's life. They potentially include: social and lifestyle data collected by either the patient or other individuals (e.g. family members, friends); social care data collected from social care providers; physiological and environmental data collected by medical devices and sensors (e.g. home care systems or wearables); clinical data coming from healthcare information systems and produced by professionals (e.g. primary care systems and electronic medical records); laboratory medical data.

The goal of this deliverable is to present a first version of the HHR model, and it is organized in the following way.

Section 3 describes some of the main existing models (terminologies, ontologies, data models) related to the information produced and consumed by the CrowdHEALTH use cases and more in general to the concept of HHR. In particular, it introduces the FHIR standard that has been chosen as starting model for the specification of the HHR model.

Section 4 describes the HHR model. It first describes the goal of this endeavour and the approach followed to realize it. Then, it presents the requirements considered for the first year and a high-level specification of the produced model.

Finally, the annexes include additional details on the resulting HHR model and report the results of analysis of the use case data models performed as first step for the design of the HHR model. In particular, annex A describes a semi-formal mapping between the HHR model, related terminologies and all FHIR extensions needed to fully translate HHR instances to FHIR resources. Annex B includes the template used to gather information about the use case data models. Annexes B1 to B5 report the analyses of use case data.



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## 3. State of the Art

### 3.1. Health terminologies

While terminology can refer to a number of different things, in healthcare it is associated with the “language” used to code entries in Electronic Health Records (EHRs) including ICD-9 (1), ICD-10 (2), LOINC (3), CPT (4) and SNOMED CT (5), among others. Most people encounter medical terminologies at some point in their lives – whether it is as physicians, medical purchasers, or patients. In the world of EHRs, terminology is one of the keys to true interoperability between systems and integrating data. For instance, in the case that it is needed to send data between two systems, for the data to be usable, those systems have to “talk” in the same language. This means that codes from one system have to be compatible with codes from the other system. While it can be easy to combine data from multiple systems in one place, in the case that these codes cannot be mapped to one another, then the data remain locked. Currently, there exist several standards, and as a result, a lot of research is performed to map these various vocabularies so that one can move easily from one to the other as long as one of the key ones listed earlier is used. To this end, there is work that has been done and is ongoing, such as mappings between ICD-9 and ICD-10 (6), LOINC and CPT (7), or LOINC and SNOMED CT (8).

#### 3.1.1. ICD-9 and ICD-10 Codes – International Classification of Diseases

The International Classification of Diseases (ICD) is a widely recognized international system for recording diagnoses. It is developed, monitored, and copyrighted by the World Health Organization (WHO). Applied to any diagnosis, symptom, or cause of death, ICD consists of alphanumeric codes that follow an international standard, making sure that the diagnosis will be interpreted in the same way by every medical professional both in the U.S. and internationally. Shortly, ICD-9 codes are three-to-five digit numeric and, in certain cases, alphanumeric codes (9). The first three digits in a code refer to the “category”. The category describes the general illness, injury, or condition of the patient. In many cases, the category is not specific enough to describe the full extent of the patient’s condition. In cases where more specificity is needed, a decimal point is added after the category and one or two more digits are added. The fourth digit of the ICD-9 code refers to the “subcategory”, and the fifth digit to the “subclassification.” The subcategory describes the etiology (cause), site, or manifestation of the disease or condition. The subdivision provides even more information about the site, cause or manifestation of a disease, and is used only when the subcategory cannot provide sufficient information.

The current version of ICD used in the U.S. is known as ICD-9, though it is in the process of being replaced by ICD-10. Rather than simply being an updated version of ICD-9, ICD-10 is a more comprehensive and complex set of codes designed to address some of the issues of ICD-9. For example, ICD-10 codes are longer than ICD-9 codes, reducing the risk of running out of possible available codes in the future. They are also more detailed, registering findings

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such as “laterality”, an option that has been previously absent in ICD-9. Codes in the ICD-10 code set can have three, four, five, six, or seven characters (10). Many three-character codes are used as headings for categories of codes that can further expand to four, five, or six characters to add more details regarding the diagnosis. The first three characters of an ICD-10 code designate the category of the diagnosis. A three-character category that has no further specificity can stand alone as a code. In this case, however, greater specificity is possible, and can be filled in as many “blanks” as they can. The next three characters (characters three through six) correspond to the related etiology, anatomic site, severity, or other vital clinical details. The seventh character represents one of the most significant differences between ICD-9 and ICD-10, because ICD-9 does not provide a mechanism to capture the details that the seventh character provides, referring mainly to the information about the phase of treatment. A seventh character must be assigned to codes in certain ICD-10 categories that must always be in the seventh position. In the case that a code has fewer than six characters and requires a seventh character extension, then all of the empty character spaces must be filled with an “X.”

In 2018, ICD-11 is scheduled to be released by WHO (11). While the idea does not have deep support among U.S. policymakers, the American Medical Association and other large organizations have suggested that replacing ICD-9 with ICD-11 and skipping ICD-10.

### **3.1.2. CPT Coding – Current Procedural Terminology**

Current Procedural Terminology (CPT) coding is a U.S. standard for coding medical procedures, maintained and copyrighted by the American Medical Association (AMA) (12). Similar to ICD coding, CPT coding is used to standardize medical communication across the board – but while ICD-9 and ICD-10 focus on the diagnosis, CPT identifies the services provided, and is used by insurance companies to determine how much physicians will be paid for their services. As is the case with ICD-9 or ICD-10, the goal of CPT codes is to summarise as much information as possible into a uniform language. CPT codes are designed to cover all kinds of procedures and are therefore very specific.

A CPT code looks like a five-digit numeric code with no decimal marks, although some have four numbers and one letter (13). Some are used frequently like 99213 or 99214 (for general check-ups). As the practice of health care changes, new codes are developed for new services, current codes may be revised, and old, unused codes are discarded. Currently, there exist three different types of CPT Coding, as mentioned below:

**CPT Category I Codes:** The first category, which is by far the largest of the three, contains codes for six subtypes of procedures. Much like ICD-9 and ICD-10, these procedural codes are organized into clusters, which are then subdivided into more specific ranges. Within that number range, procedures have a designated code, ensuring healthcare payers’ record exactly which procedure a patient has undergone.

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**CPT Category II Codes:** The second section of CPT consists of optional supplemental tracking codes. These codes are formatted with a letter as their fifth character, and are coded after the initial CPT code. These Category II codes include information on test results, patient status, and additional medical services performed within the larger Category I procedure. Like Category I codes, they are divided into clusters. These codes reduce the need for record abstraction and chart review, and lower the administrative burden on healthcare professionals. Category II CPT Codes facilitate research and the collection of data related to the quality of patient care. Some codes also relate to state or federal law, which document the blood alcohol level of a patient. These codes are a supplement, for the codes in Category I, and must always be attached to an existing Category I code.

**CPT Category III Codes:** The third section of the CPT code is devoted to new and emerging technologies or practices. This code does not indicate that the service performed is ineffectual or purely experimental. A Category III code simply means the technology or service is new and data on it is being tracked. Like Category II codes, Category III CPT codes are numeric-alpha, meaning the last digit is a letter. After a predetermined period of time (typically five years of data tracking), a procedure or technology described by a Category III code may move into Category I, unless it is demonstrated that a Category III code is still needed.

### **3.1.3. LOINC – Logical Observation Identifiers Names and Codes**

Logical Observation Identifiers Names and Codes (LOINC) (14) was created in 1994 by the Regenstrief Institute as a free, universal standard for laboratory and clinical observations, in order to enable exchange of health information across different systems. Where ICD records diagnoses and CPT services, LOINC is a code system used to identify test observations. LOINC codes are often more specific than CPT, and one CPT code can have multiple LOINC codes associated with it. Currently, more than 54,300 registered users from 170 countries use LOINC, and it has been recognized as the preferred standard for coding testing and observations in HL7. The structure of a fully specified LOINC term is determined by six distinct axes. Each axis must fit into the LOINC structure and contributes to the meaning of the LOINC term. The axes are separated by a colon. Each axis of the code provides information in an organized way. By the time that these axes are combined, a complete LOINC concept is constructed.

A formal, distinct, and unique 6-part name is given to each term for test or observation identity (15). The LOINC database currently has over 71,000 observation terms that can be accessed and understood universally. Each database record includes six fields for the unique specification of each identified single test, observation, or measurement:

- Component: what is measured, evaluated, or observed.
- Kind of property: characteristics of what is measured, such as length, mass, volume, time stamp and so on.
- Time aspect: interval of time over which the observation or measurement was made.

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- System: context or specimen type within which the observation was made.
  - Type of scale: the scale of measure (quantitative, ordinal, nominal or narrative).
  - Type of method: procedure used to make the measurement or observation.

A unique code (format: nnnnn-n) is assigned to each entry upon registration. Other database fields include status and mapping information for database change management, synonyms, related terms, substance information (e.g. molar mass, CAS registry number), choices of answers for nominal scales, translations.

#### **3.1.4. SNOMED CT – Systematized Nomenclature of Medicine**

SNOMED Clinical Terms (SNOMED CT) is a comprehensive, computerized healthcare terminology - containing more than 311,000 active concepts – with the purpose of providing a common language across different providers and sites of care (16). It is the most comprehensive existing multilingual clinical healthcare terminology. The terminology has roots with the College of American Pathologists in 1960s with the development of SNOP, or Systematized Nomenclature of Pathology, which later became SNOMED RT (Reference Terminology). In 1999, SNOMED RT merged with Clinical Terms Version 3 developed in the UK by the National Health Service (NHS), becoming SNOMED CT, which is now overseen by the International Health Terminology Standards Development Organization. It has subsequently become established as the international medical terminology standard. In addition to diagnosis, SNOMED CT includes clinical findings, symptoms, procedures, body structures, and organisms, among other semantic types. As a core EHR terminology, SNOMED CT is essential for recording clinical data such as patient problem lists and family, medical and social histories in electronic health records in a consistent, reproducible manner.

SNOMED provides a rich set of inter-relationships between concepts. Hierarchical relationships define specific concepts as children of more general concepts (17). SNOMED's design ensures clarity of meaning, consistency in aggregation, and ease of messaging. This results in a smart and structured search, with specific and relevant return of results. For diseases/disorders, SNOMED CT uses relationships between concepts to provide logical, computer readable definitions of medical concepts. There are several types of relationships described or modelled in SNOMED CT, such as "Is A", "Finding Site", "Causative agent", or "Associated morphology" relationship.

SNOMED CT content is represented using three types of components supplemented by Reference Sets, which provide additional flexible features.

Concepts: SNOMED CT concepts represent clinical hypotheses (i.e. thoughts/ logics). Every concept has a unique numeric concept identifier. Within each hierarchy, concepts are organized from the general to the more detailed. This allows detailed clinical data to be recorded and later accessed or aggregated at a more general level.

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**Descriptions:** SNOMED CT descriptions link appropriate human readable terms to concepts. A concept can have several associated descriptions, each representing a synonym that describes the same clinical concept. Each translation of SNOMED CT includes an additional set of descriptions, which link terms in another language to the same SNOMED CT concepts.

**Relationships:** SNOMED CT relationships link concepts to other concepts whose meaning is related in some way. These relationships provide formal definitions and other properties of the concept.

**Reference sets:** Reference sets (Refsets) are a flexible standard approach used by SNOMED CT to support a variety of requirements for customization and enhancement of SNOMED CT. These include the representation of subsets, language preferences for use of particular terms and mapping from or to other code systems. Every reference set has a unique numeric concept identifier.

## **3.2. Health ontologies**

In this section, we give an overview on ontologies and their status related to the information that will be contained in the holistic health records. This includes, aside from medical information, also physical and social activities, as well as nutritional information. In addition, we review ontologies that may be used to provide the information needed for support food tracking services, such as recipe ontologies and specific recipes. The distinguishing elements between ontologies and taxonomies are that ontologies allow for classes to be subclasses of different parent classes, may include relationships between classes of objects and especially include axiomatic restrictions on classes, relationships and individuals. One standard ontology language is the OWL 2 Web Ontology Language<sup>1</sup>, which for a large part has a clean semantic foundation provided by Description Logics (18).

### **3.2.1. Medical ontologies**

Medical information is typically represented following some standard, as has been presented in the previous sections. However, the mentioned SNOMED CT terminology actually also is an ontology which defines (some) concepts, such as, some diseases in terms of their cause, the part of the body they affect and how they can be diagnosed. It also includes some food categories, sport categories or activities of daily living.

The Open Biomedical Ontologies (OBO) consortium (19) is an initiative trying to integrate the many ontologies developed in the biomedical domain, which also includes ontologies formalizing patient medical care and EHRs. The consortium maintains a repository of 277 active ontologies of which 13 are concerned with diseases. It includes a Human Disease

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<sup>1</sup> <https://www.w3.org/TR/owl2-overview/>

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Ontology (DOID) (20), which describes the classification of human diseases organized by etiology and is referencing SNOMED and other medical terminologies. A similar initiative is BioPortal<sup>2</sup> which contains 654 biomedical ontologies, among which also those from the OBO consortium.

The International Classification of Functioning, Disability and Health (ICF)<sup>3</sup> is an ontology classifying health and health-related domains from a body perspective, a personal activities perspective and a societal perspective. It classifies according to the body structure (eye, ear, digestive systems, etc.), the body function (mental, voice, etc.), activities and participations and the environmental context. It thus contains medical categories as well as some social categories as part of the activities, participations and environmental domains. All concepts (resp. individuals) are linked to the ICD code in the ICD terminology.

The National Cancer Institute Thesaurus (NCIT) is a reference thesaurus covering biomedical concepts and inter-concept relationships. As part of that, it also includes medical categories, categories for physical activities, social activities and behavioural categories. There is also an experimental version of it in the OBO ontologies that tries to integrate the NCIT reference terminology with the other OBO ontologies.

The Open mHealth<sup>4</sup> is a standardization attempt providing schemas to model mobile health data in JSON format. It currently provides 91 schemas to model specific health data including date and time information, data acquisition information and links the health data with the SNOMED (Section 3.1.4), LOINC (Section 3.1.3) or RxNORM (Section 3.2.4). It is extensible and provides design rules to develop new schemas for further health information categories. Note that it also provides a schema to store data about physical activity.

### 3.2.2. Food Ontologies

Ontologies about food are mainly concerned with standardizing food categories and possibly providing nutritional information. Rare are ontologies containing actual recipes or linking food with dietary requirements.

The USDA Food Composition Database<sup>5</sup> is the standard reference for nutrients, food and food products, including classification with respect to manufacturers. It is US related, but the content is often both in English and Spanish. It provides for each entry (raw or manufactured) the nutritional information about proximates (energy, lipids, sugar, etc.) minerals and vitamins. Though this is not an ontology per se, it could in principle be easily turned into an ontology.

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<sup>2</sup> <http://bioportal.bioontology.org>

<sup>3</sup> <http://www.who.int/classifications/icf/en/>

<sup>4</sup> <http://www.openmhealth.org/>

<sup>5</sup> <https://ndb.nal.usda.gov/ndb/>



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The Food Ontology Knowledge Base (FOKB)<sup>6</sup> is an English and Turkish ontology containing details of food ingredients such as their codes (e-codex or codex numbers) and also side effects of them such as allergy.

The FOod in Open Data (FOOD)<sup>7</sup> is an ontology about Italian food products, especially of food quality certification schemes, in accordance with product specifications defined by the Italian Ministry of Agricultural, Food and Forestry Policies. The dataset is provided under a Creative Commons license and the developers provide a SPARQL end-point to query the data in the linked open data (LOD) paradigm.

The FOODON ontology as part of the OBO collection of ontologies is a full food ontology including 9000 food products. The ontology and data are only in English.

The LIRMM Food Ontology<sup>8</sup> is an attempt at defining a food ontology, but very incomplete. The Food Ontology<sup>9</sup> is a more complete ontology about recipes, including the foods they are made from, the foods they create as well as the diets they are suitable for. It is similar to Google's rich snippets for recipes, which consist of annotating published recipes using the standard schema from <http://schema.org/Recipe> to support better search and retrieval of recipes. The actual ingredient lists are typically not linked with standards such as the USDA, LanguaL or AGROVOC (see further below for these). The fact that ingredient lists in recipes are usually textual descriptions and do not make use of standard food vocabularies or ontologies seems to be a general problem, at least in open accessible recipes databases.

### 3.2.3. Social and physical activities

Specifically targeted to support research on sustained weight loss through frequent social contacts there has been an attempt to develop the SMASH<sup>10</sup> ontology (Semantic Mining of Activity, Social, and Health data). It describes concepts used in describing the semantic features of healthcare data and social networks and also includes categories for physical and social activities. However, it is not fully developed and incomplete: For instance, Occupational Activities consist only of the categories *Trimming*, *Weeding*, *Masonry* and *Plumbing*.

The already mentioned Open mHealth standard (Section 3.2.1) also contains a schema to represent health related information about physical activities. However, it does not provide a taxonomy for the activities but rather how to store information about duration, distance, calorie consumption and intensity.

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<sup>6</sup> [https://bioportal.bioontology.org/ontologies/FOOD\\_ONTOLOGY](https://bioportal.bioontology.org/ontologies/FOOD_ONTOLOGY)

<sup>7</sup> <http://etna.istc.cnr.it/food/>

<sup>8</sup> <http://data.lirmm.fr/ontologies/food>

<sup>9</sup> <https://www.bbc.co.uk/ontologies/fo>

<sup>10</sup> <https://bioportal.bioontology.org/ontologies/SMASHPHYSICAL>

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The OpenActive Activity List<sup>11</sup> is a taxonomy of standard physical activities that can be used to categorize and describe opportunities for physical activities. The list is intended to be used by publishers who are sharing open data about events providing opportunities for physical activities.

### 3.2.4. Interoperability Problems

A major problem is the success of using ontologies (and taxonomies) in many domains as it led to the development of many different not necessarily linked ontologies and taxonomies. This creates in practice the problem of interoperability, both at the taxonomic level as well as on the semantic level. To try to overcome that problem is a major effort and the reason for initiatives like OBO and BioPortal. On a general level, it is also the motivation for the OntoHub<sup>12</sup> repository, which behind the scenes attempts to utilize alignment techniques from formal methods for the ontology domain.

The Medical Subject Headings<sup>13</sup> (MeSH) is a vocabulary maintained by the US National Library of Medicine (NLM). It is a hierarchically-organized terminology of biomedical information contained in NLM database, including MEDLINE®/PubMed®. It is often combined information following the RxNorm<sup>14</sup> (database of pharmaceutical information, used, for instance, in medication histories), as well as with the LOINC standard (Logical Observation Identifiers Names and Codes) for medical laboratory observations.

An analogous activity but in the food domain is the LanguaL™ Food Description Thesaurus<sup>15</sup>. It aims to provide a standardized language to describe and classify foods and food products. One problem with food is that food ontologies in different languages are difficult to align, especially as corresponding terms in different languages do not necessarily mean the same thing. LanguaL is language-independent by using numeric codes and pointing to the equivalent terms in different languages (USA and European). More than 27000 foodstuffs in European food composition databases as well as the entire USDA National Nutrient Database for Standard Reference are now in LanguaL and can be used to facilitate retrieval of food information in different food databases.

The FoodEXplorer<sup>16</sup> from EuroFIR allows querying food composition databases from different European Countries, which should be harmonized using LanguaL. However, to date this only allows for queries in the different databases, while cross-linking between different databases is not supported.

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<sup>11</sup> <https://www.openactive.io/activity-list/>

<sup>12</sup> <https://ontohub.org/>

<sup>13</sup> <https://www.nlm.nih.gov/mesh/>

<sup>14</sup> <https://www.nlm.nih.gov/research/umls/rxnorm/>

<sup>15</sup> <http://www.languaL.org/>

<sup>16</sup> <http://www.eurofir.org/food-information/foodexplorer/>



Finally, AGROVOC is a multilingual vocabulary developed by the Food and Agriculture Organization of the United Nations (FAO) about food, nutrition, agriculture, fisheries, forestry and the environment. The vocabulary consists of over 32000 concepts and each concept has up to 22 labels in different languages, is available under a Creative Commons license and can be used in order to facilitate the search and retrieval of food information across language barriers. AGROVOC is published as Linked Open Data (LOD) and links the resources with many standard web resources, among others EUROVOC, the multilingual thesaurus maintained by the Publications Office of the European Union, and DBPedia.

### 3.3. Health data models from international standards

#### 3.3.1. HL7 FHIR

This standard was introduced in the already reported deliverable D2.1<sup>17</sup>, but this section will explore the possibilities it offers as a clinical data model, despite that it does not include a typical oriented Entity-Relationship<sup>18</sup> data model.

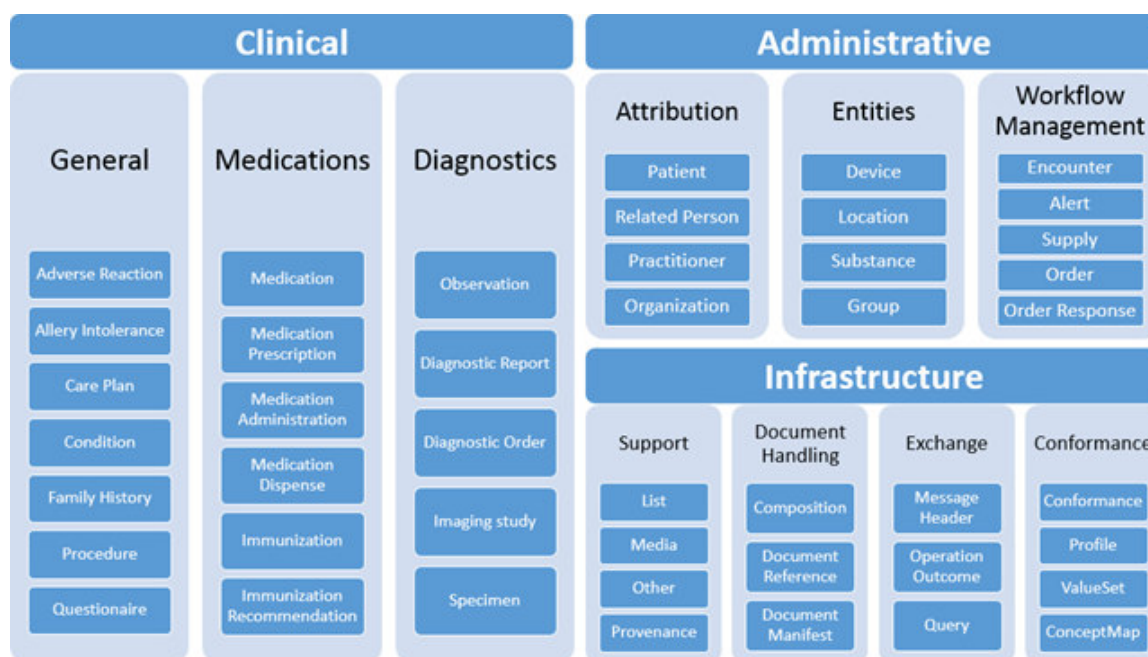


Figure 1 Classification of some FHIR resources

The data model of this standard revolves around a series of interoperability artefacts composed of a set of modular components called "Resources". These resources are discrete

<sup>17</sup> D2.1 State of the Art and Requirements Analysis v1

<sup>18</sup> [https://en.wikipedia.org/wiki/Entity%E2%80%93relationship\\_model](https://en.wikipedia.org/wiki/Entity%E2%80%93relationship_model)

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information units with defined behaviour and meaning, and describe what information can be collected for each type of clinical information.

As can be seen in the Figure 1 or in the complete list<sup>19</sup>, there are different resources for structuring information from a patient, an adverse reaction, a procedure and an observation, among many others. Within FHIR there are 6 major categories in which you can classify the different types of resources available<sup>20</sup>:

- **Clinical**: content of clinical record
- **Identification**: supporting entities involved in the care process
- **Workflow**: manage the healthcare process
- **Financial**: resources that support the billing and payment parts of FHIR
- **Conformance**: resources use to manage specification, development and testing of FHIR solutions
- **Infrastructure**: general functionality and resources for internal FHIR requirements

As discussed at the beginning of this section, this data model is not the traditional model oriented to ER, but to noSQL<sup>21</sup>. In this sense, the content of the FHIR resources can now be represented in different formats such as XML<sup>22</sup>, JSON<sup>23</sup> and Turtle<sup>24</sup>, although other formats are also allowed. In this way, it is possible to obtain information structured according to the FHIR resource data model, and represented in one of these formats, resulting that this information can be readable by both humans and machines.

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<sup>19</sup> <http://hl7.org/fhir/resourcelist.html>

<sup>20</sup> <https://www.hl7.org/fhir/resourceguide.html>

<sup>21</sup> <https://en.wikipedia.org/wiki/NoSQL>

<sup>22</sup> <https://www.w3.org/XML/>

<sup>23</sup> <http://www.json.org/>

<sup>24</sup> <https://www.w3.org/TeamSubmission/turtle/>

```
<Patient xmlns="http://hl7.org/fhir">
  <id value="glossy"/>
  <meta>
    <lastUpdated value="2014-11-13T11:41:00+11:00"/>
  </meta>
  <text>
    <status value="generated"/>
    <div xmlns="http://www.w3.org/1999/xhtml">
      <p>Henry Levin the 7th</p>
      <p>MRN: 123456. Male, 24-Sept 1932</p>
    </div>
  </text>
  <extension url="http://example.org/StructureDefinition/trials">
    <valueCode value="renal"/>
  </extension>
  <identifier>
    <use value="usual"/>
    <type>
      <coding>
        <system value="http://hl7.org/fhir/v2/0203"/>
        <code value="MR"/>
      </coding>
    </type>
    <system value="http://www.goodhealth.org/identifiers/mrn"/>
    <value value="123456"/>
  </identifier>
  <active value="true"/>
  <name>
    <family value="Levin"/>
    <given value="Henry"/>
    <suffix value="The 7th"/>
  </name>
  <gender value="male"/>
  <birthDate value="1932-09-24"/>
  <careProvider>
    <reference value="Organization/2"/>
    <display value="Good Health Clinic"/>
  </careProvider>
</Patient>
```

Figure 2 Patient information example in a FHIR resource in XML

As can be seen in the Figure 2, the patient's sample information is available using the FHIR patient resource structure and in XML format. At the end of the blue part of the example we can see how the information of this patient is structured in the fields that FHIR has in the design of this resource for that purpose, such as the name, gender, date of birth and the patient's health provider.

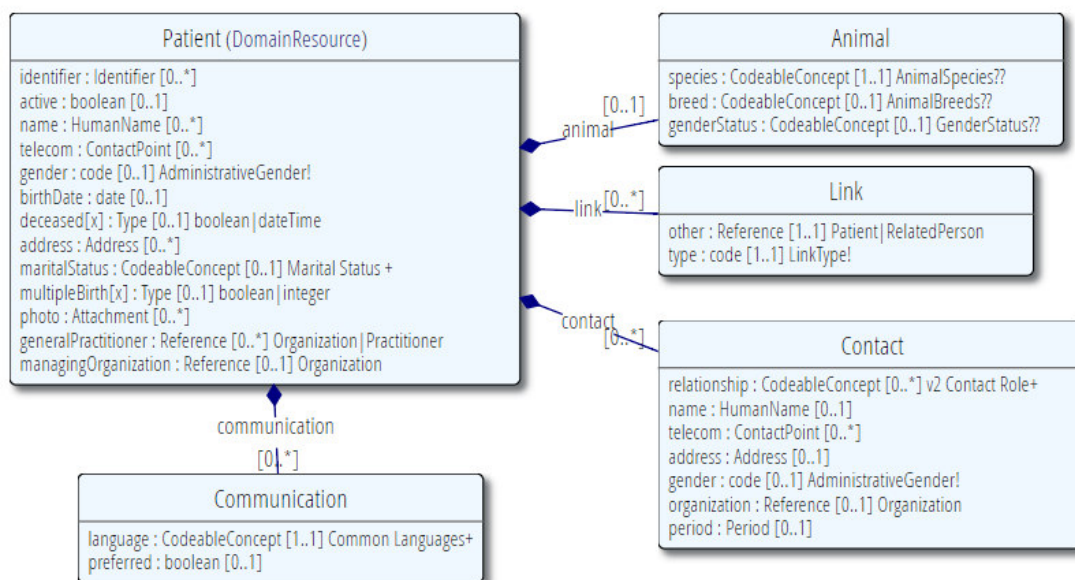


Figure 3 UML diagram of the FHIR resource Patient

Providing a complete view, a UML diagram of the patient FHIR resource is shown in Figure 3, in order to be able to check the different fields that are available in this structure, following the example already provided. Apart from the already mentioned fields of name, gender, etc., there are others available for use, such as address, data of telematic contact, etc.

Within this standard, 119 other resources (apart from the patient resource) are defined at different maturity levels. With this, the organization HL7 aims to define and limit the structures that are used for the exchange of clinical information. Taking into account that, according to claim,<sup>25</sup> they are following Pareto's principle of being able to cover 80% of the use cases with 20% of effort, meaning that with a constrained and complex definition of resources, for which a 20% of efforts is invested, can cover 80% of the use cases in a consistent manner. Instead of focusing the solution in a more flexible way to cover 100% of use cases, but losing quality, consistency and determinism to cover the fundamental use cases, and also requiring a greater amount of resources.

### 3.3.2. HL7 RIM

The HL7<sup>26</sup> Reference Information Model is part of a release of a standard created by the organization Health Level Seven. This organization published the new version of their

<sup>25</sup> Slide 11 [https://www.hl7.org/documentcenter/public\\_temp\\_43EF3352-1C23-BA17-0C875683CE804AD4/calendarofevents/himss/2016/Blazing%20a%20Trail%20Better%20Care,%20Healthier%20People%20and%20Lower%20Costs%20through%20the%20Interoperability%20Roadmap.pdf](https://www.hl7.org/documentcenter/public_temp_43EF3352-1C23-BA17-0C875683CE804AD4/calendarofevents/himss/2016/Blazing%20a%20Trail%20Better%20Care,%20Healthier%20People%20and%20Lower%20Costs%20through%20the%20Interoperability%20Roadmap.pdf)

<sup>26</sup> <http://www.hl7.org/>

standard around 2005, HL7 v3<sup>27</sup>, and as part of this release they included a reference data model, in order to serve as representation to store specific clinical or administrative data.

This model is intended to be used as a reference for the creation of information models aimed at creating information storage systems of any situation related to the environment of health services, such as patient diagnoses, sanitary material, costs for treatments and information concerning the personnel of a health organization. The main classes that compose the model can be observed in the Figure 4, having the complete model available in the references of this document<sup>28</sup>.

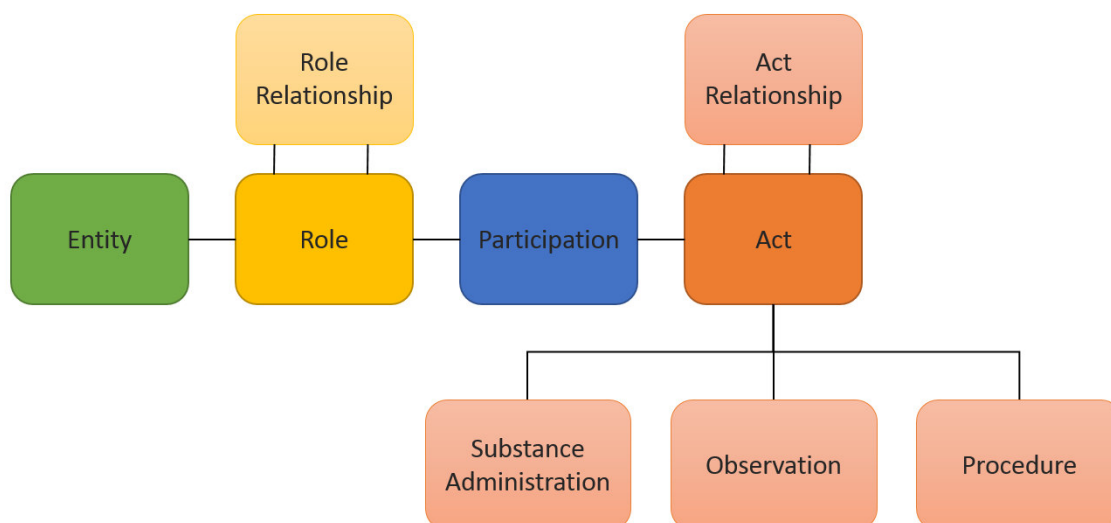


Figure 4: HL7 Reference Information Model. Core classes

A more detailed description of these classes is listed below.

- **Act:** Each instance of act represents an action (clinical or administrative of the sanitary environment) at any given time. These actions can be found in different states (planned, pending, completed, etc.), be of different types (procedures, observations, drug administrations) and involve different entities (patients, health personnel and material, etc). Therefore, of the different main classes listed, this is the main and most complex class of this model.

<sup>27</sup> [https://www.hl7.org/implement/standards/product\\_brief.cfm?product\\_id=186](https://www.hl7.org/implement/standards/product_brief.cfm?product_id=186)

<sup>28</sup> <http://www.hl7.org/implement/standards/rim.cfm>

- 
- **Participation:** Each instance represented in this class aims to indicate the type and degree of participation of different entities with different roles that may be involved in a clinical action.
  - **Role:** Each instance indicates the functions of an entity that participates in a given action. It is possible that the same entity participates with various functions in the same act, as a doctor who performs a clinical test on a patient and at the same time interprets their results.
  - **Entity:** Each instance represents any being, from a living subject such as a patient or a sample of a microscopic organism, to chemical substances or physical devices like a trocar for biopsies.

As can be observed in the same way in Figure 4, and as described in the point describing class "Act", by the importance of the same it is essential to describe each of these categories in which the acts are divided. The differences that exist in these subcategories are very relevant for the consistency of the data, and are very different from each other. Each of these subclasses has unique attributes, apart from those shared with the main class of act, in order to satisfy the needs of each of these subclasses.

- **Observation:** Indicates that the clinical action performed is an act of recognition, evaluation or indication of certain information about a subject. They can be measurements, assertive statements, research methods, etc.
- **Procedure:** Indicates that the action performed on the subject consists of some type of intervention or manipulation of part or parts of his body.
- **Substance Administration:** Indicates actions to introduce or apply a particular substance or compound to a subject. As you can suppose, it is a concrete case of "Procedure", but to have concrete requirements it is decided to place it in its own subclass.

This set of subclasses intends to group semantically as similar acts as possible, for which to design a common set of attributes that serve appropriately to be able to host information relating to the act. An example of these attributes would be the 'InterpretationCode' attribute whose purpose is to contain the interplay that is performed from an act of observation, or the attribute 'DoseQuantity' used to indicate the amount of substance or compound that is administered to a patient. As subclass 'Substance Administration' is subclass of 'Procedure', these subclasses may have other types of subclasses like 'DiagnosticImage', which are intended to subcategorize and group similar types of acts.



### 3.3.3. i2b2 CRC

The i2b2<sup>29</sup> Clinical Research Chart or Data Repository Cell was born from the star model initially proposed by Ralph Kimball as part of the i2b2 data mart. It is designed to store clinical trial data, medical records and laboratory tests, as well as many other types of clinical information. Following an approach similar to that explained with the previous section of HL7 RIM, the acts or facts in this case form the main element of this star model, forming a central table surrounded by other tables that provide additional dimensions. There are other important tables<sup>30</sup>, which are outside this main star schema, which for the purpose of providing a description of the most relevant parts have been kept out.

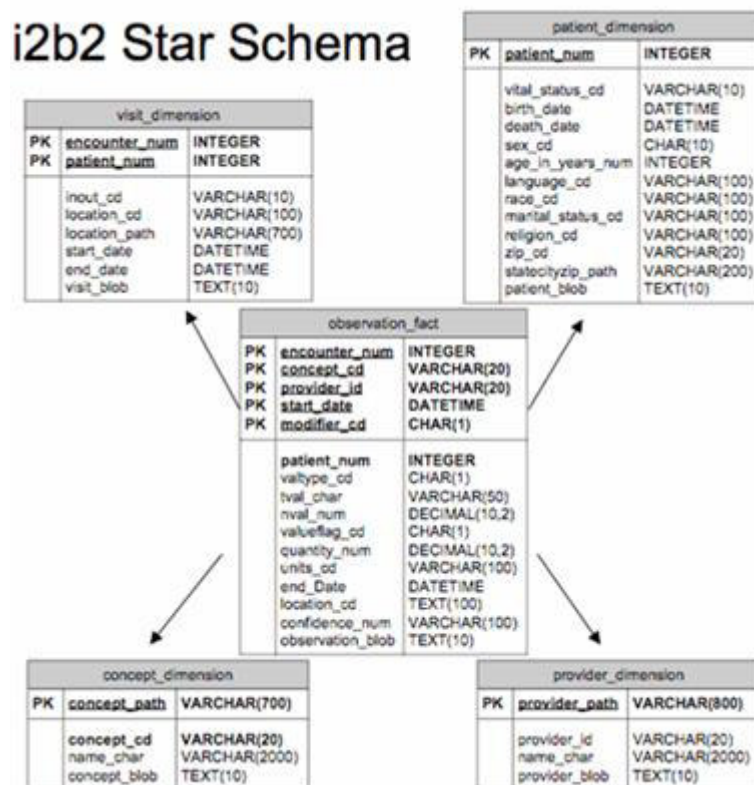


Figure 5 i2b2 Star Scheme. Main model part

The main table "observation\_fact" stores the logical facts of clinical scope. Being the center of the star schema, it intersects with the rest of the tables and each instance of it describes an observation made to a patient during a visit.

<sup>29</sup> <https://www.i2b2.org/index.html>

<sup>30</sup> [https://www.i2b2.org/software/projects/datarepo/CRC\\_Design\\_Doc\\_13.pdf](https://www.i2b2.org/software/projects/datarepo/CRC_Design_Doc_13.pdf)

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The table "patient\_dimension" would be in charge of storing all demographic information of the patient on which the clinical fact is related. This information is such as date of birth, gender, address, etc.

The "visit\_dimension" table represents the session where the observations or clinical facts were made. Containing information about visits or other encounters, with attributes such as the date of beginning and end of the visit, location, etc.

The "concept\_dimension" table contains any concept (coded clinical ideas) using in the set of other tables. This table is general enough to store concept information of any medical terminology. Attributes such as the concept label, its identification, version date, id of the terminology to which it belongs, etc.

The last table that is included is "provider\_dimension", which represents the doctor or provider of the institution in which the clinical event was performed. Therefore, it contains dedicated attributes for the identification of the professional, his name, his institutional hierarchy, etc.

### 3.3.4. OMOP CMD

The Observational Medical Outcomes Partnership<sup>31</sup> Common Data Model is oriented to the analysis of disparate observational databases. Having, as specified in its website<sup>32</sup>, the objective of transforming data contained between these databases in a common format and as a common representation (terminologies, code systems, etc.). Once the data is transformed into a common format, this would allow for systematic analysis using an analytical standard library created specifically for that common format. For the purpose of this state of the art, it is of our interest this common format that they propose.

The data model they propose is based on including any clinical observational element (experiences that the patient receives clinical attention) that is considered relevant. They propose an ER-type data model, in which they adopt a series of conventions.

These series of conventions that are assumed by this data model vary from general conventions to specific ones for concrete cases. Within the general conventions we can find that they pose this model as independent of the platform, that the data types are defined generically using ANSI SQL (such as VARCHAR, INTEGER, FLOAT, etc.), and do not provide a format of date or time, and may vary between different configurations.

The different tables that are proposed in this model are the following:

- **Person.** Demographic information about a person.

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<sup>31</sup> <http://omop.org/>

<sup>32</sup> <https://www.ohdsi.org/data-standardization/the-common-data-model/>



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- **Drug exposure.** Patient exposure to a particular drug.
  - **Drug era.** Length of time that a person is supposed to have been exposed to a drug.
  - **Condition occurrence.** Person's state.
  - **Condition era.** Equivalent to 'Drug era' but for the condition.
  - **Visit occurrence.** Person's visits to any health care facility.
  - **Procedure occurrence.** Procedures performed on patients.
  - **Observation.** General observations made to a patient.
  - **Observation period.** Time period in which a person is expected to suffer the effects of an observation.
  - **Death.** Date and cause of death of a person.
  - **Drug cost.** Cost associated with a Drug Exposure.
  - **Procedure cost.** Cost associated with a procedure.
  - **Location.** Physical location or address.
  - **Provider.** Data of the medical care providers.
  - **Organization.** Data of medical care organizations.
  - **Care website.** Data of the medical attention points, or the particular location within an organization.
  - **Payer plan period.** Data on the benefits, in terms of medical care, of a person subject to a policy.
  - **Cohort.** Data that shares a particular characteristic over a period of time, for example, cohort of patients, providers or visits.

Finally, we add that this model also facilitates a logical data model for vocabularies or terminologies ("Vocabulary Logical Data Model"), that allows to accommodate concepts of different ontologies and medical vocabularies.

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## 4. Holistic Health Record model

### 4.1. Description of the approach

#### 4.1.1. Main principles of the HHR model

As described in the state of the art section, currently there is not a unique model that covers all the aforementioned aspects in an integrated way. On the other hand, the goal of CrowdHEALTH is the development of a set of data analysis tools that can be applied to different use cases, possibly merging data coming from different contexts. Therefore, there is the need to define one integrated model for HHRs, in order to guarantee the possibility to apply these tools to all produced data. More precisely the project pursues the following principles.

First, the HHR model has to represent in a consistent way all the data required by the specific project use cases.

Second, the model is intended to be a seed for future extensions. To this end, it will include also types of data that are not currently required by any use case, but that the project partners consider very likely to be used in the near future or that are useful to exemplify how the model can be extended in the future.

Third, the model is defined using existing models as reference. In particular, on the base of use case requirements, the project has selected the FHIR standard as the main reference for the definition of the HHR model. While this standard is still under development and is mainly capable to represent clinical data, it already includes the possibility to represent data that are not necessarily clinical, such as information coming from environment sensors or related to the social aspects. Moreover, thanks to the adoption of the concept of “resource” and the definition of flexible extension mechanism, the FHIR model is conceived from the fundament to be applicable in different contexts. Together with the FHIR standard, the CrowdHEALTH project also takes into account ontologies at the state of the art, useful to qualify entity types that correspond to specializations or abstractions of entities represented by FHIR elements.

Fourth, the HHR model is designed in UML and in parallel mapped with existing standards. Several constraints (see next section) are imposed to the designer of the HHR model to guarantee the feasibility of a direct mapping to FHIR. The reason for not using directly the selected reference standard is to untie the HHR model from some assumptions adopted by FHIR (e.g. the distinction between contained and not contained resources) and to make explicit in the model some aspects that are implicit in FHIR (e.g. the fact that a measurement is a kind of event), in order to ease the usage of the HHR model independently from FHIR. Therefore, the HHR model aims on one hand to be easily implementable on top of existing FHIR implementations, on the other hand it is also intended to be easily implementable using different technologies.

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#### 4.1.2. Level of abstraction and scope of the HHR model

Similarly, to some of the existing standards, the HHR model is designed using UML. Following below is a summary of the main characteristics and constraints of the HHR model that make it strictly related but still distinct from the reference standards.

As a general rule, each class of the HHR model corresponds to a resource type or a data type of the FHIR model, but the HHR model is designed at an ontological level and (because of a more specific application context, i.e. the CrowdHEALTH use cases) the HHR model is more specialized than the FHIR model.

The usage of an ontological approach is in particular evident in two aspects that distinguish the HHR model from the FHIR model. One aspect is that the multiplicity constraints on the UML associations and attributes do not represent integrity constraints, as in the case of FHIR, but represents real world existence constraints; i.e. if an attribute has minimum multiplicity equal to 1, this does not imply that the value of that attribute must be mandatorily stored or transmitted when exchanging data, but only that at least one value of that attribute always exists in the world, also if this information is actually not stored in any IT system or not transmitted. Another aspect is the usage of abstract classes that have no direct corresponding type in FHIR, but that correspond to super-types of FHIR resource types. Such classes are introduced to make explicit some semantic commonalities that are implicit in the FHIR model.

