

Brainteaser

D9.1 Project ontology and terminology, including data mapper and RDF graph builder



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AUTHORS – CONTRIBUTORS

Name	Organization
Manuel Bettin	UNIPD
Giorgio Maria Di Nunzio	UNIPD
Dennis Dosso	UNIPD
Guglielmo Faggioli	UNIPD
Nicola Ferro	UNIPD
Nicola Marchetti	UNIPD
Gianmaria Silvello	UNIPD

PEER – REVIEWERS

Name	Organization
Laura López Pérez	UPM

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EXECUTIVE SUMMARY

The goal of this deliverable is to document the design and development of the first version of the Brainteaser Ontology (BO) focused, in particular, on retrospective data for Amyotrophic Lateral Sclerosis (ALS) and Multiple Sclerosis (MS).

The BO is innovative since it relies on very few seed concepts - `Patient`, `Clinical Trial`, `Disease`, `Event` - which allow us to jointly model ALS and MS and to grasp the time dimension entailed by the progression of such diseases.

Indeed, the core idea is that a `Patient` participates in a `Clinical Trial`, suffers from some `Diseases`, and undergoes `Events`. These `Events` are different in nature and cover a wide range of cases, e.g., `Onset`, `Pregnancy`, `Symptom`, `Trauma`, `Diagnostic Procedure` (like evoked potentials or ALS-FRS questionnaires) `Therapeutic Procedure` (like `Mechanical Ventilation` for ALS or `Disease-Modifying Therapy` for MS), `Relapse`, and more. Overall, this event-based approach allows us to model ALS and MS in an unified way, sharing concepts among these two diseases, and to track what happens during their progression.

This rolling deliverable includes the results of task 9.1 (FAIR data modelling and terminology building) and 9.2 (Linked (open) data mapping and sharing) and it will be regularly updated. In particular, we will update: i) the ontology based on the continuous review of the analysis of the requirements of the use cases; as well as ii) the graphical and textual description of the ontology together with the OWL file encoding the ontology.

The BO ontology has been co-designed in a strict collaboration with the medical partners and domain experts. We used this approach in order to embed the knowledge of the experts in the BO and, at the same time, to validate all the design choices. To this end, we operated in an iterative way, producing several intermediate versions of the ontology and discussing them with our domain experts.

The BO ontology will serve multiple purposes:

- to provide a unified and comprehensive conceptual view about ALS and MS, which are typically dealt with separately, allowing us to coherently integrate the data coming from the different medical partners in the project;
- to seamlessly represent both retrospective data and prospective data, produced during the lifetime of BRAINTEASER;
- to allow for sharing and re-using the BRAINTEASER datasets according to Open Science and FAIR principles.

The main following data sources that the BO ontology models are:

- "Raw" anonymized data (retrospective and prospective data);
- Generated data (AI models and results);
- Evaluation challenges data (evaluation corpora, AI models outputs, performance scores).

By design, the BO will also allow us to link these data sources with other resources available in the Linked Open Data Cloud.

The deliverable is organized as follows: Section 2 provides a background on ontologies and the adopted technologies, which constitute the basis for many definitions in the BO, as well as previous related work on specific ontologies for ALS and MS. Section 3 briefly summarizes the adopted design approach, involving the domain experts to elicit requirements and validate the design choices and definitions in the BO. Section 4 provides a description of the BO, providing both an overview of its different parts and a detailed account of each class. Section 5 describes the mappers developed for ingesting the retrospective data received from medical partners in the BRAINTEASER Semantic Data Cloud. Section 6 draws conclusions and outlooks for future work. Finally, Appendix A provides a detailed technical documentation of the BRAINTEASER ontology, containing the definitions for all the classes and properties.

Next iterations of the deliverable, expected at months 24 and 36, will update this initial design to cover also prospective data as well as generated data and data from the evaluation challenges. We will also enrich the ontology with multilingual linguistic information.

1. INTRODUCTION

This deliverable describes the design and development of the BRAINTEASER Ontology (BO) whose purpose is to jointly model both Amyotrophic Lateral Sclerosis (ALS) and Multiple Sclerosis (MS).

The BO will serve multiple purposes:

- to provide a unified and comprehensive conceptual view about ALS and MS, which are typically dealt with separately, allowing us to coherently integrate the data coming from the different medical partners in the project;
- to seamlessly represent both *retrospective* data and *prospective* data, produced during the lifetime of BRAINTEASER
- to allow for sharing and re-using the BRAINTEASER datasets according to Open Science and FAIR principles.

1.1 BRAINTEASER Ontology approach

The BO is innovative since it relies on very few seed concepts - Patient, Clinical Trial, Disease, Event - which allow us to jointly model ALS and MS and to grasp the time dimension entailed by the progression of such diseases.

Indeed, the core idea is that a Patient participates in a Clinical Trial, suffers from some Diseases, and undergoes Events. These Events are different in nature and cover a wide range of cases, e.g. Onset, Pregnancy, Symptom, Trauma, Diagnostic Procedure (like evoked potentials or ALS-FRS questionnaires) Therapeutic Procedure (like Mechanical Ventilation for ALS or Disease-Modifying Therapy for MS), Relapse, and more. Overall, this event-based approach allows us to model ALS and MS in an unified way, sharing concepts among these two diseases, and to track what happens during their progression. Details of the design and functioning of the BO are provided in the next sections of this deliverable.

1.2 Role of the BRAINTEASER Ontology

As also mentioned in the Data Management Plan (DMP), the BO plays an important role in the overall BRAINTEASER architecture, shown in Figure 1. Indeed, it will inform the implementation of the *BRAINTEASER Semantic Data Cloud* since the data contained here will be represented according to the BO, i.e., they will be an instance of the BO.

You can see in Figure 1 that all the data will be anonymized prior to being represented in the BO. This holds true for both the *retrospective data*, i.e., the data already held by clinical partners on the right of the figure, and the *prospective data*, i.e., the new data that will be collected during the project lifetime on the left.

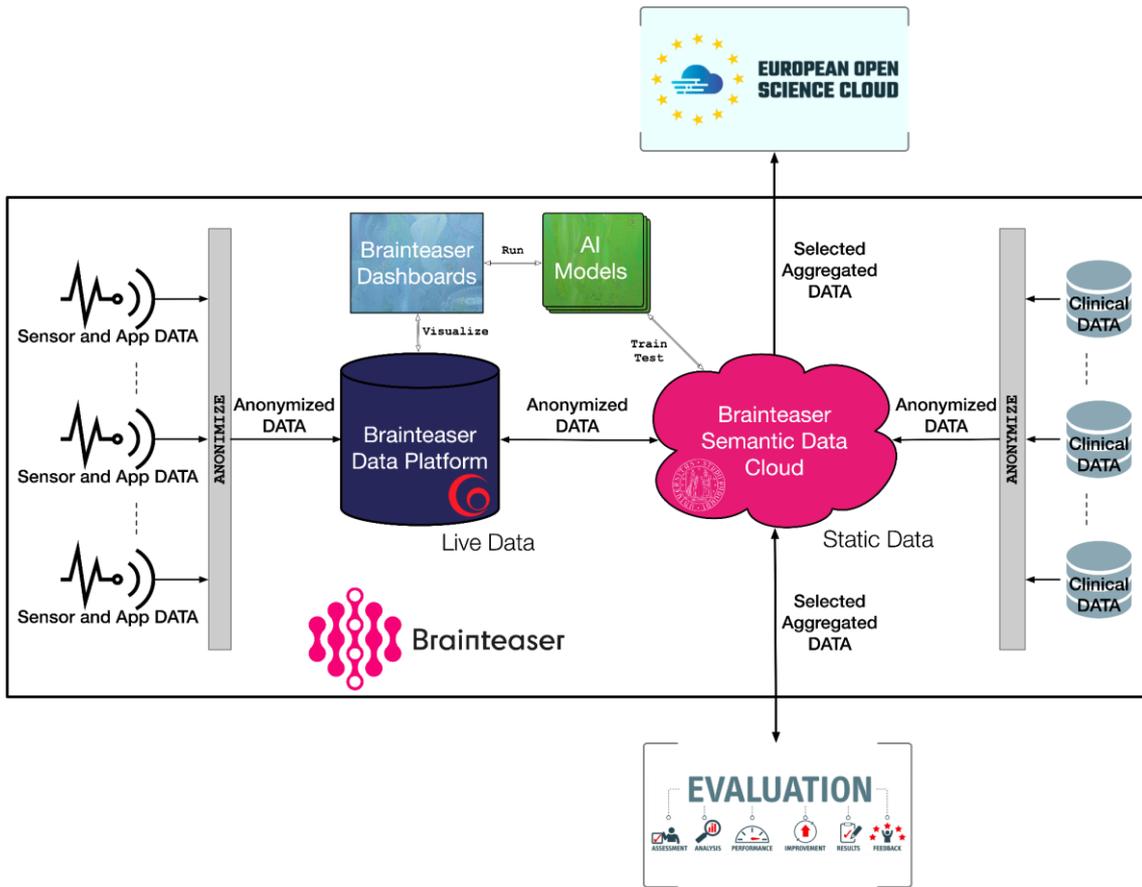


Figure 1. The BRAINTEASER ontology and its role in the overall BRAINTEASER architecture.

The data held in the BRAINTEASER Semantic Data Cloud, exported in a suitable format, will then be used to train the AI models needed to predict the progression of both ALS and MS.

Finally, a subset of the data in the BRAINTEASER Semantic Data Cloud will be exported to the European Open Science Cloud (EOSC) and they will be also shared and exploited for the Open Evaluation Challenges.

Figure 2 shows an overall picture of the whole data flow associated with the BO and the BRAINTEASER Semantic Data Cloud, also in relation to Open Evaluation Challenges and the EOSC.

In summary, the BO ontology will model the following data sources:

- *“Raw” data [anonymized]*: these are the retrospective and prospective data discussed above:
 - Clinical data
 - Sensor/App data
- *Generated data*: once trained on the above data, the AI models can be serialised as well and become part of the modelled data.
 - Serialized AI models
- *Evaluation Challenges*: they will rely on three kinds of data which become part of the modelled data:

- Evaluation Corpora: these are the training/validation/test sets and they are obtained by selecting an appropriate subset of the “raw” data;
- AI models outputs: these are the results produced by the participating systems;
- Performance scores and statistical analyses: the results produced by participants will be scored and then statistical analyses will be computed to assess them.

The BO will also allow to link these data with other resources available in the Linked Open Data Cloud¹.

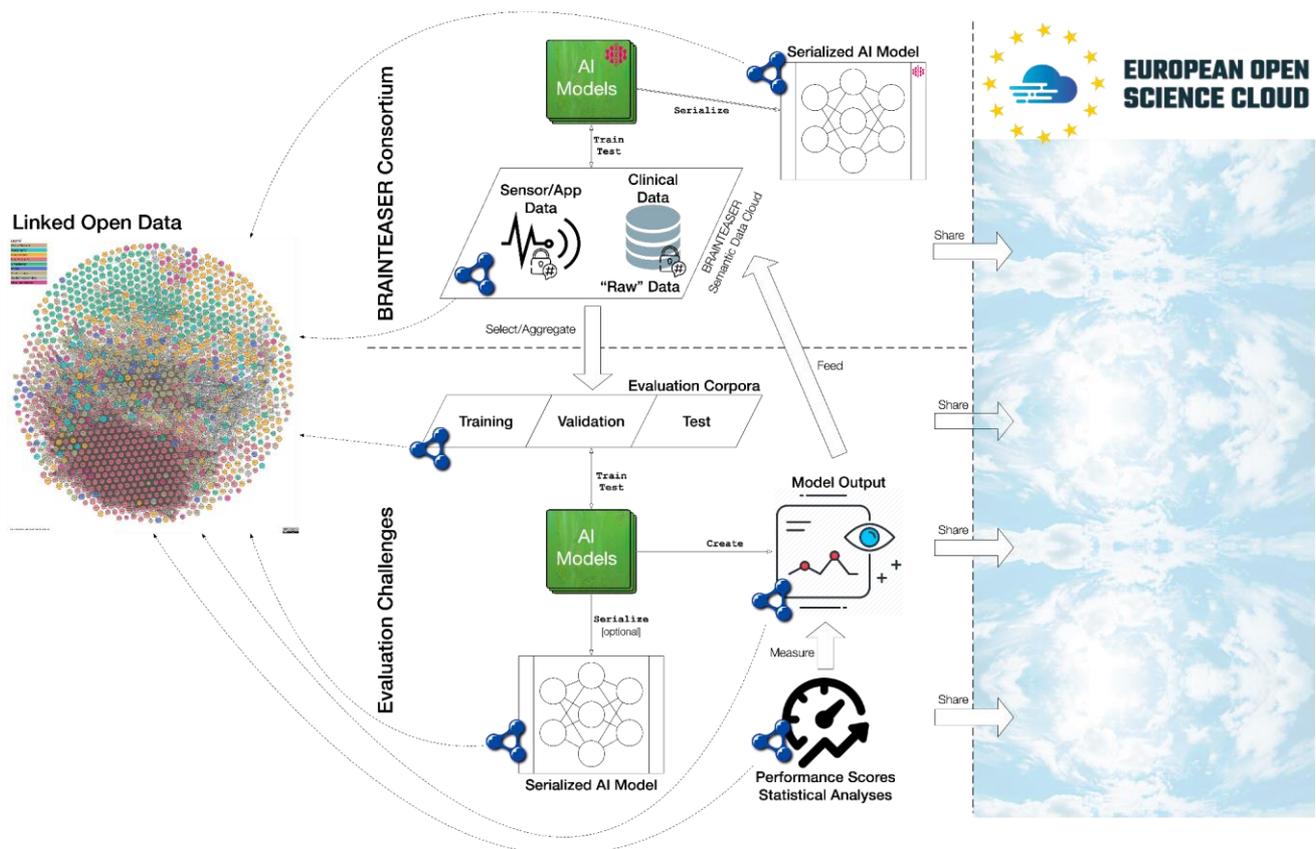


Figure 2. The BRAINTEASER ontology and the overall data flow.

1.3 Scope and organization of the deliverable

The goal of this deliverable is to design and develop a first version of the BO focused on retrospective data for ALS and MS.

Next iterations of the deliverable, expected at months 24 and 36, will update this initial design to cover also prospective data as well as generated data and data from the evaluation challenges. We will also enrich the ontology with multilingual linguistic information.

¹ <https://lod-cloud.net/>

The deliverable is organized as follows: Section 2 provides a background on ontologies and the adopted technologies, which constitute the basis for many definitions in the BO, as well as previous related work on specific ontologies for ALS and MS. Section 3 briefly summarizes the adopted design approach, involving the domain experts to elicit requirements and validate the design choices and definitions in the BO. Section 4 provides a description of the BO, providing both an overview of its different parts and a detailed account of each class. Section 5 describes the mappers developed for ingesting the retrospective data received from medical partners in the BRAINTEASER Semantic Data Cloud. Section 6 draws conclusions and outlooks for future work. Finally, Appendix A provides a detailed technical documentation of the BRAINTEASER ontology, containing the definitions for all the classes and properties.

2. BACKGROUND

The remainder of this Section describes the background that underlies the Brainteaser ontology. Subsection 2.1 Describes the role of the ontologies, how they work and why they are so important especially in the medical domain. Subsection 2.2 Concerns RDF, the approaches used to define an ontology, and the serialization process. Subsections 2.3 and 2.4, on the other hand, details on the current state-of-the-art and related works. In particular, subsection 2.3 details which other efforts have been made to model the Multiple Sclerosis and the Amyotrophic Lateral Sclerosis. Furthermore, it will describe how the proposed ontology can overcome current limitations. Finally, section 2.4 contains a brief description of the main ontologies that have been exploited to build the Brainteaser ontology which grant to our ontology the required interoperability.

2.1 Ontologies

The Semantic Web is an extension of the World Wide Web based on standards set by the W3C [FHH+07]. At its basis, the Semantic Web is a form of network of interconnected data exploiting the Web. In particular, it provides a common framework that allows data to be shared and reused across applications, enterprises, and community boundaries.

While the original Web is mainly focused on the interchange of documents connected among them by link deprived of semantic, the aim of the Semantic Web is twofold: to go beyond the simple publication of documents by adding *semantic* to the links connecting them; and enabling computers to perform more useful tasks and support trusted interactions on the network [PMZ10].

In 2006 Tim Berners Lee coined the term Linked Data to indicate structured data interlinked with other data to become more useful through the use of query that exploit this presence of semantic on the edges [HB11]. Linked Data is based on a set of rules, outlined by Berners-Lee [BHBL11]:

1. Use URIs (now IRIs) as names for things.
2. Use HTTP URIs so that people can look up those names.
3. When someone looks up a URI, provide useful information using standards such as RDF and SPARQL.
4. Include links to other URIs, so that they can discover more things.

When Linked Data is also open, i.e., it is released under an open license which does not impede its free reuse, it is usually referred to as Linked Open Data (LOD).

In this context, the word “ontology” has become extremely popular since the mid-nineties as a construct containing information and definitions about concepts and the relationships among them [IB14]. In particular, in the domain of medicine, different resources are used alongside ontologies. These are controlled vocabularies, taxonomies, and thesauri [IB14].

A controlled vocabulary is a closed list of named subjects, which can be used for classifications. The constituents are called terms, i.e., names assigned to certain concepts. A taxonomy is an abstract structure that presents subject-based classifications that arrange terms from a controlled vocabulary into a hierarchy. The term thesaurus may

refer to various subject classification structures that extend taxonomies allowing other statements about the subjects in the hierarchy. An example is the addition of associative relationships to the parent-child one.

Ontologies, more specifically, are computer science constructs [Kon15] that provide well-defined vocabularies which, in turn, allow precise and machine-readable description of knowledge about a certain domain [CJB99]. In computer science, one of the first definitions of ontology that we found is that of an “explicit, formal specification of a shared conceptualization” [Gru95].

Independently from the formal definition of the term, there are today many artifacts called ontology that provide a series of main features, used in almost all the applications based on them [HSG15]. These are:

1. The definition of classes and relations using identifiers such as the Internationalized Resource Identifier (IRI) to enable data integration across multiple databases.
2. The definition of a domain vocabulary, a list of terms associated with classes and relations.
3. Definitions, metadata, descriptions, and examples about classes and relations to allow domain experts to consistently understand their precise meaning.
4. Formal definitions using axioms that are considered true within the domain. In this way, background knowledge about the domain itself is provided. Reasoners can then use this information to unlock automated access to the meaning of classes and relations such as inference of new information from the data.
5. Ontologies are used to respond to different needs: (1) to share a common understanding of the structure of information among people or software agents; (2) to enable the reuse of the domain knowledge; (3) to make domain assumptions explicit; (4) to separate domain knowledge from the operational knowledge; (5) to analyze the domain knowledge [NM01].

In the last decade they have been pervading almost all research domains [IB14], and, in particular, the biological and biomedical ones [HSG15], where multiple examples confirm their success [Kon15].

Ontologies are today often written using the Web Ontology Language (OWL) [GHM+08], a family of knowledge representation languages for authoring ontologies characterized by formal semantics and built upon the W3C Resource Description Framework (RDF) standard.

2.2 RDF, OWL, and serialization formats

RDF is a family of specifications for the publication of information on the Web endorsed by the W3C Consortium². In recent years, it has become the de-facto standard for the publication, access and sharing of data on the Web, since it allows for the flexible

² <https://www.w3.org/RDF/>

manipulation, enrichment, discovery and reuse of data across applications, enterprises, and communities [SMS+17].

In RDF, a resource is represented by an IRI, a Literal value or a blank node. An IRI (Internationalized Resource Identifier) is an extension of the URI (Uniform Resource Identifier) that can also contain UNICODE characters. A literal³ is a string representation of a certain value such as a string, a number or a date. It may be labeled with information such as the language or the datatype of the represented value. A blank node is a URI-like string which has validity only inside the considered database [PAG09].

One RDF statement is a triple composed of a subject, a predicate and an object. Subject and predicate are IRIs, while objects can also be literals. A literal, in particular, can only be an object. A blank node can either be a subject or an object. The combination of triples, where the object of a triple becomes the subject of another triple generates a directed graph, called RDF Graph.

OWL 2⁴ is an ontology language for the Semantic Web with formally defined meaning. It is an extension and revision of the first OWL language, and it was published by the W3C Ontology Working Group in 2004. OWL 2 ontologies provide classes, properties, individuals, and data values stored in Semantic Web documents. It is intended to represent rich and complex knowledge about things, groups of things, and relations among them. Being a computational logic-based language, the knowledge expressed in OWL can be reasoned with by computer programs either to verify the consistency of that knowledge, or to make implicit knowledge explicit through inference. OWL documents, often referred simply as ontologies, can be published in the World Wide Web, and may refer to or be referred from other OWL ontologies. OWL is part of the W3C's Semantic Web technology stack, which also includes RDF and SPARQL [HKP+09].

Today several serialization formats are available for RDF data. Among these, some of the most famous are N-Triples, Turtle, RDF/XML, and JSON-LD. We briefly describe each of these and report a small example describing the same concept “head” (uberon:000033) with a label, a comment, the specification of being an owl class and sub class of “Anatomical Structure” (uberon:000061).

N-Triple⁵ is arguably the simplest RDF format. It is a line based, plain text serialization format and subset of Turtle, easy for software to parse and generate. Each line of an N-Triple file has either the form of a comment (starting with the # symbol) or of a statement. A statement consists of four parts, separated by a whitespace. These four parts are the subject, the predicate, the object, and a full stop, to indicate the end of the statement.

```
<http://purl.obolibrary.org/obo/UBERON_000033> <http://www.w3.org/1999/02/22-rdf-syntax-ns#type> <http://www.w3.org/2002/07/owl#Class> .
<http://purl.obolibrary.org/obo/UBERON_000033> <http://www.w3.org/2000/01/rdf-schema#subClassOf> <http://purl.obolibrary.org/obo/UBERON_000061> .
<http://purl.obolibrary.org/obo/UBERON_000033> <http://www.w3.org/2000/01/rdf-schema#comment> "The head is the anterior-most division of the body [G0]."@en .
<http://purl.obolibrary.org/obo/UBERON_000033> <http://www.w3.org/2000/01/rdf-
```

³<https://www.w3.org/TR/rdf11-concepts/#section-Graph-Literal>

⁴ <https://www.w3.org/TR/owl2-overview/>

⁵ <https://www.w3.org/TR/n-triples/>

```
schema#label> "head"@en .
```

Terse RDF Triple Language (Turtle)⁶ is a common data format for storing RDF triples that differs from N-Triples in that it provides ways to abbreviate the information representation by factoring out, among other things, common portions of URIs. Among the features of the Turtle language, we count: the use of **@base** IRI and relative IRIs, **@prefix** and prefixed named, predicate lists separated by “;”, object lists separated by “,”, and the token a to represent the property rdfs:type.

```
<http://purl.obolibrary.org/obo/UBERON_0000033>    rdf:type    owl:Class    ;
    rdfs:subClassOf
<http://purl.obolibrary.org/obo/UBERON_0000061>    ;
    rdfs:comment "The head is the anterior-most division of
the    body    [GO]."@en    ;
    rdfs:label "head"@en .
```

RDF/XML⁷ is a serialization to express an RDF graph as an XML document. To do so, nodes and predicates are represented in XML terms: element names, attribute names, element contents and attribute values.

```
<owl:Class rdf:about="http://purl.obolibrary.org/obo/UBERON_0000033">
  <rdfs:subClassOf
rdf:resource="http://purl.obolibrary.org/obo/UBERON_0000061"/>
  <rdfs:comment xml:lang="en">The head is the anterior-most division of the
body    [GO].</rdfs:comment>
  <rdfs:label    xml:lang="en">head</rdfs:label>
</owl:Class>
```

JSON-LD⁸ is a serialization of RDF in Javascript Object Notation whose syntax is designed to easily integrate into deployed systems that already use JSON. It is primarily intended to be a way to use Linked Data in Web-based programming environments and to store Linked Data in JSON-based storage engines. It is 100% compatible with JSON and thus also with the JSON parsers and libraries available today.

```
{
  "@id"      :      "http://purl.obolibrary.org/obo/UBERON_0000033",
  "@type"    :      [      "http://www.w3.org/2002/07/owl#Class"      ],
  "http://www.w3.org/2000/01/rdf-schema#comment"  :      [      {
    "@language"      :      "en",
    "@value"      :      "The head is the anterior-most division of the body [GO]."
  }
],
  "http://www.w3.org/2000/01/rdf-schema#label"    :      [      {
    "@language"      :      "en",
    "@value"      :      "head"
  }
],
  "http://www.w3.org/2000/01/rdf-schema#subClassOf" :      [      {
    "@id"      :      "http://purl.obolibrary.org/obo/UBERON_0000061"
  } ] ] }
```

⁶ <https://www.w3.org/TR/turtle/>

⁷ <https://www.w3.org/TR/rdf-syntax-grammar/>

⁸ <https://www.w3.org/TR/json-ld/>

2.3 Existing Ontologies for ALS and MS

Some previous effort has been devoted to developing and exploiting ontologies related to ALS and MS. The largest part of the work has been dedicated to model Multiple sclerosis [JCS+13, JCR+14, MGR+15, DLT+19, AAA+20], or related concepts such as the EDSS [GSS+05, GSS+09], potential lesions [DE06, GFB+14], or relapses [PRP2020], and use them to predict the progression of the disease [PRP2020]. With respect to ALS, the most relevant works are about the modeling of the care pathway and service provision to patients affected by ALS [CMA+18, CMA+21]. Finally, a line of work investigates the possibility of jointly modeling several diseases, either neurodegenerative [HCD08, CJD+12, JCC+13, GMR+19] or rare [SCA+20] ones - among which authors include ALS and MS.

Compared to ALS, MS has received far more attention by the research community for what concerns its modeling through ontologies. We report here the major accomplishments made in this regard. In [JCR+14] Jensen et al. developed the Multiple Sclerosis Patient Data Ontology (MSPD) to represent data from patients affected by MS in the New York State Area. Although very similar to our objective, at the time of writing the ontology is not publicly available and does not include any pieces of information about the ALS.

The Multiple Sclerosis Ontology (MSO) [MGR+15] is one of the most comprehensive efforts made in order to model the MS using an ontology. The MSO is validated in the task of automatically annotating Electronic Medical Records and it can achieve an adequate performance of 73% of F1 score. More recently, Alshamrani et al. in [AAA+20], even though not directly involved in the creation of an ontology, present a global overview of the efforts made to utilize ontologies to favour model-driven decision making in multiple sclerosis research.

Several works do not model the MS in its entirety, but only some aspects of it. Our work, on the other hand, proposes a holistic approach to model Multiple Sclerosis. For the sake of completeness, we report the main works that model minor aspects of the MS. In [GSS+05] and later in [GSS+09], Gaspari et al. explore the possibility to compute the automatic EDSS (called AEDSS) exploiting an underlying ontology. They identify four main ontological classes: the rules used to infer the EDSS scores, the anatomical functional systems associated with each rule, the questions that allow to assess the degree of impairment, and the overall score. The ontology is therefore used to improve the performance of an expert system. [DE06], on the other hand, exploits an ontology to define rules that can be applied on the automatic categorization of images, to individuate lesions on the brain due to MS. Finally, Pappalardo et al [PRP2020] modelled the Universal Immune System Simulator (UISS), an ontology that describes the immune system activities. The authors also extend the UISS to simulate underlying MS pathogenesis and its interaction with the host immune system.

Efforts have been made to ontologically model the care of patients affected by ALS [CMA+18, CMA+21]. Even though the ontologies developed are rich and detailed, they model aspects which are not directly involved in our project. In particular, the focus of both work is on the quality of life and care pathway of patients affected by ALS.

Some efforts have been devoted to model multiple neurological diseases with the intent of obtaining a general ontology. An example is the Neurological Disease Ontology (NDO) [CJD+12, JCC+13]. According to the authors, NDO can provide a set of classes to describe

the neurological diseases, their symptoms and possible interventions encountered during the clinical practice. Based on such effort, in [JCS+13] Jensen et al. try to adapt the NDO to the modeling of Multiple Sclerosis. Notice that, similarly to MSPD, at current time the NDO does not respect the FAIR principles, since it is neither Findable nor Accessible, thus also preventing Reusability. In [SCA+20] Subirats et al. aim at modeling several rare diseases, including multiple sclerosis, through an ontology, dubbed Holistic Rare Diseases Ontology (HORD). In such ontology it is possible to model also information derived from the patients' social networks, in order to maintain unstructured data that can be used to assess their current state.

2.4 Ontologies used in the BRAINTEASER ontology

The use of standard identifiers for classes and relations is a key component when creating ontologies to ensure data integration across multiple disconnected databases, files, or web sites. The ability to use parts of ontologies to generate new ones specifically tailored for some new application or context while, at the same time, maintaining interoperability with other datasets, is essential [HSG15]. When more ontologies are used in the process of searching for already defined entities and relations, ontology repositories can aid in finding ontologies suitable for annotating data within a specific domain. Among the main resources in the life science domain, we primarily used OntoBee [XMRH11], an ontology repository in which ontologies are presented as Linked Data.

Table describing the main ontologies that the BRAINTEASER ontology exploits. For each ontology, we report the prefix that is used throughout the description of the Brainteaser ontology, the URL associated with the prefix and the name of the ontology.

Table 1. Main ontologies exploited by BRAINTEASER.

prefix	url	ontology
	https://www.BRAINTEASER.health/ontology/schema/	BRAINTEASER ontology (base prefix)
foaf	http://xmlns.com/foaf/spec/	Friend of a Friend (FOAF) vocabulary
ncit	http://purl.obolibrary.org/obo/NCIT_	National Cancer Institute thesaurus (NCIT)
ogg	http://purl.obolibrary.org/obo/OGG_	Ontology of Genes and Genomes (OGG)
oboInOwl	http://www.geneontology.org/formats/oboInOwl#	OBO in OWL
uberon	http://purl.obolibrary.org/obo/UBERON_	Uberon
xsd	http://www.w3.org/2001/XMLSchema#	XML Schema
maxo	http://purl.obolibrary.org/obo/MAXO_	Medical Action Ontology (MAXO)
omit	http://purl.obolibrary.org/obo/OMIT_	Ontology for MIRNA Target (OMIT)

prefix	url	ontology
snomed	http://purl.bioontology.org/ontology/SNOMEDCT/	SNOMED Clinical Terms (SNOMED CT)
atcc	http://purl.bioontology.org/ontology/UATC	Anatomical Therapeutic Chemical Classification (ATCC)
umls	https://uts.nlm.nih.gov/uts/umls/concepts/	Unified Medical Language System
isco	http://data.europa.eu/esco/isco/	International Standard Classification of Occupations
efo	http://www.ebi.ac.uk/efo/EFO_	Experimental Factor Ontology

The ontologies used in this project are presented, together with the respective prefixes, in Table 1. Among these ontologies, some of the most important ones are:

- **FOAF (Friend of a Friend)**⁹ [GCB+07]: an ontology describing people, their activities and their relations to other people and objects.
- **The NCI (National Cancer Institute) Thesaurus OBO Edition**¹⁰ [KS05]: a reference terminology that includes broad coverage of the cancer domain, containing cancer related diseases, fundings and abnormalities.
- **XSD (XML Schema Definition)**: a recommendation of the World Wide Web Consortium, specifies how to formally describe the elements in an XML document. It presents, in particular, the definition of many data types also used in RDF.
- **OGG (Ontology of Genes and Genomes)** [HLZ14]: The Ontology of Genes and Genomes is a well-known ontology used to model Genes, their mutations and the genome of living organisms.
- **MAXO (Medical Action Ontology)** [CZV+19]: This Ontology provides classes to describe the majority of the procedures that can be carried out by medical doctors while visiting or treating the patients.
- **OMIT (Ontology for MIRNA Target)** [HTD+10]: The MiRNA Target Ontology is a well-known ontology meant to develop data exchange standards in the microRNA domain. Although we do model directly aspects related to the microRNA, being a comprehensive ontology, we exploit it to import support classes.
- **ATCC (Anatomical Therapeutic Chemical Classification)**: The ATCC Ontology associates each ATC code with the corresponding active substance. It is used to model the pharmacological prescription assigned to the patients. The ontology has substantially a class for each active substance.
- **Uberon**¹¹: an anatomical ontology that represents body parts, organs and tissues in a variety of animal species, with a focus on vertebrates.
- **SNOMED CT**¹²: SNOMED Clinical Terms is a systematically organized and computer processable collection of medical terms providing codes, terms, synonyms and definitions used in clinical documentation and reporting. It is considered one of the most comprehensive multilingual clinical healthcare terminologies in the world.

