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[1] An agreement among ontology development team (LIMICS), ontology users, domain experts, and local partners on what requirements the hyper-ontology should cover. ORSD is provided during the knowledge acquisition phase.

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Purpose

The purpose of building the hyper-ontology is to maintain and support semantic interoperability for querying and semantic search purposes. It provides the ontology-based standard and structured vocabulary with which applications exchange queries and semantic annotations are assigned to biomedical images. In the hyper-ontology semantic alignment, mapping, and merging processes are performed, maintaining its reusability and interoperability. Besides, the hyper-ontology ensures integration with the local common data models (CDMs), permitting consistent mapping with local nodes.

Scope

The hyper-ontology has to focus on the oncology domain specified in the local OMOP/FHIR AI4HI projects, including, among many others, prostate and breast cancers. The level of granularity is directly related to the competency questions and terms identified.

Implementation Language

The hyper-ontology has to be implemented in the RDFS/OWL language.

Intended Users of the Hyperontology

The hyper-ontology main user is data user/researcher who is a person or entity that wants to explore the public catalog and eventually request access to data and process them using either the tools available in the platform or their own AI tools.

Example of a Data User-Researcher with an experimental lab profile: A Data User-Researcher is leading a project related to prostate cancer, with one of the objectives being the treatment allocation based on the analysis of baseline Magnetic Resonance (MR) images at the time of diagnosis of the disease. The research team will incorporate AI tools and experience in interpreting the results obtained and applying them in a clinical setting for routine clinical practice.

Example of a Data User-Researcher with a Data Scientist profile: A Data Scientist is developing an AI tool to analyze health images and related clinical and molecular data on the most prevalent cancers in Europe. She or he has an initial model that they want to improve with new data. They are seeking quality and labeled data, and do not accept unstructured data or data without a logical folder structure.

Intended Uses of the Hyperontology

Table 1 provides the list of user stories related to data user/researcher in the context of the hyperontology.

#	User Story	User Roles	Mapping
usDU1	Exploration of collections from the public catalogue	Data User-Researcher	Researcher/ Data Scientist
usDU2	Federated search of aggregated data in the collections	Data User-Researcher	Researcher/ Data Scientist
usDU3	Process (distributed) the data from the federation by using a tool of the catalogue	Data User-Researcher	Researcher/ Data Scientist

Among the use cases dedicated to the data user/researcher, three use cases/user stories have been prioritized :

- usDU1 Exploration of collections from the public catalogue

The Public Catalogue, implemented using Molgenis, features the catalogue of datasets of the EUCAIM project, described by a set of metadata specified in D5.1. The catalogue stores the metadata, offering the researchers the descriptive information about the available datasets. It will show data access conditions. The catalogue is the browsing interface where relevant metadata can be exposed by data providers and found by researchers (public catalogue explorer). The catalogue metadata is available to anonymous users. The catalogue is intended to: Allow data providers to expose the metadata of their digital objects in a way that fulfills the FAIR (Findability, Accessibility, Interoperability, and Reusability) Data Principles; Allow data requesters to discover information about collections that contain information that they could be interested in; Provide meaningful information about collections for both humans and software agents.

- usDU2 Federated search of aggregated data in the collections
- usDU3 Process (distributed) the data from the federation by using a tool of the catalogue: image annotation

The different uses of the hyper-ontology derived from the user stories are:

Use 1. Supporting the exploration of collections from the public catalogue.

The specification of the metadata of the collections will be a subset of the Hyperontology, defining the fields and variables to be used. The metadata catalog content is based on the hyper-ontology (see an example).

The scope of Use 1 corresponds to the *knowledge from the metadata catalog.*

Use 2. Supporting the federated queries that are exchanged among applications using ontology-based (query criteria) terms (e.g., *age at diagnosis*, *diagnosis*, *imaging modality*, etc.) selected from the hyper-ontology.

Example of query:

"age at diagnosis">50 and "age at diagnosis"<60 and "diagnosis"="prostate cancer" and "imaging modality"="MRI"

The scope of Use 2 corresponds to the *common knowledge among all cancer types, mandatory clinical knowledge* and *mandatory imaging knowledge that is required to query data sets.*

Use 3. Supporting semantic annotation of cancer images by selecting ontological (clinical and imaging) terms from the hyper-ontology.

An example of cancer image data annotation is given by ProCancer-I (4.b) around "prostate gland segmentation" (see CQG3-CQ15).

Ontology Requirements

Non-Functional Requirements

NFR1. The hyper-ontology must support the English language.

NFR2. The terminology to be used in the hyper-ontology must be taken from validated biomedical ontologies and standardized terminologies.

NFR3. The ontology model should be extensible to handle the periodical updates of semantic standards and to include future ontological aspects and cancer types.

NFR4. The hyper-ontology must support the FAIR principles[2].

NFR5. The hyper-ontology must align with the General Data Protection Regulation (GDPR)[3].

NFR6. The hyper-ontology needs to be versioned; there is the need for a release-version policy.

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[2] 1Cf. Guidelines on FAIR Data Management in Horizon 2020, Version 3.0, 26 July 2016; https://www.force11.org/group/fairgroup/fairprinciples.

[3] https://commission.europa.eu/law/law-topic/data-protection/data-protection-eu_en

Functional Requirements: Groups of Competency Questions

The knowledge/data based functional requirements are specified based on the existing knowledge resources. They are organized by competency question groups (CQGs) classified into four main categories: *knowledge from metadata catalog, mandatory clinical knowledge*, *mandatory imaging knowledge,* and *common knowledge among all cancer types*. Competency Questions (CQs) are defined by considering the generality/specificity of information and by cancer type for the mandatory clinical knowledge. Also, priorities in CQs are considered to help in planning and scheduling the ontology development and deciding which parts of the ontology are going to be developed first.

In this version, we rely on the following existing knowledge resources:

1. Discussions with experts (WP5/TFT1 bi-weekly meetings, emails, etc.)
2. EUCAIM metadata catalog (*original version*, MM2 version)
3. User requirements:
    a. Federated queries (Consortium June 2023)
    b. Image annotation (bi-weekly meetings)
4. Mandatory knowledge provided by AI4HI local projects:
    a. CHAIMELEON (prostate cancer) (OMOP)
    b. ProCancer-I (prostate cancer) (OMOP)
    c. INCISIVE (breast cancer) (FHIR)
    d. EuCanImage (breast cancer) (EuCanImage_cancers) (FHIR)
    e. PRIMAGE

CQG1. Labels from Metadata Catalog (MM2 version)		
Competency Question (CQ)	**Answer**	**Src**
CQ1. What are the main diagnoses (cancer types)?	Prostate cancer, Colon cancer, Breast cancer, Rectal cancer, Lung cancer, Neuroblastoma, Diffuse intrinsic pontine glioma, Colorectal Cancer, Primary malignant neoplasm of liver, Malignant neoplasm of colon and/or rectum, Primary malignant neoplasm of breast	**2**
CQ2. What are the main topographies?	Prostate gland, Abdomen, Thorax, Pelvis, Brain stem, Colon, Breast, Rectum, Lung, Breast, Colon and rectum, Bronchus and lung, Liver	**2**
CQ3. What are the main body parts?	Prostate, Pelvis, Abdomen, Entire body, Abdomen and Pelvis, Hip joint, Chest Abdomen and Pelvis, Chest, Aorta, Extremity, Head, Arm, Breast, Chest, Foot, Uterus, Lumbar spine, Rectum, Lumbo-sacral spine (alt: lumbosacral spine), Arm, Lung, Brain, Neck, Thorax, Spine, Cervical Spine, Neck and Chest, Liver, Chest and Abdomen, Optic canal, Adrenal gland, Skull, Sacrum, Thoracic spine, Heart, Knee, Ear, Kidney, Head and Neck, Gallbladder, Femur , Pelvis and lower extremities, Shoulder, Ankle joint, Orbital structure (alt: orbit structure), Mediastinum, Urinary tract, Pancreas, Small intestine, Uterus and fallopian tubes	**2**
CQ4. What are the main image modalities?	Magnetic Resonance Imaging, Computed Tomography, Digital Radiography, Positron emission tomography, Ultrasound, Mammography, Nuclear Medicine, Histological, X-ray, Digital mammography X-Ray mammography	**2**
CQ5. What are the main image	General Electric, Philips, Siemens, Toshiba, I.M.S, Esaote, Canon, Agfa, ADAC, Marconi, Shimadzu, Elscint, Mediso, Esaote, Hitachi, MiE, Picker International, Fujifilm, Hologic.	**2**

vendors/manufacturers?		
CQ6. What are the main gender types?	MALE, FEMALE	**2**

CQG2. Mandatory Clinical Knowledge		
CQG2.1 Breast Cancer		
Sources: INCISIVE 4.c, EuCanImage 4.d (UC7, UC8)		
CDM: FHIR		
Competency Question (CQ)	**Answer: Label (Vocab, Code)**	**Src**
CQ1. Is the patient ID specified?	(SNOMED-CT,)	**4.d**
CQ1.1 Is the patient ID required in the hyper ontology as a standard concept?	to discuss regarding the user requirements (e.g., federated querying)	
CQ2. Are any values defined for vital status?	(True (0)/false(1), FHIR)	**4.d**
CQ3. How is sex defined?	Sex assigned at birth (LOINC, 76689-9)	**4.d**
CQ4. Are any sex/gender values defined?	Male (finding) (SNOMED, 248153007), Female (finding) (SNOMED, 248152002)	**4.d**
CQ5. Are any breast disorders defined?	Injury of breast (disorder) (SNOMED-CT, 62112002)	**4.c**
CQ6. Are any benign tumors/neoplasms considered?	Neoplasm, benign (morphologic abnormality) (SNOMED CT, 3898006)	**4.d UC8**
CQ7. What malignant types of breast cancer are considered?	Malignant neoplasm of breast (disorder) (SNOMED CT, 254837009)	**4.c**