Moreover, in order to represent ontological distinctions that cannot be expressed with standard UML, some specific stereotype and pattern is adopted. For example, classes of entities (e.g. Patient) that correspond to roles of instances of other classes (e.g. Person), are marked with the stereotype <role>. If needed, implementations of the HHR model may exploit the explicit representation of roles and accept to assign instances of a certain role as value of attributes which type is not that role but the type of the instances that may play that role (e.g. accepting a Practitioner as value of an attribute expecting a Person), but not vice versa (i.e. its forbidden to assign a Person to an attribute expecting a Practitioner).

When a class *C* has numerous subclasses, but these subclasses add no specific attributes or constraints, then the subclasses are reified. Each subclass is represented by an item of an enumeration (stereotype <enum>) and a mandatory attribute of the class *C* (with name *Ctype*) is used to represent the specific subclass of the instance. For instance, the subclasses of the class Condition correspond to values of the enumeration ConditionType and the specific subclass of a Condition instance is represented by the value of the attribute named conditionType.

The fact that the HHR model is more specialized than the FHIR model is also evident in several aspects. The most important aspect is the absence in the HHR model of classes and elements that are present in FHIR, because they are not needed by current CrowdHEALTH use cases, and the presence in the HHR model of additional attributes/associations that correspond to extensions of the FHIR standard.

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Moreover, an HHR class that corresponds to a certain FHIR resource class may have explicit subclasses that are not represented as distinct resource classes in FHIR. Differently from the addition of new attributes, usually the introduction in the HHR model of these explicit subclasses does not require a corresponding FHIR extension. The instances of all such HHR subclasses correspond to instances of the same FHIR resource class, and their conceptual type is distinct by assigning a specific value (chosen from some coding system) to a “category” or “code” attribute of the resource class. In other terms, the HHR model explicitly represents concepts that are needed by the CrowdHEALTH use cases and that are implicit in FHIR or that need a FHIR extension.

As said, a few constraints are imposed to the HHR model to guarantee an easy mapping with FHIR and with specific coding systems. The main constraint is that any leaf element of the HHR model (i.e. any class, attribute or association that does not have subclasses or specializations) must correspond to exactly one (resource or data) type of the FHIR model, i.e. its possible instances must represent the same entities of some possible instance of one corresponding FHIR class. Another constraint is that each instance of a HHR class must correspond to exactly one instance of the FHIR model.

On the other hand, any non-leaf element of the HHR model, is considered ontologically “abstract”, i.e. all its representable instances or values must be instances or values of some subclass. This is intended to avoid the usage of instances of non-leaf classes to represent unintended entities. Implementations may impose the instantiation of only leaf classes. As HHR classes are conceptual, advanced implementations may also allow to instantiate non-leaf classes of the HHR model, in order to allow to represent entities which type is not completely known, possibly allowing to specify a more specific type in a second moment (allowing the same instance to conceptually move from a superclass to a subclass when more information is available).

Although the semantics of HHR elements are usually more specific than the ones of the FHIR model, in order to make the mapping more evident, the name of the most general HHR element that is mapped to a specific FHIR element usually takes the same name of the corresponding FHIR element. Anyway, different names are chosen when the semantics of the HHR element is actually so specific that it would be misleading to adopt the same name than FHIR.

The higher specialization of the HHR model, with respect to more general purpose standards, has the advantage to reduce the ambiguity of the model and to simplify its comprehension, reducing the risk that different standard elements are used to represent the same type of information (a risk that is higher in standards like FHIR that by design provides alternative possibilities to represent the same information).

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#### **4.1.3. Mapping of HHR model to FHIR**

As said in section 4.1.1 the HHR model is expressed in UML and mapped to the FHIR standard in order to clarify its semantics and guarantee interoperability.

In order to make the mapping both easily comprehensible by humans and machine interpretable, it has been decided to represent it at two different levels of formality. On the first level, the mapping is expressed by means of simple tables that for each class and for each attribute or association-end of the HHR model specify the corresponding class or attribute of the FHIR model. As the HHR model is more specific than the FHIR model it can happen that an attribute of an HHR class is not mapped to an attribute of the corresponding FHIR class, but is mapped to some attribute of some nested object (i.e. value of an attribute of the class or of another nested object) of that class. The mapping to nested attributes is specified using the FHIRPath language. While the FHIRPath language is not specifically designed for mapping purposes (but is intended to extract information from a FHIR resource), its rich syntax actually allows to unambiguously refer any attribute nested at any level of any tree-like structure.

The semi-formal mapping expressed using tables and FHIRPath is sufficiently precise to be quickly expressed and used by humans.

As part of the development phase of the HHR model, the mapping of this model to FHIR will be also expressed in a machine understandable format, suitable to implement algorithms to translate HHR instances, represented as objects with a structure strictly conformant to the HHR model, to objects structured according to the FHIR model. The machine understandable mapping will be the object of a next software deliverable.

#### **4.1.4. Steps followed to define the HHR model**

Following the general incremental development approach of the CrowdHEALTH project, also the development of the HHR model will be done in different cycles. In this case, a two cycle process will be followed, producing two different versions of the HHR model aligned with the first version and the last version of the use case requirements.

In each development cycle, different tasks will be performed. Following is the description of the tasks followed in the first development cycle.

First, each use case leader has been asked to describe the information that they would like to store and analyse using the CrowdHEALTH tools, focusing on the data needed for the first version of their use case implementation. A template was provided to each use case to perform this description (annex B). In particular, it was asked to create and describe a UML conceptual diagram representing the type of entities and relationships described by their data source (abstracting from implementation details of the actual database scheme). It was also asked to describe, using specific tables, each attribute of each entity and the corresponding cardinality and value constraints.

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In a second step, different analysts have been assigned to each use case, in order to clarify ambiguity issues related to their data source and to express a mapping of their dataset scheme to the FHIR model, in order to disambiguate the semantics of each type, relationship and attribute. The mapping was expressed using specific tables and the FHIRPath language. The result of this analysis is reported in annexes B1 to B5.

In a third step, all the conceptual models produced by the use cases have been merged, one by one, in a unique HHR model. In this phase, different conceptual classes that different use cases had mapped to the same FHIR classes or to FHIR classes with similar semantics have been merged in a unique HHR class, or in different subclasses of a same abstract HHR class. The same analyses have been performed for attributes and associations.

A fourth step has been the formalization of the mapping to FHIR using the same semi-formal approach used for the mapping of data source conceptual schemes.

Next steps, subject of a next deliverable, will be the coding of the mapping in a human interpretable format.

Similar steps will be executed in the next development cycle.

#### **4.1.5. Usage of the HHR model**

A further mapping step will be performed during the development phase of the use cases. In this phase, the concrete scheme of each use case will be mapped to the HHR model (instead of FHIR, as done for the conceptual schemas during the design of the HHR model) in order to guarantee that all use cases actually use the same representation for the same kind of data.

At runtime, using the machine understandable version of the HHR mapping to FHIR and the mapping from the concrete scheme to the HHR model, it will be possible to convert all data provided by the use cases data sources in a high level HHR format or to the equivalent FHIR format.

## 4.2. Requirement coverage

The HHR model reported in this document aims to satisfy the technical requirements reported in D2.1 impacting on the data modelling and that are scheduled on the first year of the project. In particular, the following requirements are covered:

Requirement ID	Name
TL-FUNC-3211	HHR representation of physical parameters measurements provided by sensors.
TL-FUNC-3212	Creation of student HHRs.
TL-FUNC-3214	HHR representation of information recorded by patients.
TL-FUNC-3215	Creation of patient-recorded diagnosis information HHRs.
TL-FUNC-3216	Creation of patient-recorded medication HHRs.
TL-FUNC-3218	Creation of professionals-recorded diagnostic information HHRs.
TL-FUNC-3219	Creation of patient recorded medical procedures HHRs.
TL-FUNC-32110	Creation of subject recorded nutritional information HHRs.
TL-FUNC-32111	Creation of subject recorded physical activity information HHRs.
TL-FUNC-32112	Creation of sensor recorded physical activity information HHRs.
TL-DAT-32115	FHIR v.3.0.1 standard compliance.
TL-DAT-32116	FHIR v.3.0.1 extensibility mechanisms employment for additional data.

## 4.3. UML conceptual model

The conceptual HHR model is described using UML class diagrams. The overall model is divided in several fragments to simplify the representation and the description of the reported information, where each fragment regroups information related to a specific topic, e.g. the representation of the information characterizing a Person, clinical Conditions of patients or Measurements performed on Persons. For each fragment, the description of each entity and its relationships with the other entities in the fragment is reported. The semantic of the entity attributes is demanded to annex A, which describes the mapping between the conceptual model and FHIR, whenever the semantic of the HHR entity attribute differs from the semantic of the corresponding FHIR resource attribute. When the semantic of the HHR attributes or



enumerations is the same of the corresponding FHIR attribute or enumeration, their description is demanded to the FHIR documentation.

All attributes of the entities in the HHR model are not mandatory, i.e. their values are not required to be stored or transmitted for each data transmission occurrence.

The current HHR model aims to represent the information enabling the execution of the first cycle of UCs demonstrations expected for the first year of the project, and it will be next extended to satisfy the second year incoming data requirements. In particular, the current release of the HHR model fully covers CareAcross (annex B.4) and SLOfit (annex B.5) datasets and partially covers HULAFE (annex B.1) and BIOASSIST (annex B.3) datasets. During the second year, HHR model will be extended to complete the coverage of HULAFE and BIOASSIST datasets and to include the DFKI (annex B.2) and KI UCs ones.

## Person

The fragment of the conceptual HHR model shown in Figure 6 contains attributes and roles characterizing a person. The class *Person* represents demographics and administrative information about a person that are independent of any specific health context. The gender of a person is modelled by the *Gender* enumeration. “Person” inherits the unique identifier from its superclass *Agent* (see Identifier” section), by which a specific person may be identified in the CrowdHEALTH platform.

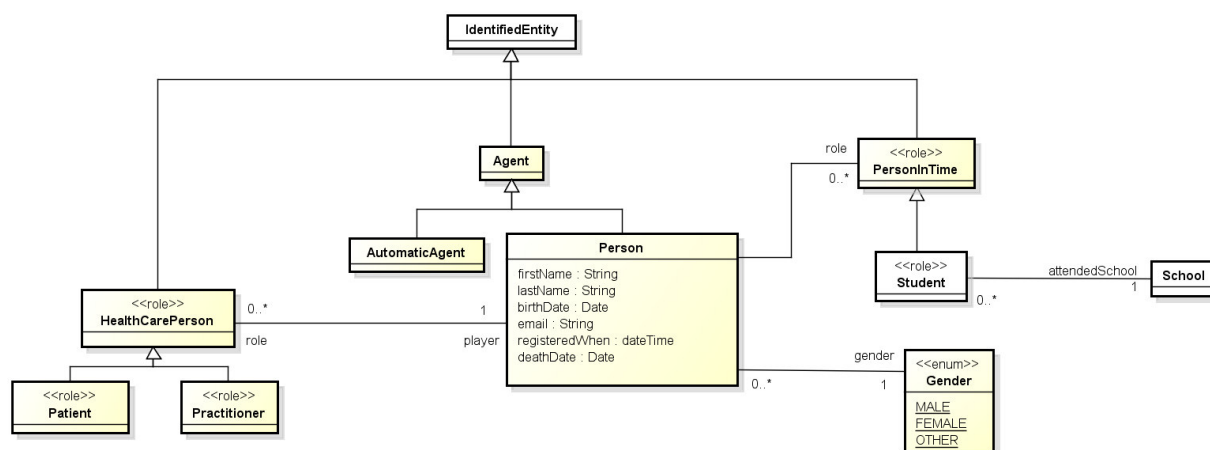


Figure 6 Person model

A same person can play different individual roles into different contexts. Each individual role of the same person is represented by a different instance of the class *HealthCarePerson*. Each instance describes information of the person that is specific to the corresponding role and is related, using the “player” association-end, to the person that plays that role. In particular, a person has the role *Patient* when he or she is the subject of the health care activities provided by HealthCare professionals. If the same person has been assisted by two different health



providers, then it plays two different Patient roles (corresponding to two different instances of the class Patient). On the other side, the person has the role of *Practitioner* when he or she is a qualified medical doctor that works for a specific organization. If the same person works as practitioner for two different organizations it plays two different practitioner roles, corresponding to two different instances of the class Practitioner. If a Person's role is tied to a specific time frame, then it is an instance of the class *PersonInTime*. As for the other kind of roles, a same person may correspond to several instances of PersonInTime. In the next version of the HHR model the class HealthCarePerson could be considered as a subclass of EntityInTime. This is still a subject of discussion.

A person is a *Student* when he or she attends a *School*. The *Grade* enumeration (Figure 7) lists all the possible grade of school handled by the HHR model. Since the school degree of a student is expected to evolve, the same person may correspond to several instances of PersonInTime, each one related to a specific school degree.

A school belongs to one and only one *Municipality* and a municipality belongs to one and only one Region.

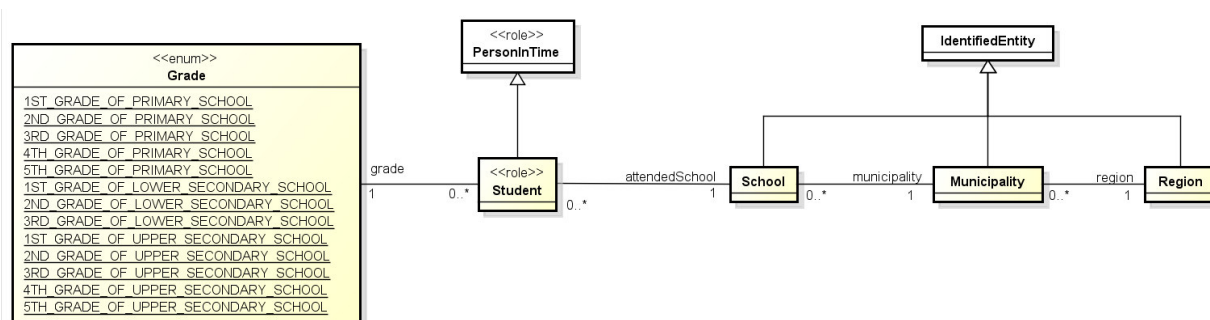


Figure 7 School model

## Identifier

All entities of the HHR model inherit from *IdentifiedEntity*, which represents any entity that can be identified using a string id that is unique within a given *IdentifierSystem*. As shown in Figure 8, an IdentifiedEntity has at least one *Identifier* representing a numeric or alphanumeric string that is associated with a single entity within a given identifier system, and each identifier is generated by one system. The acknowledged systems in the HHR model are listed in the enumeration IdentifierSystem representing a standard to associate a unique id to each entity belonging to a specific context. Each identified entity may have only one identifier per IdentifierSystem and it is not possible that two identified entities share the same identifier belonging to the same IdentifierSystem.

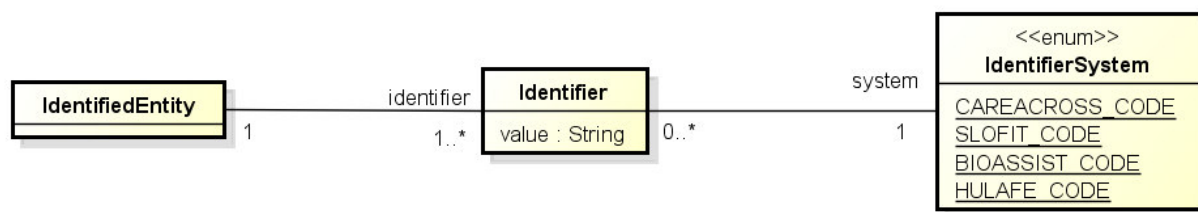


Figure 8 Identifier model

## Condition

A recorded *Event* (Figure 9) is an automatic or manual activity or observation that is performed on a person (e.g. the administration of a medication to a patient) or that produces information about a person (e.g. the calculation of the BMI of a person). It is not required that the event is directly related to a healthcare service.

The conceptual HHR model introduces several kinds of events.

A *Condition* is a statement about an objective state of a patient. The statement may be done by the patient itself (*ConditionIdentifiedByPatient*) or by a practitioner (*ConditionIdentifiedByPractitioner*).

Condition is distinct from a Measure because it refers to a persistent state, while a Measure refers to a particular instant in time.

A *ConditionType* represents a specific subtype of condition. A ConditionType may be a ClinicalFinding or a Diagnosis.

A ClinicalFinding is a statement about a persistent objective status of a patient.

A Diagnosis is a statement that is the result of a cognitive process, i.e. it is the interpretation of a set of measures and/or clinical findings.

The current status of the clinical condition of the patient is specified by the association clinicalConditionStatus and may be one of the values in the *ClinicalStatus* enumeration.

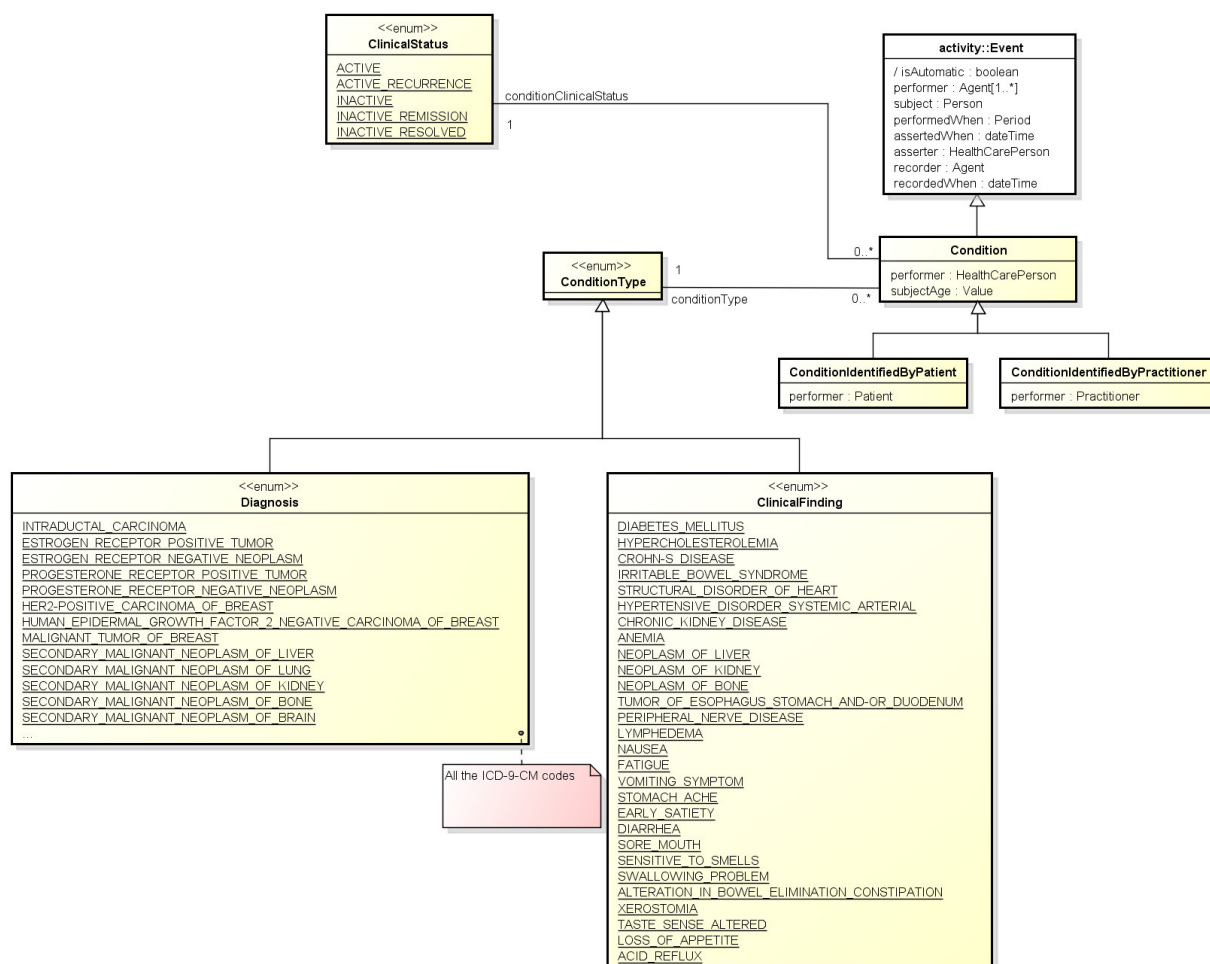


Figure 9 Condition model

### Activity

Planned or performed activities recorded in the HHR model are instances of *Event*. Each event has an *EventStatus*, and each specialization of Event may use a specialized set of status.

The Activity model shown in Figure 10 describes two specializations of Event, namely *Procedure* and *MedicationApplication*. A Procedure represents any medical action that is performed on a person. Even if there are many types of medical procedures that could be performed on a person, the current version of the HHR model includes only two possible *ProcedureTypes*, the radiotherapy and the surgery. Moreover, it is possible to associate a procedure with a *ProcedureStatus* that characterizes the status of the clinical action. Like EventStatus, the ProcedureStatus is modelled as an enumeration since that, also in this case, it can assume a predefined and limited number of different values.

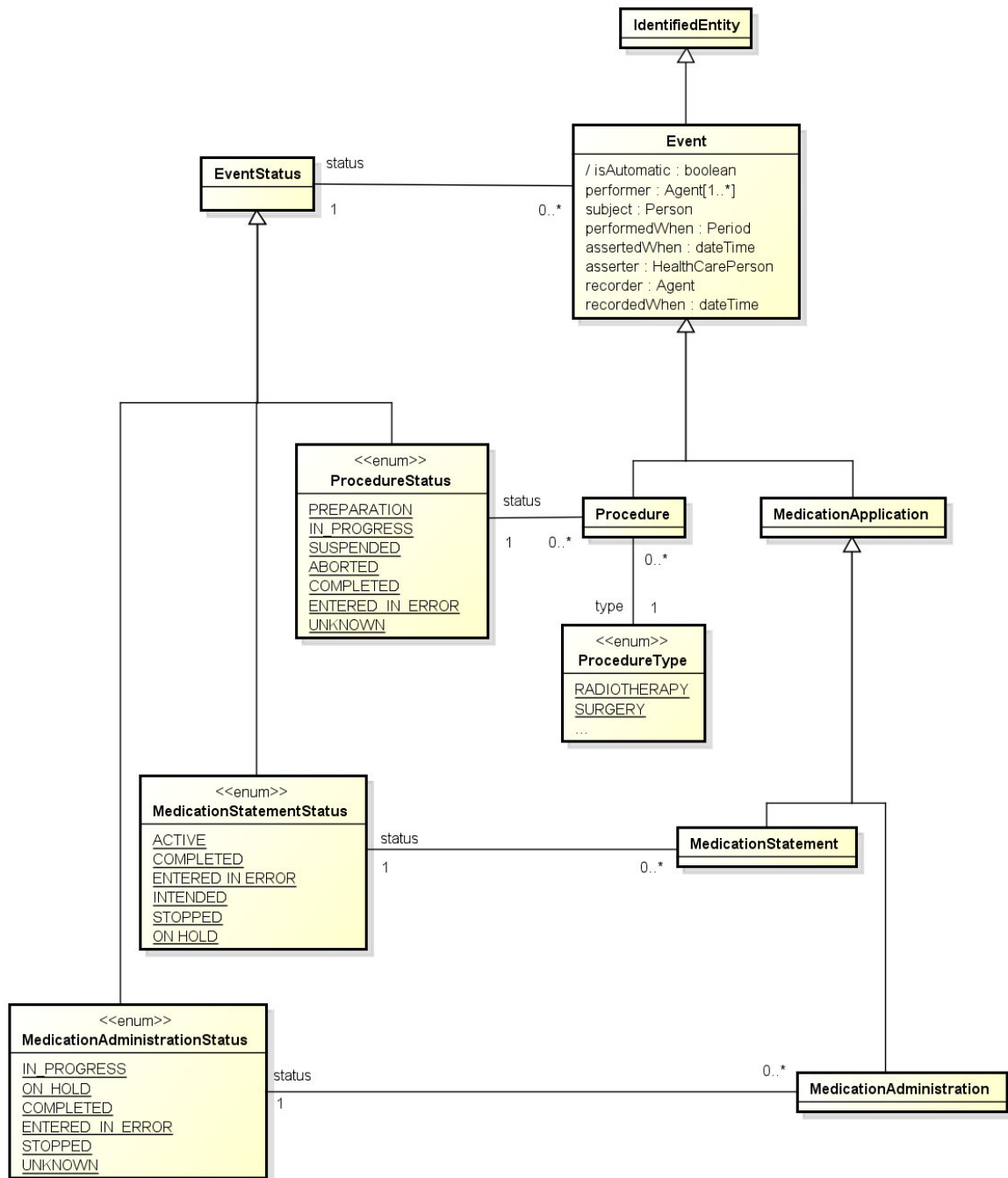


Figure 10 Activity model (part 1 of 2)

MedicationApplication is an event representing the administration of a medication. Each MedicationApplication is associated to a *Medication* entity, which represents a medication produced by the hospital pharmacy or from external producers. The composition of a Medication is specified by one or more ingredients and each ingredient is a *MedicationOrSubstance*. A *Substance* is a pure substance (i.e. a form of matter that has

constant chemical composition and cannot be separated into components by physical separation methods) or a homogeneous mixture (i.e. a material that has the same proportions of its components throughout any given sample). A Substance have a definite composition. The composition of a substance is specified by zero or more ingredients, which are other substances. The entity *MedicationApplication* is specialized by *MedicationStatement* and *MedicationAdministration*. *MedicationStatement* represents an administration of a medication asserted by an individual that doesn't belong to the organization that provide it. *MedicationAdministration* represents an administration of a medication asserted by an individual that belongs to the organization that provides it. Respectively, *MedicationStatementStatus* and *MedicationAdministrationStatus* represents the current status of those entities.

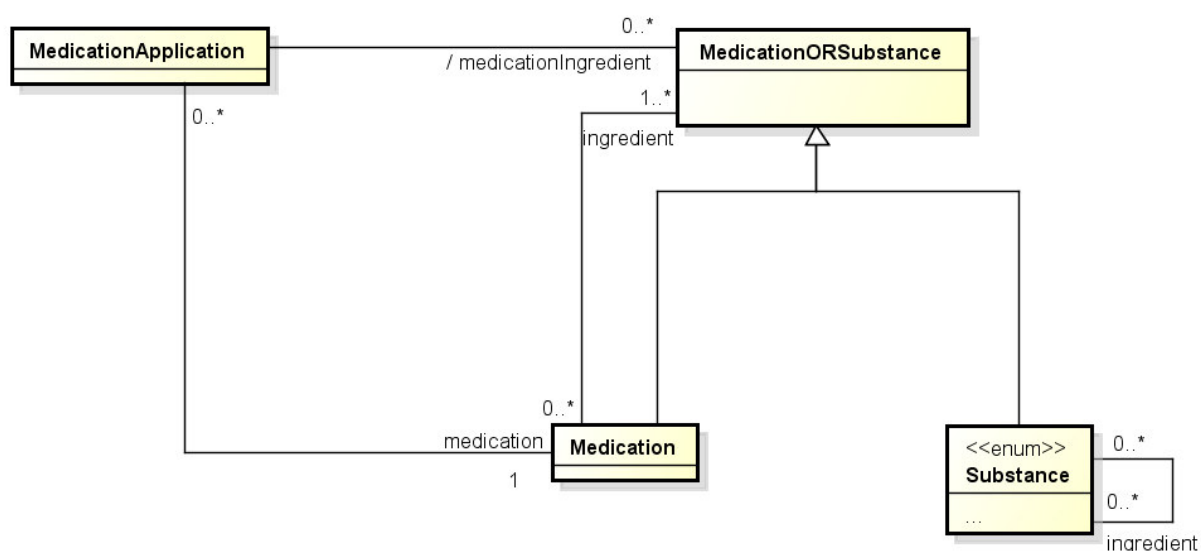


Figure 11 Activity model (part 2 of 2)

## Measurement

A *Measure* is an event consisting in a measurement or an assertion about a patient, made by the patient itself, by a device or other subject. Measures are associated to an *ObservationStatus* representing the status of the measurement observation.

Each measure results in a measured *Value*. Depending on the type of the value measured, the measure can be a *QuantitativeMeasure*, *CategoricalMeasure* and *ComposedMeasure*. A quantitative measure represents the measurement of a *Quantity* which magnitude is represented by a number. A categorical measure represents the measurement of value belonging to a certain *Category*. A composed measure represents the measurement that is composed by two or more measures of type *CategoricalMeasure* or *QuantitativeMeasure* (e.g. the measurement of the blood pressure, which is composed by systolic and diastolic pressure). Quantity values are further specialized in *ContinuousQuantity*, in which the

magnitude is represented by a real number and has a specific unit of measure, *DiscreteQuantity* in which the magnitude is represented by an integer, and *DimensionlessQuantity*, in which the value is a number and doesn't have a unit of measure.

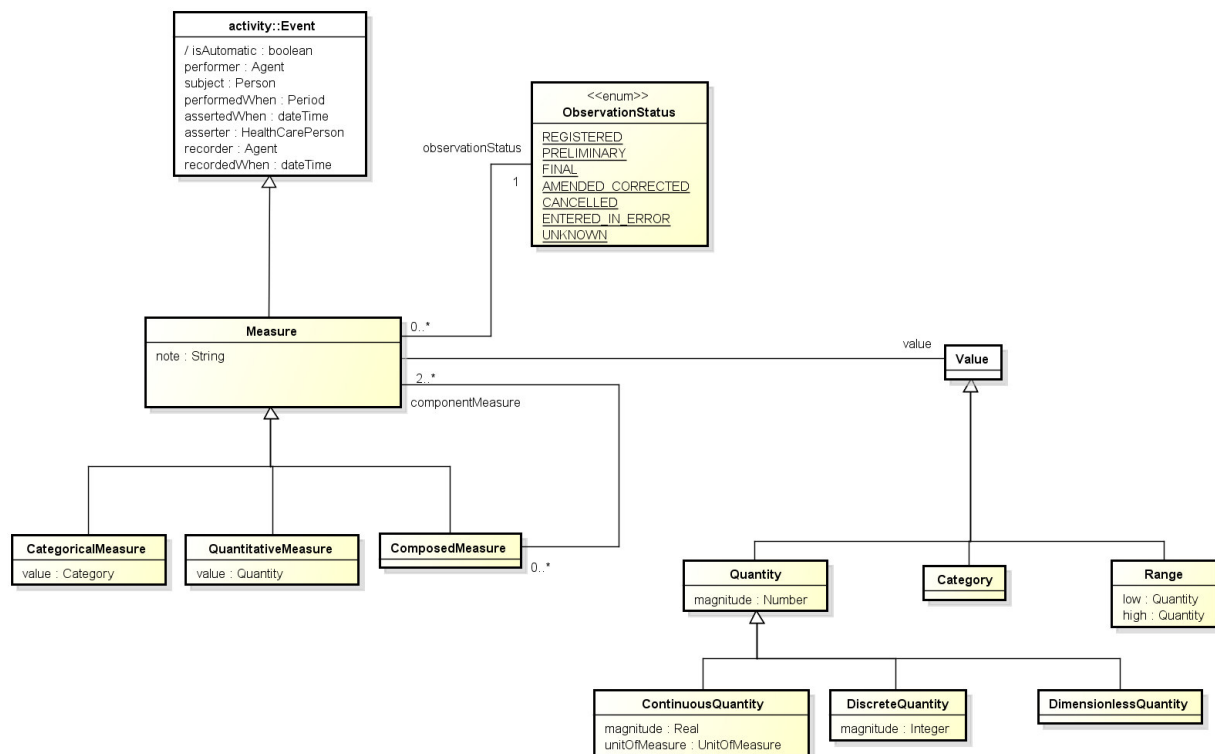


Figure 12 Measurement model

There exist many specializations of *ContinuousQuantity*, which are shown in Figure 13. Each specialization is bound to one unit of measure, which are represented in Figure 14. For example, a *TempoQuantity* is a continuous quantity which value is a real number with the *TempoUnit* unit of measure, *SpeedQuantity* is a continuous quantity which value is a real number with the *SpeedUnit* unit of measure, etc.

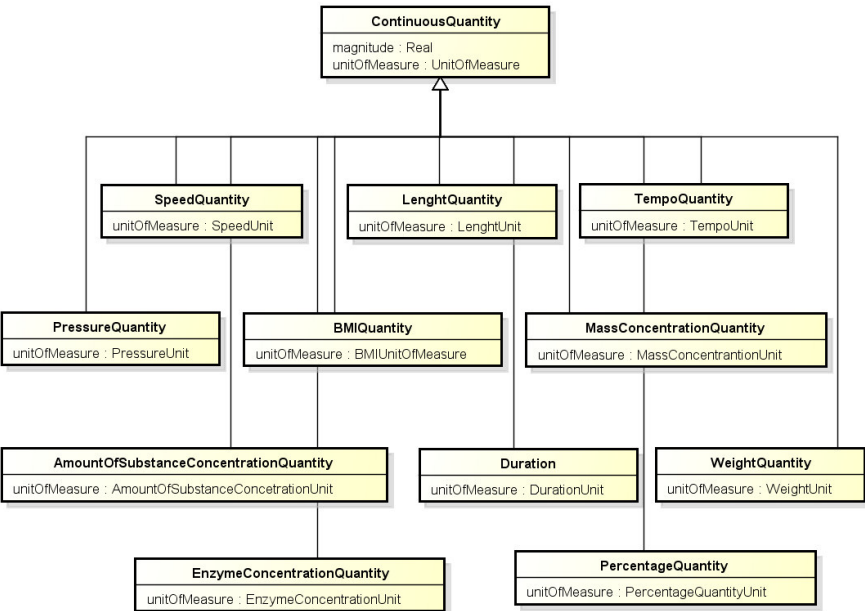


Figure 13 Continuous quantity model

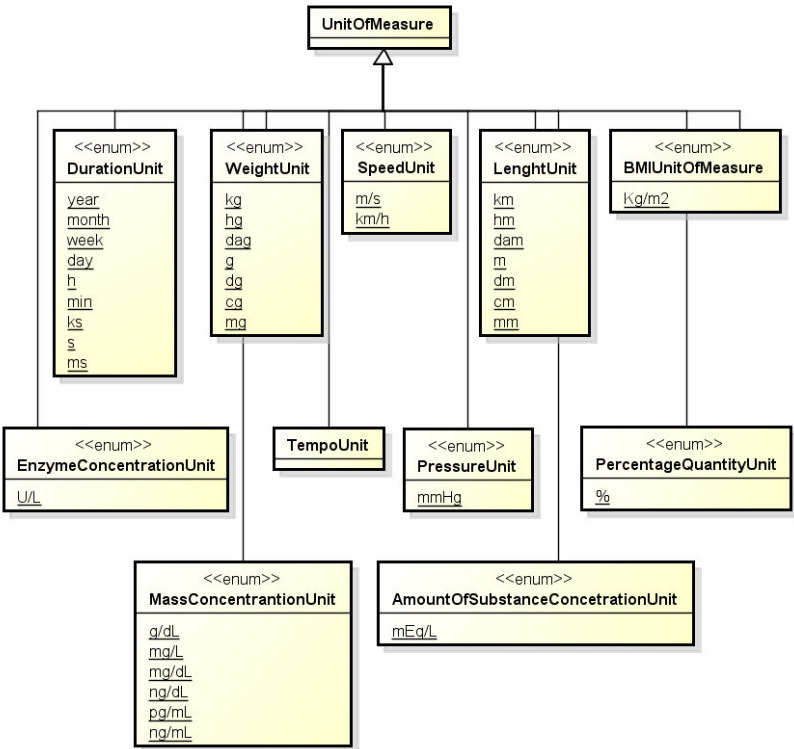


Figure 14 Unit of measure model



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### *Quantitative measures*

As already mentioned, quantitative measures are measurements of values of type Quantity, which have a (numerical) magnitude and optionally a unit of measure. Such type of measurements is specialized by a number of entities, which represents specific types of measurements.

For simplicity of representation and description, the specialized quantitative measures are grouped in fitness measures, heart rate and blood pressure measures, and laboratory test measures.

### *Fitness measures*

Fitness measures are quantitative measures representing the set of parameters measured during a fitness test, and physical body parameters. Specifically, fitness measures are:

- *Waist*: the waistline of the person.
- *Height*: the height of the person.
- *Weight*: the weight of the person.
- *TricepsSF* (Triceps skin fold): the width of a fold of skin taken over the triceps muscle. Triceps skinfold reflects the amount of peripheral sub cutaneous fat. It is a proxy for body composition.
- *Run600m*: the time need to run 600 meters.
- *Dash60m*: the time to run 60 meters.
- *StandAndReach* (flexibility of lower back and legs): the measure of the distance fingertips reaches past the toes during a stand-and-reach test.
- *BMI*: body mass index of the person. It has an interpretation, according to World Obesity Federation, that is one of the value of the *WOF\_CODE* enumeration.
- *PolygonBackwards*: the time needed to complete the whole 10m distance during the polygon backwards fitness test. It is measured during a fitness test designed to measure coordination. The subject moves backwards on all fours and covers a 10-m distance. On the course the subject crawls over and under the 35 cm high obstacles that are placed at 3 meters and 6 meters from the starting line, respectively.
- *ArmPlateTapping*: the number of taps completed in 20 seconds. It is measured during a reaction test using a tapping action which measures upper body reaction time, hand-eye quickness and coordination. It is designed to assess the speed and the coordination of limb movement.
- *StandingBroadJump*: the distance jumped from a standing position. This test measures explosive leg power.
- *SitUp60s*: the number of sit-ups performed in 60 seconds. It is a measure of the strength of the trunk.
- *BentArmHang*: the time that a person can hold a flexed arm hang position above a horizontal bar.



- *HR\_FI*: the summary measure of health-related fitness. It is calculated as the sum of individual z-scores from 3 motor tests related to health (tests that assess endurance and muscular strength and muscular endurance, i.e. 600m run, sit-ups and bent arm hang).
- *PR\_FI*: the summary measure of performance-related fitness. It is calculated as the sum of individual z-scores from 4 motor tests related to performance (tests that assess explosive strength, agility and speed i.e. standing broad jump, 60m run and polygon backwards and arm-plate tapping).
- *Total\_FI* (total physical fitness index). The sum of the individual z-scores of all 8 motor tests (i.e. *ArmPlateTapping*, *PolygonBackwards*, *BentArmHang*, *SitUp60s*, *StandingBroadJump*, *Dash60m*, *Run600m* and *StandAndReach*).

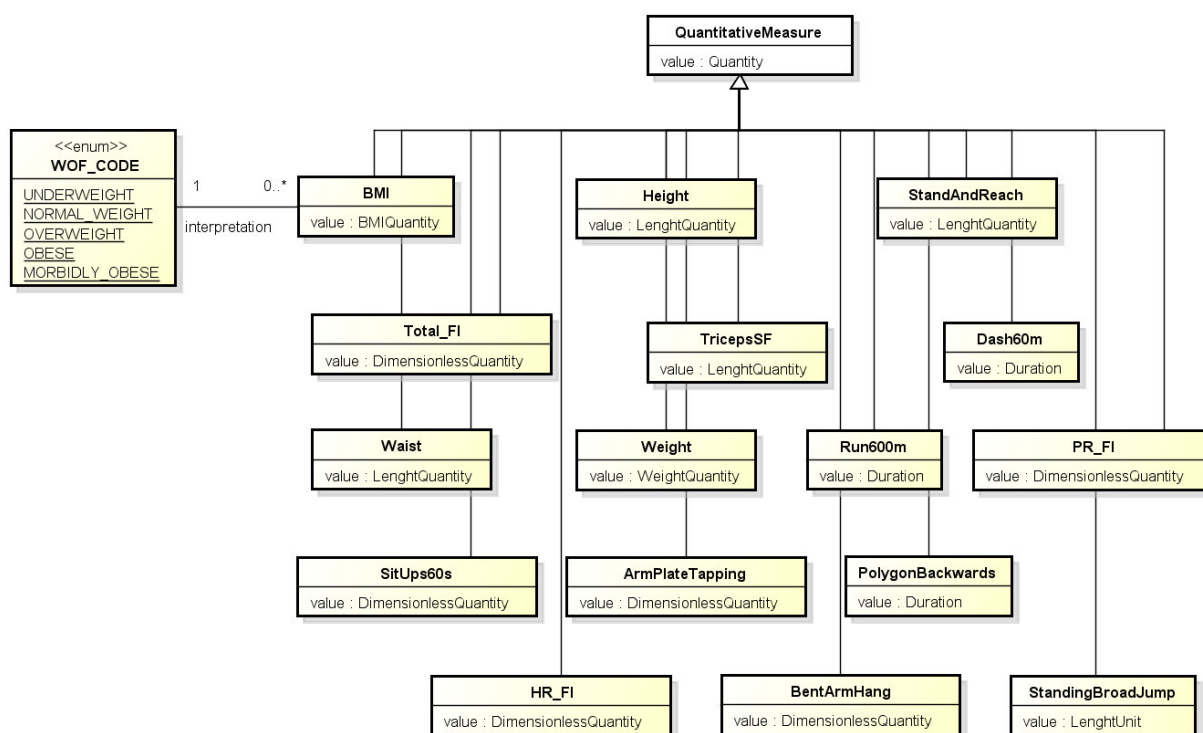


Figure 15 Fitness measurements model

### Heart rate and blood pressure measures

*HeartRateMeasure* in Figure 16 is a quantitative measure representing the heart rate of an individual. The value of the heart rate measure is an *HeartRateQuantity*, which has the unit of measure of *HeartBeatUnit*, and it is a specialization of *TempoQuantity*. *BloodPressure* is a measure composed by *SystolicBloodPressure* and *DiastolicBloodPressure*, which are two quantitative measure inheriting from *PressureMeasure*.

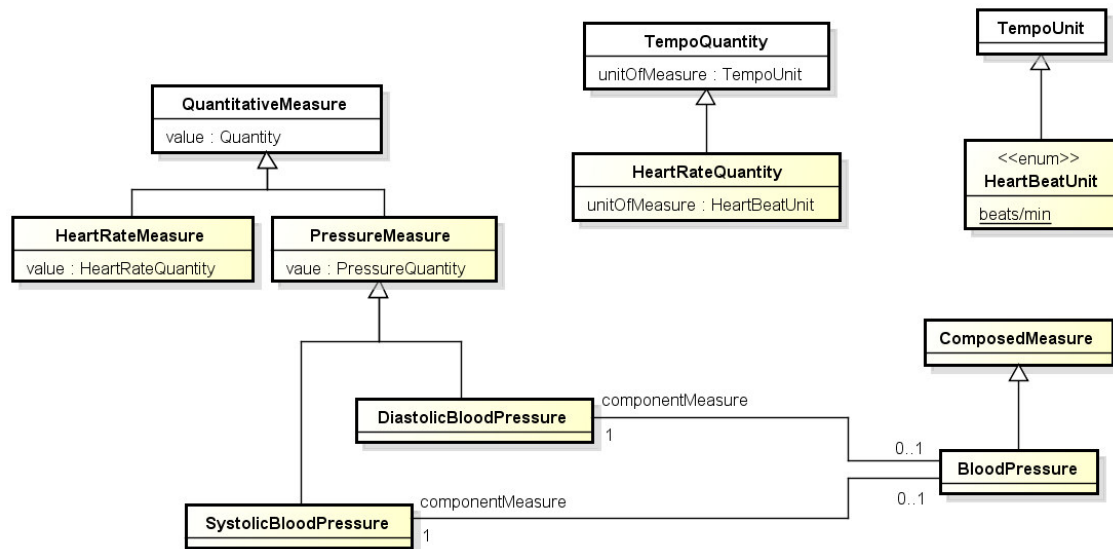


Figure 16 Heart rate and blood pressure model

### Laboratory test measures

Laboratory test measures are quantitative measures representing the results of observations generated by laboratories, and are shown in Figure 17 and Figure 18. In particular:

- *C\_ReactiveProtein*: the c-reactive protein measurement.
- *GlycosilatedHemoglobin*: the glucohemoglobin measurement.
- *MicroalbuminCreatinineRatio*: the urine microalbumin/creatinine ratio measurement.
- *Glucose*: the glucose measurement.
- *BloodUrea*: the blood urea measurement.
- *Creatinine*: the creatinine measurement.
- *TotalCholesterol*: the total cholesterol measurement.
- *LowDensityCholesterol*: the low density lipoprotein cholesterol measurement.
- *HighDensityCholesterol*: the high density lipoprotein cholesterol measurement.
- *GPTTransaminases*: the alanine aminotransferase measurement.
- *Albumine*: the albumin measurement.
- *Calcium*: the calcium measurement.
- *Sodium*: the sodium measurement.
- *Potasium*: the potassium measurement.
- *TransferrineSaturationIndex*: the transferrin saturation index.
- *Ferrinite*: the ferritin measurement.
- *Transferrine*: the transferrin measurement.
- *ArterialPh*: the hemoglobin free measurement.
- *Hematocrite*: the platelet hematocrit measurement.
- *FreeT4*: the T4 free measurement.

