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Catalogue with Codes relevant for MEDIRAD project

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Abbreviations

AI	Artificial Intelligence
CDA	Common Document Architecture
CPT	Current Procedural Terminology
DICOM	Digital Imaging and Communication in Medicine
EBM	Einheitlicher Bewertungsmaßstab (unified valuation standard)
ESR	European Society of Radiology
HL7	Health Level 7
ICD	International Classification of Diseases
IHE	Integrating the Healthcare Enterprise

LOINC	Logical Observation Identifiers Names and Codes
MRRT	IHE Radiology Management of Radiology Reporting Templates
NLP	Natural Language Processing
RadLex	RSNA Radiological Lexicon
RPID	RadLex Playbook Identifier
REM	IHE Radiology Radiation Exposure Monitoring Profile
RSNA	Radiological Society for North America
SNOMED-CT	Systematized Nomenclature of Medicine Clinical Term
TCE	IHE Radiology Teaching File and Clinical Export Profile
UMLS	Unified Medical Language System
XDS	IHE Cross Enterprise Document Exchange Profile

1. Introduction

The descriptions of procedures, clinical symptoms, findings, and other relevant information in radiological examinations are mostly in free text. Coding of such information is very different across healthcare systems throughout Europe. Sometimes, there are national coding systems, especially for billing purposes, sometimes international coding systems such as ICD (International Classification of Diseases) are in use. This makes any kind of comparison or benchmarking very difficult between EU-members. A typical example for such benchmarking is comparing the frequency of radiological examinations. A detailed analysis of the radiation protection report no. 180 makes clear why this is a difficult task: According to this report, 51% of the countries have national radiological procedure codes, and 41% did not have such coding systems (1). Furthermore, the wide range of procedures descriptions used throughout Europe (74 - 3220) is another drawback for using such data for comparison.

Regarding the evaluation of radiation exposure, it is relevant to have detailed information on procedures, anatomical locations, image acquisition, and findings. Therefore, as part of this work package, existing coding systems have been analysed, appropriate codes for the MEDIRAD project have been identified, and a tool for mapping free text or proprietary coding systems to a general coding system has been tested in a preliminary setting.

Coding schemes will become more relevant in the future for several task, e.g. structured reporting, dose monitoring, education and training, research, and especially cross-enterprise or even cross-border health-care document exchange.

2. Overview of action items

- Identification of disease entities relevant for MEDIRAD
- Description of existing coding systems with relevance for MEDIRAD
- Advantages and disadvantages of different coding systems
- Analysis of coding systems used in image management systems
- Coding in the context of DICOM and IHE profiles
- preliminary experiences with mapping-tools

2.1 Disease entities relevant for MEDIRAD

As part of the MEDIRAD project, different clinical studies are planned or already ongoing. Therefore, it is relevant to get an overview of modalities and clinical entities, which will be relevant for preparing appropriate coding proposals. A short survey has been initiated in July 2017 to get feedback from different partners.

According to this survey, these are the priorities:

- CT will be used in more than 80%, MRI in about 30% and PET-CT in about 15% as diagnostic modalities (note: several studies will use more than one modality).
- The most relevant information about the examinations will be data on image acquisition, anatomical location, findings, treatment, and image quality.
- Most relevant disease entities are: breast cancer and cardiovascular diseases, thyroid cancer and lung cancer resp. lung nodules.

This information has been used for analysis and proposals for a coding concept.

2.2 Description of existing coding systems with relevance for MEDIRAD

Today, there are already many coding systems and ontologies available, which are serving several different purposes. E.g. for general disease description including epidemiological analysis, the ICD code is preferred. For billing purposes, most countries use their own proprietary coding system, e.g. EBM in Germany or CPT in the US.

In the context of this work package, it seems appropriate to identify an existing coding solution, which has already gained acceptance and which is used in clinical practice, instead of developing a new coding system. The focus should be – according to our survey – on medical terms describing procedures, findings etc.

Different terminologies and coding systems will be described in the following paragraph.

