

The IRMA code for unique classification of medical images

Thomas M. Lehmann^{*}, Henning Schubert^a, Daniel Keysers^b,
Michael Kohnen^a, Berthold B. Wein^a

Department of Medical Informatics

^aDepartment of Diagnostic Radiology

^bChair of Computer Science VI

Aachen University of Technology (RWTH), Aachen, Germany

ABSTRACT

Modern communication standards such as Digital Imaging and Communication in Medicine (DICOM) include non-image data for a standardized description of study, patient, or technical parameters. However, these tags are rather roughly structured, ambiguous, and often optional. In this paper, we present a mono-hierarchical multi-axial classification code for medical images and emphasize its advantages for content-based image retrieval in medical applications (IRMA). Our so called IRMA coding system consists of four axes with three to four positions, each in $\{0, \dots, 9, a, \dots, z\}$, where "0" denotes "unspecified" to determine the end of a path along an axis. In particular, the technical code (T) describes the imaging modality; the directional code (D) models body orientations; the anatomical code (A) refers to the body region examined; and the biological code (B) describes the biological system examined. Hence, the entire code results in a character string of not more than 13 characters (IRMA: TTTT – DDD – AAA – BBB). The code can be easily extended by introducing characters in certain code positions, e.g., if new modalities are introduced. In contrast to other approaches, mixtures of one- and two-literal code positions are avoided which simplifies automatic code processing. Furthermore, the IRMA code obviates ambiguities resulting from overlapping code elements within the same level. Although this code was originally designed to be used in the IRMA project, other use of it is welcome.

Keywords: Standardized Nomenclature, Digital Imaging and Communication in Medicine (DICOM), Picture Archiving and Communication Systems (PACS), Content-Based Image Retrieval (CBIR), Image Classification Code

1. INTRODUCTION

Modern communication standards include non-image data for a standardized description of study, patient, body region examined, and technical parameters related to the imaging modality in use. In order to provide comprehensive, detailed coverage for multi-specialty biomedical imaging, the College of American Pathologists (CAP), secretariat of the Systematized Nomenclature of Human and Veterinary Medicine (SNOMED), has entered into partnership with the Digital Imaging and Communications in Medicine (DICOM) Standards Committee and other professional organizations to develop a nomenclature that is needed for diagnostic imaging applications [1]. The SNOMED DICOM microglossary was developed to provide context-dependent value sets for DICOM coded-entry data elements, and semantic content specifications for reports and other structures composed of multiple data elements [2].

Although the capability of storing explicitly-labeled coded descriptors in DICOM images and reports improves the potential for selective retrieval of images and related information, the controlled terminology within the DICOM tables has been found to be insufficiently detailed for order entry systems [3] or even invalid, if values are set automatically by the system [4]. Concerning the needs for content-based image retrieval in medical applications (IRMA), a detailed coding scheme is required to describe (a) the imaging modality including technical parameters, (b) the orientation of the image with respect to the body, (c) the body region examined, and (d) the biological system investigated [5,6].

^{*} lehmann@computer.org; phone +49 241 80-88793; fax +49 241 80-82426; <http://www.irma-project.org>; Department of Medical Informatics, Aachen University of Technology, Pauwelsstr. 30, D - 52057 Aachen, Germany.

In this paper, we present a mono-hierarchical (i.e., every son-node is connected to only one parent-node) multi-axial (i.e., more than one semantic axes) classification code for medical images [7] in English and emphasize its advantages for image retrieval in comparison to existing proposals supplementary to the DICOM standard.

2. METHODS

Within the IRMA system [5], categorization is the first of seven successive analyzing steps extracting content information from medical images. The categorization aims to establish intelligent processing strategies adapted to the current image under investigation. Therefore, valid relations between code and sub-code elements are "is-a" and "part-of" only. Consequently, the code must be strictly hierarchical in order to support semantic queries on a database. Furthermore, causality is important for grouping of processing strategies. Therefore, a mono-hierarchical scheme is required, where each sub-code element is connected to only one code element. Since categorization of medical images must cover all aspects influencing the image content and structure, a multi-axial scheme was designed. This scheme, which has been presented previously in German [7] is now available in English, as well.