	Primary malignant neoplasm of female breast (SNOMEDCT, 363346000)	**4.d**
CQ8. What is the main body site/structure considered for breast cancer?	Breast structure (body structure) (SNOMEDCT, 76752008)	**4.d** **UC7** **UC8**
CQ9. Are any lateral body sites/structures specified for breast cancer?	Left breast structure (body structure) (SNOMEDCT, 80248007), Right breast structure (body structure) (SNOMEDCT, 73056007)	**4.d** **UC8**
CQ10. How is breast cancer subtype specified?	Malignant neoplasm of female breast, and subtype (SNOMEDCT, 372064008:260837004),	**4.d** **UC8**
CQ11. What breast cancer subtypes are considered?	Primary malignant neoplasm of breast with axillary lymph node invasion (disorder) (SNOMED-CT, 1082901000112103),	**4.c**
CQ12. Are any “by-proxy” or molecular subtypes specified for breast cancer?	ER positive, PR positive, Her2 negative (KI67 low) (SNOMED, 416053008; 416561008; 431396003, (C162076)), ER positive, (PR positve), Her2 negative (KI67 high) (SNOMED, 416053008; (416561008), 431396003, (C146686)), ER positive, PR positive, Her2 positive, (Ki67 high) (SNOMED, 416053008; 416561008; 427685000; (C146686)), ER negative, PR negative, Her2 positive (SNOMED, 441117001; 441118006; 427685000)	**4.d** **UC7** **UC8**

	Triple negative malignant neoplasm of breast (disorder) (SNOMEDCT, 706970001),	
CQ13. What diagnostic/staging strategy is used for classifying tumors as molecular sybtypes?	PAM50 (NCIT, C120494)	**4.d** **UC7** **UC8**
CQ14. What histological types of breast cancer are defined?	DUCT CARCINOMA/ Invasive carcinoma of no special type (ICD-O3, 8500/3), LOBULAR AND OTHER DUCTAL CA. / Infiltrating duct and lobular carcinoma (ICD-O3, 8522/3), LOBULAR AND OTHER DUCTAL CA. / Infiltr. duct mixed with other types of carcinoma (ICD-O3, 8523/3), LOBULAR AND OTHER DUCTAL CA. / Lobular carcinoma, NOS (ICD-O3, 8520/3), Invasive carcinoma of breast where Type - attribute = Other (SNOMEDCT, 713609000:410657003=74964007), DUCT CARCINOMA/ Intraductal carcinoma, noninfiltrating, NOS (ICD-O3, 8500/2), LOBULAR AND OTHER DUCTAL CA. / Lobular carcinoma insitu (ICD-O3, 8520/2), LOBULAR AND OTHER DUCTAL CA. / Intraductal and lobular in situ carcinoma (ICD-O3, 8522/2), Neoplasm, benign (morphologic abnormality) (SNOMED CT, 3898006) Carcinoma in situ (morphologic abnormality)	**4.d** **UC7** **UC8**

	(SNOMED CT, 1187138006)	
CQ15. Are symptoms/signs considered for breast cancer?	Breast signs and symptoms (finding) (SNOMEDCT, 198116001)	**4.d UC8**
CQ16. What signs/situations are examined for breast cancer?	History of clinical finding in subject (situation) (SNOMED-CT, 417662000), Family history of cancer (situation) (SNOMED-CT, 275937001), Menopause, function (observable entity) (SNOMED-CT, 161712005), Number of births at term (observable entity) (SNOMED-CT, 440425000), Microscopic specimen observation (finding) (SNOMED-CT, 395538009), Biopsy (finding) (SNOMED-CT, 365855009), Lesion observable (observable entity) (SNOMED-CT, 364636000)	**4.c**
	Surviving free of recurrence of neoplastic disease (finding) (SNOMED-CT, 445150007), Survival time (observable entity) (SNOMED-CT, 445320007), Family history of clinical finding (situation) (SNOMED-CT, 416471007), Menopause, function (observable entity) (SNOMED-CT, 161712005), Gravida (observable entity) (SNOMED-CT, 161732006), Breast fed (finding) (SNOMED-CT, 169741004)	**4.d**
CQ17. What family history degrees are specified for Breast cancer?	None (qualifier value) (SNOMED-CT, 260413007), First degree (qualifier value) (SNOMED-CT, 264500008), Second degree (qualifier value) (SNOMED-CT, 263868004) unknow (SNOMED CT, 261665006)	**4.d**

CQ18. What menopausal statuses are considered for breast cancer?	Postmenopause - Menopause present (finding) (SNOMED-CT, 289903006), Premenopause - Menopause absent (finding) (SNOMED-CT, 289904000)	**4.d**
CQ19. What laboratory tests/results are considered for breast cancer?	Carcinoembryonic Ag [Mass/volume] in Serum or Plasma (LOINC, 2039-6), Cancer Ag 15-3 [Units/volume] in Serum or Plasma (LOINC, 6875-9), HER2 [Presence] in Breast cancer specimen by Immune stain (LOINC, 85319-2), Estrogen receptor Ag [Presence] in Breast cancer specimen by Immune stain (LOINC, 85337-4), Progesterone receptor Ag [Presence] in Breast cancer specimen by Immune stain (LOINC, 85339-0), Melan-A and Ki67 Ag [Identifier] in Tissue by Immune stain (LOINC, 74489-6), BRCA1 gene mutations tested for in Blood or Tissue by Molecular genetics method Nominal (LOINC, 21639-0), BRCA1+BRCA2 gene mutations tested for in Blood or Tissue by Molecular genetics method Nominal (LOINC, 59041-4), Lymphovascular invasion extent in Cancer specimen Qualitative (LOINC, 98260-3),	**4.c**
	Cells.estrogen receptor/100 cells in Breast cancer specimen by Immune stain (LOINC/UCUM, 85329-1), Cells.progesterone receptor/100 cells in Breast cancer specimen by Immune stain (LOINC/UCUM, 85325-9), Cells.Ki-67 nuclear Ag/100 cells in Breast cancer specimen by Immune stain (LOINC/UCUM, 85330-9), ERBB2 gene duplication [Presence] in Breast cancer specimen by FISH (LOINC, 85318-4)	**4.d**
CQ20. What are the HER2 IHC status values?	0 (LA6111-4, LOINC), 1+ (LA11841-6, LOINC),	**4.d**

	2+ (LA11842-4, LOINC), 3+ (LA11843-2, LOINC)	
CQ21. What are the HER2 FISH status values?	Positive (LA6576-8, LOINC), Negative (LA6577-6, LOINC)	**4.d**
CQ22. What grading values of invasive tumors are specified for breast cancer?	American Joint Committee on Cancer grade GX (qualifier value) (SNOMED-CT, 1228845001), G1 - American Joint Committee on Cancer grade G1 (qualifier value) (SNOMED-CT, 1228848004), G2 - American Joint Committee on Cancer grade G2 (qualifier value) (SNOMED-CT, 1228850007), G3 - American Joint Committee on Cancer grade G3 (qualifier value) (SNOMED-CT, 1228851006)	**4.d**
CQ23. How is tumor staging defined for breast cancer?	Tumor staging (tumor staging) (SNOMED-CT, 254292007), Edition of American Joint Commission on Cancer, Cancer Staging Manual used for TNM staging (observable entity) (SNOMED-CT, 443941007)	**4.c**
CQ24. What clinical tumor staging categories are defined for breast cancer?	American Joint Committee on Cancer clinical T category allowable value (qualifier value) (SNOMED-CT, 1222585009), American Joint Committee on Cancer clinical N category allowable value (qualifier value) (SNOMED-CT, 1222588006), Tumor histopathological grade status values (tumor staging) (SNOMED-CT, 258244004),	**4.d**
CQ25. What are the tumor staging Clinical t (cT) values (Breast cancer)?	cTx (SNOMED-CT, 1222604002), cT0 (SNOMED-CT, 1228882005), cTis (SNOMED-CT, 1228884006), cTis(DCIS) (SNOMED-CT, 1228885007), cTis(Paget) (SNOMED-CT, 1228888009), cT1 (SNOMED-CT, 1228889001), cT1a (SNOMED-CT, 1228892002), cT1b (SNOMED-CT, 1228895000), cT1c (SNOMED-CT, 1228899006), cT1mi (SNOMED-CT, 1228891009),	**4.d**

	cT2 (SNOMED-CT, 1228929004), cT3 (SNOMED-CT, 1228938002), cT4 (SNOMED-CT, 1228944003), cT4a (SNOMED-CT, 1228945002), cT4b (SNOMED-CT, 1228946001), cT4c (SNOMED-CT, 1228947005), cT4d (SNOMED-CT, 1228948000)	
CQ26. What are the tumor staging Clinical n (cN) values (Breast cancer)?	cNX (SNOMED-CT, 1229966003), cN0 (SNOMED-CT, 1229967007), cN1 (SNOMED-CT, 1229973008), cN1mi (SNOMED-CT, 1229974002), cN2 (SNOMED-CT, 1229978004), cN2a (SNOMED-CT, 1229981009), cN2b (SNOMED-CT, 1229982002), cN3 (SNOMED-CT, 1229984001), cN3a (SNOMED-CT, 1229985000), cN3b (SNOMED-CT, 1229986004), cN3c (SNOMED-CT, 1229987008)	**4.d**
CQ27. What are the main pathological categories of tumor staging for breast cancer?	American Joint Committee on Cancer pathological T category allowable value (qualifier value) (SNOMED-CT, 1222589003), American Joint Committee on Cancer pathological N category allowable value (qualifier value) (SNOMED-CT, 1222590007), American Joint Committee on Cancer pathological M category allowable value (qualifier value) (SNOMED-CT, 1222591006)	**4.d**
	pM category (observable entity) (SNOMED-CT, 371497001), T category (observable entity) (SNOMED-CT, 78873005), N category (observable entity) (SNOMED-CT, 277206009), M category (observable entity) (SNOMED-CT, 277208005)	**4.c**
CQ28. What are breast cancer's main pathological t	ypTx (SNOMED-CT, 1228862006), ypT0 (SNOMED-CT, 1228863001),	**4.d**