SNOMED CT – *Systematized Nomenclature of Medicine Clinical Term* is an ontology providing systematically organized computer processable medical codes, terms, synonyms, and definitions. SNOMED covers many different areas such as diseases, symptoms, procedures, treatment, devices or drugs. SNOMED is maintained and controlled by the International Health Terminology Standards Development Organisation (IHTSDO), a non- profit organisation located in Copenhagen (Denmark). The use of SNOMED CT in IT-systems requires a license. Several countries do have national license agreements, like Denmark, UK, and others. SNOMED CT has been preceded by SNOMED RT, which is extensively used by DICOM, especially for anatomic concepts, views, contrast agents, and general

concepts. SNOMED CT is expressed in “concepts”; currently there are more than 300.000 concepts defined (2, 3).

UMLS – the *Unified Medical Language System* is a compendium of many controlled vocabularies and is maintained by the US Library of Medicine. It is a comprehensive thesaurus and ontology of biomedical concepts, and also provides facilities for natural language processing. The metathesaurus as base of UMLS comprises more than 1 million concepts and about 5 million concept names. These concepts are assigned with one or more categories, providing semantic relationships (4).

ICD – *International Statistical Classification of Diseases and Related Health Problems* is provided by the UN-sponsored World Health Organization to support epidemiology, health management, and clinical purposes. It provides codes for diseases and clinical signs. There are specific national modifications used in different countries (2, 5) and specific classifications for groupings of diseases, e.g. the ICD-O for oncology.

LOINC - *Logical Observation Identifiers Names and Codes* is a database and universal standard primarily for identifying medical laboratory observations. It has been introduced and is still maintained by the Regenstrief Institute, a US non-profit research organisation. LOINC is referenced by IT standards (e.g. HL 7) or IT profiling organisations (e.g. IHE). LOINC terms have been translated in various other languages as e.g. Spanish or German. Also, harmonisation efforts between LOINC and SNOMED CT were initiated some years ago. Currently, LOINC version 2.64 comprises more than 87.000 terms (2, 6, 7).

RadLex / RadLex Playbook – RadLex provides a comprehensive set of terms for use in reporting, decision support, data mining or registries, education, and research. RadLex has been developed by expert members of RSNA. RadLex is available through different access forms, e.g. a browsable tree and also a programmers´ interface. Known the wide variety of procedure descriptions between different centres, or even different scanners in one department, there is a need to have a reference for such names. RSNA has addressed this by providing the RadLex Playbook. Based on RadLex, RSNA developed names for about 1,000 radiological procedures. RadLex Playbook codes are used to create consistent procedure names for data submitted to the American College of Radiology´s CT Dose Index Registry. Since 2017, RSNA is partnering with LOINC to harmonize the two terminologies. RadLex Playbook is meanwhile integrated into LOINC. Playbook entries include unique identifiers (RPID), a long version of names based on the Playbook grammar, a short version to be used in DICOM headers and human-readable definitions, and also mapping to RadLex concepts (2, 8).

2.3 Advantages and disadvantages of different coding systems

SNOMED CT – this scheme provides a large number of terms, not only for radiology. SNOMED requires a valid license. In several countries it is available via a national license agreement. But, most of the European countries do not have such a national license yet. A selected group of terms is available for use in the context with DICOM, because DICOM and SNOMED do have a specific agreement.

UMLS – consists of many concepts and terms. The direct adoption of this coding scheme in the context of imaging is not foreseen by international standards.

ICD – is very often used for coding diseases, e.g. for billing, clinical and epidemiological purposes. ICD does not provide specific terms for ordering procedures or findings while reporting. Therefore, it is mainly useful for the coding of diseases in the context of MEDIRAD’s clinical studies. Specific maps are available to translate SNOMED CT diagnosis into ICD codes.

LOINC – is freely available. Primarily used for results of laboratory medicine, LOINC is covering a wider range of terms today. Since RSNA and LOINC are partnering to maintain the RadLex Playbook for procedure descriptions, it might become the most accepted scheme for procedure codes now.

RadLex – is a radiology specific ontology providing more than 70,000 terms. RadLex is available for free, and accessible via a term browser and also a programmers´ interface. RadLex has already been translated into German and French, and a translation into Portuguese is ongoing.