3. RESULTS

The IRMA coding system consists of four axes with three to four positions, each in $\{0, \dots, 9, a, \dots, z\}$, where "0" denotes "unspecified" to determine the end of a path along an axis:

- T (technical): image modality
- D (directional): body orientation
- A (anatomical): body region examined
- B (biological): biological system examined

This allows a short and unambiguous notation (IRMA: TTTT – DDD – AAA – BBB), where T, D, A, and B denotes a coding or sub-coding digit of the technical, directional, anatomical, and biological axis, respectively. In addition, this notation avoids mixtures of one- and two-literal code positions.

3.1. Technical code for imaging modality

The T-code describes within a maximum of four positions the technical method. It starts with the physical source of image acquisition (e.g.: 1 "x-ray", 2 "ultrasound", 3 "magnetic resonance imaging", 4 "optical imaging", ...) showing more details in the modality position (e.g.: 11 "plain film projection radiography", 12 "fluoroscopy", 13 "angiography", 14 "computed tomography", ...). A third digit specifies the technique (e.g.: 111 "digital", 112 "analog", 113 "stereometry", 114 "stereography", ...), and the fourth position of the T-code assesses sub-techniques (e.g.: 1111 "tomography", 1112 "high energy", 1113 "low energy", 1114 "parallel beam", ...). A complete listing of the IRMA T-code is given in Appendix A. Note that the non-radiological part of this code (4 "nuclear medicine", 5 "optical imaging", 6 "biophysical procedures", 7 "others", 8 "secondary digitization") are not modeled completely.

3.2. Directional code for imaging orientation

This three-digit part of the IRMA-code incorporates a two-step orientation description starting with the common orientation (e.g.: 1 "coronal", 2 "sagittal", 3 "transversal", 4 "other") and giving a more detailed specification in the second position (e.g.: 11 "posteroanterior (PA)", 12 "anteroposterior (AP)"). Note that it is important to distinguish AP- and PA-directions since organs and bone structures might differ in scale, for instance, supposing plain x-ray chest imaging. Independent from the relative orientation of body region and imaging system, functional orientation tasks of the examination can also be described (e.g.: 111 "inspiration", 112 "expiration", 113, "Valsalva", 114 "phonation", ...). A complete listing of the IRMA D-code is given in Appendix B.

3.3. Anatomical code for body region examined

The IRMA-code supports complete coding of the anatomical region. In total, nine major regions are defined (e.g.: 1 "total body", 2 "head/skull", 3 "spine", 4 "upper extremity", ...). The major region is followed by up to two

hierarchical sub-codes (e.g.: 3 "spine", 31 "cervical spine", 311 "dens"). A complete listing of the IRMA A-code is given in Appendix C.

3.4. Biological code for biological system examined

The B-code determines the organ system that is imaged. This axis is necessary because the body region examined insufficiently describes content and structure of images. For example, fluoroscopy of the abdominal region may access the vascular or the gastrointestinal system depending on the way the contrast agent is administered, which results in different image textures. On the top-level of this three digit IRMA-code, ten organ systems are specified (e.g.: 1 "cerebrospinal system", 2 "cardiovascular system", 3 "respiratory system", 4 "gastrointestinal system", ...) each of which having up to three positions to exactly identify the organ in question (e.g.: 1 "cerebrospinal system", 11 "central nervous system", 111 "mesencephalon"). A complete listing of the IRMA B-code is given in Appendix D.

3.5. Examples of image coding

A web-based interface has been established for coding of radiographs [8]. All images are converted to readable icons of about 200 x 200 pixels and labeled with the appropriate code by two professional readers, i.e. board certified radiologists. This allowed the assessment of the quality of computerized image categorization and also to create a gold standard. The labeling tool is based on an relational database addressed with standard query language (postgresql 7.1.3), an interface to a web-server (apache 1.3.26 with built-in php 4.2.2 interpreter) and on the client-site on a standard internet browser (mozilla 1.1). The appropriate code is entered and remarks of the readers are collected. The code can be entered directly into the appropriate field, if known by heart, or composed – making extensive use of javascripting in the HTML-file to enable modifying pop-up menus according to the decision made at higher levels. This resulted in a stepwise refinement of the code. The radiological report is available simultaneously to judge for specific comments. Thereafter, coded images are transferred anonymously from the routine application into the IRMA research case database [8].

Figure 1 gives two examples of unambiguous image classification using the IRMA-code. The image on the left is coded: "x-ray, projection radiography, analog, high energy – sagittal, left lateral decubitus, inspiration – chest, lung – respiratory system, lung. The image on the right is coded: x-ray, fluoroscopy, analog – coronad, ap, supine – abdomen, upper abdomen, middle – gastrointestinal system, stomach".

