Journal of Digital Imaging

# JJ1017 Committee Report: Image Examination Order Codes—Standardized Codes for Imaging Modality, Region, and Direction With Local Expansion: An Extension of DICOM

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**The digital imaging and communications in medicine (DICOM) standard includes parts regarding nonimage data information, such as image study ordering data and performed procedure data, and is used for sharing information between HIS/RIS and modality systems, which is essential for IHE. To bring such parts of the DICOM standard into force in Japan, a joint committee of JIRA and JAHIS established the JJ1017 management guideline, specifying, for example, which items are legally required in Japan, while remaining optional in the DICOM standard. In Japan, the contents of orders from referring physicians for radiographic examinations include details of the examination. Such details are not used typically by referring physicians requesting radiographic examinations in the United States, because radiologists in the United States often determine the examination protocol. The DICOM standard has code tables for examination type, region, and direction for image examination orders. However, this investigation found that it does not include items that are detailed sufficiently for use in Japan, because of the above-mentioned reason. To overcome these drawbacks, we have generated the JJ1017 code for these 3 codes for use based on the JJ1017 guidelines. This report introduces the JJ1017 code. These codes (the study type codes in particular) must be expandable to keep up with technical advances in equipment. Expansion has 2 directions: width for covering more categories and depth for specifying the information in more detail (finer categories). The JJ1017 code takes these requirements into consideration and clearly distinguishes between the stem part as the common term and the expansion. The stem part of the JJ1017 code partially utilizes the DICOM codes to remain in line with the DICOM standard. This work is an example of how local requirements can be met by using the DICOM standard and extending it.**

**KEY WORDS: Order entry, image examination, hospital information system, digital imaging and communications system, IHE**

THE STANDARD FOR digital imaging and communication in medicine (DICOM standard)[1] is the most successfully received information communication standard in the field of medicine. Its scope has now gone beyond the original area of transmission of x-ray images, expanding to nonradiation images and nonimage information related to diagnostic imaging. These include modality worklist management (MWM) and modality performed procedure step (MPPS), which deal with procedures scheduling management and information on performed procedures.

In Japan, diagnostic imaging devices have been widely accepted, but hospital information systems (and order entry systems in particular) are even more widespread, which is outstanding compared with Europe and the United States. The percentage of hospital with 300 beds or more that have any kind of hospitalwide order entry system is more than 50%.[2] There exists an

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*Online publication 14 June 2002*
*doi:10.1007/s10278-002-0005-8*

obvious need for transmitting order data to modalities without reinputting. However, modality manufacturers often are different from hospital information system manufacturers. Therefore, there are significant advantages in standardizing nonimage data communications.

However, it is considered inappropriate to transpose the relevant parts of the DICOM standard into the Japanese environment without modification because of differences in diagnostic imaging procedures and special Japanese regulatory requirements for radiation recording. For example, some radiation recording items are mandatory in Japan, whereas they are not detailed enough in the DICOM standard (eg, exposure time). The contents of the order also must be specified in profound detail and are not sufficiently covered by items listed in DICOM. However, because these conditions are unique to Japan, modification of the DICOM standard for this purpose only should be avoided.

Therefore, it has been decided that guidelines should be prepared for applying the above 2 functions in Japan to specify which items be mandatory and which codes be used. The task force for this job was organized by members of the Japanese Association of Healthcare Information Systems Industry (JAHIS) and the Japan Industries Association of Radiological Systems (JIRA) and chaired by the first author. In addition, comments were collected from not only the members of both societies but also the members of the Japan Radiological Society (JRS), the Japanese Society of Radiological Technology (JSRT), and the Japanese Association of Medical Informatics (JAMI).

Specific actions were taken according to the following procedures. First, the elements of Supplement 10, 17 (at that time) were verified by radiology technicians to ensure completeness. The expanded list of these elements was reviewed by the members who were responsible for hospital information systems at each hospital to determine whether each element can be automatically sent out or accepted and which elements are necessary. Only the elements that received consensus were further examined with regard to use, usable codes, or whether they should be mandatory. In addition, it was decided that the elements for radiation dose measurement, which were elaborated on in this work, should be included in the agenda of the DICOM standard correction proposals rather than being restricted to application within Japan. The agenda for the correction proposal was sent to the DICOM Standards Committee.