2.4 Coding systems used in image management systems

There are no generally accepted and internationally wide used coding schemes known. IT systems used in image management are Radiology Information Systems (RIS), imaging modalities, dedicated image processing workstations, Picture Archiving and Communicating Systems (PACS), dedicated reporting systems, and several more. While PACS-solutions are almost provided in several markets, there are many RIS-solutions, which are focused on national markets. Other systems may vary widely. Depending on legal requirements, RIS might provide coding schemes for billing issues in many installations, but there is a lack of standardized coding schemes for orders or procedure descriptions. DICOM has addressed this lack of standardization with a first template covering CT Protocol Storage (9). The adoption of this CT specific project is still limited. A first international meeting was planned for promoting the associated IHE “Enterprise Scanner Protocol Management” during this years´ Radiological Society of America (RSNA) meeting in November 2018. Imaging systems are frequently delivered by vendors with proprietary procedure descriptions. This could result in inhomogeneous coding schemes within one department. While reporting in Radiology is still mostly done with narrative free text, there is a trend to promote structured reporting. Structured reporting is the most appropriate way to have more coded information available, which could be used for information exchange during the care process itself, e.g. between different care provided, but also for education or research. Coded or categorized information is essential for the development of solutions providing tools based on artificial intelligence (10, 11).

2.5 Coding in the context of DICOM and IHE profiles

DICOM has been introduced as a communication standard in imaging around 1993. As part of the DICOM metadata, much information on the imaging modality, the imaging protocol, anatomical representation and many more aspects of the specific procedures is available. DICOM provides a dedicated Data Dictionary to facilitate the interchange of information with definitions for all DICOM Data Elements and DICOM Unique Identifiers (12). Another part of the DICOM standard (Part 16) specifies the content mapping resource for templates and context groups used elsewhere in the standard. This is mostly based on SNOMED (former SNOMED RT), but also LOINC and other coding schemes (13).

IHE is a profiling organisation, which has been started in Radiology about 20 years ago, but covers many other domains today. The IHE XDS profiles family is the base concept in many regional or national eHealth implementations. IHE profiles have been referenced by the European Commission for public procurement in 2015 (14). In the context of MEDIRAD, three IHE profiles are particularly relevant:

- IHE Radiology Radiation Exposure Monitoring Profile (REM)
- IHE Radiology Teaching File and Clinical Export Profile (TCE)
- IHE Radiology Management of Radiology Reporting Templates (MRRT)

IHE REM is the core concept for dose exposure documentation meanwhile and used in different registries. The performed procedure code will be part of the DICOM metadata and used in the DICOM Radiation Dose Structured Report. Consistent use of this workflow enables indexing and analysis across studies and across institutions.

TCE can be used for educational purposes, but also to support clinical trials.

Based on the performed procedure code, the appropriate template for reporting can be launched. Such templates should reference findings to RadLex codes. Later on reports can be stored in different formats, e.g. as HL7 CDA, which can be propagated to an IHE XDS repository for cross enterprise communication (2).

2.6 Principles for a catalogue with codes and preliminary experiences with mapping-tools

Following an extensive analysis of requirements and existing coding schemes, several aspects should be obvious. As part of the MEDIRAD project, there is a clear, but also limited spectrum of requests for coding of different categories. In respect to the challenges in developing and establishing coding schemes, it is not helpful to develop own, new coding schemes, but to promote the best available coding scheme for the use in MEDIRAD. This could be supported by search and mapping tools. Additionally, the licence policy should be respected in decision making; coding solutions, which are not available throughout Europe should be avoided if there are comparable solutions without licence fees.

For procedure codes with RadLex Playbook, maintained by LOINC, and for reporting with RadLex from RSNA powerful systems are already available. Especially in reporting, RadLex is well established and internationally accepted. It is the preferred coding system in IHE MRRT. The development of new radiological reporting templates should follow this IHE MRRT concept. RSNA and ESR have established a joint working group to promote structured reporting and MRRT-based reporting templates.

Based on the known requirements for MEDIRAD, it is proposed to focus on RadLex for coding of imaging studies and reports, respectively on RadLex Playbook for procedure codes. An extract of a catalogue is provided in the below table:

Table 1: Codes for lung studies, representing the dimensions anatomical location and findings