⁹ <http://xmlns.com/foaf/spec/>

¹⁰ <https://www.ebi.ac.uk/ols/ontologies/ncit>

¹¹ <https://uberon.github.io/>

¹² <https://bioportal.bioontology.org/ontologies/SNOMEDCT>

- **Unified Medical Language System (UMLS):** is a set of files and software that brings together many health and biomedical vocabularies and standards to enable interoperability between computer systems. It integrates and distributes key terminology, classification and coding standards, and associated resources to promote creation of more effective and interoperable biomedical information systems and services, including electronic health records. In particular we exploited the UMLS Metathesaurus, a large biomedical thesaurus, the biggest component of UMLS, that is organized by concept, or meaning. It links synonymous names from over 200 different source vocabularies.

In BO we also use the **International Classification of Diseases**, in its tenth edition (**ICD-10**). This is a healthcare classification system that allows more than 55.000 different codes and permits tracking of many new diagnoses and procedures. It is maintained by the World Health Organization (WHO). Also, we use the **International Classification of Primary Care (ICPC)** ontology, containing the OWL version of the ICPC classification method, that allows for the classification of the patient's reason for encounter, the problem and diagnosis being managed, the primary or general health care interventions, and the ordering of the data of the primary care session in an episode of care structure.

3. CO-DESIGN APPROACH

To design the BO ontology, we adopted a co-design approach, strictly collaborating with the medical partners and domain experts, in order to embed their knowledge in the BO and, at the same time, to validate all the design choices. To this end, we operated in an iterative way, producing several intermediate versions of the ontology, and discussing them with our domain experts.

As a design approach, classes and properties already defined in external ontologies (described in Section 2.3) were used for the BO classes whenever possible. This is common practice when developing ontologies, as can be seen in other ontologies such as such as [SDD19, JCC+13]. This is more in general a best practice when developing ontologies [NM01] as described in the white paper [RSN+16]: “Identify and evaluate existing ontologies with overlapping domains. Reuse as far as possible the ontology content [...]” For this, there are different libraries of reusable ontologies on the Web and in the literature [NM01] such as the one that we used, OntoBee.

By reusing entities and properties already defined in other ontologies, we are not only able to enforce the collaboration and data consistency among database, but to guarantee the authoritativeness of the semantic meaning of these resources. We only defined new classes and properties when it was impossible to find their exact counterpart in some existing ontology available online or included in OntoBee. We exploited the iterative process of discussion with the medical partners to make sure that these newly defined concepts correctly described the corresponding real-world concepts and to guarantee the semantic quality of the ontology.

The design of the BO started by discussing with all the partners which kind of data have to be managed via the ontology and this ended-up on identifying the three categories mentioned above in Section 1: “raw” data, generated data, and evaluation campaigns data. The discussion was initiated during the kick-off meeting in January 2021 and finalized in the first plenary meeting in April 2021.

At this point, the work specifically focusing on retrospective data started. The UNIPD team received simplified samples of data from the medical partners to start understanding their features and potential issues. We then prepared forms to elicit requirements from the medical partners and collect attributes that they deemed important to describe both ALS and MS.

The requirement gathering and analysis phase ended up with a preliminary draft of the core parts of the BO and the corresponding schema. This preliminary draft of the BO was discussed face-to-face (virtually) in a dedicated meeting with medical partners in late May 2021, where we went through the overall design choices and the specific classes constituting the BO to validate them.

The further feedback gathered from the domain experts led to a revision of the BO which was further discussed in another face-to-face virtual meeting in late June 2021. This additional feedback led to a further refinement of the BO which was then presented and agreed on during the overall plenary meeting in September 2021.

Just after the plenary meeting, full (and anonymized) retrospective data were received from the medical partners: Pavia for MS; Lisbon, Turin and Madrid for ALS. The inspection

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of the full raw data allowed to further improve and refine the ontology and also to discover some issues about the instances, related to incomplete or noisy data. These updates to the BO and the solutions to address specific issues have been then discussed in one-to-one meetings with the specific medical partner during October and November 2021.

Overall, all these iterations led to the development of the first version of the BRAINTEASER ontology as well as of the mappers for ingesting the retrospective data from the medical partners.

4. DESCRIPTION OF THE BRAINTEASER ONTOLOGY

In the following, we describe more in detail the ontology designed to model the Multiple Sclerosis and the Lateral Amyotrophic Sclerosis according to the co-design approach defined in Section 3. In this section we present the main components and the choices that we made, whereas the complete documentation will be uploaded with the final OWL file in an open public repository as Zenodo which enables the seamless integration with EOSC services. Subsection 4.1 details the principles that guided the development of the ontology, while Subsection 4.2 describes the main semantic areas and the principal classes available in each of them.

4.1 Overall design principles

The ontological modeling proceeded bottom-up starting from the anonymized clinical reports about the four considered diseases provided by the “Instituto de medicina molecular Joao Lobo Antunes” (iMM, Portugal) and Università degli Studi di Torino (UNITO, Italy) for ALS, and by Fondazione Istituto Neurologico Nazionale Casimiro Mondino (MNDV-PV, Italy) for MS.

We analyzed these records and worked together with the physicians and the expert researcher in the field, following shared co-design principles, to accurately identify the classes and relations to include in the ontology. We maximized the re-use of concepts defined in already available and well-known ontologies and vocabularies, thus limiting the creation of new classes and relations to a minimum.

We represent the ontology as a graph where nodes are classes and edges are typed relationships amongst the classes. Classes (nodes) represent real-world objects such as a person, a project, a tissue or an anatomical part.

Relationships (edges) describe how the classes interact one with each other. BO is composed of 362 classes, 360 named individuals, 76 object properties, 220 data properties, and EEE annotation properties. The prefixes used in the ontologies are reported in the table above. Amongst the most used external ontologies, we count the COMPLETE with statistics

Once released, the URLs of the ontology will be secure and permanent by using the re-direction service provided by the W3 Permanent Identifier Community Group. The service works as a switchboard connecting requests for information with the true location of the information on the Web. It can be, therefore, reconfigured to point to a new location if the old location stops working.

4.1.1 Semantic Areas

The ontology is divided into eight “semantic areas”, i.e., groups of entities and relationships that pertain to different types of concepts and aspects of our domain. Each entity is therefore classified in one of the eight semantic areas. These areas are better detailed in section 4.2, and are:

1. **Patient**: the semantic area describing aspects of the patient, such as their status, their relatives, the corresponding disease, and clinical trials to which they are participating.
2. **Genetic Data** the information about the genetic mutations of a patient.
3. **Behavior** containing entities about the behaviour kept by the patient through time, such as smoking, physical activity, and more generic lifestyle aspects.
4. **Events** classes describing the possible events being registered for a patient, such as diagnosis, onset, and interventions of different nature.
5. **Contingencies** an area containing classes describing things that can happen to the patient during their life, such as comorbidities and traumas of different kinds.
6. **Intervention and Procedure** containing classes about different types of procedures that the patient may incur during their clinical history. This is one of the largest areas of the ontology, and we divided it into sub-areas to better describe them depending on the nature of the procedure.
7. **Anatomical Structure** composed of subclasses describing different parts of the human body.
8. **Symptoms** subclasses describing symptoms of different nature that may happen to the patients.

4.1.2 External Ontologies and Taxonomies

Whenever possible, we re-used classes from other ontologies to represent entities and created new classes only when unavoidable. The external ontologies used for this are described in Section 2.4.

In particular, there are some cases where we imported a subset of entities from an external ontology in order to represent taxonomies of concepts and their `rdfs:subClassOf` relationships. We only imported from these taxonomies the classes that are useful to model the data necessary for the project, i.e. we never import the full taxonomies, but only subsets of them. Some of the classes that work as roots of their respective taxonomies in the Brainteaser ontology are:

1. **Relative** (`ncit:C21480`) This class represents a generic relative of a patient, and is the root of the taxonomy containing different degrees of kinship (such as Father, Mather, Sister, etc.)
2. **Occupation** (`esco:Occupation`) The class representing a generic job or other type of occupation of the patient.
3. **Ethnic group** (`SNOMED:Ethnic_group`) Represents the ethnicity of the patient.
4. **Symptom** (`ncit:C4876`) The root class of the taxonomy describing the possible symptoms related to a patient.
5. **Gene** (`ogg:0000000002`) Root of the gene taxonomy.
6. **Anatomical Structure** (`uberon:0000061`) Root of the taxonomy of the human body locations where events, symptoms and traumas are located.
7. **Pharmacologic Substance** (`ncit:C1909`) the root of the clinical drugs that may be prescribed to patients as result of a Therapeutic Procedure or as response to a Relapse or Inflammation.
8. **Disease or Disorder** (`ncit:C2991`) the root of the taxonomy with the possible diseases (not only MS and ALS) that a patient, or one of their relatives, may manifest.

We relate each single concept in the BO with the respective concepts in the Unified Medical Language System (UMLS) metathesaurus with the `oboInOwl:equivalentClass` relationship. This connection allows us to retrieve all relevant information about a concept as reported in the rich and widely-used UMLS meta-thesaurus. UMLS comprehends alternative naming for the concepts, relationships with other relevant classification schemes such as the International Statistical Classification of Diseases and Related Health Problems, Tenth Revision (ICD-10) and multilingual information when available.

As an example, the “multiple sclerosis” concept is inherited from the MONDO ontology with URI http://purl.obolibrary.org/obo/MONDO_0005301 and in the BO definition for this concept we also report that it is the same as `umls:C0026769`. From the UMLS identifier we can retrieve all the information about other classifications such as ICD-10 that identifies multiple sclerosis with the id G35.

4.1.3 *Named Individuals*

For the classes contained in some of these taxonomies, i.e., the ones with root in Occupation, Ethnic Group, Anatomical Structure, and Pharmacological Substance, it is the case that, when they are the range of properties, no other information needs to be registered. For instance, when registering the presence of a symptom in a particular anatomical location, it is only necessary to know the location, without any further information about it.

The consequence is that each time a new triple with an object in one of these taxonomies is created, we would be forced to create a new instance.

To avoid an explosion in the number of instances of these classes, and due to the fact that no other information about them needs to be modeled, we decided to create named individuals, one for each class in these taxonomies. These named individuals are used as objects of the corresponding object properties every time a new triple needs to be instantiated.

4.2 Area-by-Area

In the remainder of this section, we describe the elements characterizing each semantic area individuated in section 4.1. We use the bold font to indicate ontological classes, monospace font to represent their URI and italic to represent their properties. In case of uri derived from other ontologies, prefixes are defined in Table 1.

4.2.1 *Patient*

The patient semantic area, represented in Figure 3, contains classes and relations pertaining to a patient participating in the clinical trials and general information about this patient, their relatives with diseases, their disease and the participation in a clinical trial.

Central to this area is the **Patient** class (`ncit:C16960`), subclass of `foaf:Person`, that presents different properties describing the Patient instance. These are: *dateOfDeath* (with range `xsd:gYear`), *genomeSequencing* (`xsd:string`), *educationLevel* (`rdf:langString`), *maritalStatus* (`rdf:langString`), *dextricity* (`xsd:string`), *retiredAtDiagnosis* (`xsd:string`), *menopause* (`xsd:int`), *MSInPaediatricAge* (`xsd:boolean`), *alive* (`xsd:boolean`).

Patient inherits from `foaf:Person` the properties *birthplaceCharacteristics* (rural or urban areas), and *birthplace* (defined as an enumeration among village, country town, small town, middle town, and large town). The **Patient** is further linked to two additional attributes, *gender* through the `foaf:gender` property, and *birthday*, via `foaf:birthday` property. In order to preserve the anonymity of the patients, real instances will only present the birth year, and not the birth date.

Patient is connected through the *ethnicity* property to class **Ethnic Group** (`SNOMEDCT:Ethnic_Group`), representing a generic ethnic group. This class is the root of a taxonomy of ethnicities whose classes are taken from other ontologies.

To model the familial predisposition, it is necessary to register the presence of a patient's relatives that may have the studied diseases of their own. To do so, we considered the class **Relative** (`ncit:C21480`) that models a generic relative of a patient. **Relative**, in turn, is the root class of a taxonomy of kinship classifications such as **Parent**, **FirstDegreeRelative**, **Father** and **Mother** (these classes are imported directly from the `ncit` ontology).

A relative may or may not be a patient in the database. In the first case, the relative instance is connected to its corresponding patient instance through the *isPerson* property. In the other case, an instance of the class `foaf:Person` is created, and the relative instance is connected through *isPerson* to this instance. One patient or one generic person can be a relative of more than one patient, and for this reason multiple instances of relative may be instantiated, one for each degree of kinship occurring for that patient/person in the database. Each of these instances will be connected through *isPerson* to the corresponding instance of **Patient** or `foaf:Person`.

The class **Occupation** (`ESCO:Occupation`) represents the job of the user. It is the root class of a taxonomy of classes representing different types of jobs, and a patient instance is connected to **Occupation** through *hasOccupation*.

`foaf:Person` is connected through the property *enrolledIn* to **Clinical Trial Participation** (`:ClinicalTrialParticipation`), representing the fact that a patient is participating in a clinical trial. A clinical trial instance may have a *startData* property, an *endDate* property and an ending reason, provided by the *endReason* property.

Each instance of clinical trial participation is part of a **Clinical Trial** (`ncit:C71104`) and connected to this class through the *participate* property. In turn, a clinical trial pertains to a certain hospital, and therefore the property connects the class **Clinical Trial** to the class **Clinics** and **Hospitals** (`ncit:C19326`).

Finally, a person (thus both a patient and a relative who is not present in a trial) can have a disease. `foaf:Person` is connected to **Disease or Disorder** (`ncit:C2991`) through *hasDisease*. Also, the class **Clinical Trial** is connected to **Disease or Disorder** through *isAboutDisease* to indicate which is the disease studied in the specific trial.

4.2.2 Genetic Data

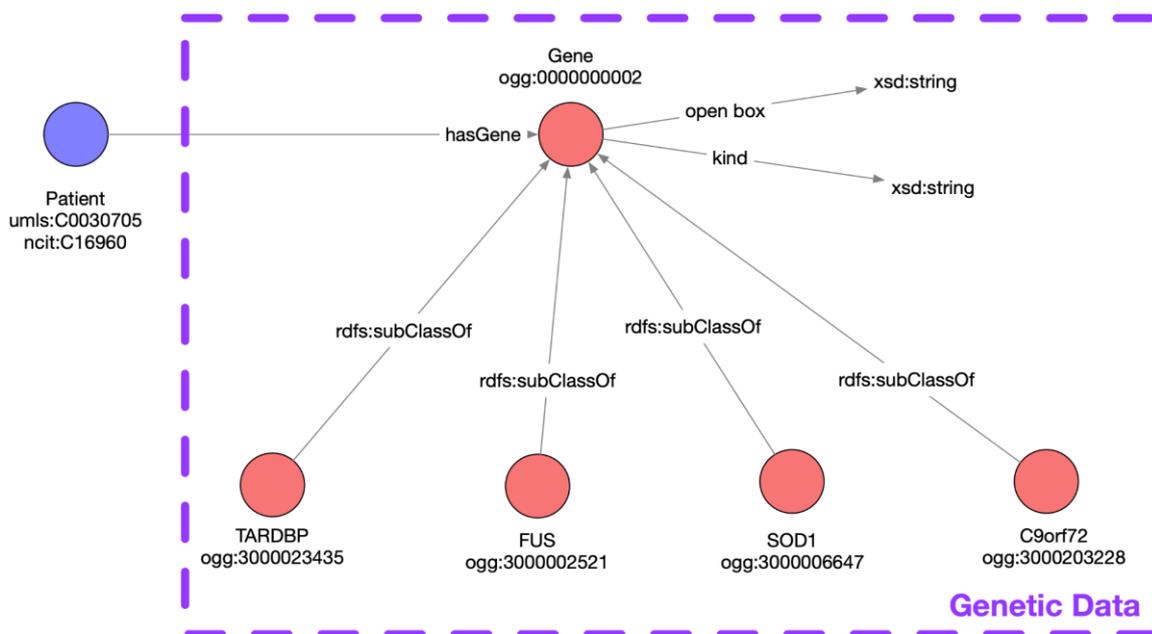


Figure 4. Semantic Area containing the information about a patient's gene and their mutations.

A **Patient** may be associated with data concerning their genetic heritage. To do so, the ontology links the **Patient**, via the property *hasGene*, to the class **Gene** (`ogg:0000000002`), as shown in Figure 4. Instances of this class can have two properties: *kind* and *open box*. The former allows to express the type of mutation present on the gene, while the latter allows to add further information via unstructured text. The **Gene** instance can be instantiated either using the **Gene** class, or one of its relevant subclasses for this specific domain: **SOD1** (`ogg:3000006647`), **FUS** (`ogg:3000002521`), **C9orf72** (`ogg:3000203228`), and **tardbp** (`ogg:3000023435`).

4.2.3 Behaviour

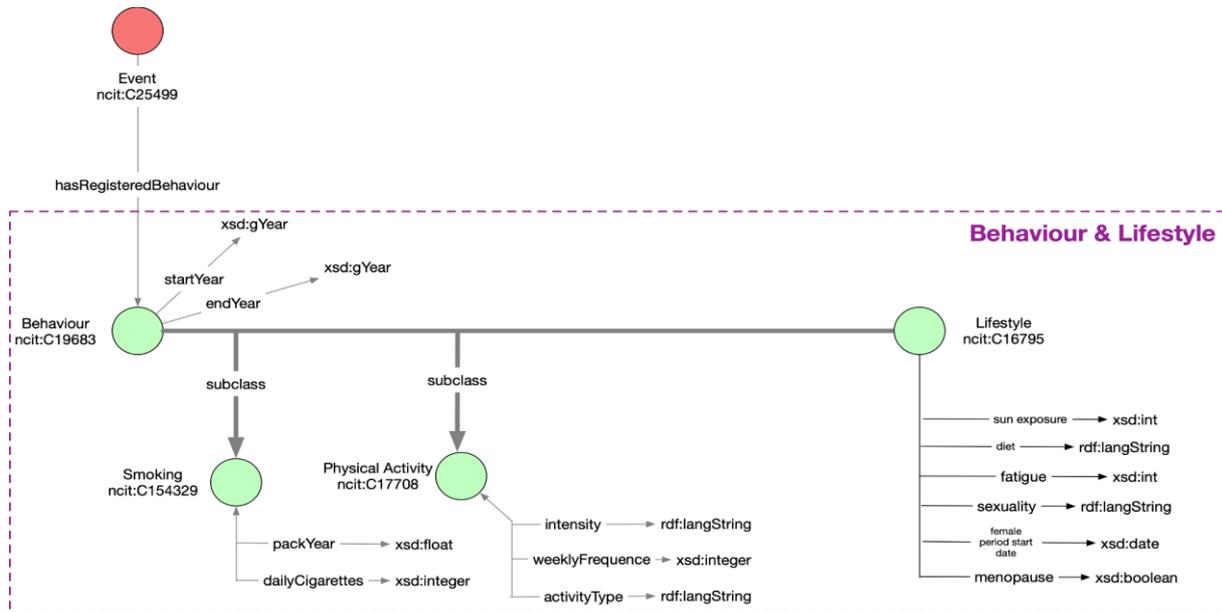


Figure 5. Behaviour and Lifestyle semantic area, including the subclasses Smoking, Physical Activity and Lifestyle.

Different aspects of the behaviour of the patient during the passing of time are modeled with classes in this semantic area.

As reported in Figure 5, the main class is **Behaviour** (ncit:C19683), presenting the properties *startYear* and *endYear* (both with range *xsd:gYear*), describing the starting and ending dates of said behaviour. Each instance of the subclasses of Behaviour therefore offers the possibility to register the time span in which such behaviour was sustained. The class **Event** is connected to Behaviour through *hasRegisteredBehaviour*.

Different types of behaviours are modeled through the use of subclasses of this main class.

Smoking (ncit:C154329) represents the patient's habit of smoking. It presents the relations *packYear* (a quantification of lifetime tobacco exposure defined as: (number of cigarettes smoked per day) x (number of years smoked)/20. Thus, one pack-year corresponds to smoking 20 cigarettes a day for one year), and *dailyCigarettes* (the number of cigarettes smoked in one day on average).

The class **Physical Activity** (ncit:C17708) describes the physical activity usually exerted by the patient. Its properties are *intensity* (*xsd:string*), *weeklyFrequency* (*xsd:integer*) and *activityType* (*xsd:string*).

The class **Lifestyle** (ncit:C16795) acts as a container where to put different types of behavioral information concerning the patient. Such behaviors are modeled as properties of the Lifestyle instance, and are: *sunExposure* (with range *xsd:int*), *diet* (*xsd:int*), *fatigue* (*xsd:int*), *sexuality* (*rdf:langString*), *femalePeriodStartDate* (*xsd:date*), and *menopause* (*xsd:boolean*).

properties *endDate* and *startDate* (both with range `xsd:date`), describing the period in which this **Event** manifested.

Different types of Event are represented through the use of subclasses.

Protocol Event (`ncit:C74589`) represents a planned protocol activity such as randomization and study completion, and occurrences, conditions, or incidents independent of planned study evaluations occurring during the trial (e.g., adverse events) or prior to the trial (e.g., medical history). Its subclass is **Patient Visit** (`ncit:C39564`), describing a specific type of protocol event, i.e., a visit of the patient in a hospital.

The event **Diagnosis** (`ncit:C25279`) represents the moment in which the patient is officially diagnosed with the disease.

The last two types of Event are the **Onset** (`ncit:C25279`) and **Before Onset** (`:BeforeOnset`). The first one represents the event in which the first symptoms are manifested for the first time to the patient. The **Onset**, in particular, may be of different types, which are represented as boolean (`xsd:boolean`) properties: *limbs*, *bulbar*, *axial*, and *generalized*. An onset may also present the property *cerebrospinalOligoconalBands*, which indicates, if the test has been carried out, the presence of such bands in the patient's blood flow. The onset is located in a part of the human body, and thus the **Onset** event is connected to the class **Anatomical Structure** (`uberon:0000061`) through the *site* property. The second one, **Before Onset**, describes an event that happened before the onset, whatever its nature may be. The property *howLong* registers how much time before the onset this event happened, and it may assume only two string values, defining an event that happened in the last five years, or before the last five years.

An Event instance, in turn, may be linked to various other classes. **Event** is linked through *hasPregnancy* to **Pregnancy**, describing the presence of a pregnancy; to **Trauma** through *hasTrauma*, describing the registration of a traumatic event happened to the patient; to **Symptom** through *hasSymptom*, describing the presence of symptoms being registered during an event, to **Recurrent Disease** through *hasRelapse*, and finally to one or more **Intervention or Procedure** that may be applied to the patient, through the *consist* property.

4.2.5 Contingencies

The Contingencies semantic area, represented in Figure 7, contains classes representing “things that may happen”: occurrences to the patient that may or may not be related to the disease. They correspond to phenomena in the patient body that cannot be directly planned. We also included a pregnancy among contingencies since, even though partially plannable, it represents a change in the patient body that cannot be ascribed among the medical procedures. These contingencies are still registered during an **Event** and therefore are linked to the **Event** in which they are registered via a specific property each.

- **Trauma** (ncit:C3671), that describes the presence of a trauma to the body of the patient. It also reports the properties *traumaDate* (xsd:date) and *traumaDescription* (rdf:langString). The **Trauma** class is connected to the **Anatomical Structure** class through the *traumaArea* object property. It is furthermore linked to the **Event** during which it is registered via the *hasMajorTrauma* property.
- **Pregnancy** (ncit:C25742) describes the presence of a pregnancy. **Event** is connected to this class through the *hasPregnancy* property. This class presents a series of properties about the pregnancy itself: *startDate* and *endDate* (xsd:date), *endEvent* (rdf:langString, it describes how the pregnancy ended), *complications* (rdf:langString).
- **Recurrent Disease (Relapse)** (ncit:C38155) describes a relapse that may happen to the patient. This class has, in turn, a series of properties describing the relapse, such as *relapseStartDate*, *sequela*, *recovery*, *length*, etc. The **Event** object is connected to the **Relapse** class through the *hasRelapse* property. **Relapse**, in turn, may be associated to a **Pregnancy** (*hasAssociatedPregnancy*), to a prescribed **Pharmacologic Substance** (*associatedSubstance*), to a requested **MRI** (*requiresMRI*), and to a possible **Intervention** (*relapseAssessment*) required to assess the presence of the relapse itself.
- **Comorbidity** (ncit:C16457) represents the presence of two or more diseases or medical conditions in a patient. The **Comorbidity** is characterized by the *startYear* and *endYear* property, together with *treatment* (xsd:string), reporting the prescribed treatment, and *severity*, describing the severity of the comorbidity from a set of string values (slight, moderate, serious, life risk). A **Comorbidity** is registered during an **Event**, and the two classes are connected through *hasRegisteredComorbidity*.

4.2.6 Intervention and Procedure

This semantic area contains the classes describing the interventions done to a patient to understand, keep under control, and intervene on their clinical condition.

The class **Event** is connected to the main class of this area, **Intervention or Procedure** (ncit:C25218), through the *consists* object property. This class represents “a general activity that produces an effect, is meant to clinically assess, or is intended to alter the course of a disease in a patient” (from its NCI Thesaurus definition).

Instances of the **Intervention or Procedure** class can have two properties: *startDate* and *endDate*. Such dates allow us to register the starting and ending moment of the intervention, if this is something continued in time. Notice that, thanks to an abuse of notation, by leaving empty the *endDate*, we can also represent interventions and procedures that are atomic in time, i.e., are not distributed through more days. The ontology contains different subclasses for Intervention, and each of them supersedes a semantic sub-area depending on the nature of the procedure itself. We describe the characteristics of the main intervention and procedures in the remainder of this subsection.

4.2.6.1 Therapeutic Procedure

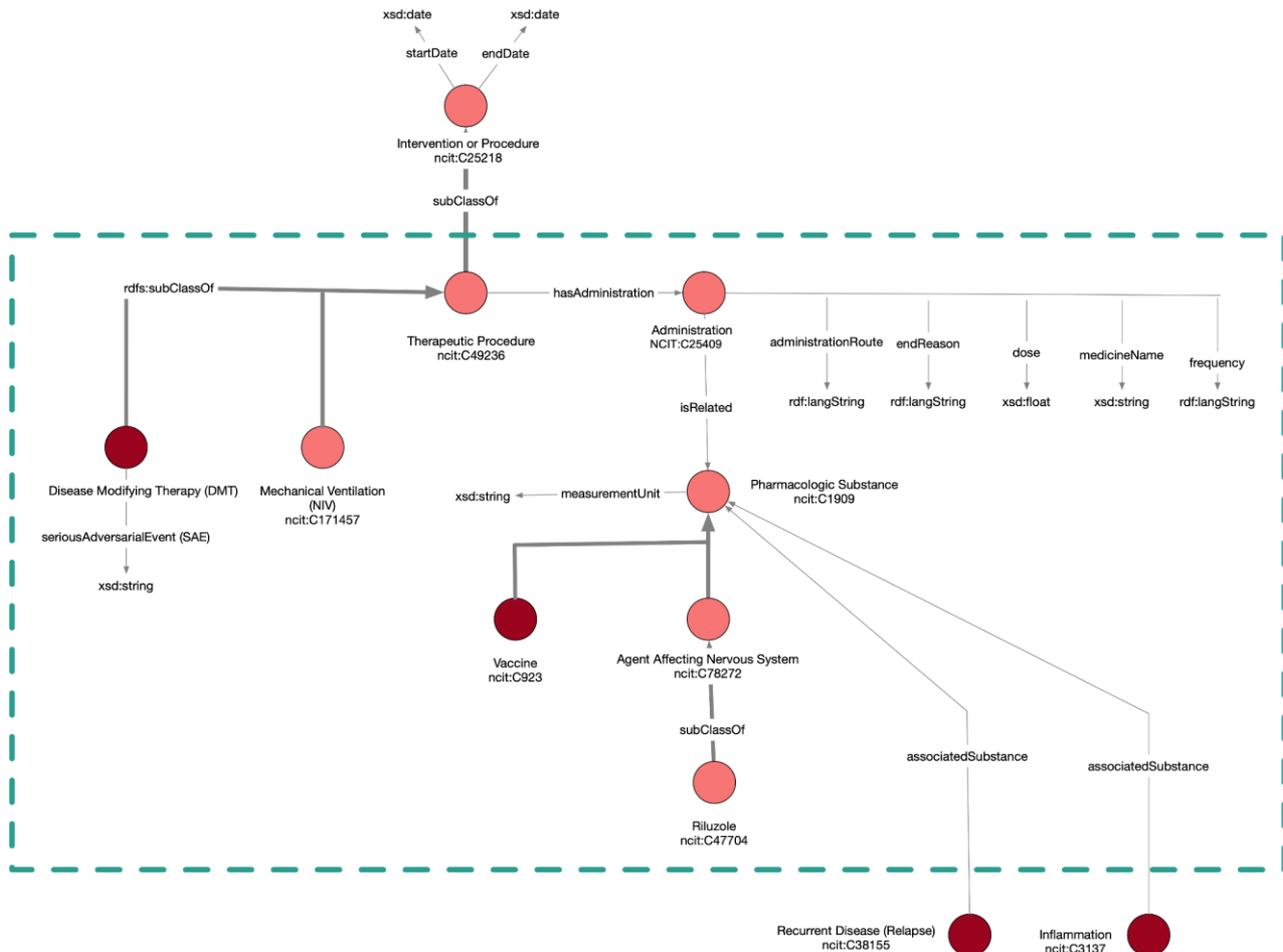


Figure 8. Therapeutic Procedure semantic area, sub-area of the Intervention or Procedure area.

The subclass **Therapeutic Procedure** (ncit:C49236), depicted in Figure 8, represents the action or administration of therapeutic agents to produce an effect that is intended to alter or stop a pathologic process.

We considered three possible types of therapeutic procedures: a generic therapy (the **Therapeutic Procedure** class itself), a **Disease Modifying Therapy (DMT)** and a **Mechanical Ventilation (NIV)** (ncit:C171457).

DMT presents the property *seriousAdversarialEvent* (also referred to in the documents as SAE), which indicates the occurrence of a serious adverse reaction to a specific Disease modifying therapy.

All the possible therapeutic procedures might involve the prescription or the associated usage of one or more pharmacological substances. The administration of these substances is modeled here through the use of the class **Administration** (ncit:C25409), characterized by properties describing the administration itself: *administrationRoute* (rdf:langString), *endReason* (rdf:langString), *dose* (xsd:float), *medicineName* (xsd:string), *frequency* (rdf:langString).

An **Administration** is related to the administered substance, here represented through the class **Pharmacological Substance** (ncit:C1909), through the object property *isRelated*.