- *FreeT3*: free tri-iodothyronine measurement used to assess thyroid function (unit of measure).
- *VenousPh*: the ph measurement venous.

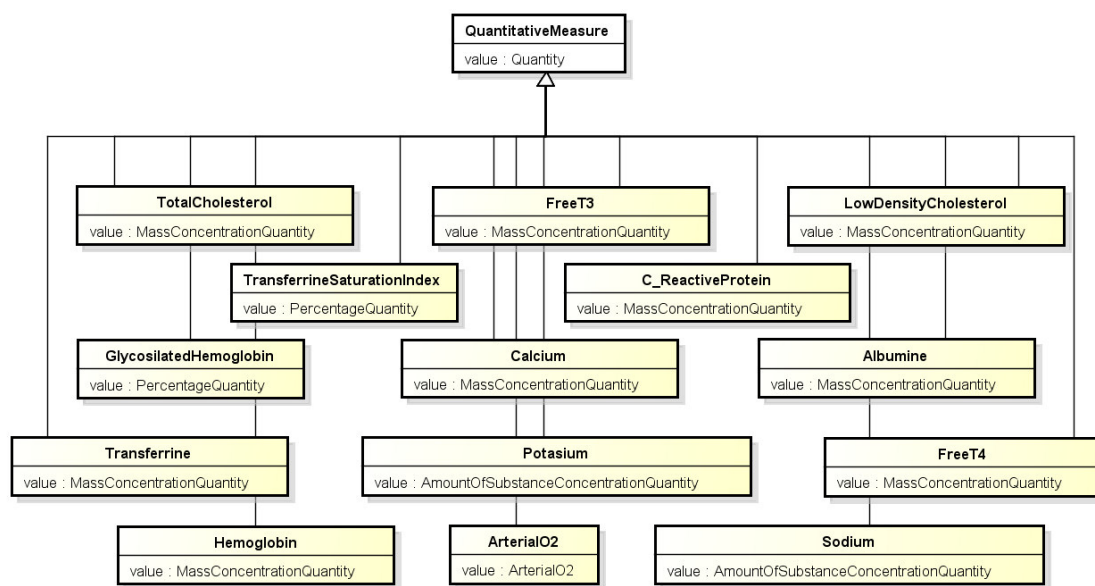


Figure 17 Laboratory tests (part 1 of 2)

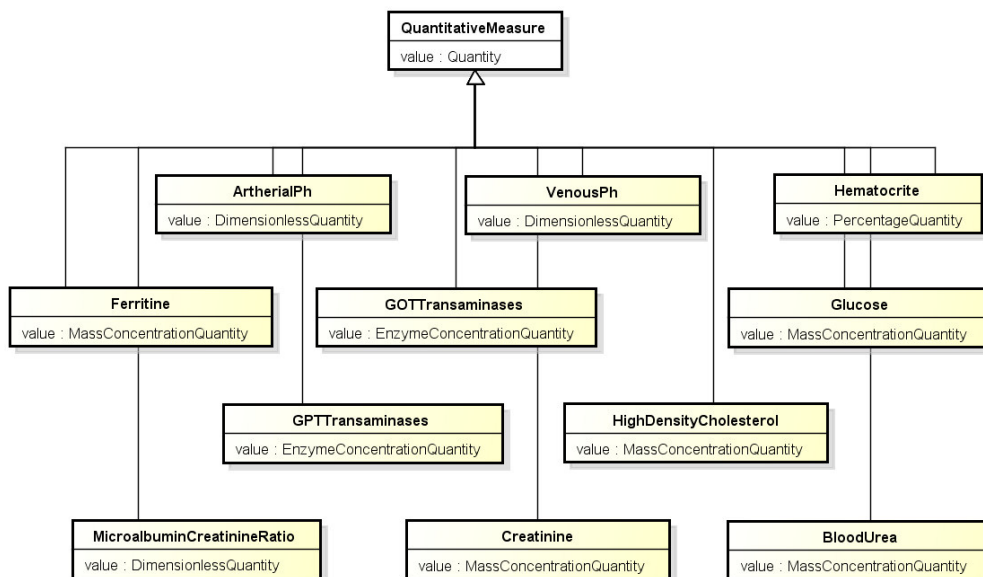


Figure 18 Laboratory tests (part 2 of 2)

### Food intake measures

*FoodIntakeFrequency* is a categorical measure representing the intake frequency of a specific food by an individual (Figure 19). The current HHR model limits the types of food intake to the values listed in the *Food* enumeration (e.g. “read\_meat\_intake”, “white\_meat\_intake” etc.). The value of the frequency can be a value listed in the *FoodIntakeFrequencyCategory*, which typically represents the number of the portions per week of the specific food.

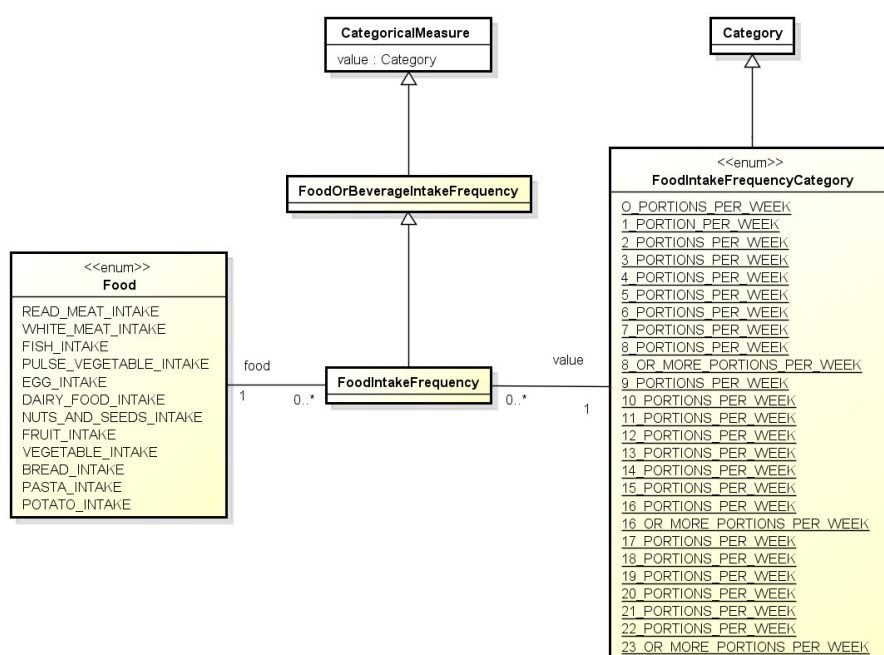


Figure 19 Food intake model

### Episode of care

This section describes the fragment of the HHR model with the information related to an episode of care. The *Encounter* is an event representing an interaction between a patient and healthcare provider(s) with the purpose of providing healthcare service(s) or assessing the health status of a patient (Figure 20). *HospitalizationEncounter*, *EmergencyEncounter*, *HospitalAtHomeEncounter* and *OutPatientEncounter* are specialization of *Encounter*. In particular:

*HospitalizationEncounter* represents an inpatient encounter where a patient is admitted to a hospital to receive a specific healthcare service.

*EmergencyEncounter* represents an encounter that takes place at a dedicated healthcare service delivery location where the patient receives immediate evaluation and treatment,

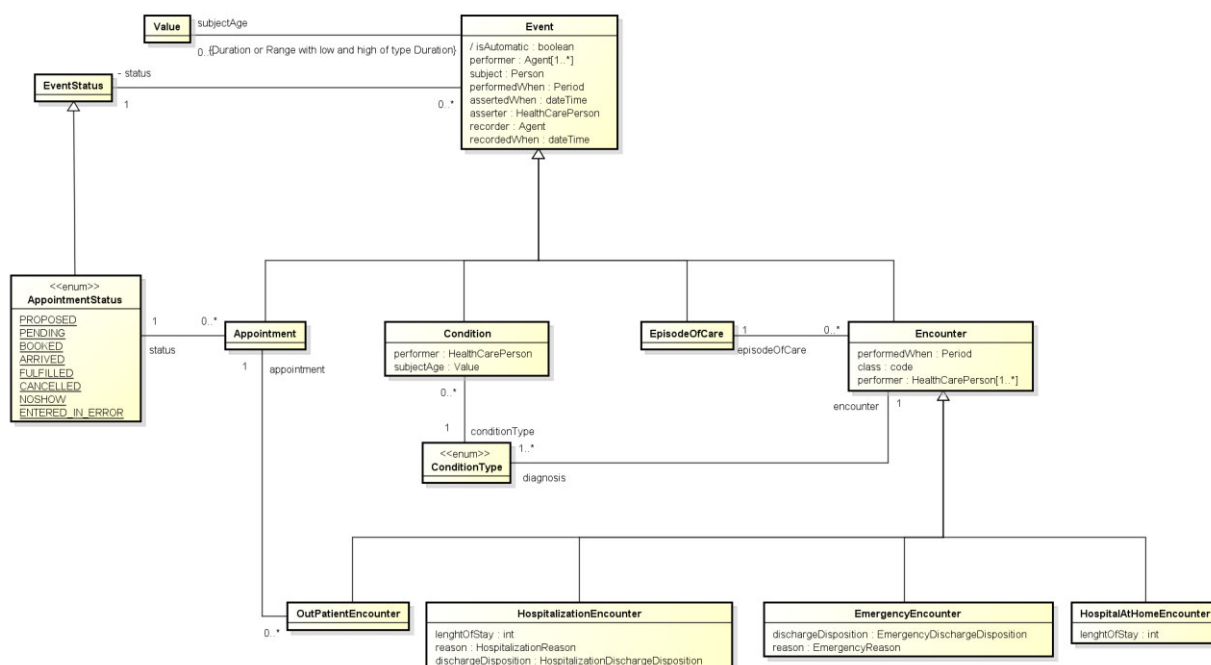
provided until he or she is discharged or the responsibility for the patient's care is transferred elsewhere.

*HospitalAtHomeEncounter* represents a healthcare encounter that takes place in the residence of the patient.

*OutPatientEncounter* represents all data regarding an outpatient encounter.

An *EpisodeOfCare* is an association between a patient and an organization/healthcare provider during which time encounters may occur. In other words, *EpisodeOfCare* is the container that can link a series of *Encounter(s)* together.

The current status of *Encounter* and *EpisodeOfCare* is represented by *EncounterStatus* and *EpisodeOfCareStatus*, respectively (Figure 21). *Encounter* is associated to at least one diagnosis relevant for the specific encounter. The diagnoses are of type *ConditionType* (see *Condition* section). Each encounter has a *Priority* that indicates the urgency of the encounter. *DischargeDisposition* is the destination of the patient at the end of the encounter (after the discharge). As shown in Figure 22, discharge dispositions may be one of the destinations listed in the *HospitalizationDischargeDisposition* and *EmergencyDischargeDisposition* enumerations, which represents, respectively, the possible destinations after the discharge from hospital and from emergency.



to inpatient encounter are represented by *HospitalizationReason* and possible reasons to be admitted to an emergency encounter are represented by *EmergencyReason*.

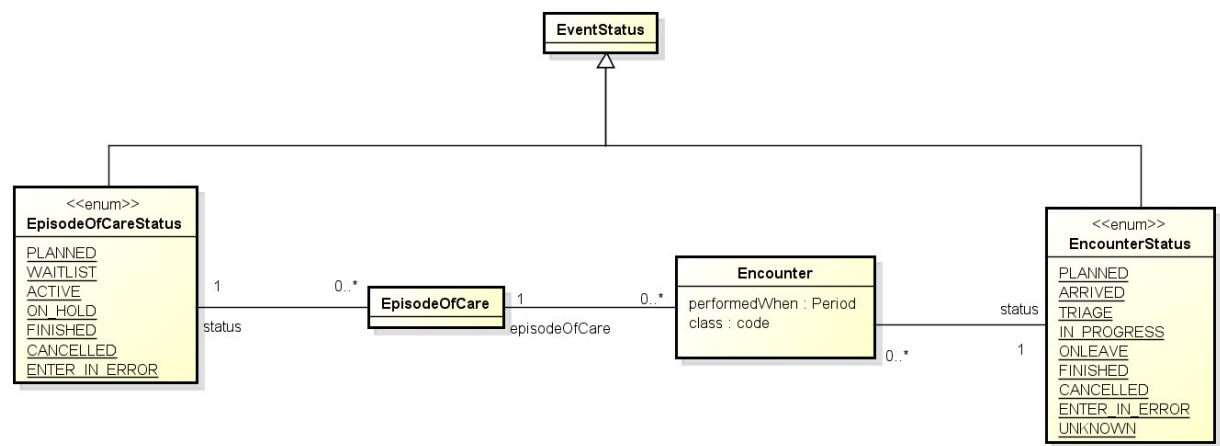


Figure 21 Episode of care (part 2 of 3)

An *Appointment* represents a booking of a healthcare event among patient, practitioner and related persons for a specific date/time. The current status of the appointment is represented by *AppointmentStatus*.

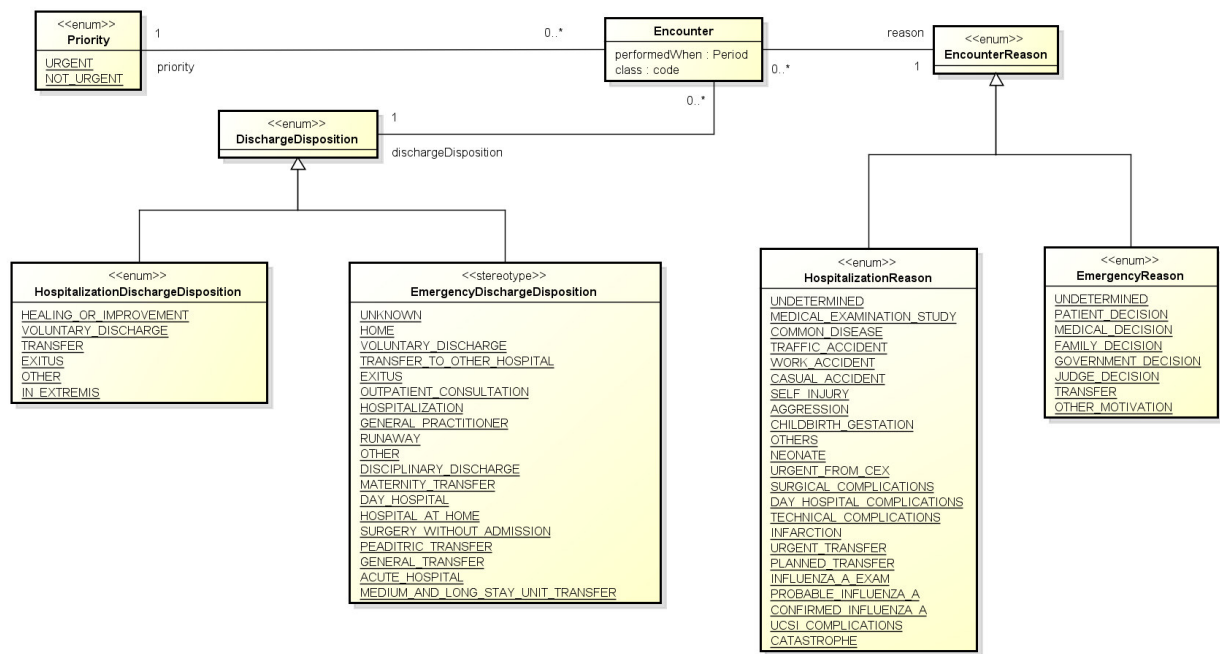
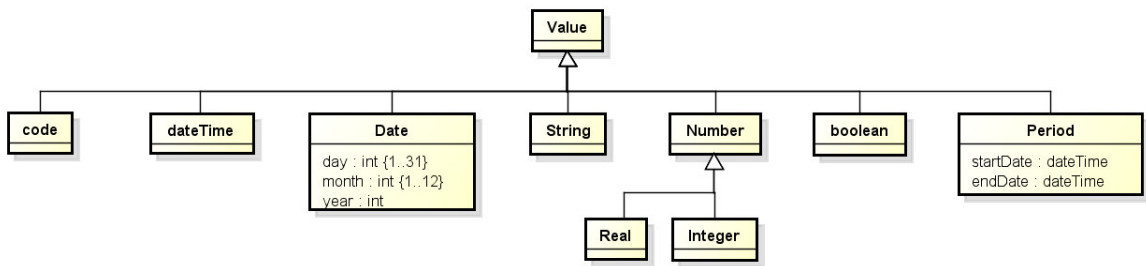


Figure 22 Episode of care (part 3 of 3)

*Data types*

HHR model defines a set of data types that are used for the HHR attributes.



*Figure 23 Primitive data types model*

The semantic of the HHR data types is the same of the FHIR data types. Refer to the FHIR specification for their description.



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## 5. Conclusions

In a context with several sources of data like the one targeted from the CrowdHEALTH project, the setting of a baseline allowing the aggregation of information avoiding ambiguities is crucial. Many standards and best practices have been defined over the years with this purpose (the most relevant of them for the project have been presented in the State of the Art section). Among them, HL7/FHIR is the specification more tailored to the needs of the project. It has been selected to found the HHR model, because of its high coverage of clinical data actually present in the use cases datasets and of its flexible extension mechanism that allows to model also not yet supported clinical data types.

FHIR covers a big number of requirements for representing and exchanging clinical data, some of them matching with the CrowdHEALTH requirements, like for example the modelling of medical observations and clinical conditions. Many other requirements covered by FHIR are, instead, out of the scope of this project, like the modelling of financial information and clinical workflows, for which the CrowdHEALTH use cases don't require any support, at least for the first year of the project. To this respect, FHIR results in an oversized tool introducing complexities that are unneeded for the purposes of the project. In some case FHIR allows to represent the same data using different Resource types and hidden important conceptual distinction on the choice of the right code values. Therefore, in actual applications the standard needs to be constrained to simplify the interoperability. On the other hand, FHIR don't cover some of the requirements of the project, lacking a specific representation of information that is present in the analysed use cases dataset. For these reasons, a new model, the HHR model, has been designed and tailored to the CrowdHEALTH use cases. It represents information about persons and their individual roles, the organizations to which the role players belong, diagnosis and clinical findings of the patients, medical procedures, medication applications and related medication and substances administered to patients, episodes of care and medical encounters (hospitalization, outpatient, emergency, hospitalization at home), measurement of vital signs, physiological parameters, physical activities results and laboratory test results.

The HHR model has been mapped to FHIR, by identifying FHIR resources and their attributes which correspond to HHR classes and attributes. The extension mechanisms of FHIR has been used to represent information required by use cases and modelled in the HHR model, but not yet present in the FHIR resource. The defined extensions aim to add details to health-related events, like the specification of who assert and/or perform an event during an episode of care and when it occurs, indicating if the performer is an automatic agent, the age (or range of age) of the subject at the time the event occurs, the date when a person is registered into the system.

The mapping to FHIR is expressed in a semi-formal way, documented in an annex to this deliverable, and in a machine interpretable format that will be documented in a separate deliverable.

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As FHIR requires also the usage of suitable coding systems, the possibility to use SNOMED CT for encoding clinical concepts has been investigated. Given the limitations imposed by its terms of license, such ontology has been discarded and a project specific terminology has been defined and used. Anyway, acceptable SNOMED terms of license that may apply to the CrowdHEALTH project are currently under investigation with SNOMED International, and its usage in next phases of the project will be evaluated.

The next versions of the HHR model will introduce new data entities for representing nutritional, social and lifestyle information, together with other possible new data requirements from use cases. The mapping with FHIR will be updated accordingly, and the current terminology will be possibly extended.

By maintaining a double view, the HHR model aims on one hand to guarantee the interoperability and the possibility to implement it on top of existing FHIR libraries, and on the other hand it is also intended to be usable independently from FHIR (and its future evolutions) and applicable also for different purposes than the exchange of health data. For example, it can be more suitable than FHIR as data schema for Object Oriented local APIs.

The current HHR model aims to represent the information enabling the execution of the first cycle of use case demonstrations, expected for the first year of the project. In particular, the current release of the HHR model fully covers CareAcross and SLOfit datasets and partially covers HULAFE and BIOASSIST datasets. During the second year, the HHR model will be extended to satisfy new requirements, to complete the coverage of HULAFE and BIOASSIST datasets and to include the DFKI and KI datasets.

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# CrowdHEALTH

**Collective Wisdom Driving Public Health Policies**

## **Del. no. – D3.1 Annex A: HHR to FHIR mapping, terminology and FHIR extensions Project Deliverable**



This project has received funding from the European Union's Horizon 2020 Programme (H2020-SC1-2016-CNECT) under Grant Agreement No. 727560

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## 1. HHR to FHIR mapping, terminology and FHIR extensions

The mapping between the conceptual model and HL7-FHIR is expressed as a set of constraints that follows the FHIRPath syntax (documented at: <http://hl7.org/fhirpath/>) extended with the notation *<expression>*.

There is a subsection for each package and a sub-subsection for each conceptual class of that package. The title of the sub-subsection indicates the name of the mapped conceptual class and (in brackets) the name of the corresponding FHIR resource. Each section contains at least a table that defines the constraints of the mapped class. Each row describes the mapping of a conceptual attribute (or nested attribute). The column “Assumptions” lists the assumptions for mapping the conceptual attribute.

Assumptions of the form *pathExpression=<attribute>* or *pathExpression.resolve()=<attribute>* (where *pathExpression* evaluates to a reference in the second case) are equivalent to writing the *pathExpression* in the column “FHIRMapping” of the corresponding *attribute* row.

The value of the construct *<expression>* is obtained by evaluating the FHIRPath *expression* on the mapped object, and returning it, if it is a primitive value, or returning its translation (using the mapping here defined) in case it is a complex value. Adhoc parameters not corresponding to any attribute of the mapped object, and explained in the notes, can be used in place of *expression* (e.g. a note could explain that “*<category\_code>* represents a code corresponding to the value of the attribute *category*, as defined by table *Category\_Code*”).

Abstract classes are mapped only if the mapping of their attributes is the same for all subclasses, otherwise the mapping of the attributes is expressed directly in the tables of the subclasses.

When alternative mappings exist for the same attribute, the table contains multiple rows for the attribute, one per alternative mapping, and the column “Note” specifies in which condition each mapping applies.

When alternative mappings exist for the same class, more tables are specified for the same class. Each table specifies in the first row (in the column assumptions) a set of constraints that the mapped object (this) has to fulfill to apply the mapping specified by the table.

*<enum>* classes may be mapped to FHIR value sets or to FHIR resources. In the first case, for each instance of the enum the tables specify the corresponding value of the value set.

In the case of enumerations (stereotype *<<enum>>*) additional tables are used to map each instance of the enumeration to a specific concept/code from the corresponding ValueSet of FHIR or the corresponding Vocabulary. Such tables have a different colour (orange).

A description of the HHR entity attributes is provided whenever its semantic differs from the semantic of the corresponding HL7-FHIR resource attribute, otherwise it is implicitly understood that the semantic is the same as in FHIR.

### 1.1. Mapping conceptual model on HL7 FHIR

In this section the mapping of HHR conceptual model on HL7-FHIR is described.

#### *Person model mapped to HL7-FHIR*

##### **HHR <role> Patient (Person) mapped to FHIR Patient**

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Notes
<b>player.identifier</b>	Identifier	YES	Patient.identifier	Patient.identifier.value=<IdentifierEntity.Identifier.value>, Patient.identifier.system=<IdentifierEntity.Identifier.system>	
<b>player.firstName</b>	String	NO	Patient.name.given		
<b>player.lastName</b>	String	NO	Patient.name.family		
<b>player.email</b>	String	NO	Patient.telecom.value	Patient.telecom.system='email'	
<b>player.registeredWhen</b>	dateTime	NO	EXTENSION: Patient.registeredWhen		When the patient was registered for the first time into the system
<b>player.gender</b>	Gender	NO	Patient.gender		
<b>player.birthDate</b>	Date	NO	Patient.birthDate		
<b>player.deathDate</b>	Date	NO	Patient.deceased	Patient.deceased is dateTime	

##### **HHR <role> Practitioner (Person) mapped to FHIR Practitioner**

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Notes
<b>player.identifier</b>	Identifier	YES	Practitioner.identifier	Practitioner.identifier.value=<IdentifierEntity.Identifier.value>, Practitioner.identifier.system=<IdentifierEntity.Identifier.system>	
<b>player.firstName</b>	String	NO	Practitioner.practitioner.name.given		
<b>player.lastName</b>	String	NO	Practitioner.practitioner.name.family		
<b>player.email</b>	String	NO	Practitioner.practitioner.telecom.value	Practitioner.practitioner.telecom.system='email'	
<b>player.registeredWhen</b>	dateTime	NO	EXTENSION: Practitioner.registeredWhen		When the practitioner was registered for the first time into the system
<b>player.gender</b>	Gender	NO	Practitioner.practitioner.gender		
<b>player.birthDate</b>	Date	NO	Practitioner.birthDate		
<b>player.deathDate</b>	Date	NO	Practitioner.deceased	Practitioner.deceased is	



				dateTime	
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### HHR <role> Student (Person) mapped to FHIR Patient

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Notes
<b>identifier</b>	Identifier	YES	Patient.identifier	Patient.identifier.value=<IdentifierEntity.Identifier.value>, Patient.identifier.system=<IdentifierEntity.Identifier.system>	This is the id of the student
<b>firstName</b>	String	NO	Patient.name.given		
<b>lastName</b>	String	NO	Patient.name.family		
<b>dateOfBirth</b>	date	NO	Patient.birthDate		
<b>email</b>	String	NO	Patient.telecom.value	Patient.telecom.system='email'	
<b>registeredWhen</b>	dateTime	NO	EXTENSION: Patient.registeredWhen		
<b>gender</b>	Gender	NO	Patient.gender		
<b>birthDate</b>	Date	NO	Patient.birthDate		
<b>deathDate</b>	Date	NO	Patient.deceased		
<b>attendedSchool</b>	School	NO	Patient.managingOrganization		This is a reference to the FHIR Organization resource representing the School to which the student belongs to.
<b>grade</b>	Grade			Observation.category.coding[0].display="social-history" Observation.category.coding[0].code="Social history" Observation.category.coding[0].system=" <a href="http://hl7.org/fhir/observation-category">http://hl7.org/fhir/observation-category</a> " Observation.status="final", Observation.code.coding[0].code="school-grade" Observation.code.coding[0].display="School grade", Observation.code.coding[0].system=" <a href="http://www.crowdhealth.eu/hhr-t">http://www.crowdhealth.eu/hhr-t</a> " Observation.value is CodeableConcept Observation.code.coding[0].code=<grade code> Observation.code.coding[0].display=<grade display> Observation.code.coding[0].system=" <a href="http://www.crowdhealth.eu/hhr-t">http://www.crowdhealth.eu/hhr-t</a> " Observation.subject.reference.resolve() is Patient Observation.subject=<this>	Observation.subject contains the reference to the FHIR resource representing the student.

### Condition model mapped to HL7-FHIR

#### HHR Condition mapped to FHIR Condition

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
<b>identifier</b>	Identifier	YES	Condition.identifier	Condition.identifier.value=<IdentifierEntity.Identifier.value>, Condition.identifier.system=<IdentifierEntity.Identifier.system>	
<b>isAutomatic</b>	Boolean	NO	isAutomatic		USED EXTENSION: Condition.isAutomatic
<b>subject</b>	Person	YES	Condition.subject	Condition.subject.reference.resolve() is Patient	
<b>performer</b>	HealthCarePerson	NO	performer		USED EXTENSION: Condition.performer
<b>performedWhen</b>	DateTime	NO	performedWhen		USED EXTENSION: Condition.performedWhen
<b>conditionClinicalStatus</b>	ClinicalStatus	YES	Condition.clinicalStatus	Condition.clinicalStatus="active"	
<b>conditionType</b>	Diagnosis/ClinicalFinding	YES		Condition.code.coding[0].code=<value_code> Condition.code.coding[0].display=<description> Condition.code.coding[0].system=<terminology URI>	If conditionType is a Diagnosis: Condition.category.coding[0].code="diagnosis", Condition.category.coding[0].display="Diagnosis" Condition.category.coding[0].system="http://crowdhealth.eu/hhr-t" If conditionType is a ClinicalFinding: Condition.category.coding[0].code="clinicalFinding", Condition.category.coding[0].display="Clinical finding" Condition.category.coding[0].system="http://crowdhealth.eu/hhr-t"
<b>asserter</b>	HealthCarePerson	NO	Condition.asserter	Condition.asserter.reference.resolve() is Patient Condition.asserter.reference.resolve() is Practitioner	
<b>assertedWhen</b>	dateTime	NO	Condition.assertedDate		
<b>recorder</b>	Agent	NO	<this_provenance>.agent.who	<this_provenance>.target=<this> <this_provenance>.agent.who is Reference	The parameter <this> refers to the FHIR resource mapped to the translated object.
<b>recordedWhen</b>	dateTime	NO	<this_provenance>.recorded		<this_provenance> refers to a FHIR resource of type Provenance specifically created

					to record the provenance of <this>.
subjectAge	Value	NO	Condition.onset	Condition.onset is Age	

### Activity model mapped to HL7-FHIR

#### HHR Radiotherapy mapped to FHIR Procedure

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Notes
				Procedure..code.coding[0].code="radiation-oncology-and-or-radiotherapy" Procedure.code.coding[0].display="Radiation oncology AND/OR radiotherapy" Procedure.code.coding[0].system="http://crowdhealth.eu/hhr-t"	
identifier	Identifier	YES	Procedure.identifier	Procedure.identifier.value=<IdentifierEntity.Identifier.value>, Condition.identifier.system=<IdentifierEntity.Identifier.system>	
isAutomatic	boolean	NO	isAutomatic		USED EXTENSION: Procedure.isAutomatic
subject	HealthCarePerson	YES	Procedure.subject		
performer	Agent	NO	Procedure.Performed.actor		
performedWhen	DateTime	NO	Procedure.performed	Procedure.performed is dateTime	
asserter	HealthCarePerson	NO	asserter		USED EXTENSION: Procedure.asserter
assertedWhen	DateTime	NO	assertedWhen		USED EXTENSION: Procedure.assertedWhen
recorder	Agent	NO	<this_provenance>.agent.who	<this_provenance>.target=<this> <this_provenance>.agent.who is Reference	The parameter <this> refers to the FHIR resource mapped to the translated object. <this_provenance> refers to a FHIR resource of type Provenance specifically created to record the provenance of <this>.
recordedWhen	DateTime	NO	<this_provenance>.recorded		
status	ProcedureStatus	YES	Procedure.status		

#### HHR Surgery mapped to FHIR Procedure

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Notes
				Procedure..code.coding[0].code="surgical-procedure" Procedure.code.coding[0].display="Surgical procedure" Procedure.code.coding[0].system=" <a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a> "	
<b>identifier</b>	Identifier	YES	Procedure.identifier	Procedure.identifier.value=<IdentifierEntity.Identifier.value>, Condition.identifier.system=<IdentifierEntity.Identifier.system>	
<b>isAutomatic</b>	boolean	NO	isAutomatic		USED EXTENSION: Procedure.isAutomatic
<b>subject</b>	Patient	YES		Procedure.subject.reference.resolve() is Patient	
<b>performer</b>	Agent	NO	Procedure.Performed.actor		
<b>performedWhen</b>	DateTime	NO	Procedure.performed	Procedure.performed is dateTime	
<b>asserter</b>	HealthCarePerson	NO	asserter		USED EXTENSION: Procedure.asserter
<b>assertedWhen</b>	DateTime	NO	assertedWhen		USED EXTENSION: Procedure.assertedWhen
<b>recorder</b>	Agent	NO	<this_provenance>.agent.who	<this_provenance>.target=<this> <this_provenance>.agent.who is Reference	The parameter <this> refers to the FHIR resource mapped to the translated object. <this_provenance> refers to a FHIR resource of type Provenance specifically created to record the provenance of <this>.
<b>recordedWhen</b>	DateTime	NO	<this_provenance>.recorded		
<b>status</b>	ProcedureStatus	YES	Procedure.status		

## HHR Medication mapped to FHIR Medication

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Notes
<b>ingredient</b>	MedicationOrSubstance	NO	Medication.ingredient		

## HHR MedicationAdministration mapped to MedicationAdministration

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Notes
<b>identifier</b>	Identifier	YES	MedicationAdministration.identifier	MedicationAdministration.identifier.value=<IdentifierEntity.Identifier.value>, MedicationAdministration.identifier.system=<Id	

				entifierEntity.Identifier.system>	
<b>subject</b>	Patient	YES	MedicationAdministration.subject		
<b>performer</b>	Agent	NO	MedicationAdministration.performer.actor		
<b>performedWhen</b>	DateTime	NO	MedicationAdministration.effective	MedicationAdministration.effective is dateTime	
<b>asserter</b>	HealthCarePerson	NO	asserter		USED EXTENSION: MedicationAdministration.asserter
<b>assertedWhen</b>	DateTime	NO	assertedWhen		USED EXTENSION: MedicationAdministration.assertedWhen
<b>recorder</b>	Agent	NO	<this_provenance>.agent.who	<this_provenance>.target=<this> <this_provenance>.agent.who is Reference	The parameter <this> refers to the FHIR resource mapped to the translated object. <this_provenance> refers to a FHIR resource of type Provenance specifically created to record the provenance of <this>.
<b>recordedWhen</b>	DateTime	NO	<this_provenance>.recorded		
<b>status</b>	MedicationAdministrationStatus	YES	MedicationAdministration.status		
<b>medication</b>	MedicationOrSubstance	YES	MedicationAdministration.medication		

### HHR MedicationStatement mapped to FHIR MedicationStatement

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Notes
<b>identifier</b>	Identifier	YES	MedicationAdministration.identifier	MedicationAdministration.identifier.value=<IdentifierEntity.Identifier.value>, MedicationAdministration.identifier.system=<IdentifierEntity.Identifier.system>	
<b>subject</b>	Patient	YES	MedicationStatement.subject		
<b>performer</b>	Agent	NO	performer		USED EXTENSION: MedicationStatement.performer
<b>performedWhen</b>	DateTime	NO	MedicationStatement.effective	MedicationAdministration.effective is dateTime	
<b>asserter</b>	HealthCarePerson	NO	MedicationStatement.informationSource		See also mapping of subclasses of HealthCarePerson
<b>assertedWhen</b>	DateTime	NO	MedicationStatement.dateAsserted		
<b>recorder</b>	Agent	NO	<this_provenance>.agent.who	<this_provenance>.target=<this> <this_provenance>.agent.who	The parameter <this> refers to the FHIR resource

<b>recordedWhen</b>	DateTime	NO	<this_provenance>.recorded	is Reference	mapped to the translated object. <this_provenance> refers to a FHIR resource of type Provenance specifically created to record the provenance of <this>.
<b>status</b>	MedicationStatementStatus	YES	MedicationStatement.status		
<b>medication</b>	MedicationOrSubstance	YES	MedicationStatement.medication		

### Measurement model mapped to HL7-FHIR

The following table doesn't represent the mapping of Measure to FHIR Observation resource because, according to the rule, an abstract class must not be mapped to any FHIR resources. This mapping avoids, merely, to report all the attributes that are mapped in the same way to Observation resource in every subclass of Measure. This choice simplifies the representation of the mapping to FHIR. specification.

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
<b>identifier</b>	Identifier	YES	Observation.identifier	Observation.identifier.value=<IdentifierEntity.Identifier.value>, Observation.identifier.system=<IdentifierEntity.Identifier.system>	
<b>performedWhen</b>	DateTime	YES	Observation.effective	Observation.effective is DateTime	
<b>note</b>	String	NO	Observation.comment		
<b>subject</b>	Patient	YES		Observation.subject.reference.resolve() is Patient	The subject attribute holds a Reference to the Patient
<b>performer</b>	HealthCarePerson	YES		Observation.performer.reference.resolve() is Patient or is Practitioner	The attribute type must be mapped on one of Patient or Practitioner according to the user who is performing the measurement
<b>observationStatus</b>	ObservationStatus	YES	Observation.status	Observation.status="final"	
<b>assertedWhen</b>	dateTime	NO	USED EXTENSION: Observation.assertedWhen		
<b>asserter</b>	HealthCarePerson	NO	USED EXTENSION: Observation.asser		
<b>recorder</b>	Agent	NO	<this_provenance>.agent.who	<this_provenance>.target=<this> <this_provenance>.agent.who is Reference	The parameter <this> refers to the FHIR resource mapped to the

<b>recordedWhen</b>	dateTime	NO	<this_provenance>.recorded		translated object. <this_provenance> refers to a FHIR resource of type Provenance specifically created to record the provenance of <this>.
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### HHR Weight mapped to FHIR Observation

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
				Observation.category.coding[0].display="Vital Signs" Observation.category.coding[0].code="vital-signs" Observation.category.coding[0].system=" <a href="http://hl7.org/fhir/observation-category">http://hl7.org/fhir/observation-category</a> "	
<b>value</b>	WeightQuantity	YES	Observation.value	Observation.value is Quantity Observation.value.unit="Kg" Observation.value.system="http://unitsofmeasure.org" Observation.value.value=<ContinuousQuantity.magnitude>	The preferred unit of measure used for Body Weight is UCUM kilograms (Kg).
			Observation.code	Observation.code.coding[0].display="Body Weight" Observation.code.coding[0].code="body-weight" Observation.code.coding[0].system="http://crowdhealth.eu/hr-t"	

### HHR Height mapped to FHIR Observation

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
				Observation.category.coding[0].display="Vital Signs" Observation.category.coding[0].code="vital-signs" Observation.category.coding[0].system=" <a href="http://hl7.org/fhir/observation-category">http://hl7.org/fhir/observation-category</a> "	
<b>value</b>	LengthQuantity	YES	Observation.value	Observation.value is Quantity Observation.value.unit="m" Observation.value.system="http://unitsofmeasure.org" Observation.value.value=<ContinuousQuantity.magnitude>	The preferred unit of measure used for Body Height is UCUM meters (m).
			Observation.code	Observation.code.coding[0].display="Body height" Observation.code.coding[0].code	



				e="body-height" Observation.code.coding[0].system="http://crowdhealth.eu/hr-t"	
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### HHR Waist mapped to FHIR Observation

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
				Observation.category.coding[0].display="Vital Signs" Observation.category.coding[0].code="vital-signs" Observation.category.coding[0].system="http://hl7.org/fhir/observation-category"	
value	LenghtQuantity	YES	Observation.value	Observation.value is Quantity Observation.value.unit="cm" Observation.value.system="http://unitsofmeasure.org" Observation.value.value=<ContinuousQuantity.magnitude>	The preferred unit of measure used for Body Waist is UCUM centimeters (cm).
			Observation.code	Observation.code.coding[0].display="Waist circumference" Observation.code.coding[0].code="waist-circumference" Observation.code.coding[0].system="http://crowdhealth.eu/hr-t"	

### HHR BMI mapped to FHIR Observation

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
				Observation.category.coding[0].display="Vital Signs" Observation.category.coding[0].code="vital-signs" Observation.category.coding[0].system="http://hl7.org/fhir/observation-category"	
value	BMIQuantity	YES	Observation.value	Observation.value is Quantity Observation.value.unit="Kg/m2" Observation.value.system="http://unitsofmeasure.org" Observation.value.value=<ContinuousQuantity.magnitude>	
			Observation.code	Observation.code.coding[0].display="Body mass index (BMI)" Observation.code.coding[0].code="bmi" Observation.code.coding[0].system="http://crowdhealth.eu/hr-t"	

interpretation	WOF_CODE	NO	Observation.interpretation	Observation.code.coding[0].display=<display value> Observation.code.coding[0].code=<code value> Observation.code.coding[0].system="https://www.worldobesity.org/"	
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### HHR Total\_FI mapped to FHIR Observation

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
				Observation.category.coding[0].display="Vital Signs" Observation.category.coding[0].code="vital-signs" Observation.category.coding[0].system="http://hl7.org/fhir/observation-category"	
value	DimensionlessQuantity	YES	Observation.value	Observation.value is Quantity Observation.value.value=<ContinuousQuantity.magnitude>	
			Observation.code	Observation.code.coding[0].code="Total_FI" Observation.code.coding[0].display="Total physical fitness index" Observation.code.coding[0].system="http://www.crowdhealth.eu/hhr-t"	

### HHR TricepSF mapped to FHIR Observation

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
				Observation.category.coding[0].display="Vital Signs" Observation.category.coding[0].code="vital-signs" Observation.category.coding[0].system="http://hl7.org/fhir/observation-category"	
value	LengthQuantity	YES	Observation.value	Observation.value is Quantity Observation.value.value=<ContinuousQuantity.magnitude> Observation.value.unit="Millimeter" Observation.value.system="http://unitsofmeasure.org" Observation.value.code="mm"	
			Observation.code	Observation.code.coding[0].code="triceps-skin-fold-thickness" Observation.code.coding[0].display="Triceps skin fold thickness"	

				Observation.code.coding[0].system="http://crowdhealth.eu/hr-t"	
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### HHR Run600m mapped to FHIR Observation

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
				Observation.category.coding[0].display="Vital Signs" Observation.category.coding[0].code="vital-signs" Observation.category.coding[0].system="http://hl7.org/fhir/observation-category"	
value	Duration	YES	Observation.value	Observation.value is Quantity Observation.value.value=<ContinuousQuantity.magnitude> Observation.value.unit="Second" Observation.value.system="http://unitsofmeasure.org" Observation.value.code="s"	
			Observation.code	Observation.code.coding[0].code="600m-run" Observation.code.coding[0].display="600m run" Observation.code.coding[0].system="http://www.crowdhealth.eu/hr-t"	

### HHR Dash60m mapped to FHIR Observation

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
				Observation.category.coding[0].display="Vital Signs" Observation.category.coding[0].code="vital-signs" Observation.category.coding[0].system="http://hl7.org/fhir/observation-category"	
value	Duration	YES	Observation.value	Observation.value is Quantity Observation.value.value=<ContinuousQuantity.magnitude> Observation.value.unit="Second" Observation.value.system="http://unitsofmeasure.org" Observation.value.code="s"	
			Observation.code	Observation.code.coding[0].code="60m-dash" Observation.code.coding[0].display="60m dash" Observation.code.coding[0].system="http://www.crowdhealth.eu/hr-t"	

				em="http://www.crowdhealth.eu/hhr-t"	
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### HHR StandAndReach mapped to FHIR Observation

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
				Observation.category.coding[0].display="Vital Signs" Observation.category.coding[0].code="vital-signs" Observation.category.coding[0].system="http://hl7.org/fhir/observation-category"	
value	LenghtQuantity	YES	Observation.value	Observation.value is Quantity Observation.value.value=<ContinuousQuantity.magnitude> Observation.value.unit="Centimeter" Observation.value.system="http://unitsofmeasure.org" Observation.value.code="cm"	
			Observation.code	Observation.code.coding[0].code="stand-and-reach" Observation.code.coding[0].display="Stand and reach" Observation.code.coding[0].system="http://www.crowdhealth.eu/hhr-t"	