Anatomical locations (RID3)			Findings (RID34785)		
Pref. name	Synonyms	RadLex ID	Pref. name	Synonyms	RadLex ID
thorax	chest	RID1243	adult respiratory distress syndrome	ARDS	RID5319
lung		RID1301	airway abnormality		RID46026
left lung		RID1326	asthma		RID5327
right lung		RID1302	bronchitis		RID34637
lower lobe of lung		RID34696	interstitial pneumonia		RID5329
middle lobe of lung		RID1310	chronic obstructive pulmonary disease	COPD	RID5317
upper lobe of lung		RID34695	disorder of pulmonary circulation		RID34888
apical segment of upper lobe of right lung	S1 segment of upper lobe of right lung	RID1304	pulmonary infarction		RID34889
posterior segment of upper lobe of right lung	S2 segment of upper lobe of right lung	RID1306	interstitial lung disease	interstitial disease	RID28799
anterior segment of upper lobe of right lung	S3 segment of upper lobe of right lung	RID1308	pneumoconiosis		RID5343
lateral segment of middle lobe of right lung	S4 segment of middle lobe of right lung	RID1311	pneumonia		RID5350
medial segment of middle lobe of right lung	S5 segment of middle lobe of right lung	RID1313	pneumothorax	pneumo	RID5352
superior segment of lower lobe of right lung	S6 segment of lower lobe of right lung	RID1316	tension pneumothorax		RID28525
medial basal segment of lower lobe of right lung	S7 segment of lower lobe of right lung	RID1318	pulmonary aspiration		RID5321
anterior basal segment of lower lobe of right lung	S8 segment of lower lobe of right lung	RID1320	small-airways disease		RID43278
lateral basal segment of lower lobe of right lung	S9 segment of lower lobe of right lung	RID1322	lung cancer		RID45686
posterior basal segment of lower lobe of right lung	S10 segment of lower lobe of right lung	RID1324	coin lesion	solitary pulmonary nodule, SPN	RID35095
apicoposterior segment of upper lobe of left lung	S1+2 segment of upper lobe of left lung	RID1329	pulmonary nodule	lung nodule	RID50149
anterior segment of upper lobe of left lung	S3 segment of upper lobe of left lung	RID1331	pulmonary embolism	pulmonary embolus, PE	RID4834
inferior segment of lingula	S4 segment of lingula	RID1334			
superior segment of lingula	S5 segment of lingula	RID1336			
superior segment of lower lobe of left lung	S6 segment of lower lobe of left lung	RID1339			
anteromedial basal segment of lower lobe of left lung	S7+8 segment of lower lobe of left lung	RID1341			
lateral basal segment of lower lobe of left lung	S9 segment of lower lobe of left lung	RID1343			
posterior basal segment of lower lobe of left lung	S10 segment of lower lobe of left lung	RID1345			
superior division of upper lobe of left lung		RID1328			
lingula		RID1333			
trachea	trach	RID1247			
pulmonary vein		RID1231			
left common pulmonary vein		RID1238			
right common pulmonary vein		RID1232			
pulmonary artery		RID974			
left pulmonary artery		RID993			
lobar artery		RID28910			
main pulmonary artery		RID975			
right pulmonary artery		RID976			
segmental pulmonary artery		RID28913			
subsegmental pulmonary artery		RID35825			

The full list of coding tables is added as addendum, representing also dimensions like imaging modality, quality descriptor, or treatment. The tables are based on a systematic search for terms for clinical scenarios, which are mentioned in MEDIRAD. These tables contain all relevant codes, which belong to clinical studies in MEDIRAD known so far. Of course, based on the concept chosen, it is possible to add more codes according to the new clinical requirements in future. Furthermore, it is worth to mention, that the Natural Language Processing (NLP) based approach for seeking codes will use the full context of RadLex.

It is obvious that coding should be part of the regular workflow and be supported as much as possible. Using MRRT compatible reporting templates, such coding can be presented as part of the templates and choosing distinct values while reporting, e.g. anatomical location or findings, will automatically provide the relevant codes. Generating codes is more difficult and time-consuming using narrative, free-text reports. There are first experiences to NLP with support by Artificial Intelligence to analyse such texts. NLP could analyse reports and provide RadLex codes, which would represent the context of the free-text report. It is planned to do some more research in this field and – if successful – to provide a solution as part of this work package for MEDIRAD's clinical studies.

3. Conclusion

Coding of medical information does have a wide range of applications, from ordering studies to procedure codes, funding, dose management, education, or even research.

Several coding schemes are available on an international level. Use of coding is mostly established for billing, clinical practice and epidemiological analyses, e.g. ICD. Going beyond these applications, more powerful coding schemes are required.

Developing new coding schemes and especially establishing such tools in clinical scenarios would be a very costly and time-consuming activity, which would be out of scope for this work package.