Among the possible substances that may be administered (subclasses of **Pharmacological Substance**), the following have been identified as particularly relevant to the domain: **Vaccine** (ncit:C923), **Agent Affecting Nervous System** (ncit:C78927) (and especially its subclass **Riluzole** (ncit:C47704)), and **cortisone treatment** (:cortisone_treatment).

4.2.6.2 Diagnostic Procedure

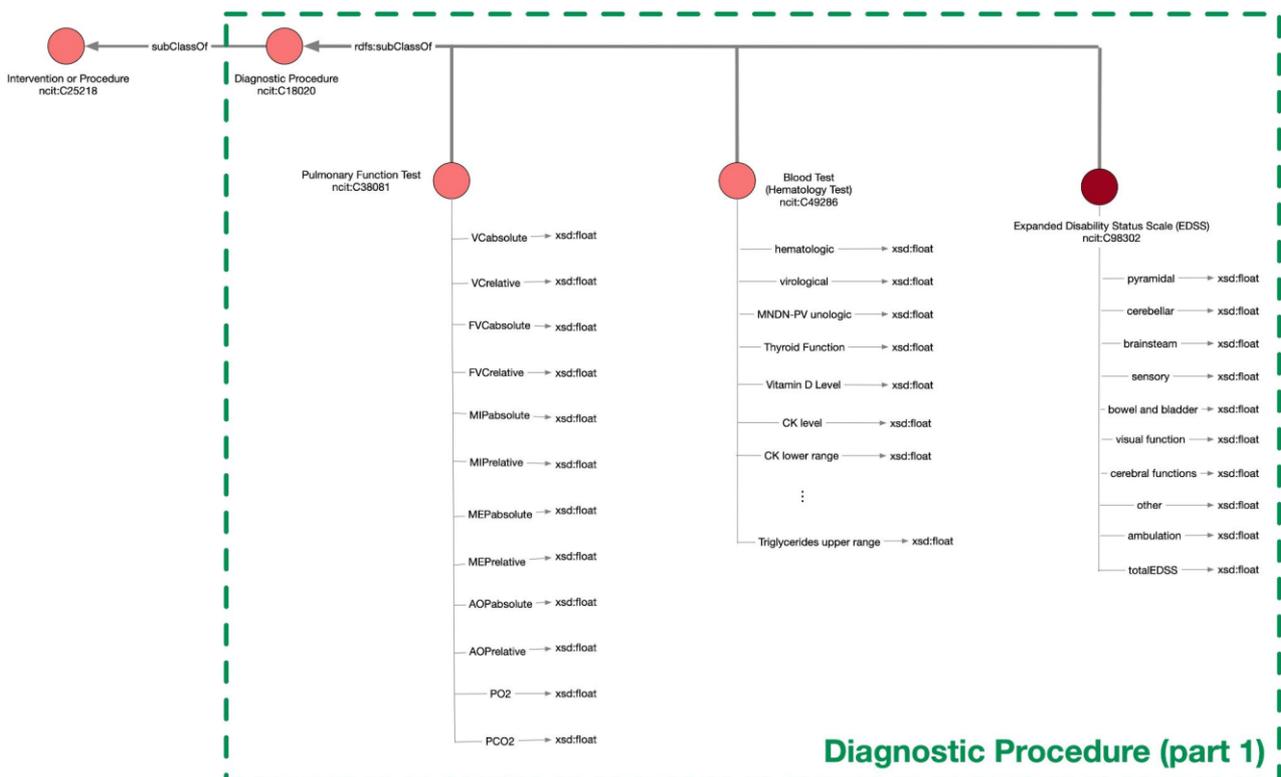


Figure 9.a. Part 1 of the Diagnostic Procedure semantic area, a sub-area of the Intervention or Procedure area. This figure reports the subclasses Pulmonary Function Test, Blood Test and EDSS.

Diagnostic Procedure (ncit:C18020) is another subclass of Intervention or Procedure, and it represents any procedure or test to diagnose and assess the progression of a disease or disorder. This, in turn, presents many subclasses. Due to this, we further divided the graphical representation of this sub-area in different Figures: Figure 9.a, 9.b and 9.c, to help their readability.

Starting from Figure 9.a, we see the **Pulmonary Function Test** (ncit:C38081). As the name suggests, it is used to store information about pulmonary function tests carried out on the patient. Instances of such class have several properties associated, each of which correspond to a parameter used to assess the quality of the respiratory functions of the patient (i.e., VC, FVC, etc. ...). Another subclass here is the **Blood Test** (ncit:C49286), representing a test to measure hematopoietic components and investigate hematologic disorders. The relevant parameters assessed via a blood test are represented through the use of properties of this class.

The **Expanded Disability Status Scale (EDSS)** (`ncit:C98302`) is a subclass describing a system for quantifying the level of disability for multiple sclerosis. The EDSS is traditionally computed considering 12 different items: each of these items is represented by a property of this class with range `xsd:float`.

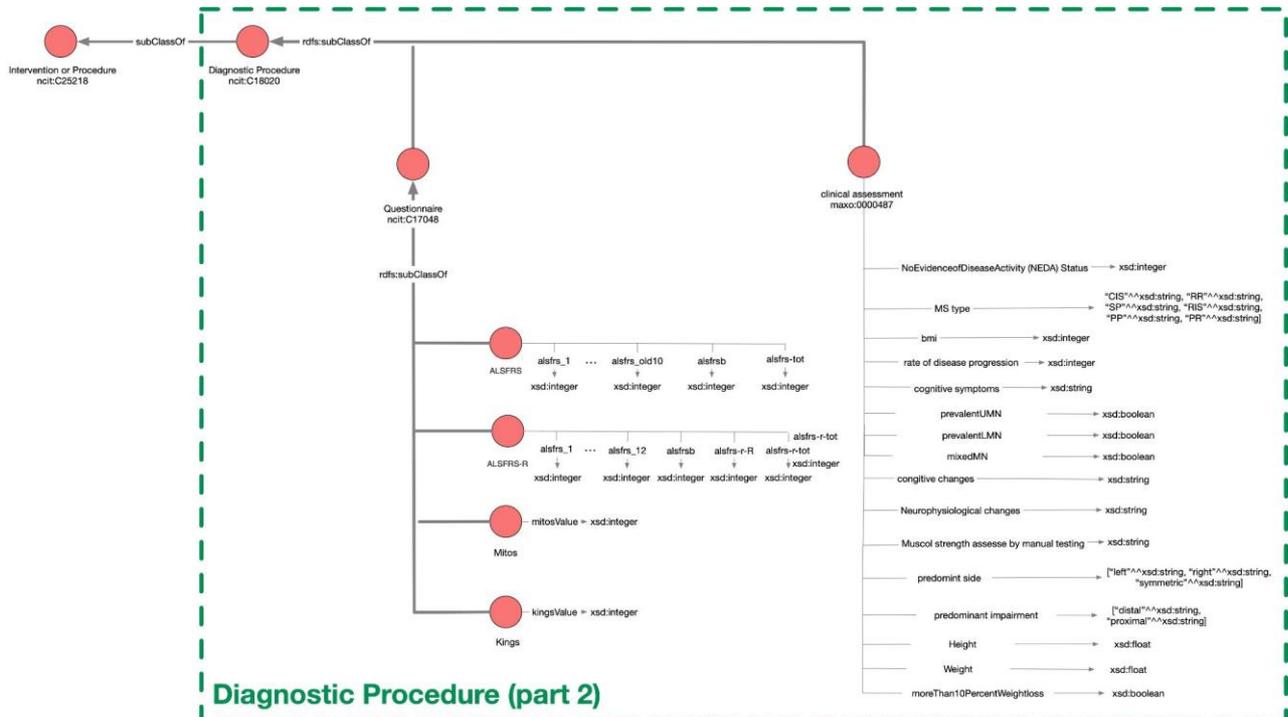


Figure 9.b. Part 2 of the Diagnostic Procedure semantic area, a sub-area of the Intervention or Procedure area. This figure reports the subclasses Questionnaire and clinical assessment.

We continue with the classes belonging to this sub-area in Figure 9.b. The **Questionnaire** (`ncit:C17048`) class represents a questionnaire that is submitted to the patients at each visit. In turn, different types of questionnaires may be submitted, with different sets of questions.

The class **Clinical Assessment** (`maxo:0000487`) represents a measurement performed in a clinical setting using clinicians' observations and instrument data to inform patient care and research. The instances of this class may contain different fields with the data collected during the assessment itself, as can be seen in the figure.

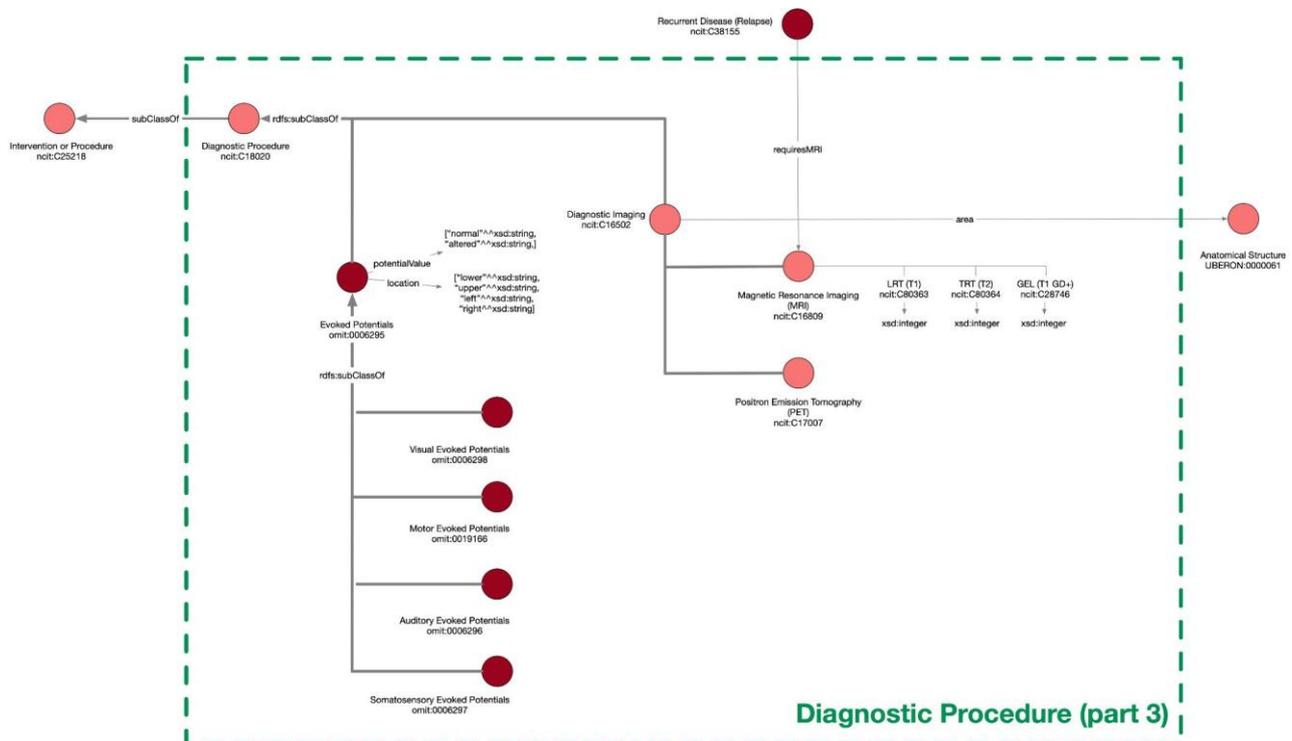


Figure 9.c. Part 3 of the Diagnostic Procedure semantic area, a sub-area of the Intervention or Procedure area. This figure reports the subclasses Evoked Potentials and Diagnostic Imaging, together with the properties connecting them to other classes of the ontology belonging to different semantic areas.

Finally, Figure 9.c reports the last classes of this sub-area. With **Evoked Potentials** (omit:0006295) we mean a class of tests used to measure the electrical activity in certain areas of the brain and spinal cord. Evoked potentials test and record how quickly and completely the nerve signals reach the brain. These types of tests are helpful in diagnosing such conditions as multiple sclerosis and other neurological disorders. Key properties for this type of Procedures are the *potential/Value* (a value among normal and altered), and the *location*. Electrical activity is produced by stimulation of specific sensory nerve pathways. In the ontology there are subclasses describing the different types of Evoked Potentials: **Visual Evoked Potentials** (omit:0006298), **Motor Evoked Potentials** (omit:0019166), **Auditory Evoked Potentials** (omit:0006296) and the **Somatosensory Evoked Potential** (omit:0006297).

With **Diagnostic Imaging** (ncit:C16502) we refer to various techniques of viewing the inside of the body to help figure out the cause of an illness or injury, and thus confirm a diagnosis. Doctors also use it to see how well a patient's body is responding to treatment for a fracture or illness. Subclasses of Diagnostic Imaging are the **Magnetic Resonance Imaging**, also known as **MRI** (ncit:C16809), characterized by properties describing its results, and the **Positron Emission Tomography**, also known as **PET** (ncit:C17007).

4.2.6.3 Surgical Procedure

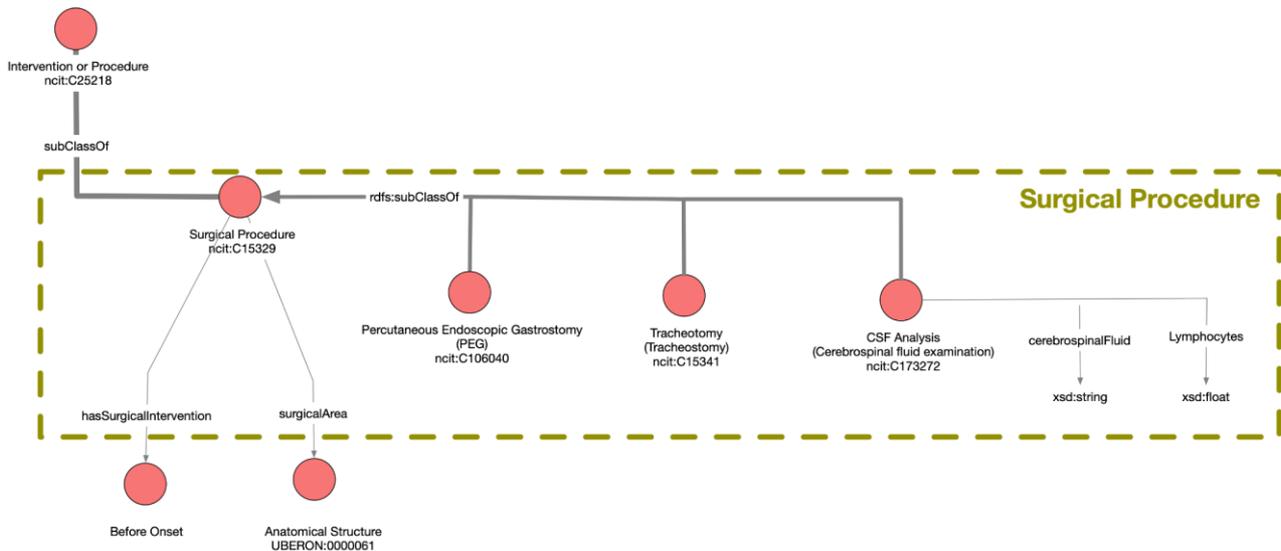


Figure 10. Surgical Procedure semantic area, sub are of the Intervention or Procedure area.

The **Surgical Procedure** class describes a generic surgical operation performed on the patient. As seen in Figure 10, its subclasses in the ontology are: **Percutaneous Endoscopic Gastrostomy (PEG)** (ncit:C10604), a procedure in which a flexible feeding tube is placed through the abdominal wall and into the stomach, allowing nutrients, fluids and medications to be put directly into the stomach, thus bypassing mouth and esophagus; **tracheotomy** (or **tracheostomy**, ncit:C15341), an opening surgically created through the neck into the trachea to allow direct access to the breathing tube; **Cerebrospinal fluid examination (CSF Analysis)** (ncit:C173272), the analysis of the cerebrospinal fluid, a clear, colorless liquid found in the brain and spinal cord, acting like a cushion against sudden impact or injury to the brain or spinal cord. This last class is characterized by the properties *cerebrospinalFluid* and *lymphocytes*, describing aspects of the test's results.

4.2.7 Anatomical Structure

This area, shown in Figure 11, contains the **Anatomical Structure** (uberon:0000061) class. Such class, due to its nature and function, cannot be assimilated to any other already available classes and semantic areas.

The class **Anatomical Structure** is the root of a taxonomy containing classes representing parts of the human anatomy used throughout the ontology. To avoid creating new instances of a certain location every time it is required, we define a named individual for each of the required anatomical structures: all the resources that need to be associated with one or more anatomical structures will point to the same name individual.

The **Anatomical Structure** is the range of many object properties in the Brainteaser ontology. Some examples are *site* (connecting the **Onset** to the **Anatomical Location**), *traumaArea* (connecting the class **Trauma** and indicating where it happened), *area* (connecting the class **Diagnostic Imaging**), *surgicalArea* (connecting **Anatomical Structure** to the class **Surgical Procedure**), and *symptomArea* (connecting it to the class **Symptom**).

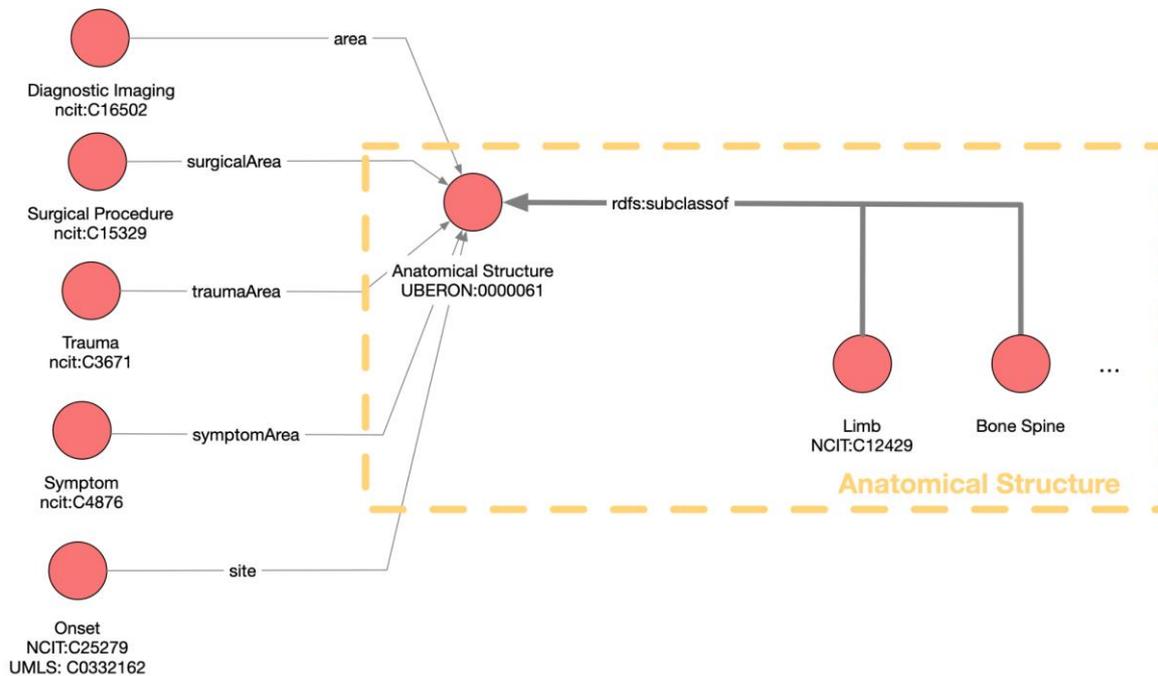


Figure 11. Anatomical Structure Semantic Area.

4.2.8 Symptoms

The Symptoms semantic area, shown in Figure 12, contains classes describing the symptoms that may happen to a patient and be registered during an Event.

The class **Event** is connected to the main class of this area, **Symptom** (ncit:C4876), through the *hasSymptom* object property. The **Symptom** class, in turn, is connected to the **Anatomical Structure** class through the *symptomArea* property, allowing to specify the area associated with a specific symptom.

The resources will be rarely of type Symptom, since it is too generic to describe any real characteristic of the patient's disease course. Among symptom instances, we list here the **Nervous System Finding** (ncit:C36280) and its subclass, the **Fasciculation** (ncit:C34606) and the **Inflammation** (ncit:C3137). These symptoms are among the most relevant concerning the diseases modeled in this ontology. For the case of **Inflammation**, in particular, we register the **Pharmacologic Substance** being administered, through the *associatedSubstance* object property.

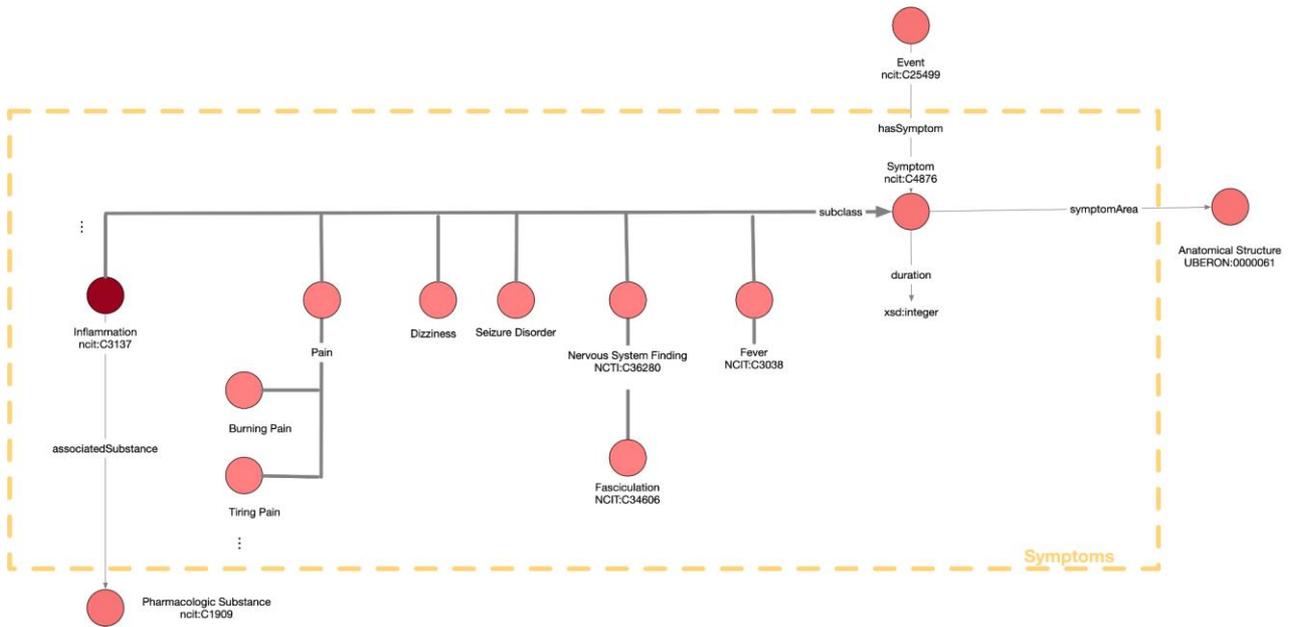


Figure 12. Symptoms semantic area.

5. DATA MAPPER AND RDF GRAPH BUILDER

The data mapper is the part of our software architecture dedicated to mapping the clinical data provided to us by the hospitals into a structured RDF graph compliant with our ontology.

Data came from different sources, each of them used to adopt its own notation and standards for managing knowledge, so different sources would likely state the same knowledge in two different ways, according to their data management system. Different mappers are needed to deal with this fact. Then the aim is to uniform all the knowledge provided by the partners and structure it according to a graph-based model. Moreover, we are going to collect data about ALS and MS, so it's pretty natural to have different needs in terms of information to map.

Since we need to deal with different sources of information as discussed above we chose a pluggable architecture for mappers: dedicated modules for digesting the information coming from different sources, then we collect everything in a single RDF graph employing a well-known python library rdflib, and at the end, we serialize in several formats (turtle, RDF/XML, JSON-LD, NT) as shown in Figure 13.

We export data even in csv format, those will be used by the ML algorithms for prediction purposes.

Every new resource that we are introducing to the graph is identified by a URI as follow:

a common base = "https://w3id.org/BRAINTEASER/ontology/resource/" plus a local unique id generated during the mapping phase.

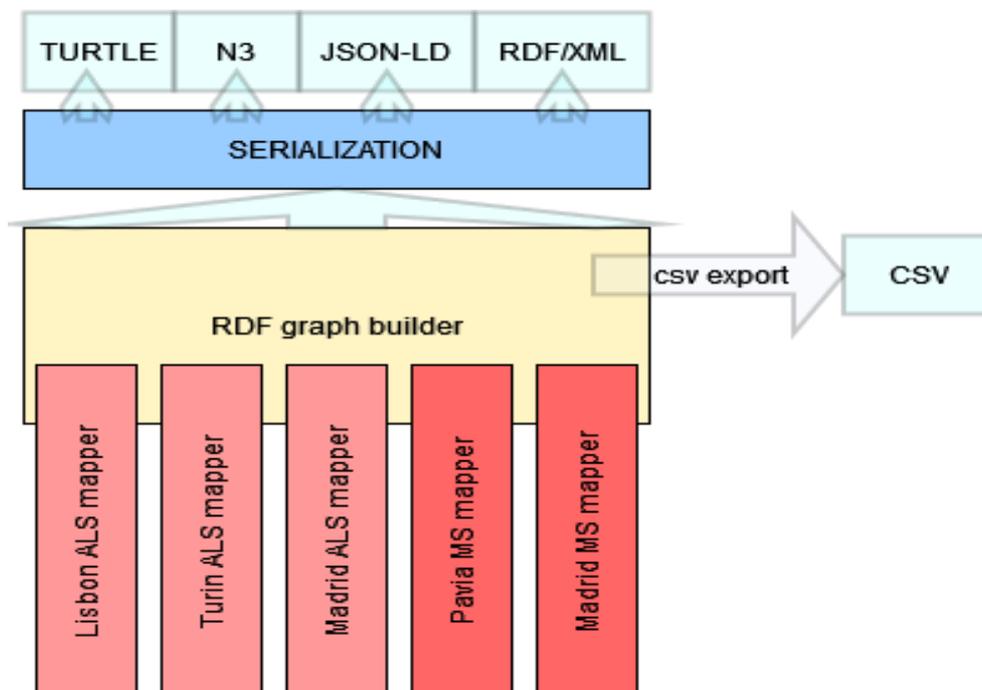


Figure 13. Data mapper architecture.

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We have two possible cases during the id generation phase: in the first one, we are creating an id for a resource that already has one in its original data source, in the other one the resource has no id in the original data source. For the first case, we compute a hash of the original id plus some strings to avoid collisions between different types of resources and different data sources. In this way, we can retrieve all the information regarding any kind of resource that we know the original id by re-computing the hash. For the second case, we randomly generate a UUID, and then we apply the same hash algorithm in order to uniformize all the IDs.

Mappers are completely developed using python since it allows us to use plenty of libraries useful for our scopes and permits us to write code in a very fast and easy to read manner, so from one side it speeds up the development and from the other one give the possibility to clearly understand how the whole framework is supposed to works, with benefits for future improvements. For manipulating data we employ *pandas*, so managing the input reading and the data cleaning was carried out using *pandas*' tools.

Follows all the external libraries and modules adopted during the mappers' development:

- *pandas*, for data manipulation;
- *rdflib*, for managing RDF graphs;
- *uuid*, for generating UUID codes;
- *mmh3*, for the hashing phase;
- *csv*, for writing data into a CSV file;
- *gc*, for managing the garbage collector.

A mapper has the aim of structuring the information according to the ontology schema, let's observe the following example. We want to map personal data about a patient, we have those data in a table format:

Table 2. A snippet of patient personal data table.

Patient personal data				
Patient ID	Date of birth	Date of death	Sex	Ethnicity
123456	1981-01-01		Female	Caucasian

Table 3. A snippet of a table where patient's visits information are present.

Patient visit			
Id	Patient ID	...	First visit date
1111	123456	...	2015-01-01

In the following sections, we will discuss how we manage the input case by case, but in this first introduction, we will focus on what a mapper that receives those kinds of data is supposed to do, and what we expect in practice as a final output. Then, separately, we will analyse for each mapper the input and the output phase.

The very first step is to compute the IRI to uniquely identify the patient, so following the above, the mapper will compute a hash based on the "Patient ID" field. In this example the final IRI will be:

<https://w3id.org/BRAINTEASER/ontology/resource/43656211465908772746389440564526451541>

Once we have an identifier for the resource, we can start adding triples to the RDF graph, for collecting all the non-empty information.

Every time we add an instance of a patient we register its clinical trial participation, linked to an instance of a clinical trial (that it's common for all patients involved in the same clinical trial). Since we don't have an id for the clinical trial participation, we compute a UUID and then we apply a hash algorithm. The final result is presented in Figure 14.

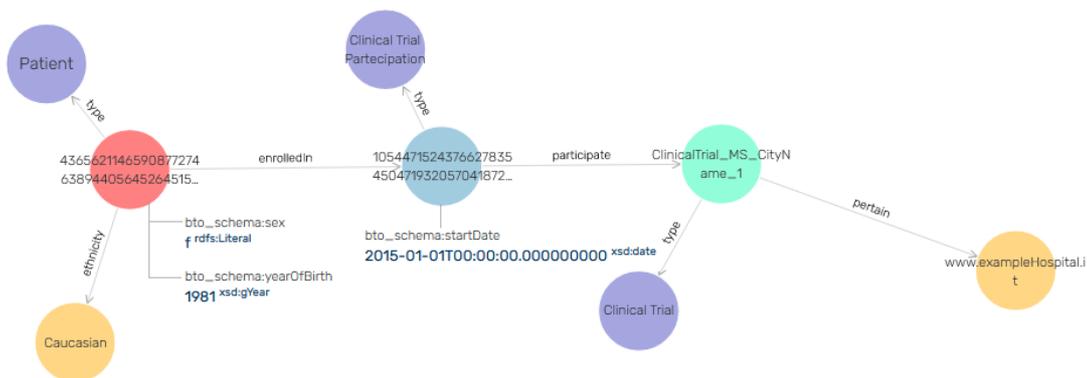


Figure 14. RDF graph relative to the patient's personal data and its participation into the clinical trial.

The last phase regards serialization. In this process, we convert the RDF graph obtained, presented in a complex data structure, into a textual representation for storage, transfer and distribution purposes on physical devices. For what about our example, if we serialize in *turtle* format the final result would be the following:

```
@prefix bto_resource: <https://w3id.org/BRAINTEASER/ontology/resource/> .
@prefix bto_schema: <https://w3id.org/BRAINTEASER/ontology/schema/> .
@prefix bto_ni: <https://w3id.org/BRAINTEASER/ontology/named-individual/> .
@prefix po: <http://purl.obolibrary.org/obo/> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
@prefix xsd: <http://www.w3.org/2001/XMLSchema#> .
bto_resource:43656211465908772746389440564526451541 a po:NCIT_C16960 ;
    bto_schema:enrolledIn bto_resource:105447152437662783545047193205704187210 ;
    bto_schema:ethnicity bto_ni:Caucasian ;
```

```

    bto_schema:sex "f"^^rdfs:Literal ;

    bto_schema:yearOfBirth "1981"^^xsd:gYear .

bto_resource:105447152437662783545047193205704187210 a bto_schema:Clinical_Trial_Partecipation ;

    bto_schema:participate bto_ni:ClinicalTrial_MS_CityName_1 ;

    bto_schema:startDate "2015-01-01T00:00:00.000000000"^^xsd:date .
  