(ypT) staging values?	ypTis (SNOMED-CT, 1228865008), ypTis(DCIS) (SNOMED-CT, 1228866009), ypTis(Paget) (SNOMED-CT, 1228868005), ypT1 (SNOMED-CT, 1228869002), ypT1mi (SNOMED-CT, 1228870001), ypT1a (SNOMED-CT, 1228872009), ypT1b (SNOMED-CT, 1228897008), ypT1c (SNOMED-CT, 1228905006), ypT2 (SNOMED-CT, 1228910005), ypT3 (SNOMED-CT, 1228917008), ypT4 (SNOMED-CT, 1228922008), ypT4a (SNOMED-CT, 1228923003), ypT4b (SNOMED-CT, 1228924009), ypT4c (SNOMED-CT, 1228925005), ypT4d (SNOMED-CT, 1228926006)	
CQ29. What are breast cancer's main pathological n (ypN) staging values?	pNX (SNOMED-CT, 1229877005), ypN0 (SNOMED-CT, 1229878000), ypN1 (SNOMED-CT, 1229884002), ypN1mi (SNOMED-CT, 1229885001), ypN1a (SNOMED-CT, 1229887009), ypN1b (SNOMED-CT, 1229889007), ypN1c (SNOMED-CT, 1229890003), ypN2 (SNOMED-CT, 1229892006), ypN2a (SNOMED-CT, 1229893001), ypN2b (SNOMED-CT, 1229896009), ypN3 (SNOMED-CT, 1229897000), ypN3a (SNOMED-CT, 1229898005), ypN3b (SNOMED-CT, 1229899002), ypN3c (SNOMED-CT, 1229900007)	**4.d**
CQ30. What are breast cancer's main pathological m (ypM) staging values?	pM0 (NCIT, C48740), pM1 (SNOMED-CT, 1229916009), pM1a (SNOMED-CT, 1229917000), pM1b (SNOMED-CT, 1229920008), pM1c (SNOMED-CT, 1229923005), pM1d (SNOMED-CT, 1229926002)	**4.d**
CQ31. Are any chemotherapy medications specified for	Capecitabine (RxNorm, 194000), Doxorubicin (RxNorm, 3639), Epirubicin (RxNorm, 3995),	**4.d**

breast cancer?	Doxorubicin liposomal (RxNorm, 214525), Paclitaxel (RxNorm, 56946), Nab paclitaxel (Snomed, SCTID: 426653008), Docetaxel (RxNorm, 72962), Carboplatin (RxNorm, 40048), Cyclophosphamide (RxNorm, 3002), Eribulin (RxNorm, 1045453), Methotrexate (6851), Fluorouracil (RxNorm, 4492), Vinorelbine (RxNorm, 39541), Gemcitabine (RxNorm, 12574), Sacituzumab govitecán (RxNorm, 2360232)	
CQ32. Are any Anti-HER2 medications specified for breast cancer?	Trastuzumab (RxNorm, 224905), Pertuzumab (RxNorm, 1298944), TDM1 (RxNorm, 1371041), Lapatinib (RxNorm, 480167), Trastuzumab deruxtecán (RxNorm, 2267582), Tucatinib (RxNorm, 2361285)	**4.d**
CQ33. Are any hormonotherapy medications specified for breast cancer?	Exemestane (RxNorm, 258494), Letrozole (RxNorm, 72965), Anastrozole (RxNorm, 84857), Tamoxifen (RxNorm, 10324)	**4.d**
CQ34. Are any immunotherapies medications specified for breast cancer)?	Pembrolizumab (RxNorm, 1547545), Durvalumab (RxNorm, 1919503), Atezolizumab (RxNorm, 1792776)	**4.d**
CQ35. Are any CDK4/6 INHIBITORS medications specified for breast cancer?	Palbociclib (RxNorm, 1601374), Abemaciclib (RxNorm, 1946825), Ribociclib (RxNorm, 1873916)	**4.d**
CQ36. Are any specific laboratory procedures/treatments/ (medication) therapies considered for breast cancer?	Laboratory procedure performed (situation) (SNOMED-CT, 165331007), Biopsy (procedure) (SNOMED-CT, 86273004), Surgical procedure (procedure) (SNOMED-CT, 387713003), Histopathology test (procedure) (SNOMED-CT, 252416005), Procedure on lymph node (procedure) (SNOMED-CT, 118890000),	**4.c**

	Chemotherapy (procedure) (SNOMED-CT, 367336001), Combined chemotherapy and radiation therapy (procedure) (SNOMED-CT, 703423002), Antineoplastic chemoimmunotherapy (regime/therapy) (SNOMED-CT, 897713009), Radiation therapy care (regime/therapy) (SNOMED-CT, 385798007), Hormone therapy (procedure) (SNOMED-CT, 169413002), Targeted medication therapy review (procedure) (SNOMED-CT, 6021000124103), Immunotherapy (procedure) (SNOMED-CT, 76334006), Pharmaceutical / biologic product (product) (SNOMED-CT, 373873005), Staining method (procedure) (SNOMED-CT, 127790008), Sampling - action (qualifier value) (SNOMED-CT, 257915005)	
	Hormone replacement therapy (procedure) (SNOMED-CT, 266717002), Chemotherapy cycle (procedure) (SNOMED-CT, 399042005), Uses hormone method of contraception (finding) (SNOMED-CT, 1237404009)	**4.d**
CQ37. What are the main genetic testing types considered for breast cancer?	BRCA1 mutation carrier detection test (procedure) (SNOMED-CT, 405823003), BRCA2 mutation carrier detection test (procedure) (SNOMED-CT, 405826006), PALB2 gene targeted mutation analysis in Blood or Tissue by Molecular genetics method (LOINC, 100761-6)	**4.d**
CQ38. What are the specific genetic results types of BRCA1 considered for breast cancer?	BRCA1 gene mutation positive (finding) (SNOMED-CT, 412734009), BRCA1 gene mutation negative (finding) (SNOMED-CT, 412736006),	**4.d**

	Unknown (qualifier value) (SNOMED-CT, 261665006)	
CQ39. What are the specific genetic results types of BRCA2 considered for breast cancer?	BRCA2 gene mutation positive (finding) (SNOMED-CT, 412738007), BRCA2 gene mutation negative (finding) (SNOMED-CT, 412739004), Unknown (qualifier value) (SNOMED-CT, 261665006)	**4.d**
CQ40. What are the specific genetic results types of PALB2 considered for breast cancer?	Positive (qualifier value) (SNOMED-CT, 10828004), Negative (qualifier value) (SNOMED-CT, 260385009), Unknown (qualifier value) (SNOMED-CT, 261665006)	**4.d**
CQ41. What are the specific genetic results types of CHEK2 considered for breast cancer?	Positive (qualifier value) (SNOMED-CT, 10828004), Negative (qualifier value) (SNOMED-CT, 260385009), Unknown (qualifier value) (SNOMED-CT, 261665006)	**4.d**
CQ42. Are any specific radiographic/screening imaging procedures considered for breast cancer?	Mammography (procedure) (SNOMED-CT, 71651007), Diagnostic ultrasonography (procedure) (SNOMED-CT, 16310003), Computed tomography (procedure) (SNOMED-CT, 77477000), Magnetic resonance imaging (procedure) (SNOMED-CT, 113091000), Positron emission tomography (procedure) (SNOMED-CT, 82918005), Radiographic imaging procedure (procedure) (SNOMED-CT, 363680008), Diagnostic ultrasonography (procedure) (SNOMED-CT, 16310003)	**4.c**
	Magnetic resonance imaging of breast for screening for malignant neoplasm (procedure) (SNOMEDCT, 609223006, Procedure)	**4.d** **UC8**

CQ43. What imaging/radiological/ pathological results/signs are considered for assessing breast cancer?	Mammography assessment finding (finding) (SNOMED-CT, 397137005), Ultrasound scan finding (finding) (SNOMED-CT, 370380004), Primary tumor size (observable entity) (SNOMED-CT, 399734001), Radiographic lesion shape finding (finding) (SNOMED-CT, 129732008), Laterality (attribute) (SNOMED-CT, 272741003), Radiographic lesion margin characteristics (finding) (SNOMED-CT, 129737002), Mammography reference location (finding) (SNOMED-CT, 129771006), Finding of change compared to previous radiologic examination (finding) (SNOMED-CT, 442301001), Mammographic breast composition finding (SNOMED-CT, 129715009), Mammographic architectural distortion of breast (finding) (SNOMED-CT, 129792006), Tumor calcification (finding) (SNOMED-CT, 409769002), Tumor configuration (observable entity) (SNOMED-CT, 371500007), Qualitative distribution of primary malignant neoplasm (SNOMED-CT, 1163261007), Acoustic feature of mass (SNOMED-CT, 420415002), Length dimension of neoplasm (observable entity) (SNOMED-CT, 263605001)	**4.c**

	Presence of direct invasion by primary malignant neoplasm to lymphatic vessel and/or small blood vessel (observable entity) (SNOMED-CT, 371512006), Number of lymph nodes containing metastatic neoplasm in excised specimen (observable entity) (SNOMED-CT, 443527007), Status of regression of tumor (observable entity) (SNOMED-CT, 396432002), Note or method: Miller and Payne's Tumor Regression Grade, Residual cancer burden class (observable entity) (SNOMED-CT, 444987009), Number of lymph nodes examined by microscopy in excised specimen (observable entity) (SNOMED-CT, 444025001), Mammography normal (finding) (SNOMEDCT, 168749009)	**4.d**
CQ44. What laboratory tests are required for assessing breast cancer after treatment?	Leukocytes [#/volume] in Stem cell product (LOINC, 95218-4), Hemoglobin [Mass/volume] in Blood (LOINC, 718-7), Hematocrit [Volume Fraction] of Blood (LOINC, 20570-8), Platelets [#/volume] in Blood (LOINC, 26515-7), Glucose [Mass/volume] in Venous blood (LOINC, 41652-9), Insulin [Units/volume] in Serum or Plasma (LOINC, 20448-7), Urea [Mass/volume] in Blood (LOINC, 20977-5), Creatinine [Mass/volume] in Blood (LOINC, 38483-4), Urate [Mass/volume] in Blood (LOINC, 98981-4), Potassium [Mass/volume] in Blood (LOINC, 75940-7), Sodium [Moles/volume] in Blood (LOINC, 2947-0), Calcium [Mass/volume] in Blood (LOINC, 49765-1), Cholesterol [Mass/volume] in Serum or Plasma (LOINC, 2093-3), Triglyceride [Mass/volume] in Blood (LOINC, 3043-7), Cholesterol in HDL [Mass/volume] in Serum or Plasma (LOINC, 2085-9), Cholesterol in LDL [Mass/volume] in Serum or Plasma (LOINC, 2089-1),	**4.c**