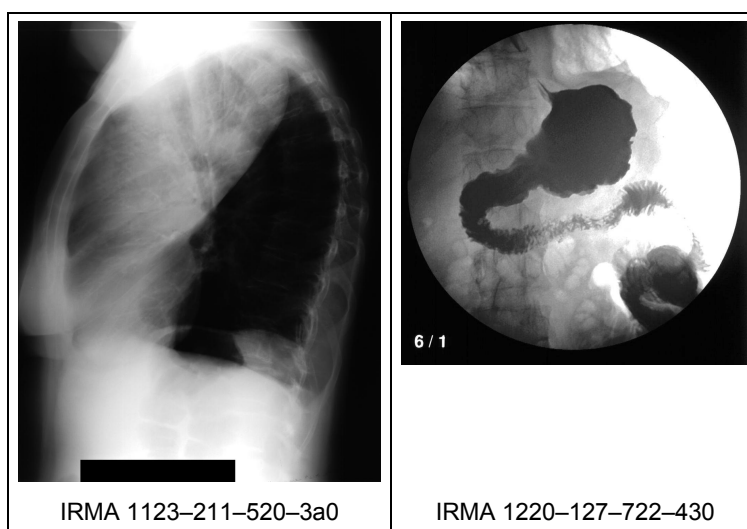


Figure 1: IRMA-coded chest and abdomen radiograph.

4. DISCUSSION

A basic requirement for coding medical images according to processing within a system for content-based retrieval is the mono-hierarchical structure of the code. Although several nomenclatures exist, these are neither causal, hierarchical, complete, nor unambiguous. For instance, valid instances for the DICOM tag "body part examined" are "skull", "cspine", "tspine", "lspine", "sspine", "coccyx", "chest", "clavicle", "breast", "abdomen", "pelvis", "hip", "shoulder", "elbow", "knee", "ankle", "hand", "foot", "extremity", "head", "heart", "neck", "arm", "jaw", and "special" [9]. Note the different grade of differentiation (e.g., "cspine", "tspine", "lspine", "sspine" vs. "skull"), the incompleteness (e.g., "arm" but not "leg"), and the ambiguities (e.g., "extremity" vs. "arm" or "hand").

The MeSH thesaurus is a poly-hierarchical structure where entities can be reached on different paths [10]. For instance, the IRMA T-code 1111 "dual energy digital plain x-ray" corresponds to the 2002 MeSH codes E01.370.350.700.700.700, E01.370.350.760.700, and E01.370.350.600.350.700.700 for "radiography, dual energy scanned projection". Furthermore, the MeSH thesaurus is not sufficiently detailed in all of the IRMA axis, especially for the T-axis.

Although it was demonstrated that SNOMED [11] is the most complete reference terminology in existence today for the clinical environment [12], its incompleteness with respect to technical usage for image retrieval reveals a major disadvantage of SNOMED when compared to the IRMA code. For instance, the SNOMED DICOM microglossary offers "breast" but not "mammary gland" [3].

In summary, the IRMA coding scheme is closest related to the JJ1017 code [3]. Likewise the JJ1017 approach, the IRMA code enables image classification with respect to technical, directional, anatomical, and biological criterions. In contrast to JJ1017, IRMA is more detailed, offers four instead of three separated axes for the four parameters described above, and is strictly mono-hierarchical in each axis. In addition, ambiguities of JJ1017 are avoided. For instance, JJ1017 offers "chest", "chest/abdomen", and "abdomen" on the first level of its "large region code" and hence, it is not suitable for content-based image retrieval in medical applications.

Based on its structure, the IRMA code can easily be extended (adding new characters to a certain code position) and refined. For instance, the IRMA B-code 411 "oral cavity" for the biological system imaged can be further specified if required for other usage than content-based image retrieval, e.g., 4110 "unspecified", 4111 "tongue", 4112 "floor of mouth", 4113 "hard palate", 4114 "soft palate", 4115 "cheek".

So far, the coding support was easy to use in about 6,000 single images, the loading time for the small images (about 200 pixels either direction) was short, the support of the javascripts in case of unknown combinations of the coding scheme was helpful. It turned out that rarely (less than 0.1 %) the regional code is too limited to describe the body parts depicted on a radiograph. This is especially true for long extremity overviews. The extremity codes allow only a very general or a highly specific localization of a combination of two nearby regions [8].