```

Where `po:NCIT_C16960` is the class Patient imported from NCIT, and in the ontology, we state that the entity `bto_ni:ClinicalTrial_MS_Pavia_1` has type `po:NCIT_C71104` (clinical trial), and it's related (towards the object property `bto_schema:pertain`) to a hospital. We use the hospital's site URL to identify a hospital in our graph.

```

bto_ni:ClinicalTrial_MS_CityName_1 a po:NCIT_C71104 ;

    bto_schema:pertain <https://www.exampleHospital.it/> .
  
```

Once we have introduced the patient in our RDF graph we are interested in storing different clinical information about him. The entity of those information depends on the type of clinical trial in which the patient is involved: it could be about multiple sclerosis or amyotrophic lateral sclerosis.

In the following sections we are going to introduce the *MS data mappers* and the *ALS data mappers*, we will discuss the information that we are going to store in our graph, and we will present some examples of the mapping process.

5.1 MS Data Mappers

Information, that mappers for MS have to deal with, regard the following areas:

- *Onset and Diagnosis;*
- *Visits;*
- *Relapses;*
- *Clinical events (Comorbidity and Traumas);*
- *DMT and Pharmacological treatments;*
- *Pregnancies;*
- *Comorbidities;*
- *Family medical history*
- *Hematology test;*
- *CSF test;*
- *RMI;*
- *Evoked potentials.*

For each of them we have a dedicated module that takes the input (usually in xlsx or csv format), computes some kind of cleaning of the data (e. g. verify the consistency of dates, discard empty values, ...), build up all the RDF triples needed to store and then add them into the graph.

Since each module is dedicated to mapping a single area we build up a pipeline that invokes sequentially each of them, and step by step updates the RDF graph. This approach permits to keep separate subprocesses and gives the possibility to better understand each task. Moreover, it permits us to put our hands on a single module in the future, for improving the code or fixing any kind of problems, in an easy way and with the assurance of not affecting the rest of the code.

At the end of the pipeline, we compute the serialization, in several formats already discussed, and we obtain a serialized RDF file.

5.1.1 **Input: Pavia**

Pavia (Mondino) provides the dataset as an excel file, in xlsx format. This document is composed of several sheets: each of them refers to a particular medical area that we want to model in our database as discussed in previous sections. Follows the list of all non-empty sheets provided:

- Anagrafica
- Esordio e diagnosi
- Visite
- Riacutizzazioni
- Eventi clinici
- Trattamenti
- Gravidanze
- Gravidanze (Complicanze)
- Gravidanze (Anomalie)
- Co-Morbilità
- Anamnesi Patologica Familiare
- Ematochimici di routine
- Altri esami specifici
- Ematochimici specifici
- Liquor
- RMN
- Potenziali Evocati
- EEG
- ECG
- Controllo Pressione

Each table has a reference to the *patient id*, so it's always possible to link an event to him. Moreover, each table has its own id field, so we decided to use it during the IRI generation instead of hash a uuid randomly generated: in this way we can always identify that resource in our graph by re-computing the hash.

Since the file is composed of many sheets, and some of them are very high populated, reading directly from the excel file, with *pandas.read_excel*, was not a good solution in terms of times and performance we decided to first convert each sheet in a separated csv file (Figure 15) and then to read one of it at the time with *pandas.read_csv* (Figure 16).

```

# input and output path
path = str(Path(os.path.abspath(os.getcwd())).parent.parent.absolute())
savePath = path + '\data\input\pavia\'
paviaDataPath = path + '\data\input\MNDN_PV-retrospective-data.xlsx'
# read the input
xls = pd.ExcelFile(paviaDataPath)
# for each sheet convert it
for sheet in xls.sheet_names:
    sh = pd.read_excel(paviaDataPath, sheet_name=sheet)
    sh.to_csv(savePath+sheet+".csv")

```

Figure 15. Script for converting the excel file into a set of csv files (one for each sheet). Imports are omitted.

```

# start the visits mapper
# read the input
visits_pavia = pd.read_csv(paviaDataPathBase+"Visite.csv",
                          index_col="Id", parse_dates=["Data visita"])

```

Figure 16. Reading the input from csv file, this function allows to parse some fields of the table as dates and to compute other useful operations on data during the reading.

Once we have the data frame for starting the mapping we need to do some operations in order to clean up the data, check their consistency and check before reading if there are missing values. In Figure 17 you can see that given a pandas data frame (that's the object returned by `pd.read_csv`, which contains all the data present in the table) we can iterate over each row of the table and access each element using the column name as index. With `pd.isna()` we check that the element is not empty or null. Moreover, since for edss (cerebellar) the range is between 0 and 5 we check that data are not corrupted, if not we can add the triple to the graph using the function `add()` from `rdflib`.

```

def visitsMapper(visits, g, BTO_schema, BTO_resource, BTO_ni, PO, obsProgression, patientCodes):
    for index, row in visits.iterrows():
        if not pd.isna(row["Cerebellare"]):
            value = float(row["Cerebellare"])
            if value >= 0 and value <= 5:
                g.add((edssId, BTO_schema["cerebellar"], Literal(value, datatype=XSD.float)))

```

Figure 17. An example of how we iterate over data, and how we check the values of data.

5.1.2 Input: Madrid

Madrid (Sermas) provided an excel file for retrospective data too. In this case, all the information is compressed in a single sheet, where for each patient we have all the retrospective information recorded on several columns.

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Since up to now this table is not very huge in terms of memory size and we just read it once for the whole execution of the program, we decided to directly read the content of the file from the excel file. This choice didn't affect the general performance, but for future works we will proceed as we did for Pavia's dataset.

Pavia and Madrid stored their information according to different schemas. This implies that we had to set up ad hoc solutions to uniformize all the knowledge. An example could be the following: Pavia registers with a boolean value if a patient observed for the first time the disease (MS) in pediatric age, instead Madrid provides just the date of the first symptom and the date of birth. What we have to do in this case to uniformize those two different notations and map the information to our graph, based on the ontology schema, is shown in Figure 18. As always, we get the input data, we check that it's not null using pandas.

```
# MS in pediatric age
if not pd.isna(row["date_first_symptom"]) and not (pd.isna(row["dob"])):
    onsetAgeDays = row["date_first_symptom"]-row["dob"]
    # 1 year == 365.25 days
    # 18 years == 6574.5 days
    # if onsetAgeDays < 6575 days then MSinPaediatricAge
    if onsetAgeDays < pd.Timedelta(6574.5, "days"):
        g.add((patient, BTO_schema["MSInPaediatricAge"], Literal("True", datatype=XSD.boolean)))
    elif onsetAgeDays >= pd.Timedelta(6574.5, "days"):
        g.add((patient, BTO_schema["MSInPaediatricAge"], Literal("False", datatype=XSD.boolean)))
```

Figure 18. An example of how we get the input and we process it before the actual insertion of the triple into the graph.

5.1.3 Output

Let's observe a brief example, as we have already done with the patient's personal data. Let's assume that we have read and cleaned the data as described in previous sections. Supposed to start from the example seen in the introduction, now we want to add new information to the graph. Let's consider the following tables and see the final result after the mapping phase.

Table 4. Information about onset and diagnosis of MS per patient.

Patient onset and diagnosis						
Id	Patient ID	MS onset date	Brainstem Symptom	Eye Symptom	...	Data diagnosis
11222	123456	2013-06-15	Yes	No	...	2013-07-15

Table 5. In this table are present information regarding the patient's relapses.

Relapses								
Id	Patient ID	Relapse start date	Duration	sphincter	brainstem	impact on ADL	...	Cortisone treatment
353	123456	2016-01-15	45	Yes	No	Yes	...	Yes

In this case the mappers for onset-diagnosis will read and work on the first table, while the mappers for relapses will read and work on the second one. At the end, the whole graph will be serialized and we will obtain the following result:

```

bto_resource:43656211465908772746389440564526451541 a po:NCIT_C16960 ;

  bto_schema:enrolledIn bto_resource:105447152437662783545047193205704187210 ;

  bto_schema:ethnicity bto_ni:Caucasian ;

  bto_schema:sex "f"^^rdfs:Literal ;

  bto_schema:yearOfBirth "1981"^^xsd:gYear ;

  bto_schema:undergo bto_resource:159797724900171375544148818486363204607,

    bto_resource:208770789890135987113826355467922944057,

    bto_resource:257993460123931817679681788238827909432 .

bto_resource:159797724900171375544148818486363204607 a po:NCIT_C25279 ;

  bto_schema:hasSymptom bto_ni:Brainstem_Symptom ;

  bto_schema:startDate "2013-06-15T00:00:00"^^xsd:date .

bto_resource:208770789890135987113826355467922944057 a po:NCIT_C74589 ;

  bto_schema:hasRelapse bto_resource:236384851988027814653410756338243797684 ;

  bto_schema:startDate "2016-01-15T00:00:00"^^xsd:date .

bto_resource:236384851988027814653410756338243797684 a po:NCIT_C38155 ;

  bto_schema:associatedSubstance bto_ni:cortisone_treatment ;

  bto_schema:impactOnADL true ;

  bto_schema:relapseLength 45 ;

  bto_schema:sphincter_relapse true .

bto_resource:257993460123931817679681788238827909432 a po:NCIT_C15220 ;

  bto_schema:startDate "2013-07-15T00:00:00"^^xsd:date .

```

Where “po:NCIT_C25279” is the class onset, “po:NCIT_C74589” is the class protocol event, “po:NCIT_C38155” is the class relapse and “NCIT_C15220” is the class diagnosis. All of them are imported from NCIT.

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- *ALSFRS sheet;*
- *Pulmonary function test sheet;*
- *OWD vars sheet that includes:*
 - *Blood test data (only for IMM and SERMAS);*
 - *Smoking behavior data (only for IMM);*
 - *Trauma and surgery (only for IMM).*

For each excel sheet, there is a module that takes care of reading the input data, pre-processing them, and creating the RDF triples to be added to the graph. At the end, serialization is performed and the file containing the RDF dataset is returned as output.

5.2.1 Input

All xlsx input files are read using the `read_excel` function of the pandas library.

In particular, this function converts each excel sheet contained in the input file into a DataFrame object, which is a tabular like structure. It is also important to mention the use of `parse_dates` within the `read_excel` function, which allows an integer value to be parsed as a DateTime (e.g. “Birth_year” in Figure 20).

```
# load the static vars tab in memory
staticVars = pd.read_excel(datasetUrl, sheet_name="Static vars", index_col="PARALS_CODALS", parse_dates=["Birth_year"])
staticVars.info()
```

Figure 20. Use of the `read_excel` function on the “Static vars” sheet of Turin.

Each DataFrame contains the id of the patient, and in some cases, the id of certain events, which are used to generate IRIs. When the event ids are not present, a randomly generated UUID is used to identify them (use of `uuid` library). As mentioned above, a hash function is computed on all ids and UUIDs using the `mmh3` library.

All patient information is read from the DataFrame row by row, through the use of the `iterrows()` function, and for each cell in the row, some pre-processing operations are subsequently carried out.

Pre-processing operations are concerned with ensuring that each piece of data is consistent with its domain, in particular checking that a cell is not empty using the `isna()` function of the pandas library, verifying the value of sums (e.g. for ALSFRS), looking for correspondence between input strings and labels/codes (e.g. search the occupation among the ESCO classification labels/codes, Figure 22 and Figure 23), and converting values to a particular unit of measurement (as in the case of blood test variables).

Another important pre-processing operation concerns all those excel sheets that have a single row per patient and a set of duplicate columns for each test performed (this is the case of IMM in the sheets related to ALSFRS and spirometry tests). In the latter case, a dedicated module takes care of reading in input the excel sheet and creating a new CSV file (using the `csv` python module), where for each patient the single row is broken into multiple rows (see example in Figure 21, Table 6, and Table 7). After this operation, the new CSV file is read with the `read_csv()` function.

```

# Pre-processing operation for FVC data
with open(savePath + 'lisbon-fvc.csv', 'w') as file:
    writer = csv.writer(file)
    #Column labels
    writer.writerow(['REF', 'Date', '%FVC'])
    #Get column labels from excel file
    columnsName = fvc.columns.values
    columnsNumber = len(columnsName)

    fvcArray = []

    for index, row in fvc.iterrows():
        i = 0
        while i < columnsNumber:
            #Insert Patient ID
            tempArray = [index]
            #Check if empty
            check = False
            if not(pd.isna(row[columnsName[i+1]])):
                check = check or True

            if(check == False):
                break
            else:
                for x in range (i, i+2):
                    tempArray.append(row[columnsName[x]])
                fvcArray.append(tempArray)
                i += 2

    #Write into csv file
    for fvcTest in fvcArray:
        writer.writerow([fvcTest[0], fvcTest[1], fvcTest[2]])

    print('--- csv completed ---')

```

Figure 21. A snippet of code for pre-processing of pulmonary function test data.

Table 6. The source data about pulmonary function test.

REF	DATE1	%FVC1	DATE2	%FVC2	DATE3	%FVC3
012345	13/10/2001	95,62	05/01/2002	81,95		
123456	12/05/2003	97,65	21/07/2003	95,39	20/10/2003	88,55

Table 7. The csv data about pulmonary function test after pre-processing.

REF	DATE	%FVC
012345	13/10/2001	95,62
012345	05/01/2002	81,95
123456	12/05/2003	97,65
123456	21/07/2003	95,39
123456	20/10/2003	88,55

All of these pre-processing steps are essential to avoid the mapping of incorrect data.

After that, each module is responsible for updating the graph with the RDF triples related to the data contained in its sheet using the `add()` function of RDFLib library (Figure 23).

code	label	uri
1	Commissioned armed forces officers	https://w3id.org/brainteaser/ontology/named-individual/Commissioned_armed_forces_officers
2	Non-commissioned armed forces officers	https://w3id.org/brainteaser/ontology/named-individual/Non-commissioned_armed_forces_officers
3	Armed forces occupations, other ranks	https://w3id.org/brainteaser/ontology/named-individual/Armed_forces_occupations_other_ranks
11	Chief executives, senior officials and legislators	https://w3id.org/brainteaser/ontology/named-individual/Chief_executives_senior_officials_and_legislators
12	Administrative and commercial managers	https://w3id.org/brainteaser/ontology/named-individual/Administrative_and_commercial_managers
13	Production and specialised services managers	https://w3id.org/brainteaser/ontology/named-individual/Production_and_specialised_services_managers
14	Hospitality, retail and other services managers	https://w3id.org/brainteaser/ontology/named-individual/Hospitality_retail_and_other_services_managers
21	Science and engineering professionals	https://w3id.org/brainteaser/ontology/named-individual/Science_and_engineering_professionals
22	Health professionals	https://w3id.org/brainteaser/ontology/named-individual/Health_professionals
23	Teaching professionals	https://w3id.org/brainteaser/ontology/named-individual/Teaching_professionals
24	Business and administration professionals	https://w3id.org/brainteaser/ontology/named-individual/Business_and_administration_professionals
25	Information and communications technology professionals	https://w3id.org/brainteaser/ontology/named-individual/Information_and_communications_technology_professionals
26	Legal, social and cultural professionals	https://w3id.org/brainteaser/ontology/named-individual/Legal_social_and_cultural_professionals

Figure 22. A part of the csv file concerning ESCO classification codes and labels.

```
#load esco classification codes and labels
esco = pd.read_csv(escoURL, sep=',', index_col='code')

#add occupation to patient
if not (pd.isna(row['Main occupation'])):
    if((esco.index == row['Main occupation']).any() == True):
        occupation = str(esco.loc[esco.index == row['Main occupation']].uri.values[0])
        g.add((patient, BTOschema['hasOccupation'], URIRef(occupation)))
```

Figure 23. A snippet of code responsible for creating RDF triples for patient occupation.

5.2.2 Output

Once the graph is completed, data serialization is finally performed obtaining the RDF dataset as output. The following is an example where a portion of ALS data is added to the patient's personal data.

Table 8. A snippet of data about the static vars sheet.

Static vars							
REF	Age onset	Date Of 1 st Symptoms	Onset	Limb ULvsLL	Blood hypertension	SOD1 Mutation	...
123456	54,8	10/03/2010	1	1	Yes	Yes	...

Table 9. A snippet of data about the ALSFRS sheet.

ALSFRS					
REF	Date	ALS-FRS-R	ALS-FRSb	R	...
123456	05/04/2010	35	10	12	...

Table 10. A snippet of data about the pulmonary function test sheet.

Pulmonary Function Test			
REF	Date	%FVC	...
123456	07/04/2010	83,55	...

In Table 8, the cell "Onset" = 1 and "Onset UL vs as LL" = 1 means the onset is located in the upper limb. So, this is the result after serialization:

```

bto_resource:43656211465908222746389440564526451541 a po:NCIT_C16960 ;
  bto_schema:enrolledIn bto_resource:105441232437662783545047193205704187210 ;
  bto_schema:ethnicity bto_ni:Caucasian ;
  bto_schema:sex "m"^^rdfs:Literal ;
  bto_schema:yearOfBirth "1956"^^xsd:gYear ;
  bto_schema:hasDisease bto_ni:Hypertension ;
  bto_schema:hasGene bto_ni:SOD1 ;
  bto_schema:undergo bto_resource:100250032260027629766819832602045775650 ,
    bto_resource:110393828140358462411202500110832554642 ,
    bto_resource:257993460123931817679681788212327909432 .
bto_resource:100250032260027629766819832602045775650 a po:NCIT_C25279 ;
  bto_schema:age_onset "54.8"^^xsd:float ;
  bto_schema:limbs true ;
  bto_schema:site bto_ni:upper-limb ;
  bto_schema:startDate "2010-03-10T00:00:00"^^xsd:date .
bto_resource:110393828140358462411202500110832554642 a po:NCIT_C25499 ;
  bto_schema:consists bto_resource:147047295166563760799544983811520453911;
  bto_schema:startDate "2010-04-05T00:00:00"^^xsd:date
bto_resource:147047295166563760799544983811520453911 a bto_schema:ALSFRS-R ;
  bto_schema:alsfrs-r-tot 35 ;
  bto_schema:alsfrsb 10 ;
  bto_schema:alsfrs-r-R 12 .
bto_resource:257993460123931817679681788212327909432 a po:NCIT_C25499 ;
  bto_schema:consists bto_resource:147047295166563712339544983811520453911;

```

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```

bto_schema:startDate "2010-04-07T00:00:00"^^xsd:date .

bto_resource:147047295166563712339544983811520453911 a po:NCIT_C38081 ;