	Aspartate aminotransferase [Enzymatic activity/volume] in Serum or Plasma (LOINC, 1920-8), Alanine aminotransferase [Enzymatic activity/volume] in Blood (LOINC, 76625-3), Gamma glutamyl transferase [Enzymatic activity/volume] in Serum or Plasma (LOINC, 2324-2), Alkaline phosphatase [Enzymatic activity/volume] in Blood (LOINC, 1783-0), Lactate dehydrogenase [Enzymatic activity/volume] in Red Blood Cells (LOINC, 11053-6), Thyrotropin [Units/volume] in Blood (LOINC, 3015-5), Cortisol [Mass/volume] in Serum or Plasma (LOINC, 2143-6), Creactive protein [Mass/volume] in Blood by High sensitivity method (LOINC, 71426-1), Natriuretic peptide B [Mass/volume] in Blood (LOINC, 42637-9), Hemoglobin A1c/Hemoglobin.total in Blood by HPLC (LOINC, 17856-6), Albumin/Protein.total in 24 hour Urine by Electrophoresis (LOINC, 13986-5), Creatinine [Mass/volume] in Urine (LOINC, 2161-8)	
CQ45. Are any medical statuses/decisions considered for breast cancer after treatment?	Follow-up status (finding) (SNOMED-CT, 308273005), Treatment changed (situation) (SNOMED-CT, 445528004), Performance measure status (finding) (SNOMED-CT, 241000124106)	**4.c**
CQ46. What imaging/radiographic signs are considered for examining breast cancer after treatment?	Tumor progression (finding) (SNOMED-CT, 419835002), Radiographic lesion shape finding (finding) (SNOMED-CT, 129732008), Radiographic lesion margin characteristics (finding) (SNOMED-CT, 129737002), Mammography reference location (finding) (SNOMED-CT, 129771006),	**4.c**

	Acoustic feature of mass (observable entity) (SNOMED-CT, 420415002), Finding of change compared to previous radiologic examination (finding) (SNOMED-CT, 442301001), Tumor calcification (finding) (SNOMED-CT, 409769002), Mammographic breast composition finding (finding) (SNOMED-CT, 129715009), Mammographic architectural distortion of breast (finding) (SNOMED-CT, 129792006), Tumor configuration (observable entity) (SNOMED-CT, 371500007), Qualitative distribution of primary malignant neoplasm (observable entity) (SNOMED-CT, 1163261007),	

CQG2. Mandatory Clinical Knowledge		
CQG2.2 Prostate Cancer		
Sources: CHAIMELEON 4.a, ProCancer-I 4.b		
CDM: OMOP		
Competency Question (CQ)	**Answer: Label (Vocab, Code)**	**Src**
CQ1. How is the patient's age specified?	birth_datetime	**4.a**
	Age at onset of clinical finding (SNOMED)	**4.b**
CQ2. Are any sex/gender values defined?	MALE (GENDER, M) FEMALE (GENDER, F)	**4.a**
CQ3. What are the main diagnoses considered for prostate cancer?	Malignant tumor of prostate (SNOMED), Primary malignant neoplasm of prostate (SNOMED)	**4.b**
CQ4. Are any specific diagnoses/disorders considered for prostate cancer?	Benign prostatic hyperplasia (SNOMED, 266569009), Hormone refractory prostate cancer (SNOMED, 427492003), Hormone sensitive prostate cancer (SNOMED, 722103009)	**4.a**
CQ5. How is Benign prostatic hyperplasia interpreted?	Known present (SNOMED, 410515003), Known absent (SNOMED, 410516002)	**4.a**
CQ6. Are any histology types considered for specifying malignant neoplasm of the prostate?	Adenocarcinoma, NOS, of prostate gland (ICD-O-3, 8140/3-C61.9), Small cell carcinoma, NOS, of prostate gland (ICD-O-3, 8141/3-C61.9), Neuroendocrine tumor, NOS, of prostate gland (ICD-O-3, 8240/3-C61.9),	**4.a**

	Transitional cell carcinoma, NOS, of prostate gland (ICD-O-3, 8120/3-C61.9), Neoplasm, malignant of prostate gland (Display + "Other") (ICD-O-3)	
	Acinar cell carcinoma of prostate gland (ICD-O-3) Intraductal carcinoma, noninfiltrating, NOS, of prostate gland (ICD-O-3), Infiltrating duct carcinoma, NOS, of prostate gland (ICD-O-3), Transitional cell carcinoma, NOS, of prostate gland (ICD-O-3), Adenosquamous carcinoma of prostate gland (ICD-O-3), Squamous cell carcinoma, NOS, of prostate gland (ICD-O-3), Basal cell adenocarcinoma of prostate gland (ICD-O-3), Adenocarcinoma with neuroendocrine differentiation of prostate gland (ICD-O-3), Small cell carcinoma, NOS, of prostate gland (ICD-O-3), Large cell neuroendocrine carcinoma of prostate gland (ICD-O-3)	**4.b**
CQ7. How is family history classified?	Family history of clinical finding (SNOMED), No family history of clinical finding (SNOMED), Family history unknown (SNOMED)	**4.b**
CQ8. Are any specific laboratory measurement/ tests considered for prostate cancer?	Total prostate specific antigen level (SNOMED, 377981000000102), Serum testosterone measurement (SNOMED, 270973006)	**4.a**
	Free prostate specific antigen level (SNOMED), Total PSA level (SNOMED), Free:total PSA ratio (SNOMED), Prostate specific antigen normal (SNOMED),	**4.b**
CQ9. How are biopsy results classified?	Biopsy result normal (SNOMED), Biopsy result abnormal (SNOMED),	**4.b**

CQ10. How are imaging results classified?	MRI scan abnormal (SNOMED), MRI scan normal (SNOMED)	**4.b**
CQ11. What measurement units are considered for the laboratory tests?	nanogram per milliliter (UCUM), percent (UCUM)	**4.b**
	nanogram per milliliter (UCUM, 8842), nanogram per deciliter (UCUM, 8817), nanomole per liter (UCUM, 8736)	**4.a**
CQ12. Are any imaging/examination procedures considered for prostate cancer?	Digital examination of rectum (SNOMED), Multiparametric MRI of prostate (SNOMED)	**4.b**
CQ13. Are any imaging results examined for assessing prostate cancer?	Tumor volume (SNOMED), Lesion size, greatest dimension (SNOMED), Lesion size, additional dimension (SNOMED)	**4.b**
CQ14. What measurement units are specified for imaging results?	cubic millimeter (UCUM), millimeter (UCUM)	**4.b**
CQ15. Are any lesion sites specified for identifying prostate cancer?	Left basal anterior fibromuscular stroma of prostate (SNOMED), Right basal anterior fibromuscular stroma of prostate (SNOMED,), Left anterior basal transition zone of prostate (SNOMED,), Right anterior basal transition zone of prostate (SNOMED,), Left posterior basal transition zone of prostate (SNOMED,), Right posterior basal transition zone of prostate (SNOMED,), Central zone of left half prostate (SNOMED,), Central zone of right half prostate (SNOMED,), Left anterior basal peripheral zone of prostate (SNOMED,), Right anterior basal peripheral zone of prostate (SNOMED,),	**4.b**

	Left posterolateral basal peripheral zone of prostate (SNOMED,), Right posterolateral basal peripheral zone of prostate (SNOMED,), Left middle anterior fibromuscular stroma of prostate (SNOMED,), Right middle anterior fibromuscular stroma of prostate (SNOMED,), Left anterior middle transition zone of prostate (SNOMED,), Right anterior middle transition zone of prostate (SNOMED,), Left posterior middle transition zone of prostate (SNOMED,), Right posterior middle transition zone of prostate (SNOMED,), Left anterior middle peripheral zone of prostate (SNOMED,), Right anterior middle peripheral zone of prostate (SNOMED,), Left posterolateral middle peripheral zone of prostate (SNOMED,), Right posterolateral middle peripheral zone of prostate (SNOMED,), Left posteromedial middle peripheral zone of prostate (SNOMED,), Right posteromedial middle peripheral zone of prostate (SNOMED,), Left apical anterior fibromuscular stroma of prostate (SNOMED,), Right apical anterior fibromuscular stroma of prostate (SNOMED,), Left anterior apical part of transition zone of prostate (SNOMED,), Right anterior apical part of transition zone of prostate (SNOMED,), Left posterior apical part of transition zone of prostate (SNOMED,), Right posterior apical part of transition zone of prostate (SNOMED,),	

	Left anterior apical peripheral zone of prostate (SNOMED,), Right anterior apical peripheral zone of prostate (SNOMED,), Left posterolateral apical peripheral zone of prostate (SNOMED,), Right posterolateral apical peripheral zone of prostate (SNOMED,), Left posteromedial apical peripheral zone of prostate (SNOMED,), Right posteromedial apical peripheral zone of prostate (SNOMED,),	
CQ16. Are any Gleason primary patterns defined for staging/grading prostate cancer?	Primary Gleason Pattern 1 (Cancer Modifier, OMOP4998758), Primary Gleason Pattern 2 (Cancer Modifier, OMOP4999762), Primary Gleason Pattern 3 (Cancer Modifier, OMOP4998055), Primary Gleason Pattern 4 (Cancer Modifier, OMOP4998909), Primary Gleason Pattern 5 (Cancer Modifier, OMOP4999307),	**4.a**
	Gleason Primary Pattern Grade 1 (Cancer Modifier), Gleason Primary Pattern Grade 2 (Cancer Modifier), Gleason Primary Pattern Grade 3 (Cancer Modifier), Gleason Primary Pattern Grade 4 (Cancer Modifier), Gleason Primary Pattern Grade 5 (Cancer Modifier), Primary pattern unknown, secondary pattern unknown (NAACCR)	**4.b**
CQ17. Are any Gleason secondary patterns defined for staging/grading prostate cancer?	Secondary Gleason Pattern 1 (Cancer Modifier, OMOP4997849), Secondary Gleason Pattern 2 (Cancer Modifier, OMOP4997987), Secondary Gleason Pattern 3 (Cancer Modifier, OMOP4997982), Secondary Gleason Pattern 4 (Cancer Modifier, OMOP4998047),	**4.a**