5. CONCLUSION

A mono-hierarchical multi-axial code scheme is presented that enables a unique classification of medical images. The entire code results in a character string of not more than 13 characters. The code can be easily extended by introducing characters in certain code positions, e.g., if new modalities are introduced. In contrast to other approaches, mixtures of one- and two-literal code positions are avoided which simplifies automatic code processing. Furthermore, the IRMA code steers clear of ambiguities resulting from overlapping code elements within the same level. Although this code was originally designed to be used in the IRMA project, other use is welcome.

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APPENDIX

A Technical code for imaging modality

Note that the non-radiological part of this code (4 “nuclear medicine”, 5 “optical imaging”, 6 “biophysical procedures”, 7 “others”, 8 “secondary digitization”) are not modeled completely.

0	unspecified
1	x-ray
10	unspecified
11	plain radiography
110	unspecified
111	digital
1110	unspecified
1111	overview image

1112	tomography
1113	high beam energy
1114	low beam energy
1115	far view projection
1116	1:1 projection
1117	dual energy
112	analog
1120	unspecified
1121	overview image
1122	tomography
1123	high beam energy
1124	low beam energy
1125	far view projection
1126	1:1 projection
113	x-ray stereometry
114	x-ray stereography

	115	tomosynthesis
	116	xeroradiography
12		fluoroscopy
	120	unspecified
	121	digital
	122	analog
13		angiography
	130	unspecified
	131	digital
	1310	unspecified
	1311	subtraction (DSA)
	1312	rotation
		angiography
	1313	pathfinder technique
	132	analog
	1320	unspecified
	1321	photo subtraction
14		computed tomography (CT)
	140	unspecified
	141	conventional CT
	1410	unspecified
	1411	low dose
	1412	high resolution
	1413	bolus tracking
	142	quantitative CT
	1420	unspecified
	1421	dual energy
15		DEXA (quantitative radiography)
	150	unspecified
	151	digital
	1510	unspecified
	1511	dual energy
16		radiotherapy
	160	unspecified
	161	digital
	162	analog
2		sonography
	20	unspecified
	21	A-mode
	210	unspecified
	221	3.5 MHz
	212	5.0 MHz
	213	7.5 MHz
	214	10 MHz
	215	variable frequency
22		B-mode
	220	unspecified
	221	sector scan
	2210	unspecified
	2211	3.5 MHz
	2212	5.0 MHz
	2213	7.5 MHz
	2214	10 MHz

	2215	variable frequency
	222	linear scan
	2220	unspecified
	2221	3.5 MHz
	2222	5.0 MHz
	2223	7.5 MHz
	2224	10 MHz
	2225	variable frequency
23		M-mode
	230	unspecified
	231	3.5 MHz
	232	5.0 MHz
	233	7.5 MHz
	234	10 MHz
	235	variable frequency
24		compound mode
	240	unspecified
	241	3.5 MHz
	242	5.0 MHz
	243	7.5 MHz
	244	10 MHz
	245	variable frequency
25		SieScape mode
	250	unspecified
	251	3.5 MHz
	252	5.0 MHz
	253	7.5 MHz
	254	10 MHz
	255	variable frequency
26		duplex mode
	260	unspecified
	261	3.5 MHz
	262	5.0 MHz
	263	7.5 MHz
	264	10 MHz
	265	variable frequency
27		Doppler mode
	270	unspecified
	271	3.5 MHz
	272	5.0 MHz
	273	7.5 MHz
	274	10 MHz
	275	variable frequency
28		3D imaging
	280	unspecified
	281	3.5 MHz
	282	5.0 MHz
	283	7.5 MHz
	284	10 MHz
	285	variable frequency
3		magnetic resonance measurements
	30	unspecified
	31	magnetic resonance imaging (MRI)
	310	unspecified

311 T1-weighted
3110 unspecified
3111 endo coil
3112 body
3113 body array
3114 head coil
3115 neck coil
3116 spine coil
3117 loop coil
3118 shoulder coil
3119 knee coil
311a hand / small FOV
311b mamma coil
311c flexible coil, large
311d flexible coil, small
311e endorectal coil
311f wrap around coil