Based on a survey on requirements as part of the clinical studies in MEDIRAD, RadLex and RadLex Playbook would be the most appropriate coding schemes for images. RadLex is propagated by IHE for the creation to reporting templates and RadLex Playbook is already in use for dose registries.

A suitable catalogue for MEDIRAD has been built based on these coding schemes (see addendum). Further research is ongoing to analyse the potential of NLP in providing automatic coding out of narrative texts.

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5. Addendum

Table 2: General terms

Treatment (RID8)		
Pref. Name	Synonyms	RadLex ID
chemotherapy	chemo	RID39252
transplantation		RID1649
tumor enucleation		RID1662
pharmacologic intervention		RID49655
radiotherapy	radiation therapy	RID39262
Imaging modality (RID10311)		
Pref. Name	Synonyms	RadLex ID
magnetic resonance imaging	MR, MRI	RID10312
computed tomography	CT	RID10321
ultrasound	US, sonography	RID10326
PET-CT		RID10341
SPECT-CT	NM-CT	RID49583
echocardiography	echocardiogram	RID39220
mammography	mammo	RID10357
scintigraphy		RID34428
Quality descriptor (RID39077)		
Pref. Name	Synonyms	RadLex ID
adequate		RID39308
diagnostic		RID39446
excellent		RID39079
fair		RID39080
good		RID39088
improved		RID39105
nonevaluable		RID39225
poor		RID39081
satisfactory		RID39170
suboptimal		RID39174
unsatisfactory		RID39182
Descripton of table 1: list of general terms, which apply for different clinical scenarios and studies		

Table 3: Terms for anatomical locations and findings in chest studies

	Anatomical locations (RID3)			Findings (RID34785)		
	Pref. name	Synonyms	RadLex ID	Pref. name	Synonyms	RadLex ID
lung	thorax	chest	RID1243	adult respiratory distress syndrome	ARDS	RID5319
	lung		RID1301	airway abnormality		RID46026
	left lung		RID1326	asthma		RID5327
	right lung		RID1302	bronchitis		RID34637
	lower lobe of lung		RID34696	interstitial pneumonia		RID5329
	middle lobe of lung		RID1310	chronic obstructive pulmonary disease	COPD	RID5317
	upper lobe of lung		RID34695	disorder of pulmonary circulation		RID34888
	apical segment of upper lobe of right lung	S1 segment of upper lobe of right lung	RID1304	pulmonary infarction		RID34889
	posterior segment of upper lobe of right lung	S2 segment of upper lobe of right lung	RID1306	interstitial lung disease	interstitial disease	RID28799
	anterior segment of upper lobe of right lung	S3 segment of upper lobe of right lung	RID1308	pneumoconiosis		RID5343
	lateral segment of middle lobe of right lung	S4 segment of middle lobe of right lung	RID1311	pneumonia		RID5350
	medial segment of middle lobe of right lung	S5 segment of middle lobe of right lung	RID1313	pneumothorax	pneumo	RID5352
	superior segment of lower lobe of right lung	S6 segment of lower lobe of right lung	RID1316	tension pneumothorax		RID28525
	medial basal segment of lower lobe of right lung	S7 segment of lower lobe of right lung	RID1318	pulmonary aspiration		RID5321
	anterior basal segment of lower lobe of right lung	S8 segment of lower lobe of right lung	RID1320	small-airways disease		RID43278
	lateral basal segment of lower lobe of right lung	S9 segment of lower lobe of right lung	RID1322	lung cancer		RID45686
	posterior basal segment of lower lobe of right lung	S10 segment of lower lobe of right lung	RID1324	coin lesion	solitary pulmonary nodule, SPN	RID35095
	apicoposterior segment of upper lobe of left lung	S1+2 segment of upper lobe of left lung	RID1329	pulmonary nodule	lung nodule	RID50149
	anterior segment of upper lobe of left lung	S3 segment of upper lobe of left lung	RID1331	pulmonary embolism	pulmonary embolus, PE	RID4834
	inferior segment of lingula	S4 segment of lingula	RID1334			
	superior segment of lingula	S5 segment of lingula	RID1336			
	superior segment of lower lobe of left lung	S6 segment of lower lobe of left lung	RID1339			
	anteromedial basal segment of lower lobe of left lung	S7+8 segment of lower lobe of left lung	RID1341			
	lateral basal segment of lower lobe of left lung	S9 segment of lower lobe of left lung	RID1343			
	posterior basal segment of lower lobe of left lung	S10 segment of lower lobe of left lung	RID1345			
	superior division of upper lobe of left lung		RID1328			
	lingula		RID1333			
	trachea	trach	RID1247			
	pulmonary vein		RID1231			
	left common pulmonary vein		RID1238			
	right common pulmonary vein		RID1232			
	pulmonary artery		RID974			
	left pulmonary artery		RID993			
	lobar artery		RID28910			
	main pulmonary artery		RID975			
	right pulmonary artery		RID976			
	segmental pulmonary artery		RID28913			
	subsegmental pulmonary artery		RID35825			