	Secondary Gleason Pattern 5 (Cancer Modifier, OMOP4998874)	
	Gleason Secondary Pattern Grade 1 (Cancer Modifier), Gleason Secondary Pattern Grade 2 (Cancer Modifier), Gleason Secondary Pattern Grade 3 (Cancer Modifier), Gleason Secondary Pattern Grade 4 (Cancer Modifier), Gleason Secondary Pattern Grade 5 (Cancer Modifier),	**4.b**
CQ18. Are any Gleason grade scores defined for staging/grading prostate cancer?	Gleason grade score 2 out of 10 (SNOMED, 49878003), Gleason grade score 3 out of 10 (SNOMED, 46677009), Gleason grade score 4 out of 10 (SNOMED, 18430005), Gleason grade score 5 out of 10 (SNOMED, 74013009), Gleason grade score 6 out of 10 (SNOMED, 84556003), Gleason grade score 7 out of 10 (SNOMED, 57403001), Gleason grade score 8 out of 10 (SNOMED, 33013007), Gleason grade score 9 out of 10 (SNOMED, 58925000), Gleason grade score 10 out of 10 (SNOMED, 24514009)	**4.a**
CQ19. Are any Gleason grade groups defined for staging/grading prostate cancer?	Gleason grade group 1 (SNOMED, 860742008), Gleason grade group 2 (SNOMED, 860743003), Gleason grade group 3 (SNOMED, 860744009), Gleason grade group 4 (SNOMED, 860745005), Gleason grade group 5 (SNOMED, 860746006)	**4.a**

CQ20. How is the tumor invasion of prostate cancer diagnosed?	Tumor invasion of perineural tissue present (prostate) (SNOMED, 372296009), Tumor invasion of perineural tissue absent (prostate) (SNOMED, 372297000), Vascular invasion by tumor present (SNOMED, 372287009), No vascular invasion by tumor (SNOMED, 127494000), Lymphatic (small vessel) invasion by tumor present (SNOMED, 395717001), Lymphatic (small vessel) invasion by tumor absent (SNOMED, 395716005)	**4.a**
	Extraprostatic Extension (EPE) (Cancer Modifier), Perineural Invasion (Cancer Modifier), Invasion into the Seminal vesicle (Cancer Modifier)	**4.b**
CQ21. Are any procedures/therapies/treatments considered for prostate cancer?	Pelvic lymphadenectomy (SNOMED, 14059008), Radiation oncology AND/OR radiotherapy (SNOMED, 108290001), Chemotherapy (SNOMED, 367336001), Androgen deprivation therapy (SNOMED, 707266006), Active surveillance of prostate cancer (SNOMED, 712837004), No anti-cancer treatment - watchful waiting (SNOMED, 373818007)	**4.a**
	US-guided systematic biopsy (SNOMED), MRI-US fusion guided prostate biopsy (SNOMED), MRI guided biopsy of prostate (SNOMED), Prostatectomy (SNOMED), Biopsy of prostate (SNOMED), Radiotherapy (HemOnc), Endocrine therapy (HemOnc), Hormone therapy (SNOMED), Multiparametric MRI of prostate (SNOMED), Active surveillance of prostate cancer (SNOMED)	**4.b**

CQ22. Are any specific methods of Prostatectomy treatment defined for prostate cancer?	Radical perineal prostatectomy (SNOMED, 8782006), Laparoscopic radical prostatectomy (SNOMED, 853771000000105), Robot assisted laparoscopic radical prostatectomy (SNOMED, 708919000),	**4.a**
	Radical Retropubic prostatectomy (SNOMED), Robot assisted laparoscopic radical prostatectomy (SNOMED), Laparoscopic prostatectomy (SNOMED), Radical Perineal prostatectomy (SNOMED), Laparoscopy, surgical prostatectomy, retropubic radical, including nerve sparing, includes robotic assistance, when performed (CPT4),	**4.b**
CQ23. Are any specific types of radiotherapy treatment defined for prostate cancer?	Intensity modulated radiation therapy (SNOMED), IGRT (image-guided radiation therapy) (SNOMED), 3D CRT (three dimensional conformal radiation therapy) (SNOMED), Hypofractionated stereotactic radiotherapy using megavoltage radiation (SNOMED)	**4.b**
	Radiation Therapy @ Male Reproductive System @ Beam Radiation @ Prostate (Display label: "Beam Radiation of Prostate") (ICD10PCS, DV00), Radiation Therapy @ Male Reproductive System @ Brachytherapy @ Prostate @ High Dose Rate (HDR) (Display label: "Brachytherapy of Prostate - High Dose Rate") (ICD10PCS, DV109), Radiation Therapy @ Male Reproductive System @ Brachytherapy @ Prostate @ Low Dose Rate (LDR) (Display label: "Brachytherapy of Prostate - Low Dose Rate") (ICD10PCS, DV10B)	**4.a**
CQ24. Are any drugs/medication types specified for Androgen deprivation therapy?	Gonadotropin releasing hormone analogues (ATC, L02AE) Other hormone antagonists and related agents (ATC, L02BX)	**4.a**

CQ25. Are any drugs/medications specified for chemotherapy treatment?	Docetaxel Injection (RxNorm, 1860479), Carbamazepine Injection (RxNorm, 1813507)	**4.a**
CQ26. Are any medical signs/health status considered for prostate cancer after treatment?	Urinary incontinence (SNOMED, 165232002), Continent of urine (SNOMED, 45850009), Bowels: fully continent (SNOMED, 24029004), Incontinence of feces (SNOMED, 72042002), Normal sexual function (SNOMED, 11512006), Abnormal sexual function (SNOMED, 56925008), Tumor Progression (SNOMED, 419835002), Recurrent tumor (SNOMED, 25173007)	**4.a**
CQ27. How is the ECOG performance status classified?	ECOG performance status - grade 0 (SNOMED, 425389002), ECOG performance status - grade 1 (SNOMED, 422512005), ECOG performance status - grade 2 (SNOMED, 422894000), ECOG performance status - grade 3 (SNOMED, 423053003), ECOG performance status - grade 4 (SNOMED, 423237006), ECOG performance status - grade 5 (SNOMED, 423409001)	**4.a**
CQ28. Are any tumor-staging TNM pathological categories defined?	TNM Path T (NAACCR, 880), TNM Path N (NAACCR, 890), TNM Path Stage Group (NAACCR, 910),	**4.a**
	TNM Path T (NAACCR), TNM Path N (NAACCR)	**4.b**
CQ29. Are any tumor-staging TNM clinical categories defined?	TNM Clin T (NAACCR, 940), TNM Clin N (NAACCR, 950), TNM Clin M (NAACCR, 960), TNM Clin Stage Group (NAACCR, 970)	**4.a**
CQ30. What are the TNM Path T staging values?	pT0 (NAACCR, 880@p0), pT1 (NAACCR, 880@p1), pT2 (NAACCR, 880@p2),	**4.a**

	pT2a (NAACCR, 880@p2A), pT2b (NAACCR, 880@p2B), pT2c (NAACCR, 880@p2C), pT3 (NAACCR, 880@p3), pT3a (NAACCR, 880@p3A), pT3b (NAACCR, 880@p3B), pT4 (NAACCR, 880@p4)	
CQ30.1 What are the TNM Path T staging categories?	AJCC/UICC 7th pathological TX Category (Cancer Modifier), AJCC/UICC 7th pathological T1 Category (Cancer Modifier), AJCC/UICC 7th pathological T1a Category (Cancer Modifier), AJCC/UICC 7th pathological T1b Category (Cancer Modifier), AJCC/UICC 7th pathological T1c Category (Cancer Modifier), AJCC/UICC 7th pathological T2 Category (Cancer Modifier), AJCC/UICC 7th pathological T2a Category (Cancer Modifier), AJCC/UICC 7th pathological T2b Category (Cancer Modifier), AJCC/UICC 7th pathological T2c Category (Cancer Modifier), AJCC/UICC 7th pathological T3 Category (Cancer Modifier), AJCC/UICC 7th pathological T3a Category (Cancer Modifier), AJCC/UICC 7th pathological T3b Category (Cancer Modifier), AJCC/UICC 7th pathological T4 Category (Cancer Modifier)	**4.b**
CQ31. What are the TNM Path N staging values?	pN0 (NAACCR,890@p0), pN1 (NAACCR, 890@p1)	**4.a**

CQ31.1 What are the TNM Path N staging categories?	AJCC/UICC 7th pathological NX Category (Cancer Modifier), AJCC/UICC 7th pathological N0 Category (Cancer Modifier), AJCC/UICC 7th pathological N1 Category (Cancer Modifier)	**4.b**
CQ32. What are the TNM Path M staging values?	cM0 (NAACCR, 900@c0), pM1 (NAACCR, 900@p1), pM1a (NAACCR, 900@p1A) pM1b (NAACCR, 900@p1B), pM1c (NAACCR, 900@p1C)	**4.a**
CQ33. What are the TNM Path Stage Groups staging values?	I (NAACCR, 910@1), II (NAACCR, 910@2), IIA (NAACCR, 910@2A), IIB (NAACCR, 910@2B), IIC (NAACCR, 910@2C), III (NAACCR, 910@3), IIIA (NAACCR, 910@3A), IIIB (NAACCR, 910@3B), IIIC (NAACCR, 910@3C), IV (NAACCR, 910@4), IVA (NAACCR, 910@4A), IVB (NAACCR, 910@4B)	**4.a**
CQ34. What are the TNM Clin T staging values?	cT0 (NAACCR, 940@c0), cT1 (NAACCR, 940@c1), cT2 (NAACCR, 940@c2), cT2a (NAACCR, 940@c2A), cT2b (NAACCR, 940@c2B), cT2c (NAACCR, 940@c2C), cT3 (NAACCR, 940@c3), cT3a (NAACCR, 940@c3A), cT3b (NAACCR, 940@c3B), cT4 (NAACCR, 940@c4)	**4.a**
	AJCC/UICC 7th clinical TX Category (Cancer Modifier), AJCC/UICC 7th clinical T2a Category (Cancer Modifier), AJCC/UICC 7th clinical T2b Category (Cancer	**4.b**