### HHR PR\_FI mapped to FHIR Observation

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
				Observation.category.coding[0].display="Vital Signs" Observation.category.coding[0].code="vital-signs" Observation.category.coding[0].system="http://hl7.org/fhir/observation-category"	
value	DimensionlessQuantity	YES	Observation.value	Observation.value is Quantity Observation.value.value=<ContinuousQuantity.magnitude>	
			Observation.code	Observation.code.coding[0].code="performance-related-physical-fitness-index" Observation.code.coding[0].display="Performance related physical fitness index" Observation.code.coding[0].system="http://www.crowdhealth.eu/hhr-t"	

### HHR PolygonBackwards mapped to FHIR Observation

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
				Observation.category.coding[0].display="Vital Signs" Observation.category.coding[0].code="vital-signs" Observation.category.coding[0].system=" <a href="http://hl7.org/fhir/observation-category">http://hl7.org/fhir/observation-category</a> "	
value	Duration	YES	Observation.value	Observation.value is Quantity Observation.value.value=<ContinuousQuantity.magnitude> Observation.value.unit="Second" Observation.value.system="http://unitsofmeasure.org" Observation.value.code="s"	
			Observation.code	Observation.code.coding[0].code="polygon-backwards" Observation.code.coding[0].display="Polygon backwards" Observation.code.coding[0].system="http://www.crowdhealth.eu/hhr-t"	

### HHR ArmPlateTapping mapped to FHIR Observation

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
				Observation.category.coding[0].display="Vital Signs" Observation.category.coding[0].code="vital-signs" Observation.category.coding[0].system=" <a href="http://hl7.org/fhir/observation-category">http://hl7.org/fhir/observation-category</a> "	
value	DimensionlessQuantity	YES	Observation.value	Observation.value is Quantity Observation.value.value=<ContinuousQuantity.magnitude>	
			Observation.code	Observation.code.coding[0].code="arm-plate-tapping" Observation.code.coding[0].display="Arm plate tapping" Observation.code.coding[0].system="http://www.crowdhealth.eu/hhr-t"	

### HHR StandingBroadJump mapped to FHIR Observation

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
				Observation.category.coding[0].display="Vital Signs" Observation.category.coding[0]	

				.code="vital-signs" Observation.category.coding[0].system=" <a href="http://hl7.org/fhir/observation-category">http://hl7.org/fhir/observation-category</a> "	
value	lengthQuantity	YES	Observation.value	Observation.value is Quantity Observation.value.value=<ContinuousQuantity.magnitude> Observation.value.unit="CentiMeter" Observation.value.system="http://unitsofmeasure.org" Observation.value.code="cm"	
			Observation.code	Observation.code.coding[0].code="standing-long-jump" Observation.code.coding[0].display="Standing long jump" Observation.code.coding[0].system="http://www.crowdhealth.eu"	

### HHR HR\_FI mapped to FHIR Observation

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
				Observation.category.coding[0].display="Vital Signs" Observation.category.coding[0].code="vital-signs" Observation.category.coding[0].system=" <a href="http://hl7.org/fhir/observation-category">http://hl7.org/fhir/observation-category</a> "	
value	DimensionlessQuantity	YES	Observation.value	Observation.value is Quantity Observation.value.value=<ContinuousQuantity.magnitude>	
			Observation.code	Observation.code.coding[0].code="health-related-physical-fitness-index" Observation.code.coding[0].display="Health-related physical fitness index" Observation.code.coding[0].system="http://www.crowdhealth.eu/hhr-t"	

### HHR SitUps60s mapped to FHIR Observation

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
				Observation.category.coding[0].display="Vital Signs" Observation.category.coding[0].code="vital-signs" Observation.category.coding[0].system=" <a href="http://hl7.org/fhir/observation-category">http://hl7.org/fhir/observation-category</a> "	
value	Dimension	YES	Observation.value	Observation.value is Quantity	

	nlessQuantity			Observation.value.value=<ContinuousQuantity.magnitude>	
			Observation.code	Observation.code.coding[0].code="sit-ups-60-seconds" Observation.code.coding[0].display="Sit ups 60 seconds" Observation.code.coding[0].system="http://www.crowdhealth.eu/hhr-t"	

### HHR BentArmHang mapped to FHIR Observation

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
				Observation.category.coding[0].display="Vital Signs" Observation.category.coding[0].code="vital-signs" Observation.category.coding[0].system="http://hl7.org/fhir/observation-category"	
value	DimensionlessQuantity	YES	Observation.value	Observation.value is Quantity Observation.value.value=<ContinuousQuantity.magnitude>	
			Observation.code	Observation.code.coding[0].code="bent-arm-hang" Observation.code.coding[0].display="Bent arm-hang" Observation.code.coding[0].system="http://www.crowdhealth.eu/hhr-t"	

### Food intake model mapped to HL7-FHIR

### HHR FoodIntakeFrequency mapped to FHIR Observation

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
value	Category	YES		Observation.category[0].coding[0].code="social-history", Observation.category[0].coding[0].display="Social History", Observation.category[0].coding[0].system="https://www.hl7.org/fhir/valueset-observation-category.html"	
food	Food	YES	Observation.code	Observation.code.coding[0].code=<value_code> Observation.code.coding[0].display=<description> Observation.code.coding[0].system=<terminology URI>	
foodIntakeFrequencyCa	FoodInta		Observation.value	Observation.value is Quantity	



category	keFrequencyCategory				
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### *Heart rate and blood pressure model*

#### **HHR HeartRateMeasure mapped to FHIR Observation**

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
				Observation.category[0].coding[0].code="vital-signs", Observation.category[0].coding[0].display="Vital Signs", Observation.category[0].coding[0].system="http://hl7.org/fhir/observation-category"	
value	HeartRateQuantity	YES	Observation.code	Observation.code.coding[0].code="heart-rate" Observation.code.coding[0].display="Heart rate" Observation.code.coding[0].system="http://crowdhealth.eu/hhr-t"	
			Observation.value	Observation.value is Quantity Observation.value.value=<value>, Observation.value.unit="beats/minute", Observation.value.system="http://unitsofmeasure.org", Observation.value.code="/min"	

#### **HHR SystolicBloodPressure and HHR DiastolicBloodPressure mapped to FHIR Observation**

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
				Observation.category[0].coding[0].code="vital-signs", Observation.category[0].coding[0].display="Vital Signs", Observation.category[0].coding[0].system="http://hl7.org/fhir/observation-category"	
			Observation.code	Observation.code.coding[0].code="blood-pressure" Observation.code.coding[0].display="Blood pressure" Observation.code.coding[0].system="http://crowdhealth.eu/hhr-t"	
SystolicBloodPressure.value	Pressure Quantity	NO	Observation.component	Observation.component[0].value is Quantity Observation.component[0].code.coding[0].code="systolic-blood-pressure"	

				<p>Observation.component[0].code.coding[0].display="Systolic blood pressure", Observation.component[0].code.coding[0].system="<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>"</p> <p>Observation.component[0].value.value=&lt;value&gt;, Observation.component[0].value.unit="mmHg", Observation.component[0].value.system="<a href="http://unitsofmeasure.org">http://unitsofmeasure.org</a>", Observation.component[0].value.code="mm[Hg]"</p>	
DiastolicBloodPressure.value	Pressure Quantity	NO	Observation.component	<p>Observation.component[0].value is Quantity</p> <p>Observation.component[0].code.coding[0].code="diastolic-blood-pressure" Observation.component[0].code.coding[0].display="Diastolic blood pressure", Observation.component[0].code.coding[0].system="<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>"</p> <p>Observation.component[0].value.value=&lt;value&gt;, Observation.component[0].value.unit="mmHg", Observation.component[0].value.system="<a href="http://unitsofmeasure.org">http://unitsofmeasure.org</a>", Observation.component[0].value.code="mm[Hg]"</p>	

### HHR CReactiveProtein mapped to FHIR Observation

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
				<p>Observation.category.coding[0].display="Vital Signs" Observation.category.coding[0].code="vital-signs" Observation.category.coding[0].system="<a href="http://hl7.org/fhir/observation-category">http://hl7.org/fhir/observation-category</a>"</p>	
value	MassConcentrationQuantity	YES	Observation.value	<p>Observation.value is Quantity Observation.value.value=&lt;ContinuousQuantity.magnitude&gt; Observation.value.unit="milligram per liter" Observation.value.system="<a href="http://unitsofmeasure.org">http://unitsofmeasure.org</a>"</p>	

				Observation.value.code="mg/L">	
			Observation.code	Observation.code.coding[0].code="c-reactive-protein" Observation.code.coding[0].display="C-reactive protein measurement" Observation.code.coding[0].system=" <a href="http://www.crowdhealth.eu/hhr-t">http://www.crowdhealth.eu/hhr-t</a> "	

### HHR GlycosilatedHemoglobin mapped to FHIR Observation

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
				Observation.category.coding[0].display="Vital Signs" Observation.category.coding[0].code="vital-signs" Observation.category.coding[0].system=" <a href="http://hl7.org/fhir/observation-category">http://hl7.org/fhir/observation-category</a> "	
value	PercentageQuantity	YES	Observation.value	Observation.value is Quantity Observation.value.value=<ContinuousQuantity.magnitude> Observation.value.unit="percent" Observation.value.system=" <a href="http://unitsofmeasure.org">http://unitsofmeasure.org</a> " Observation.value.code="%">	
			Observation.code	Observation.code.coding[0].code="glycosilated-hemoglobin" Observation.code.coding[0].display="Glucohemoglobin measurement" Observation.code.coding[0].system=" <a href="http://www.crowdhealth.eu/hhr-t">http://www.crowdhealth.eu/hhr-t</a> "	

### HHR MicroalbuminCreatinineRatio mapped to FHIR Observation

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
				Observation.category.coding[0].display="Vital Signs" Observation.category.coding[0].code="vital-signs" Observation.category.coding[0].system=" <a href="http://hl7.org/fhir/observation-category">http://hl7.org/fhir/observation-category</a> "	
value	DimensionlessQuantity	YES	Observation.value	Observation.value is Quantity Observation.value.value=<ContinuousQuantity.magnitude>	
			Observation.code	Observation.code.coding[0].code="microalbumin-creatinine-	

				ratio" Observation.code.coding[0].display="Urine microalbumin/creatinine ratio measurement" Observation.code.coding[0].system="http://www.crowdhealth.eu/hhr-t"	
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### HHR Glucose mapped to FHIR Observation

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
				Observation.category.coding[0].display="Vital Signs" Observation.category.coding[0].code="vital-signs" Observation.category.coding[0].system="http://hl7.org/fhir/observation-category"	
value	MassConcentrationQuantity	YES	Observation.value	Observation.value is Quantity Observation.value.value=<ContinuousQuantity.magnitude> Observation.value.unit="milligram per deciliter" Observation.value.system="http://unitsofmeasure.org" Observation.value.code="mg/dL"	
			Observation.code	Observation.code.coding[0].code="glucose" Observation.code.coding[0].display="Glucose measurement" Observation.code.coding[0].system="http://www.crowdhealth.eu/hhr-t"	

### HHR BloodUrea mapped to FHIR Observation

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
				Observation.category.coding[0].display="Vital Signs" Observation.category.coding[0].code="vital-signs" Observation.category.coding[0].system="http://hl7.org/fhir/observation-category"	
value	MassConcentrationQuantity	YES	Observation.value	Observation.value is Quantity Observation.value.value=<ContinuousQuantity.magnitude> Observation.value.unit="milligram per deciliter" Observation.value.system="http://unitsofmeasure.org" Observation.value.code="mg/dL"	

			Observation.code	L"	
				Observation.code.coding[0].code="blood-urea" Observation.code.coding[0].display="Blood urea measurement" Observation.code.coding[0].system=" <a href="http://www.crowdhealth.eu/hhr-t">http://www.crowdhealth.eu/hhr-t</a> "	

### HHR Creatinine mapped to FHIR Observation

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
				Observation.category.coding[0].display="Vital Signs" Observation.category.coding[0].code="vital-signs" Observation.category.coding[0].system=" <a href="http://hl7.org/fhir/observation-category">http://hl7.org/fhir/observation-category</a> "	
value	MassConcentrationQuantity	YES	Observation.value	Observation.value is Quantity Observation.value.value=<ContinuousQuantity.magnitude> Observation.value.unit="milligram per deciliter" Observation.value.system=" <a href="http://unitsofmeasure.org">http://unitsofmeasure.org</a> " Observation.value.code="mg/dL"	
			Observation.code	Observation.code.coding[0].code="creatinine" Observation.code.coding[0].display="Creatinine measurement" Observation.code.coding[0].system=" <a href="http://www.crowdhealth.eu/hhr-t">http://www.crowdhealth.eu/hhr-t</a> "	

### HHR TotalCholesterol mapped to FHIR Observation

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
				Observation.category.coding[0].display="Vital Signs" Observation.category.coding[0].code="vital-signs" Observation.category.coding[0].system=" <a href="http://hl7.org/fhir/observation-category">http://hl7.org/fhir/observation-category</a> "	
value	MassConcentrationQuantity	YES	Observation.value	Observation.value is Quantity Observation.value.value=<ContinuousQuantity.magnitude> Observation.value.unit="milligram per deciliter" Observation.value.system=" <a href="http://unitsofmeasure.org">http://unitsofmeasure.org</a> "	

				<a href="http://unitsofmeasure.org">p://unitsofmeasure.org</a> Observation.value.code="mg/dL"	
			Observation.code	Observation.code.coding[0].code="total-cholesterol" Observation.code.coding[0].display="Total Cholesterol" Observation.code.coding[0].system="http://www.crowdhealth.eu/hhr-t"	

### HHR LowDensityCholesterol mapped to FHIR Observation

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
				Observation.category.coding[0].display="Vital Signs" Observation.category.coding[0].code="vital-signs" Observation.category.coding[0].system="http://hl7.org/fhir/observation-category"	
value	MassConcentrationQuantity	YES	Observation.value	Observation.value is Quantity Observation.value.value=<ContinuousQuantity.magnitude> Observation.value.unit="milligram per deciliter" Observation.value.system="http://unitsofmeasure.org" Observation.value.code="mg/dL"	
			Observation.code	Observation.code.coding[0].code="low-density-cholesterol" Observation.code.coding[0].display="Low density lipoprotein cholesterol measurement" Observation.code.coding[0].system="http://www.crowdhealth.eu/hhr-t"	

### HHR HighDensityCholesterol mapped to FHIR Observation

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
				Observation.category.coding[0].display="Vital Signs" Observation.category.coding[0].code="vital-signs" Observation.category.coding[0].system="http://hl7.org/fhir/observation-category"	
value	MassConcentrationQuantity	YES	Observation.value	Observation.value is Quantity Observation.value.value=<ContinuousQuantity.magnitude> Observation.value.unit="milligram per deciliter"	

				Observation.value.system=" <a href="http://unitsofmeasure.org">http://unitsofmeasure.org</a> " Observation.value.code="mg/dL"	
			Observation.code	Observation.code.coding[0].code="high-density-cholesterol" Observation.code.coding[0].display="High density lipoprotein cholesterol measurement" Observation.code.coding[0].system=" <a href="http://www.crowdhealth.eu/hhr-t">http://www.crowdhealth.eu/hhr-t</a> "	

### HHR GOTTransaminases mapped to FHIR Observation

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
				Observation.category.coding[0].display="Vital Signs" Observation.category.coding[0].code="vital-signs" Observation.category.coding[0].system=" <a href="http://hl7.org/fhir/observation-category">http://hl7.org/fhir/observation-category</a> "	
value	EnzymeConcentrationQuantity	YES	Observation.value	Observation.value is Quantity Observation.value.value=<ContinuousQuantity.magnitude> Observation.value.unit="enzyme unit per liter" Observation.value.system=" <a href="http://unitsofmeasure.org">http://unitsofmeasure.org</a> " Observation.value.code="U/L"	
			Observation.code	Observation.code.coding[0].code="got-transaminases" Observation.code.coding[0].display="Aspartate aminotransferase measurement" Observation.code.coding[0].system=" <a href="http://www.crowdhealth.eu/hhr-t">http://www.crowdhealth.eu/hhr-t</a> "	

### HHR GPTTransaminases mapped to FHIR Observation

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
				Observation.category.coding[0].display="Vital Signs" Observation.category.coding[0].code="vital-signs" Observation.category.coding[0].system=" <a href="http://hl7.org/fhir/observation-category">http://hl7.org/fhir/observation-category</a> "	
value	EnzymeConcentrationQuantity	YES	Observation.value	Observation.value is Quantity Observation.value.value=<ContinuousQuantity.magnitude>	

	ity			Observation.value.unit="enzyme unit per liter" Observation.value.system=" <a href="http://unitsofmeasure.org">http://unitsofmeasure.org</a> " Observation.value.code="U/L"	
			Observation.code	Observation.code.coding[0].code="gpt-transaminases" Observation.code.coding[0].display="Alanine aminotransferase measurement" Observation.code.coding[0].system=" <a href="http://www.crowdhealth.eu/hhr-t">http://www.crowdhealth.eu/hhr-t</a> "	

### HHR Albumine mapped to FHIR Observation

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
				Observation.category.coding[0].display="Vital Signs" Observation.category.coding[0].code="vital-signs" Observation.category.coding[0].system=" <a href="http://hl7.org/fhir/observation-category">http://hl7.org/fhir/observation-category</a> "	
value	MassConcentrationQuantity	YES	Observation.value	Observation.value is Quantity Observation.value.value=<ContinuousQuantity.magnitude> Observation.value.unit="gram per deciliter" Observation.value.system=" <a href="http://unitsofmeasure.org">http://unitsofmeasure.org</a> " Observation.value.code="g/dL"	
			Observation.code	Observation.code.coding[0].code="albumine" Observation.code.coding[0].display="Albumin measurement" Observation.code.coding[0].system=" <a href="http://www.crowdhealth.eu/hhr-t">http://www.crowdhealth.eu/hhr-t</a> "	

### HHR Calcium mapped to FHIR Observation

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
				Observation.category.coding[0].display="Vital Signs" Observation.category.coding[0].code="vital-signs" Observation.category.coding[0].system=" <a href="http://hl7.org/fhir/observation-category">http://hl7.org/fhir/observation-category</a> "	
value	MassConcentrationQuantity	YES	Observation.value	Observation.value is Quantity Observation.value.value=<ContinuousQuantity.magnitude> Observation.value.unit="milligr	



				am per deciliter" Observation.value.system=" <a href="http://unitsofmeasure.org">http://unitsofmeasure.org</a> " Observation.value.code="mg/dL"	
			Observation.code	Observation.code.coding[0].code="calcium" Observation.code.coding[0].display="Calcium measurement" Observation.code.coding[0].system=" <a href="http://www.crowdhealth.eu/hhr-t">http://www.crowdhealth.eu/hhr-t</a> "	

### HHR Sodium mapped to FHIR Observation

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
				Observation.category.coding[0].display="Vital Signs" Observation.category.coding[0].code="vital-signs" Observation.category.coding[0].system=" <a href="http://hl7.org/fhir/observation-category">http://hl7.org/fhir/observation-category</a> "	
value	AmountOfSubstanceConcentrationQuantity	YES	Observation.value	Observation.value is Quantity Observation.value.value=<ContinuousQuantity.magnitude> Observation.value.unit="milliequivalent per liter" Observation.value.system=" <a href="http://unitsofmeasure.org">http://unitsofmeasure.org</a> " Observation.value.code="meq/L"	
			Observation.code	Observation.code.coding[0].code="sodium" Observation.code.coding[0].display="Sodium measurement" Observation.code.coding[0].system=" <a href="http://www.crowdhealth.eu/hhr-t">http://www.crowdhealth.eu/hhr-t</a> "	

### HHR Potassium mapped to FHIR Observation

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
				Observation.category.coding[0].display="Vital Signs" Observation.category.coding[0].code="vital-signs" Observation.category.coding[0].system=" <a href="http://hl7.org/fhir/observation-category">http://hl7.org/fhir/observation-category</a> "	
value	AmountOfSubstanceConcentrationQuantity	YES	Observation.value	Observation.value is Quantity Observation.value.value=<ContinuousQuantity.magnitude> Observation.value.unit="millieq"	

	antity			ivalent per liter" Observation.value.system=" <a href="http://unitsofmeasure.org">http://unitsofmeasure.org</a> " Observation.value.code="meq/L"	
			Observation.code	Observation.code.coding[0].code="potassium" Observation.code.coding[0].display="Potassium measurement" Observation.code.coding[0].system=" <a href="http://www.crowdhealth.eu/hhr-t">http://www.crowdhealth.eu/hhr-t</a> "	

### HHR TransferrineSaturationIndex mapped to FHIR Observation

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
				Observation.category.coding[0].display="Vital Signs" Observation.category.coding[0].code="vital-signs" Observation.category.coding[0].system=" <a href="http://hl7.org/fhir/observation-category">http://hl7.org/fhir/observation-category</a> "	
value	PercentageQuantity	YES	Observation.value	Observation.value is Quantity Observation.value.value=<ContinuousQuantity.magnitude> Observation.value.unit="percent" Observation.value.system=" <a href="http://unitsofmeasure.org">http://unitsofmeasure.org</a> " Observation.value.code="%"	
			Observation.code	Observation.code.coding[0].code="transferrine-saturation-index" Observation.code.coding[0].display="Transferrin saturation index" Observation.code.coding[0].system=" <a href="http://www.crowdhealth.eu/hhr-t">http://www.crowdhealth.eu/hhr-t</a> "	

### HHR Ferritine mapped to FHIR Observation

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
				Observation.category.coding[0].display="Vital Signs" Observation.category.coding[0].code="vital-signs" Observation.category.coding[0].system=" <a href="http://hl7.org/fhir/observation-category">http://hl7.org/fhir/observation-category</a> "	
value	MassConcentrationQuantity	YES	Observation.value	Observation.value is Quantity Observation.value.value=<ContinuousQuantity.magnitude>	

	y			Observation.value.unit="nanogram per milliliter" Observation.value.system=" <a href="http://unitsofmeasure.org">http://unitsofmeasure.org</a> " Observation.value.code="ng/mL"	
			Observation.code	Observation.code.coding[0].code="ferritine" Observation.code.coding[0].display="Ferritine measurement" Observation.code.coding[0].system=" <a href="http://www.crowdhealth.eu/hhr-t">http://www.crowdhealth.eu/hhr-t</a> "	

### HHR Transferrine mapped to FHIR Observation

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
				Observation.category.coding[0].display="Vital Signs" Observation.category.coding[0].code="vital-signs" Observation.category.coding[0].system=" <a href="http://hl7.org/fhir/observation-category">http://hl7.org/fhir/observation-category</a> "	
<b>value</b>	MassConcentrationQuantity	YES	Observation.value	Observation.value is Quantity Observation.value.value=<ContinuousQuantity.magnitude> Observation.value.unit="milligram per deciliter" Observation.value.system=" <a href="http://unitsofmeasure.org">http://unitsofmeasure.org</a> " Observation.value.code="mg/dL"	
			Observation.code	Observation.code.coding[0].code="transferrine" Observation.code.coding[0].display="Transferrine measurement" Observation.code.coding[0].system=" <a href="http://www.crowdhealth.eu/hhr-t">http://www.crowdhealth.eu/hhr-t</a> "	

## HHR ArterialPh mapped to FHIR Observation

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
				Observation.category.coding[0].display="Vital Signs" Observation.category.coding[0].code="vital-signs" Observation.category.coding[0].system=" <a href="http://hl7.org/fhir/observation-category">http://hl7.org/fhir/observation-category</a> "	
value	DimensionlessQuantity	YES	Observation.value	Observation.value is Quantity Observation.value.value=<ContinuousQuantity.magnitude>	
			Observation.code	Observation.code.coding[0].code="arterial-ph" Observation.code.coding[0].display="pH measurement, arterial" Observation.code.coding[0].system=" <a href="http://www.crowdhealth.eu/hhr-t">http://www.crowdhealth.eu/hhr-t</a> "	

## HHR Hemoglobin mapped to FHIR Observation

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
				Observation.category.coding[0].display="Vital Signs" Observation.category.coding[0].code="vital-signs" Observation.category.coding[0].system=" <a href="http://hl7.org/fhir/observation-category">http://hl7.org/fhir/observation-category</a> "	
value	MassConcentrationQuantity	YES	Observation.value	Observation.value is Quantity Observation.value.value=<ContinuousQuantity.magnitude> Observation.value.unit="gram per deciliter" Observation.value.system=" <a href="http://unitsofmeasure.org">http://unitsofmeasure.org</a> " Observation.value.code="g/dL"	
			Observation.code	Observation.code.coding[0].code="hemoglobin" Observation.code.coding[0].display="Hemoglobin, free measurement" Observation.code.coding[0].system=" <a href="http://www.crowdhealth.eu/hhr-t">http://www.crowdhealth.eu/hhr-t</a> "	

## HHR Hematocrite mapped to FHIR Observation

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
				Observation.category.coding[0].display="Vital Signs" Observation.category.coding[0].code="vital-signs" Observation.category.coding[0].system=" <a href="http://hl7.org/fhir/observation-category">http://hl7.org/fhir/observation-category</a> "	
value	PercentageQuantity	YES	Observation.value	Observation.value is Quantity Observation.value.value=<ContinuousQuantity.magnitude> Observation.value.unit="percent" Observation.value.system=" <a href="http://unitsofmeasure.org">http://unitsofmeasure.org</a> " Observation.value.code="%"	
				Observation.code.coding[0].code="hematocrite" Observation.code.coding[0].display="Hematocrite" Observation.code.coding[0].system=" <a href="http://www.crowdhealth.eu/hhr-t">http://www.crowdhealth.eu/hhr-t</a> "	

## HHR FreeT4 mapped to FHIR Observation

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
				Observation.category.coding[0].display="Vital Signs" Observation.category.coding[0].code="vital-signs" Observation.category.coding[0].system=" <a href="http://hl7.org/fhir/observation-category">http://hl7.org/fhir/observation-category</a> "	
value	MassConcentrationQuantity	YES	Observation.value	Observation.value is Quantity Observation.value.value=<ContinuousQuantity.magnitude> Observation.value.unit="nanogram per deciliter" Observation.value.system=" <a href="http://unitsofmeasure.org">http://unitsofmeasure.org</a> " Observation.value.code="ng/dL"	
			Observation.code	Observation.code.coding[0].code="free-t4" Observation.code.coding[0].display="T4 free measurement" Observation.code.coding[0].system=" <a href="http://www.crowdhealth.eu/hhr-t">http://www.crowdhealth.eu/hhr-t</a> "	

## HHR FreeT3 mapped to FHIR Observation

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
				Observation.category.coding[0].display="Vital Signs" Observation.category.coding[0].code="vital-signs" Observation.category.coding[0].system=" <a href="http://hl7.org/fhir/observation-category">http://hl7.org/fhir/observation-category</a> "	
value	MassConcentrationQuantity	YES	Observation.value	Observation.value is Quantity Observation.value.value=<ContinuousQuantity.magnitude> Observation.value.unit="picogram per deciliter" Observation.value.system=" <a href="http://unitsofmeasure.org">http://unitsofmeasure.org</a> " Observation.value.code="pg/dL"	
			Observation.code	Observation.code.coding[0].code="free-t3" Observation.code.coding[0].display="Free T3" Observation.code.coding[0].system=" <a href="http://www.crowdhealth.eu/hhr-t">http://www.crowdhealth.eu/hhr-t</a> "	

## HHR VenousPh mapped to FHIR Observation

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
				Observation.category.coding[0].display="Vital Signs" Observation.category.coding[0].code="vital-signs" Observation.category.coding[0].system=" <a href="http://hl7.org/fhir/observation-category">http://hl7.org/fhir/observation-category</a> "	
value	DimensionlessQuantity	YES	Observation.value	Observation.value is Quantity Observation.value.value=<ContinuousQuantity.magnitude>	
			Observation.code	Observation.code.coding[0].code="venous-ph" Observation.code.coding[0].display="pH measurement, venous" Observation.code.coding[0].system=" <a href="http://www.crowdhealth.eu/hhr-t">http://www.crowdhealth.eu/hhr-t</a> "	

### *School model mapped to HL7-FHIR*

#### **HHR School mapped to FHIR Organization**

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
				Organization.type.code.system = " <a href="http://hl7.org/fhir/organization-type">http://hl7.org/fhir/organization-type</a> " Organization.type.code.display = "Educational Institute" Organization.type.code.code = "edu"	
<b>identifier</b>	Identifier	YES	Organization.identifier	Organization.identifier.value = <IdentifierEntity.Identifier.value>, Organization.identifier.system = <IdentifierEntity.Identifier.system>	
<b>municipality</b>	Municipality	YES	Organization.partOf		This is a reference to the FHIR Organization resource representing the Municipality to which the School belongs to.

#### **HHR Municipality mapped to FHIR Organization**

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
				Organization.type.code.system = " <a href="http://hl7.org/fhir/organization-type">http://hl7.org/fhir/organization-type</a> " Organization.type.code.display = "Government" Organization.type.code.code = "govt" Organization.name = <name of the Municipality>	
<b>identifier</b>	Identifier	YES	Organization.identifier	Organization.identifier.value = <IdentifierEntity.Identifier.value>, Organization.identifier.system = <IdentifierEntity.Identifier.system>	IdentifierEntity.Identifier.value is the id of the Municipality
<b>region</b>	Region	YES	Organization.partOf		This is a reference to the FHIR Organization resource representing the Region to which the Municipality belongs to.

## HHR Region mapped to FHIR Organization

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
				Organization.type.code.system="http://hl7.org/fhir/organization-type" Organization.type.code.display="Government" Organization.type.code.code="govt" Organization.name=<name of the Region>	
<b>identifier</b>	Identifier	YES	Organization.identifier	Organization.identifier.value=<IdentifierEntity.Identifier.value>, Organization.identifier.system=<IdentifierEntity.Identifier.system>	IdentifierEntity.Identifier.value is the id of the Region

## EpisodeOfCare model mapped to HL7-FHIR

### HHR Encounter mapped to FHIR Encounter

The following table doesn't represent the mapping of Encounter to FHIR Encounter resource because, according to the rule, an abstract class must not be mapped to any FHIR resources. This mapping avoids, merely, to report all the attributes that are mapped in the same way to Encounter resource in every subclass of Encounter. This choice simplifies the representation of the mapping to FHIR specification.

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
<b>identifier</b>	Identifier	YES	Encounter.identifier	Encounter.identifier.value=<IdentifierEntity.Identifier.value>, Encounter.identifier.system=<IdentifierEntity.Identifier.system>	
<b>performedWhen</b>	Period	NO	Encounter.period		
<b>class</b>	code	NO	Encounter.class		
<b>priority</b>	Priority	NO	Encounter.priority		
<b>dischargeDisposition</b>	Discharge Disposition	NO	Encounter.hospitalization.dischargeDisposition		
<b>reason</b>	Reason	NO	Encounter.reason		
<b>diagnosis</b>	Condition Type	NO	Encounter.diagnosis.condition.code		
<b>status</b>	EncounterStatus	YES	Encounter.status		
<b>episodeOfCare</b>	EpisodeOfCare	NO	Encounter.episodeOfCare		
<b>isAutomatic</b>	Boolean	NO	USED Extension: Encounter.isAutomatic		It's true if the performer is an AutomaticAgent
<b>performer</b>	Agent	NO	Encounter.participant.individual	Encounter.participant.type.coding.system="http://hl7.org/fhir/v3/ParticipationType" Encounter.participant.type.con	



				ding.code="PPRF" Encounter.participant.type.con ding.display="primary- performer" Encounter.participant.individua l.resolve() is Practitioner	
<b>subject</b>	Person	NO	Encounter.subject		
<b>assertedWhen</b>	dateTime	NO	USED Extension: Encounter.assertedWhen		
<b>asserter</b>	HealthCa rePerson	NO	USED Extension: Encounter.assertedWhen		
<b>recorder</b>	Agent	NO	<this_provenance>.agent. who	<this_provenance>.target=<this > <this_provenance>.agent.who is Reference	The parameter <this> refers to the FHIR resource mapped to the translated object. <this_provenance> refers to a FHIR resource of type Provenance specifically created to record the provenance of <this>.
<b>recordedWhen</b>	dateTime	NO	<this_provenance>.recorde d		
<b>subjectAge</b>	Value	NO	USED Extension: Encounter.subjectAge		

### HHR HospitalizationEncounter mapped to FHIR Encounter

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
				Encounter.class.system=" <a href="http://hl7.org/fhir/v3/ActCode">http://hl7.org/fhir/v3/ActCode</a> " Encounter.class.code="IMP" Encounter.class.display="inpati ent encounter" Encounter.status="unknown"	
<b>lengthOfStay</b>	int	NO	Encounter.lengthOfStay		Quantity of time the encounter lasted.
<b>reason</b>	Hospitaliz ationRea son	NO	Encounter.reason		
<b>dischargeDisposition</b>	Hospitaliz ationDisc hargeDis position	NO	Encounter.hospitalization.d ischargeDisposition		

### HHR EmergencyEncounter mapped to FHIR Encounter

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
				Encounter.class.system=" <a href="http://hl7.org/fhir/v3/ActCode">http://hl7.org/fhir/v3/ActCode</a> " Encounter.class.code="EMER" Encounter.class.display="emerg ency" Encounter.status="unknown"	

<b>reason</b>	EmergencyReason	NO	Encounter.reason		
<b>dischargeDisposition</b>	EmergencyDischargeDisposition	NO	Encounter.hospitalization.dischargeDisposition		

### HHR EmergencyEncounter mapped to FHIR Encounter

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
				Encounter.class.system=" <a href="http://hl7.org/fhir/v3/ActCode">http://hl7.org/fhir/v3/ActCode</a> " Encounter.class.code="AMB" Encounter.class.display="ambulatory" Encounter.status="unknown"	
<b>appointment</b>	Appointment	NO	Encounter.appointment		The appointment that scheduled the encounter.

### HHR HospitalAtHomeEncounter mapped to FHIR EpisodeOfCare

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
				Encounter.class.system=" <a href="http://hl7.org/fhir/v3/ActCode">http://hl7.org/fhir/v3/ActCode</a> " Encounter.class.code="HH" Encounter.class.display="home health" Encounter.status="unknown"	
<b>lengthOfStay</b>	int	NO	Encounter.lengthOfStay		Quantity of time the encounter lasted.

### HHR EpisodeOfcare mapped to FHIR EpisodeOfcare

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
<b>identifier</b>	Identifier	YES	EpisodeOfCare.identifier	EpisodeOfCare.identifier.value=<IdentifierEntity.Identifier.value>, EpisodeOfCare.identifier.system=<IdentifierEntity.Identifier.system>	
<b>status</b>	EpisodeOfCareStatus	YES	EpisodeOfCare.status	EpisodeOfCare.status="unknown"	
<b>subjectAge</b>	Value	NO	USED Extension: Encounter.subjectAge		
<b>isAutomatic</b>	Boolean	NO	USED Extension: Encounter.isAutomatic		It's true if the performer is an AutomaticAgent
<b>subject</b>	Person	NO	EpisodeOfCare.patient		
<b>performer</b>	HealthCarePerson	NO	EpisodeOfCare.team	CareTeam.participant.role.system=" <a href="http://crowdhealth.eu/hhr-">http://crowdhealth.eu/hhr-</a>	A resource CareTeam is

				<code>CareTeam.participant.role.code="performer-of-event"</code> <code>CareTeam.participant.role.display="Performer of event"</code> <code>CareTeam.participant.member.resolve()</code> is Practitioner or <code>CareTeam.participant.member.resolve()</code> is Patient	created containing the references to the performers. EpisodeOfCare.performer contains the reference to the created CareTeam resource.
<b>performedWhen</b>	Period	NO	EpisodeOfCare.period		
<b>assertedWhen</b>	dateTime	NO	USED Extension EpisodeOfCare.assertedWhen		
<b>asserter</b>	HealthCarePerson	NO	USED Extension EpisodeOfCare.asserter		
<b>recorder</b>	Agent	NO	<code>&lt;this_provenance&gt;.agent.who</code>	<code>&lt;this_provenance&gt;.target=&lt;this&gt;</code> <code>&lt;this_provenance&gt;.agent.who</code> is Reference	The parameter <code>&lt;this&gt;</code> refers to the FHIR resource mapped to the translated object. <code>&lt;this_provenance&gt;</code> refers to a FHIR resource of type Provenance specifically created to record the provenance of <code>&lt;this&gt;</code> .
<b>recordedWhen</b>	dateTime	NO	<code>&lt;this_provenance&gt;.recorded</code>		

## HHR Appointment mapped to FHIR Appointment

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Note
<b>identifier</b>	Identifier	YES	Appointment.identifier	Appointment.identifier.value= <code>IdentifierEntity.Identifier.value</code> , Appointment.identifier.system= <code>IdentifierEntity.Identifier.system</code>	
<b>status</b>	AppointmentStatus	YES	Appointment.status	EpisodeOfCare.status="unknown"	
<b>subjectAge</b>	Value	NO	USED Extension: Appointment.subjectAge		
<b>isAutomatic</b>	Boolean	NO	USED Extension: Appointment.isAutomatic		It's true if the performer is an AutomaticAgent
<b>subject</b>	Person	NO	Appointment.patient		
<b>performer</b>	Agent	NO	Appointment.participant.actor	Encounter.participant.type.code="http://hl7.org/fhir/v3/ParticipationType" Encounter.participant.type.code="PPRF" Encounter.participant.type.code.display="primary-performer" Encounter.participant.type.status="accepted"	
<b>performedWhen</b>	Period	NO	Appointment.start Appointment.end		Either start and end are specified, or neither

assertedWhen	dateTime	NO	USED Extension: Appointment.assertedWhen		
asserter	HealthCarePerson	NO	USED Extension Appointment.asserter		
recorder	Agent	NO	<this_provenance>.agent.who	<this_provenance>.target=<this> <this_provenance>.agent.who is Reference	The parameter <this> refers to the FHIR resource mapped to the translated object. <this_provenance> refers to a FHIR resource of type Provenance specifically created to record the provenance of <this>.
recordedWhen	dateTime	NO	<this_provenance>.recorded		

## 1.2. Used Terminologies

In this section there is the list of terminologies that are adopted for the FHIR representation of the HHRs.

### *Gender enumeration*

Code system: <http://hl7.org/fhir/administrative-gender>

Instance	Code	Display	Definition
MALE	male	male	Male
FEMALE	female	female	Female
OTHER	other	Other	Other

### *ClinicalStatus enumeration*

Code system: <http://hl7.org/fhir/condition-clinical>

Instance	Code	Display	Definition
ACTIVE	active	Active	The subject is currently experiencing the symptoms of the condition or there is evidence of the condition.
ACTIVE_RECURRENCE	recurrence	Recurrence	The subject is having a relapse or re-experiencing the condition after a period of remission or presumed resolution.
INACTIVE	inactive	Inactive	The subject is no longer experiencing the symptoms of the condition or there is no longer evidence of the condition.
INACTIVE_REMISSION	remission	Remission	The subject is no longer experiencing the symptoms of the condition, but there is a risk of the symptoms returning.
INACTIVE_RESOLVED	resolved	Resolved	The subject is no longer experiencing the symptoms of the condition and there is a negligible perceived risk of the symptoms returning.

### Diagnosis enumeration

Code system: <http://crowdhealth.eu/hhr-t>

Instance	Code	Display
INTRADUCTAL_CARCINOMA	intraductal-carcinoma	Intraductal carcinoma
ESTROGEN_RECEPTOR_POSITIVE_TUMOR	estrogen-receptor-positive-tumor	Estrogen receptor positive tumor
ESTROGEN_RECEPTOR_NEGATIVE_NEOPLASM	estrogen-receptor-negative-neoplasm	Estrogen receptor negative neoplasm
PROGESTERONE_RECEPTOR_POSITIVE_TUMOR	progesterone-receptor-positive-tumor	Progesterone receptor positive tumor
PROGESTERONE_RECEPTOR_NEGATIVE_NEOPLASM	progesterone-receptor-negative-neoplasm	Progesterone receptor negative neoplasm
POSITIVE_CARCINOMA_OF_BREAST	her2-positive-carcinoma-of-breast	HER2-positive carcinoma of breast
HUMAN_EPIDERMAL_GROWTH_FACTOR_2_NEGATIVE_CARCINOMA_OF_BREAST	human-epidermal-growth-factor-2-negative-carcinoma-of-breast	Human epidermal growth factor 2 negative carcinoma of breast
MALIGNANT_TUMOR_OF_BREAST	malignant-tumor-of-breast	Malignant tumor of breast
SECONDARY_MALIGNANT_NEOPLASM_OF_LIVER	secondary-malignant-neoplasm-of-liver	Secondary malignant neoplasm of liver
SECONDARY_MALIGNANT_NEOPLASM_OF_LUNG	secondary-malignant-neoplasm-of-lung	Secondary malignant neoplasm of lung
SECONDARY_MALIGNANT_NEOPLASM_OF_KIDNEY	secondary-malignant-neoplasm-of-kidney	Secondary malignant neoplasm of kidney
SECONDARY_MALIGNANT_NEOPLASM_OF_BONE	secondary-malignant-neoplasm-of-bone	Secondary malignant neoplasm of bone
SECONDARY_MALIGNANT_NEOPLASM_OF_BRAIN	secondary-malignant-neoplasm-of-brain	Secondary malignant neoplasm of brain

### ClinicalFinding enumeration

Code system: <http://crowdhealth.eu/hhr-t>

Instance	Code	Display
DIABETES_MELLITUS	diabetes-mellitus	Diabetes mellitus
HYPERCHOLESTEROLEMIA	hypercholesterolemia	Hypercholesterolemia
CROHN-S_DISEASE	crohn-s-disease	Crohn's disease
IRRITABLE_BOWEL_SYNDROME	irritable-bowel-syndrome	Irritable bowel syndrome
STRUCTURAL_DISORDER_OF_HEART	structural-disorder-of-heart	Structural disorder of heart
HYPERTENSIVE_DISORDER_SYSTEMIC_ARTERIAL	hypertensive-disorder-systemic-arterial	Hypertensive disorder, systemic arterial
CHRONIC_KIDNEY_DISEASE	chronic-kidney-disease	Chronic kidney disease
ACID_REFLUX	acid-reflux	Acid reflux
ANEMIA	anemia	Anemia
NEOPLASM_OF_LIVER	neoplasm-of-liver	Neoplasm of liver
NEOPLASM_OF_KIDNEY	neoplasm-of-kidney	Neoplasm of kidney
NEOPLASM_OF_BONE	neoplasm-of-bone	Neoplasm of bone
TUMOR_OF_ESOPHAGUS_STOMACH_AND-OR_DUODENUM	tumor-of-esophagus-stomach-and-or-duodenum	Tumor of esophagus, stomach and/or duodenum
LOSS_OF_APPETITE	loss-of-appetite	Loss of appetite
TASTE_SENSE_ALTERED	taste-sense-altered	Taste sense altered
SWALLOWING_PROBLEM	swallowing-problem	Swallowing problem
NAUSEA	nausea	Nausea
VOMITING_SYMPTOM	vomiting-symptom	Vomiting symptom
ALTERATION_IN_BOWEL_ELIMINATION_CONSTIPATION	alteration-in-bowel-elimination-constipation	Alteration in bowel elimination: constipation

DIARRHEA	diarrhea	Diarrhea
SORE_MOUTH	sore-mouth	Sore mouth
XEROSTOMIA	xerostomia	Xerostomia
SENSITIVE_TO_SMELLS	sensitive-to-smells	Sensitive to smells
EARLY_SATIETY	early-satiety	Early satiety
FATIGUE	fatigue	Fatigue
STOMACH_ACHE	stomach-ache	Stomach ache
PERIPHERAL_NERVE_DISEASE	peripheral-nerve-disease	Peripheral nerve disease
LYMPHEDEMA	lymphedema	Lymphedema

### *ProcedureStatus enumeration*

Code system: <http://hl7.org/fhir/event-status>

Instance	Code	Display	Definition
PREPARATION	preparation	Preparation	The core event has not started yet, but some staging activities have begun (e.g. surgical suite preparation). Preparation stages may be tracked for billing purposes.
IN_PROGRESS	in-progress	In progress	The event is currently occurring.
SUSPENDED	suspended	Suspended	The event has been temporarily stopped but is expected to resume in the future.
ABORTED	aborted	Aborted	The event was prior to the full completion of the intended actions.
COMPLETED	completed	Completed	The event has now concluded.
ENTERED_IN_ERROR	entered-in-error	Entered in error	This electronic record should never have existed, though it is possible that real-world decisions were based on it. (If real-world activity has occurred, the status should be "cancelled" rather than "entered-in-error".)
UNKNOWN	unknown	Unknown	The authoring system does not know which of the status values currently applies for this request. Note: This concept is not to be used for "other" - one of the listed statuses is presumed to apply, it's just not known which one.