Table 4: Terms for anatomical locations and findings in cardiac studies

	Anatomical locations (RID3)			Findings (RID34785)		
	Pref. name	Synonyms	RadLex ID	Pref. name	Synonyms	RadLex ID
cardiovascular	aortic valve		RID1394	heart disease		RID3234
	mitral valve		RID1395	cardiac tamponade		RID3283
	pulmonic valve		RID1396	cardiomyopathy	cardmyop	RID3243
	tricuspid valve		RID1397	dilated cardiomyopathy		RID3244
	left atrium		RID1390	arrhythmogenic right ventricular cardiomyopathy	ARVD, ARVC	RID3245
	left ventricle		RID1392	high-output syndrome		RID3249
	right atrium		RID1387	hypertrophic cardiomyopathy	HCM	RID3251
	right ventricle		RID1389	hypertrophic nonobstructive cardiomyopathy		RID3254
	interventricular septum	ventricular septum	RID1404	hypertrophic obstructive cardiomyopathy	HOCM	RID3252
				ischemic cardiomyopathy		RID3250
	aorta		RID480	restrictive cardiomyopathy		RID3255
	aortic arch	arch of aorta	RID581	carcinoid heart disease		RID3259
	left pulmonary artery		RID993	endomyocardial fibrosis		RID3256
	lobar artery		RID28910	Loeffler endocarditis		RID3257
	main pulmonary artery		RID975	cor pulmonale		RID3282
	right pulmonary artery		RID976	heart failure	cardiac failure, congestive failure	RID34795
	segmental pulmonary artery		RID28913	ischemic heart disease		RID3235
	anterior basal segmental artery		RID35830	inducible ischemia		RID3241
	left lower lobe anterior segment artery		RID1004	microvascular ischemia		RID3242
	right lower lobe anterior segment artery		RID989	myocardial infarction	MI	RID3236
	anterior segmental artery		RID35835	resting ischemia		RID3237
	left upper lobe anterior segment artery		RID996	partial anomalous pulmonary venous return		RID34766
	right upper lobe anterior segment artery		RID980	pericardial constriction		RID3281
	apical segmental artery		RID35833	septal defect		RID3274
	left upper lobe apical segment artery		RID995	tetralogy of Fallot		RID34611
	right upper lobe apical segment artery		RID978	total anomalous pulmonary venous return	TAPVR	RID34773
	lateral basal segmental artery		RID35829	valvular heart disease	valve disease	RID3260
	left lower lobe lateral segment artery		RID1005	bicuspid heart valve		RID3261
	right lower lobe lateral segment artery		RID990	carcinoid valvulopathy		RID3273
	lateral segmental artery		RID983	Ebstein anomaly		RID34612
	lingular inferior segment artery		RID1000	flail leaflet		RID3264
	medial basal segmental artery		RID35831	mitral valve insufficiency		RID34748
	left lower lobe medial segment artery		RID29108	mitral valve prolapse	MVP, Barlow syndrome	RID3269
	right lower lobe medial segment artery		RID988	parachute mitral valve	PMV	RID4794
	medial segmental artery		RID35828	relapsing leaflet		RID3267
	right middle lobe medial segment artery		RID984	systolic doming		RID3263
	posterior basal segmental artery		RID35832	tricuspid valve disease		RID3262
	left lower lobe posterior segment artery		RID1006			
	right lower lobe posterior segment artery		RID991	bicuspid heart valve		RID3261
	posterior segmental artery		RID35836	coarctation of aorta	aortic coarctation	RID34589
	left upper lobe posterior segment artery		RID35837			
	right upper lobe posterior segment artery		RID979			
	superior segmental artery		RID35834			
	left lower lobe superior segment artery		RID1003			
	right lower lobe superior segment artery		RID987			
	subsegmental pulmonary artery		RID35825			
	left lower lobe subsegment artery		RID1007			
	left upper lobe subsegment artery		RID997			
	lingula inferior subsegment artery		RID35826			
	lingula superior subsegment artery		RID1001			
	right lower lobe subsegment artery		RID992			
	right middle lobe subsegment artery		RID985			
	right upper lobe subsegment artery		RID981			
	superior vena cava		RID1010			
	inferior vena cava	ivc	RID1178			
	left common pulmonary vein		RID1238			
	inferior left pulmonary vein		RID1241			
	superior left pulmonary vein		RID1239			
	right common pulmonary vein		RID1232			
	inferior right pulmonary vein		RID1236			
	right middle pulmonary vein		RID1235			
	superior right pulmonary vein		RID1233			