312 T2-weighted
3120 unspecified
3121 endo coil
3122 body
3123 body array
3124 head coil
3125 neck coil
3126 spine coil
3127 loop coil
3128 shoulder coil
3129 knee coil
312a hand / small FOV
312b mamma coil
312c flexible coil, large
312d flexible coil, small
312e endorectal coil
312f wrap around coil

313 proton-weighted
3130 unspecified
3131 endo coil
3132 body
3133 body array
3134 head coil
3135 neck coil
3136 spine coil
3137 loop coil
3138 shoulder coil
3139 knee coil
313a hand / small FOV
313b mamma coil
313c flexible coil, large
313d flexible coil, small
313e endorectal coil
313f wrap around coil

314 fat suppression
3140 unspecified
3141 endo coil

3142 body
3143 body array
3144 head coil
3145 neck coil
3146 spine coil
3147 loop coil
3148 shoulder coil
3149 knee coil
314a hand / small FOV
314b mamma coil
314c flexible coil, large
314d flexible coil, small
314e endorectal coil
314f wrap around coil

315 Cine-Lolo
3150 unspecified
3151 endo coil
3152 body
3153 body array
3154 head coil
3155 neck coil
3156 spine coil
3157 loop coil
3158 shoulder coil
3159 knee coil
315a hand / small FOV
315b mamma coil
315c flexible coil, large
315d flexible coil, small
315e endorectal coil
315f wrap around coil

316 inversion recovery
3160 unspecified
3161 endo coil
3162 body
3163 body array
3164 head coil
3165 neck coil
3166 spine coil
3167 loop coil
3168 shoulder coil
3169 knee coil
316a hand / small FOV
316b mamma coil
316c flexible coil, large
316d flexible coil, small
316e endorectal coil
316f wrap around coil

317 FLARE
3170 unspecified
3171 endo coil
3172 body
3173 body array
3174 head coil

	3175	neck coil
	3176	spine coil
	3177	loop coil
	3178	shoulder coil
	3179	knee coil
	317a	hand / small FOV
	317b	mamma coil
	317c	flexible coil, large
	317d	flexible coil, small
	317e	endorectal coil
	317f	wrap around coil
318	3D-FFE	high resolution
	3180	unspecified
	3181	endo coil
	3182	body
	3183	body array
	3184	head coil
	3185	neck coil
	3186	spine coil
	3187	loop coil
	3188	shoulder coil
	3189	knee coil
	318a	hand / small FOV
	318b	mamma coil
	318c	flexible coil, large
	318d	flexible coil, small
	318e	endorectal coil
	318f	wrap around coil
4	32	spectroscopy
	nuclear medicine	
	40	unspecified
	41	scintillation probe
	42	gamma camera
	43	single photon emission
		computed tomography (SPECT)
	44	positron emission tomography (PET)
5	optical imaging	
	50	unspecified
	51	endoscopy
	52	microscopy
	53	photography
	54	funduscopy
	55	laser surface scan
	56	thermography
6	biophysical procedures	
	60	unspecified
	61	electric
	62	magnetic
	63	probes
7	others	
	70	unspecified
	71	workstation
	72	hardcopy
	73	secondary capture

	74	documentation
	740	unspecified
	741	value
	742	curve local
	743	curve temporal
	744	area complex (3D)
	745	picture
	746	local series
	747	temporal series
	748	complex series (4D)
	749	cine documentation
	74a	fluoroscopy
	74b	volume (data set)
	74c	volume temporal (data set)
8	secondary digitalization	
	80	unspecified
	81	laser sampling
	82	LCD sampling
	83	video digitizing

B Directional code for imaging orientation

0	unspecified
1	coronal
	10 unspecified
	11 posteroanterior (PA)
	110 unspecified
	111 inspiration
	112 expiration
	113 valsalva
	114 phonation
	115 upright
	116 sitting
	117 supine
	118 prone
	119 lateral decubitus
	11a flexion, left
	11b flexion, right
	11c swallow
	11d micturition
	11e bending
	12 anteroposterior (AP, coronal)
	120 unspecified
	121 inspiration
	122 expiration
	123 valsalva
	124 phonation
	125 upright
	126 sitting
	127 supine
	128 prone
	129 lateral decubitus
	12a flexion, left
	12b flexion, right
	12c swallow