### *MedicationAdministrationStatus enumeration*

Code system: <http://hl7.org/fhir/medication-admin-status>

Instance	Code	Display	Definition
IN_PROGRESS	in-progress	In progress	The administration has started but has not yet completed.
ON_HOLD	on-hold	On hold	Actions implied by the administration have been temporarily halted, but are expected to continue later. May also be called "suspended".
COMPLETED	completed	Completed	All actions that are implied by the administration have occurred.
ENTERED_IN_ERROR	entered-in-error	Entered in error	The administration was entered in error and therefore nullified.
STOPPED	stopped	Stopped	Actions implied by the administration have been permanently halted, before all of them occurred.
UNKNOWN	unknown	Unknown	The authoring system does not know which of the status values currently applies for this request. Note: This concept is not to be used for "other" - one of the listed statuses is presumed to apply, it's just not known which one.

### MedicationStatementStatus enumeration

Code system: <http://hl7.org/fhir/medication-statement-status>

Instance	Code	Display	Definition
ACTIVE	active	Active	The medication is still being taken.
COMPLETED	completed	Completed	The medication is no longer being taken.
ENTERED_IN_ERROR	entered_in_error	Entered in error	The statement was recorded incorrectly.
INTENDED	intended	Intended	The medication may be taken at some time in the future.
STOPPED	stopped	Stopped	Actions implied by the statement have been permanently halted, before all of them occurred.
ON_HOLD	on_hold	On hold	Actions implied by the statement have been temporarily halted, but are expected to continue later. May also be called "suspended".

### Substance enumeration

This enumeration is mapped on different FHIR type depending on if the ingredients attribute id empty or not.

#### HHR Substance encoded with FHIR Substance

Attribute or associationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Notes
				this.ingredients.empty().not()	Mapping to be used for Substances with ingredients.
ingredient	Substance	NO		Substance.ingredient.item=<ingredient>	

#### HHR Substance encoded with FHIR CodeableConcept

Attribute or AssociationEnd	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Notes
				this.ingredients.empty()	Mapping to be used for Substances without ingredients.
				CodeableConcept.coding.code[0].code=<Code> CodeableConcept.coding[0].display=<Display> CodeableConcept.coding[0].system=" <a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a> "	The values <Code> and <Display> depend from the specific translated instance of the enumeration. See next table.

Code system: <http://crowdhealth.eu/hhr-t>

Instance	Value of Attribute: name	Values of attribute: ingredient	Code	Display
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Anastrozole	Anastrozole (Arimidex ®)		anastrozole	Anastrozole
Bevacizumab	Bevacizumab (Avastin ®)		bevacizumab	Bevacizumab
Cisplatin	Cisplatin		cisplatin	Cisplatin
Cyclophosphamide	Cyclophosphamide		cyclophosphamide	Cyclophosphamide
Docetaxel	Docetaxel (Taxotere ®)		docetaxel	Docetaxel
Doxorubicin	Doxorubicin		doxorubicin	Doxorubicin
Epirubicin	Epirubicin (Pharmorubicin ®)		epirubicin	Epirubicin
Eribulin	Eribulin (Halaven ®)		eribulin	Eribulin
Exemestane	Exemestane (Aromasin ®)		exemestane	Exemestane
FEC	FEC: fluorouracil (5FU), epirubicin, cyclophosphamide	<b>Fluorouracil Epirubicin Cyclophosphamide</b>		
FEC-T	FEC-T: fluorouracil (5FU), epirubicin, cyclophosphamide, docetaxel (Taxotere ®)	<b>Fluorouracil Epirubicin Cyclophosphamide Docetaxel</b>		
Fluorouracil	Fluorouracil (5FU)		fluorouracil	Fluorouracil
Fulvestrant	Fulvestrant (Faslodex ®)		fulvestrant	Fulvestrant
Gemcitabine	Gemcitabine (Gemzar ®)		gemcitabine	Gemcitabine
Goserelin	Goserelin (Zoladex ®)		goserelin	Goserelin
Letrozole	Letrozole (Femara ®)		letrozole	Letrozole
Methotrexate	Methotrexate		methotrexate	Methotrexate
Paclitaxel	Paclitaxel (Taxol ®)		paclitaxel	Paclitaxel
Tamoxifen	Tamoxifen (Nolvadex ®)		tamoxifen	Tamoxifen
Toremifene	Toremifene (Fareston ®)		toremifene	Toremifene
Trastuzumab	Trastuzumab (Herceptin ®)		trastuzumab	Trastuzumab
TrastuzumabEmtansine	Trastuzumab emtansine (Kadcyla ®)		trastuzumab- emtansine	Trastuzumab emtansine
Everolimus	Everolimus (Afinitor ®)		everolimus	Everolimus
Palbociclib	Palbociclib (Ibrance ®)		palbociclib	Palbociclib
Pertuzumab	Pertuzumab (Perjeta ®)		pertuzumab	Pertuzumab
Capecitabine	Capecitabine (Xeloda ®)		capecitabine	Capecitabine
Lapatinib	Lapatinib (Tyverb®)		lapatinib	Lapatinib
AC	AC (doxorubicin (Adriamycin ®), cyclophosphamide)	<b>Doxorubicin Cyclophosphamide</b>		
Capecitabine-Taxotere	Capecitabine (Xeloda ®) and Docetaxel (Taxotere ®)	<b>Capecitabine Docetaxel</b>		
EC	EC (epirubicin, cyclophosphamide)	<b>Epirubicin Cyclophosphamide</b>		
ECF	ECF (epirubicin (Pharmorubicin ®), cisplatin, fluorouracil (5FU))	<b>Epirubicin Cisplatin Fluorouracil</b>		
E-CMF	E-CMF (epirubicin (Pharmorubicin ®), cyclophosphamide, methotrexate, fluorouracil)	<b>Epirubicin Cyclophosphamide Methotrexate Fluorouracil</b>		

### WOF\_CODE enumeration

Code system: <https://www.worldobesity.org/>

Instance	Code	Display
UNDERWEIGHT	underweight	underweight
NORMAL_WEIGHT	normal-weight	normal weight
OVER_WEIGHT	over-weight	over weight



OBESE	obese	obese
MORBIDLY_OBESE	morbidly-obese	morbidly obese

### Food enumeration

Code system: <http://crowdhealth.eu/hhr-t>

Instance	Code	Display
READ_MEAT_INTAKE	red-meat-intake	Red meat intake
WHITE_MEAT_INTAKE	white-meat-intake	White meat intake
FISH_INTAKE	fish-intake	Fish intake
PULSE_VEGETABLE_INTAKE	pulse-vegetable-intake	Pulse vegetable intake
EGG_INTAKE	egg-intake	Egg intake
DAIRY_FOOD_INTAKE	dairy-food-intake	Dairy food intake
NUTS_AND_SEEDS_INTAKE	nuts-and-seeds-intake	Nuts and seeds intake
FRUIT_INTAKE	fruit-intake	Fruit intake
VEGETABLE_INTAKE	vegetable-intake	Vegetable intake
BREAD_INTAKE	bread-intake	Bread intake
PASTA_INTAKE	pasta-intake	Pasta intake
POTATO_INTAKE	potato-intake	Potato intake

### FoodIntakeFrequencyCategory enumeration

Attribute or association	Type	Mandatory (YES/NO)	FHIR mapping	Assumptions	Notes
				Quantity.value=<Value> Quantity.unit="portions per week" Quantity.system=" <a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a> " Quantity.code=portions-per-week Quantity.comparator=<Comparator>	The values <Value>, <URI> and <Comparator> depend from the specific translated instance of the enumeration. See next table.

Code system: <http://crowdhealth.eu/hhr-t>

Instance	Value	Comparator
O_PORTIONS_PER_WEEK	0	N/A
1_PORTION_PER_WEEK	1	N/A
2_PORTIONS_PER_WEEK	2	N/A
3_PORTIONS_PER_WEEK	3	N/A
4_PORTIONS_PER_WEEK	4	N/A

5_PORTIONS_PER_WEEK	5	N/A
6_PORTIONS_PER_WEEK	6	N/A
7_PORTIONS_PER_WEEK	7	N/A
8_PORTIONS_PER_WEEK	8	N/A
8_OR_MORE_PORTIONS_PER_WEEK	8	>=
9_PORTIONS_PER_WEEK	9	N/A
10_PORTIONS_PER_WEEK	10	N/A
11_PORTIONS_PER_WEEK	11	N/A
12_PORTIONS_PER_WEEK	12	N/A
13_PORTIONS_PER_WEEK	13	N/A
14_PORTIONS_PER_WEEK	14	N/A
15_PORTIONS_PER_WEEK	15	N/A
16_PORTIONS_PER_WEEK	16	N/A
16_OR_MORE_PORTIONS_PER_WEEK	16	>=
17_PORTIONS_PER_WEEK	17	N/A
18_PORTIONS_PER_WEEK	18	N/A
19_PORTIONS_PER_WEEK	19	N/A
20_PORTIONS_PER_WEEK	20	N/A
21_PORTIONS_PER_WEEK	21	N/A
22_PORTIONS_PER_WEEK	22	N/A
23_OR_MORE_PORTIONS_PER_WEEK	23	>=

### Grade enumeration

Code system: <http://crowdhealth.eu/hhr-t>

Instance	Code	Display
1ST_GRADE_OF_PRIMARY_SCHOOL	<u>1st-grade-of-primary-school</u>	1st grade of primary school
2ND_GRADE_OF_PRIMARY_SCHOOL	2nd-grade-of-primary-school	2nd grade of primary school
3RD_GRADE_OF_PRIMARY_SCHOOL	3rd-grade-of-primary-school	3rd grade of primary school
4TH_GRADE_OF_PRIMARY_SCHOOL	4th-grade-of-primary-school	4th grade of primary school
5TH_GRADE_OF_PRIMARY_SCHOOL	5th-grade-of-primary-school	5th grade of primary school
1ST_GRADE_OF_LOWER_SECONDARY_SCHOOL	1st-grade-of-lower-secondary-school	1st grade of lower secondary school
2ND_GRADE_OF_LOWER_SECONDARY_SCHOOL	2nd-grade-of-lower-secondary-school	2nd grade of lower secondary school
3RD_GRADE_OF_LOWER_SECONDARY_SCHOOL	3rd-grade-of-lower-secondary-school	3rd grade of lower secondary school
1ST_GRADE_OF_UPPER_SECONDARY_SCHOOL	1st-grade-of-upper-secondary-school	1st grade of upper secondary school
2ND_GRADE_OF_UPPER_SECONDARY_SCHOOL	2nd-grade-of-upper-secondary-school	2nd grade of upper secondary school
3RD_GRADE_OF_UPPER_SECONDARY_SCHOOL	3rd-grade-of-upper-secondary-school	3rd grade of upper secondary school
4TH_GRADE_OF_UPPER_SECONDARY_SCHOOL	4th-grade-of-upper-secondary-school	4th grade of upper secondary school
5TH_GRADE_OF_UPPER_SECONDARY_SCHOOL	5th-grade-of-upper-secondary-school	5th grade of upper secondary school

### *Slovenian Regions enumeration*

Code system: <http://crowdhealth.eu/hhr-t>

Region id	Region Name
1	Pomurska
2	Podravska
3	Koroška
4	Savinjska
5	Zasavska
6	Posavska
7	Jugovzhodna Slovenija
8	Osrednjeslovenska
9	Gorenjska
10	Primorsko-notranjska
11	Goriška
12	Obalno-kraška

### *Slovenian Municipalities*

Code system: <http://crowdhealth.eu/hhr-t>

Municipalities	Name
1	Municipality of Ajdovščina
...	
212	Municipality of Mirna

### *HospitalizationDischargeDisposition enumeration*

Code system: <http://crowdhealth.eu/hhr-t>

Instance	Code	Display
HEALING_OR_IMPROVEMENT	hearing-or-improvement	Hearing or improvement
VOLUNTARY_DISCHARGE	voluntary-discharge	Voluntary discharge
TRANSFER	transfer	Transfer
EXITUS	exitus	Exitus
OTHER	other	Other
IN_EXTREMIS	in-extremis	In extremis

### *EmergencyDischargeDisposition enumeration*

Code system: <http://crowdhealth.eu/hhr-t>

Instance	Code	Display
UNKNOWN	unknown	Unknown
HOME	home	Home

VOLUNTARY_DISCHARGE	voluntary-discharge	Voluntary discharge
TRANSFER_TO_OTHER_HOSPITAL	transfer-to-other-hospital	Transfer to other hospital
EXITUS	exitus	Exitus
OUTPATIENT_CONSULTATION	outpatient-consultation	Outpatient consultation
HOSPITALIZATION	hospitalization	Hospitalization
GENERAL_PRACTITIONER	general-practitioner	General practitioner
RUNAWAY	runaway	Runaway
OTHER	other	Other
DISCIPLINARY_DISCHARGE	disciplinary-discharge	Disciplinary discharge
MATERNITY_TRANSFER	maternity-transfer	Maternity transfer
DAY_HOSPITAL	day-hospital	Day hospital
HOSPITAL_AT_HOME	hospital-at-home	Hospital at home
SURGERY_WITHOUT_ADMISSION	surgery-without-admission	Surgery without admission
PEADITRIC_TRANSFER	peaditric-transfer	Peaditric transfer
GENERAL_TRANSFER	general-transfer	General transfer
ACUTE_HOSPITAL	acute-hospital	Acute hospital
MEDIUM_AND_LONG_STAY_UNIT_TRANSFER	medium-and-long-stay-unit-transfe	Medium and long stay unit transfer

### *HospitalizationReason enumeration*

Code system: <http://crowdhealth.eu/hhr-t>

Instance	Code	Display
UNDETERMINED	undetermined	Undetermined
MEDICAL_EXAMINATION_STUDY	medical-examination -study	Medical examination study
COMMON_DISEASE	common-disease	Common disease
TRAFFIC_ACCIDENT	traffic-accident	Traffic accident
WORK_ACCIDENT	work-accident	Work accident
CASUAL_ACCIDENT	casual-accident	Casual accident
SELF_INJURY	self-injury	Self injury
AGGRESSION	aggression	Aggression
CHILDBIRTH_GESTATION	childbirth-gestation	Childbirth gestation
OTHERS	others	Others
NEONATE	neonate	Neonate
URGENT_FROM_CEX	urgent-from-cex	Urgent from cex
SURGICAL_COMPLICATIONS	surgical-complications	Surgical complications
DAY_HOSPITAL_COMPLICATIONS	day-hospital-complications	Day hospital complications
TECHNICAL_COMPLICATIONS	technical-complications	Technical complications
INFARCTION	infarction	Infarction
URGENT_TRANSFER	urgent-transfer	Urgent transfer
PLANNED_TRANSFER	planned-transfer	planned transfer
INFLUENZA_A_EXAM	influenza-a-exam	Influenza A exam
PROBABLE_INFLUENZA_A	probable-influenza-a	Probable influenza A

CONFIRMED_INFLUENZA_A	confirmed-influenza-a	Confirmed influenza A
UCSI_COMPLICATIONS	ucsi-complications	UCSI complications
CATASTROPHE	catastrophe	Catastrophe

### *EmergencyReason enumeration*

Code system: <http://crowdhealth.eu/hhr-t>

Instance	Code	Display
UNDETERMINED	undetermined	Undetermined
PATIENT_DECISION	patient decision	Patient decision
MEDICAL_DECISION	medical decision	Medical decision
FAMILY_DECISION	family decision	Family decision
GOVERNMENT_DECISION	government decision	Government decision
JUDGE_DECISION	judge decision	Judge decision
TRANSFER	transfer	Transfer
OTHER_MOTIVATION	other motivation	Other motivation

### *AppointmentStatus enumeration*

Code system: <https://www.hl7.org/fhir/appointmentstatus>

Instance	Code	Display	Definition
PROPOSED	proposed	Propose	None of the participant(s) have finalized their acceptance of the appointment request, and the start/end time may not be set yet.
PENDING	pending	Pending	Some or all of the participant(s) have not finalized their acceptance of the appointment request.
BOOKED	booked	Booked	All participant(s) have been considered and the appointment is confirmed to go ahead at the date/times specified.
ARRIVED	arrived	Arrived	Some of the patients have arrived.
FULFILLED	fulfilled	Fulfilled	This appointment has completed and may have resulted in an encounter.
CANCELLED	cancelled	Cancelled	The appointment has been cancelled.
NOSHOW	noshow	No Show	Some or all of the participant(s) have not/did not appear for the appointment (usually the patient).
ENTER-IN-ERROR	enter-in-error	Enter in error	This instance should not have been part of this patient's medical record.

### *EncounterStatus enumeration*

Code system: <https://www.hl7.org/fhir/encounter-status>

Instance	Code	Display	Definition
PLANNED	planned	Planned	The Encounter has not yet started.
ARRIVED	arrived	Arrived	The Patient is present for the encounter, however is not currently meeting with a practitioner.

<b>TRIAGE</b>	triage	Triage	The patient has been assessed for the priority of their treatment based on the severity of their condition.
<b>IN-PROGRESS</b>	in-progress	In Progress	The Encounter has begun and the patient is present / the practitioner and the patient are meeting.
<b>ONLEAVE</b>	onleave	Onleave	The Encounter has begun, but the patient is temporarily on leave.
<b>FINISHED</b>	finished	Finished	The Encounter has ended..
<b>CANCELLED</b>	cancelled	Cancelled	The Encounter has ended before it has begun.
<b>ENTER-IN-ERROR</b>	enter-in-error	Enter In Error	This instance should not have been part of this patient's medical record.
<b>UNKNOWN</b>	unknown	Unknown	The encounter status is unknown.

### *EpisodeOfCareStatus enumeration*

Code system: <https://www.hl7.org/fhir/episode-of-care-status>

Instance	Code	Display	Definition
<b>PLANNED</b>	planned	Planned	This episode of care is planned to start at the date specified in the period.start. During this status, an organization may perform assessments to determine if the patient is eligible to receive services, or be organizing to make resources available to provide care services.
<b>WAITLIST</b>	waitlist	Waitlist	This episode has been placed on a waitlist, pending the episode being made active.
<b>ACTIVE</b>	active	Active	This episode of care is current.
<b>ON-HOLD</b>	on-hold	On Hold	This episode of care is on hold, the organization has limited responsibility for the patient.
<b>FINISHED</b>	finished	Finished	This episode of care is finished and the organization is not expecting to be providing further care to the patient. Can also be known as "closed", "completed" or other similar terms.
<b>CANCELLED</b>	cancelled	Cancelled	The episode of care was cancelled, or withdrawn from service, often selected during the planned stage as the patient may have gone elsewhere, or the circumstances have changed and the organization is unable to provide the care. It indicates that services terminated outside the planned/expected workflow.
<b>ENTER-IN-ERROR</b>	enter-in-error	Enter In Error	This instance should not have been part of this patient's medical record.

## 1.3. FHIR Extensions

Extensions are a key part of the FHIR specification, providing a standardized way to place additional data in a resource (or extend the data included in a defined element)<sup>1</sup>. In the case some data is not representable with some existing FHIR elements, an extension to the

<sup>1</sup> You can find all information about FHIR extensions at this link: <https://www.hl7.org/fhir/extensibility.html>

standard is provided. When a new element is defined, to be added to an existing FHIR resource, the following information are provided:

- **ResourceName**: name of the resource where the element is added.
- **ElementName**: the name of the element (sequence of Unicode characters).
- **ElementDefinition**: short description of the semantics of the new element.
- **ElementCardinality**: the minimum number of required appearances and the maximum number. These numbers specify the number of times the element may appear in any instance of the resource type. The cardinalities allow are: 0..1, 0..\*, 1..1, and 1..\*.
- **ElementType**<sup>2</sup>: data type of the element (for example string, date, boolean, CodeableConcept, Identifier, Coding etc.).
- **Comment**: any additional information need to explain how to use the element.
- **Is-modifier (true/false)**: an element is labelled “Is-modifier = true” if the value it contains may change the interpretation of the element that contains it (including if the element is the resource as a whole).
- **Terminology Binding**: if the element has a coded value<sup>3</sup>, in other words if the values of the element are restricted to a given set of codes or values, the used terminology or value set is indicated or defined (if not already existing).

#### *Extensions for the resource Patient*

ResourceName	Patient
ElementName	registeredWhen
ElementDefinition	When the patient was registered for the first time into the system
ElementCardinality	0..1
ElementType	dateTime
Comment	
Is-modifier	false
Terminology Binding	N.A.

#### *Extensions for the resource Practitioner*

ResourceName	Practitioner
ElementName	registeredWhen
ElementDefinition	When the practitioner was registered for the first time into the system
ElementCardinality	0..1
ElementType	dateTime
Comment	
Is-modifier	false
Terminology Binding	N.A.

<sup>2</sup> Fhir contains four categories of data types: Primitive types, Complex types, Complex data for metadata and special purpose data types.

<sup>3</sup> <https://www.hl7.org/fhir/terminologies.html>

### *Extensions for the resource Condition*

ResourceName	Condition
ElementName	isAutomatic
ElementDefinition	It's true if the performer is an automatic Agent
ElementCardinality	0..1
ElementType	Boolean
Comment	
Is-modifier	false
Terminology Binding	N.A.

ResourceName	Condition
ElementName	performer
ElementDefinition	Who performed the recorded Condition.
ElementCardinality	0..1
ElementType	Reference: Patient   Practitioner
Comment	
Is-modifier	false
Terminology Binding	N.A.

ResourceName	Condition
ElementName	performedWhen
ElementDefinition	When the recorded Condition was performed.
ElementCardinality	0..1
ElementType	dateTime
Comment	
Is-modifier	false
Terminology Binding	N.A.

### *Extensions for the resource Procedure*

ResourceName	Procedure
ElementName	isAutomatic
ElementDefinition	It's true if the performer is an automatic Agent
ElementCardinality	0..1
ElementType	Boolean
Comment	
Is-modifier	false
Terminology Binding	N.A.

ResourceName	Procedure
ElementName	asserter
ElementDefinition	Who asserted that the recorded Procedure happened.
ElementCardinality	0..1
ElementType	Reference: Patient   Practitioner
Comment	
Is-modifier	false
Terminology Binding	N.A.



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ResourceName	Procedure
ElementName	assertedWhen
ElementDefinition	When the asserted stated that the recorded Procedure happened.
ElementCardinality	0..1
ElementType	dateTime
Comment	
Is-modifier	false
Terminology Binding	N.A.

### *Extensions for the resource Observation*

ResourceName	Observation
ElementName	asserter
ElementDefinition	Who asserted that the recorded Observation happened
ElementCardinality	0..1
ElementType	Reference: Patient   Practitioner   RelatedPerson
Comment	
Is-modifier	false
Terminology Binding	N.A.

ResourceName	Observation
ElementName	assertedWhen
ElementDefinition	When the asserted stated that the recorded Observation happened
ElementCardinality	0..1
ElementType	dateTime
Comment	
Is-modifier	false
Terminology Binding	N.A.

### *Extensions for the resource Encounter*

ResourceName	Encounter
ElementName	isAutomatic
ElementDefinition	It's true if the performer is an AutomaticAgent
ElementCardinality	0..1
ElementType	boolean
Comment	
Is-modifier	false
Terminology Binding	N.A.

ResourceName	Encounter
ElementName	assertedWhen
ElementDefinition	When the asserted stated that the recorded encounter happened.
ElementCardinality	0..1
ElementType	dateTime
Comment	
Is-modifier	false
Terminology Binding	N.A.

---

ResourceName	Encounter
ElementName	asserter
ElementDefinition	Who asserted that the recorded event (Encounter) happened.
ElementCardinality	0..1
ElementType	Reference Patient   Practitioner   Person
Comment	
Is-modifier	false
Terminology Binding	N.A.

ResourceName	Encounter
ElementName	subjectAge
ElementDefinition	Age of the subject at the time of the event.
ElementCardinality	0..1
ElementType	Duration   Range
Comment	
Is-modifier	false
Terminology Binding	N.A.

### *Extensions for the resource EpisodeOfCare*

ResourceName	EpisodeOfCare
ElementName	isAutomatic
ElementDefinition	It's true if the performer is an AutomaticAgent.
ElementCardinality	0..1
ElementType	boolean
Comment	
Is-modifier	false
Terminology Binding	N.A.

ResourceName	EpisodeOfCare
ElementName	assertedWhen
ElementDefinition	When the asserted stated that the recorded episode of care happened.
ElementCardinality	0..1
ElementType	datetime
Comment	
Is-modifier	false
Terminology Binding	N.A.

ResourceName	EpisodeOfCare
ElementName	asserter
ElementDefinition	Who asserted that the recorded event (EpisodeOfCare) happened.
ElementCardinality	0..1
ElementType	Reference Patient   Practitioner   Person
Comment	
Is-modifier	false
Terminology Binding	N.A.

ResourceName	EpisodeOfCare
ElementName	subjectAge
ElementDefinition	Age of the subject at the time of event.
ElementCardinality	0..1
ElementType	Duration   Range

<b>Comment</b>	
<b>Is-modifier</b>	false
<b>Terminology Binding</b>	N.A.

### *Extensions for the resource Appointment*

<b>ResourceName</b>	<b>Appointment</b>
<b>ElementName</b>	isAutomatic
<b>ElementDefinition</b>	It's true if the performer is an AutomaticAgent.
<b>ElementCardinality</b>	0..1
<b>ElementType</b>	boolean
<b>Comment</b>	
<b>Is-modifier</b>	false
<b>Terminology Binding</b>	N.A.

<b>ResourceName</b>	<b>Appointment</b>
<b>ElementName</b>	assertedWhen
<b>ElementDefinition</b>	Who asserted that the recorded event (Appointment) happened.
<b>ElementCardinality</b>	0..1
<b>ElementType</b>	datetime
<b>Comment</b>	
<b>Is-modifier</b>	false
<b>Terminology Binding</b>	N.A.

<b>ResourceName</b>	<b>Appointment</b>
<b>ElementName</b>	asserter
<b>ElementDefinition</b>	When the asserted stated that the recorded event happened.
<b>ElementCardinality</b>	0..1
<b>ElementType</b>	Reference Patient   Practitioner   Person
<b>Comment</b>	
<b>Is-modifier</b>	false
<b>Terminology Binding</b>	N.A.

<b>ResourceName</b>	<b>Appointment</b>
<b>ElementName</b>	subjectAge
<b>ElementDefinition</b>	Age of the subject at the time of the appointment.
<b>ElementCardinality</b>	0..1
<b>ElementType</b>	Duration   Range
<b>Comment</b>	
<b>Is-modifier</b>	false
<b>Terminology Binding</b>	N.A.



# CrowdHEALTH

**Collective Wisdom Driving Public Health Policies**

## **Del. no. – D3.1 Annex B: Use case dataset description template**

**Project Deliverable**



This project has received funding from the European Union's Horizon 2020 Programme (H2020-SC1-2016-CNECT) under Grant Agreement No. 727560

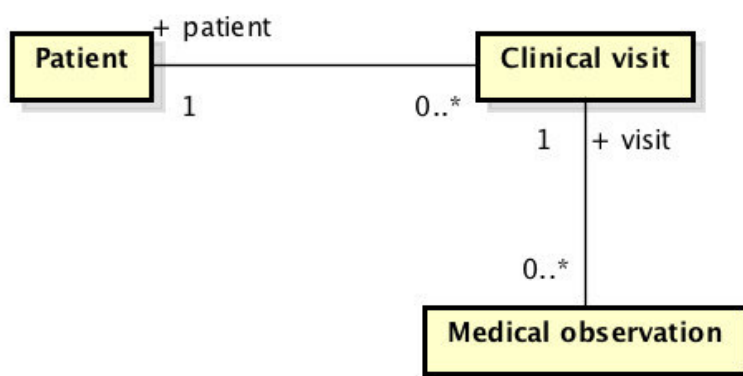
## Appendix A.

### <Dataset name>

< Add one section for each dataset you have in your UC. >

### Conceptual diagram

< Provide a simple UML class diagram representing the names of entities described in the dataset, their relationship and cardinality. Just for reference, the following figure provides an example of class diagram to be replaced with the actual diagram of the dataset. The class diagram is not required if there is only one entity in the dataset or there are only entities without relationships. >



### List of entities

<List and describe the entities reported in the conceptual diagram of the previous section using a table as in the following example.>

Entity Name	Description
Patient	Demographics and other administrative information about an individual receiving care or other health-related services.
Clinical visit	An interaction between a patient and healthcare provider for the purpose of providing healthcare services or assessing the health status of a patient.

Medical Observation	Measurements and simple assertions made about a patient.
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### Patient

< Add a sub-section for each entity reported in the previous section. In each section, list and describe the attributes or variables belonging to the corresponding entity. Report in the 'Type' field the data type of the attribute/variable, and describe the used terms if non-standard data types are used. Otherwise, specify the standard you are referring to, e.g. SQL data types, XML scheme data types or others.

If the values of an attribute/variable are restricted to a given set of values or categories or codes, the 'Constraint' field have to be filled and described in the 'Constraints' section. >

Attribute	Mandatory (YES/NO)	Type	Max num. of characters	Description	Constraint
ID	YES	Numeric	20	The unique identifier of the patient.	N.A.
birthdate	NO	Date	10	The date of birth of the patient	N.A.
gender	YES	String	10	The gender of the patient.	GenderCode
...	...	...	...	...	...

### Clinical visit

Attribute	Mandatory (YES/NO)	Type	Max num. of characters	Description	Constraint
ID	YES	Numeric	20	The unique identifier of the visit.	N.A.
date	NO	Date	10	The start time of the visit.	N.A.
patient	YES	Numeric	20	The patient that has been visited.	N.A.
...	...	...	...	...	...

### Medical observation

Attribute	Mandatory (YES/NO)	Type	Max num. of characters	Description	Constraint
ID	YES	Numeric	20	The unique identifier of the medical observation.	N.A.
measurement	YES	String	10	The observed feature.	ClinicalMeasurement
visit	YES	Numeric	20	The visit during which this observation is made.	N.A.
...	...	...	...	...	...

## Constraints

< Add a sub-section for each constraint reported in the previous section. For each section, report in 'Level of measurement' the nature of information, (e.g. Nominal/Ordinal/Interval/Ratio) and clarify the used terminology, possibly pointing to existing documentation/web-pages.

If applicable, report in 'Coding standard' the used coding system (e.g. LOINC, SNOMED, ICD10), and report in 'Link' the web-page URL of the used coding system. Report in a table, like the following example, all the values/codes applicable to the attribute/variable. The table is not required if all codes of a known coding system are applicable. >

### GenderCode

Level of measurement: Nominal

Coding standard: None

Link: None

Value/Code	Name	Description
male	Male	Male
female	Female	Female
other	Other	The gender of a person that is not uniquely defined as male or female, such as hermaphrodite.
unknown	Unknown	The value is non known.

### ClinicalMeasurement

Level of measurement: Nominal

Coding standard: LOINC

Link: <http://loinc.org>

Value/Code	Name	Description
59574-4	BMI Pctl	Body mass index (BMI) [Percentile]
56087-0	Child Waist Circumf	Child Waist Circumference Protocol



CrowdHEALTH

**Collective Wisdom Driving Public Health Policies**

**Del. no. – D3.1 Annex B1: Data scheme  
Hospital La Fe mapped to FHIR**

**Project Deliverable**



This project has received funding from the European Union's Horizon 2020 Programme (H2020-SC1-2016-CNECT) under Grant Agreement No. 727560



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# Data sources scheme

## 1. BI\_HULAFE

The data that the Health Research Institute can use from the Hospital La Fe are gathered directly from datamarts where the sources of information are the Information Systems from Hospital La Fe. Hence, a data scientist is unable to gather data from the original databases/sources of the Hospital but from datamarts that are almost ready for data analysis and business intelligence applications.

In this data extraction we did get the data from the following available datamarts:

- Patients<sup>1</sup>
- Hospitalizations activity
- Emergency room activity
- Hospital at Home activity
- Morbidity information
- Laboratory tests results

Since the Use Case of Hospital La Fe is based on Obesity and Overweight, the data gathering has been filtered to find out just patients that were identified as being overweight or obese at any time in their visits to the Hospital. Please, take into account that the datamarts are continuously being upgraded and some more information may be available during the development of the project.

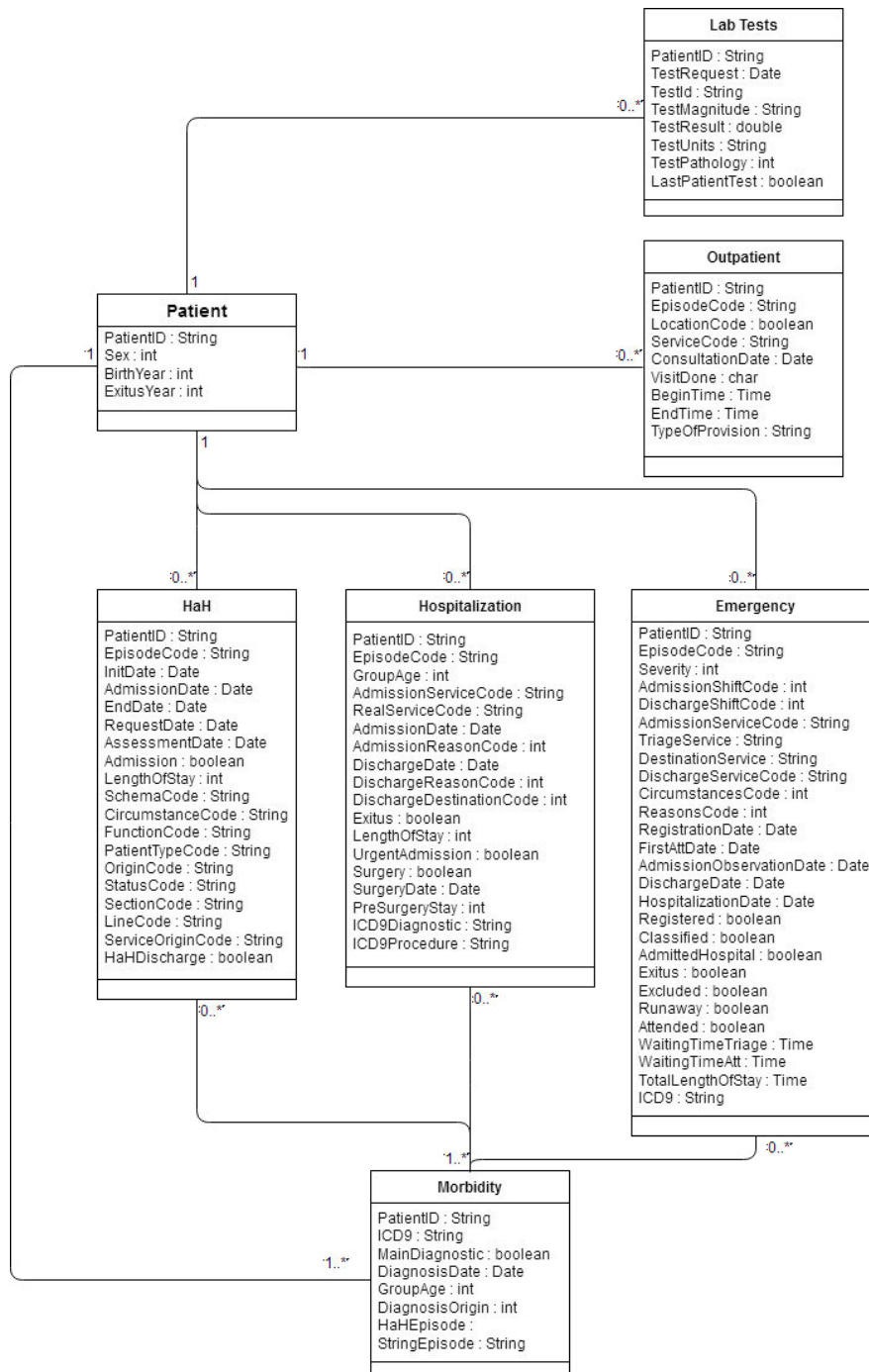
The present report tries to give some insight into the data structure that the project CrowdHEALTH in general and the data architects and data analysts of this project in particular, will be able to work with.

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<sup>1</sup> The information about patients is reduced to allow de-identification. In the original databases there is complete information: complete birthdate, zip codes, address, identity numbers, etc.

## 1.1 Conceptual diagram

See Figure with UML diagram.



## 1.2 List of entities

Entity Name	Description	FHIR mapping (name of the resource)	Note
Patients	Description of the patients with overweight or obesity diagnosis (target patients).	Patient	
Morbidity	All the ICD 9 codes associated to the target patients, with the date and origin of the diagnosis.	Condition, EpisodeOfCare/Encounter	
Hospitalization	All the data regarding hospitalization episodes of the target patients, with admission date, discharge date and other administrative and clinical information	Encounter, Procedure, Condition, Location	The hospitalization includes diagnosis (condition) on the discharge and if a procedure took place during the hospitalization
Emergency	All data regarding emergency episodes of the target patients, with administrative and clinical information	Encounter, Observation, Condition, Location	The observation related to the triage. Condition for the diagnoses on the discharge. This also includes hospitalization information, so multiple encounters from this
Outpatient	All data regarding secondary outpatient consultations of the target patients, with administrative and clinical information	Encounter, Location, Appointment	

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HaH	All the Hospital at Home episodes of the target patients and whether they are included in a Case Management program or not. Administrative and clinical information is included	Encounter, Location	
Lab Tests	Specific laboratory tests done and results of the target patients. The amount of possible tests is quite high. The lab tests have been reduced to a list of tests that are considered highly relevant to the Use Case and other co-morbidities: glycosylated hemoglobin, Microalbumin/creatinine ratio, Glucose, Blood Urea, Creatinine, Albumine, Calcium, Sodium, Potassium, Transferrine, Troponin T, arterial CO2, arterial O2, hemoglobin, hematocrite, venous CO2, venous O2, Pro-BNP, Ferritine, Transferrine saturation Index, C-Reactive protein, arterial Ph, venous Ph, Total cholesterol, Low density cholesterol LDL, High density cholesterol, GOT transaminases, GPT transaminases, TSH thyroid, Free T3, Total T3, Free T4, Total T4.	Observation	

### 1.2.1 Patients

Attribute	Mandatory (YES/NO)	Type	Max num. of characters	Description	Constraint	FHIR mapping	Assumptions	Note	Y1 convergence
<b>PatientID</b>	Yes	String	36	Anonymized patient identification	N.A.	Patient.identifier[0].value	Patient.identifier[0].system="http://www.hospital-lafe.com/"		YES
<b>Sex</b>	No	Numerical	1	Sex of the patient.	GenderCode	Patient.gender[0].code	1=male 2=female, 3=other		YES
<b>BirthYear</b>	No	Numerical	4	Year of birth	N.A.	Patient.birthDate[0].date			YES
<b>ExitusYear</b>	No	Numerical	4	Year of death	NULL=Alive	Patient.deceased[0]	Patient.deceased[0].deceasedDateTime.dateTime  Patient.deceased[0].deceasedBoolean.boolean		YES

## 1.2.2 Morbidity

Attribute	Mandatory (YES/NO)	Type	Max num. of characters	Description	Constraint	FHIR mapping	Assumptions	Note	Y1 coverage
<b>PatientID</b>	Yes	String	36	Anonymized patient identification	N.A.	Condition.getSubject().setReference(PatientIdInFHIR)		If all the information is going to be send within a bundle, a temporal id for the patient resource must be created, and this temporal id of the patient resource must be referenced here. If patient resource is not within the same bundle, the id of the patient resource on the server must be resolved	YES
<b>ICD9</b>	Yes	String	6	Diagnosis of the patient codified using ICD-	ICD9Code	Condition.code.coding[0].code="code"  Condition.code.coding[			YES

				9-CM codes		0].display="Label"  Condition.code.coding[0].system="terminology URI"			
<b>MainDiagnostic</b>	No	Categorical		Whether the diagnosis is the primary diagnosis of the episode or not. An episode is fulfilled with a single primary ICD9 code and many secondary codes related with the first one.	MainDiagnosticCode	Encounter/EpisodeOfCare.diagnosis.reference (to this Condition)		If it is a secondary diagnostic, such relation with the primary one is found through the encounter linkage between both conditions	NO
<b>Diagnosis Date</b>	No	Date		Date when the diagnosis	N.A.	Condition.onset[0].assertedDate.dateTime			YES

				was informed to the system					
<b>GroupAge</b>	No	Numerical	3	Age at the time of diagnosis in groups	GroupAgeCode	Condition.onset[0].onsetRange.low Condition.onset[0].onsetRange.high		The ranges of Age seems to be 5 years	YES
<b>Diagnosis Origin</b>	No	Numerical	1	Type of episode that originates the diagnosis.	DiagnosisOriginCode			Implicit on the type of Encounter/EpisodeOfCare	YES
<b>HaHEpisode</b>	No	Numerical		Identification of the Hospital at Home episode that gave this diagnosis	N.A.	Condition.context.reference()		An EpisodeOfCare could be generated from this	YES
<b>Episode</b>	No	Numerical		Identification of the Hospitalization/Emergency	N.A.	Condition.context.reference()		An EpisodeOfCare could be generated from	YES



				episode taht gave this diagnosis				this	
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### 1.2.3 Hospitalization

Attribute	Mandatory (YES/NO)	Type	Max num. of characters	Description	Constraint	FHIR mapping	Assumptions	Note	Y1 convergence
						Encounter.class="inpatient"			
<b>PatientID</b>	Yes	String	36	Anonymized patient identification	N.A.	Encounter.getSubject().setReference(PatientIDnFHIR)		If all the information is going to be send within a bundle, a temporal id for the patient resource must be created, and this temporal id of the patient resource must be referenced here. If patient resource is not within the	YES

								same bundle, the id of the patient resource on the server must be resolved	
<b>EpisodeCode</b>	Yes	Numerical		Identifier of the episode	N.A.	Encounter.episodeOfCare.reference()		An EpisodeOfCare could be generated from this	NO
<b>GroupAge</b>	No	Numerical	3	Age at the time of hospitalization in groups	GroupAgeCode			Calculated from the BirthDate of the subject and the admission date	YES
<b>AdmissionServiceCode</b>	No	Categorical		Admission Service Code	<a href="#">See additional Table<sup>2</sup></a>	Encounter.hospitalization[0].origin.reference(Location of the service)			NO
<b>RealService</b>	No	Categ		Code of the health	<a href="#">See additional</a>	Encounter.location.reference (location of the			NO

<sup>2</sup> Some tables are very large and they are included as an additional Excel table in a directory called 'additionalTables'. These are mainly codes that refer to services in this hospital. Each hospital may have a different codification and organization of services. This should be taken into account. The names of the services are not translated.