	Modifier), AJCC/UICC 7th clinical T2c Category (Cancer Modifier), AJCC/UICC 7th clinical T3a Category (Cancer Modifier), AJCC/UICC 7th clinical T3b Category (Cancer Modifier), AJCC/UICC 7th clinical T4 Category (Cancer Modifier),	
CQ35. What are the TNM Clin N staging values?	cN0 (NAACCR, 950@c0), cN1 (NAACCR, 950@c1)	**4.a**
	AJCC/UICC 7th clinical N0 Category (Cancer Modifier), AJCC/UICC 7th clinical N1 Category (Cancer Modifier), AJCC/UICC 7th clinical NX Category (Cancer Modifier)	**4.b**
CQ36. What are the TNM Clin M staging values?	cM0 (NAACCR, 960@c0) cM1 (NAACCR, 960@c1) cM1a (NAACCR, 960@c1A) cM1b (NAACCR, 960@c1B) cM1c (NAACCR, 960@c1C)	**4.a**
CQ36.1. What are the TNM Clin M staging categories?	AJCC/UICC 7th clinical M0 Category (Cancer Modifier), AJCC/UICC 7th clinical MX Category (Cancer Modifier), AJCC/UICC 7th clinical M1a Category (Cancer Modifier), AJCC/UICC 7th clinical M1b Category (Cancer Modifier), AJCC/UICC 7th clinical M1c Category (Cancer Modifier)	**4.b**
CQ37. What are the TNM Clin Stage Groups staging values?	I (NAACCR, 970@1), II (NAACCR, 970@2), IIA (NAACCR, 970@2A), IIB (NAACCR, 970@2B), IIC (NAACCR, 970@2C),	**4.a**

	III (NAACCR, 970@3), IIIA (NAACCR, 970@3A), IIIB (NAACCR, 970@3B), IIIC (NAACCR, 970@3C), IV (NAACCR, 970@4), IVA (NAACCR, 970@4A), IVB (NAACCR, 970@4B)	
CQ38. How is the recurrence of prostate cancer classified?	Low risk of recurrence, prostate cancer (PRCA) (CPT4, 3271F), Intermediate risk of recurrence, prostate cancer (PRCA) (CPT4, 3272F), High risk of recurrence, prostate cancer (PRCA) (CPT4, 3273F), Prostate cancer risk of recurrence not determined or neither low, intermediate nor high (PRCA) (CPT4, 3274F)	**4.a**
CQ39. Are any metastasis locations defined for prostate cancer?	Lymph Nodes with Metastasis (Cancer Modifier, OMOP4998666), Metastasis to the Viscera (Cancer Modifier, OMOP5032006), Metastasis to the Bone (Cancer Modifier, OMOP4998978), Distant Metastasis (NOS) (Cancer Modifier, OMOP4998641)	**4.a**
	Metastasis to bone (Cancer Modifier), Lymph Nodes with Metastasis (Cancer Modifier), Metastasis to liver (Cancer Modifier), Metastasis to lung (Cancer Modifier), Metastasis to brain (Cancer Modifier), Metastasis to digestive organ (Cancer Modifier), Metastasis to retroperitoneum (Cancer Modifier), Metastasis to kidney (Cancer Modifier), Metastasis to adrenal gland (Cancer Modifier), Metastasis (Cancer Modifier)	**4.b**
CQ40. How is the pathology of prostate cancer specified?	Tissue specimen from prostate (SNOMED, 128170008)	**4.a**

CQ41. Are any values defined for the vital status (at the end of the follow-up period)?	Alive (SNOMED, 438949009) Dead (SNOMED, 419099009)	**4.a**

CQG2. Mandatory Clinical Knowledge		
CQG2.3 Liver Cancer		
Sources: EuCanImage 4.d (UC1 - Liver)		
CDM: FHIR		
Competency Question (CQ)	**Answer: Label (Vocab, Code)**	**Src**
CQ1 : Is the patient ID specified?	Patient ID	**4.d**
CQ1.1 Is the patient ID required in the hyper-ontology as a standard concept?	*to discuss regarding the user requirements (e.g., federated querying)*	
CQ2. How is sex defined?	Sex assigned at birth (LOINC, 76689-9)	**4.d**
CQ3. Are any sex/gender values defined?	Male (LOINC, LA2-8), Female (LOINC, LA3-6)	**4.d**
CQ4. Are any primary types of liver cancer defined?	Primary malignant neoplasm of liver (SNOMED CT, 95214007)	**4.d**
CQ5. What are the primary body sites considered for liver cancer?	Liver structure (SNOMED CT, 10200004)	**4.d**
CQ6. How is age defined?	Age at diagnosis	**4.d**
CQ7. Any histopathological diagnoses for indeterminate nodules are defined?	Liver cell carcinoma (disorder) (SNOMEDCT, 109841003)	**4.d**
CQ8. How are	Confirmed (FHIR,),	**4.d**

histopathological diagnoses for indeterminate nodules evaluated?	Refuted (FHIR,)	
CQ9. What are the sources of diagnoses?	Histopathology (SNOMED CT, 394597005), Imaging - action (SNOMED CT, 360037004)	**4.d**
CQ10. What etiologies are associated with liver disease?	Finding of Hepatitis B status (finding) (SNOMED CT, 365863005), Finding of Hepatitis C status (finding) (SNOMED CT, 365865003), Alcoholic liver damage (disorder)(SNOMED CT, 41309000), Non-alcoholic fatty liver disease (disorder) (SNOMED CT,1231824009) , Primary sclerosing cholangitis (disorder) (SNOMED CT, 197441003), Autoimmune hepatitis (SNOMED CT, 408335007), Hepatopathy where Due to = Other (SNOMED CT, 235856003:42752001=74964007)	**4.d**
CQ11. Using which values the Hepatitis are estimated?	Positive (SNOMED CT, 10828004), Negative (SNOMED CT, 260385009), Unknow (SNOMED CT, 261665006)	**4.d**
CQ12. Using which values the liver diseases are estimated?	Yes (SNOMED CT, 373066001), Not detected (SNOMED CT, 260415000), Unknow (SNOMED CT, 261665006)	**4.d**
CQ13. Are any other liver diseases/diagnoses considered?	Chronic hepatitis (disorder) (SNOMEDCT, 76783007),	**4.d**

	Cirrhosis of liver (disorder) (SNOMEDCT, 19943007)	
CQ14. Any assessment scale is defined for liver disorders?	Child-Pugh score (assessment scale) (SNOMEDCT, 3191000175106)	**4.d**
CQ15. What are the available Child-Pugh scores?	Child-Pugh score class A (SNOMED CT, 710065009), Child-Pugh score class B (SNOMED CT, 710066005), Child-Pugh score class C (SNOMED CT, 710067001)	**4.d**

CQG2. Mandatory Clinical Knowledge		
CQG2.4 Liver Colon Cancer		
Sources: EucanImage 4.d (UC3 - Liver Colon)		
CDM: FHIR		
Competency Question (CQ)	**Answer: Label (Vocab, Code)**	**Src**
CQ1 : Is the patient ID specified?	Patient ID	**4.d**
CQ1.1 Is the patient ID required in the hyper-ontology as a standard concept?	*to discuss regarding the user requirements (e.g., federated querying)*	
CQ2. How is sex/gender defined?	Sex assigned at birth (LOINC, 76689-9)	**4.d**
CQ3. Are any sex/gender values defined?	Male (LOINC, LA2-8), Female (LOINC, LA3-6)	**4.d**
CQ4. How is colon cancer specified?	Secondary malignant neoplasm of liver where Site of primary tumour = Primary malignant neoplasm of colon (SNOMED CT, 94381002:260716003=93761005)	**4.d**
CQ4.1 Are any specific types of liver cancer defined ?	Secondary malignant neoplasm of liver (SNOMED CT, 94381002)	**4.d**
CQ4.2. Are any sites of primary tumor defined for liver cancer types?	Primary malignant neoplasm of colon (SNOMED CT, 93761005)	**4.d**
CQ5. What is the body structure of interest for liver	Liver structure (SNOMED CT, 10200004)	**4.d**

cancer?		
CQ6. How is age defined?	Age at diagnosis	**4.d**
CQ7. How are histological types of liver lesion specified?	Secondary malignant neoplasm of liver where Site of primary tumour = Primary malignant neoplasm of colon (SNOMED CT (postcoordination), 94381002:260716003=93761005), Lesion where Type - attribute = Other (SNOMED CT (postcoordination), 52988006:410657003=74964007), Lesion where Type - attribute = Not detected (SNOMED CT (postcoordination), 52988006:410657003=260415000)	**4.d**
CQ7.1. How is lesion defined?	Lesion (SNOMED CT, 52988006),	**4.d**
CQ7.2. Are any histological types of liver lesion specified?	Secondary malignant neoplasm of liver (SNOMED CT, 94381002), Primary malignant neoplasm of colon (SNOMED CT, 93761005)	**4.d**
CQ7.3. Are any specific type attributes defined for liver lesions?	Other (SNOMED CT, 74964007), Not detected (SNOMED CT, 260415000)	**4.d**
CQ8. What are the sources of diagnoses?	Histopathology (SNOMED CT, 394597005), Imaging - action (SNOMED CT, 360037004)	**4.d**
CQ9. Is comorbidity considered for liver disease?	Co-morbid conditions (finding) (SNOMED CT, 398192003)	**4.d**
CQ10. How is comorbidity evaluated?	True/False	**4.d**