Table 5: Terms for anatomical locations and findings in breast imaging

	Anatomical locations (RID3)			Findings (RID34785)		
	Pref. name	Synonyms	RadLex ID	Pref. name	Synonyms	RadLex ID
breast	breast	mammary region	RID28749	breast cancer		RID45682
	left female breast		RID29897	edema		RID4865
	right female breast		RID29896	carcinoma in situ		RID4265
	left male breast		RID29900	nipple retraction		RID34269
	right male breast		RID29899	medullary carcinoma		RID4488
	areola		RID29911	mucinous cystic neoplasm	mucinous cystadenocarcinoma, macrocystic adenoma	RID4164
	nipple		RID29902	papillary cystadenocarcinoma		RID4155
	lactiferous duct	mammary duct	RID49972	nipple changes		RID34314
				asymmetry		RID34265
	breast tissue		RID49902	ulcerated		RID5918
	fibroglandular tissue		RID49901			
	breast proper		RID29920			
	axillary lymph node group		RID28849			
	axillary lymph node		RID1517			
	pectoral lymph node	anterior axillary lymph node	RID28897			
	pectoral part proper of female chest		RID29966			
	left pectoral part proper of female chest		RID29968			
	right pectoral part proper of female chest		RID29967			
	pectoral part proper of male chest		RID29963			
	left pectoral part proper of male chest		RID29965			
	right pectoral part proper of male chest		RID29964			
	accessory breast		RID29955			
	central region of left breast		RID29951			
	central region of right breast		RID29950			
	lateral region of left breast		RID29948			
	lateral region of right breast		RID29947			
	medial region of left breast		RID29945			
	medial region of right breast		RID29944			
	left nipple		RID29910			
	right nipple		RID29909			
	lower inner quadrant of breast		RID29937			
	lower inner quadrant of left female breast		RID29939			
	lower inner quadrant of right female breast		RID29938			
	lower outer quadrant of breast		RID29934			
	lower outer quadrant of left female breast		RID29936			
	lower outer quadrant of right female breast		RID29935			
	upper inner quadrant of breast		RID29931			
	upper inner quadrant of left female breast		RID29933			
	upper inner quadrant of right female breast					
	upper outer quadrant of breast		RID29928			
	upper outer quadrant of left female breast		RID29930			
	upper outer quadrant of right female breast		RID29929			
	subareolar region of left breast		RID29954			
	subareolar region of right breast		RID29953			
	superior region of left breast		RID29942			
	superior region of right breast		RID29941			

Table 6: Terms for anatomical locations and findings in thyroid studies

	Anatomical locations (RID3)			Findings (RID34785)		
	Pref. name	Synonyms	RadLex ID	Pref. name	Synonyms	RadLex ID
Thyroid gland	thyroid gland	thyroid	RID7578	thyroid cancer		RID45691
	zone of thyroid gland		RID50013	anaplastic thyroid carcinoma		RID4248
	lobe of thyroid gland		RID50344	medullary carcinoma		RID4488
	right lobe of thyroid gland	right thyroid lobe	RID7581	dysphagia		RID5266
	left lobe of thyroid gland	left thyroid lobe	RID7579			
	thyroid tubercle		RID50014			
	fibrous capsule of thyroid gland		RID7586			
	pyramidal lobe of thyroid gland		RID7583			
	isthmus of thyroid gland	thyroid isthmus	RID7584			