ceCode		orical		service that finally treated the patient	<a href="#">Table</a>	service where is treated)			
<b>AdmissionDate</b>	No	Date		Date of the admission to the hospital	N.A.	Encounter.period.start			YES
<b>AdmissionReasonCode</b>	No	Categorical		Reason for the admission	AdmissionReasonCode	Encounter.reason.coding[0].code	Encounter.identifier[0].system="https://http://www.hospital-lafe.com/AdmissionReasonCode"	ValueSet required	YES
<b>DischargeDate</b>	No	Date		Date of discharge	N.A.	Encounter.period.end			YES
<b>DischargeReasonCode</b>	No	Categorical		Reason for discharge	DischargeReasonCode	Encounter.hospitalization.dischargeDisposition.coding[0].code		ValueSet required	YES
<b>DischargeDestinationCode</b>	No	Categorical		Destination after discharge	N.A.	Encounter.hospitalization[0].destination.reference(location of the service)			NO
<b>Exitus</b>	No	Binary	1	If the patient has passed	ExitusCode			Explicit on the discharge reason	NO

				away.					
<b>LengthOf Stay</b>	No	Numerical		Length of stay	N.A.	Encounter.length			YES
<b>UrgentAdmission</b>	No	Binary		Urgent admission	AcuityCode	Encounter.priority.coding[0].code	Encounter.priority.coding[0].system="https://http://www.hospital-lafe.com/AcuityCodes"	ValueSet required	YES
<b>Surgery</b>	No	Binary		If the patient has received a surgical intervention	SurgeryCode	Procedure.context.reference(to this Encounter)		A procedure resource could be generated	YES
<b>SurgeryDate</b>	No	Date		Date of the surgical intervention	N.A.	Procedure.performed.dateTime			YES
<b>PreSurgeryStay</b>	No	Numerical		Time taken since the hospitalization until the intervention NULL=0	N.A.			Difference between the admission date and the date of the surgery.	NO
<b>ICD9Diagn</b>	No	String		Admission	ICD9Code	Encounter.diagnosis.reference ( ref to a new			NO

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<b>ostic</b>				ICD9 code		Condition generated with the code used in this value)			
<b>ICD9Procedure</b>	No	String		Admission procedure ICD9 code	ICD9Code	Procedure.code[0].code	Procedure.code[0].system="ICD9 URI"		NO

## 1.2.4 Emergency

Attribute	Mandatory (YES/NO)	Type	Max num. of characters	Description	Constraint	FHIR mapping	Assumptions	Note	Y1 converge
						Encounter.class="emergency"			
<b>PatientID</b>	Yes	String	36	Anonymized patient identification	N.A.	Encounter.getSubject().setReference(PatientIDnFHIR)		If all the information is going to be send within a bundle, a temporal id for the patient resource must be created, and this temporal id of the patient resource must be referenced here. If patient resource is not within the same bundle, the id of the patient resource on the server must be resolved	YES

<b>EpisodeCode</b>	Yes	String		Identifier of the episode	N.A.	Encounter.episodeOfCare.reference()		An EpisodeOfCare could be generated from this	YES
<b>Severity</b>	No	Categorical		Level of severity of the present episode. Not coded the same in all hospitals.	SeverityCode	Observation.code Observation.value.code		ValueSet creation for this set of codes  Result of the Observation of triage procedure	NO
<b>AdmissionShiftCode</b>	No	Categorical		Episode shift, whether the patient has been admitted in the morning, in the evening or at night	ShiftCode				NO
<b>DischargeShiftCode</b>	No	Categorical		Episode shift, whether	ShiftCode				NO

				the patient has been discharged in the morning, in the evening or at night					
<b>AdmissionServiceCode</b>	No	Categorical		Service code of the admission in the emergency room	<a href="#">See additional Table</a>	Encounter.hospitalization[0].origin.reference(Location of the service)			NO
<b>TriageService</b>	No	Categorical		Service code of the triage procedure	<a href="#">See additional Table</a>	Procedure.location.reference() Procedure.subject.....		A new resource of procedure needs to be created	NO
<b>DestinationService</b>	No	Categorical		The 16 possible destinations that the triage refers you to	<a href="#">See additional Table</a>			A different encounter this hospitalization should be created	NO
<b>DischargeServiceCode</b>	No	Categ		Code of the	<a href="#">See additional</a>	Encounter.hospitalization[0].destination			YES



de		orical		discharge service	<a href="#">Table</a>	tion.reference(Location of the service)			
<b>CircumstancesCode</b>	No	Categorical		Code defining the circumstances of discharge	EmergencyCircumstancesCode	Encounter.hospitalization.dischargeDisposition.coding[0].code			YES
<b>ReasonsCode</b>	No	Categorical		Reasons for admission.	EmergencyAdmissionReasonCode	Encounter.reason.coding[0].code	Encounter.identifier[0].system="https://http://www.hospital-lafe.com/AdmissionReasonCode"	ValueSet required	YES
<b>RegistrationDate</b>	No	Date		Date when the patient is registered in the emergency department	N.A.				NO
<b>FirstAttDate</b>	No	Date		Date when the patient is attended for the first time	N.A.				NO
<b>AdmissionObservation</b>	No	Date		Date when the patient is admitted	N.A.				NO

<b>ionDate</b>				to observatio n unit					
<b>Discharge Date</b>	No	Date		Discharge Date	N.A.				NO
<b>Hospitaliz ationDate</b>	No	Date		Date of hospitalizat ion from the emergency room	NULL=Not hospitalized				NO
<b>Registere d</b>	No	Binar y		The patient was registered at the emergency room	0=No; 1=Yes				NO
<b>Classified</b>	No	Binar y		The patient has been in the triage	0=No; 1=Yes				NO
<b>AdmittedH ospital</b>	No	Binar y		The patient has been admitted to	0=No; 1=Yes				NO

				hospital					
<b>Exitus</b>	No	Binary		The patient has passed away	0=No; 1=Yes				NO
<b>Excluded</b>	No	Binary		The patient was excluded from the emergency room	0=No; 1=Yes				NO
<b>Runaway</b>	No	Binary		The patient ran away	0=No; 1=Yes				NO
<b>Attended</b>	No	Binary		The patient was attended	0=No; 1=Yes				NO
<b>WaitingTimeTriage</b>	No	Time		Time that the patient has been waiting for the triage	N.A.				NO
<b>WaitingTimeAtt</b>	No	Time		Time that the patient has been waiting for	N.A.				NO

				attention					
<b>TotalLengthOfStay</b>	No	Time		Total time for the patient in the emergency room	N.A.				NO
<b>ICD9</b>	No	String		First diagnosis in ED when is discharged	ICD9Code				NO

### 1.2.5 Outpatient consultation

Attribute	Mandatory (YES/NO)	Type	Max num. of characters	Description	Constraint	FHIR mapping	Assumptions	Note	Y1 convergence
						Encounter.class="ambulatory"			
<b>PatientID</b>	Yes	String	36	Anonymized patient	N.A.	Encounter.getSubject().setReference(PatientId)		If all the information is	YES

				identification		nFHIR)		going to be send within a bundle, a temporal id for the patient resource must be created, and this temporal id of the patient resource must be referenced here. If patient resource is not within the same bundle, the id of the patient resource on the server must be resolved	
<b>EpisodeCode</b>	Yes	String		Code of the episode of the consultation	N.A.	Encounter.episodeOfCare.reference()		An EpisodeOfCare could be generated from this	YES
<b>LocationCode</b>	No	Binary		The consultation is in the hospital or in a specialized	LocationCode	Encounter.location		A location resource must be created	NO

				clinic					
<b>ServiceCode</b>	No	Categorical		Service code	<a href="#">See additional Table</a>	Encounter.location			NO
<b>ConsultationDate</b>	No	Date		Date of the appointment	N.A.	Encounter.appointment		An appointment resource must be created	NO
<b>VisitDone</b>	No	Categorical		The consultation has been conducted	VisitCode	Encounter.appointment.status			YES
<b>BeginTime</b>	No	Time		Start time	N.A.	Encounter.period.start			YES
<b>EndTime</b>	No	Time		End time	N.A.	Encounter.period.end			YES
<b>TypeOfProvision</b>	No	Categorical		Type of Provision	ProvisionCode				NO

## 1.2.6 Hospital at Home

Attribute	Mandatory (YES/NO)	Type	Max num. of characters	Description	Constraint	FHIR mapping	Assumptions	Note	Y1 coverage
						Encounter.class="home health"			
<b>PatientID</b>	Yes	String	36	Anonymized patient identification	N.A.	Encounter.getSubject().setReference(PatientIDnFHIR)		If all the information is going to be send within a bundle, a temporal id for the patient resource must be created, and this temporal id of the patient resource must be referenced here. If patient resource is not within the same bundle, the id of the patient resource on the server must be resolved	YES

<b>EpisodeCode</b>	Yes	String		Identification of the episode	N.A.	Encounter.episodeOfCare.reference()		An EpisodeOfCare could be generated from this	YES
<b>InitDate</b>	No	Date		Start Date of the episode	N.A.	Encounter.period.start			YES
<b>AdmissionDate</b>	No	Date		Date of admission	N.A.				NO
<b>EndDate</b>	No	Date		End date of the episode	N.A.	Encounter.period.end			YES
<b>RequestDate</b>	No	Date		Date of the request to be admitted to SP	N.A.			Is it necessary to store information about the request? If so, we should model it with the Encounter.statusHistory	NO
<b>AssessmentDate</b>	No	Date		Date of assessment of the request to be	N.A.			Is it necessary to store information about the request? If so, we should model it	NO



				admitted to SP				with the Encounter.statusHistory	
<b>Admission</b>	No	Binary		The patient has been "admitted" (attended) to HaH	0=No;1=Yes				NO
<b>LengthOfStay</b>	No	Numerical		Duration of the episode	N.A.	Encounter.length			YES
<b>SchemaCode</b>	No	Categorical		Type of scheme	SchemaCode				NO
<b>CircumstanceCode</b>	No	Categorical		Status on discharge from the episode of HaH	HaHCircumstanceCode				NO
<b>FunctionCode</b>	No	Categorical		Type of HaH healthcare attention (function)	FunctionCode				NO
<b>PatientType</b>	No	Categorical		Type of patient	TypePatient				NO

peCode		orical		when admitted to SF	Code				
<b>OriginCode</b>	No	Categorical		Origin/Sour ce of the referral of this episode	OriginCode				NO
<b>StatusCode</b>	No	Categorical		Administrat ive status of the referral	StatusCode				NO
<b>SectionCode</b>	No	Categorical		Clinical section origin of the referral of this episode	<a href="#">See additional table</a>				NO
<b>LineCode</b>	No	Categorical		Profile of the patient	SectionCode				NO
<b>ServiceOriginCode</b>	No	Categorical		Service origin of the referral of this episode	<a href="#">See additional Table</a>				NO

<b>HaHDischarge</b>	No	Binary		HaH discharge	0=No;1=Yes				NO
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### 1.2.7 Laboratory tests

Attribute	Mandatory (YES/NO)	Type	Max num. of characters	Description	Constraint	FHIR mapping	Assumptions	Note	Y1 coverage
<b>PatientID</b>	Yes	String	36	Anonymized patient identification	N.A.	Observation.getSubject().setReference(PatientIdInFHIR)		If all the information is going to be send within a bundle, a temporal id for the patient resource must be created, and this temporal id of the patient resource must be referenced here. If patient resource is not within the same bundle, the id of the patient resource on the server must be	YES

								resolved	
<b>TestRequestDate</b>	No	Date		Date when the laboratory test request is introduced in the system	N.A.	Observation.effective.effectiveDateTime		This is not the date	YES
<b>TestId</b>	No	String		Identifier of the type of test	LabTestCode (values)	Observation.identifier[0].value	Encounter.identifier[0].system="https://http://www.hospital-lafe.com/"		YES
<b>TestMagnitude</b>	No	String		Description of the magnitude measured by the test (related with TestId)	LabTestCode (names)	Observation.code[0].code	Observation.code[0].system="https://http://www.hospital-lafe.com/AdmissionReasonCode"	ValueSet required	YES
<b>TestResult</b>	No	Numerical		Value of the result of the lab test	N.A.	Observation.value			YES
<b>TestUnits</b>	No	String		Description of the	N.A.	Observation.value.units			YES

				measurement unit upon which the lab test is based					
<b>TestPathology</b>	No	String		Whether the test result seems pathologic or not. Standard measures are used. But not in all hospitals are coded with this ranges	LabPathologyCode	Observation.referenceRange			NO
<b>LastPatientTest</b>	No	Binary		The test is the last test carried out to this patient	0=No;1=Yes				YES

## 1.3 Constraints

### 1.3.1 GenderCode

Level of measurement: Nominal

Coding standard: None

Link: None

Mapping to valueSet: <http://hl7.org/fhir/valueset-administrative-gender.html>

Value/Code	Name	Description	Code identifier	Code description	Note
1	Male	Male	male	Male	
2	Female	Female	female	Female	
3	Unspecified	The gender of a person that is not uniquely defined as male or female, such as	other	Other	

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		hermaphrodite.			
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### 1.3.2 ICD9Code

Level of measurement: Nominal

Coding standard: ICD-9-CM

Link: <http://www.icd9data.com/>

### 1.3.3 MainDiagnosticCode

Level of measurement: Nominal

Coding standard: None

Link: None

Value/Code	Name	Description
1	Primary	This is the primary diagnostic code of the episode of the patient (the reason why the

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		patient was given health care)
2	Secondary	This is a secondary diagnostic code of the episode of the patient that is usually related to the primary diagnostic (There can be up to 26 secondary codes)

#### 1.3.4 GroupAgeCode

Level of measurement: Interval

Coding standard: None

Link: None

Value/Code	Name	Description
0	[0, 5[	Age between 0 and 5 years old
5	[5, 10[	Age between 5 and 10 years old
10	[10, 15[	Age between 10 and 15 years old
15	[15, 20[	Age between 15 and 20 years old



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### 1.3.5 **DiagnosisOriginCode**

Level of measurement: Nominal

Coding standard: None

Link: None

Value/Code	Name	Description
1	Emergency	The originating episode of this diagnosis was an emergency visit
2	Hospitalization	The originating episode of this diagnosis was a hospitalization
3	Hospital at Home	The originating episode of this diagnosis was a hospital at home episode
4	Ambulatory surgery	The originating episode of this diagnosis

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		was an ambulatory surgery episode
5	Outpatient	The originating episode of this diagnosis was an outpatient consultation

#### 1.3.6 AdmissionReasonCode

Level of measurement: Nominal

Coding standard: None

Link: None

Mapping to valueSet: <http://crowdhealth.eu/fhir/ValueSet/encounter-reason>

Value/Code	Name	Description	Code	Description	Note
0	Undetermined	The reason for admission in the hospital is undetermined			No mapping, the reason code will be

					blank in this case
1	Medical examination-Study	The patient is admitted for medical examination inside a study	general-examination-of-patient	General examination of patient	
2	Common disease	The patient is admitted due to a common disease	disease	Disease	
3	Traffic accident	The patient is admitted with injuries due to a traffic accident	driving-related-medical-examination	Driving-related medical examination	
4	Work accident	The patient is admitted with injuries due to a work accident	examination-for-work-accident	Examination for work accident	
5	Casual accident	The patient is admitted with injuries due to any other type of accident	examination-for-accident	Examination for accident	
6	Self-injury	The patient is admitted with injuries made by himself/herself	self-inflicted-injury	Self inflicted injury	

7	Agression	The patient is admitted with injuries due to an aggression	victim-of-physical-assault	Victim of physical assault	
8	Childbirth/Gestation	The patient is admitted due to gestation problems or due to an imminent childbirth	patient-currently-pregnant	Patient currently pregnant	
9	Others	The patient is admitted due to a reason other than those described in the other values			
10	Neonate	The neonate patient is admitted due to any pathology	newborn	Newborn	
11	Urgent from CEX	The patient is admitted urgently from outpatient consultation			This is specified on the origin of the admission
12	Surgical complications	The patient is admitted due to complications from a previous surgery	complication-of-surgical-procedure	Complication of surgical procedure	
13	Day hospital complications	The patient is admitted due to complications from the	complication-of-procedure	Complication of procedure	Day hospital is specified on the origin of the

		day hospital			admission
14	Technical Complications	The patient is admitted due to technical complications from any other intervention	complication-of-procedure	Complication of procedure	
15	Infarction	The patient is admitted due to a heart attack	myocardial-infarction	Myocardial infarction	
19	Urgent Transfer	The patient is urgently admitted as a transfer from other hospital			This is specified on the origin of the admission
20	Planned Transfer	The patient is admitted as a planned transfer from other hospital			This is specified on the origin of the admission
60	Influenza A exam	The patient is admitted for examination of influenza A	serologic-test-for-influenza-virus-A	Serologic test for influenza virus A	
61	Probable Influenza A	The patient is admitted for probable influenza A			
62	Confirmed Influenza A	The patient is admitted for confirmed influenza A	influenza-A-virus-present	Influenza A virus present	

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63	Common disease (deprecated)		disease	Disease	
90	UCSI Complications	The patient is admitted due to complications from the Surgery Without Admission Unit	complication-of-surgical-procedure	Complication of surgical procedure	The origin is specified on the origin of the admission
99	Catastrophe	The patient is admitted with injuries due to a catastrophe	victim-of-environmental-event	Victim of environmental event	

#### 1.3.7 DischargeReasonCode

Level of measurement: Nominal

Coding standard: None

Link: None

Mapping to ValueSet: <http://hl7.org/fhir/valueset-encounter-discharge-disposition.html>

Value/Code	Name	Description	Code	Description	Note
1	Healing or improvement	The patient was discharged due to an improvement in his/her health	home	Home	
2	Voluntary discharge	The patient was voluntarily discharged	aadvice	Left against advice	
3	Transfer	The patient was transferred to another healthcare facility	Other-hcf	Other healthcare facility	
4	Exitus	The patient died during the hospitalization	exp	Expired	
5	Other	Other reasons for discharge	oth	Other	
6	In extremis	A patient in an end-of-life situation is voluntarily discharged	hosp	Hospice	The patient has been discharged into palliative care.

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### 1.3.8 ExitusCode

Level of measurement: Ordinal

Coding standard: None

Link: None

Value/Code	Name	Description
0	No exitus	The patient did not die during the episode
1	Exitus	The patient passed away during the episode

### 1.3.9 AcuityCode

Level of measurement: Ordinal

Coding standard: None



Link: None

Value/Code	Name	Description	Code	Descriptio	Note
0	Not urgent	The admission was planned	R	Routine	
1	Urgent	The admission was urgent and unplanned	UR	Urgent	

#### 1.3.10 SurgeryCode

Level of measurement: Nominal

Coding standard: None

Link: None

Value/Code	Name	Description
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0	No	No surgical intervention was done to the patient during the episode
1	Yes	A surgical intervention was done to the patient during the episode

#### 1.3.11 SeverityCode

Level of measurement: Ordinal

Coding standard: Manchester Triage System

Link: <http://alsq.org/uk/MTS>

Observation.code[0].code = 713011005

Observation.code[0].display = Assessment using Manchester Triage System (procedure)

Observation.code[0].system = <http://snomed.info/sct>

---

Observation.value =

Value/Code	Name	Description
0	No triage	No triage done
1	Immediate	Patient in need of immediate treatment for preservation of life
2	Very urgent	Seriously ill or injured patients whose lives are not in immediate danger
3	Urgent	Patients with serious problems, but apparently stable conditions
4	Not very urgent	Standard cases without immediate danger or distress
5	Not urgent	Patients whose conditions are not true accidents or emergencies

---

### 1.3.12 ShiftCode

Level of measurement: Nominal

Coding standard: None

Link: None

Value/Code	Name	Description
1	Morning	The event happened from 8:00 to 14:59
2	Afternoon	The event happened from 15:00 to 21:59
3	Evening	The event happened from 22:00 to 7:59

### 1.3.13 EmergencyAdmissionReasonCode

Level of measurement: Nominal

Coding standard: None

Link: None

Value/Code	Name	Description
0	Undetermined	The reason for emergency visit is not determined
1	Patient decision	The reason for emergency visit is decided by the patient
2	Medical decision	The reason for emergency visit is decided by a physician
3	Family decision	The reason for emergency visit is decided by the family of the patient
4	Government decision	The reason for emergency visit is decided by a governmental authority
5	Judge decision	The reason for emergency visit is decided by a judge
6	Transfer	The reason for emergency visit is a transfer from another healthcare

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		facility
7	Undefined	Not in use
8	Undefined	Not in use
9	Other motivation	The reason for emergency visit is another

#### 1.3.14 EmergencyCircumstancesCode

Level of measurement: Nominal

Coding standard: None

Link: None

Value/Code	Name	Description
0	Unkonwn	Unkown

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1	Home	The patient is discharged home
2	Voluntary discharge	The patient is voluntarily discharged
3	Transfer to other hospital	The patient is transferred to another hospital
4	Exitus	The patients passed away
5	Outpatient consultation	The patient is sent to outpatient consultation
6	Hospitalization	The patient is hospitalized
7	General Practitioner	The patient is sent to his GP for primary care
8	Runaway	The patient run away
9	Other	Other circumstance
10	Disciplinary discharge	The patient is discharge from the emergency room

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		due to his/her behaviour
12	Maternity Transfer (deprecated)	
13	Day hospital	The patient is sent to day hospital
14	Hospital at home	The patient is sent to the Hospital at Home Unit
15	Surgery without admission (UCSI)	The patient is sent to the Surgery without Admission Unit
16	Peaditric Transfer (deprecated)	
17	General Transfer (deprecated)	
31	Acute Hospital Transfer	The patient is sent to another Acute Hospital
32	Medium and Long	The patient is sent to the Medium and Long Stay

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	stay Unit Transfer	Unit
99	NULL	NULL

#### 1.3.15 LocationCode

Level of measurement: Nominal

Coding standard: None

Link: None

Value/Code	Name	Description
0	Hospital	The outpatient consultation is located inside the Hospital facilities
1	Specialized Clinic	The outpatient consultation is located in a community setting

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### 1.3.16 VisitCode

Level of measurement: Nominal

Coding standard: None

Link: None

Value/Code	Name	Description
<b>Urgent</b>	Urgent	The outpatient consultation was an urgent consultation
<b>N</b>	No	The outpatient consultation did not take place
<b>Y</b>	Yes	The outpatient consultation was done

### 1.3.17 ProvisionCode

Level of measurement: Nominal

Coding standard: None

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Link: None

Value/Code	Name	Description
<b>PRI</b>	First	The outpatient consultation is the first consultation
<b>SUC</b>	Succesives	The outpatient consultation is a successive consultation for follow-up
<b>ENF</b>	Nurse	The outpatient consultation was done by nurses
<b>TEC</b>	Technical	The outpatient consultation was done by nurses using technological devices (electrocardiogram, ...)

#### 1.3.18 SchemaCode

Level of measurement: Nominal

Coding standard: None

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Link: None

Value/Code	Name	Description
<b>TEPIUHDN</b>	Common HaH episode	The hospital at home episode is a common admission due to a decompensation, exacerbation or follow-up
<b>TEPIUHDSP</b>	HaH Scheduled follow-up episode	The patient is admitted to a case management scheduled follow-up program

#### 1.3.19 HaHCircumstancesCode

Level of measurement: Nominal

Coding standard: None

Link: None

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Value/Code	Name	Description
DESTD00	Primary Care	The patient is discharged/sent to a Primary Care attention
DESTD01	Hospital admission: medical reason	The patient is admitted to hospital due to a medical reason
DESTD02	Hospital admission: diagnostic/treatment	The patient is admitted to hospital for a diagnosis or treatment
DESTD03	Hospital admission: emergency out of hospital	The patient is admitted to hospital from an emergency department out of the hospital (community setting or other hospital)
DESTD04	Hospital admission: patient/family decision	The patient is admitted to hospital by the patient/family decision with the consent of a physician
DESTD05	Admission UMLE	The patient is admitted to the Long- and Medium- Stay Unit
DESTD06	Transfer other HaH	The patient is transferred to another HaH Unit of other hospital

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<b>DESTD07</b>	Scheduled Follow-up: CM	The patient is admitted/sent to the Case Management Scheduled Follow-u Program of the HaH Unit
<b>DESTD08</b>	Scheduled Follow-up: Nurse	The patient is followed-up by the case manager nurse
<b>DESTD09</b>	Exitus	The patient passed away
<b>DESTD10</b>	Voluntary discharge	The patient is discharged voluntarily
<b>DESTD11</b>	Outpatient consultation	The patient is sent to outpatient consultation
<b>DESTD12</b>	Mental Health Unit	The patient is sent to the Mental Heath Unit

#### 1.3.20 FunctionCode

Level of measurement: Nominal

Coding standard: None

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Link: None

Value/Code	Name	Description
UHD_T1	Assessment/Outpatient consultation	Aimed at giving response to specific clinical attention (often 1 day). For instance: Is this patient under an exacerbation of the chronic disease? Or developing diagnostic test or treatments that primary care can't develop on patients with mobility problems
UHD_T2	Day hospital	Aimed at giving response to specific clinical attention but usually known and expected by the team responsible of the patient (often 2-3 days). For instance: patients treated with mobility problems require the first day to make sure about the clinical needs and the second/third day to give the treatment

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<b>UHD_T3</b>	Hospitalization at Home	Aimed at following clinical situations at home but with a conventional hospital intensity, when possible
<b>UHD_T4</b>	Case Management Program	Describes the patients under case management program
<b>UHD_T5</b>	Transition	Patients already under case management who need to be followed closely after an hospital discharge by the case manager. Usually during two weeks after discharge.
<b>UHD_T6</b>	PEPS	When a patient is identified to be included on case management intervention. A complete health and psychosocial assessment, educational and preventive interventions related with the chronic diseases are developed. Usually, the admission referral is received from GP-primary health care team (proactive identification)



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UHD_T7	Transition PEPS	When a patient is identified to be included on case management intervention. A complete health and psychosocial assessment, educational and preventive interventions related with the chronic diseases are developed. The admission referral is received a hospital ward, (reactive identification).
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#### 1.3.21 TypePatientCode

Level of measurement: Nominal

Coding standard: None

Link: None

Value/Code	Name	Description
UHD_TP1	Post-surgical (simple)	The patients is a post-surgical patient with simple condition for

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		recovery
<b>UHD_TP2</b>	Post-surgical (complex)	The patients is a post-surgical patient with complex condition for recovery
<b>UHD_TP3</b>	Post-transplant	The patient had a transplant
<b>UHD_TP4</b>	Chronic monoorganic	Chronic patient with only one chronic disease or condition
<b>UHD_TP5</b>	Chronic pluripathology	Chronic patient with multimorbidity
<b>UHD_TP6</b>	Mental health	Mental health patient
<b>UHD_TP7</b>	Oncological	Oncological patient
<b>UHD_TP8</b>	Palliative (oncological)	Palliative patient with oncological disease
<b>UHD_TP9</b>	Palliative (non oncological)	Palliative patient without any oncological disease
<b>UHD_TP10</b>	Acute with chronic pathology	The patient is an acute patient with a chronic disease as a base condition

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<b>UHD_TP11</b>	Acute without chronic pathology	The patient is an acute patient
<b>UHD_TP12</b>	Neonate	The patient is a newborn child
<b>UHD_TP13</b>	Paediatric	The patient is a paediatric patient

#### 1.3.22 OriginCode

Level of measurement: Nominal

Coding standard: None

Link: None

Value/Code	Name	Description
<b>UHD_P1</b>	Self-derivation	The patient proposed himself/herself the healthcare attention by the HaH Unit
<b>UHD_P2</b>	Primary care	A GP proposed the healthcare

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		attention by the HaH Unit
<b>UHD_P3</b>	Outpatient consultation	A physician at outpatient consultation proposed the healthcare attention by the HaH Unit
<b>UHD_P4</b>	CMA	A physician from the Major Ambulatory Surgery Unit proposed the healthcare attention by the HaH Unit
<b>UHD_P5</b>	HACLE	A physician from the Long- and Medium- stay Unit proposed the healthcare attention by the HaH Unit
<b>UHD_P6</b>	Day Hospital	A physician at day hospital proposed the healthcare attention by the HaH Unit
<b>UHD_P7</b>	Other HaH / Hospital	A Hospital at Home unit from other Hospital or other Hospital suggest the healthcare attention by the HaH Unit
<b>UHD_P8</b>	Residence	A residence proposes the healthcare

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		attention by the HaH Unit
<b>UHD_P9</b>	Ward	The proposal for the HaH Unit comes from a ward in the Hospital
<b>UHD_P10</b>	Mental Health Unit	The proposal for the HaH Unit comes from a the Mental Health Unit in the Hospital
<b>UHD_P11</b>	Emergency Unit	The proposal for the HaH Unit comes from Emergency Room

#### 1.3.23 StatusCode

Level of measurement: Nominal

Coding standard: None

Link: None

Value/Code	Name	Description
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<b>EE12</b>	Administrative discharge	The patient has been discharge and the administrative process has bee completely finished
<b>EE17</b>	Discharge with Administrative discharge pending	The patient has been discharge but the administrative process is still pending
<b>EIUHD</b>	Admitted to HaH	The patient has been admitted to the HaH Unit
<b>EPANUHD</b>	Proposal to HaH cancelled	The proposal to admit a patient to the HaH Unit has been cancelled
<b>EPAUHD</b>	Proposal to HaH accepted	The proposal to admit a patient to the HaH Unit has been accepted
<b>EPRUHD</b>	Proposal to HaH rejected	The proposal to admit a patient to the HaH Unit has been rejected with justification
<b>EPTUHD</b>	Proposal to another HaH	The proposal is to admit a patient to another HaH Unit
<b>EPUHD</b>	Proposal to HaH	A proposal to admit a patient to the

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	admission	HaH Unit has been carried out
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#### 1.3.24 SectionCode

Level of measurement: Nominal

Coding standard: None

Link: None

Value/Code	Name	Description
1	Pediatric	The patient is a pediatric one
2	Mental Health	The patient is a mental health patient
3	Rehabilitation	The patient is in a rehabilitation stage
4	Adults	The patient is an adult one

### 1.3.25 LabPathologyCode

Level of measurement: Ordinal

Coding standard: None

Link: None

Value/Code	Name	Description
0	Normal	The result of the laboratory test is within the normal ranges
1	Validation	The result of the laboratory test is out of the normal ranges, but within valid ranges. It means that the patient has possible pathologic results
2	Outlier	The result of the laboratory test is out of the normal and validation range. It could be an abnormal result due to technical reasons or due to an extreme condition of the patient



### 1.3.26 LabTestCode

Level of measurement: Nominal

Coding standard: None

Link: None

Value/Code	Name	Description	Code	Description	Y1 coverage
429	C-Reactive protein	Laboratory test that measured...	c-reactive-protein-measurement	C-reactive protein measurement	YES
452	Glycosilated Hemoglobin	Laboratory test that measured...	glucohemoglobin-measurement	Glucohemoglobin measurement	YES
471	Microalbumin/creatinine ratio	Laboratory test that measured...	urine-microalbumin-creatinine-ratio-measurement	Urine microalbumin/creatinine ratio measurement	YES
478	Glucose	Laboratory test that	glucose-	Glucose measurement	YES

		measured...	measurement		
<b>490</b>	Blood Urea	Laboratory test that measured...	blood-urea-measurement	Blood urea measurement	YES
<b>491</b>	Creatinine	Laboratory test that measured...	creatinine-measurement	Creatinine measurement	YES
<b>493</b>	Total cholesterol	Laboratory test that measured...	total-cholesterol-measurement	Total cholesterol measurement	YES
<b>494</b>	Low density cholesterol LDL	Laboratory test that measured...	low-density-lipoprotein-cholesterol-measurement	Low density lipoprotein cholesterol measurement	YES
<b>495</b>	High density cholesterol HDL	Laboratory test that measured...	high-density-lipoprotein-cholesterol-measurement	High density lipoprotein cholesterol measurement	YES
<b>499</b>	GOT transaminases	Laboratory test that measured...	aspartate-aminotransferase-measurement	Aspartate aminotransferase measurement	YES

500	GPT transaminases	Laboratory test that measured...	alanine-aminotransferase-measurement	Alanine aminotransferase measurement	YES
509	Albumine	Laboratory test that measured...	albumin-measurement	Albumin measurement	YES
510	Calcium	Laboratory test that measured...	calcium-measurement	Calcium measurement	YES
514	Sodium	Laboratory test that measured...	sodium-measurement	Sodium measurement	YES
515	Potasium	Laboratory test that measured...	potassium-measurement	Potassium measurement	YES
519	Transferrine saturation Index	Laboratory test that measured...	transferrin-saturation-index	Transferrin saturation index	YES
520	Ferritine	Laboratory test that measured...	ferritin-measurement	Ferritin measurement	YES
521	Transferrine	Laboratory test that measured...	transferrin-measurement	Transferrin measurement	YES

905	Troponin T	Laboratory test that measured...	troponin-t-measurement	Troponin T measurement	NO
906	PRO-BNP	Laboratory test that measured...	pro-bnp	PRO-BNP	NO
940	Arterial CO2	Laboratory test that measured...	measurement-of-arterial-partial-pressure-of-carbon-dioxide	Measurement of arterial partial pressure of carbon dioxide	NO
941	Arterial O2	Laboratory test that measured...	arterial-o2	Arterial O2	YES
942	Arterial Ph	Laboratory test that measured...	ph-measurement,-arterial	pH measurement, arterial	YES
1099	Hemoglobin	Laboratory test that measured...	hemoglobin,-free-measurement	Hemoglobin, free measurement	YES
1101	Hematocrite	Laboratory test that measured...	platelet-hematocrit-measurement	Platelet hematocrit measurement	YES
1276	Free T4	Laboratory test that	t4-free-	T4 free measurement	YES

		measured...	measurement		
<b>1277</b>	Total T4	Laboratory test that measured...	serum-total-t4-measurement	Serum total T4 measurement	NO
<b>1278</b>	Free T3	Laboratory test that measured...	free-t3-measurement	Free T3 measurement	
<b>1279</b>	Total T3	Laboratory test that measured...	tri-iodothyronine-measurement,-total	Tri-iodothyronine measurement, total	NO
<b>1280</b>	TSH thyroid	Laboratory test that measured...	thyroid-stimulating-hormone-measurement	Thyroid stimulating hormone measurement	NO
<b>1601</b>	Venous CO2	Laboratory test that measured...	measurement-of-venous-partial-pressure-of-carbon-dioxide	Measurement of venous partial pressure of carbon dioxide	NO
<b>1602</b>	Venous O2	Laboratory test that measured...	venous-oxygen-concentration-measurement	Venous oxygen concentration measurement	NO

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1603	Venous Ph	Laboratory test that measured...	ph-measurement, - venous	pH measurement, venous	YES
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CrowdHEALTH

**Collective Wisdom Driving Public Health Policies**

## **Del. no. – D3.1 Annex B2: Data scheme of DFKI living lab mapped to FHIR**

**Project Deliverable**



This project has received funding from the European Union's Horizon 2020 Programme (H2020-SC1-2016-CNECT) under Grant Agreement No. 727560

# Data sources scheme

The Use Case is driven by the data entered by participants using our web application to log their nutritional habits and will be further annotated by manual and automatic activity detection via fitness tracking hardware.

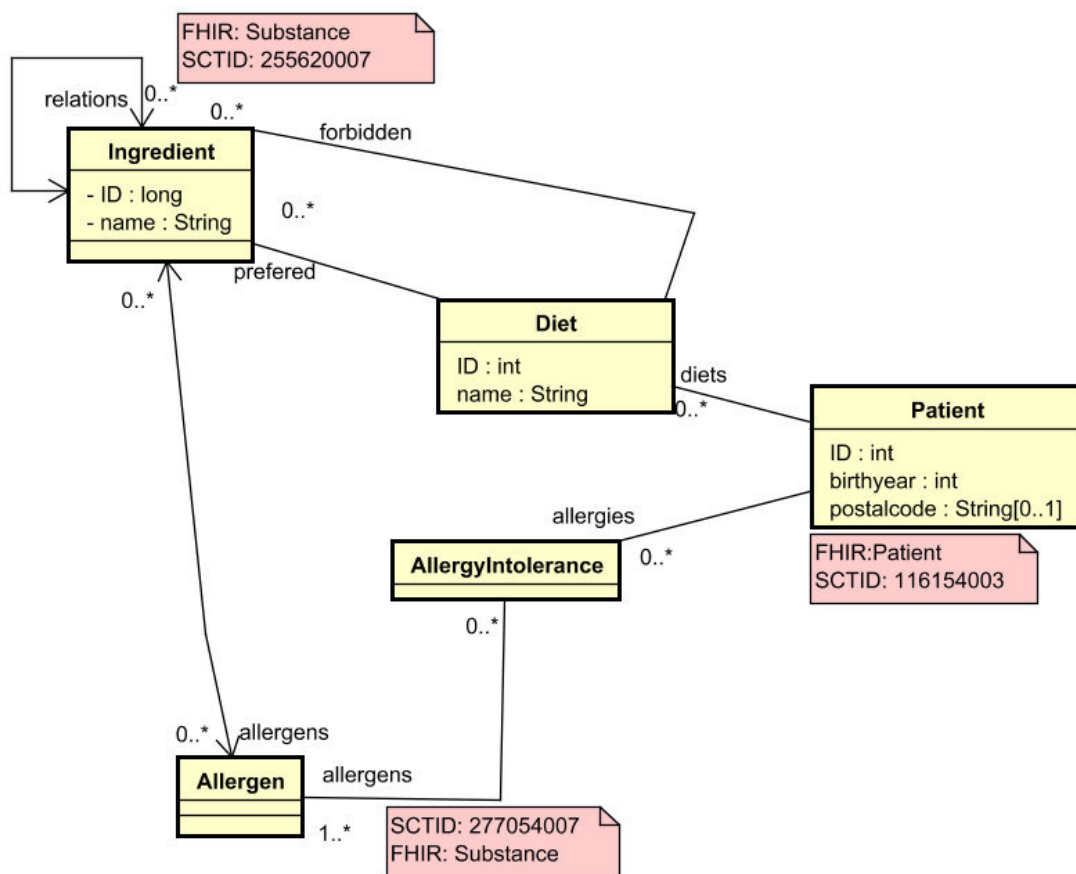


Figure 1: Patient



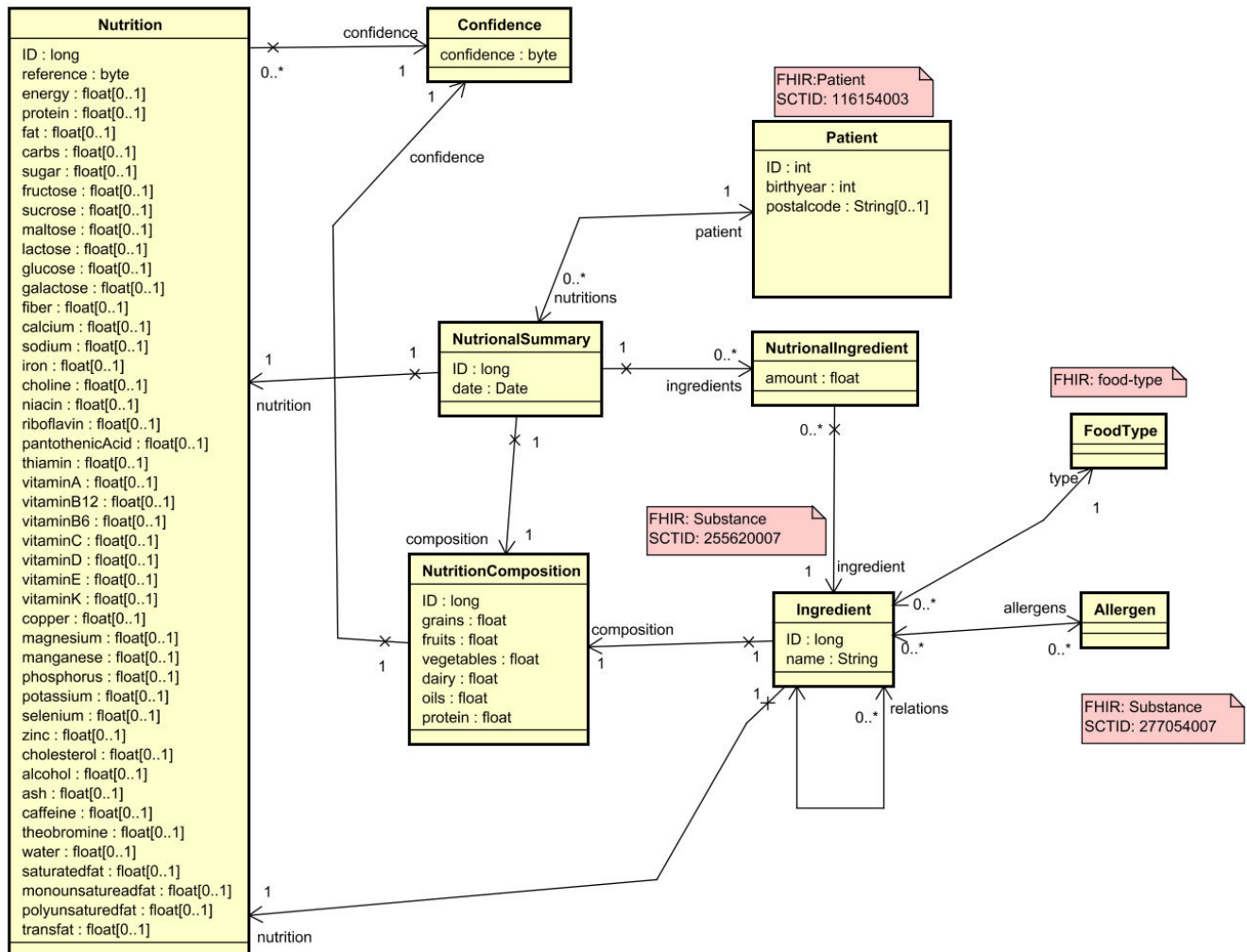


Figure 2: Nutrition

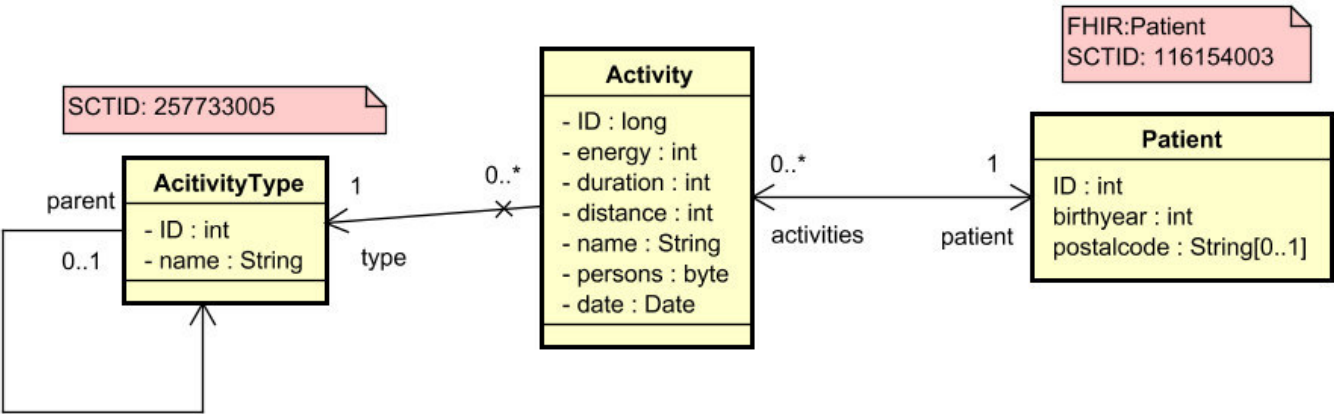


Figure 3: Activity

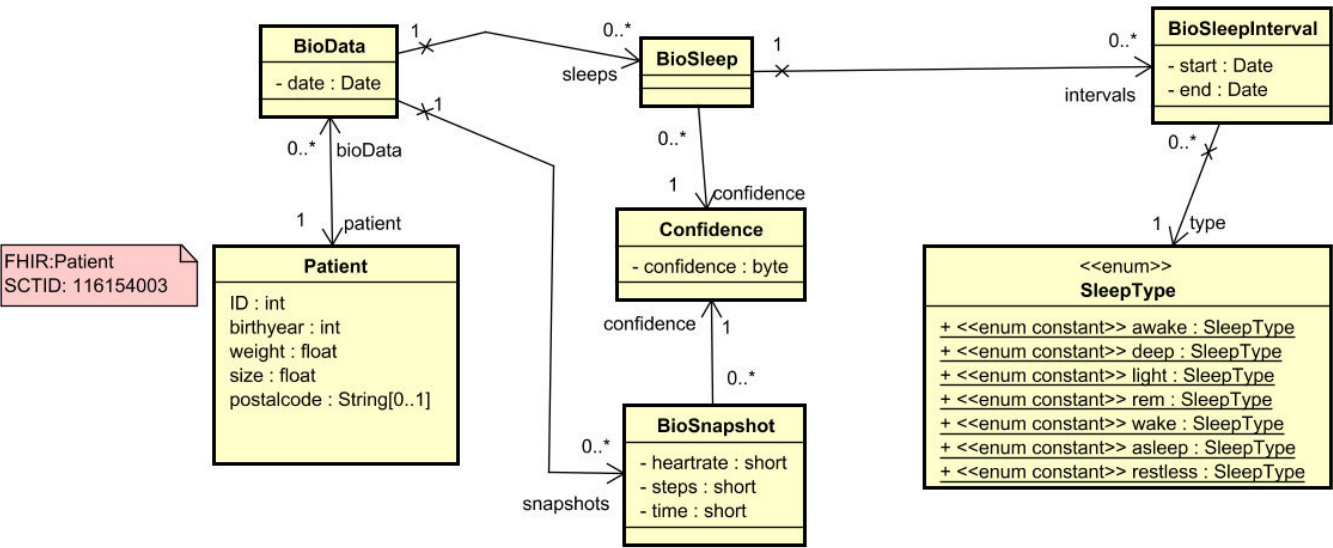


Figure 4: BioData

## 1. Patient

Attribute	Mandatory (YES/NO)	Type	Max # of char	Description	Constraint	FHIR mapping	Note
<b>ID</b>	YES	Numeric		The unique identifier of the patient.	long	Patient.identifier[0].value	
<b>allergies</b>	YES	List	0..*	List of allergies connected to patient		AllergyIntolerance	<a href="https://www.hl7.org/fhir/allergyintolerance.html">https://www.hl7.org/fhir/allergyintolerance.html</a>
<b>diets</b>	YES	List	0..*	List of diets connected to the patient		Diet	See below