Some of the activities already have been outlined.[3,4] This report introduces practical codes for the type, region, and direction of image studies. This report details the inadequacy of the codes provided in the DICOM standard, and then introduces various new codes, and finally explains how expandability is ensured.

## INADEQUACY OF THE CODES IN THE DICOM STANDARD

### Study Type Code

"Modality" (0008/0060), an element of the DICOM standard, is specified to contain the study modality, for which about 30 codes are listed as General Series Module Attributes in Table C.7.4. This table does list computed tomography (CT) or magnetic resonance (MR), but does not specify codes for more detailed information such as "contrast-enhanced CT." The JIRA DICOM Committee once pointed out this drawback to the DICOM Committee, which rejected the proposal saying that such detailed information can be described as a study order comment. In America, radiologists are given extensive discretion and greater responsibility in judging the details of the type of study to be conducted. This means that requesting physicians do not specify details in their orders in many cases. It is true that these codes are difficult to maintain consistently globally in the face of rapid advances in imaging equipment.

Also in Japan, different facilities have different detail levels of orders. The necessity of contrast study may be judged at the stage of scheduling in most facilities. However, more details, such as the procedures for contrast study (rapid intravenous injection) or the type of CT system used for the study (specification to use a multislice CT system, in particular) are different from facility to facility. Such detailed information could be processed successfully using local codes specific to each facility,

but this strategy would not be suitable in future environments in which interfacility communication is expected to become more common.

In this environment, a desired coding scheme should be capable of representing detailed information as local codes, while supporting a standardized stem as a common term. More desirable, the code meaning (0008/0104) should be conveyed together with the code itself in natural language. This is necessary when a detailed code is received, and the table for the code is not found on the receiver side, leaving the receiver with no way of understanding the meaning of the code. In such cases, the receiver of the code can understand the meaning of the code if it is accompanied by the meaning expressed in natural language.

### Study Region Code

The following situation has become apparent: as more nonimage data are involved in the DICOM standard, a code needs to be contained in various elements; therefore, such codes must be standardized for successful information transfer. In response to this request, the DICOM Committee collected all codes listed in the code tables for the elements specified in the DICOM standard, picked up the necessary region and pathological codes from SNOMED[5] generated by the College of American Pathologists, and compiled them into the SNOMED-DICOM-Microglossary (SNM3) consisting of 909 words.

A comparison of this SNOMED-DICOM-Microglossary (SNM3) with the regions of the image study codes used in Toyama Medical and Pharmaceutical University, Osaka University, and Hamamatsu University has found that as few as approximately 30% of SNOMED-DICOM-Microglossary (SNM3) terms are available for medical purposes in Japan. For example, ''cornea'' is available, but ''eye pit'' is not. ''Breast'' is available, but ''galactophorous duct'' and ''mammary gland'' are not.

Further, SNM3 uses both anatomic region codes and body region codes for many regions because SNOMED has both types of region codes. An actual example is that an order for fluoroscopy is placed for body region such as ''upper digestive tract,'' whereas an order for general radiography or CT scan is placed for anatomic region such as ''chest'' or ''abdomen.'' If these 2 types of codes are mixed, manual merging is required to obtain information such as ''No. of acquisitions of chest.''

Therefore, desirable region codes must be qualified for specifying a body part based on a body region or organ, as well as for covering the regions for which image studies are ordered.

### Study Directional Codes

Most study directional codes are covered by SNM3 with some exceptions. For example, ''axial'' and ''apex of lung'' are not covered by SNM3. Our policy is that JJ1017 uses the study directional codes supported by SNM3 and adds some codes not covered by SNM3 as JJ1017 directional codes.