bto_schema:FVCrelative "83.55"^^xsd:float .

```

According to the ontology, `po:NCIT_C25279` corresponds to the class "Onset", `po:C25499` refers to the class "Event", while `po:NCIT_C38081` relates to the class "Pulmonary Function Test". It is important to note that the instance of class "ALSFRS-R" is connected to an instance of class "Event" via the object property `bto_schema:consists`, and in turn the patient is connected to that event via the object property `bto_schema:undergo`. The same applies to instances of the class "Pulmonary Function Test".

In this example, it can be seen that the onset data has been mapped using the data properties `bto_schema:age_onset`, `bto_schema:limbs`, `bto_schema:startDate`, and the object property `bto_schema:site` linked to the "upper-limb" named individual.

While for the instances of ALSFRS and Pulmonary Function Test, the data properties `bto_schema:alsfrs-r-tot`, `bto_schema:alsfrsb`, `bto_schema:alsfrs-r-R`, and `bto_schema:FVCrelative` were used, respectively.

In conclusion, Figure 24 shows the graphic representation of the final graph.

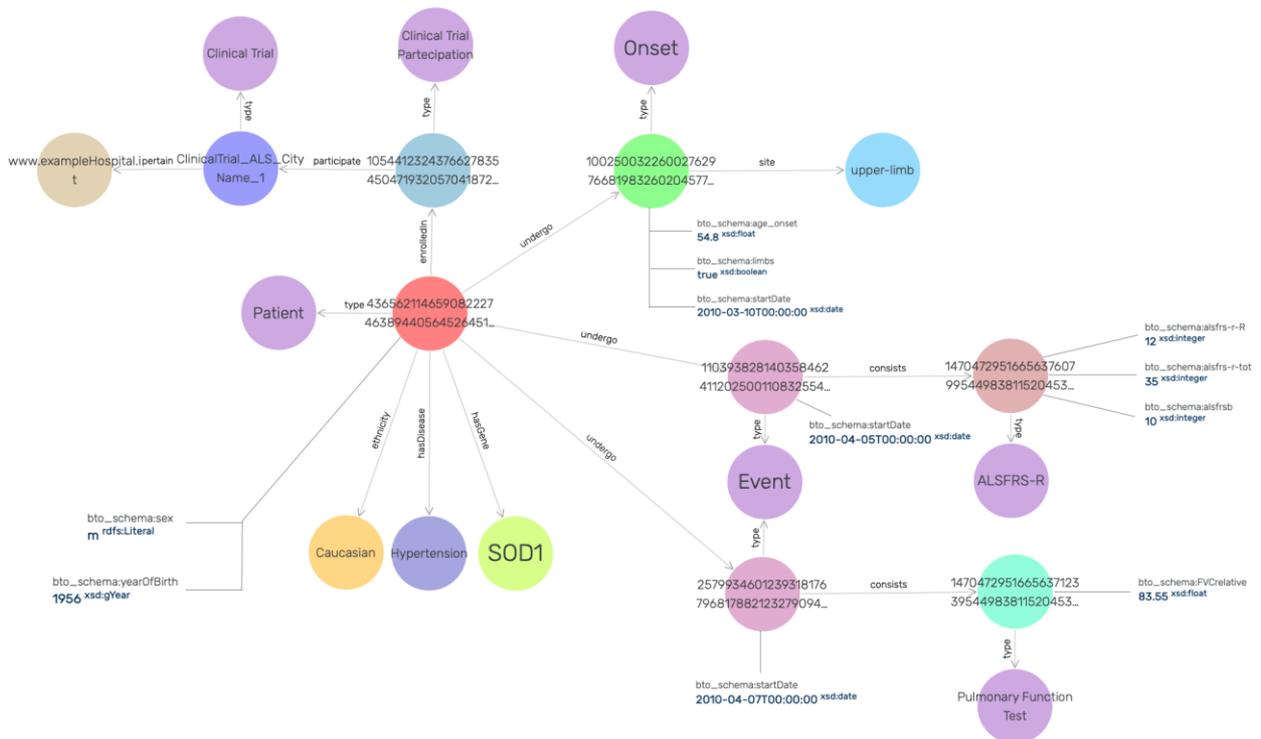


Figure 24. The final graph for the example of ALS data.

6. CONCLUSIONS AND FUTURE WORK

The goal of this deliverable is to document the design and development of the first version of the Brainteaser Ontology (BO) focused, in particular, on retrospective data for Amyotrophic Lateral Sclerosis (ALS) and Multiple Sclerosis (MS).

This rolling deliverable includes the results of task 9.1 (FAIR data modelling and terminology building) and 9.2 (Linked (open) data mapping and sharing) and it will be regularly updated. In particular, we will update i) the ontology based on the continuous review of the analysis of the requirements of the use cases; as well as ii) the graphical and textual description of the ontology together with the OWL file encoding the ontology.

The BO ontology has been co-designed in a strict collaboration with the medical partners and domain experts. We used this approach in order to embed the knowledge of the experts in the BO and, at the same time, to validate all the design choices. To this end, we operated in an iterative way, producing several intermediate versions of the ontology, and discussing them with our domain experts.

The BO ontology will serve multiple purposes:

- to provide a unified and comprehensive conceptual view about ALS and MS, which are typically dealt with separately, allowing us to coherently integrate the data coming from the different medical partners in the project;
- to seamlessly represent both retrospective data and prospective data, produced during the lifetime of BRAINTEASER;
- to allow for sharing and re-using the BRAINTEASER datasets according to Open Science and FAIR principles.

The main following data sources that the BO ontology models are:

- "Raw" anonymized data (retrospective and prospective data),
- Generated data (AI models and results),
- Evaluation challenges data (evaluation corpora, AI models outputs, performance scores).

By design, the BO will also allow us to link these data sources with other resources available in the Linked Open Data Cloud.

We have anticipated in this deliverable the requirements analysis for a data mapper in order to have it ready for the open evaluation challenges (which will be anticipated as well). A first prototype of the data mapper has been implemented as part of the software architecture dedicated to mapping the clinical data provided to us by the hospitals into a structured RDF graph compliant with the BO ontology. Since data comes from different sources, each one using its own notation and standards for managing knowledge, different mappers are needed to deal with this variability in order to uniform all the knowledge provided by the partners and structure it according to a graph-based model. For these reasons, a pluggable architecture for mappers will be designed to digest the information coming from different sources and collect it in a single RDF graph.

As future work, we will enrich the ontology with multilingual linguistic information. On one hand, we will use an onto-terminology approach [ROC12] to map the linguistic

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knowledge extracted semi-automatically from text to the ontologies derived from domain experts. The aim is to jointly model the different definitions for a term in the medical text (that derives from the natural language explanation) and for a concept in the ontology (as a formal definition as a combination of characteristics). On the other hand, we will use a "FAIR Terminology" approach [VEZ20] which aims at providing a paradigm for the optimal organization of terminological data compliant with the FAIR principles, in particular for the medical special languages used in ALS and MS.

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APPENDIX A: DOCUMENTATION OF THE BRAINTEASER ONTOLOGY

A.1 Classes

abdominal fascia

IRI: http://purl.obolibrary.org/obo/UBERON_0013493

Abdominal fascia refers to the various types of fascia found in the abdominal region.

Abdominal Pain

IRI: http://purl.obolibrary.org/obo/NCIT_C26682

Painful sensation in the abdominal region. [Definition Source: NCI]

Acute Myocardial Infarction

IRI: http://purl.obolibrary.org/obo/NCIT_C35204

Necrosis of the myocardium, as a result of interruption of the blood supply to the area. It is characterized by a severe and rapid onset of symptoms that may include chest pain, often radiating to the left arm and left side of the neck, dyspnea, sweating, and palpitations. [Definition Source: NCI]

Adenocarcinoma

IRI: http://purl.obolibrary.org/obo/NCIT_C2852

A common cancer characterized by the presence of malignant glandular cells. Morphologically, adenocarcinomas are classified according to the growth pattern (e.g., papillary, alveolar) or according to the secreting product (e.g., mucinous, serous). Representative examples of adenocarcinoma are ductal and lobular breast carcinoma, lung adenocarcinoma, renal cell carcinoma, hepatocellular carcinoma (hepatoma), colon adenocarcinoma, and prostate adenocarcinoma. [Definition Source: NCI]

Administration

IRI: http://purl.obolibrary.org/obo/NCIT_C25409

The act of the dispensing, applying, or tendering of something to another, such as administration of a medicine. [Definition Source: NCI]

Administrative and commercial managers

IRI: <http://data.europa.eu/esco/isco/C12>

Administrative and commercial managers plan, organize, direct, control and coordinate the financial, administrative, human resource, policy, planning, research and development, advertising, public relations, and sales and marketing activities of enterprises and organizations, or of enterprises that provide such services to other enterprises and organizations. Competent performance in most occupations in this sub-major group requires skills at the fourth ISCO skill level Tasks performed by workers in

this sub-major group usually include: formulating and administering policy advice and strategic and financial planning; establishing and directing operational and administrative procedures; implementing, monitoring and evaluating strategies and policies; providing advice to senior managers; directing the development of initiatives for new products, marketing, public relations and advertising campaigns; determining and directing sales activities, product mix and customer service standards; setting prices and credit arrangements; ensuring compliance with relevant legislation, regulations and standards; controlling selection, training and performance of staff; preparing budgets and overseeing financial operations; consulting with the chief executive and with managers of other departments or sections; controlling expenditure and ensuring the efficient use of resources; representing the enterprise or organization in negotiations, and at conventions, seminars, public hearings and forums. Occupations in this sub-major group are classified into the following minor groups: 121 Business Services and Administration Managers 122 Sales, Marketing and Development Managers Notes Specialized qualifications and extensive experience relevant to one or more occupations classified in Major Group 2: Professionals, or Major Group 3: Technicians and Associate Professionals, are usually required. Regional managers and other senior managers who coordinate and supervise the activities of subordinate managers who have a diverse range of functional responsibilities are included in Unit Group 1120: Managing Directors and Chief Executives.

agent

IRI: <http://purl.org/dc/terms/Agent>

Agent

IRI: <http://xmlns.com/foaf/0.1/Agent>

An agent (eg. person, group, software or physical artifact).

Agricultural, forestry and fishery labourers

IRI: <http://data.europa.eu/esco/isco/C92>

Agricultural, forestry and fishery labourers perform simple and routine tasks in the production of crops and livestock, cultivation and maintenance of gardens and parks, exploitation and conservation of forests, and conduct of aquaculture and fisheries operations. Most occupations in this sub-major group require skills at the first ISCO skill level. Tasks performed by workers in this sub-major group usually include: digging, raking and shovelling using hand tools; loading, unloading and stacking supplies, produce and other materials; watering, thinning, weeding and tending crops by hand or using hand tools; planting, harvesting, picking and collecting produce by hand; feeding, watering and cleaning animals and keeping their quarters clean; monitoring livestock and reporting on their condition; preparing and operating nets, lines and other fishing tackle and deck equipment; grading, sorting, bunching and packing produce into containers; performing minor repairs on fixtures, buildings, equipment, vessels and fences. Occupations in this sub-major group are classified into the following minor group: 921 Agricultural, Forestry and Fishery Labourers

ALSFERS

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/ALSFERS>

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Amyotrophic Lateral Sclerosis Functional Rating Scale.

ALSFRS-R

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/ALSFRS-R>

Revised Amyotrophic Lateral Sclerosis Functional Rating Scale.

amyotrophic lateral sclerosis

IRI: http://purl.obolibrary.org/obo/MONDO_0004976

Amyotrophic lateral sclerosis (ALS) is a neurodegenerative disease characterized by progressive muscular paralysis reflecting degeneration of motor neurons in the primary motor cortex, corticospinal tracts, brainstem and spinal cord. [Orphanet:803]

anatomical structure

IRI: http://purl.obolibrary.org/obo/UBERON_0000061

Material anatomical entity that is a single connected structure with inherent 3D shape generated by coordinated expression of the organism's own genome.

Anemia

IRI: http://purl.obolibrary.org/obo/NCIT_C2869

A reduction in the number of red blood cells, the amount of hemoglobin, and/or the volume of packed red blood cells. Clinically, anemia represents a reduction in the oxygen-transporting capacity of a designated volume of blood, resulting from an imbalance between blood loss (through hemorrhage or hemolysis) and blood production. Signs and symptoms of anemia may include pallor of the skin and mucous membranes, shortness of breath, palpitations of the heart, soft systolic murmurs, lethargy, and fatigability. [Definition Source: NCI]

Ann Arbor Stage IV T-Cell Non-Hodgkin Lymphoma

IRI: http://purl.obolibrary.org/obo/NCIT_C8668

Ann Arbor Classification: Stage IV: Diffuse or disseminated involvement of one or more extralymphatic organs, with or without associated lymph node involvement; or isolated extralymphatic organ involvement in the absence of adjacent regional lymph node involvement, but in conjunction with disease in distant site(s); or any involvement of the liver or bone marrow, lungs (other than by direct extension from another site), or cerebrospinal fluid. [Definition Source: NCI]

Anxiety Disorder

IRI: http://purl.obolibrary.org/obo/NCIT_C2878

A category of psychiatric disorders which are characterized by anxious feelings or fear often accompanied by physical symptoms associated with anxiety. [Definition Source: NCI]

Armed forces occupations, other ranks

IRI: <http://data.europa.eu/esco/isco/C03>

Armed forces occupations, other ranks include all conscripted and non-conscripted members of the armed forces except commissioned and non-commissioned officers. They perform specific military tasks and/or perform similar tasks to those performed in a variety of civilian occupations outside the armed forces. Most occupations in this sub-major group require skills at the first ISCO skill level. Occupations in this sub-major group are classified into the following minor group: 031 Armed Forces Occupations, Other Ranks Excluded from this group are: - jobs held by persons in civilian employment of government establishments concerned with defence issues; - police (other than military police); - customs inspectors and members of border or other armed civilian services.

Asian - ethnic group

IRI: <http://purl.bioontology.org/ontology/SNOMEDCT/315280000>

A person having origins in any of the original peoples of the Far East, Southeast Asia, or the Indian subcontinent, including for example, Cambodia, China, India, Japan, Korea, Malaysia, Pakistan, the Philippine Islands, Thailand, and Vietnam. (OMB) [Definition Source: NCI]

Aspiration Pneumonitis

IRI: http://purl.obolibrary.org/obo/NCIT_C34932

Inflammation of the lungs due to the inhalation of solid or liquid material. [Definition Source: NCI]

Assemblers

IRI: <http://data.europa.eu/esco/isco/C82>

Assemblers assemble prefabricated parts or components to form subassemblies, products and equipment, according to procedures strictly laid down. The products worked on may be moved from one worker to the next along assembly lines. Competent performance in most occupations in this sub-major group requires skills at the second ISCO skill level. Tasks performed by workers in this sub-major group usually include: assembling components into various types of product and equipment, according to strictly laid down procedures; reviewing work orders, specifications, diagrams and drawings to determine materials needed and assembly instructions; recording production and operational data on specified forms; inspecting and testing completed components and assemblies, wiring installations and circuits; rejecting faulty assemblies and components. Occupations in this sub-major group are classified into the following minor group: 821 Assemblers

Atrial Fibrillation

IRI: http://purl.obolibrary.org/obo/NCIT_C50466

A disorder characterized by an electrocardiographic finding of a supraventricular arrhythmia characterized by the replacement of consistent P waves by rapid oscillations or fibrillatory waves that vary in size, shape and timing and are accompanied by an irregular ventricular response. (CDISC) [Definition Source: NCI]

Atrial Flutter

IRI: http://purl.obolibrary.org/obo/NCIT_C51224

A disorder characterized by an electrocardiographic finding of an organized, regular atrial rhythm with atrial rate of 240-340 beats per minute. Multiple P waves typically appear in the inferior leads in a saw tooth-like pattern between the QRS complexes. (CDISC) [Definition Source: NCI]

Aunt

IRI: http://purl.obolibrary.org/obo/NCIT_C71405

The sister of your father or mother; the wife of your uncle. [Definition Source: NCI]

Autoimmune Disease

IRI: http://purl.obolibrary.org/obo/NCIT_C2889

A disorder resulting from loss of function or tissue destruction of an organ or multiple organs, arising from humoral or cellular immune responses of the individual to his own tissue constituents. It may be systemic (e.g., systemic lupus erythematosus), or organ specific, (e.g., thyroiditis). [Definition Source: NCI]

Baker Cyst

IRI: http://purl.obolibrary.org/obo/NCIT_C34935

Swelling and protrusion of the gastrocnemius-semimembranosus bursa due to an accumulation of synovial fluid. [Definition Source: NCI]

Basal Cell Carcinoma

IRI: http://purl.obolibrary.org/obo/NCIT_C156767

A carcinoma involving the basal cells. [Definition Source: NCI]

Before Onset

IRI: https://w3id.org/BRAINTEASER/ontology/schema/Before_Onset

The events occurring before onset.

Black African

IRI: <http://purl.bioontology.org/ontology/SNOMEDCT/18167009>

Denotes a person with ancestral origins are in any of the countries of Africa. [Definition Source: NCI]

Blepharitis

IRI: http://purl.obolibrary.org/obo/NCIT_C112183

Inflammation of the eyelids near the eyelashes. [Definition Source: NCI][attribution: NICHHD]

Blepharospasm

IRI: http://purl.obolibrary.org/obo/NCIT_C118723

Involuntary twitching of the eyelid. [Definition Source: NCI]

bone spine

IRI: http://purl.obolibrary.org/obo/UBERON_0013706

Semantic Types: Body Location or Region

Bowel Obstruction

IRI: http://purl.obolibrary.org/obo/NCIT_C9175

Blockage of the normal flow of the intestinal contents within the bowel. [Definition Source: NCI]

Brain Stem

IRI: http://purl.obolibrary.org/obo/NCIT_C12441

Three sections, the midbrain, pons and medulla oblongata, that are located at the base of the brain. The brain stem regulates the central nervous system, and is vital as a conduit for motor and sensory innervations. [Definition Source: NCI]

Brainstem Symptom

IRI: https://w3id.org/BRAINTEASER/ontology/schema/Brainstem_Symptom

Brother

IRI: http://purl.obolibrary.org/obo/NCIT_C25289

A male sibling. [Definition Source: NCI]

Brown-Sequard Syndrome

IRI: http://purl.obolibrary.org/obo/NCIT_C84601

A disorder caused by a spinal injury leading to an incomplete spinal lesion. Patients develop paralysis, ataxia and loss of sensation. Causes include spinal cord tumors, spinal traumas, ischemia, and inflammatory processes affecting the spine. [Definition Source: NCI]

Building and related trades workers, excluding electricians

IRI: <http://data.europa.eu/esco/isco/C71>

Building and related trades workers construct, maintain and repair buildings; erect and repair foundations, walls and structures of brick, stone and similar materials; shape and finish stone for building and other purposes. Competent performance in most occupations in this sub-major group requires skills at the second ISCO skill level. The work is carried out by hand and by hand-powered and other tools which are used to reduce the amount of physical effort and time required for specific tasks, as well as to improve the quality of the products. The tasks call for an understanding of the work organization, the materials and tools used, and the nature and purpose of the final product. Tasks performed by workers in this sub-major group usually include: constructing, maintaining and repairing buildings and other structures, using traditional and/or modern building techniques; constructing and repairing foundations, walls and structures of brick, stone and similar materials; breaking quarried stone into slabs or blocks; cutting, shaping and finishing stone for building, ornamental, monumental and other purposes; erecting

reinforced concrete frameworks and structures as well as finishing and repairing cement surfaces; cutting, shaping, assembling and maintaining wooden structures and fittings; performing miscellaneous construction and building maintenance tasks. Supervision of other workers may be included. Occupations in this sub-major group are classified into the following minor groups: 711 Building Frame and Related Trades Workers 712 Building Finishers and Related Trades Workers 713 Painters, Building Structure Cleaners and Related Trades Workers

Business and administration associate professionals

IRI: <http://data.europa.eu/esco/isco/C33>

Business and administration associate professionals perform mostly technical tasks connected with the practical application of knowledge relating to financial accounting and transaction matters, mathematical calculations, human resource development, selling and buying financial instruments, specialized secretarial tasks, and enforcing or applying government rules. Also included are workers who provide business services such as customs clearance, conference planning, job placements, buying and selling real estate or bulk commodities, and serving as agents for performers such as athletes and artists. Competent performance in most occupations in this sub-major group requires skills at the third ISCO skill level. Tasks performed by workers in this sub-major group usually include recording and transmitting buy and sell orders for securities, stocks, bonds or other financial instruments and for foreign exchange for future or immediate delivery; submitting credit and loan applications to management with recommendations for approval or rejection; approving or rejecting applications within authorized limits ensuring that credit standards of the institution are respected; maintaining complete records of all financial transactions of an undertaking according to general bookkeeping principles, with guidance from accountants; assisting in planning and performing mathematical, statistical, actuarial, accounting and related calculations; selling and buying financial instruments. Occupations in this sub-major group are classified into the following minor groups: 331 Financial and Mathematical Associate Professionals 332 Sales and Purchasing Agents and Brokers 333 Business Services Agents 334 Administrative and Specialized Secretaries 335 Government Regulatory Associate Professionals

Business and administration professionals

IRI: <http://data.europa.eu/esco/isco/C24>

Business and administration professionals perform analytical, conceptual and practical tasks to provide services in financial matters, human resource development, public relations, marketing and sales in the technical, medical, information and communications technology areas; and conduct reviews of organizational structures, methods and systems as well as quantitative analyses of information affecting investment programmes. Competent performance in most occupations in this sub-major group requires skills at the fourth ISCO skill level. Tasks performed by workers in this sub-major group usually include: collecting, analysing and interpreting information on the financial viability, cost structures and trading effectiveness of organizations; conducting audits, preparing financial statements and controlling treasury systems for organizations; developing and reviewing financial plans and strategies, executing buy and sell orders, and negotiating the purchase and sale of commodities; developing, implementing and evaluating staff recruitment, training and development programmes; researching, developing and implementing marketing and public relations campaigns; studying and

developing methods and policies to improve and promote government and business operations and effectiveness; acquiring and updating knowledge of employers' and competitors' goods and services, and of market conditions; assessing customers' needs and explaining and demonstrating goods and services to them. Occupations in this sub-major group are classified into the following minor group: 241 Finance Professionals 242 Administration Professionals 243 Sales, Marketing and Public Relations Professionals

C9orf72

IRI: http://purl.obolibrary.org/obo/OGG_3000203228

This gene may play a role in cell death. [Definition Source: NCI]

Cardiovascular Disorder

IRI: http://purl.obolibrary.org/obo/NCIT_C2931

A non-neoplastic or neoplastic disorder affecting the heart or the vessels (arteries, veins and lymph vessels). Representative examples of non-neoplastic cardiovascular disorders are endocarditis and hypertension. Representative examples of neoplastic cardiovascular disorders are endocardial myxoma and angiosarcoma. [Definition Source: NCI]

Cardioversion

IRI: http://purl.obolibrary.org/obo/NCIT_C70911

The conversion of one cardiac rhythm or electrical pattern to another, almost always from an abnormal to a normal one, by pharmacologic means using medications or by electrical cardioversion using a defibrillator. [Definition Source: NCI]

Caucasian

IRI: <http://purl.bioontology.org/ontology/SNOMEDCT/14045001>

A person having origins in any of the original peoples of Europe, the Middle East, or North Africa. (OMB) [Definition Source: NCI]

Cervical region of vertebral column

IRI: http://purl.obolibrary.org/obo/UBERON_0006072

That portion of the spine comprising the cervical vertebrae. The neck area of the spine. [<http://medical-dictionary.thefreedictionary.com/>]

Chief executives, senior officials and legislators

IRI: <http://data.europa.eu/esco/isco/C11>

Chief executives, senior officials and legislators formulate and review the policies, and plan, direct, coordinate and evaluate the overall activities of enterprises, governments and other organizations with the support of other managers. Competent performance in most occupations in this sub-major group requires skills at the fourth ISCO skill level. Tasks performed by workers in this sub-major group usually include: presiding over or participating in the proceedings of legislative bodies, boards of directors and committees; formulating and advising on the policy budgets, laws and regulations of enterprises, governments and other organizations; establishing objectives for enterprises,

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government departments or agencies and other organizations; formulating or approving and evaluating programmes and policies and procedures for their implementation; ensuring appropriate systems and procedures are developed and implemented to provide budgetary control; authorizing material, human and financial resources to implement policies and programmes; monitoring and evaluating performance of the organization or enterprise; selecting or approving the selection of senior staff; performing ceremonial duties and representing the enterprise, government, organization or community at official occasions and in meetings, negotiations, conventions and public hearings. Occupations in this sub-major group are classified into the following minor groups: 111 Legislators and Senior Officials 112 Managing Directors and Chief Executives

Cleaners and helpers

IRI: <http://data.europa.eu/esco/isco/C91>

Cleaners and helpers perform various tasks in private households, hotels, offices, hospitals and other establishments, as well as in aircraft, trains, coaches, trams and similar vehicles, in order to keep the interiors and fixtures clean, and launder and press garments and textiles by hand. Most occupations in this sub-major group require skills at the first ISCO skill level. Tasks performed by workers in this sub-major group usually include: sweeping or vacuum cleaning; washing and polishing floors, furniture and other objects; taking care of linen and bedmaking; helping with preparation of meals and cleaning in kitchens; washing and cleaning cars and windows; pressing or laundering garments and textiles by hand. Occupations in this sub-major group are classified into the following minor groups: 911 Domestic, Hotel and Office Cleaners and Helpers 912 Vehicle, Window, Laundry and Other Hand Cleaning Workers

Clinical assessment

IRI: http://purl.obolibrary.org/obo/MAXO_0000487

A measurement performed in a clinical setting using clinician's observations and instrument data to inform patient care and research. [database_cross_reference: PMID:2647562][database cross reference: PMID:2647562][database_cross_reference: PMID:2647562][database cross reference: PMID:2647562][database_cross_reference: PMID:2647562][database cross reference: PMID:2647562]

Clinical Trial

IRI: http://purl.obolibrary.org/obo/NCIT_C71104

A research study that prospectively assigns human participants or groups of humans to one or more health-related interventions to evaluate the effects on health outcomes. [Definition Source: NCI]

Clinical Trial Participation

IRI: https://w3id.org/BRAINTEASER/ontology/schema/Clinical_Trial_Participation

The participation in a clinical trial.

Clinics and Hospitals

IRI: http://purl.obolibrary.org/obo/NCIT_C19326

Institutions with an organized medical staff for the medical care, treatment, and cure of the sick and wounded, for the study of disease, and for the training of physicians, nurses, and allied health personnel. [Definition Source: NCI]

Commissioned armed forces officers

IRI: <http://data.europa.eu/esco/isco/C01>

Commissioned armed forces officers provide leadership and management to organizational units in the armed forces and/or perform similar tasks to those performed in a variety of civilian occupations outside the armed forces. This group includes all members of the armed forces holding the rank of second lieutenant (or equivalent) or higher. Competent performance in most occupations in this sub-major group requires skills at the fourth ISCO skill level. Occupations in this sub-major group are classified into the following minor group: 011 Commissioned Armed Forces Officers Excluded from this group are: - jobs held by persons in civilian employment of government establishments concerned with defence issues; - police (other than military police); - customs inspectors and members of border or other armed civilian services.

Comorbidity

IRI: http://purl.obolibrary.org/obo/NCIT_C16457

The coexistence of two or more disease processes. [Definition Source: NCI]

Concept

IRI: <http://www.w3.org/2004/02/skos/core#Concept>

Congenital Adrenal Hyperplasia

IRI: http://purl.obolibrary.org/obo/NCIT_C34360

A genetic disorder characterized by defects in the synthesis of cortisol and/or aldosterone, resulting in hyperplasia of the adrenal cortical cells. [Definition Source: NCI]

Cortisone treatment

IRI: https://w3id.org/BRAINTEASER/ontology/schema/cortisone_treatment

This entity refers to a cortisone treatment associated to a relapse.

Creative work

IRI: <http://schema.org/CreativeWork>

Critical Episode

IRI: https://w3id.org/BRAINTEASER/ontology/schema/Critical_Episode

CSF Analysis

IRI: http://purl.obolibrary.org/obo/NCIT_C173272

A laboratory analysis of a sample of cerebrospinal fluid. [Definition Source: NCI]

Customer services clerks

IRI: <http://data.europa.eu/esco/isco/C42>

Customer services clerks deal with clients in connection with money-handling operations, travel arrangements, requests for information, making appointments, operating telephone switchboards, and interviewing for surveys or to complete applications for eligibility for services. Competent performance in most occupations in this sub-major group requires skills at the second ISCO skill level. Tasks performed by workers in this sub-major group usually include: performing money-handling operations in banks, post offices, betting and gambling establishments, or dealing with travel arrangements; supplying information requested by clients and making appointments; operating telephone switchboards; greeting and receiving visitors; interviewing survey respondents; interviewing applicants for services. Occupations in this sub-major group are classified into the following minor groups: 421 Tellers, Money Collectors and Related Clerks 422 Client Information Workers

Daughter

IRI: http://purl.obolibrary.org/obo/NCIT_C25165

A female human offspring. [Definition Source: NCI]

Deep Vein Thrombosis

IRI: http://purl.obolibrary.org/obo/NCIT_C49343

A blood clot in a deep vein, predominantly in the lower extremity, but may include the pelvis or upper extremity. [Definition Source: NCI][attribution: NICHD]

Depression

IRI: http://purl.obolibrary.org/obo/NCIT_C2982

A melancholy feeling of sadness and despair. [Definition Source: NCI]

Diabetes Mellitus

IRI: http://purl.obolibrary.org/obo/NCIT_C2985

A metabolic disorder characterized by abnormally high blood sugar levels due to diminished production of insulin or insulin resistance/desensitization. [Definition Source: NCI]

Diagnosis

IRI: http://purl.obolibrary.org/obo/NCIT_C15220

The investigation, analysis and recognition of the presence and nature of disease, condition, or injury from expressed signs and symptoms; also, the scientific determination of any kind; the concise results of such an investigation. [Definition Source: NCI]

Diagnostic Imaging

IRI: http://purl.obolibrary.org/obo/NCIT_C16502

Any method that uses a visual display of structural or functional patterns of organs or tissues for diagnostic evaluation. [Definition Source: NCI]

Diagnostic Procedure

IRI: http://purl.obolibrary.org/obo/NCIT_C18020

Any procedure or test to diagnose a disease or disorder. [Definition Source: NCI]

Disease Modifying Therapy

IRI: https://w3id.org/BRAINTEASER/ontology/schema/Disease_Modifying_Therapy

Disease or Disorder

IRI: http://purl.obolibrary.org/obo/NCIT_C2991

Any abnormal condition of the body or mind that causes discomfort, dysfunction, or distress to the person affected or those in contact with the person. The term is often used broadly to include injuries, disabilities, syndromes, symptoms, deviant behaviors, and atypical variations of structure and function. [NCIT_P378: NCI][NCIT_P378: NCI][NCIT_P378: NCI]

Dizziness

IRI: http://purl.obolibrary.org/obo/NCIT_C37943

A sensation of lightheadedness, unsteadiness, turning, spinning or rocking. [Definition Source: NCI]

Document

IRI: <http://xmlns.com/foaf/0.1/Document>

A document.

Drivers and mobile plant operators

IRI: <http://data.europa.eu/esco/isco/C83>

Drivers and mobile plant operators drive and tend trains and motor vehicles, or drive, operate and monitor industrial and agricultural machinery and equipment, or execute deck duties on board ship and other water-borne craft. Competent performance in most occupations in this sub-major group requires skills at the second ISCO skill level. Tasks performed by workers in this sub-major group usually include: driving and tending trains and motor vehicles; driving, operating and monitoring mobile industrial and agricultural machinery and equipment; carrying out deck duties on board ship and other water-borne craft. Occupations in this sub-major group are classified into the following minor groups: 831 Locomotive Engine Drivers and Related Workers 832 Car, Van and Motorcycle Drivers 833 Heavy Truck and Bus Drivers 834 Mobile Plant Operators 835 Ships' Deck Crews and Related Workers

Dyslipidemia

IRI: http://purl.obolibrary.org/obo/NCIT_C80385

A lipoprotein metabolism disorder characterized by decreased levels of high-density lipoproteins, or elevated levels of plasma cholesterol, low-density lipoproteins and/or triglycerides. [Definition Source: NCI]

Electrical and electronic trades workers

IRI: <http://data.europa.eu/esco/isco/C74>

Electrical and electronics trades workers install, fit and maintain electrical wiring systems and machinery and other electrical apparatus, electrical transmission and supply lines and cables, and electronic and telecommunications equipment and systems. Competent performance in most occupations in this sub-major group requires skills at the second ISCO skill level. The work is carried out by hand and by hand-powered and other tools which are used to reduce the amount of physical effort and time required for specific tasks, as well as to improve the quality of the products. The tasks call for an understanding of the work organization, materials and tools used, and the nature and purpose of the final product. Tasks performed by workers in this sub-major group usually include: installing, maintaining, fitting and adjusting electrical and electronic wiring systems, machinery and equipment; examining blueprints, wiring diagrams and specifications to determine sequences and methods of operation; inspecting and testing electrical and electronic systems, equipment, cables and machinery to identify hazards, defects and the need for adjustment or repair; installing, maintaining and repairing electrical and telecommunications transmission lines; joining electrical, telecommunications and data cables; maintaining, troubleshooting, fitting, adjusting, testing and repairing electronic equipment such as commercial and office machines, electronic instruments and control systems, computers, and telecommunications and data transmission equipment. Occupations in this sub-major group are classified into the following minor groups: 741 Electrical Equipment Installers and Repairers 742 Electronics and Telecommunications Installers and Repairers

Elementary occupations

IRI: <http://data.europa.eu/esco/isco/C9>

Elementary occupations involve the performance of simple and routine tasks which may require the use of hand-held tools and considerable physical effort. Most occupations in this major group require skills at the first ISCO skill level. Tasks performed by workers in elementary occupations usually include: cleaning, restocking supplies and performing basic maintenance in apartments, houses, kitchens, hotels, offices and other buildings; washing cars and windows; helping in kitchens and performing simple tasks in food preparation; delivering messages or goods; carrying luggage and handling baggage and freight; stocking vending-machines or reading and emptying meters; collecting and sorting refuse; sweeping streets and similar places; performing various simple farming, fishing, hunting or trapping tasks; performing simple tasks connected with mining, construction and manufacturing including product-sorting; packing and unpacking produce by hand, and filling shelves; providing various street services; pedalling or hand-guiding vehicles to transport passengers and goods; driving animal-drawn vehicles or machinery. Supervision of other workers may be included. Occupations in this major group are classified into the following sub-major groups: 91 Cleaners and Helpers 92 Agricultural, Forestry and Fishery Labourers 93 Labourers in Mining, Construction, Manufacturing and Transport 94 Food Preparation Assistants 95 Street and Related Sales and Services Workers 96 Refuse Workers and Other Elementary Workers

Epidermal Inclusion Cyst

IRI: http://purl.obolibrary.org/obo/NCIT_C3134

The most common type of cutaneous cyst. It results from the proliferation of epidermal cells in a circumscribed space within the dermis. It is usually asymptomatic and presents as a firm, round nodule. [Definition Source: NCI]

Ethnic group

IRI: <http://purl.bioontology.org/ontology/SNOMEDCT/372148003>

A social group characterized by a distinctive social and cultural tradition that is maintained from generation to generation. Members share a common history and origin and a sense of identification with the group. They have similar and distinctive features in their lifestyle habits and shared experiences. They often have a common genetic heritage which may be reflected in their experience of health and disease. [Definition Source: NCI]

Event

IRI: http://purl.obolibrary.org/obo/NCIT_C25499

Something that happens at a given place and time. [Definition Source: NCI]

Evoked Potentials

IRI: http://purl.obolibrary.org/obo/OMIT_0006295

Evoked potentials (EPs) are the electrical signals produced by the nervous system in response to an external stimulus.

Evoked Potentials, Auditory

IRI: http://purl.obolibrary.org/obo/OMIT_0006296

Auditory evoked potentials (AEPs), also referred to as evoked responses, are a record of the time it takes nerves in the auditory system to respond to sound and electrical stimulation.

Evoked Potentials, Motor

IRI: http://purl.obolibrary.org/obo/OMIT_0019166

Motor evoked potentials (MEPs) are the electrical signals recorded from the descending motor pathways or from muscles following stimulation of motor pathways within the brain.

Evoked Potentials, Somatosensory

IRI: http://purl.obolibrary.org/obo/OMIT_0006297

Somatosensory evoked potentials (SSEPs) are brain and spinal cord responses elicited by sensory stimuli.

Evoked Potentials, Visual

IRI: http://purl.obolibrary.org/obo/OMIT_0006298

A visual evoked potential is an evoked potential caused by a visual stimulus, such as an alternating checkerboard pattern on a computer screen.

Expanded Disability Status Scale

IRI: http://purl.obolibrary.org/obo/NCIT_C98302