## Extensions

<b>ResourceName</b>	<b>Patient</b>
<b>ElementName</b>	postalcode
<b>ElementDefinition</b>	the anonymised postal code, referring to a general area
<b>ElementCardinality</b>	0..1
<b>ElementType</b>	String
<b>Comment</b>	Useful for context based information gathering, like temperatures or pollination
<b>Is-modifier</b>	false
<b>Terminology Binding</b>	

## 2. Diet

Attribute	Mandatory (YES/NO)	Type	Max # of char	Description	Constraint	FHIR mapping	Note
<b>ID</b>	YES	Numeric		The unique identifier of the diet.	long	Identifier	
<b>name</b>	YES	String	100	The name of the diet			
<b>forbidden</b>	YES	List	0..*	List of Ingredients forbidden		Ingredient	See below
<b>preferred</b>	YES	List	0..*	List of Ingredients preferred		Ingredient	See below

### 3. Ingredient (Substance)

Attribute	Mandatory (YES/NO)	Type	Max # of character	Description	Constraint	FHIR mapping	Note
<b>ID</b>	YES	Numeric		The unique identifier of the diet.	N.A.	Identifier	
<b>name</b>	YES	String	100	The name of the ingredient		Substance.description	
<b>relations</b>	YES	List	0..*	List of Ingredients related		Ingredient/Substance	Used to map relations, like <->meat<->red meat<->pork<->porkchop<->bacon
<b>type</b>	YES	Food-type	0..*	The food type (taxonomy)		Food-type	<a href="http://hl7.org/fhir/ValueSet/food-type">http://hl7.org/fhir/ValueSet/food-type</a>
<b>nutrition</b>	YES	Nutrition				Nutrition	See below
<b>allergens</b>	YES	List	0..*	List of allergens contained		Substance	
<b>composition</b>	YES	NutritionComposition		the composition		NutritionComposition	

#### Extensions

<b>ResourceName</b>	<b>Substance</b>
<b>ElementName</b>	relations
<b>ElementDefinition</b>	the relations to other ingredients
<b>ElementCardinality</b>	0..*
<b>ElementType</b>	Substance
<b>Comment</b>	useful to link ingredients for inheritance and parsing of diets
<b>Is-modifier</b>	false

---

### Terminology Binding

ResourceName	Substance
ElementName	type
ElementDefinition	the food type
ElementCardinality	0..1 (0 for any substance, 1 for any ingredient)
ElementType	food-type
Comment	<a href="http://hl7.org/fhir/ValueSet/food-type">http://hl7.org/fhir/ValueSet/food-type</a>
Is-modifier	false

### Terminology Binding

ResourceName	Substance
ElementName	nutrition
ElementDefinition	the linked nutritions
ElementCardinality	0..1 (0 for any substance, 1 for any ingredient)
ElementType	Nutrition
Comment	the known nutritions for the ingredient
Is-modifier	false

### Terminology Binding

ResourceName	Substance
ElementName	composition
ElementDefinition	the nutrional composition
ElementCardinality	0..1 (0 for any substance, 1 for any ingredient)

---

<b>ElementType</b>	NutritionalComposition
<b>Comment</b>	
<b>Is-modifier</b>	false
<b>Terminology Binding</b>	

<b>ResourceName</b>	<b>Substance</b>
<b>ElementName</b>	allergens
<b>ElementDefinition</b>	the list of contained allergens (substances)
<b>ElementCardinality</b>	0..*
<b>ElementType</b>	Substance
<b>Comment</b>	
<b>Is-modifier</b>	false
<b>Terminology Binding</b>	

## 4. Nutrition

Attribute	Mandatory (YES/NO)	Type	Max # of char	Description	Constraint	FHIR mapping	Assumptions	Note
<b>ID</b>	YES	Numeric		The unique identifier of the Nutrition.	N.A.	Identifier		
<b>confidence</b>	YES	Confidence		The confidence in the data		Confidence		see below
<b>reference</b>	YES	Numeric		Is the data based on 100g, piece, dish	byte		1: per 100g/ml 2: per piece 4: per dish	
<b>energy</b>	NO	Float						In Joule
<b>protein</b>	NO	Float						In gram
<b>fat</b>	NO	Float						In gram
<b>carbs</b>	NO	Float						In gram
<b>sugar</b>	NO	Float						In gram
<b>fructose</b>	NO	Float						In gram
<b>sucrose</b>	NO	Float						In gram
<b>maltose</b>	NO	Float						In gram
<b>lactose</b>	NO	Float						In gram
<b>glucose</b>	NO	Float						In gram
<b>galactose</b>	NO	Float						In gram



<b>fiber</b>	N O	Float						In gram
<b>calcium</b>	N O	Float						In gram
<b>sodium</b>	N O	Float						In gram
<b>iron</b>	N O	Float						In gram
<b>choline</b>	N O	Float						In gram
<b>niacin</b>	N O	Float						In gram
<b>riboflavin</b>	N O	Float						In gram
<b>pantothenicAcid</b>	N O	Float						In gram
<b>thiamin</b>	N O	Float						In gram
<b>vitaminA</b>	N O	Float						In gram
<b>vitaminB12</b>	N O	Float						In gram
<b>vitaminB6</b>	N O	Float						In gram
<b>vitaminC</b>	N O	Float						In gram
<b>vitaminD</b>	N O	Float						In gram
<b>vitaminE</b>	N O	Float						In gram
<b>vitaminK</b>	N O	Float						In gram
<b>copper</b>	N O	Float						In gram
<b>magnesium</b>	N O	Float						In gram
<b>manganese</b>	N O	Float						In gram
<b>phosphorus</b>	N O	Float						In gram

potassium	N O	Float						In gram
selenium	N O	Float						In gram
zinc	N O	Float						In gram
cholesterol	N O	Float						In gram
alcohol	N O	Float						In gram
ash	N O	Float						In gram
caffeine	N O	Float						In gram
theobromine	N O	Float						In gram
water	N O	Float						In gram
saturatedfat	N O	Float						In gram
monounsaturatedfat	N O	Float						In gram
polyunsaturatedfat	N O	Float						In gram
transfat	N O	Float						In gram

**Value Set URI:** <http://crowdhealth.eu/fhir/ValueSet/Confidence>

Code	Display	Definition
0	no confidence	no confidence in the data
4	unsure	the confidence in the data is not very high
8	moderate	the data should be accurate enough
16	confident	the information is most likely accurate
32	very confident	the information should be very accurate

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64	guaranteed	the information is guaranteed to be correct
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## 5. NutritionalSummary

Attribute	Man dato ry (YE S/N O)	Type	Max # of char	Description	Constrai nt	Note
<b>ID</b>	YES	Numeri c		the unique identifier	unique, long	
<b>date</b>	YES	Date		the date		
<b>patient</b>	YES	Numeri c		the ID of the patient	long	
<b>composition</b>	YES	Numeri c		the ID of the NutritionalComposition	long	
<b>nutrition</b>	YES	Numeri c		the ID of the Nutrition	long	
<b>ingredients</b>	YES	List	0..*	the <i>known</i> NutritionalIngredient used in this summary		<b>not guaranteed to have all ingredients</b>

## 6. NutritionalIngredient

Attribute	Man dato ry (YE S/N O)	Type	Max # of char	Description	Constrai nt	Note
<b>ID</b>	YES	Numeri c		the unique identifier	unique, long	
<b>ingredient</b>	YES	Numeri c		the ID of the Ingredient	long	
<b>amount</b>	YES	Numeri c		the ID of the patient	float	

## 7. NutritionalComposition

Attribute	Mandatory (YES/NO)	Type	Max # of char	Description	Constraint	Note
<b>ID</b>	YES	Numeric		the unique identifier	unique, long	
<b>grain</b>	YES	Numeric		the amount of grain	float	in gram
<b>fruits</b>	YES	Numeric		the amount of fruits	float	in gram
<b>vegetables</b>	YES	Numeric		the amount of vegetables	float	in gram
<b>dairy</b>	YES	Numeric		the amount of dairy	float	in gram
<b>oils</b>	YES	Numeric		the amount of oil	float	in ml
<b>protein</b>	YES	Numeric		the amount of protein	float	in gram

## 8. Activity

Attribute	Man dato ry (YE S/N O)	Type	Max # of char	Description	Constrai nt	Note
<b>ID</b>	YES	Numeri c		the unique identifier	unique, long	
<b>patient</b>	YES	Numeri c		the ID of the patient	long	
<b>date</b>	YES	date		the date		
<b>name</b>	YES	String	100	the name given by the patient or the system		
<b>type</b>	YES	Numeri c		the ID of the ActivityType		
<b>energy</b>	YES	Numeri c		the energy burned in kj (above idle consumption)		in kj
<b>distance</b>	YES	Numeri c		the amount of dairy		in m
<b>duration</b>	YES	Numeri c		the amount of oil		in s
<b>persons</b>	YES	Numeri c		how many persons where involved	byte	

---

## 9. ActivityType

Attribute	Mandatory (YES/ NO)	Type	Max # of char	Description	Constraint
<b>ID</b>	YES	Numeric		the unique identifier	unique, long
<b>name</b>	YES	String	100	the name given by the patient or the system	
<b>parent</b>	NO	Numeric		the ID of the ActivityType parent	



## 10. BioData

Attribute	Mandatory (YES/ NO)	Type	Amount	Description	Constraint
<b>ID</b>	YES	Numeric		the unique identifier	unique, long
<b>patient</b>	YES	Numeric		the patients ID	long
<b>date</b>	YES	Date		the date matching this dataset, only day portion relevant	
<b>sleeps</b>	YES	List	0..*	the IDs of the BioSleeps that day	long
<b>snapshots</b>	YES	List	0..*	the IDs of the BioSnapshots that day	long

## 11. BioSnapshot

Attribute	Mandatory (YES/NO)	Type	Description	Constraint
<b>ID</b>	YES	Numeric	the unique ID	long
<b>heartrate</b>	YES	Numeric	the heartrate (average) at that time	short
<b>steps</b>	YES	Numeric	the delta of steps between now and the entry before	short
<b>time</b>	YES	Numeric	the minutes passed since 00:00	short
<b>confidence</b>	YES	Numeric	the confidence in the data	byte

---

## 12. BioSleep

Attribute	Mandatory (YES/NO)	Type	Amount	Description	Constraint
<b>ID</b>	YES	Numeric		the unique ID	long
<b>intervals</b>	YES	List	1..*	the IDs of the SleepIntervals	long

## 13. BioSleepInterval

Attribute	Mandatory (YES/NO)	Type	Description	Constraint	FHIR mapping
<b>ID</b>	YES	Numeric	the unique ID	long	
<b>start</b>	YES	Date	the begin of this interval		
<b>end</b>	YES	Date	the end of this interval		
<b>type</b>	YES	Numeric		byte	SleepType

### SleepType

**Value Set URI:**<http://crowdhealth.eu/fhir/ValueSet/SleepType>

Code	Display	Definition	Note
1	deep	deep sleep	30 seconds granularity, better accuracy, normal case
2	light	light sleep	
4	rem	rem phase	
8	wake	awake	
16	asleep	asleep	60 seconds granularity, slightly worse, can happen if data is not synced regularly and has to be compressed
32	restless	restless	
64	awake	awake	



# CrowdHEALTH

**Collective Wisdom Driving Public Health Policies**

## **Del. no. – D3.1 Annex B3: Data scheme of BioAssist mapped to FHIR**

**Project Deliverable**



This project has received funding from the European Union's Horizon 2020 Programme (H2020-SC1-2016-CNECT) under Grant Agreement No. 727560

# Data sources scheme

The Use Case is driven by the data entered or gathered by patients on the BioAssist platform. More specifically, patients provide information on their vital signs, allergies, and medication. In addition, data is gathered by the patients' Personal Health Records (PHRs), while BioAssist also gathers social data from its platform, referring to the patient's daily life and behaviour.

## Vital Signs

### Conceptual diagram

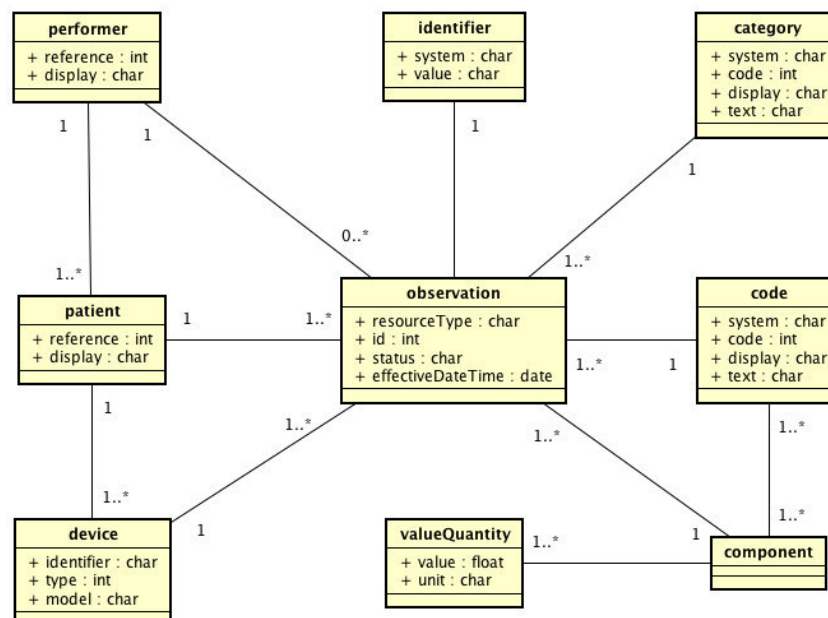


Figure 1 - Vital signs conceptual diagram

### List of entities

Entity Name	Description	FHIR mapping (name of the resource)	Note
patient	Demographics and other administrative information about an individual receiving care or other health-related services.	Patient	
observation	Signals that belong to a patient that is continually measured and monitored, using sensors such as oximeters, glucometers, etc.	Observation	
performer	The one that is responsible for the observation,	Performer	

	which can be either the practitioner, or the organization, or the patient, or the related person.		
device	The device that is used for the specific measurement	Device	
identifier	A unique identifier assigned to the observation	Observation	
category	A code that classifies the general type of observation being made	Observation	
code	It describes what was observed	Observation	

### Observation

Attribute	Mandatory (YES/NO)	Type	Max # of character	Description	Constraint	FHIR mapping	Assumptions	Y1 coverage
resourceType	YES	String	100	The type of the resource	N.A.	Observation		YES
id	YES	Int	15	The unique identifier of the observation	N.A.	Observation.identifier		YES
status	YES	String	100	The status of the observation	ObsStatus	Observation.status		YES
effectiveDateTime	YES	Date/Time	24	The date-time of the observation	N.A.	Observation.effectiveDateTime		YES

### Category

Attribute	Mandatory (YES/NO)	Type	Max # of character	Description	Constraint	FHIR mapping	Assumptions	Y1 coverage
category	YES	CodeableConcept	-	A code that classifies the general type of observation	N.A.	Observation.category		YES
coding	YES	-	-	-	N.A.		Category is of type CodeableConcept. As a result its structure should contain ([coding[system, code, display],text)	YES
system	YES	String	100	Standard used for referring to the	Coding			YES

				category of the observation				
<b>code</b>	YES	Int	9	Unique Code of the category of the observation	Coding			YES
<b>display</b>	YES	String	100	The way that the category of the observation is displayed into a non-standard format (e.g. Vital Signs)	N.A.			YES
<b>text</b>	NO	String	100	Text describing the category	N.A.			YES

## Code

Attribute	Mandatory (YES/NO)	Type	Max # of char	Description	Constraint	FHIR mapping	Assumptions	Y1 coverage
<b>code</b>	YES	CodeableConcept	-	It describes what was observed	N.A.	Observation.code		YES
<b>coding</b>	YES	-	-	-	N.A.		Code is of type CodeableConcept. As a result its structure should contain ([coding[system, code, display],text)	YES
<b>system</b>	YES	String	100	Standard used for referring to the component of the category	Coding			YES
<b>code</b>	YES	Int	9	Unique Code of the component of the category	Coding			YES
<b>display</b>	YES	String	100	The way that the component of the category of is displayed into a non-standard format (e.g. Blood Pressure)	N.A.			YES
<b>text</b>	NO	String	100	Text describing	N.A.			NO



				the component of the category				
--	--	--	--	--	--	--	--	--

## Component

Attribute	Mandatory (YES/NO)	Type	Max # of char	Description	Constraint	FHIR mapping	Assumptions	Y1 coverage
<b>component</b>	NO	BackBone element	-	The component observations	N.A.	Observation.component		YES

## ValueQuantity

Attribute	Mandatory (YES/NO)	Type	Max # of char	Description	Constraint	FHIR mapping	Assumptions	Y1 coverage
<b>valueQuantity</b>	YES	-	-	An amount that can be measured	N.A.	Observation.component.valueQuantity		YES
<b>value</b>	YES	Float	5	The value of the measurement	N.A.	Observation.component.value		YES
<b>unit</b>	NO	String	10	The unit of the measurement	UnitCode	Observation.device.reference.resolve().unit	Observation.device is DeviceMetric	YES

## Identifier

Attribute	Mandatory (YES/NO)	Type	Max # of char	Description	Constraint	FHIR mapping	Assumptions	Y1 coverage
<b>identifier</b>	NO	-	-	The unique identifier of the observation	N.A.	Identifier		YES
<b>system</b>	YES	String	17	The namespace for the identifier value	N.A.	Identifier.system		YES
<b>value</b>	YES	String	31	The value that is unique within the context of the system	N.A.	Observation.identifier		YES

## Patient

Attribute	Mandatory (YES/NO)	Type	Max # of char	Description	Constraint	FHIR mapping	Assumptions	Y1 coverage
<b>subject</b>	YES	-	-	The patient whose characteristics are	N.A.	Observation.subject	Observation.subject is Patient	YES

				described by the observatio n				
<b>reference</b>	YES	Int	4	Unique identifier of the patient whose observatio n is measured	N.A.	Observation.subject.reference.resolve().ident ifier[0].value	Observation.s ubject is Patient	YES
<b>display</b>	YES	Stri ng	100	Display name of the patient	N.A.	Observation.subject.reference.resolve().name	Observation.s ubject is Patient	YES

## Performer

Attribu te	Mandat ory (YES/N O)	Typ e	Ma x # of cha r	Descripti on	Constra int	FHIR mapping	Assumptions	Y1 covera ge
<b>performer</b>	YES	-	-	The responsi ble of the observati on	N.A.	Observation.subject	Observation.su bject is Patient	YES
<b>reference</b>	YES	Int	4	Unique identifier of the patient whose vital signs are measured	N.A.	Observation.subject.reference.resolve().identi fier[0].value	Observation.su bject is Patient	YES
<b>display</b>	YES	Stri ng	100	Display name of the patient	N.A.	Observation.subject.reference.resolve().name	Observation.su bject is Patient	YES

## Device

Attribu te	Mandat ory (YES/N O)	Typ e	Ma x # of cha r	Descripti on	Constra int	FHIR mapping	Assumptions	Y1 covera ge
<b>device</b>	NO	-	-	The device used for the observati on	N.A.	Observation.device	Observation.de vice is Device	NO
<b>identifier</b>	YES	Stri ng	17	The Serial Number of the device that takes the	N.A.	Observation.device.reference.resolve().identi fier[0].value	Observation.de vice is Device	NO

				measurement				
<b>type</b>	YES	Int	10	The identifier of the type of the device	N.A.	Observation.device.reference.resolve().type	Observation.device is Device	NO
<b>model</b>	YES	String	100	The model of the device	N.A.	Observation.device.reference.resolve().udi.name	Observation.device is Device	NO

## Constraints

### UnitCode

Value/Code	Name	Description	Code - identifier	Code - description	Terminology URI	Y1 coverage
<b>mmHg</b>	millimeters of mercury	The units used to measure blood pressure	millimeter-of-mercury	Millimeter of mercury	<a href="http://www.crowdhealth.eu/hhr-t">http://www.crowdhealth.eu/hhr-t</a>	YES
<b>bpm</b>	beats per minute	The units used to measure the resting heart rate	beats-minute	Beats/minute	<a href="http://www.crowdhealth.eu/hhr-t">http://www.crowdhealth.eu/hhr-t</a>	YES
<b>%</b>	Per cent	The units used to measure the oxygen saturation	percent	Percent	<a href="http://www.crowdhealth.eu/hhr-t">http://www.crowdhealth.eu/hhr-t</a>	YES
<b>mg/dL</b>	Milligram per deciliter	Milligram/deciliter	milligram-deciliter	Milligram/deciliter	<a href="http://www.crowdhealth.eu/hhr-t">http://www.crowdhealth.eu/hhr-t</a>	YES
<b>L/s</b>	Liter per second	Liter/second	liter-second	Liter/second	<a href="http://www.crowdhealth.eu/hhr-t">http://www.crowdhealth.eu/hhr-t</a>	NO
<b>L</b>	liter	liter	liter	liter	<a href="http://www.crowdhealth.eu/hhr-t">http://www.crowdhealth.eu/hhr-t</a>	NO
<b>L/m</b>	Liter per minute	Liter/minute	liter-minute	Liter/minute	<a href="http://www.crowdhealth.eu/hhr-t">http://www.crowdhealth.eu/hhr-t</a>	NO
<b>kg</b>	kilogram	kilogram	kilogram	kilogram	<a href="http://www.crowdhealth.eu/hhr-t">http://www.crowdhealth.eu/hhr-t</a>	YES

### ObsStatus

Value/Code	Name	Description	Code - identifier	Code - description	Terminology URI	Y1 coverage
<b>Final</b>	Final	The status of the observation	end-stage	End-stage	<a href="http://www.crowdhealth.eu/hhr-t">http://www.crowdhealth.eu/hhr-t</a>	YES

## Coding

Value/Code	Name	Description	Code - identifier	Code - description	Terminology URI	Y1 coverage
<b>Vital Signs</b>	Vital Signs	The main category of the observation	vital-sign	Vital sign	<a href="http://www.crowdhealth.eu/hhr-t">http://www.crowdhealth.eu/hhr-t</a>	YES
<b>Blood Pressure</b>	Blood Pressure	The component of the main category of the observation	blood-pressure	Blood pressure	<a href="http://www.crowdhealth.eu/hhr-t">http://www.crowdhealth.eu/hhr-t</a>	YES
<b>Heart Rate</b>	Heart Rate	The component of the main category of the observation	heart-rate	Heart rate	<a href="http://www.crowdhealth.eu/hhr-t">http://www.crowdhealth.eu/hhr-t</a>	YES
<b>Systolic Blood Pressure</b>	Systolic Blood Pressure	The specific measurement of the component	systolic-blood-pressure	Systolic blood pressure	<a href="http://www.crowdhealth.eu/hhr-t">http://www.crowdhealth.eu/hhr-t</a>	YES
<b>Diastolic Blood Pressure</b>	Diastolic Blood Pressure	The specific measurement of the component	diastolic-blood-pressure	Diastolic blood pressure	<a href="http://www.crowdhealth.eu/hhr-t">http://www.crowdhealth.eu/hhr-t</a>	YES
<b>Peripheral oxygen saturation</b>	Peripheral oxygen saturation	The specific measurement of the component	peripheral-oxygen-saturation	Peripheral oxygen saturation	<a href="http://www.crowdhealth.eu/hhr-t">http://www.crowdhealth.eu/hhr-t</a>	NO
<b>Blood glucose concentration</b>	Blood glucose concentration	The specific measurement of the component	blood-glucose-concentration	Blood glucose concentration	<a href="http://www.crowdhealth.eu/hhr-t">http://www.crowdhealth.eu/hhr-t</a>	NO
<b>Emotion</b>	Emotion	The specific measurement of the component	emotion	Emotion	<a href="http://www.crowdhealth.eu/hhr-t">http://www.crowdhealth.eu/hhr-t</a>	NO
<b>Forced expiratory flow rate between 25+75% of vital capacity</b>	Forced expiratory flow rate between 25+75% of vital capacity	The specific measurement of the component	forced-expiratory-flow-rate-between-25-75-percent-of-vital-capacity	Forced expiratory flow rate between 25+75% of vital capacity	<a href="http://www.crowdhealth.eu/hhr-t">http://www.crowdhealth.eu/hhr-t</a>	NO
<b>Forced expired volume in 1 second</b>	Forced expired volume in 1 second	The specific measurement of the component	forced-expired-volume-in-1-second	Forced expired volume in 1 second	<a href="http://www.crowdhealth.eu/hhr-t">http://www.crowdhealth.eu/hhr-t</a>	NO
<b>Forced expiratory volume in one second/Forced vital capacity percent</b>	Forced expiratory volume in one second/Forced vital capacity percent	The specific measurement of the component	forced-expiratory-volume-in-one-second-forced-vital-capacity-percent	Forced expiratory volume in one second/Forced vital capacity percent	<a href="http://www.crowdhealth.eu/hhr-t">http://www.crowdhealth.eu/hhr-t</a>	NO
<b>Forced expired volume in 6 seconds</b>	Forced expired volume in 6 seconds	The specific measurement of the component	forced-expired-volume-in-6-seconds	Forced expired volume in 6 seconds	<a href="http://www.crowdhealth.eu/hhr-t">http://www.crowdhealth.eu/hhr-t</a>	NO
<b>Forced vital capacity</b>	Forced vital capacity	The specific measurement of the component	forced-vital-capacity	Forced vital capacity	<a href="http://www.crowdhealth.eu/hhr-t">http://www.crowdhealth.eu/hhr-t</a>	NO

<b>Peak expiratory flow rate</b>	Peak expiratory flow rate	The specific measurement of the component	peak-expiratory-flow-rate	Peak expiratory flow rate	<a href="http://www.crowdhealth.eu/hhr-t">http://www.crowdhealth.eu/hhr-t</a>	NO
<b>Perfusion index Tissue by Pulse oximetry</b>	Perfusion index Tissue by Pulse oximetry	The specific measurement of the component	61006-3	Perfusion index Tissue by Pulse oximetry	<a href="https://loinc.org">https://loinc.org</a>	NO
<b>Pulse oximetry waveform</b>	Pulse oximetry waveform	The specific measurement of the component	pulse-oximetry-waveform	Pulse oximetry waveform	<a href="http://www.crowdhealth.eu/hhr-t">http://www.crowdhealth.eu/hhr-t</a>	NO
<b>Body weight</b>	Body weight	The specific measurement of the component	body-weight	Body weight	<a href="http://www.crowdhealth.eu/hhr-t">http://www.crowdhealth.eu/hhr-t</a>	YES

## Phr\_sample

### Conceptual diagram

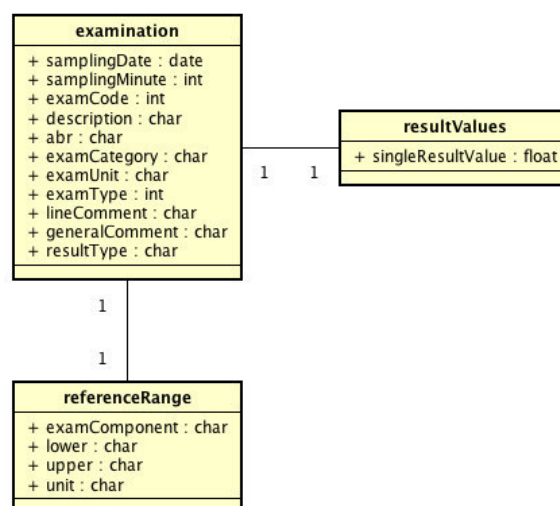


Figure 2 - Phr conceptual diagram

### List of entities

Entity Name	Description	FHIR mapping (name of the resource)	Note
examination	A physical evaluation of a prospective insured, conducted by a doctor acting as the insured's agent	DiagnosticReport	
referenceRange	The range of values for a physiologic measurement in healthy persons	DiagnosticReport	
resultValues	The value of the examination's results	DiagnosticReport	

## Phr

Attribute	Mand atory (YES/ NO)	Typ e	Max # of ch ar	Descri ption	Const raint	FHIR mapping	Assumptions	Y1 conv erage
sampling Date	YES	Date	10	The date of the sampling	N.A.	DiagnosticReport.issued		NO
examCode	YES	Int	4	The unique identifier of the specific examination	N.A.	DiagnosticReport. result.reference.resolve().identifier[0].value		NO
description	YES	String	100	Description of the examination	N.A.	DiagnosticReport.result.reference.resolve().context.reference.resolve().type	DiagnosticReport.result is Observation  DiagnosticReport.result.reference.resolve().context is EpisodeOfCare	NO
abbr	YES	String	10	The abbreviation of the examination	N.A.	DiagnosticReport.code		NO
examCategory	YES	String	10	The category of the examination	N.A.	DiagnosticReport.category		NO
examUnit	YES	String	10	The measurement unit of the examination	Exam Un	DiagnosticReport. result.reference.resolve().identifier[0].device.reference.resolve().unit	DiagnosticReport.result is Observation  DiagnosticReport. result.reference.resolve().identifier[0].device is DeviceMetric	NO
examType	YES	Int	10	The unique identifier of the general examination	Exam Type	DiagnosticReport.identifier		NO
LineComment	NO	String	100	A specific	N.A.	DiagnosticReport.result.reference.resolve().comment	DiagnosticReport.result is	NO

				c comme nt concer ning a part of the examin ation			Observation	
<b>GeneralC omment</b>	NO	Str ing	10 0	A general comme nt concer ning the whole examin ation	N.A.	DiagnosticReport.conclusion		NO
<b>resultTyp e</b>	YES	Str ing	10 0	The expect ed type of the examin ation result	N.A.	FHIR extension		NO

**Element: resultType** - The expected data type of the result

ResourceName	DiagnosticReport
ElementName	resultType
ElementDefinition	The expected data type of the result
ElementCardinality	1..1
ElementType	String
Comment	Example of resultType: numeric/description
Is-modifier	False
Terminology Binding	resultType

**Value Set:** resultType

**Value Set URI:** <http://crowdhealth.eu/fhir/ValueSet/resultType>

Code	Display	Definition
<b>numeric</b>	numeric/description	The result data type contains only numbers
<b>string</b>	string/description	The result data type contains strings and/or numbers
<b>other</b>	Other	Any other data type not listed in this Value Set

resultValues

Attribute	Mandatory (YES/NO)	Type	Max # of character	Description	Constraint	FHIR mapping	Assumptions	Y1 coverage
<b>singleResultValue</b>	YES	Float	10	The result of the examination	N.A.	DiagnosticReport.result.reference.resolve().value	DiagnosticReport.result is Observation	NO

referenceRange

Attribute	Mandatory (YES/NO)	Type	Max # of character	Description	Constraint	FHIR mapping	Assumptions	Y1 coverage
<b>examComponent</b>	YES	String	10	The abbreviation of the examination	Same as the abbr	DiagnosticReport.code		NO
<b>lower</b>	NO	String	10	The minimum limit of the examination result	It depends on the measured value	DiagnosticReport.result.reference.resolve().referenceRange.low	DiagnosticReport.result is Observation	NO
<b>upper</b>	YES	String	10	The maximum	It depends	DiagnosticReport.result.reference.resolve().referenceRange.high	DiagnosticReport.result is	NO



				m limit of the examinat ion result	s on the measur ed value		Observation	
<b>unit</b>	YES	Stri ng	10	The measure ment unit of the examinat ion	Same as the exam unit	DiagnosticReport. result.reference.resolve().identifier[0].devi ce.reference.resolve().unit	DiagnosticReport. result is Observation	NO

## Constraints

### ExamUn

Value/Code	Name	Description	Code - identifier	Code - description	Terminology URI	Y1 coverage
<b>mm/h</b>	Milimeters per hour	The units used to measure a medical test	millimeter- hour	Millimeter/hour	<a href="http://www.crowdhealth.eu/hhr-t">http://www.crowdhealth.eu/hhr- t</a>	NO
<b>ng/ml</b>	Nanogram per milliliter	The units used to measure a medical test	nanogram- milliliter	Nanogram/milliliter	<a href="http://www.crowdhealth.eu/hhr-t">http://www.crowdhealth.eu/hhr- t</a>	YES

### ExamType

Value/Code	Name	Description	Code - identifier	Code - description	Terminology URI	Y1 coverage
<b>1</b>	1	A unique identifier of the examination type				NO
<b>2</b>	2	A unique identifier of the examination type				NO

## Allergies

### Conceptual diagram

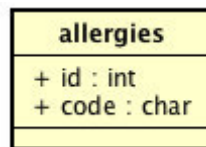


Figure 3 - Allergies conceptual diagram

### List of entities

Entity Name	Description	FHIR mapping (name of the resource)	Note
allergies	A number of conditions caused by hypersensitivity of the immune system to something in the environment that usually causes little or no problem in most people	AllergyIntolerance	

## Allergies

Attribute	Mandatory (YES/NO)	Type	Max # of char	Description	Constraint	FHIR mapping	Assumptions	Y1 coverage
id	YES	Int	15	The unique identifier of the allergy	N.A.	AllergyIntolerance.identifier		NO
code	YES	String	100	A code that identifies the allergy or intolerance	N.A.	AllergyIntolerance.code		NO

## Medication

### Conceptual diagram

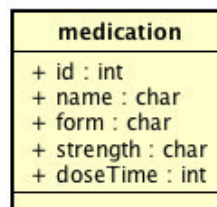


Figure 4 - Medication conceptual diagram

### List of entities

Entity Name	Description	FHIR mapping (name of the resource)	Note
medication	A drug or other form of medicine that is used to treat or prevent disease	Medication	

### Medication

Attribute	Mandatory (YES/NO)	Type	Max # of character	Description	Constraint	FHIR mapping	Assumptions	Y1 coverage
id	YES	Integer	15	The unique identifier of the medication	medID	Medication.code		YES
name	YES	String	100	The name of the medication	N.A.	FHIR Extension		NO
form	YES	String	100	The form of the item	N.A.	Medication.form		NO
strength	YES	String	100	It defined the strength of the medication	N.A.	FHIR Extension		NO
doseTime	YES	Integer	9	The time that the medication should be provided	N.A.	MedicationStatement.effectiveDateTime		YES

---

**Element: name** - The name of the medication

ResourceName	Medication
ElementName	name
ElementDefinition	The name of the medication
ElementCardinality	1..1
ElementType	string
Comment	-
Is-modifier	false
Terminology Binding	-

**Element: strength** - The strength of the medication

ResourceName	Medication
ElementName	strength
ElementDefinition	The strength of the medication
ElementCardinality	1..1
ElementType	string
Comment	-
Is-modifier	false
Terminology Binding	-



CrowdHEALTH

**Collective Wisdom Driving Public Health Policies**

## **Del. no. – D3.1 Annex B4: Data scheme of CareCross mapped to FHIR**

**Project Deliverable**

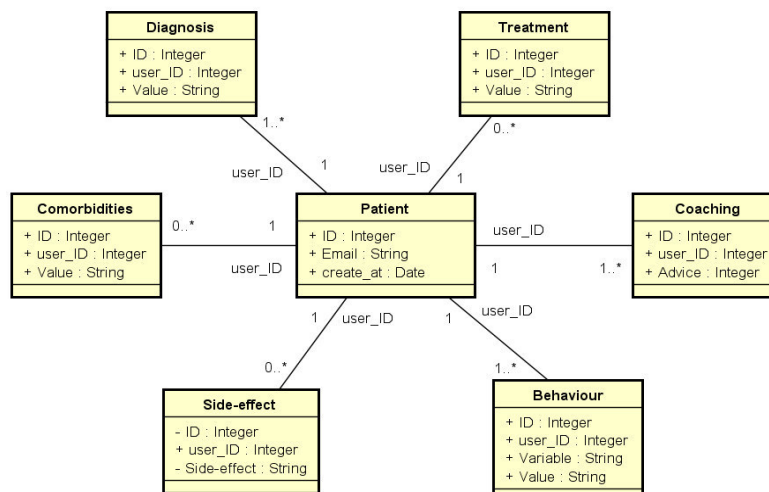


This project has received funding from the European Union's Horizon 2020 Programme (H2020-SC1-2016-CNECT) under Grant Agreement No. 727560

# Data source scheme

The Use Case is driven by the data entered by cancer patients on the secure CareAcross web platform. More specifically, patients provide information on their diagnosis, treatment, co-morbidities, health behaviours and side-effects. The platform then provides medical information based on this input, and attempts to “coach” the patients into behaviour change based on medical research.

## Conceptual diagram



## List of entities

Entity Name	Description	FHIR mapping (name of the resource)	Note
Patient	Patient's contact info (email address), used only for communications.	Patient	
Diagnosis	The diagnosis data, including metastases.	Condition	
Treatment	Treatment(s) received	Procedure or MedicationStatement	
Comorbidities	Other condition(s)	Condition	
Behaviour	The behaviour as entered by the patient.	Observation	
Coaching	The coaching provided	CarePlan.Activity.Detail.Goal or	Each row of the

	due to the behaviour entered by the patient.	CarePlan.Activity.Detail	table Coaching related to the same Patient is mapped to the same CarePlan.
Side-effects	The side-effect reported by the patient	Condition	

## Patient

Attribute	Mandatory (YES/NO)	Type	Max # of char	Description	Constraint	FHIR mapping	Assumptions	Note
ID	YES	Numeric	10	The unique identifier of the patient.	N.A.	Patient.identifier[0].value	Patient.identifier[0].system="https://www.careacross.com/"	
Email	YES	String	100	Patient's email.	N.A.	Patient.telecom[0].value	Patient.telecom[0].system="Email"	
created_at	YES	Date	10	Registration date	N.A.	Resource.meta.lastUpdate		

## Diagnosis

Attribute	Mandatory (YES/NO)	Type	Max # of char	Description	Constraint	FHIR mapping	Assumptions	Note
							Condition.category.coding[0].code="diagnosis", Condition.category.coding[0].display="Diagnosis" Condition.category.coding[0].system="http://crowdhealth.eu/hhr-t"	This assumptions must be used if the <value_code> (see row Value) is a subconcept of "Neoplastic disease"
							Condition.category.coding[0].code="morphologically-abnormal-structure", Condition.category.coding[0].display="Morphologically abnormal structure" Condition.category.coding[0].system="http://crowdhealth.eu/hhr-t"	This assumptions must be used if the <value_code> (see row Value) is a SNOMED concept "Intraductal carcinoma, noninfiltrating, no International Classification of Diseases for Oncology subtype"
ID	YES	Numeric	20	The unique identifier of the diagnosis.	N.A.	Not mapped		

<b>User_ID</b>	YES	Numeric	20	The unique ID of the patient.	Unique_Patient_ID: Matches one entry of Patient entity.	Condition.subject.reference.resolve().identifier[0].value  Condition.asserter.reference.resolve().identifier[0].value	Condition.subject.reference.resolve() is Patient Condition.asserter.reference.resolve() is Patient	This mapping uses the function "resolve()" (see section B.3.3 of FHIRPath specification) to return the FHIR resource pointed by a FHIR Reference (that in this case is a Patient).
<b>Value</b>	YES	String	100	The diagnosis information entered by the patient.	DiagnosisValue		Condition.code.coding[0].code=<value_code> Condition.code.coding[0].display=<description> Condition.code.coding[0].system=<terminology URI> Condition.code.text=<Description of the selected DiagnosisValue>	<p>Each <b>Value</b> must be converted in a corresponding &lt;value_code&gt; selected from a specific dictionary identified by a &lt;terminology_URI&gt;. The &lt;description&gt; of that &lt;value_code&gt; as specified by the dictionary must be included. See codes, descriptions and terminology URIs in the table DiagnosisValue.</p> <p>In case of reverse translation (from FHIR to CRA system) any Condition which code.coding[0].code is specialization of the concept "Neoplastic disease" or of the concept "Intraductal carcinoma" must be mapped to a (CRA) Diagnosis entity.</p> <p><b>To simplify analytics processing a FHIR extension of the Diagnosis resource (e.g. boolean attribute isCancerDiagnosis) could be defined and put</b></p>



								in a namespace specific for CRA use case (in order to distinguish it from general purpose extensions).
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## Treatment

Attribute	Mandatory (YES/NO)	Type	Max # of char	Description	Constraint	FHIR mapping	Assumptions	Note
<b>ID</b>	YES	Numeric	20	The unique identifier of the treatment.	N.A.	Not Mapped		
<b>User_ID</b>	YES	Numeric	20	The unique ID of the Patient.	Unique_Patient_ID: Matches one entry of Patient	MedicationStatement.subject.reference.resolve().identifier[0].value	MedicationStatement.subject.reference.resolve() is Patient	This mapping uses the function "resolve()" (see section B.3.3 of <a href="#">FHIRPath</a> specification) to return the FHIR resource pointed by a FHIR Reference (that in this case is a Patient).
						Procedure.subject.reference.resolve().identifier[0].value	Procedure.subject.reference.resolve() is Patient	
<b>Value</b>	YES	String	100	The treatment information entered by the patient.	TreatmentValue	MedicationStatement		Here we specify alternative mappings because the correct "FHIR mapping" depends from the content of the "Value" attribute, as specified in table <a href="#">TreatmentValue</a> .
						Procedure		

## Comorbidities

Attribute	Mandatory (YES/NO)	Type	Max # of char	Description	Constraint	FHIR mapping	Assumptions	Note
							Condition.category.coding[0].code="clinical-finding", Condition.category.coding[0].display="Clinical finding" Condition.category.coding[0].system="http://crowdhealth.eu/hhr-t"	
<b>ID</b>	YES	Numeric	20	The unique identifier of the comorbidity.	N.A.	Not mapped.		
<b>User_ID</b>	YES	Numeric	20	The unique identifier of the patient.	Unique_Patient_ID: Matches one entry of Patient entity.	Condition.subject.reference.resolve().identifier[0].value  Condition.asserter.reference.resolve().identifier[0].value	Condition.subject.reference.resolve() is Patient Condition.asserter.reference.resolve() is Patient	This mapping uses the function "resolve()" (see section B.3.3 of <a href="#">FHIRPath</a> specification) to return the FHIR resource pointed by a FHIR Reference (that in this case is a Patient).
<b>Value</b>	YES	String	100	Comorbidities for the patient.	ComorbiditiesValue.		Condition.code.coding[0].code=<value_code> Condition.code.coding[0].display=<description> Condition.code.coding[0].system=<terminology_URI> Condition.code.text=<Name of the selected ComorbiditiesValue>	Each <b>Value</b> must be converted in a corresponding <value_code> selected from a specific dictionary identified by a <terminology_URI>. The <description> of that <value_code> as specified by the dictionary must be included. See codes, descriptions and

							<p>terminology URIs in the table Comorbiditie sValue.</p> <p>In case of reverse translation (from FHIR to CRA system) any Condition which code.coding[ 0].code is the concept “Acid reflux” or is a subconcept of concept “Disease” and is not a cancer diagnosis recorded by CRA (see note in Diagnosis table) must be mapped to a (CRA) Comorbidity entity.</p> <p><b>To simplify analytics processing a FHIR extension of the Diagnosis resource (eg. boolean attribute isCancerCo morbidity) could be defined and put in a namespace specific for CRA use case (in order to distinguish it from general purpose extensions).</b></p>
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## Behaviour

Attribute	Mandatory (YES/NO)	Type	Max # of character	Description	Constraint	FHIR mapping	Assumptions	Note
							<p>Observation.category[0].coding[0].code=&lt;value_code&gt;,            Observation.category[0].coding[0].display=&lt;value_display&gt;,            Observation.category[0].coding[0].system="https://www.hl7.org/fhir/value-set-observation-category.html"            Observation.status="Unknown"</p>	The value of <code> and <display> depends on the kind of field "Value" (for example if value="smoking" then category.code="social-history"). "status" is a mandatory element of the Observation resource and must be filled in.
<b>ID</b>	YES	Numeric	20	The unique identifier of the behaviour	N.A.	Not mapped.		
<b>User_ID</b>	YES	Numeric	20	The unique ID of the patient	Unique_Patient_ID: Matches one entry of Patient entity.	<p>Observation.subject.reference.resolve().identifier[0].value</p> <p>Observation.performer.reference.resolve().identifier[0].value</p>	Observation.subject.reference.resolve() is Patient	
<b>Variable</b>	YES	String	50	The kind of behaviour provided	Variable Value		<p>Observation.code.coding[0].code=&lt;value_code&gt;            Observation.code.coding[0].display=&lt;description&gt;            Observation.code.coding[0].system=&lt;terminology_URI&gt;            Condition.code.text=&lt;Description of the selected ComorbiditiesValue&gt;</p>	Each <b>VariableValue</b> must be converted in a corresponding <value_code> selected from a specific dictionary identified by a <terminology_URI>. The <description> of that <value_code> as specified by the dictionary have to be included.