## POLICIES OF CODE GENERATION

Although a trial for generating a detailed image study codes for common use throughout the nation had been performed in the past, the rapid progress in imaging system development made it difficult to reach the establishment. At the same time, if a local code is trusted, not only are the merits of the standard reduced, but there may be obstacles in comparing the same data at different facilities, because it is expected that analysis of various data sets at image examination departments will be more important. This problem has been pointed out already.[6,7,8]

Basic category codes then were generated to provide common terms regarding studies (techniques), regions, and directions so they can be used as the base if detailed local codes are further required.

## STUDY TYPE CODES

A part of the code table is shown in Table 1. In the Table 1, 47 codes are available, and 8 modalities are available including CT, MR, x-ray, radiography, angiography, nuclear medicine, therapy, lithotrity, and ultrasonography. The modality codes are compatible with the DICOM modality codes. The large category indicates major study types for each modality,

**Table 1. Study Type Codes**

| Modality | Large category | Small category | Code |
|---|---|---|---|
| CT | General CT | NOS | CT.01.00 |
| | Contrast-enhanced CT | NOS | AT.02.00 |
| | | Angiography | CT.02.01 |
| | | Organ contrast imaging | CT.02.02 |
| | CTA | NOS | CT.03.00 |
| MRI | General MRI | NOS | MR.01.00 |
| | | T1 | MR.01.01 |
| | | T2 | MR.01.02 |
| | | Proton | MR.01.03 |
| | | NOS | MR.02.00 |
| | Contrast-enhanced | NOS | MR.03.00 |
| | MRA | 2D | MR.03.01 |
| | | 3D | MR.03.02 |
| X-ray radiography | General | NOS | GX.01.00 |
| | | Portable | GX.01.01 |
| | Contrast radiography | NOS | GX.02.00 |
| | | Gastrointestinal contrast imaging | GX.02.01 |

whereas the small category further details each study type classified in the large category to a level permitting the code to be used for expression of a technique. ''NOS'' (not otherwise specified) is defined for each large category for cases in which no small category is specified.

The coding scheme identifier is ''JJ1017T.'' Codes are constructed by connecting the ''modality,'' ''large category,'' ''small category,'' and ''fine category'' (if any) with periods. For example, general MRI (NOS) is represented as MR. General MR.NOS and the extension of dynamic angiography CT is represented as CT.Contrast-enhanced CT.Angiography. Dynamic contrast imaging.

## REGION CODES

In generating the region codes, 205 types of region information have been taken from image study item codes actually used in Japanese hospitals for use as the basic vocabulary for the small region. A region code is a 6-digit number consisting of the large category (2 digits), organ-system category (1 digit), and small region (3 digits), with period(.) between regions for code representation as with the type codes. The coding scheme is characterized by the large category and organ-system category, which facilitates understanding of the code meaning and makes it possible to exchange codes between facilities regardless of local expansion.

The coding scheme identifier is ''JJ1017P,'' and a description corresponding to the small region code is used as the code meaning. The large region code is an approximate representation of the region to be imaged (studied) and projected on film. It is not just a simple term such as *chest* or *abdomen*, but consists of combinations such as *chest-abdomen* (meaning both chest and abdomen), which are used to express several regions and have been defined to accommodate current use. Some of the large region codes are shown in Table 2.

Imaging (study) target organs are classified based on the organ system and then expressed. Some of the organ codes are shown in Table 3.

The small region codes are coded vocabulary for the small region. NOS (not otherwise specified) is available for the large category code and organ codes but not available for the small region codes. Some of the region codes generated by combining these codes are shown in Table 4.

**Table 2. Large Region Codes**

| Code description | Code |
|---|---|
| Whole body | 10 |
| General trunk | 20 |
| Chest | 25 |
| Chest/abdomen | 30 |
| Abdomen | 35 |
| NOS | 00 |

**Table 3. Organ System Codes**

| Code description | Code |
|---|---|
| General organ parenchyma | 1 |
| Skeleton system | 3 |
| Cardiovascular system | 4 |
| Digestive system | 5 |
| Respiratory system | 6 |
| Urinary/genital system | 7 |
| NOS | 0 |

## DIRECTIONAL CODES

Currently used SNM3 codes are used for the directional codes, whereas codes not covered by SNM3 are added to "JJ1017D," which is the coding scheme identifier for the directional codes. A code description is used as the code meaning. Some of the directional codes in which both JJ1017D and SNM3 are mixed are shown in Table 5.