A system for quantifying disability in multiple sclerosis (MS). Based on a standard neurological examination, the Expanded Disability Status Scale quantifies disability in seven Functional Systems (plus "Other") and assigns a Functional System Score in each. Results are ranked as steps from 0 to 10, with steps 1 through 4.5 describing MS patients who are fully ambulatory and steps 5 through 9.5 describing increasing impairment to ambulation. Step 10 refers to death due to MS. [Definition Source: NCI]

Eye

IRI: http://purl.obolibrary.org/obo/NCIT_C12401

The organ of sight or vision. [Definition Source: NCI]

Eye Symptom

IRI: https://w3id.org/BRAINTEASER/ontology/schema/Eye_Symptom

Facial Nerve Palsy

IRI: http://purl.obolibrary.org/obo/NCIT_C26769

Partial or complete paralysis of the facial muscles of one side of a person's face. It is caused by damage to the seventh cranial nerve. It is usually temporary but it may recur. [Definition Source: NCI]

Father

IRI: http://purl.obolibrary.org/obo/NCIT_C25174

A male parent. [Definition Source: NCI]

Fever

IRI: http://purl.obolibrary.org/obo/NCIT_C3038

Elevation of body temperature above normal due to inflammatory or immune responses. [Definition Source: NCI]

First Degree Relative

IRI: http://purl.obolibrary.org/obo/NCIT_C21481

Any relative who is one meiosis away from a particular individual in a family; a relative with whom one half of an individual's genes is shared (i.e., parent, sibling, offspring) (from Genetics Home Reference glossary) [Definition Source: NCI]

Flu-Like Symptoms

IRI: http://purl.obolibrary.org/obo/NCIT_C78302

Complaints describing a pattern similar to influenza, which may include one or more of the following symptoms: fever, chills, muscle or body aches, cough, sore throat, rhinitis, or fatigue. [Definition Source: NCI]

Food preparation assistants

IRI: <http://data.europa.eu/esco/isco/C94>

Food preparation assistants prepare and cook to order a small variety of pre-cooked food or beverages, clear tables, clean kitchen areas and wash dishes. Most occupations in this sub-major group require skills at the first ISCO skill level. Tasks performed by workers in this sub-major group usually include: preparing simple or pre-prepared foods and beverages such as sandwiches, pizzas, fish and chips, salads and coffee; washing, cutting, measuring and mixing foods for cooking; operating cooking equipment such as grills, microwaves and deep-fat fryers; cleaning kitchens, food preparation areas and service areas; cleaning cooking and general utensils used in kitchens and restaurants. Occupations in this sub-major group are classified into the following minor group: 941 Food Preparation Assistants

Food processing, wood working, garment and other craft and related trades workers

IRI: <http://data.europa.eu/esco/isco/C75>

Food processing, woodworking, garment and other craft and related trades workers treat and process agricultural and fisheries raw materials into food and other products, and produce and repair goods made of wood, textiles, fur, leather or other materials. Competent performance in most occupations in this sub-major group requires skills at the second ISCO skill level. The work is carried out by hand and by hand-powered and other tools which are used to reduce the amount of physical effort and time required for specific tasks, as well as to improve the quality of the products. The tasks call for an understanding of the work organization, materials and tools used, and the nature and purpose of the final product. Tasks performed by workers in this sub-major group usually include: treating and processing meat, fish, grain, fruit, vegetables and related materials into food stuffs, and tobacco into tobacco products; tasting and grading food products and beverages; treating and processing natural fibres, skins and hides; making and repairing furniture and other goods made of wood; preparing hides, skins and pelts for further use; making and repairing textiles, garments, hats, shoes and related products. Supervision of other workers may be included. Occupations in this sub-major group are classified into the following minor groups: 751 Food Processing and Related Trades Workers 752 Wood Treaters, Cabinet-makers and Related Trades Workers 753 Garment and Related Trades Workers 754 Other Craft and Related Workers

FUS

IRI: http://purl.obolibrary.org/obo/OGG_3000002521

This gene is involved in gene expression, genomic integrity and RNA processing. [Definition Source: NCI]

Gene

IRI: http://purl.obolibrary.org/obo/OGG_0000000002

A gene is a material entity that represents the entire DNA sequence required for synthesis of a functional protein or RNA molecule.

General and keyboard clerks

IRI: <http://data.europa.eu/esco/isco/C41>

General and keyboard clerks record, organize, store and retrieve information and perform a wide range of clerical and administrative tasks according to established procedures. Competent performance in most occupations in this sub-major group requires skills at the second ISCO skill level. Tasks performed by workers in this sub-major group usually include: recording, preparing, sorting, classifying and filing information; sorting, opening and sending mail; preparing reports and correspondence of a routine nature; photocopying and faxing documents; operating personal computers, word processors or typewriters to record, input and process text and data; proofreading and correcting copy; preparing invoices and checking figures. Occupations in this sub-major group are classified into the following minor groups: 411 General Office Clerks 412 Secretaries (general) 413 Keyboard Operators

Glatiramer acetate

IRI: <http://purl.bioontology.org/ontology/ATC/L03AX13>

Glatiramer acetate (also known as Copolymer 1, Cop-1), sold under the brand name Copaxone among others, is an immunomodulator medication used to treat multiple sclerosis. Glatiramer acetate is approved in the United States to reduce the frequency of relapses, but not for reducing the progression of disability.

Grand Relative

IRI: http://purl.obolibrary.org/obo/NCIT_C71388

A relative separated by two generations. [Definition Source: NCI]

Grandchild

IRI: http://purl.obolibrary.org/obo/NCIT_C71397

A child of your son or daughter. [Definition Source: NCI]

Grandparent

IRI: http://purl.obolibrary.org/obo/NCIT_C71385

A parent of your father or mother. [Definition Source: NCI]

Group

IRI: <http://xmlns.com/foaf/0.1/Group>

A class of Agents.

Handicraft and printing workers

IRI: <http://data.europa.eu/esco/isco/C73>

Handicraft and printing workers combine artistic and manual skills to design, produce, maintain and decorate precision instruments, musical instruments, jewellery and other precious metals, pottery, porcelain and glassware, items made of wood or textile, leather or related materials, and printed products such as books, newspapers and magazines. They apply traditional and/or recently developed techniques to carve, mould, assemble, weave and decorate various articles; to compose and set type prior to printing; to set up and operate printing presses; to bind and finish printed products; and to prepare stencils

and operate screen printing equipment. Competent performance in most occupations in this sub-major group requires skills at the second ISCO skill level. The work may be carried out by hand or involve the use of hand tools and hand-held power tools, and in some cases the set-up and operation of machinery and machine tools. The tasks call for an understanding of the work organization, materials and tools used, and the nature and purpose of the final product. Tasks performed by workers in this sub-major group usually include: making and repairing nautical, meteorological, optical and other precision instruments and equipment; making and repairing musical instruments; making jewellery and precious metalware; making pottery, porcelain ware, ceramics and glassware; painting and decorating various articles; producing handicraft articles in wood or textile, leather and related materials; performing printing or book-binding tasks. Supervision of other workers may be included. Occupations in this sub-major group are classified into the following minor groups: 731 Handicraft Workers 732 Printing Trades Workers

Hashimoto Thyroiditis

IRI: http://purl.obolibrary.org/obo/NCIT_C27191

An autoimmune disorder caused by the production of autoantibodies against thyroid tissue. There is progressive destruction of the thyroid follicles leading to hypothyroidism. [Definition Source: NCI]

Head

IRI: http://purl.obolibrary.org/obo/UBERON_0000033

The head is the anterior-most division of the body [GO]. [<http://en.wikipedia.org/wiki/Head> <http://amigo.geneontology.org/amigo/term/GO:0060322>]

Health associate professionals

IRI: <http://data.europa.eu/esco/isco/C32>

Health associate professionals perform technical and practical tasks to support diagnosis and treatment of illness, disease, injuries and impairments in humans and animals, and to support implementation of health care, treatment and referral plans usually established by medical, veterinary, nursing and other health professionals. Competent performance in most occupations in this sub-major group requires skills at the third ISCO skill level. Tasks performed by workers in the sub-major group usually include: testing and operating medical imaging equipment and administering radiation therapy; performing clinical tests on specimens of bodily fluids and tissues; preparing medications and other pharmaceutical compounds under the guidance of pharmacists; designing, fitting, servicing and repairing medical and dental devices and appliances; providing nursing and personal care and midwifery support services; using herbal and other therapies based on theories, beliefs and experiences originating in specific cultures. Occupations in this sub-major group are classified into the following minor groups: 321 Medical and Pharmaceutical Technicians 322 Nursing and Midwifery Associate Professionals 323 Traditional and Complementary Medicine Associate Professionals 324 Veterinary Technicians and Assistants 325 Other Health Associate Professionals

Health professionals

IRI: <http://data.europa.eu/esco/isco/C22>

Health professionals conduct research,; improve or develop concepts, theories and operational methods; and apply scientific knowledge relating to medicine, nursing, dentistry, veterinary medicine, pharmacy, and promotion of health. Competent performance in most occupations in this sub-major group requires skills at the fourth ISCO skill level. Tasks performed by workers in this sub-major group usually include: conducting research and obtaining scientific knowledge through the study of human and animal disorders and illnesses and ways of treating them; advising on or applying preventive and curative measures, or promoting health; preparing scientific papers and reports. Supervision of other workers may be included. Occupations in this sub-major group are classified into the following minor groups: 221 Medical Doctors 222 Nursing and Midwifery Professionals 223 Traditional and Complementary Medicine Professionals 224 Paramedical Practitioners 225 Veterinarians 226 Other Health Professionals Note In using ISCO in applications that seek to identify, describe or measure the health workforce, it should be noted that a number of professions considered to be a part of the health workforce are classified in groups other than Sub-major Group 22: Health Professionals. Such occupations include but are not restricted to: addictions counsellors, biomedical engineers, clinical psychologists and medical physicists.

Heart Disorder

IRI: http://purl.obolibrary.org/obo/NCIT_C3079

A non-neoplastic or neoplastic disorder that affects the heart and/or the pericardium. Representative examples include endocarditis, pericarditis, atrial myxoma, cardiac myeloid sarcoma, and pericardial malignant mesothelioma. [Definition Source: NCI]

Heart Failure

IRI: http://purl.obolibrary.org/obo/NCIT_C50577

Inability of the heart to pump blood at an adequate rate to meet tissue metabolic requirements. Clinical symptoms of heart failure include: unusual dyspnea on light exertion, recurrent dyspnea occurring in the supine position, fluid retention or rales, jugular venous distension, pulmonary edema on physical exam, or pulmonary edema on chest x-ray presumed to be cardiac dysfunction. [Definition Source: NCI]

Hematology Test

IRI: http://purl.obolibrary.org/obo/NCIT_C49286

A laboratory test to measure hematopoietic components and investigate hematologic disorders in a blood sample. [Definition Source: NCI]

Hepatitis A Infection

IRI: http://purl.obolibrary.org/obo/NCIT_C3096

Acute inflammation of the liver caused by the hepatitis A virus. It is highly contagious and usually contracted through close contact with an infected individual or their feces, contaminated food or water. [Definition Source: NCI]

Hernia

BRAINTEASER – D9.1

IRI: http://purl.obolibrary.org/obo/NCIT_C34685

The protrusion of part of an organ or fibroadipose tissue through an abnormal opening. [Definition Source: NCI]

Herniated Disk

IRI: https://w3id.org/BRAINTEASER/ontology/schema/Herniated_Disk

Herpes Labialis

IRI: https://w3id.org/BRAINTEASER/ontology/schema/Herpes_Labialis

Herpes simplex, caused by type 1 virus, primarily spread by oral secretions and usually occurring as a concomitant of fever. It may also develop in the absence of fever or prior illness. It commonly involves the facial region, especially the lips and the nares. (Dorland, 27th ed.) (MSH)

Herpes Zoster

IRI: http://purl.obolibrary.org/obo/NCIT_C71079

A common dermal and neurologic disorder caused by reactivation of the varicella-zoster virus that has remained dormant within dorsal root ganglia, often for decades, after the patient's initial exposure to the virus in the form of varicella (chickenpox). It is characterized by severe neuralgic pain along the distribution of the affected nerve and crops of clustered vesicles over the area. [Definition Source: NCI]

Herpetic Keratitis

IRI: https://w3id.org/BRAINTEASER/ontology/schema/Herpetic_Keratitis

A superficial, epithelial Herpesvirus hominis infection of the cornea, characterized by the presence of small vesicles which may break down and coalesce to form dendritic ulcers (KERATITIS, DENDRITIC). (Dictionary of Visual Science, 3d ed) ... (MSH)

Hispanic

IRI: <http://purl.bioontology.org/ontology/SNOMEDCT/414408004>

The term Hispanic (Spanish: hispano) refers to people, cultures, or countries related to Spain, most notably the Spanish-speaking countries of the Americas.

Hospitality, retail and other services managers

IRI: <http://data.europa.eu/esco/isco/C14>

Hospitality, retail and other services managers plan, organize and direct the operations of establishments which provide accommodation, hospitality, retail and other services. Competent performance in most occupations in this sub-major group requires skills at the third ISCO skill level. Tasks performed by workers in this sub-major group usually include: planning and organizing special functions, sporting, gaming and entertainment activities and the range and mix of products, stock levels and service standards; promoting and selling goods and services; observing liquor, gaming, health and other laws and regulations; developing and reviewing policies, programmes and procedures concerning customer relations and goods and services provided; promoting facilities for

conferences, conventions and trade shows to potential customers; organizing the purchase and maintenance of transport vehicles, equipment and fuel, and transporting goods; controlling the selection, training and supervision of staff; ensuring compliance with occupational health and safety regulations. Occupations in this sub-major group are classified into the following minor groups: 141 Hotel and Restaurant Managers 142 Retail and Wholesale Trade Managers 143 Other Services Managers Notes Sub-major Group 14: Hospitality, Retail and Other Services Managers is for managers of establishments that provide services directly to the public, usually in organizations that are too small to have hierarchies of managers. Managers responsible for planning, directing and coordinating the provision of specialized professional and technical services that usually require specialized qualifications are classified in various unit groups in Sub-major Groups 12: Administrative and Commercial Managers and 13: Production and Specialized Services Managers. Operators of small shops, guest houses, cafes, restaurants and bars for whom the management and supervision of staff is not a significant component of the work are classified in the relevant unit group in Sub-major Groups 51: Personal Services Workers or 52: Sales Workers, depending on the main tasks performed.

Hypertension

IRI: http://purl.obolibrary.org/obo/NCIT_C3117

Blood pressure that is abnormally high. [Definition Source: NCI]

Hyperthyroidism

IRI: http://purl.obolibrary.org/obo/NCIT_C3123

Overactivity of the thyroid gland resulting in overproduction of thyroid hormone and increased metabolic rate. Causes include diffuse hyperplasia of the thyroid gland (Graves' disease), single nodule in the thyroid gland, and thyroiditis. The symptoms are related to the increased metabolic rate and include weight loss, fatigue, heat intolerance, excessive sweating, diarrhea, tachycardia, insomnia, muscle weakness, and tremor. [Definition Source: NCI]

Hypothyroidism

IRI: http://purl.obolibrary.org/obo/NCIT_C26800

Abnormally low levels of thyroid hormone. [Definition Source: NCI][attribution: NICHD]

Image

IRI: <http://xmlns.com/foaf/0.1/Image>

An image.

Image object

IRI: <http://schema.org/ImageObject>

Infectious Mononucleosis

IRI: http://purl.obolibrary.org/obo/NCIT_C34726

A condition characterized by an increase in mononuclear white blood cells and swollen lymph nodes, which is usually caused by infection with the Epstein-Barr virus. [Definition Source: NCI]

Inflammation

IRI: http://purl.obolibrary.org/obo/NCIT_3137

A pathological process characterized by injury or destruction of tissues caused by a variety of cytologic and chemical reactions. It is usually manifested by typical signs of pain, heat, redness, swelling, and loss of function. (MSH)

Information and communications technicians

IRI: <http://data.europa.eu/esco/isco/C35>

Information and communications technicians provide support for the day-to-day running of computer systems, communications systems and networks, and perform technical tasks related to telecommunications, broadcast image and sound as well as other types of telecommunications signals on land, sea or in aircraft. Competent performance in most occupations in this sub-major group requires skills at the third ISCO skill level. Tasks performed by workers in this sub-major group usually include: providing assistance to information and communications systems users; installing new programs and equipment; establishing, operating and maintaining network and other data communications systems; installing, monitoring and supporting Internet and Intranet websites or web server hardware or software; modifying web pages; and performing web server backup and recovery operations; controlling equipment to record sound, edit and mix image and sound recordings; controlling and maintaining transmitting and broadcast systems and satellite systems for radio and television programmes; controlling and maintaining radio communications systems, satellite services and multiplex systems on land, sea or in aircraft; providing technical assistance connected with research and development of computer systems and telecommunications equipment, or testing prototypes; designing and preparing blueprints of circuitry according to the specifications given; providing technical supervision of the manufacture, utilization, maintenance and repair of telecommunications systems. Occupations in this sub-major group are classified into the following minor groups: 351 Information and Communications Technology Operations and User Support Technicians 352 Telecommunications and Broadcasting Technicians

Information and communications technology professionals

IRI: <http://data.europa.eu/esco/isco/C25>

Information and communications technology professionals conduct research; plan, design, write, test, provide advice and improve information technology systems, hardware, software and related concepts for specific applications; develop associated documentation including principles, policies and procedures; and design, develop, control, maintain and support databases and other information systems to ensure optimal performance and data integrity and security. Tasks performed by workers in this sub-major group usually include: researching information technology use in business functions; identifying areas for improvement and researching the theoretical aspects and operational methods for the use of computers; evaluating, planning and designing hardware or software configurations for specific applications including for Internet,

Intranet and multimedia systems; designing, writing, testing and maintaining computer programs; designing and developing database architecture and database management systems; developing and implementing security plans and data administration policy, and administering computer networks and related computing environments; analysing, developing, interpreting and evaluating complex system design and architecture specifications, data models and diagrams in the development, configuration and integration of computer systems. Occupations in this sub-major group are classified into the following minor groups: 251 Software and Applications Developers and Analysts 252 Database and Network Professionals

Injury

IRI: http://purl.obolibrary.org/obo/NCIT_C3671

Damage inflicted on the body as the direct or indirect result of an external force, with or without disruption of structural continuity. [Definition Source: NCI]

Institution

IRI: <https://dbpedia.org/ontology/institution>

interferon beta-1a

IRI: <http://purl.bioontology.org/ontology/ATC/L03AB07>

Interferon beta-1a (also interferon beta 1-alpha) is a cytokine in the interferon family used to treat multiple sclerosis (MS).

Interstitial Pneumonia

IRI: http://purl.obolibrary.org/obo/NCIT_C27006

Inflammation of interstitial lung tissue, usually associated with infection. [Definition Source: NCI]

Intervention or Procedure

IRI: http://purl.obolibrary.org/obo/NCIT_C25218

An activity that produces an effect, or that is intended to alter the course of a disease in a patient or population. This is a general term that encompasses the medical, social, behavioral, and environmental acts that can have preventive, therapeutic, or palliative effects. [Definition Source: NCI]

Iridocyclitis

IRI: http://purl.obolibrary.org/obo/NCIT_C34736

Inflammation of the iris and the ciliary body. [Definition Source: NCI]

Iron-Deficiency Anemia

IRI: http://purl.obolibrary.org/obo/NCIT_C84484

Anemia caused by low iron intake, inefficient iron absorption in the gastrointestinal tract, or chronic blood loss. [Definition Source: NCI]

Kings

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/Kings>

King's staging system.

Label Property

IRI: <http://xmlns.com/foaf/0.1/LabelProperty>

A foaf:LabelProperty is any RDF property with textual values that serve as labels.

Labourers in mining, construction, manufacturing and transport

IRI: <http://data.europa.eu/esco/isco/C93>

Labourers in mining, construction, manufacturing and transport perform simple and routine manual tasks in mining, quarrying, civil engineering, building, manufacturing, transport and storage operations, and operate human-powered and animal-drawn vehicles and machinery. Most occupations in this sub-major group require skills at the first ISCO skill level. Task performed by workers in this sub-major group usually include: digging holes and spreading excavated materials, sand, soil and gravel using hand-held tools; sorting, loading, unloading, moving, stacking and storing materials, equipment, products, supplies, baggage and cargo by hand; cleaning machinery, equipment, tools and work sites; packing and unpacking material and products and filling containers and shelves with products by hand; operating human-powered and animal-drawn vehicles and machinery. Occupations in this sub-major group are classified into the following minor groups: 931 Mining and Construction Labourers 932 Manufacturing Labourers 933 Transport and Storage Labourers

Langerhans Cell Histiocytosis

IRI: http://purl.obolibrary.org/obo/NCIT_C3107

A neoplastic proliferation of Langerhans cells which contain Birbeck granules by ultrastructural examination. Three major overlapping syndromes are recognized: eosinophilic granuloma, Letterer-Siwe disease, and Hand-Schuller-Christian disease. The clinical course is generally related to the number of organs affected at presentation. (WHO, 2001) [Definition Source: NCI]

Legal, social and cultural professionals

IRI: <http://data.europa.eu/esco/isco/C26>

Legal, social and cultural professionals conduct research; improve or develop concepts, theories and operational methods; or apply knowledge relating to the law, storage and retrieval of information and artefacts, psychology, social welfare, politics, economics, history, religion, languages, sociology, other social sciences, and arts and entertainment. Competent performance in most occupations in this sub-major group requires skills at the fourth ISCO skill level. Tasks performed by workers in this sub-major group usually include: conducting research on legal problems; drafting laws and regulations; advising clients on legal cases; pleading and conducting cases in a court of law; presiding over judicial proceedings in a court of law; developing and maintaining library and gallery collections of archives; conducting research, improving or developing concepts, theories and operational methods or applying knowledge relating to the field of social sciences;

conceiving, creating and performing in literary and artistic works; interpreting and communicating news, ideas, impressions and facts. Occupations in this sub-major group are classified into the following minor groups: 261 Legal Professionals 262 Librarians, Archivists and Curators 263 Social and Religious Professionals 264 Authors, Journalists and Linguists 265 Creative and Performing Artists

Legal, social, cultural and related associate professionals

IRI: <http://data.europa.eu/esco/isco/C34>

Legal, social, cultural and related associate professionals perform technical tasks connected with the practical application of knowledge relating to legal services, social work, culture, food preparation, sport and religion. Competent performance in most occupations in this sub-major group requires skills at the third ISCO skill level. Tasks performed by workers in this sub-major group usually include: providing technical and practical services and support functions in legal processes and investigations, social and community assistance programmes, and religious and cultural activities; participating and adjudicating in sporting events; developing and delivering sports coaching, fitness and recreational programmes; combining creative and technical skills in a variety of artistic, cultural and culinary activities; creating dishes and menus and overseeing the preparation of meals. Occupations in this sub-major group are classified into the following minor groups: 341 Legal, Social and Religious Associate Professionals 342 Sports and Fitness Workers 343 Artistic, Cultural and Culinary Associate Professionals

Leukopenia

IRI: http://purl.obolibrary.org/obo/NCIT_C26816

A laboratory test result indicating a decreased number of white blood cells in the peripheral blood. [Definition Source: NCI]

Lifestyle

IRI: http://purl.obolibrary.org/obo/NCIT_C16795

A manner of living that reflects the person's values and attitudes. [Definition Source: NCI]

Limb

IRI: http://purl.obolibrary.org/obo/NCIT_C12429

A body region referring to an upper or lower extremity. [Definition Source: NCI]

Lumbar Hernia

IRI: https://w3id.org/BRAINTEASER/ontology/schema/Lumbar_Hernia

Lumbosacral nerve plexus

IRI: http://purl.obolibrary.org/obo/UBERON_0001815

An arrangement of nerve fibers, running from the spine that travels to the pelvic appendage where it innervates skin and muscle. [http://purl.obolibrary.org/obo/UBERON_cjm]

Lymphopenia

IRI: http://purl.obolibrary.org/obo/NCIT_C26823

An abnormally small number of lymphocytes in the circulating blood. [Definition Source: NCI]

Magnetic Resonance Imaging

IRI: http://purl.obolibrary.org/obo/NCIT_C16809

Imaging that uses radiofrequency waves and a strong magnetic field rather than x-rays to provide detailed pictures of internal organs and tissues. The technique is valuable for the diagnosis of many pathologic conditions, including cancer, heart and vascular disease, stroke, and joint and musculoskeletal disorders. [Definition Source: NCI]

Market-oriented skilled agricultural workers

IRI: <http://data.europa.eu/esco/isco/C61>

Market-oriented skilled agricultural workers plan, organize and perform farming operations to grow and harvest field or tree and shrub crops; and to produce a variety of animals and animal products for sale or delivery on a regular basis to wholesale buyers, marketing organizations or at markets. Competent performance in most occupations in this sub-major group requires skills at the second ISCO skill level. Tasks performed by workers in this sub-major group usually include: preparing the soil; sowing, planting, spraying, fertilizing and harvesting field crops; growing fruit and other tree and shrub crops; growing garden vegetables and horticultural products; raising, breeding and tending animals mainly to obtain meat, milk, hair, fur, skin, or sericultural, apiarian or other products; storing and carrying out some processing of produce; selling their products to purchasers, marketing organizations or at markets. Supervision of other workers may be included. Occupations in this sub-major group are classified into the following minor groups: 611 Market Gardeners and Crop growers 612 Animal Producers 613 Mixed Crop and Animal Producers Notes Jobs should be classified in Sub-major Group 63: Subsistence Farmers, Fishers, Hunters and Gatherers when goods (mostly food) are produced mainly for own consumption or for consumption by other members of the worker's household. If a large surplus is produced, and more goods are sold than consumed, but the main aim of production was own consumption, the jobs should nevertheless be classified in Sub-major Group 63. Jobs should only be classified in Sub-major Group 61: Market-oriented Skilled Agricultural Workers, or 62: Market-oriented Skilled Forestry, Fishery and Hunting Workers, if the main aim of the activity is to produce goods for the market.

Market-oriented skilled forestry, fishery and hunting workers

IRI: <http://data.europa.eu/esco/isco/C62>

Market-oriented skilled forestry, fishery and hunting workers plan, organize and perform operations to cultivate, conserve and exploit natural and plantation forests; breed and raise fish; harvest and catch fish; and hunt and trap animals, for sale or delivery on a regular basis to wholesale buyers, marketing organizations or at markets. Competent performance in most occupations in this sub-major group requires skills at the second ISCO skill level. Tasks performed by workers in this sub-major group usually include: renting or investing in equipment and machinery and purchasing supplies; planning and undertaking forestry, aquaculture, fishery and hunting operations; maintaining buildings, tanks, machinery and other equipment; delivering or marketing products; supervising

and training other workers. Occupations in this sub-major group are classified into the following minor groups: 621 Forestry and Related Workers 622 Fishery Workers, Hunters and Trappers Notes Jobs should be classified in Sub-major Group 63: Subsistence Farmers, Fishers, Hunters and Gatherers when goods (mostly food) are produced mainly for own consumption or for consumption by other members of the worker's household. If a large surplus is produced, and more goods are sold than consumed, but the main aim of production was own consumption, the jobs should nevertheless be classified in Sub-major Group 63. Jobs should only be classified in Sub-major Group 61: Market-oriented Skilled Agricultural Workers, or 62: Market-oriented Skilled Forestry, Fishery and Hunting Workers, if the main aim of the activity is to produce goods for the market.

Melanocytic Nevus

IRI: http://purl.obolibrary.org/obo/NCIT_C7570

A neoplasm composed of melanocytes that usually appears as a dark spot on the skin. [Definition Source: NCI]

Metal, machinery and related trades workers

IRI: <http://data.europa.eu/esco/isco/C72>

Metal, machinery and related trades workers cast, weld, forge and, by other methods, form metal; erect, maintain and repair heavy metal structures; engage in machine-tool setting as well as in fitting, maintaining and repairing machinery including engines and vehicles; or they produce tools and various non-precious metal articles. Competent performance in most occupations in this sub-major group requires skills at the second ISCO skill level. The work is carried out by hand and by hand-powered and other tools which are used to reduce the amount of physical effort and time required for specific tasks, as well as to improve the quality of the products. The tasks call for an understanding of the work organization, materials and tools used, and the nature and purpose of the final product Tasks performed by workers in this sub-major group usually include: making moulds and cores for casting metal; casting, welding and shaping metal; installing, erecting, maintaining and repairing heavy metal structures, tackle and related equipment; forging and forming steel and other non-precious metals to make and repair machinery, tools, equipment and other articles; setting for operators or setting and operating various machine tools; fitting, maintaining and repairing industrial machinery, including engines and vehicles. Supervision of other workers may be included. Occupations in this sub-major group are classified into the following minor groups: 721 Sheet and Structural Metal Workers, Moulders and Welders, and Related Workers 722 Blacksmiths, Toolmakers and Related Trades Workers 723 Machinery Mechanics and Repairers

Methotrexate

IRI: <http://purl.bioontology.org/ontology/ATC/L01BA01>

Methotrexate (MTX), formerly known as amethopterin, is a chemotherapy agent and immune-system suppressant.

Methylprednisolone

IRI: <http://purl.bioontology.org/ontology/UATC/H02AB04>

Methylprednisolone (Depo-Medrol, Medrol, Solu-Medrol) is a synthetic glucocorticoid, primarily prescribed for its anti-inflammatory and immunosuppressive effects.

Migraine With Aura

IRI: http://purl.obolibrary.org/obo/NCIT_C117005

A migraine disorder characterized by episodes that are preceded by focal neurological symptoms. [Definition Source: NCI]

Mitos

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/Mitos>

MiToS staging system.

Monoclonal Gammopathy

IRI: http://purl.obolibrary.org/obo/NCIT_C35548

An abnormal laboratory test result indicating the presence of monoclonal immunoglobulins in the blood or urine. [Definition Source: NCI]

Mother

IRI: http://purl.obolibrary.org/obo/NCIT_C25189

A female parent. [Definition Source: NCI]

Multiple sclerosis

IRI: http://purl.obolibrary.org/obo/MONDO_0005301

A progressive autoimmune disorder affecting the central nervous system resulting in demyelination. Patients develop physical and cognitive impairments that correspond with the affected nerve fibers. [NCIT:P378]

Myasthenia Gravis

IRI: http://purl.obolibrary.org/obo/NCIT_C60989

A chronic autoimmune neuromuscular disorder characterized by skeletal muscle weakness. It is caused by the blockage of the acetylcholine receptors at the neuromuscular junction. [Definition Source: NCI]

ncit c3390

IRI: http://purl.obolibrary.org/obo/NCIT_C3390

Naltrexone

IRI: <http://purl.bioontology.org/ontology/ATC/N07BB04>

Naltrexone, sold under the brand names ReVia, Antaxone and Vivitrol among others, is a medication primarily used to manage alcohol or opioid use disorder by reducing cravings and feelings of euphoria associated with substance use disorder. It has also been found to be effective in the treatment of other addictions and may be used for them off-label.

Natalizumab

IRI: <http://purl.bioontology.org/ontology/ATC/L04AA23>

Natalizumab, sold under the brand name Tysabri among others, is a medication used to treat multiple sclerosis and Crohn's disease. It is a humanized monoclonal antibody against the cell adhesion molecule $\alpha 4$ -integrin.

Neck

IRI: http://purl.obolibrary.org/obo/UBERON_0000974

An organism subdivision that extends from the head to the pectoral girdle, encompassing the cervical vertebral column. [<http://orcid.org/0000-0002-6601-2165>]

Neonatal Hearing Impairment

IRI: http://purl.obolibrary.org/obo/NCIT_C50667

An abnormality that affects hearing within the first month after birth. It may or may not result in hearing loss. [Definition Source: NCI]

Neoplasia

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/Neoplasia>

Phenotype that consists of abnormal growth of a tissue or organ due to increased numbers of cells, but in which the affected tissue or organ does not maintain its normal form. Excluding the non-melanoma skin cancer (NMSC).

Nephew

IRI: http://purl.obolibrary.org/obo/NCIT_C71409

A son of your brother or sister. [Definition Source: NCI]

Nervous System Finding

IRI: http://purl.obolibrary.org/obo/NCIT_C36280

Symptoms, physical examination results, and/or laboratory test results related to the nervous system. [Definition Source: NCI]

Niece

IRI: http://purl.obolibrary.org/obo/NCIT_C71408

A daughter of your brother or sister. [Definition Source: NCI]

NMSC

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/NMSC>

Nonmelanoma Skin Cancers

Non-commissioned armed forces officers

IRI: <http://data.europa.eu/esco/isco/C02>

Non-commissioned armed forces officers enforce military discipline and supervise the activities of those employed in Sub-major Group 03: Armed Forces Occupations, Other Ranks, and/or perform similar tasks to those performed in a variety of civilian occupations outside the armed forces. This group includes members of the armed forces holding ranks such as sergeant, warrant officer and sergeant major. Competent performance in most occupations in this sub-major group requires skills at the second ISCO skill level. Occupations in this sub-major group are classified into the following minor group: 021 Non-commissioned Armed Forces Officers Excluded from this group are: - jobs held by persons in civilian employment of government establishments concerned with defence issues; - police (other than military police); - customs inspectors and members of border or other armed civilian services.

Non-Invasive Mechanical Ventilation

IRI: http://purl.obolibrary.org/obo/NCIT_C171457

A type of mechanical ventilation procedure that uses a non-invasive means, such as a face mask or nasal mask, to deliver oxygenated air into the lungs. [Definition Source: NCI]

Numerical and material recording clerks

IRI: <http://data.europa.eu/esco/isco/C43>

Numerical and material recording clerks obtain, compile and compute accounting, bookkeeping, statistical, financial and other numerical data, and take charge of cash transactions incidental to business matters. Some occupations classified here keep records of goods produced, purchased, stocked and dispatched, and of materials needed at specified production dates, or keep records of operational aspects and coordinate the timing of passenger and freight transport. Competent performance in most occupations in this sub-major group requires skills at the second ISCO skill level. Tasks performed by workers in this sub-major group usually include: helping with accounting and bookkeeping records and computations; calculating unit production costs; calculating wages and in some cases preparing wage packets and paying wages; taking charge of cash transactions incidental to the business; obtaining, compiling and computing statistical or actuarial data; performing clerical tasks relating to the financial transactions of an insurance establishment, bank or similar establishment; recording produced, stocked, ordered and dispatched goods; recording production materials received, put into stock or issued; computing quantities of the production materials required at specified dates and helping with preparation and checking of production operation schedules; keeping records of operational aspects and coordinating the timing of passenger and freight transport. Occupations in this sub-major group are classified into the following minor groups: 431 Numerical Clerks 432 Material Recording and Transport Clerks