		12d	micturition
		12e	bending
2	sagittal		
	20		unspecified
	21		lateral, right-left
		210	unspecified
		211	inspiration
		212	expiration
		213	valsalva
		214	Hitzenberg maneuver
		215	upright
		216	supine
		217	prone
		218	inclination
		219	reclination
		21a	swallow
		21b	defaecation
		21c	micturition
	22		lateral, left-right
		220	unspecified
		221	inspiration
		222	expiration
		223	valsalva
		224	Hitzenberg maneuver
		225	upright
		226	supine
		227	prone
		228	inclination
		229	reclination
		22a	swallow
		22b	defaecation
		22c	micturition
	23		mediolateral
	24		lateromedial
3	axial		
	30		unspecified
	31		craniocaudal
	32		caudocranial (transversal, axial)
4	other orientation		
	40		unspecified
	41		oblique
	42		occipitofrontal
	43		occipitomenal
	44		bregmaticooccipital
	45		submentobregmatical
	46		submentobregmaticofrontal
	47		bregmaticooral
	48		bregmaticosubmental
	49		right anterior oblique (RAO)
	4a		left anterior oblique (LAO)
5	RSA / ap and lateral (simultaneously)		
C	Anatomical code for body region examined		
0			unspecified

1	whole body		
	10		unspecified
	11		torso
	12		extremities
2	cranium		
	20		unspecified
	21		facial cranium
		210	unspecified
		211	forehead
		212	eye area
		213	nose area
		214	maxilla
		215	mandible
		216	temporo mandibular area
	22		cranial base
		220	unspecified
		221	petrous bone
		222	sella
	23		neuro cranium
		230	unspecified
		231	frontal area
		232	parietal area
		233	occipital area
3	spine		
	30		unspecified
	31		cervical spine
		310	unspecified
		311	dens
		312	axis
		313	upper cervical spine
		314	lower cervical spine
	32		thoracic spine
		320	unspecified
		321	cervico-thoracic conjunction
		322	upper thoracic spine
		323	middle thoracic spine
		324	lower thoracic spine
	33		lumbar spine
		330	unspecified
		331	thoraco-lumbar conjunction
		332	upper lumbar spine
		333	lower lumbar spine
	34		sacral bone
		340	unspecified
		341	lumbo-sacral conjunction
	35		coccygeal bone
4	upper extremity / arm		
	40		unspecified
	41		hand
		410	unspecified
		411	finger
		412	middle hand
		413	carpal bones
	42		radio carpal joint

5	43	forearm
	430	unspecified
	431	distal forearm
	432	proximal forearm
	44	elbow
	45	upper arm
	450	unspecified
	451	distal upper arm
	452	proximal upper arm
	46	shoulder
	460	unspecified
	461	scapula
	462	humero-scapular joint
	463	acromio-scapula joint
	chest	
	50	unspecified
	51	bones
	510	unspecified
	511	clavicle
	512	sternoclavicle region
	513	sternum
	514	upper ribs
	515	lower ribs
	52	lung
	520	unspecified
	521	upper lobe
	522	middle lobe
	523	lower lobe
	53	hilum
	54	mediastinum
	540	unspecified
	541	anterior mediastinum
	542	middle mediastinum
	543	posterior mediastinum
	55	heart
	56	diaphragm
6	breast (mammary)	
7	abdomen	
	70	unspecified
	71	upper abdomen
	710	unspecified
	711	upper right quadrant
	712	upper middle quadrant
	713	upper left quadrant
	72	middle abdomen
	720	unspecified
	721	middle right abdomen
	722	peri navel region
	723	middle left quadrant
	73	lower abdomen
	730	unspecified
	731	lower right quadrant
	732	lower middle quadrant
	733	lower left quadrant

8	pelvis		
	80	unspecified	
	81	sacral bone	
		810	unspecified
		811	iliosacral-junction
	82	iliac bone	
	83	pubic bone	
		830	unspecified
		831	symphysis
	84	small pelvis	
		840	unspecified
		841	sacral bone
		842	ischial bone
9	lower extremity / leg		
	90	unspecified	
	91	foot	
		910	unspecified
		911	toe
		912	middle foot
		913	tarsal bones
	92	ankle joint	
	93	lower leg	
		930	unspecified
		931	distal lower leg
		932	proximal lower leg
	94	knee	
		940	unspecified
		941	patella
	95	upper leg	
		950	unspecified
	951	distal upper leg	
	952	proximal upper leg	
96	hip		