								See codes, descriptions and terminology URIs in the table BehaviourVariable.
<b>Value</b>	YES	String	100	Any value also provided (usually numerical but not necessarily)	N.A.	Observation.value	<p>Observation.value is Quantity</p> <p>Observation.value.value=&lt;value&gt; Observation.value.unit="portions per week" Observation.value.system=&lt;URI of the system that provides the coded form of the unit&gt; Observation.value.code="portions/week"</p>	When the value is equal to "8+" or "15+" or "23+" the element Observation.value.comparator must be ">="

## Coaching

Attribute	Mandatory (YES/NO)	Type	Max # of char	Description	Constraint	FHIR mapping	Assumptions	Note
							CarePlan.intent="Proposal". CarePlan.status="Unknown". CarePlan.author.reference.resolve() is Organization CarePlan.author.name="CareAcross" CarePlan.telecom[0].system="URL" CarePlan.telecom[0].value="https://www.careacross.com/"	
<b>ID</b>	YES	Numeric	20	The unique identifier of the coaching.	N.A.	Not mapped.		
<b>User_ID</b>	YES	Numeric	20	The unique ID of the patient.	Unique_Patient_ID: Matches one entry of Patient entity.	CarePlan.subject.reference.resolve().identifier[0].value	CarePlan.subject is Patient	
<b>Advice</b>	YES	String	500	The coaching provided.	Advice Value			At this stage information about advices are not included

## Side-effects

Attribute	Mandatory (YES/NO)	Type	Max # of char	Description	Constraint	FHIR mapping	Assumptions	Note
							Condition.category.coding[0].code="clinical-finding", Condition.category.coding[0].display="Clinical finding" Condition.category.coding[0].system="http://crowdhealth.eu/hhr-t"	
<b>ID</b>	YES	Numeric	20	The unique identifier of the side-effect.	N.A.	Not mapped		
<b>User_ID</b>	YES	Numeric	20	The unique ID of the patient.	Unique_Patient_ID: Matches one entry of Patient entity.	Condition.subject.reference.resolve().identifier[0].value  Condition.asserter.reference.resolve().identifier[0].value	Condition.subject.reference.resolve() is Patient Condition.asserter.reference.resolve() is Patient	This mapping uses the function "resolve()" (see section B.3.3 of <a href="#">FHIRPath specification</a> ) to return the FHIR resource pointed by a FHIR Reference (that in this case is a Patient).
<b>Side-effects</b>	YES	String	500	The side-effect reported.	Side-effectValue		Condition.code.coding[0].code=<value_code> Condition.code.coding[0].display=<description> Condition.code.coding[0].system=<terminology_URI> Condition.code.text=<Description of the selected Side-effectValue>	Each <b>Value</b> must be converted in a corresponding <value_code> selected from a specific dictionary identified by a <terminology_URI>. The <description> of that <value_code> as specified by the dictionary

							<p>must be included. See codes, descriptions and terminology URIs in the table Side-effectValue.</p> <p>In case of reverse translation (from FHIR to CRA system) any Condition which code.coding[0].code is specialization of concept “Clinical finding” and is not a Diagnosis or a Comorbidity (see note in corresponding tables) must be mapped to a (CRA) Side-effects entity.</p> <p><b>To simplify analytics processing a FHIR extension of the Diagnosis resource (e.g. boolean attribute isCancerSideEffect) could be defined and put in a namespace specific for CRA use case</b></p>
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							(in order to distinguish it from general purpose extensions).
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## Constraints

### DiagnosisValue

Value/Code	Name	Description	Code - identifier	Code - description	Terminology URI
<b>DCIS</b>	DCIS (Ductal Carcinoma in Situ)	Breast Ductal Carcinoma in Situ	intraductal-carcinoma,	Intraductal carcinoma, noninfiltrating, no International Classification of Diseases for Oncology subtype	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>
<b>ER+</b>	Oestrogen Receptor (ER) positive	Oestrogen Receptor positive breast cancer	estrogen-receptor-positive- tumor	Estrogen receptor positive tumor	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>
<b>ER-</b>	Oestrogen Receptor (ER) negative	Oestrogen Receptor negative breast cancer	estrogen-receptor-negative-neoplasm	Estrogen receptor negative neoplasm	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>
<b>PR+</b>	Progesterone Receptor (PR) positive	Progesterone Receptor positive breast cancer	progesterone-receptor-positive-tumor	Progesterone receptor positive tumor	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>
<b>PR-</b>	Progesterone Receptor (PR) negative	Progesterone Receptor negative breast cancer	progesterone-receptor-negative-neoplasm	Progesterone receptor negative neoplasm	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>
<b>HER2+</b>	HER2 positive	Human Epidermal growth factor Receptor 2 positive breast cancer	her2-positive-carcinoma-of-breast	HER2-positive carcinoma of breast	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>
<b>HER2-</b>	HER2 negative	Human Epidermal growth factor Receptor 2 negative breast cancer	human-epidermal-growth-factor-2	Human epidermal growth factor 2 negative carcinoma of breast	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>
<b>GenericBreastCancer</b>	Simply Breast Cancer (not characterised by ER, PR, HER2)	Breast Cancer (generic)	malignant-tumor-of-breast	Malignant tumor of breast	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>
<b>Metastasis.Liver</b>	Metastasis to liver	Breast cancer with metastasis to liver	secondary-malignant-neoplasm-of-liver	Secondary malignant neoplasm of liver	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>
<b>Metastasis.Lung</b>	Metastasis to lung	Breast cancer with metastasis to lung	secondary-malignant-neoplasm-of-lung	Secondary malignant neoplasm of lung	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>
<b>Metastasis.Kidney</b>	Metastasis to kidney	Breast cancer with metastasis to kidney	secondary-malignant-neoplasm-of-	Secondary malignant neoplasm of kidney	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>



			kidney		
<b>Metastasis.Bones</b>	Metastasis to bones	Breast cancer with metastasis to bones	secondary-malignant-neoplasm-of-bone	Secondary malignant neoplasm of bone	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>
<b>Metastasis.Brain</b>	Metastasis to brain	Breast cancer with metastasis to brain	secondary-malignant-neoplasm-of-brain	Secondary malignant neoplasm of brain	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>

## TreatmentValue

Value/Code	Name	Code - identifier	Code - description	Terminology URI	FHIR mapping	Assumption
<b>NoTreatment</b>	No treatment				Not mapped	Not mapped
<b>Surgery</b>	Surgery	surgical-procedure	Surgical procedure	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>	Procedure.code	Procedure.status="Unknown"
<b>Radiotherapy</b>	Radiation therapy	radiotherapy	Radiation oncology AND/OR radiotherapy	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>	Procedure.code	Procedure.status="Unknown"
<b>Anastrozole</b>	Anastrozole (Arimidex®)	anastrozole	Anastrozole	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>	MedicationStatement.medication	MedicationStatement.medication is CodeableConcept MedicationStatement.status="Active" MedicationStatement.taken="Unknown"
<b>Bevacizumab</b>	Bevacizumab (Avastin®)	bevacizumab	Bevacizumab	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>	MedicationStatement.medication	MedicationStatement.medication is CodeableConcept MedicationStatement.status="Active" MedicationStatement.taken="Unknown"
<b>Docetaxel</b>	Docetaxel (Taxotere®)	docetaxel	Docetaxel	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>	MedicationStatement.medication	MedicationStatement.medication is CodeableConcept MedicationStatement.status="Active" MedicationStatement.taken="Unknown"
<b>Epirubicin</b>	Epirubicin (Pharmorubicin®)	epirubicin	Epirubicin	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>	MedicationStatement.medication	MedicationStatement.medication is CodeableConcept MedicationStatement.status="Active" MedicationStatement.taken="Unknown"
<b>Eribulin</b>	Eribulin (Halaven®)	eribulin	Eribulin	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>	MedicationStatement.medication	MedicationStatement.medication is CodeableConcept MedicationStatement.status="Active"

						MedicationStatement.taken= "Unknown"
<b>Exemestane</b>	Exemestane (Aromasin ®)	exemestane	Exemestane	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>	MedicationStatement.medication	MedicationStatement.medication is CodeableConcept  MedicationStatement.status= "Active"  MedicationStatement.taken= "Unknown"
<b>FEC</b>	FEC: fluorouracil (5FU), epirubicin, cyclophosphamide	fluorouracil	Fluorouracil	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>	MedicationStatement.medication.ingredient[0].item	MedicationStatement.medication is Medication  MedicationStatement.status= "Active"
		epirubicin	Epirubicin	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>	MedicationStatement.medication.ingredient[1].item	MedicationStatement.taken= "Unknown"
		cyclophosphamide	Cyclophosphamide	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>	MedicationStatement.medication.ingredient[2].item	MedicationStatement.medication.ingredient.item is CodeableConcept
<b>FEC-T</b>	FEC-T: fluorouracil (5FU), epirubicin, cyclophosphamide, docetaxel (Taxotere ®)	fluorouracil	Fluorouracil	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>	MedicationStatement.medication.ingredient[0].item	MedicationStatement.medication is Medication
		epirubicin	Epirubicin	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>	MedicationStatement.medication.ingredient[1].item	MedicationStatement.status= "Active"
		cyclophosphamide	Cyclophosphamide	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>	MedicationStatement.medication.ingredient[0].item	MedicationStatement.taken= "Unknown"
		docetaxel	Docetaxel	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>	MedicationStatement.medication.ingredient[0].item	MedicationStatement.medication.ingredient.item is CodeableConcept
<b>Fluorouracil</b>	Fluorouracil (5FU)	fluorouracil	Fluorouracil	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>	MedicationStatement.medication	MedicationStatement.medication is CodeableConcept  MedicationStatement.status= "Active"  MedicationStatement.taken= "Unknown"
<b>Fulvestrant</b>	Fulvestrant (Faslodex ®)	fulvestrant	Fulvestrant	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>	MedicationStatement.medication	MedicationStatement.medication is CodeableConcept  MedicationStatement.status= "Active"  MedicationStatement.taken= "Unknown"
<b>Gemcitabine</b>	Gemcitabine (Gemzar ®)	gemcitabine	Gemcitabine	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>	MedicationStatement.medication	MedicationStatement.medication is CodeableConcept  MedicationStatement.status= "Active"  MedicationStatement.taken= "Unknown"
<b>Goserelin</b>	Goserelin (Zoladex ®)	goserelin	Goserelin	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>	MedicationStatement.medication	MedicationStatement.medication is CodeableConcept  MedicationStatement.status= "Active"  MedicationStatement.taken= "Unknown"

<b>Letrozole</b>	Letrozole (Femara ®)	letrozole	Letrozole	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>	MedicationStatement.medication	MedicationStatement.medication is CodeableConcept  MedicationStatement.status="Active"  MedicationStatement.taken="Unknown"
<b>Paclitaxel</b>	Paclitaxel (Taxol ®)	paclitaxel	Paclitaxel	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>	MedicationStatement.medication	MedicationStatement.medication is CodeableConcept  MedicationStatement.status="Active"  MedicationStatement.taken="Unknown"
<b>Tamoxifen</b>	Tamoxifen (Nolvadex ®)	tamoxifen	Tamoxifen	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>	MedicationStatement.medication	MedicationStatement.medication is CodeableConcept  MedicationStatement.status="Active"  MedicationStatement.taken="Unknown"
<b>Toremifene</b>	Toremifene (Fareston ®)	toremifene	Toremifene	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>	MedicationStatement.medication	MedicationStatement.medication is CodeableConcept  MedicationStatement.status="Active"  MedicationStatement.taken="Unknown"
<b>Trastuzumab</b>	Trastuzumab (Herceptin ®)	trastuzumab	Trastuzumab	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>	MedicationStatement.medication	MedicationStatement.medication is CodeableConcept  MedicationStatement.status="Active"  MedicationStatement.taken="Unknown"
<b>Trastuzumab Emtansine</b>	Trastuzumab emtansine (Kadcyla ®)	Trastuzumab emtansine	Trastuzumab emtansine	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>	MedicationStatement.medication	MedicationStatement.medication is CodeableConcept  MedicationStatement.status="Active"  MedicationStatement.taken="Unknown"
<b>Everolimus</b>	Everolimus (Afinitor ®)	everolimus	Everolimus (substance)	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>	MedicationStatement.medication	MedicationStatement.medication is CodeableConcept  MedicationStatement.status="Active"  MedicationStatement.taken="Unknown"
<b>Palbociclib</b>	Palbociclib (Ibrance ®)	palbociclib	Palbociclib	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>	MedicationStatement.medication	MedicationStatement.medication is CodeableConcept  MedicationStatement.status="Active"  MedicationStatement.taken="Unknown"
<b>Pertuzumab</b>	Pertuzumab (Perjeta ®)	pertuzumab	Pertuzumab	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>	MedicationStatement.medication	MedicationStatement.medication is CodeableConcept

						MedicationStatement.status= "Active"
						MedicationStatement.taken= "Unknown"
<b>Capecitabine</b>	Capecitabine (Xeloda®)	capecitabine	Capecitabine	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>	MedicationStatement.medication	MedicationStatement.medication is CodeableConcept  MedicationStatement.status= "Active"
						MedicationStatement.taken= "Unknown"
<b>Lapatinib</b>	Lapatinib (Tyverb®)	lapatinib	Lapatinib	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>	MedicationStatement.medication	MedicationStatement.medication is CodeableConcept  MedicationStatement.status= "Active"
						MedicationStatement.taken= "Unknown"
<b>AC</b>	AC (doxorubicin (Adriamycin®), cyclophosphamide)	doxorubicin	Doxorubicin	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>	MedicationStatement.medication.ingredient[0].item	MedicationStatement.medication is Medication
		cyclophosphamide	Cyclophosphamide	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>	MedicationStatement.medication.ingredient[1].item	MedicationStatement.status= "Active"
						MedicationStatement.taken= "Unknown"
						MedicationStatement.medication.ingredient.item is CodeableConcept
<b>Capecitabine +Taxotere</b>	Capecitabine (Xeloda®) and Docetaxel (Taxotere®)	capecitabine	Capecitabine	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>	MedicationStatement.medication.ingredient[0].item	MedicationStatement.medication is Medication
		docetaxel	Docetaxel	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>	MedicationStatement.medication.ingredient[1].item	MedicationStatement.status= "Active"
						MedicationStatement.taken= "Unknown"
						MedicationStatement.medication.ingredient.item is CodeableConcept
<b>EC</b>	EC (epirubicin, cyclophosphamide)	epirubicin	Epirubicin	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>	MedicationStatement.medication.ingredient[0].item	MedicationStatement.medication is Medication
		cyclophosphamide	Cyclophosphamide	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>	MedicationStatement.medication.ingredient[1].item	MedicationStatement.status= "Active"
						MedicationStatement.taken= "Unknown"
						MedicationStatement.medication.ingredient.item is CodeableConcept
<b>ECF</b>	ECF (epirubicin (Pharmorbicin®), cisplatin, fluorouracil (5FU))	epirubicin	Epirubicin	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>	MedicationStatement.medication.ingredient[0].item	MedicationStatement.medication is Medication
		cisplatin	Cisplatin	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>	MedicationStatement.medication.ingredient[1].item	MedicationStatement.status= "Active"
		fluorouracil	Fluorouracil	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>	MedicationStatement.medication.ingredient[2].item	MedicationStatement.taken= "Unknown"
						MedicationStatement.medication

						tion.ingredient.item is CodeableConcept
<b>E-CMF</b>	E-CMF (epirubicin (Pharmorubicin®), cyclophosphamide, methotrexate, fluorouracil)	epirubicin	Epirubicin	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>	MedicationStatement.medication.ingredient[0].item	MedicationStatement.medication is Medication
						MedicationStatement.status="Active"
						MedicationStatement.taken="Unknown"
						MedicationStatement.medication.ingredient.item is CodeableConcept

## ComorbiditiesValue

Value/Code	Name	Code - identifier	Code - description	Terminology URI
<b>Diabetes</b>	Diabetes	diabetes-mellitus	Diabetes mellitus	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>
<b>Cholesterol</b>	Cholesterol	hypercholesterolemia	Hypercholesterolemia	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>
<b>Chrons</b>	Crohn's disease	crohns-disease	Crohn's disease	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>
<b>IBS</b>	IBS (Irritable Bowel Syndrome)	irritable-bowel-syndrome	Irritable bowel syndrome	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>
<b>Heart</b>	Heart condition (coronary heart disease, etc)	structural-disorder-of-heart	Structural disorder of heart	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>
<b>Hypertension</b>	Hypertension	hypertensive-disorder-systemic-arterial	Hypertensive disorder, systemic arterial	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>
<b>ChronicKidney Disease</b>	Kidney function failure	chronic-kidney-disease	Chronic kidney disease	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>
<b>AcidReflux</b>	Acid Reflux	acid-reflux	Acid reflux (finding)	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>
<b>Anaemia</b>	Anaemia	anemia	Anemia	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>
<b>Tumour.Liver</b>	Other tumours: in the liver	neoplasm-of-liver	Neoplasm of liver	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>
<b>Tumour.Kidney</b>	Other tumours: in the kidney	neoplasm-of-kidney	Neoplasm of kidney	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>
<b>Tumour.Bones</b>	Other tumours: in the bones	neoplasm-of-bone	Neoplasm of bone	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>
<b>Tumour.GI</b>	Other tumours: oesophageal, stomach, or bowel	tumor-of-esophagus-stomach-and-or-duodenum	Tumor of esophagus, stomach and/or duodenum	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>

## BehaviourVariable

Value/Code	Name	Description	Code - identifier	Code - description	Terminology URI
<b>RedMeat[0-8+]</b>	RedMeat[0-8+]	Number of portions of RedMeat per week (from 0 to 8+)	red-meat-intake	Red meat intake	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>
<b>Poultry[0-8+]</b>	Poultry[0-8+]	Number of portions of Poultry per week (from 0 to 8+)	white-meat-intake	White meat intake	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>
<b>Fish[0-8+]</b>	Fish[0-8+]	Number of portions of Fish per week (from 0 to 8+)	fish-intake	Fish intake	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>

<b>Legumes[0-8+]</b>	Legumes[0-8+]	Number of portions of Legumes per week (from 0 to 8+)	pulse-vegetable-intake	Pulse vegetable intake	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>
<b>Eggs[0-8+]</b>	Eggs[0-8+]	Number of portions of Eggs per week (from 0 to 8+)	egg-intake	Egg intake	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>
<b>Dairy[0-22+]</b>	Dairy[0-22+]	Number of portions of Dairy per week (from 0 to 22+)	dairy-food-intake	Dairy food intake	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>
<b>Nuts[0-8+]</b>	Nuts[0-8+]	Number of portions of Nuts per week (from 0 to 8+)	nuts-and-seeds-intake-	Nuts and seeds intake	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>
<b>Fruits[0-22+]</b>	Fruits[0-22+]	Number of portions of Fruits per week (from 0 to 22+)	fruit-intake	Fruit intake	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>
<b>Vegetables[0-22+]</b>	Vegetables[0-22+]	Number of portions of Vegetables per week (from 0 to 22+)	vegetable-intake-	Vegetable intake	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>
<b>Bread[0-15+]</b>	Bread[0-15+]	Number of portions of Bread per week (from 0 to 15+)	bread-intake	Bread intake	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>
<b>Pasta[0-15+]</b>	Pasta[0-15+]	Number of portions of Pasta per week (from 0 to 15+)	pasta-intake	Pasta intake	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>
<b>Potatoes[0-15+]</b>	Potatoes[0-15+]	Number of portions of Potatoes per week (from 0 to 15+)	potato-intake	Potato intake	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>

## Side-effectValue

Value/Code	Name	Description	Code - identifier	Code - description	Terminology URI
<b>NoAppetite</b>	No appetite		loss-of-appetite	Loss of appetite	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>
<b>FoodTaste</b>	Food tastes funny or has no taste		taste-sense-altered	Taste sense altered	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>
<b>ProblemsSwallowing</b>	Problems swallowing		swallowing-problem	Swallowing problem	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>
<b>Nausea</b>	Nausea		nausea	Nausea	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>
<b>Vomiting</b>	Vomiting		vomiting-symptom	Vomiting symptom	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>
<b>Constipation</b>	Constipation		alteration in-bowel-elimination-constipation	Alteration in bowel elimination: constipation	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>
<b>Diarrhoea</b>	Diarrhoea		diarrhea	Diarrhea	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>
<b>MouthSores</b>	Mouth sores		sore-mouth	Sore mouth	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>
<b>DryMouth</b>	Dry mouth		xerostomia	Xerostomia	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>
<b>Smells</b>	Smells are bothering me		sensitive-to-smells	Sensitive to smells	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>
<b>FullQuickly</b>	Feeling full very quickly		early-satiety	Early satiety	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>
<b>Fatigue</b>	Fatigue		fatigue	Fatigue	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>
<b>StomachPain</b>	Pain in stomach		stomach-ache	Stomach ache	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>
<b>PeripheralNeuropathy</b>	Peripheral neuropathy		peripheral nerve-disease	Peripheral nerve disease	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>

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Lymphoedema	Lymphoedema		lymphedema	Lymphedema	<a href="http://crowdhealth.eu/hhr-t">http://crowdhealth.eu/hhr-t</a>
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# CrowdHEALTH

**Collective Wisdom Driving Public Health Policies**

## **Del. no. – D3.1 Annex B5: Data scheme of Ljubljana mapped to FHIR**

**Project Deliverable**



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# Data sources scheme

## 1 Introduction

SLOfit data are stored in relational database (SQL), consisting of around 25 tables, which contain longitudinal data of (currently around 8.000, in 2018 around 200.000) primary and secondary school students' physical fitness. Data are collected by schools' physical education teachers, then usually entered into Excel spreadsheet and imported into database. Now, data are accessible to all students on personal hand-written chart. In April 2018, data will be accessible online (<http://www.slofit.org/>) by students, their parents and physical education teachers (currently) over on-line graphs/tables and PDF reports.

### 1.1 Conceptual diagram



### 1.2 List of entities

Entity Name	Description	FHIR mapping (name of the resource)	Note
Child	Demographics and other administrative information about a child	Patient, Observation	
School	Administrative information about the school	Organization	
Observation	Measurements of fitness attributes collected yearly	Observation	

### 1.2.1 Child

Attribute	Mandatory (YES/NO)	Type	Maximum of characters	Description	Constraint	FHIR mapping	Assumptions	Note
							<p>Observation.subject.reference.resolve() is Patient</p> <p>Observation.status="final"</p> <p>Observation.category.coding[0].code="social-history",</p> <p>Observation.category.coding[0].display="Social History"</p> <p>Observation.category.coding[0].system="http://hl7.org/fhir/observation-category"</p> <p>Observation.code.coding[0].code="05421008"</p> <p>Observation.code.coding[0].display="Educational achievement (observable entity)"</p> <p>Observation.code.coding[0].system="http://snomed.info/"</p> <p>Observation.value is String</p> <p>Observation.value=&lt;Grade Code description&gt;</p> <p>Observation.effective is dateTime</p> <p>Observation.effective=&lt;date of the last observation made&gt;</p>	

						Patient.birthDate		This attribute contains the birth year of the Child. It is calculated as year of the observation minus age of the Child
<b>CROWD_ID</b>	YES	Nominal	9	Unique anonymized identifier of a child	N.A.	Patient.identifier[0].value	Patient.identifier[0].system="http://www.slofit.org/"	
<b>School_ID</b>	YES	Nominal	4	Unique identifier of a school	N.A.	Patient.manageOrganization.reference.resolve().identifier.value	Patient.manageOrganization.reference.resolve() is Organization	
<b>Sex</b>	YES	Nominal	1	Sex of child	Sex_code	Patient.gender		
<b>Age</b>	YES	Numerical, interval	2	Age at the moment of the observation	N.A.	Not mapped		
<b>Grade</b>	YES	Nominal	2	School's grade at the moment of the observation	Grade_code	Observation	<p>Observation.subject.reference.resolve() is Patient</p> <p>Observation.status="final"</p> <p>Observation.category.coding[0].code="social-history",</p> <p>Observation.category.coding[0].display="Social History"</p> <p>Observation.category.coding[0].system="http://hl7.org/fhir/observation-category"</p> <p>Observation.code.coding[0].code="14679004"</p> <p>Observation.code.coding[0].display="Occupation (occupation)"</p> <p>Observation.code.coding[0].system="http://snomed.info/"</p> <p>Observation.value.coding[0].code="1160498000"</p> <p>Observation.value.coding[0].display="School Child (occupation)"</p> <p>Observation.value.coding[0].s</p>	

							ystem=" <a href="http://snomed.info/">http://snomed.info/</a> "	
							Observation.effective is dateTime	
							Observation.effective=<date of the last observation made>	

### 1.2.2 School

Attribute	Mandatory	Type	Max num. of characters	Description	Constraint	FHIR mapping	Assumptions	Note
<b>School_ID</b>	YES	Nominal	4	Unique identifier of the school	N.A.	Not Mapped		
<b>Municipality</b>	YES	Nominal	3	Location of the school according to municipality	Municipality_code	Organization.address.city		
<b>Region</b>	YES	Nominal	2	Location of the school according to municipality	Region_code	Organization.address.district=<Region Name presents in Region_Code>	Organization.address.county="Slovenia"	

### 1.2.3 Medical observation

Attribute	Mandatory	Type	Max num. of characters	Description	Constraint	FHIR mapping	Assumptions	Note
<b>Height</b>	No	Numerical	10	Fitness component (FC)#1: Body height (Longitudinal dimension of	N.A.	Observation.value	Observation.code.coding[0].code="50373000"  Observation.code.coding[0].display="Body height measure (observable	

				the body)			<p>entity")</p> <p>Observation.code.coding[0].system="<a href="http://snomed.info/">http://snomed.info/</a>"</p> <p>Observation.code.text="Body height (Longitudinal dimension of the body)"</p> <p>Observation.status="final"</p> <p>Observation.subject.reference.resolve() is Patient</p> <p>Observation.value is Quantity</p> <p>Observation.value.value=&lt;value&gt;</p> <p>Observation.value.unit="CentiMeter"</p> <p>Observation.value.system="http://unitsofmeasure.org"</p> <p>Observation.value.code="cm"</p>	
<b>Weight</b>	No	Numerical	10	FC#2: Body weight (Voluminous dimension of the body)	N.A.	Observation.value	<p>Observation.code.coding[0].code="27113001"</p> <p>Observation.code.coding[0].display="Body weight (observable entity)"</p> <p>Observation.code.coding[0].system="<a href="http://snomed.info/">http://snomed.info/</a>"</p> <p>Observation.code.text="Body weight (Voluminous dimension of the body)"</p> <p>Observation.status="final"</p> <p>Observation.subject.reference.resolve() is Patient</p> <p>Observation.value is Quantity</p> <p>Observation.value.value=&lt;value&gt;</p> <p>Observation.value.unit="KiloGram"</p> <p>Observation.value.system="http://unitsofmeasure.org"</p>	

							Observation.value.code="kg"	
<b>Triceps_sf</b>	No	Numerical	10	FC#3: Triceps skinfold reflects the amount of peripheral subcutaneous fat. It is a proxy for body composition.	N.A.	Observation.value	<p>Observation.code.coding[0].code="301851003"</p> <p>Observation.code.coding[0].display="Triceps skin fold thickness (observable entity)"</p> <p>Observation.code.coding[0].system="http://snomed.info/"</p> <p>Observation.code.text="Triceps skinfold reflects"</p> <p>Observation.status="final"</p> <p>Observation.subject.reference.resolve() is Patient</p> <p>Observation.value is Quantity</p> <p>Observation.value.value=&lt;value&gt;</p> <p>Observation.value.unit="MilliMeter"</p> <p>Observation.value.system="http://unitsofmeasure.org"</p> <p>Observation.value.code="mm"</p>	
<b>Arm_plate_tapping</b>	No	Numerical	10	FC#4: Arm plate tapping represents repetitive speed.	N.A.	Observation.value	<p>Observation.code.coding[0].code="FC#4"</p> <p>Observation.code.coding[0].display="Arm plate tapping"</p> <p>Observation.code.coding[0].system="http://www.crowdhealth.eu/fhir/ValueSet/fitnessTest"</p> <p>Observation.code.text="Arm plate tapping represents repetitive speed"</p> <p>Observation.status="final"</p> <p>Observation.subject.reference.resolve() is Patient</p> <p>Observation.value is Quantity</p>	The unit of measure is the number of taps completed in 20 seconds.

<b>Standing broad jump</b>	No	Numerical	10	FC#5: Standing long jump is a measure of explosive strength.	N.A.	Observation.value	<p>Observation.code.coding[0].code="FC#5"</p> <p>Observation.code.coding[0].display="Standing long jump"</p> <p>Observation.code.coding[0].system="http://www.crowdhealth.eu/fhir/ValueSet/fitnessTest"</p> <p>Observation.code.text="Standing long jump is a measure of explosive strength."</p> <p>Observation.status="final"</p> <p>Observation.subject.reference.resolve() is Patient</p> <p>Observation.value is Quantity</p> <p>Observation.value.value=&lt;value&gt;</p> <p>Observation.value.unit="CentiMeter"</p> <p>Observation.value.system="http://unitsofmeasure.org"</p> <p>Observation.value.code="cm"</p>	
<b>Polygon backwards</b>	No	Numerical	10	FC#6: Polygon backwards represents coordination.	N.A.	Observation.value	<p>Observation.code.coding[0].code="FC#6"</p> <p>Observation.code.coding[0].display="Polygon backwards"</p> <p>Observation.code.coding[0].system="http://www.crowdhealth.eu/fhir/ValueSet/fitnessTest"</p> <p>Observation.code.text="Polygon backwards represents coordination"</p> <p>Observation.status="final"</p> <p>Observation.subject.reference.resolve() is Patient</p> <p>Observation.value is Quantity</p>	

							<p>Observation.value.value=&lt;value&gt;</p> <p>Observation.value.unit="Second"</p> <p>Observation.value.system="http://unitsofmeasure.org"</p> <p>Observation.value.code="s"</p>	
<b>Sit_ups_60s</b>	No	Numerical	10	<p>FC#7: Sit-ups reflect repetitive strength which can be also called muscle endurance. This is a component of muscle fitness</p>	N.A.	Observation.value	<p>Observation.code.coding[0].code="FC#7"</p> <p>Observation.code.coding[0].display="Sit ups 60 seconds"</p> <p>Observation.code.coding[0].system="http://www.crowdhealth.eu/fhir/ValueSet/fitnessTest"</p> <p>Observation.code.text="Sit-ups reflect repetitive strength which can be also called muscle endurance. This is a component of muscle fitness"</p> <p>Observation.status="final"</p> <p>Observation.subject.reference.resolve() is Patient</p> <p>Observation.value is Quantity</p>	Unit of measure: reps (Repetitive strength)
<b>Stand_and_reach</b>	No	Numerical	10	<p>FC#8: Stand and reach (Flexibility of lower back and legs)</p>	N.A.	Observation.value	<p>Observation.code.coding[0].code="FC#8"</p> <p>Observation.code.coding[0].display="Stand and reach"</p> <p>Observation.code.coding[0].system="http://www.crowdhealth.eu/fhir/ValueSet/fitnessTest"</p> <p>Observation.code.text="Stand and reach (Flexibility of lower back and legs)."</p> <p>Observation.status="final"</p> <p>Observation.subject.reference.resolve() is Patient</p> <p>Observation.value is Quantity</p>	



							<p>Observation.value.value=&lt;value&gt;</p> <p>Observation.value.unit="CentiMeter"</p> <p>Observation.value.system="http://unitsofmeasure.org"</p> <p>Observation.value.code="cm"</p>	
<b>Bent arm hang</b>	No	Numerical	10	<p>FC#9: Bent arm-hang measures the strength of arms and shoulder which can be also called muscle endurance.</p> <p>This is a component of muscle fitness</p>	N.A.	Observation.value	<p>Observation.code.coding[0].code="FC#9"</p> <p>Observation.code.coding[0].display="Bent arm-hang"</p> <p>Observation.code.coding[0].system="http://www.crowdhealth.eu/fhir/ValueSet/fitnessTest"</p> <p>Observation.code.text="Bent arm-hang measures the strength of arms and shoulder which can be also called muscle endurance."</p> <p>Observation.status="final"</p> <p>Observation.subject.reference.resolve() is Patient</p> <p>Observation.value is Quantity</p> <p>Observation.value.value=&lt;value&gt;</p> <p>Observation.value.unit="Second"</p> <p>Observation.value.system="http://unitsofmeasure.org"</p> <p>Observation.value.code="s"</p>	
<b>Dash60m</b>	No	Numerical	10	FC#10: 60m dash (Speed)	N.A.	Observation.value	<p>Observation.code.coding[0].code="FC#10"</p> <p>Observation.code.coding[0].display="60m dash"</p> <p>Observation.code.coding[0].system="http://www.crowdhealth.eu/fhir/ValueSet/fitnessTest"</p> <p>Observation.code.text="60"</p>	

							<p>m dash (Speed)"</p> <p>Observation.status="final"</p> <p>Observation.subject.reference.resolve() is Patient</p> <p>Observation.value is Quantity</p> <p>Observation.value.value=&lt;value&gt;</p> <p>Observation.value.unit="Second"</p> <p>Observation.value.system="http://unitsofmeasure.org"</p> <p>Observation.value.code="s"</p>	
<b>Run600m</b>	No	Numerical	10	FC#11: 600m run (Aerobic capacity)	N.A.	Observation.value	<p>Observation.code.coding[0].code="FC#11"</p> <p>Observation.code.coding[0].display="600m run"</p> <p>Observation.code.coding[0].system="http://www.crowdhealth.eu/fhir/ValueSet/fitnessTest"</p> <p>Observation.code.text="600m run (Aerobic capacity)"</p> <p>Observation.status="final"</p> <p>Observation.subject.reference.resolve() is Patient</p> <p>Observation.value is Quantity</p> <p>Observation.value.value=&lt;value&gt;</p> <p>Observation.value.unit="Second"</p> <p>Observation.value.system="http://unitsofmeasure.org"</p> <p>Observation.value.code="s"</p>	
<b>BMI</b>	No	Numerical	10	Body mass index	N.A.	Observation.value	<p>Observation.code.coding[0].code="60621009"</p> <p>Observation.code.coding[0].display="Body mass"</p>	

							<p>index (observable entity)"</p> <p>Observation.code.coding[0].system="<a href="http://snomed.info/">http://snomed.info/</a>"</p> <p>Observation.code.text="Body mass index"</p> <p>Observation.status="final"</p> <p>Observation.subject.reference.resolve() is Patient</p> <p>Observation.value is Quantity</p> <p>Observation.value.value=&lt;value&gt;</p> <p>Observation.value.unit="kg/m2"</p> <p>Observation.value.system="http://unitsofmeasure.org"</p> <p>Observation.value.code="kg/m2"</p>	
<b>WS_WOF</b>	No	Numerical	1	Weight status according to World Obesity Federation cut-off points	WOF_Code	Observation.interpretation	<p>Observation.interpretation.coding[0].code=&lt;WOF_Code value&gt;</p> <p>Observation.interpretation.coding[0].display=" WOF_Code name"</p> <p>Observation.interpretation.coding[0].system="http://hl7.org/fhir/ValueSet/observation-interpretation"</p> <p>Observation.interpretation.text=&lt;WOF_Code description&gt;</p> <p>Observation.status="final"</p> <p>Observation.subject.reference.resolve() is Patient</p> <p>Observation.value is Quantity</p>	This attribute can be mapped to Observation.value
<b>Total_FI</b>	No	Numerical	10	total physical fitness index, aggregated measure of all fitness tests	N.A.	Observation.value	<p>Observation.code.coding[0].code="Total_FI"</p> <p>Observation.code.coding[0].display="Total physical fitness index"</p> <p>Observation.code.coding[0]</p>	

							<p>]system="http://www.crowdhealth.eu/fhir/ValueSet/fitnessTest""</p> <p>Observation.code.text="Total physical fitness index, aggregated measure of all fitness tests"</p> <p>Observation.status="final"</p> <p>Observation.subject.reference.resolve() is Patient</p> <p>Observation.value is Quantity</p> <p>Observation.value.value=&lt;value&gt;</p>	
<b>HR_FI</b>	No	Numerical	10	health-related physical fitness index, aggregated measure of 3 tests evaluating endurance and strength	N.A.	Observation.value	<p>Observation.code.coding[0].code="HR_FI"</p> <p>Observation.code.coding[0].display="Health-related physical fitness index"</p> <p>Observation.code.coding[0].system="http://www.crowdhealth.eu/fhir/ValueSet/fitnessTest""</p> <p>Observation.code.text="performance-related physical fitness index, aggregated measure of 4 tests evaluating explosive strength, speed and coordination"</p> <p>Observation.status="final"</p> <p>Observation.subject.reference.resolve() is Patient</p> <p>Observation.value is Quantity</p> <p>Observation.value.value=&lt;value&gt;</p>	
<b>PR_FI</b>	No	Numerical	10	performance-related physical fitness index, aggregated measure of 4 tests evaluating explosive strength, speed and coordination	N.A.	Observation.value	<p>Observation.code.coding[0].code="PR_FI"</p> <p>Observation.code.coding[0].display="Performance-related physical fitness index"</p> <p>Observation.code.coding[0].system="http://www.crowdhealth.eu/fhir/ValueSet/fitnessTest""</p> <p>Observation.code.text="</p>	

							<p>performance-related physical fitness index, aggregated measure of 4 tests evaluating explosive strength, speed and coordination"</p> <p>Observation.status="final"</p> <p>Observation.subject.reference.resolve() is Patient</p> <p>Observation.value is Quantity</p> <p>Observation.value.value=&lt;value&gt;</p>	
<b>Year_measured</b>	Yes	Interval	4	year when measurements were performed	N.A.	Not mapped		This value is the year of Data_measured
<b>Date_measured</b>	Yes	Date	10	Date of fitness assessment	N.A.	Observation.effective	Observation.effective is dateTime	

## 1.3 Constraints

### 1.3.1 Sex\_Code

Level of measurement: Nominal

Coding standard: None

Link: <https://www.hl7.org/fhir/valueset-administrative-gender.html>

Value/Code	Name	Description	Code	Display	Definition
1	Male	Male	male	Male	Male
2	Female	Female	female	Female	Female

### 1.3.2 Grade\_Code

Level of measurement: Nominal

Coding standard: None

Link: None

Value/Code	Name	Description
1	1st grade	1 <sup>st</sup> grade of primary school
...	...	...
14	14th grade	5th grade of secondary school

### 1.3.3 Municipality\_Code

Level of measurement: Nominal

Coding standard: LOINC

Link: None

Value/Code	Name	Description	Note
1	1	Identifier for a municipality	List of Slovenian Municipalities: <a href="https://en.wikipedia.org/wiki/Municipalities_of_Slovenia">https://en.wikipedia.org/wiki/Municipalities_of_Slovenia</a>
...	...	...	
212	212	Identifier for a municipality	

#### 1.3.4 Region\_Code

Level of measurement: Nominal

Coding standard: LOINC

Link: None

Value/Code	Name	Description	Region Name
1	1	Identifier for a region	Pomurska
2	2	Identifier for a region	Podravska
3	3	Identifier for a region	Koroška
4	4	Identifier for a region	Savinjska
5	5	Identifier for a region	Zasavska
6	6	Identifier for a region	Posavska
7	7	Identifier for a region	Jugovzhodna Slovenija
8	8	Identifier for a region	Osrednjeslovenska
9	9	Identifier for a region	Gorenjska
10	10	Identifier for a region	Primorsko-notranjska
11	11	Identifier for a region	Goriška
12	12	Identifier for a region	Obalno-kraška

### 1.3.5 WOF\_Code

Level of measurement: Nominal

Coding standard: LOINC

Link: None

Value/Code	Name	Description
-1	Underweight	Child has lower than ideal weight according to World obesity federation standards (a.k.a. IOTF standards).
0	Normal_weight	Child has ideal weight according to World obesity federation standards(a.k.a. IOTF standards).
1	Overweight	Child has slightly higher than ideal weight according to World obesity federation standards(a.k.a. IOTF standards).
2	Obese	Child has much higher than ideal weight according to World obesity federation standards(a.k.a. IOTF standards).
3	Morbidly obese	Child has much higher than ideal weight according to World obesity federation standards(a.k.a. IOTF standards). This is the highest category of weight status

## 1.4 ValueSet

### 1.4.1 Fitness Test

Link: <http://www.crowdhealth.eu/fhir/ValueSet/fitnessTest>

Code	Display	Description
FC#4	Arm plate tapping	Arm plate tapping represents repetitive speed.
FC#5	Standing long jump	Standing long jump is a measure of explosive strength.



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<b>FC#6</b>	Polygon backwards	Polygon backwards represents coordination.
<b>FC#7</b>	Sit ups 60 seconds	Sit-ups reflect repetitive strength which can be also called muscle endurance. This is a component of muscle fitness
<b>FC#8</b>	Stand and reach	Stand and reach (Flexibility of lower back and legs)
<b>FC#9</b>	Bent arm-hang	Bent arm-hang measures the strength of arms and shoulder which can be also called muscle endurance. This is a component of muscle fitness
<b>FC#10</b>	60m dash	60m dash (Speed)
<b>FC#11</b>	600m run	600m run (Aerobic capacity)