CQ11. What are the different comorbidities associated with liver disease or any other oncology diagnosis ?	Liver cell carcinoma (disorder) (SNOMED CT, 109841003), Hemangioma (SNOMED CT, 400210000), “Focal nodular hyperplasia of liver (disorder)” (SNOMED CT, 278527001), “Adenoma of liver (disorder)” (SNOMED CT, 424263008), “Cyst of liver (disorder)” (SNOMED CT, 85057007), “Abscess of liver (disorder)” (SNOMED CT, 27916005), “Intraabdominal bile collection” (SNOMED CT, 445137006), “Cystadenoma of liver (disorder)” (SNOMED CT, 448997008), “Echinococcosis of liver (disorder)” (SNOMED CT, 26103000), “Steatosis of liver where Associated morphology = Focal damage” (SNOMED CT, 197321007:116676008=860692001), “Dysplastic nodule (morphologic abnormality)” (SNOMED CT, 448149008), “Fibrolamellar hepatocellular carcinoma (disorder)” (SNOMED CT, 253018005), “Cholangiocarcinoma (morphologic abnormality)” (SNOMED CT, 70179006), “Malignant lymphoma of liver (disorder)” (SNOMED CT, 1153383006), “Angiosarcoma of liver (disorder)” (SNOMED CT, 109844006), Cirrhosis of liver (disorder) (SNOMED CT, 19943007)	**4.d**
CQ12. What classifications are considered for the primary tumor?	American Joint Committee on Cancer clinical T category allowable value (qualifier value) (SNOMED-CT, 1222585009), American Joint Committee on Cancer pathological T category allowable value (qualifier value) (SNOMED-CT, 1222589003),	**4.d**

	American Joint Committee on Cancer clinical N category allowable value (qualifier value) (SNOMED-CT, 1222588006), American Joint Committee on Cancer pathological N category allowable value (qualifier value) (SNOMED, 1222590007), American Joint Committee on Cancer clinical M category allowable value (qualifier value) (SNOMED-CT, 1222587001), American Joint Committee on Cancer pathological M category allowable value (qualifier value) (SNOMED-CT, 1222591006)	
CQ13. What are the possible values of the clinical T classification?	cTx (SNOMED-CT, 1222604002), cT0 (SNOMED-CT, 1228882005), cTis (SNOMED-CT, 1228884006), cT1 (SNOMED-CT, 1228889001), cT2 (SNOMED-CT, 1228929004), cT3 (SNOMED-CT, 1228938002), cT4 (SNOMED-CT, 1228944003), cT4a (SNOMED-CT, 1228945002, cT4b (SNOMED-CT, 1228946001)	**4.d**
CQ14. What are the possible values of the pathological T classification?	pTX (SNOMED-CT, 1228950008), pT0 (SNOMED-CT, 1228951007), pTis (SNOMED-CT, 1228953005), pT1 (SNOMED-CT, 1228957006), pT2 (SNOMED-CT, 1229852009), pT3 (SNOMED-CT, 1229859000), pT4 (SNOMED-CT, 1229864001), pT4a (SNOMED-CT, 1229865000), pT4b (SNOMED-CT, 1229866004)	**4.d**
CQ15. What are the possible values of the clinical N	cNX (SNOMED-CT, 1229966003), cN0 (SNOMED-CT, 1229967007),	**4.d**

classification?	cN1 (SNOMED-CT, 1229973008), cN2 (SNOMED-CT, 1229978004)	
CQ16. What are the possible values of the pathological N classification?	pNx (SNOMED-CT, 1229945006), pN0 (SNOMED-CT, 1229947003), pN1 (SNOMED-CT, 1229951001), pN2 (SNOMED-CT, 1229957002)	**4.d**
CQ17. What are the possible values of the clinical M classification?	cM0 (SNOMED-CT, 1229901006), cM1 (SNOMED-CT, 1229903009), cM1a (SNOMED-CT, 1229904003), cM1b (SNOMED-CT, 1229907005), cM1c (SNOMED-CT, 1229910003)	**4.d**
CQ18. What are thepossible values of the pathological M classification?	pM0 (NCIT, C48740), pM1 (SNOMED-CT, 1229916009), pM1a (SNOMED-CT, 1229917000), pM1b (SNOMED-CT, 1229920008), pM1c (SNOMED-CT, 1229923005)	**4.d**

CQG2. Mandatory Clinical Knowledge		
CQG2.5 Rectum Cancer		
Sources: EuCanImage 4.d (UC 4&5 Rectum)		
CDM: FHIR		
Competency Question (CQ)	**Answer: Label (Vocab, Code)**	**Src**
CQ1. Is the patient ID specified?	Patient ID	**4.d**
CQ1.1. Is the patient ID required in the hyper-ontology as a standard concept?	*to discuss its requirements for specific tasks (e.g., federated querying)*	
CQ2. How is sex defined?	Sex assigned at birth (LOINC, 76689-9)	**4.d**
CQ2. Are any sex/gender values defined??	Male (LOINC, LA2-8), Female (LOINC, LA3-6)	**4.d**
CQ3. What kinds of rectum cancer are present?	Primary malignant neoplasm of rectum (disorder) (SNOMED CT, 93984006)	**4.d**
CQ4. What is the body structure of interest?	Rectum structure (body structure) (SNOMED CT, 34402009)	**4.d**
CQ5. How is age defined?	Age at diagnosis	**4.d**
CQ6. How is the histologic type of rectum cancer referred to?	Histologic type of primary malignant neoplasm (observable entity) (SNOMED CT, 512001000004108)	**4.d**
CQ7. What are the available histologic types of rectum	Adenocarcinoma NOS (ICD-O-3, 8140/3),	**4.d**

cancer?	Neuroendocrine Carcinoma, NOS (ICD-O-3, 8246/3), Mixed neuroendocrine non-neuroendocrine neoplasm (MiNEN) (ICD-O-3, 8154/3), Mucinous adenocarcinoma (ICD-O-3, 8480/3), Adenocarcinoma with mixed subtypes (ICD-O-3, 8255/3)	
CQ8. What classification categories are defined for rectum cancer?	American Joint Committee on Cancer clinical T category allowable value (qualifier value) (SNOMED-CT, 1222585009), American Joint Committee on Cancer pathological T category allowable value (qualifier value) (SNOMED-CT, 1222589003), American Joint Committee on Cancer pathological N category allowable value (qualifier value) (SNOMED, 1222590007), American Joint Committee on Cancer pathological M category allowable value (qualifier value) (SNOMED-CT, 1222591006)	**4.d**
CQ9. What are the possible values for the clinical T classification?	cTx (SNOMED-CT, 1222604002), cT0 (SNOMED-CT, 1228882005), cTis (SNOMED-CT, 1228884006), cT1 (SNOMED-CT, 1228889001), cT2 (SNOMED-CT, 1228929004), cT3 (SNOMED-CT, 1228938002), cT4 (SNOMED-CT, 1228944003), cT4a (SNOMED-CT, 1228945002, cT4b (SNOMED-CT, 1228946001)	**4.d**
CQ10. What are the possible values for the pathological T classification?	pTX (SNOMED-CT, 1228950008), pT0 (SNOMED-CT, 1228951007), pTis (SNOMED-CT, 1228953005), pT1 (SNOMED-CT, 1228957006), pT2 (SNOMED-CT, 1229852009), pT3 (SNOMED-CT, 1229859000), pT4 (SNOMED-CT, 1229864001),	**4.d**

	pT4a (SNOMED-CT, 1229865000), pT4b (SNOMED-CT, 1229866004)	
CQ11. What are the possible values for the pathological N classification?	pNx (SNOMED-CT, 1229945006), pN0 (SNOMED-CT, 1229947003), pN1 (SNOMED-CT, 1229951001), pN2 (SNOMED-CT, 1229957002)	**4.d**
CQ12. What are the possible values for the pathological M classification?	pM0 (NCIT, C48740), pM1 (SNOMED-CT, 1229916009), pM1a (SNOMED-CT, 1229917000), pM1b (SNOMED-CT, 1229920008), pM1c (SNOMED-CT, 1229923005)	**4.d**
CQ13. Is any tumor staging specified for rectum cancer?	Tumor histopathological grade status values (tumor staging) (SNOMED-CT, 258244004)	**4.d**
CQ14. What are the available tumor grades?	American Joint Committee on Cancer grade GX (qualifier value) (SNOMED-CT, 1228845001) G1 - American Joint Committee on Cancer grade G1 (qualifier value) (SNOMED-CT, 1228848004) G2 - American Joint Committee on Cancer grade G2 (qualifier value) (SNOMED-CT, 1228850007) G3 - American Joint Committee on Cancer grade G3 (qualifier value) (SNOMED-CT, 1228851006)	**4.d**
CQ15. Are any specific laboratory tests or evaluations defined for rectum cancer?	Lymphovascular invasion (LOINC, LP428220-0), Perineural invasion [Presence] in Cancer specimen (LOINC, 92837-4), Extramural vein invasion [Presence] in Colorectal cancer specimen by Light microscopy (LOINC, 84889-5), Regional lymph nodes examined [#] Specimen (LOINC, 21894-1), Number of lymph nodes containing metastatic neoplasm in excised specimen (observable entity) (SNOMED-CT, 443527007), Presence of metastatic discontinuous spread of malignant neoplasm of colon to pericolic tissue (observable entity) (SNOMED-CT, 630001000004109),	**4.d**