D Biological code for system examined

0	unspecified
1	cerebrospinal system
10	unspecified
11	central nervous system
110	unspecified
111	metencephalon, cerebrum
112	mesencephalon, diencephalon
113	neurohypophysis, posterior pituitary gland
114	cerebellum
115	pons
116	medulla oblongata
117	spinal cord, cervical
118	spinal cord, thoracic
119	spinal cord, lumbar
11a	spinal cord, sacral (cauda equina)
12	sense organs

	120	unspecified
	121	vestibular sense
	122	hearing sense
	123	gustatory sense
	124	tactile sense
	125	vision sense
	126	olfactory sense
13	vegetative nervous system	
	130	unspecified
	131	sympathic chain
	132	glomus jugulare
	133	glomus caroticum
	134	ganglion stellatum
	135	ganglion coeliacum
	136	organ of Zuckerkandl
	137	adrenal medulla
2	cardiovascular system	
	20	unspecified
	21	heart
	210	unspecified
	211	pericardium
	212	atrium
	213	mitral valve
	214	tricuspidal valve
	215	ventricle
	216	aortic valve
	217	pulmonary valve
22	arteries	
	220	unspecified
	221	ascending aorta
	222	aortic arche
	223	brachiocephalic trunk
	224	common carotic artery
	225	botalli ligament & ductus arteriosus
	226	descending aorta
	227	bronchial trunk
	228	abdominal aorta
	229	celiac trunk
	22a	common iliac artery
	22b	other arteries
23	veins	
	230	unspecified
	231	anonymus vein
	232	brachiocephalic vein
	233	superior vena cava
	234	inferior vena cava
	235	common iliac vein
	236	other veins
3	respiratory system	
	30	unspecified
	31	nose
	32	sinuses
	33	nasopharynx & epipharynx

	34	mesopharynx
	35	hypopharynx
	36	larynx
	37	trachea
	38	main bronchus
	39	bronchi
	3a	lung
	3b	pleura
	3c	ribs
	3d	diaphragma
	3e	intercostal muscles
4	gastrointestinal system	
	40	unspecified
	41	oropharynx
	410	unspecified
	411	oral cavity
	412	epipharynx
	413	mesopharynx
	414	hypopharynx
42	esophagus	
	420	unspecified
	421	upper esophagus sphincter
	422	upper third
	423	middle third
	424	lower third
	425	lower esophagus sphincter
43	stomach	
	430	unspecified
	431	cardia
	432	fundus
	433	corpus
	434	antrum
	435	pylorus
44	small intestine	
	440	unspecified
	441	duodenum
	442	jejunum
	443	ileum
	444	terminal ileum
	445	ileoceocal valve
45	large intestine	
	450	unspecified
	451	ascending colon
	452	transverse colon
	453	descending colon
	454	sigmoid colon
	455	rectum
46	appendix	
47	anus	
48	liver	
	480	unspecified
	481	parenchyma
	482	bile ducts
	483	portal vein

	484	arteries		94	mediastinal lymph node
	485	veins		95	thymus
49		biliary system		96	spleen
	490	unspecified		97	retroperitoneal lymph node
	491	bile ducts		98	intraperitoneal lymph node
	492	gallbladder		980	unspecified
4a		salivary glands		981	mesenterial lymph node
	4a0	unspecified		99	iliac lymph node
	4a1	parotic gland		9a	inguinal lymph node
	4a2	sublingual gland		9b	bone marrow
	4a3	mandibular gland	a		dermal system
	4a4	pancreas			
5		uropoietic system			
	50	unspecified			
	51	kidney			
	510	unspecified			
	511	parenchyma			
	512	renal pelvis			
	52	ureter			
	53	urinary bladder			
	54	urethra			
6		reproductive system			
	60	unspecified			
	61	male system			
	610	unspecified			
	611	testes			
	612	deferent duct & seminal vesicle			
	613	prostate gland			
	614	penis (incl. corpus cavernosum)			
	62	female system			
	620	unspecified			
	621	ovaries			
	622	tuba uterina			
	623	uterus			
	624	vagina			
	625	breast			
7		musculoskeletal system			
8		endocrinic system			
	80	unspecified			
	81	thyroid gland			
	82	parathyroid gland			
	83	adrenal gland			
	84	pituitary gland			
	85	hypothalamus			
	86	ovaries			
	87	testes			
	88	pancreas			
9		immunic system			
	90	unspecified			
	91	tonsils			
	92	cervial lymph node			
	93	axillary lymph node			