Obesity

IRI: http://purl.obolibrary.org/obo/NCIT_C3283

Having a high amount of body fat (body mass index [BMI] of 30 or more). [Definition Source: NCI]

Occupation

IRI: <http://data.europa.eu/esco/model#Occupation>

The principal activity that a person does to earn money. [Definition Source: NCI]

Online Account

IRI: <http://xmlns.com/foaf/0.1/OnlineAccount>

An online account.

Online Chat Account

IRI: <http://xmlns.com/foaf/0.1/OnlineChatAccount>

An online chat account.

Online E-commerce Account

IRI: <http://xmlns.com/foaf/0.1/OnlineEcommerceAccount>

An online e-commerce account.

Online Gaming Account

IRI: <http://xmlns.com/foaf/0.1/OnlineGamingAccount>

An online gaming account.

Onset

IRI: http://purl.obolibrary.org/obo/NCIT_C25279

The start, beginning, or early stages. [Definition Source: NCI]

Organization

IRI: <http://xmlns.com/foaf/0.1/Organization>

An organization.

Osteoporosis

IRI: http://purl.obolibrary.org/obo/NCIT_C3298

A condition of reduced bone mass, with decreased cortical thickness and a decrease in the number and size of the trabeculae of cancellous bone (but normal chemical composition), resulting in increased fracture incidence. Osteoporosis is classified as primary (Type 1, postmenopausal osteoporosis; Type 2, age-associated osteoporosis; and idiopathic, which can affect juveniles, premenopausal women, and middle-aged men) and secondary osteoporosis (which results from an identifiable cause of bone mass loss). [Definition Source: NCI]

Other clerical support workers

IRI: <http://data.europa.eu/esco/isco/C44>

Other clerical support workers sort and deliver mail, file documents, prepare information for processing, maintain personnel records, check material for consistency with original source material, assist persons who cannot read or write, and perform various other specialized clerical duties. Competent performance in most occupations in this sub-

major group requires skills at the second ISCO skill level. Tasks performed by workers in this sub-major group usually include: recording information regarding acquisition, issue and return of library books; classifying and filing various documents and other records; maintaining personnel records; sorting, recording and delivering mail from post offices, as well as from or within an enterprise; coding; correcting proofs; performing a range of miscellaneous clerical duties; writing on behalf of persons who are unable to read or write. Occupations in this sub-major group are classified into the following minor group: 441 Other Clerical Support Workers

Partial Epilepsy

IRI: http://purl.obolibrary.org/obo/NCIT_C122812

A seizure caused by a localized disorder. [Definition Source: NCI]

Patient

IRI: http://purl.obolibrary.org/obo/NCIT_C16960

A person who receives medical attention, care, or treatment, or who is registered with medical professional or institution with the purpose to receive medical care when necessary. [Definition Source: NCI]

Patient Visit

IRI: http://purl.obolibrary.org/obo/NCIT_C39564

A visit by a patient or study participant to a medical professional. [Definition Source: NCI]

Pelvic complex

IRI: http://purl.obolibrary.org/obo/UBERON_0010709

Appendage girdle complex that when present, encompasses the pelvic appendicular skeleton and the pelvic girdle. [VSAO:0000215]

Penicillin Allergy

IRI: http://purl.obolibrary.org/obo/NCIT_C34911

An allergy to Penicillin. [Definition Source: NCI]

Percutaneous Endoscopic Gastrostomy

IRI: http://purl.obolibrary.org/obo/NCIT_C106040

The placement of a feeding tube through the abdominal wall into the stomach using an endoscope. [Definition Source: NCI]

Person

IRI: <http://schema.org/Person>

Person

IRI: <http://www.w3.org/2000/10/swap/pim/contact#Person>

A person.

Person

IRI: <http://xmlns.com/foaf/0.1/Person>

A person.

Personal Behavior

IRI: http://purl.obolibrary.org/obo/NCIT_C19683

The observable response of a person. [Definition Source: NCI]

Personal care workers

IRI: <http://data.europa.eu/esco/isco/C53>

Personal care workers provide care, supervision and assistance for children, patients and elderly, convalescent or disabled persons in institutional and residential settings. Competent performance in most occupations in this sub-major group requires skills at the second ISCO skill level. Tasks performed by workers in this sub-major group usually include: assisting with mobility, washing and other personal needs; assisting children individually to learn social skills; supervising and participating in activities that enhance children's physical, social, emotional and intellectual development; observing and reporting concerns to appropriate health or social service workers. Occupations in this sub-major group are classified into the following minor groups: 531 Child Care Workers and Teachers' Aides 532 Personal Care Workers in Health Services

Personal service workers

IRI: <http://data.europa.eu/esco/isco/C51>

Personal services workers provide personal services related to travel, housekeeping, catering and hospitality, hairdressing and beauty treatment, animal care grooming and training, companionship and other services of a personal nature. Competent performance in most occupations in this sub-major group requires skills at the second ISCO skill level. Tasks performed by workers in this sub-major group usually include: organizing and providing services in connection with travel and sightseeing; housekeeping; preparing and serving food and beverages; hairdressing and beauty treatment; telling fortunes; embalming and arranging funerals; grooming, caring for and training animals; teaching people to drive motor vehicles; providing companionship and other personal services. Supervision of other workers may be included. Occupations in this sub-major group are classified into the following minor groups: 511 Travel Attendants, Conductors and Guides 512 Cooks 513 Waiters and Bartenders 514 Hairdressers, Beauticians and Related Workers 515 Building and Housekeeping Supervisors 516 Other Personal Services Workers

Personality Disorder

IRI: http://purl.obolibrary.org/obo/NCIT_C34922

A diverse category of psychiatric disorders characterized by behavior that deviates markedly from the expectations of the individual's culture; this pattern of deviation is pervasive and inflexible and is stable over time. The behavioral pattern negatively interferes with relationships and work. [Definition Source: NCI]

PersonalProfileDocument

IRI: <http://xmlns.com/foaf/0.1/PersonalProfileDocument>

A personal profile RDF document.

Pharmacologic Substance

IRI: http://purl.obolibrary.org/obo/NCIT_C1909

Any natural, endogenously-derived, synthetic or semi-synthetic compound with pharmacologic activity. A pharmacologic substance has one or more specific mechanism of action(s) through which it exerts one or more effect(s) on the human or animal body. They can be used to potentially prevent, diagnose, treat or relieve symptoms of a disease. Formulation specific agents and some combination agents are also classified as pharmacologic substances. [Definition Source: NCI]

Physical Activity

IRI: http://purl.obolibrary.org/obo/NCIT_C17708

Any form of exercise or movement. Physical activity may include planned activity such as walking, running, basketball, or other sports. Physical activity may also include other daily activities such as household chores, yard work, walking the dog, etc. [Definition Source: NCI][attribution: from NIDDK Glossary; <http://www.niddk.nih.gov/health/nutrit/pubs/glossary/glossaryintro.htm>]

Pituitary Gland Adenoma

IRI: http://purl.obolibrary.org/obo/NCIT_C3329

A non-metastasizing tumor that arises from the adenohypophysial cells of the anterior lobe of the pituitary gland. The tumor can be hormonally functioning or not. The diagnosis can be based on imaging studies and/or radioimmunoassays. Due to its location in the sella turcica, expansion of the tumor mass can impinge on the optic chiasm or involve the temporal lobe, third ventricle and posterior fossa. A frequently associated physical finding is bitemporal hemianopsia which may progress to further visual loss. [Definition Source: NCI]

Pneumococcal Pneumonia

IRI: http://purl.obolibrary.org/obo/NCIT_C157959

Pneumonia that is attributed to the bacteria *Streptococcus pneumoniae*. [Definition Source: NCI]

Positron Emission Tomography

IRI: http://purl.obolibrary.org/obo/NCIT_C17007

A technique for measuring the gamma radiation produced by collisions of electrons and positrons (anti-electrons) within living tissue. In positron emission tomography (PET), a subject is given a dose of a positron-emitting radionuclide attached to a metabolically active substance (for example, 2-fluoro-2-deoxy-D-glucose (FDG), which is similar to a naturally occurring sugar, glucose, with the addition of a radioactive fluorine atom). When living tissue containing the positron emitter is bombarded by electrons, gamma radiation

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produced by collisions of electrons and positrons is detected by a scanner, revealing in fine detail the tissue location of the metabolically-active substance administered. [Definition Source: NCI]

Postoperative Hypothyroidism

IRI: https://w3id.org/BRAINTEASER/ontology/schema/Postoperative_Hypothyroidism

Pregnancy

IRI: http://purl.obolibrary.org/obo/NCIT_C25742

The state or condition of having a developing embryo or fetus in the body (uterus), after union of an ovum and spermatozoon, during the period from conception to birth. [Definition Source: NCI]

Primary Neoplasm

IRI: http://purl.obolibrary.org/obo/NCIT_C8509

A tumor at the original site of origin. [Definition Source: NCI]

Production and specialised services managers

IRI: <http://data.europa.eu/esco/isco/C13>

Production and specialized services managers plan, direct and coordinate the production of the goods and the provision of the specialized professional and technical services provided by an enterprise or organization, either as the manager of a department or as the general manager of an enterprise or organization that does not have a hierarchy of managers. They are responsible for manufacturing, mining, construction, logistics, information and communications technology operations for large-scale agricultural, forestry and fisheries operations, and for the provision of health, education, social welfare, banking, insurance and other professional and technical services. Competent performance in most occupations in this sub-major group requires skills at the fourth ISCO skill level. Tasks performed by workers in this sub-major group usually include: planning details of activities in terms of output, services provided, quality, quantity, cost, timeliness and labour requirements; setting standards and objectives; controlling the operation of plant and of procedures; assuring quality of the goods produced and services provided; preparing tenders and contract bids; establishing and managing budgets, monitoring costs, and adjusting activities, procedures and resources to minimize costs; overseeing the acquisition and installation of new plant and equipment; coordinating the implementation of health and safety requirements; planning and directing daily operations; overseeing the selection, training and performance of staff; preparing, or arranging for the preparation of, reports, budgets and forecasts; representing the enterprise or organization in negotiations with other agencies, and at conventions, seminars, public hearings and forums. Occupations in this sub-major group are classified into the following minor groups: 131 Production Managers in Agriculture, Forestry and Fisheries 132 Manufacturing, Mining, Construction and Distribution Managers 133 Information and Communications Technology Services Managers 134 Professional Services Managers Note Specialized qualifications and extensive experience relevant to one or more occupations classified in Major Group 2: Professionals, or Major Group 3: Technicians and Associate Professionals, are usually required. Regional managers and other senior managers who coordinate and supervise the activities of subordinate

managers who have a diverse range of functional responsibilities are included in Unit Group 1120: Managing Directors and Chief Executives.

Project

IRI: <http://xmlns.com/foaf/0.1/Project>

A project (a collective endeavour of some kind).

Protective services workers

IRI: <http://data.europa.eu/esco/isco/C54>

Protective services workers protect individuals and property against fire and other hazards, maintain law and order and enforce laws and regulations. Competent performance in most occupations in this sub-major group requires skills at the second ISCO skill level. Tasks performed by workers in this sub-major group usually include: preventing, fighting and extinguishing fires; rescuing people from burning buildings and accident sites and those trapped in dangerous situations; maintaining law and order, enforcing laws and regulations, patrolling public areas and arresting suspected offenders; directing traffic and assuming authority in the event of accidents; watching over and maintaining order among inmates of prisons, reformatories or penitentiaries; patrolling or monitoring premises to guard property against theft and vandalism, controlling access to establishments and maintaining order and enforcing regulations at public events and within establishments. Supervision of other workers may be included. Occupations in this sub-major group are classified into the following minor group: 541 Protective Services Workers

Protocol Event

IRI: http://purl.obolibrary.org/obo/NCIT_C74589

Other important events that occur during a trial but are not driven by protocol requirements. [Definition Source: NCI]

Psoriasis

IRI: http://purl.obolibrary.org/obo/NCIT_C3346

An autoimmune condition characterized by red, well-delineated plaques with silvery scales that are usually on the extensor surfaces and scalp. They can occasionally present with these manifestations: pustules; erythema and scaling in intertriginous areas, and erythroderma, that are often distributed on extensor surfaces and scalp. [Definition Source: NCI][attribution: NICHD]

Pulmonary Embolism

IRI: http://purl.obolibrary.org/obo/NCIT_C50713

The obstruction of the pulmonary artery or one of its branches by an embolus, sometimes associated with infarction of the lung. [Definition Source: NCI]

Pulmonary Function Test

IRI: http://purl.obolibrary.org/obo/NCIT_C38081

A broad range of tests that are performed to assess how well lungs inhale and exhale air and how efficiently they transfer oxygen into the blood. [Definition Source: NCI]

Pulmonary Sarcoidosis

IRI: http://purl.obolibrary.org/obo/NCIT_C34997

Sarcoidosis affecting the lung parenchyma. It is characterized by the presence of non-necrotizing granulomas in the lung tissues. It is manifested with dyspnea, cough, fever, night sweats, fatigue, and weight loss. [Definition Source: NCI]

Pulmonary Thromboembolism

IRI: https://w3id.org/BRAINTEASER/ontology/schema/Pulmonary_Thromboembolism

Questionnaire

IRI: http://purl.obolibrary.org/obo/NCIT_C17048

A predetermined set of questions. [Definition Source: NCI]

Recurrent Disease

IRI: http://purl.obolibrary.org/obo/NCIT_C38155

The return of a disease after a period of remission. [Definition Source: NCI]

Refuse workers and other elementary workers

IRI: <http://data.europa.eu/esco/isco/C96>

Refuse workers and other elementary workers collect, process and recycle garbage from buildings, yards, streets and other public places. They keep streets and other public places clean and tidy, deliver and carry messages and packages and perform odd jobs for private households or establishments. Most occupations in this sub-major group require skills at the first ISCO skill level. Tasks performed by workers in this sub-major group usually include: collecting, loading and unloading garbage; sweeping streets, parks and other public places; chopping firewood; collecting and carrying firewood, water, packages, luggage and messages; beating dust out of carpets and performing other odd-job tasks. Occupations in this sub-major group are classified into the following minor groups: 961 Refuse Workers 962 Other Elementary Workers

Relative

IRI: http://purl.obolibrary.org/obo/NCIT_C21480

A person related by blood or marriage. [Definition Source: NCI]

Renal Colic

IRI: http://purl.obolibrary.org/obo/NCIT_C78593

Paroxysmal and severe flank pain radiating to the inguinal area. It is caused by the passage of a kidney stone through the ureter. [Definition Source: NCI]

Rheumatoid Arthritis

IRI: http://purl.obolibrary.org/obo/NCIT_C2884

A chronic, systemic autoimmune disorder characterized by inflammation in the synovial membranes and articular surfaces. It manifests primarily as a symmetric, erosive polyarthritis that spares the axial skeleton and is typically associated with the presence in the serum of rheumatoid factor. [Definition Source: NCI]

Sales workers

IRI: <http://data.europa.eu/esco/isco/C52>

Sales workers sell and demonstrate goods in wholesale or retail shops, at stalls and markets, door-to-door, via telephone or customer contact centres. They may record and accept payment for goods and services purchased, and may operate small retail outlets. Competent performance in most occupations in this sub-major group requires skills at the second ISCO skill level. Tasks performed by workers in this sub-major group usually include: selling goods in wholesale or retail establishments, at street or market stalls, door-to-door, via telephone or customer contact centres; demonstrating and displaying goods to potential customers; selling and serving food for immediate consumption at counters and in the street; buying or contracting a regular supply of products to be sold; stacking and displaying goods for sale and wrapping or packing goods sold; determining product mix, stock and price levels for goods to be sold; operating cash registers, optical price scanners, computers or other equipment to record and accept payment for the purchase of goods and services. Supervision of other workers may be required in some occupations classified here. Occupations in this sub-major group are classified into the following minor groups: 521 Street and Market Salespersons 522 Shop Salespersons 523 Cashiers and Ticket Clerks 524 Other Sales Workers Note Shop managers and sales managers are classified in Major Group 1: Managers. Technical, medical and information and communications technology sales professionals are classified in Major Group 2: Professionals. Commercial sales and insurance representatives, finance and trade brokers, are classified in Major Group 3: Technicians and Associate Professionals. Street vendors (excluding food) are classified in Major Group 9: Elementary Occupations.

Scarlet Fever

IRI: http://purl.obolibrary.org/obo/NCIT_C94575

A streptococcal infection, mainly occurring among children, that is characterized by a red skin rash, sore throat, and fever. [Definition Source: NCI]

Science and engineering associate professionals

IRI: <http://data.europa.eu/esco/isco/C31>

Science and engineering associate professionals perform technical tasks connected with research and operational methods in science and engineering. They supervise and control technical and operational aspects of mining, manufacturing, construction and other engineering operations, and operate technical equipment including aircraft and ships. Competent performance in most occupations in this sub-major group requires skills at the third ISCO skill level. Tasks performed by workers in this sub-major group usually include: setting up, monitoring and operating instruments and equipment, conducting and monitoring experiments and tests of systems; collecting and testing samples; recording observations and analysing data; preparing, revising and interpreting technical drawings and diagrams; coordinating, supervising, controlling and scheduling the activities of other workers; operating and monitoring switchboards, computerized

control systems, and multi-function process control machinery; performing technical functions to ensure safe and efficient movement and operations in ships, aircraft and other equipment. Occupations in this sub-major group are classified into the following minor groups: 311 Physical and Engineering Science Technicians 312 Mining, Manufacturing and Construction Supervisors 313 Process Control Technicians 314 Life Science Technicians and Related Associate Professionals 315 Ship and Aircraft Controllers and Technicians

Science and engineering professionals

IRI: <http://data.europa.eu/esco/isco/C21>

Science and engineering professionals conduct research; improve or develop concepts, theories and operational methods; or apply scientific knowledge relating to fields such as physics, astronomy, meteorology, chemistry, geophysics, geology, biology, ecology, pharmacology, medicine, mathematics, statistics, architecture, engineering, design and technology. Competent performance in most occupations in this sub-major group requires skills at the fourth ISCO skill level. Tasks performed by workers in this sub-major group usually include: conducting research, enlarging, advising on or applying scientific knowledge obtained through the study of structures and properties of physical matter and phenomena, chemical characteristics and processes of various substances, materials and products, all forms of human, animal and plant life and of mathematical and statistical concepts and methods; advising on, designing and directing construction of buildings, towns and traffic systems, or civil engineering and industrial structures, as well as machines and other equipment; advising on and applying mining methods and ensuring their optimum use; surveying land and sea and making maps; studying and advising on technological aspects of particular materials, products and processes, and on efficiency of production and work organization; preparing scientific papers and reports. Supervision of other workers may be included. Occupations in this sub-major group are classified into the following minor groups: 211 Physical and Earth Science Professionals 212 Mathematicians, Actuaries and Statisticians 213 Life Science Professionals 214 Engineering Professionals (excluding Electrotechnology) 215 Electrotechnology Engineers 216 Architects, Planners, Surveyors and Designers

Second Degree Relative

IRI: http://purl.obolibrary.org/obo/NCIT_C19811

Any relative who is two meioses away from a particular individual in a family; a relative with whom one quarter of an individual's genes is shared (i.e., grandparent, grandchild, uncle, aunt, nephew, niece, half-sibling) (from Genetics Home Reference glossary) [Definition Source: NCI]

Seizure Disorder

IRI: http://purl.obolibrary.org/obo/NCIT_C3020

A brain disorder characterized by episodes of abnormally increased neuronal discharge resulting in transient episodes of sensory or motor neurological dysfunction, or psychic dysfunction. These episodes may or may not be associated with loss of consciousness or convulsions. [Definition Source: NCI]

Sensory Disorder

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IRI: http://purl.obolibrary.org/obo/NCIT_C63711

An interruption or alteration in the sensory activity or functions of the nervous system. [Definition Source: NCI]

Serum Glutamic Pyruvic Transaminase, CTCAE

IRI: http://purl.obolibrary.org/obo/NCIT_C55098

Severe Or Immunosuppression-related Infection

IRI: https://w3id.org/BRAINTEASER/ontology/schema/Severe_Or_Immunosuppression-related_Infection

Severe infection or related to immunosuppression

Shoulder Dislocation

IRI: http://purl.obolibrary.org/obo/NCIT_C35020

A dislocation of the shoulder joint. [Definition Source: NCI]

Sibling

IRI: http://purl.obolibrary.org/obo/NCIT_C25204

A person's brother or sister. [Definition Source: NCI]

Sister

IRI: http://purl.obolibrary.org/obo/NCIT_C25680

A female sibling. [Definition Source: NCI]

Sjogren Syndrome

IRI: http://purl.obolibrary.org/obo/NCIT_C26883

An autoimmune disorder affecting the salivary and lacrimal glands. Morphologically, it is characterized by the presence of lymphocytic and plasmacytic infiltrates which cause destruction of these glands. It results in dry mouth and dry eyes. It may be associated with the presence of other autoimmune disorders, including rheumatoid arthritis and lupus erythematosus. [Definition Source: NCI]

Smoking

IRI: http://purl.obolibrary.org/obo/NCIT_C154329

The act of puffing and/or inhaling the combustion products of a substance so as to be tasted and absorbed into the bloodstream. [Definition Source: NCI]

SOD1

IRI: http://purl.obolibrary.org/obo/OGG_3000006647

This gene plays a role in the detoxification of superoxide radicals in the cytosol. [Definition Source: NCI]

Son

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IRI: http://purl.obolibrary.org/obo/NCIT_C25205

A male human offspring. [Definition Source: NCI]

Spatial Thing

IRI: http://www.w3.org/2003/01/geo/wgs84_pos#SpatialThing

Spinal Cord

IRI: http://purl.obolibrary.org/obo/NCIT_C12464

The elongated, approximately cylindrical part of the central nervous system of vertebrates that lies in the vertebral canal and from which the spinal nerves emerge. [Definition Source: NCI][attribution: On-line Medical Dictionary]

Spinal Cord Symptom

IRI: https://w3id.org/BRAINTEASER/ontology/schema/Spinal_Cord_Symptom

Stationary plant and machine operators

IRI: <http://data.europa.eu/esco/isco/C81>

Stationary plant and machine operators monitor and operate stationary industrial plant, machinery and equipment, or for which mobility is not an integral part of operation. Competent performance in most occupations in this sub-major group requires skills at the second ISCO skill level. The work mainly calls for experience with and an understanding of the industrial plant, machinery or equipment being operated and monitored. Ability to cope with machine-paced operations and to adapt to innovations in machinery and equipment are often required. Tasks performed by workers in this sub-major group usually include: setting up, operating and monitoring a variety of stationary plant and machinery; detecting malfunctions and taking corrective action; examining outputs for defects and conformity with specifications and adjusting machine settings accordingly; performing maintenance, repairs and cleaning; recording data and maintaining production records. Supervision of other workers may be included. Occupations in this sub-major group are classified into the following minor groups: 811 Mining and Mineral Processing Plant Operators 812 Metal Processing and Finishing Plant Operators 813 Chemical and Photographic Products Plant and Machine Operators 814 Rubber, Plastic and Paper Products Machine Operators 815 Textile, Fur and Leather Products Machine Operators 816 Food and Related Products Machine Operators 817 Wood Processing and Papermaking Plant Operators 818 Other Stationary Plant and Machine Operators Note Operators of machinery that involves automated control of multiple processes or functions are included in Minor Group 313: Process Control Technicians.

Street and related sales and service workers

IRI: <http://data.europa.eu/esco/isco/C95>

Street and related sales and services workers sell goods (excluding food) for immediate consumption, and provide a variety of services on streets and in other public places such as stations. Most occupations in this sub-major group require skills at the first ISCO skill level. Tasks performed by workers in this sub-major group usually include: buying or making various items for sale; loading and unloading items for sale and transporting

them; obtaining the materials necessary to perform services; approaching people on the street to offer goods or services; cleaning and polishing shoes; cleaning and polishing car windows; running errands; assisting car drivers to find a parking place and ensuring that the car is not damaged during the driver's absence; handing out leaflets and free newspapers; receiving immediate payment. Occupations in this sub-major group are classified into the following minor groups: 951 Street and Related Services Workers 952 Street Vendors (excluding Food)

Stroke

IRI: http://www.ebi.ac.uk/efo/EFO_0000712

A sudden loss of neurological function secondary to hemorrhage or ischemia in the brain parenchyma due to a vascular event. [NCIT:C3390]

Subsistence farmers, fishers, hunters and gatherers

IRI: <http://data.europa.eu/esco/isco/C63>

Subsistence farmers, fishers, hunters and gatherers grow and harvest field or tree and shrub crops, vegetables and fruit; gather wild fruits, medicinal and other plants; tend or hunt animals; catch fish and gather various forms of aquatic life in order to provide food, shelter and, in some cases, a minimum of cash income for themselves and their households. Competent performance in most occupations in this sub-major group requires skills at the second ISCO skill level. Tasks performed by workers in this sub-major group usually include: preparing the soil; sowing, planting, tending and harvesting field crops; growing vegetables, fruit and other tree and shrub crops; gathering wild fruits, medicinal and other plants; breeding, tending and feeding animals and poultry mainly to obtain meat, eggs, milk, hair, skin or other products; hunting or trapping animals; catching fish and gathering other forms of aquatic life; fetching water and gathering firewood; storing produce for later use and carrying out some processing of produce; building and maintaining houses and other shelters; making tools, clothes and utensils for use by the household; selling or bartering some products at local markets. Occupations in this sub-major group are classified into the following minor groups: 631 Subsistence Crop Farmers 632 Subsistence Livestock Farmers 633 Subsistence Mixed Crop and Livestock Farmers 634 Subsistence Fishers, Hunters, Trappers and Gatherers Notes Jobs should be classified in Sub-major Group 63: Subsistence Farmers, Fishers, Hunters and Gatherers when goods (mostly food) are produced mainly for own consumption or for consumption by other members of the worker's household. If a large surplus is produced, and more goods are sold than consumed, but the main aim of production was for own consumption, the jobs should nevertheless be classified in Sub-major Group 63. Jobs should only be classified in Sub-major Group 61: Market-oriented Skilled Agricultural Workers, or 62: Market-oriented Skilled Forestry, Fishery and Hunting Workers, if the main aim of the activity is to produce goods for the market. Jobs are also classified in Sub-major Group 63 when goods are produced only for own consumption or for consumption by members of the worker's household, and no cash income or bartering is involved.

Supratentorial Symptom

IRI: https://w3id.org/BRAINTEASER/ontology/schema/Supratentorial_Symptom

Surgical Procedure

IRI: http://purl.obolibrary.org/obo/NCIT_C15329

A diagnostic or treatment procedure performed by manual and/or instrumental means, often involving an incision and the removal or replacement of a diseased organ or tissue; of or relating to or involving or used in surgery or requiring or amenable to treatment by surgery. [Definition Source: NCI]

Symptom

IRI: http://purl.obolibrary.org/obo/NCIT_C4876

Subjective evidence of disease perceived by the patient. [Definition Source: NCI]

Syncope

IRI: http://purl.obolibrary.org/obo/NCIT_C35053

A spontaneous loss of consciousness caused by insufficient blood supply to the brain. [Definition Source: NCI]

TARDBP

IRI: http://purl.obolibrary.org/obo/OGG_3000023435

This gene is involved in transcription and mRNA splicing. [Definition Source: NCI]

Teaching professionals

IRI: <http://data.europa.eu/esco/isco/C23>

Teaching professionals teach the theory and practice of one or more disciplines at different educational levels; conduct research; improve or develop concepts, theories and operational methods pertaining to their particular discipline; and prepare scholarly papers and books. Competent performance in most occupations in this sub-major group requires skills at the fourth ISCO skill level. Tasks performed by workers in this sub-major group usually include: conducting classes, courses, or tutorials at a particular educational level for educational and vocational purposes, including private lessons; conducting adult literacy programmes; teaching and educating persons with learning difficulties or special needs; designing and modifying curricula; inspecting and advising on teaching methods and aids; participating in decisions concerning the organization of teaching and related activities at schools and universities; conducting research in particular subjects to improve or develop concepts, theories or operational methods for application in industrial and other fields; preparing scholarly papers and books. Supervision of other workers may be included. Occupations in this sub-major group are classified into the following minor group: 231 University and Higher Education Teachers 232 Vocational Education Teachers 233 Secondary Education Teachers 234 Primary School and Early Childhood Teachers 235 Other Teaching Professionals

Thalassemia

IRI: http://purl.obolibrary.org/obo/NCIT_C35069

An inherited blood disorder characterized by a decreased synthesis of one of the polypeptide chains that form hemoglobin. Anemia results from this abnormal hemoglobin formation. [Definition Source: NCI]

Therapeutic Procedure

IRI: http://purl.obolibrary.org/obo/NCIT_C49236

An action or administration of therapeutic agents to produce an effect that is intended to alter or stop a pathologic process. [Definition Source: NCI]

Thoracic skeleton

IRI: http://purl.obolibrary.org/obo/UBERON_0014477

Subdivision of skeletal system that consists of all skeletal elements in the thoracic region of the trunk. In most vertebrates this is the rib cage and sternum. [http://en.wikipedia.org/wiki/Rib_cage <https://orcid.org/0000-0002-6601-2165>]

Thromboembolism

IRI: http://purl.obolibrary.org/obo/NCIT_C28195

Occlusion of the lumen of a vessel by a thrombus that has migrated from a distal site via the blood stream. [Definition Source: NCI]

Thyroid Gland Disorder

IRI: http://purl.obolibrary.org/obo/NCIT_C26893

A non-neoplastic or neoplastic disorder that affects the thyroid gland. Representative examples include hyperthyroidism, hypothyroidism, thyroiditis, follicular adenoma, and carcinoma. [Definition Source: NCI]

Tracheotomy

IRI: http://purl.obolibrary.org/obo/NCIT_C15341

Creation of a surgical opening into the trachea. [Definition Source: NCI]

Transient Ischemic Attack

IRI: http://purl.obolibrary.org/obo/NCIT_C50781

A brief attack (from a few minutes to an hour) of cerebral dysfunction of vascular origin, with no persistent neurological deficit. [Definition Source: NCI]

Trospium

IRI: <http://purl.bioontology.org/ontology/ATC/G04BD09>

Trospium chloride is used to treat overactive bladder.

Type 1 Diabetes Mellitus

IRI: http://purl.obolibrary.org/obo/NCIT_C2986

A chronic condition characterized by minimal or absent production of insulin by the pancreas. [Definition Source: NCI][attribution: NICHD]

Type 2 Diabetes Mellitus

IRI: http://purl.obolibrary.org/obo/NCIT_C26747

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A type of diabetes mellitus that is characterized by insulin resistance or desensitization and increased blood glucose levels. This is a chronic disease that can develop gradually over the life of a patient and can be linked to both environmental factors and heredity. [Definition Source: NCI]

Uncle

IRI: http://purl.obolibrary.org/obo/NCIT_C71404

The brother of your father or mother; the husband of your aunt. [Definition Source: NCI]

Vertebral Hernia

IRI: https://w3id.org/BRAINTEASER/ontology/schema/Vertebral_Hernia

A.2 Object Properties

account

IRI: <http://xmlns.com/foaf/0.1/account>

Indicates an account held by this agent.

account

IRI: <http://xmlns.com/foaf/0.1/holdsAccount>

Indicates an account held by this agent.

account service homepage

IRI: <http://xmlns.com/foaf/0.1/accountServiceHomepage>

Indicates a homepage of the service provide for this online account.

AIM chat ID

IRI: <http://xmlns.com/foaf/0.1/aimChatID>

area

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/area>

The area of diagnostic imaging.

associatedSubstance

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/associatedSubstance>

When something of interest is associated to a pharmaceutical substance.

based near

IRI: http://xmlns.com/foaf/0.1/based_near

A location that something is based near, for some broadly human notion of near.

consists

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/consists>

An event consists of an intervention or procedure.

current project

IRI: <http://xmlns.com/foaf/0.1/currentProject>

A current project this person works on.

depiction

IRI: <http://xmlns.com/foaf/0.1/depiction>

A depiction of some thing.

depicts**IRI:** <http://xmlns.com/foaf/0.1/depicts>

A thing depicted in this representation.

determinedBy**IRI:** <https://w3id.org/BRAINTEASER/ontology/schema/determinedBy>

A comorbidity determined by a disease or disorder.

employs**IRI:** <https://w3id.org/BRAINTEASER/ontology/schema/employs>

When a disease, which might be related to a comorbidity, employs a particular therapeutic procedure.

enrolledIn**IRI:** <https://w3id.org/BRAINTEASER/ontology/schema/enrolledIn>

A person enrolled in a clinical trial participation.

ethnicity**IRI:** <https://w3id.org/BRAINTEASER/ontology/schema/ethnicity>

The ethnicity of a patient.

focus**IRI:** <http://xmlns.com/foaf/0.1/focus>

The underlying or 'focal' entity associated with some SKOS-described concept.

funded by**IRI:** <http://xmlns.com/foaf/0.1/fundedBy>

An organization funding a project or person.

hasAdministration**IRI:** <https://w3id.org/BRAINTEASER/ontology/schema/hasAdministration>

When a therapeutic procedure involves the administration of pharmacologic substances.

hasAssociatedPregnancy**IRI:** <https://w3id.org/BRAINTEASER/ontology/schema/hasAssociatedPregnancy>

When a relapse is related to a pregnancy.

hasDisease**IRI:** <https://w3id.org/BRAINTEASER/ontology/schema/hasDisease>

A person has a disease or disorder.

hasGene

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/hasGene>

A patient has a gene.

hasMajorTrauma

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/hasMajorTrauma>

Major trauma before onset.

hasOccupation

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/hasOccupation>

A patient has an occupation.

hasPregnancy

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/hasPregnancy>

An event that consists in a pregnancy.

hasRegisteredBehaviour

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/hasRegisteredBehaviour>

An event has a registered behaviour.

hasRegisteredComorbidity

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/hasRegisteredComorbidity>

An event has a registered comorbidity.

hasRelapse

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/hasRelapse>

State that an event consists on a relapse.

hasRelative

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/hasRelative>

A patient has a relative.

hasSurgicalIntervention

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/hasSurgicalIntervention>

Surgical intervention before onset.

hasSymptom

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/hasSymptom>

An event is associated to a symptom.

hasTrauma

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/hasTrauma>