	Modified Ryan Scheme for Tumor Regression (NCIT, C155939)	
CQ16. How are the laboratory tests/evaluations assessed?	True, False, Present (LOINC, LA9633-4), Absent (LOINC, LA9634-2), Not identified (LOINC, LA11902-6)	**4.d**
CQ17. What are the available values for the tumor regression evaluation?	GX: Histologic grade cannot be assessed (qualifier value) (SNOMED-CT, 1155705000), Tumor Regression Score 0 (NCIT, C155941), Tumor Regression Score 1 (NCIT, C155942), Tumor Regression Score 2 (NCIT, C155943), Tumor Regression Score 3 (NCIT, C155944)	**4.d**
CQ18. How is the time spent between neoadjuvant treatment and surgery referred?	Intervals of weeks and months where Start time = Neoadjuvant antineoplastic therapy, and Stop time = Surgical procedure (SNOMED postcoordination , 307474000:398201009=1259200004,397898000=387713003)	**4.d**
CQ18.1 Are any patterns defined for measuring the time spent between treatments?	Intervals of weeks and months (SNOMED CT, 307474000), Start time (SNOMED CT, 398201009), Stop time (SNOMED CT, 397898000),	**4.d**
CQ18.2 What treatment is considered at start time?	Neoadjuvant antineoplastic chemotherapy (SNOMED CT, 1259200004)	**4.d**
CQ18.3 What treatment is considered at stop time?	Surgical procedure (SNOMED CT, 387713003)	**4.d**
CQ19. What treatments are specified for rectum cancer?	Radiation oncology AND/OR radiotherapy (procedure) (SNOMED-CT, 108290001), Surgical procedure (procedure) (SNOMED-CT, 387713003), Neoadjuvant antineoplastic therapy (procedure) (SNOMED-CT, 400001000004103)	**4.d**

CQ20. How are these treatments qualified?	not-done, stopped, completed, unknow	**4.d**
CQ21. What medication is specified for chemotherapy?	FOLFOX (NCIT, C11197), FOLFIRI (NCIT, C63593), FOLFIRINOX (NCIT, C11764), Capecitabine (RxNorm, 194000), Fluorouracil (RxNorm, 4492)	**4.d**
CQ22. Are any chemotherapy accumulation doses defined?	mg/m2, mg, mg/kg	**4.d**
CQ23. How is the completed cycle of therapy referred to?	Chemotherapy cycle (procedure) (SNOMED-CT, 399042005)	**4.d**

CQG3. Mandatory[4] Imaging Metadata Knowledge		
Sources: CHAIMELEON 4.a, ProCancer-I 4.b, INCISIVE 4.c		
Competency Question (CQ)	**Answer: Label (Vocab, Code)**	**Src**
CQ1. How is the image modality defined?	Modality (Radlex, RID10311)	**4.b**
	Magnetic Resonance (0008,0060), Computed Tomography (0008,0060), Nuclear Medicine (0008,0060), Positron emission tomography (PET) (0008,0060), Single-photon emission computed tomography (SPECT) (0008,0060)	**4.a**
CQ2. How is the image laterality defined?	Laterality (Radlex, RID5821)	**4.b**
CQ3. How is the anatomic region defined?	Anatomic Region (Radlex, RID13390)	**4.b**
CQ4. How is the patient position defined?	Patient Position (Radlex, RID10420)	**4.b**
CQ5. How is the patient orientation defined?	Patient Orientation (Radlex, RID10461)	**4.b**
CQ6. How is the anatomical plane defined?	Anatomical Plane (Radlex, RID13250)	**4.b**
CQ7. How is MR Echo Type defined?	MR Echo Type (Radlex, RID10738)	**4.b**

[4] Mandatory imaging metadata table presents the imaging knowledge required to be represented in the hyper-ontology

CQ8. How is MR tissue contrast defined?	Tissue Contrast (Radlex, RID10791)	**4.b**
CQ9. Are any specific study attributes defined? (pending: imaging metadata decision)	StudyID (0020,0010), StudyDate (0008,0020), StudyDescription (0008,1030)	**4.a**
CQ10. Are any specific series attributes defined? (pending: imaging metadata decision)	SeriesDescription (0008,103E)	**4.a**
CQ11. How is the examined body part defined?	BodyPartExamined (0018,0015)	**4.a**
CQ12. How is the contrast/bolus agent interpreted? (pending: imaging metadata decision)	ContrastBolusAgent (0018,0010)	**4.a**
CQ13. Is Radiopharmaceutical considered? (pending: imaging metadata decision)	Radiopharmaceutical (0018,0031)	**4.a**
CQ14. How is timepoint defined?	Baseline, Follow-up	**4.a**
CQ15. Are any imaging metadata attributes defined for querying DICOM-SEG? (pending: imaging metadata decision)	study_uid (0020,000D) source_series_uid (0020,000E) derived_series_uid (0020,000E) series_description (0008,103E) slice_thickness (0018,0050) spacing_between_slices (0018,0088) pixel_row_spacing (0028,0030)	**4.b**

	pixel_col_spacing (0028,0030) segment label (0062,0005) method annotated_region	
CQ15.1 What values (labels) are given to segment label attribute?	PZ (peripheral zone of prostate) TZ (transitional zone of prostate) CZ (central zone of prostate) SV (seminal vesicle)	**4.b**
CQ15.2 What values (labels) are given for annotated region attribute?	Prostate, Lesion	**4.b**
CQ15.3 What values (labels) are given for method attribute?	Manual, Semiautomatic, Automatic	**4.b**
CQ16. Are any annotation procedures labels/values defined for image annotations?	Bounding Box, Contouring	**4.c**
CQ17. Are any labels specified for image annotations?	Suspicious, Problematic, Malignant, Suspicious or Indeterminate, Benign, Calcification, Surgical clip, Axillary lymph node, Macrocalcifications, Lymph node	**4.c**

CQG4. Common Knowledge[5]		
Sources: TFT1 (meetings 1), User-requirements (Federated querying 3.a, Data Annotation WP 3.b)		
Competency Question (CQ)	**Answer: Label**	**Src**
CQ1. Is any common knowledge specified?	Date of birth, Date of diagnosis, Age at diagnosis,	**1-3**
CQ2. Are any query criteria specified for the federated query task?	Gender, Diagnosis, Body part, Age at diagnosis, Imaging modality, Manufacturer	**1** **3.a**
CQ3. Are any specific concepts/relations required?	Define a relationship *hasUndergone* linking *Cancer Patient* to *Surgical Procedure*	**1**

[5] Common knowledge is neither clinical nor imaging.

Ontological Resources (Health and Biomedical Ontologies/Terminologies/Vocabularies/Standards/Classifications)

SNOMEDCT

SNOMED CT provides the core general terminology for the electronic health record (EHR). The concepts have unique meanings and formal logic-based definitions organized into hierarchies. Each International Release includes the core of the terminology (concepts, descriptions, and relationships), together with works to support the implementation and use of SNOMED CT, including subsets, cross maps to existing classifications and coding schemes, and an extensive set of guidelines.

Available from: http://www.ihtsdo.org/snomed-ct/

BioPortal: https://bioportal.bioontology.org/ontologies/SNOMEDCT

ICD-O-3

ICD-O-3 is the International Classification of Diseases for Oncology, third edition. ICD-O-3 is a dual classification. It contains both a topographical code and a histological code for each neoplasm. The topographical describes the site of the neoplasm; in general, it uses the same three- or four-character codes as used in ICD-10 for malignant neoplasms. The morphological code describes the cell type of the neoplasm and its biological behavior. It thus characterizes the neoplasm itself.

Available from:
https://www.bfarm.de/EN/Code-systems/Classifications/ICD/ICD-O-3/_node.html

Radiology Lexicon (RADLEX)

RadLex is produced to recognize the benefits that come from radiologists using a common language to communicate diagnostic results. RadLex is a comprehensive set of radiology terms for use in radiology reporting, decision support, data mining, data registries, education, and research.

The base RadLex ontology is available from: https://radlex.org/

BioPortal: https://bioportal.bioontology.org/ontologies/RADLEX

Gender Identity (GENDER)

GENDER is a vocabulary that makes up the different gender identities - Female, Male and Other.

BioPortal: https://bioportal.bioontology.org/ontologies/GENDER

Cancer Modifier

Diagnostic Modifiers of Cancer (OMOP)

OMOP generated

LOINC

LOINC is a terminology standard for identifying medical laboratory measurements, observations, and documents. LOINC helps make health data more portable. It facilitates the exchange and pooling of results, such as laboratory tests or vital signs, for clinical care, outcomes management, and research.

Available from: https://loinc.org/

BioPortal: https://bioportal.bioontology.org/ontologies/LOINC

RxNORM

RxNorm is two things: a normalized naming system for generic and branded drugs; and a tool for supporting semantic interoperation between drug terminologies and pharmacy knowledge base systems. The National Library of Medicine (NLM) produces RxNorm.

Available from: https://www.nlm.nih.gov/research/umls/rxnorm/docs/rxnormfiles.html

UCUM

Unified Code for Units of Measure (UCUM) is a code system intended to include all units of measures being contemporarily used in international science, engineering, and business.

Available from: https://ucum.org/

NAACCR

NAACCR (North American Association of Central Cancer Registries) is a data standard used to code data in the US Cancer Registries. It covers the majority of cancer types and includes critical diagnostic features and high-level treatment classification used in cancer epidemiology. The NAACCR Data Standards and Data Dictionary is intended for hospital and central cancer registries, programmers, and analysts. It provides detailed specifications and codes for each data item in the NAACCR data exchange record layout.

Available from: https://www.naaccr.org/data-standards-data-dictionary/

CPT4

The Current Procedural Terminology (CPT-4) is a uniform coding system consisting of descriptive terms and identifying codes that are used primarily to identify medical services and procedures furnished by physicians and other health care professionals.

Available from:
https://www.ama-assn.org/practice-management/cpt-current-procedural-terminology

ATC

The Anatomical Therapeutic Chemical (ATC) Classification System is a drug classification system that classifies the active ingredients of drugs according to the organ or system on which they act and their therapeutic, pharmacological and chemical properties. It is controlled by the World Health Organization Collaborating Centre for Drug Statistics Methodology (WHOCC).

Available from: https://www.whocc.no/atc/structure_and_principles/

BioPortal: https://bioportal.bioontology.org/ontologies/ATC

ICD10PCS

ICD-10-PCS is a medical classification coding system for procedural codes.

Available from: https://www.cms.gov/medicare/coding-billing/icd-10-codes

BioPortal: https://bioportal.bioontology.org/ontologies/ICD10PCS

Non-ontological Resources

DICOM

DICOM (Digital Imaging and Communications in Medicine) is a standard protocol for the management and transmission of medical images and related data and is used in many healthcare facilities.

Available from: https://www.dicomstandard.org/

Ontologies Repositories

UMLS

BioPortal