The IRMA code for unique classification of medical images

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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,...9,a,...,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].

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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 tan 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,...9,a,...,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/scull", 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 sytem, lung. The image on the right is coded: x-ray, fluoroscopy, analog – coronad, ap, supine – abdomen, upper abdomen, middle – gastrointestinal system, stomach".

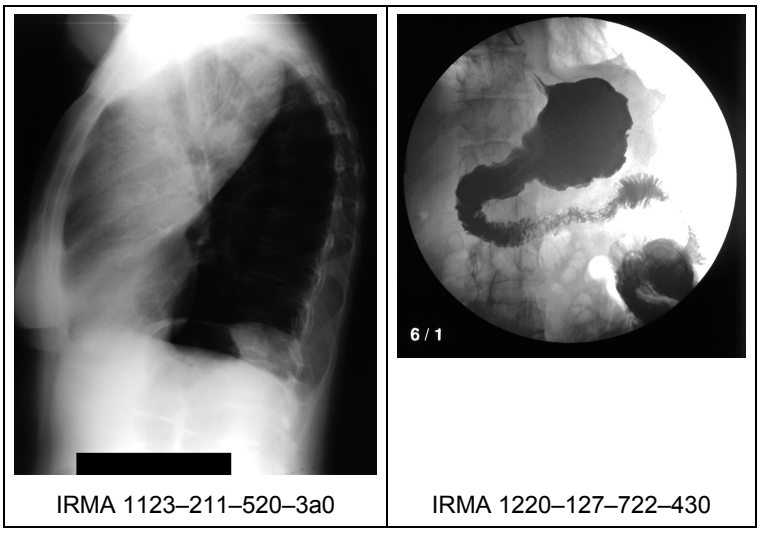

Figure 1: IRMA-coded chest and abdomen radiograph.

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 allows 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-weigthed
- 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

32 spectroscopy

4 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 occipitomental
- 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

- 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

5 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 (mamma)

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 sarcral 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, lumbal
  - 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 unspecfied

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
- 485 veins

49 biliary system
- 490 unspecified
- 491 bile ducts
- 492 gallbladder

4a salivary glands
- 4a0 unspecified
- 4a1 parotic gland
- 4a2 sublingual gland
- 4a3 mandibular gland
- 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 musculosceletal 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
- 94 mediastinal lymph node
- 95 thymus
- 96 spleen
- 97 retroperitoneal lymph node
- 98 intraperitoneal lymph node
  - 980 unspecified
  - 981 mesenterial lymph node
- 99 iliac lymph node
- 9a inguinal lymph node
- 9b bone marrow

a dermal system