An event has a registered trauma.

homepage

IRI: <http://xmlns.com/foaf/0.1/homepage>

A homepage for some thing.

ICQ chat ID

IRI: <http://xmlns.com/foaf/0.1/icqChatID>

image

IRI: <http://xmlns.com/foaf/0.1/img>

An image that can be used to represent some thing (ie. those depictions which are particularly representative of something, eg. one's photo on a homepage).

interest

IRI: <http://xmlns.com/foaf/0.1/interest>

A page about a topic of interest to this person.

is primary topic of

IRI: <http://xmlns.com/foaf/0.1/isPrimaryTopicOf>

A document that this thing is the primary topic of.

isAboutDisease

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/isAboutDisease>

A clinical trial is about disease or disorder.

isPerson

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/isPerson>

A relative is a person.

isRelated

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/isRelated>

An administration regards a pharmacologic substance.

jabber ID

IRI: <http://xmlns.com/foaf/0.1/jabberID>

knows

IRI: <http://xmlns.com/foaf/0.1/knows>

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A person known by this person (indicating some level of reciprocated interaction between the parties).

logo

IRI: <http://xmlns.com/foaf/0.1/logo>

A logo representing some thing.

made

IRI: <http://xmlns.com/foaf/0.1/made>

Something that was made by this agent.

maker

IRI: <http://xmlns.com/foaf/0.1/maker>

An agent that made this thing.

member

IRI: <http://xmlns.com/foaf/0.1/member>

Indicates a member of a Group

MSN chat ID

IRI: <http://xmlns.com/foaf/0.1/msnChatID>

openid

IRI: <http://xmlns.com/foaf/0.1/openid>

An OpenID for an Agent.

page

IRI: <http://xmlns.com/foaf/0.1/page>

A page or document about this thing.

partecipate

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/partecipate>

A clinical trial participation participates in a clinical trial.

past project

IRI: <http://xmlns.com/foaf/0.1/pastProject>

A project this person has previously worked on.

personal mailbox

IRI: <http://xmlns.com/foaf/0.1/mbox>

A personal mailbox, ie. an Internet mailbox associated with exactly one owner, the first owner of this mailbox. This is a 'static inverse functional property', in that there is (across time and change) at most one individual that ever has any particular value for foaf:mbox.

pertain

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/pertain>

A clinical trial pertains clinics and hospitals.

phone

IRI: <http://xmlns.com/foaf/0.1/phone>

A phone, specified using fully qualified tel: URI scheme (refs: <http://www.w3.org/Addressing/schemes.html#tel>).

primary topic

IRI: <http://xmlns.com/foaf/0.1/primaryTopic>

The primary topic of some page or document.

publications

IRI: <http://xmlns.com/foaf/0.1/publications>

A link to the publications of this person.

relapseAssessment

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/relapseAssessment>

Refers to the assessment related to a relapse.

requiresMRI

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/requiresMRI>

When a relapse requires an MRI.

schoolHomepage

IRI: <http://xmlns.com/foaf/0.1/schoolHomepage>

A homepage of a school attended by the person.

sha1sum of a personal mailbox URI name

IRI: http://xmlns.com/foaf/0.1/mbox_sha1sum

site

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/site>

Site of onset.

surgicalArea

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/surgicalArea>

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The area involved in a surgical procedure.

symptomArea

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/symptomArea>

The area involved in a symptom.

theme

IRI: <http://xmlns.com/foaf/0.1/theme>

A theme.

thumbnail

IRI: <http://xmlns.com/foaf/0.1/thumbnail>

A derived thumbnail image.

tipjar

IRI: <http://xmlns.com/foaf/0.1/tipjar>

A tipjar document for this agent, describing means for payment and reward.

topic

IRI: <http://xmlns.com/foaf/0.1/topic>

A topic of some page or document.

topic_interest

IRI: http://xmlns.com/foaf/0.1/topic_interest

A thing of interest to this person.

traumaArea

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/traumaArea>

The area involved in a trauma.

undergo

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/undergo>

A patient undergoes an event.

weblog

IRI: <http://xmlns.com/foaf/0.1/weblog>

A weblog of some thing (whether person, group, company etc.).

work info homepage

IRI: <http://xmlns.com/foaf/0.1/workInfoHomepage>

A work info homepage of some person; a page about their work for some organization.

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workplace homepage

IRI: <http://xmlns.com/foaf/0.1/workplaceHomepage>

A workplace homepage of some person; the homepage of an organization they work for.

Yahoo chat ID

IRI: <http://xmlns.com/foaf/0.1/yahooChatID>

A.3 Data Properties

account name

IRI: <http://xmlns.com/foaf/0.1/accountName>

Indicates the name (identifier) associated with this online account.

activityType

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/activityType>

The type of physical activity carried out.

administrationRoute

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/administrationRoute>

A route of administration in pharmacology and toxicology is the path by which a drug, fluid, poison, or other substance is taken into the body.

age

IRI: <http://xmlns.com/foaf/0.1/age>

The age in years of some agent.

age_onset

IRI: https://w3id.org/BRAINTEASER/ontology/schema/age_onset

Age of the patient at onset (expressed in years).

AIM chat ID

IRI: <http://xmlns.com/foaf/0.1/aimChatID>

albumin

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/albumin>

A quantitative measurement of albumin present in a sample of CSF. Unit of measure : [mg/l].

Albumin level

IRI: https://w3id.org/BRAINTEASER/ontology/schema/Albumin_level

A quantitative measurement of albumin present in a sample [defined in grams per decilitre (g/dL)].

Albumin lower range

IRI: https://w3id.org/BRAINTEASER/ontology/schema/Albumin_lower_range

A lower range of albumin present in a sample [defined in grams per decilitre (g/dL)].

Albumin upper range

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IRI: https://w3id.org/BRAINTEASER/ontology/schema/Albumin_upper_range

An upper range of albumin present in a sample [defined in grams per decilitre (g/dL)].

alive

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/alive>

The status indicating whether the patient is still alive.

alsfrs-r-R

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/alsfrs-r-R>

Revised respiratory subscore. Sum of items 10,11 and 12.

alsfrs-r-tot

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/alsfrs-r-tot>

Revised Amyotrophic Lateral Sclerosis Functional Rating Scale. Sum of items 1,2,3,4,5,6,7,8,9,10,11 and 12.

alsfrs-tot

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/alsfrs-tot>

Amyotrophic Lateral Sclerosis Functional Rating Scale. Sum of items 1,2,3,4,5,6,7,8,9 and old 10.

alsfrs_1

IRI: https://w3id.org/BRAINTEASER/ontology/schema/alsfrs_1

Item 1: speech.

alsfrs_10

IRI: https://w3id.org/BRAINTEASER/ontology/schema/alsfrs_10

Item 10: dyspnea.

alsfrs_11

IRI: https://w3id.org/BRAINTEASER/ontology/schema/alsfrs_11

Item 11: orthopnea.

alsfrs_12

IRI: https://w3id.org/BRAINTEASER/ontology/schema/alsfrs_12

Item 12: respiratory insufficiency.

alsfrs_2

IRI: https://w3id.org/BRAINTEASER/ontology/schema/alsfrs_2

Item 2: salivation.

alsfrs_3

IRI: https://w3id.org/BRAINTEASER/ontology/schema/alsfrs_3
Item 3: swallowing.

alsfrs_4

IRI: https://w3id.org/BRAINTEASER/ontology/schema/alsfrs_4
Item 4: handwriting.

alsfrs_5

IRI: https://w3id.org/BRAINTEASER/ontology/schema/alsfrs_5
Item 5: cutting food and handling utensils.

alsfrs_6

IRI: https://w3id.org/BRAINTEASER/ontology/schema/alsfrs_6
Item 6: dressing and hygiene.

alsfrs_7

IRI: https://w3id.org/BRAINTEASER/ontology/schema/alsfrs_7
Item 7: turning in bed and adjusting bed clothes.

alsfrs_8

IRI: https://w3id.org/BRAINTEASER/ontology/schema/alsfrs_8
Item 8: walking.

alsfrs_9

IRI: https://w3id.org/BRAINTEASER/ontology/schema/alsfrs_9
Item 9: climbing stairs.

alsfrs_old10

IRI: https://w3id.org/BRAINTEASER/ontology/schema/alsfrs_old10
Item old 10: breathing.

alsfrsb

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/alsfrsb>
Bulbar subscore. Sum of items 1,2 and 3.

ambulation

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/ambulation>
EDSS score that regards the ambulation.

AOPabsolute

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/AOPabsolute>

The airway occlusion pressure, P0.1, is the negative airway pressure generated during the first 100 msec of an occluded inspiration.

AOPrelative

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/AOPrelative>

The airway occlusion pressure, P0.1, is the negative airway pressure generated during the first 100 msec of an occluded inspiration.

axial

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/axial>

The part of the skeleton that includes the skull and spinal column and sternum and ribs. [Definition Source: NCI]

birthday

IRI: <http://xmlns.com/foaf/0.1/birthday>

The birthday of this Agent, represented in mm-dd string form, eg. '12-31'.

birthplace

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/birthplace>

The birthplace of a person. We do not specify the exact geographical location, but we classify the birthplace into one out of five possible categories based on birthplace size.

birthplaceCharacteristics

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/birthplaceCharacteristics>

The main characteristics of the birthplace. We define a coarse grained classification

bloodAlbuminNormal

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/bloodAlbuminNormal>

States if the value of albumin observed in the blood test is normal or not.

bloodBasophil

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/bloodBasophil>

A percentage measure of eosinophil present in a sample of blood. Unit of measure : [%].

bloodBasophilNormal

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/bloodBasophilNormal>

States if the value of basophil observed in the blood test is normal or not.

bloodEosinophil

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IRI: <https://w3id.org/BRAINTEASER/ontology/schema/bloodEosinophil>

A percentage measure of eosinophil present in a sample of blood. Unit of measure : [%].

bloodEosinophilNormal

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/bloodEosinophilNormal>

States if the value of eosinophil observed in the blood test is normal or not.

bloodErythrocytes

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/bloodErythrocytes>

A quantitative measurement of erythrocytes present in a sample of blood. Unit of measure : [10e12/L].

bloodErythrocytesNormal

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/bloodErythrocytesNormal>

States if the value of erythrocytes observed in the blood test is normal or not.

bloodHemoglobin

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/bloodHemoglobin>

A quantitative measurement of platelet present in a sample of blood. Unit of measure : [g/dL].

bloodHemoglobinNormal

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/bloodHemoglobinNormal>

States if the value of hemoglobin observed in the blood test is normal or not.

bloodLeukocytes

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/bloodLeukocytes>

A quantitative measurement of leukocytes present in a sample of blood. Unit of measure : [10e9/L].

bloodLeukocytesNormal

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/bloodLeukocytesNormal>

States if the value of leukocytes observed in the blood test is normal or not.

bloodLymphocytes

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/bloodLymphocytes>

A percentage measure of leukocytes present in a sample of blood. Unit of measure : [%].

bloodLymphocytesNormal

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/bloodLymphocytesNormal>

States if the value of lymphocytes observed in the blood test is normal or not.

bloodMonocytes

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/bloodMonocytes>

A percentage measure of monocytes present in a sample of blood. Unit of measure : [%].

bloodMonocytesNormal

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/bloodMonocytesNormal>

States if the value of monocytes observed in the blood test is normal or not.

bloodNeutrophil

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/bloodNeutrophil>

A percentage measure of neutrophil present in a sample of blood. Unit of measure : [%].

bloodNeutrophilNormal

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/bloodNeutrophilNormal>

States if the value of neutrophil observed in the blood test is normal or not.

bloodPlatelet

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/bloodPlatelet>

A quantitative measurement of platelet present in a sample of blood. Unit of measure : [10e9/L].

bloodPlateletNormal

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/bloodPlateletNormal>

States if the value of platelet observed in the blood test is normal or not.

bloodSugar

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/bloodSugar>

A quantitative measurement of blood sugar present in a sample of CSF. Unit of measure : [mg/l].

bloodTotalProtein

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/bloodTotalProtein>

A quantitative measurement of total protein present in a sample of blood. Unit of measure : [g/dL].

bloodTotalProteinNormal

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/bloodTotalProteinNormal>

States if the value of the protein observed in the blood test is normal or not.

bmi

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/bmi>

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Body Mass Index (BMI).

bowel and bladder

IRI: https://w3id.org/BRAINTEASER/ontology/schema/bowel_and_bladder

EDSS is based on measures of impairment in eight functional systems (FS). This is about bowel and bladder function.

brainstem

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/brainstem>

EDSS is based on measures of impairment in eight functional systems (FS). Brainstem is about problems with speech, swallowing and nystagmus

brainstem_relapse

IRI: https://w3id.org/BRAINTEASER/ontology/schema/brainstem_relapse

States if the relapse involves the brainstem.

bulbar

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/bulbar>

A rounded dilation or expansion in a canal, vessel, or organ. [Definition Source: NCI]

cerebellar

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/cerebellar>

EDSS is based on measures of impairment in eight functional systems (FS). Cerebellar is about ataxia, loss of balance, coordination or tremor

cerebellum_relapse

IRI: https://w3id.org/BRAINTEASER/ontology/schema/cerebellum_relapse

States is the relapse involves the cerebellum.

cerebral functions

IRI: https://w3id.org/BRAINTEASER/ontology/schema/cerebral_functions

EDSS is based on measures of impairment in eight functional systems (FS). Cerebral functions is about problems with thinking and memory.

cerebrospinalFluid

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/cerebrospinalFluid>

States if there are alterations or not.

cerebrospinalOligoconalBands

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/cerebrospinalOligoconalBands>

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The presence of more than one immunoglobulin band in the serum, urine, or cerebrospinal fluid. It usually results from infectious or immunologic disorders. [Definition Source: NCI]

CK level

IRI: https://w3id.org/BRAINTEASER/ontology/schema/CK_level

A quantitative measurement of the amount of creatine kinase present in a sample [defined in units per litre (U/L)].

CK lower range

IRI: https://w3id.org/BRAINTEASER/ontology/schema/CK_lower_range

A lower range of the amount of creatine kinase present in a sample [defined in units per litre (U/L)].

CK upper range

IRI: https://w3id.org/BRAINTEASER/ontology/schema/CK_upper_range

An upper range of the amount of creatine kinase present in a sample [defined in units per litre (U/L)].

clinicalTrialDescription

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/clinicalTrialDescription>

The description of a clinical trial participation.

cognitive changes

IRI: https://w3id.org/BRAINTEASER/ontology/schema/cognitive_changes

Pertinente o caratterizzato dalla cognizione. Quell'operazione della mente che ci rende consapevoli degli oggetti di pensiero o di percezione; include tutti gli aspetti del percepire, pensare o ricordare. [Fonte di definizione: NCI]

cognitive symptoms

IRI: https://w3id.org/BRAINTEASER/ontology/schema/cognitive_symptoms

Signs and symptoms of higher cortical dysfunction caused by organic conditions. These include certain behavioral alterations and impairments of skills involved in the acquisition, processing, and utilization of knowledge or information.

complications

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/complications>

Any kind of complications related to the pregnancy

contiguousLesions

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/contiguousLesions>

Presence of extended contiguous lesions equal to or greater than 3 vertical segments.

Creatinine level

IRI: https://w3id.org/BRAINTEASER/ontology/schema/Creatinine_level

A quantitative measurement of the amount of creatinine present in a sample [defined in milligrams per decilitre (mg/dL)].

Creatinine lower range

IRI: https://w3id.org/BRAINTEASER/ontology/schema/Creatinine_lower_range

A lower range of the amount of creatinine present in a sample [defined in milligrams per decilitre (mg/dL)].

Creatinine upper range

IRI: https://w3id.org/BRAINTEASER/ontology/schema/Creatinine_upper_range

An upper range of the amount of creatinine present in a sample [defined in milligrams per decilitre (mg/dL)].

criteria

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/criteria>

Criteria for the evaluation of the diagnosis.

dailyCigarettes

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/dailyCigarettes>

The daily number of cigarettes smoked.

dateOfDeath

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/dateOfDeath>

The exact date a patient died.

dextricity

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/dextricity>

The preferred hand of use for controlled and efficient performance of motor tasks. [Definition Source: NCI]

diet

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/diet>

The things a person eats and drinks.

DNA checksum

IRI: <http://xmlns.com/foaf/0.1/dnaChecksum>

A checksum for the DNA of some thing. Joke.

dose

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IRI: <https://w3id.org/BRAINTEASER/ontology/schema/dose>

Dose related to the administration of a pharmaceutical substance.

duration

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/duration>

The duration of a symptom.

educationLevel

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/educationLevel>

An indication of the years of schooling completed in graded public, private, or parochial schools, and in colleges, universities, or professional schools. [Definition Source: NCI]

endDate

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/endDate>

The date on which something ends.

endEvent

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/endEvent>

The event that caused the end of the pregnancy

endReason

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/endReason>

The reason for the end of something.

endYear

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/endYear>

The year on which something ends.

family_name

IRI: http://xmlns.com/foaf/0.1/family_name

The family name of some person.

familyName

IRI: <http://xmlns.com/foaf/0.1/familyName>

The family name of some person.

fatigue

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/fatigue>

Overall tiredness and lack of energy. [Definition Source: NCI][attribution: NICHD]

female period start date

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IRI: https://w3id.org/BRAINTEASER/ontology/schema/female_period_start_date

The exact date on which the menstrual cycle came.

firstName

IRI: <http://xmlns.com/foaf/0.1/firstName>

The first name of a person.

frequency

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/frequency>

Frequency related to the administration of a pharmaceutical substance.

FVCabsolute

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/FVCabsolute>

Absolute forced vital capacity (FVC). This is the amount of air exhaled forcefully and quickly after inhaling as much as you can.

FVCrelative

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/FVCrelative>

Relative forced vital capacity (FVC). This is the amount of air exhaled forcefully and quickly after inhaling as much as you can.

geekcode

IRI: <http://xmlns.com/foaf/0.1/geekcode>

A textual geekcode for this person, see <http://www.geekcode.com/geek.html>

gender

IRI: <http://xmlns.com/foaf/0.1/gender>

The gender of this Agent (typically but not necessarily 'male' or 'female').

generalized

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/generalized>

Widespread, broadly dispersed, common. [Definition Source: NCI]

genomeSequencing

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/genomeSequencing>

A procedure that can determine the DNA sequence for nearly the entire genome of an individual. [Definition Source: NCI]

Given name

IRI: <http://xmlns.com/foaf/0.1/givenName>

The given name of some person.

Given name

IRI: <http://xmlns.com/foaf/0.1/givenname>

The given name of some person.

HDL Cholesterol level

IRI: https://w3id.org/BRAINTEASER/ontology/schema/HDL_Cholesterol_level

The determination of the amount of high-density lipoprotein cholesterol present in a sample [defined in milligrams per decilitre (mg/dL)].

HDL Cholesterol lower range

IRI: https://w3id.org/BRAINTEASER/ontology/schema/HDL_Cholesterol_lower_range

The lower range of high-density lipoprotein cholesterol present in a sample [defined in milligrams per decilitre (mg/dL)].

HDL Cholesterol upper range

IRI: https://w3id.org/BRAINTEASER/ontology/schema/HDL_Cholesterol_upper_range

The upper range of high-density lipoprotein cholesterol present in a sample [defined in milligrams per decilitre (mg/dL)].

Height

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/Height>

The vertical measurement or distance from the base to the top of a subject or participant. [Definition Source: NCI]

hematologic

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/hematologic>

howLong

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/howLong>

The time elapsed since the occurrence of a 'Before Onset' event.

ICQ chat ID

IRI: <http://xmlns.com/foaf/0.1/icqChatID>

IgG

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/IgG>

Immunoglobulin G (IgG): This is the most common antibody. It's in blood and other body fluids, and protects against bacterial and viral infections.

IgG-index

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/IgG-index>

A CSF IgG index measures the levels of IgG in your cerebrospinal fluid. High levels of IgG can mean you have an autoimmune disorder.

impactOnADL

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/impactOnADL>

States if the related relapse affected the Activities of Daily Living.

intensity

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/intensity>

The level of intensity with which the physical activity is carried out.

jabber ID

IRI: <http://xmlns.com/foaf/0.1/jabberID>

kind

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/kind>

The kind of a specific gene.

kingsValue

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/kingsValue>

The score of King's staging system [six stages, from 0 to 5].

lastName

IRI: <http://xmlns.com/foaf/0.1/lastName>

The last name of a person.

LDL Cholesterol level

IRI: https://w3id.org/BRAINTEASER/ontology/schema/LDL_Cholesterol_level

The determination of the amount of low-density lipoprotein cholesterol present in a sample [defined in milligrams per decilitre (mg/dL)].

LDL Cholesterol lower range

IRI: https://w3id.org/BRAINTEASER/ontology/schema/LDL_Cholesterol_lower_range

The lower range of low-density lipoprotein cholesterol present in a sample [defined in milligrams per decilitre (mg/dL)].

LDL Cholesterol upper range

IRI: https://w3id.org/BRAINTEASER/ontology/schema/LDL_Cholesterol_upper_range

The upper range of low-density lipoprotein cholesterol present in a sample [defined in milligrams per decilitre (mg/dL)].

lesionsTI

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IRI: <https://w3id.org/BRAINTEASER/ontology/schema/lesionsT1>

States if the MRI observes some lesions in T1.

lesionsT1-Gadolinium

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/lesionsT1-Gadolinium>

States if there are some Gadolinium-enhancing lesions.

leukocyteCounts

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/leukocyteCounts>

leukocyte counts (/mm³)

limbs

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/limbs>

A body region referring to an upper or lower extremity. [Definition Source: NCI]

location

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/location>

Property for localize the body part involved in the exam.

maritalStatus

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/maritalStatus>

A demographic parameter indicating a person's current conjugal status. [Definition Source: NCI]

measurementUnit

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/measurementUnit>

A unit of measurement is a definite magnitude of a quantity, defined and adopted by convention or by law, that is used as a standard for measurement of the same kind of quantity.

medicineName

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/medicineName>

The full name of the prescribed medicine

menopause

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/menopause>

The permanent cessation of menses, usually defined by 6 to 12 months of amenorrhea in a woman over 45 years of age. [Definition Source: NCI]

MEPabsolute

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/MEPabsolute>

The maximum expiratory pressure (MEP) measures the strength of the muscles that are used during normal and forced breathing out.

MEPrelative

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/MEPrelative>

The maximum expiratory pressure (MEP) measures the strength of the muscles that are used during normal and forced breathing out.

MIPabsolute

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/MIPabsolute>

The maximum inspiratory pressure (MIP) measures the strength of your muscles that are you use during the inspiration of air during normal and forced breathing in.

MIPrelative

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/MIPrelative>

The maximum inspiratory pressure (MIP) measures the strength of your muscles that are you use during the inspiration of air during normal and forced breathing in.

mitosValue

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/mitosValue>

The score of MiToS staging system [five stages, from 1 to 5].

mixedMN

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/mixedMN>

Both lower and upper motor neuron prevalence.

MNDN-PV unologic

IRI: https://w3id.org/BRAINTEASER/ontology/schema/MNDN-PV_unologic

moreThan10PercentWeightloss

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/moreThan10PercentWeightloss>

A patient who has lost more than 10% weight.

MS type

IRI: https://w3id.org/BRAINTEASER/ontology/schema/MS_type

The type of the MS observed during a clinical assessment.

MSInPaediatricAge

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/MSInPaediatricAge>

The patient who contracted multiple sclerosis in paediatric age.

MSN chat ID

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IRI: <http://xmlns.com/foaf/0.1/msnChatID>

Muscle strength assessed by manual testing

IRI:

https://w3id.org/BRAINTEASER/ontology/schema/Muscle_strength_assessed_by_manual_testing

An assessment of muscle strength is typically performed as part of a patient's objective assessment and is an important component of the physical exam that can reveal information about neurologic deficits.

myersBriggs

IRI: <http://xmlns.com/foaf/0.1/myersBriggs>

A Myers Briggs (MBTI) personality classification.

name

IRI: <http://xmlns.com/foaf/0.1/name>

Neurophysiological changes

IRI: https://w3id.org/BRAINTEASER/ontology/schema/Neurophysiological_changes

Neurophysiology is the study of nerve cells (neurones) as they receive and transmit information.

newOrEnlargedLesionsT2

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/newOrEnlargedLesionsT2>

States if there are new or enlarged lesions in T2 since last MRI.

nickname

IRI: <http://xmlns.com/foaf/0.1/nick>

A short informal nickname characterising an agent (includes login identifiers, IRC and other chat nicknames).

NoEvidenceofDiseaseActivity Status

IRI:

https://w3id.org/BRAINTEASER/ontology/schema/NoEvidenceofDiseaseActivity_Status

The concept of 'no evidence of disease activity' (NEDA) has been proposed as a surrogate for treatment response based on the absence of relapses, disability progression and radiological activity.

numberOfLesionsT1-Gadolinium

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/numberOfLesionsT1-Gadolinium>

The number of Gadolinium-enhancing lesions.

numberOfNewOrEnlargedLesionsT2

IRI:

<https://w3id.org/BRAINTEASER/ontology/schema/numberOfNewOrEnlargedLesionsT2>

Number of new or enlarged lesions in T2 since last MRI.

numberOfOligoclonalBands

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/numberOfOligoclonalBands>

The number of bands of immunoglobulins that are seen when a patient's cerebrospinal fluid (CSF) is analyzed.

oligoclonalBands

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/oligoclonalBands>

Oligoclonal bands (OCBs) are bands of immunoglobulins that are seen when a patient's cerebrospinal fluid (CSF) is analyzed.

open box

IRI: https://w3id.org/BRAINTEASER/ontology/schema/open_box

Description of the mutation status of the gene.

other

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/other>

EDSS is based on measures of impairment in eight functional systems (FS). This regards other functional systems not already mentioned.

others_relapse

IRI: https://w3id.org/BRAINTEASER/ontology/schema/others_relapse

States if the relapse involves others disorders.

packYear

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/packYear>

A quantification of lifetime tobacco exposure defined as (number of cigarettes smoked per day x number of years smoked)/20. One pack-year is smoking 20 cigarettes a day for one year. [Definition Source: NCI]

PCO2

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/PCO2>

PCO2 (partial pressure of carbon dioxide) reflects the the amount of carbon dioxide gas dissolved in the blood.

plan

IRI: <http://xmlns.com/foaf/0.1/plan>

A .plan comment, in the tradition of finger and '.plan' files.

PO2

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/PO2>

PO2 (partial pressure of oxygen) reflects the amount of oxygen gas dissolved in the blood. It primarily measures the effectiveness of the lungs in pulling oxygen into the blood stream from the atmosphere.

potentialValue

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/potentialValue>

It states if the evoked potential test has observed an alteration or not.

predominant impairment

IRI: https://w3id.org/BRAINTEASER/ontology/schema/predominant_impairment

Proximal or distal predominant impairment.

predominant side

IRI: https://w3id.org/BRAINTEASER/ontology/schema/predominant_side

Predominant side of the body.

prevalentLMN

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/prevalentLMN>

Prevalence of lower motor neuron.

prevalentUMN

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/prevalentUMN>

Prevalence of upper motor neuron.

protein

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/protein>

A quantitative measurement of albumin present in a sample of CSF [/mm³].

psychic_relapse

IRI: https://w3id.org/BRAINTEASER/ontology/schema/psychic_relapse

States if the relapse involves psychic aspects.

pyramidal

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/pyramidal>

EDSS is based on measures of impairment in eight functional systems (FS). Pyramidal is about muscle weakness or difficulty moving limbs.

pyramidal_relapse

IRI: https://w3id.org/BRAINTEASER/ontology/schema/pyramidal_relapse

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States if the relapse involves pyramidal disorders.

Q-albumin

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/Q-albumin>

The ratio of cerebrospinal fluid albumin to serum albumin.

rate of disease progression

IRI: https://w3id.org/BRAINTEASER/ontology/schema/rate_of_disease_progression

Rate of disease progression DFS is calculated = (48 - ALSFRS-R score at initial visit) dividing by symptom duration at initial visit (months).

recovery

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/recovery>

The recovery status.

relapseLength

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/relapseLength>

The duration of the relapse.

relapseStartDate

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/relapseStartDate>

Start date of the relapse

retiredAtDiagnosis

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/retiredAtDiagnosis>

A retired patient at the time of diagnosis.

sensory

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/sensory>

EDSS is based on measures of impairment in eight functional systems (FS). Sensory is about numbness or loss of sensations

sensory_relapse

IRI: https://w3id.org/BRAINTEASER/ontology/schema/sensory_relapse

States if the relapse involves sensory disorders.

sequela

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/sequela>

Sequela is the possibility to have a symptom continuing in time, maybe less severe

seriousAdversarialEvent

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IRI: <https://w3id.org/BRAINTEASER/ontology/schema/seriousAdversarialEvent>

A serious adverse event (SAE) in human drug trials is defined as any untoward medical occurrence that at any dose.

severity

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/severity>

The severity of a comorbidity.

sex

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/sex>

The assemblage of physical properties or qualities by which male is distinguished from female; the physical difference between male and female; the distinguishing peculiarity of male or female. [Definition Source: NCI][attribution: from On-line Medical Dictionary]

sexuality

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/sexuality>

The feeling an individual has about their own sexual preferences and how those views are acted upon. [Definition Source: NCI]

sha1sum (hex)

IRI: <http://xmlns.com/foaf/0.1/sha1>

A sha1sum hash, in hex.

sha1sum of a personal mailbox URI name

IRI: http://xmlns.com/foaf/0.1/mbox_sha1sum

Skype ID

IRI: <http://xmlns.com/foaf/0.1/skypeID>

A Skype ID

sphincter_relapse

IRI: https://w3id.org/BRAINTEASER/ontology/schema/sphincter_relapse

States if the relapse involves the sphincter.

startDate

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/startDate>

The date on which something starts.

startYear

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/startYear>

The year on which something starts.

status

IRI: <http://xmlns.com/foaf/0.1/status>

A string expressing what the user is happy for the general public (normally) to know about their current activity.

sun exposure

IRI: https://w3id.org/BRAINTEASER/ontology/schema/sun_exposure

The exposure to incident light from the sun. [Definition Source: NCI]

Surname

IRI: <http://xmlns.com/foaf/0.1/surname>

The surname of some person.

Thyroid Function

IRI: https://w3id.org/BRAINTEASER/ontology/schema/Thyroid_Function

Physiological activity and functions of the highly vascular thyroid gland, such as producing the thyroid hormones which are concerned in regulating the metabolic rate of the body.

title

IRI: <http://xmlns.com/foaf/0.1/title>

Title (Mr, Mrs, Ms, Dr. etc)

Total Cholesterol level

IRI: https://w3id.org/BRAINTEASER/ontology/schema/Total_Cholesterol_Level

The determination of the amount of total cholesterol present in a sample [defined in milligrams per decilitre (mg/dL)].

Total Cholesterol lower range

IRI: https://w3id.org/BRAINTEASER/ontology/schema/Total_Cholesterol_lower_range

The lower range of total cholesterol present in a sample [defined in milligrams per decilitre (mg/dL)].

Total Cholesterol upper range

IRI: https://w3id.org/BRAINTEASER/ontology/schema/Total_Cholesterol_upper_range

The upper range of total cholesterol present in a sample [defined in milligrams per decilitre (mg/dL)].

totalEDSS

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/totalEDSS>

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The Expanded Disability Status Scale (EDSS) is a method of quantifying disability in multiple sclerosis and monitoring changes in the level of disability over time. It is widely used in clinical trials and in the assessment of people with MS. The EDSS scale ranges from 0 to 10 in 0.5 unit increments that represent higher levels of disability. Scoring is based on an examination by a neurologist.

totalLesionsT2

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/totalLesionsT2>

The number of total lesions in T2.

traumaDate

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/traumaDate>

The date when trauma occurs.

traumaDescription

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/traumaDescription>

A detailed description of the trauma.

treatment

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/treatment>

The treatment used for the comorbidity.

Triglycerides level

IRI: https://w3id.org/BRAINTEASER/ontology/schema/Triglycerides_level

A quantitative measurement of the amount of triglyceride present in a sample [defined in milligrams per decilitre (mg/dL)].

Triglycerides lower range

IRI: https://w3id.org/BRAINTEASER/ontology/schema/Triglycerides_lower_range

A lower range of triglyceride present in a sample [defined in milligrams per decilitre (mg/dL)].

Triglycerides upper range

IRI: https://w3id.org/BRAINTEASER/ontology/schema/Triglycerides_upper_range

An upper range of triglyceride present in a sample [defined in milligrams per decilitre (mg/dL)].

typeOfOligoclonalBands

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/typeOfOligoclonalBands>

The type of bands of immunoglobulins that are seen when a patient's cerebrospinal fluid (CSF) is analyzed.

VCabsolute

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IRI: <https://w3id.org/BRAINTEASER/ontology/schema/VCabsolute>

Absolute vital capacity (VC). This is the total volume of air that can be exhaled after inhaling as much as you can.

VCrelative

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/VCrelative>

Relative vital capacity (VC). This is the total volume of air that can be exhaled after inhaling as much as you can.

virological

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/virological>

vision_relapse

IRI: https://w3id.org/BRAINTEASER/ontology/schema/vision_relapse

States if the relapse involves vision disorders.

visual function

IRI: https://w3id.org/BRAINTEASER/ontology/schema/visual_function

EDSS is based on measures of impairment in eight functional systems (FS). Visual function is about problems with sight.

Vitamin D Level

IRI: https://w3id.org/BRAINTEASER/ontology/schema/Vitamin_D_Level

The determination of the amount of vitamin D present in a sample. [Definition Source: NCI]

weeklyFrequency

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/weeklyFrequency>

The number of times per week that physical activity takes place.

Weight

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/Weight>

The weight of a subject. [Definition Source: NCI]

Yahoo chat ID

IRI: <http://xmlns.com/foaf/0.1/yahooChatID>

yearOfBirth

IRI: <https://w3id.org/BRAINTEASER/ontology/schema/yearOfBirth>

The exact year a person was born.

yearOfDeath

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IRI: <https://w3id.org/BRAINTEASER/ontology/schema/yearOfDeath>

The exact year a patient died.