## EXAMPLE OF CODE USE IN THE DICOM WORKLIST MANAGEMENT AND PERFORMED PROCEDURE STEP

In the DICOM standard, a study type stores study items in the scheduled action item code sequence. To do this, a value is entered into the following 4 items of this sequence: "code value" (0008/0100), "coding scheme designator" (0008/0101), "code scheme version" (0008/0102), and "code meaning" (0008/0103). The study type has at least 1 set of these 4 items, the region has 0 to 16 sets of these 4 items, and the direction has 0 or 1 set of these 4 items. Examples of the codes are shown in Table 6.

## USE OF EXISTING CODES AND LOCAL EXTENSION CODES

We do not think the codes described above can support all situations. It does not matter if, as required, a detailed description is given. At this time, it is desirable not only to give such a detailed description, but also to find out what basic category (for common terms) corresponds to the description and add the description to the category to generate fine category codes locally. For example, although "Contrast-enhanced CT (NOS)" is CT.02.01, some facilities add "01" to the end to differentiate dynamic contrast-enhanced CT from normal contrast-enhanced CT. This makes it possible to transfer detailed information locally. The contents are based on the category for common terms, and the minimum information can be transferred using common term "CT.02.01," enabling comparison of the same data at different facilities. When a small region code category is classified into finer categories, the code shall be extended to .01, .02… in the same manner as for the fine classification of modality.

To extend a large or small category instead of a fine category, the following shall be performed: (1) extension of large category for modality .51 .52 .53…, (2) extension of small category for modality .51 .52 .53…, (3) extension of small category for region .901 .902 .903…
For example, if some facilities differentiate normal CT systems from multislice CT systems when placing an order, CT.51.00 "Multislice CT, NOS" should be set because multislice CT systems belong to an extension of a large category.

It is also recommended that the contents of an order (character string) displayed in the order screen be sent using the code meaning (character string). This is to communicate the intent of the order issuer to the receiver more precisely. In addition, information can be communicated to a receiver who does not have the same code, because the meaning can be understood by reading it.[8,9]

Usually, "JJ1017P," "JJ1017T," etc. are entered as code identifiers. If an extension like this

**Table 4. Study Region Codes**

| Region name | Code |
|---|---|
| Head/brain | 55.1.100 |
| Cerebrum | 55.1.101 |
| Cerebellum | 55.1.102 |
| Parotid gland | 55.1.154 |
| Head/neck | 60.1.160 |
| Neck | 65.1.170 |
| Pharynx | 65.1.171 |

**Table 5. Study Directional Codes**

| Coding scheme identifier | Code | Code description |
|---|---|---|
| SNM3 | G-A100 | Right |
| SNM3 | G-A101 | Left |
| JJ1017D | 001 | Both left and right |
| SNM3 | G-5200 | A→P |
| SNM3 | G-5209 | RPO |
| JJ1017D | 002 | Axial |
| JJ1017D | 003 | Half axial |

**Table 6. Examples of "Code Sequence" Using JJ1017 Codes**

| | |
|---|---|
| "General X-ray radiography, chest A->P" | |
| (0040/0008) | # Scheduled action Item code sequence |
| >(FFFE/E000) | # Item Tag |
| >(0008/0100): GX.01.00 | # Code value |
| >(0008/0102): JJ1017T | # Coding scheme designator |
| >(0008/0103): 1.0 | # Coding scheme version |
| >(0008/0104): X-ray_radiography.General.NOS | # Code meaning |
| >(FFFE/E000) | # Item Tag |
| >(0008/0100): 25.1.200 | # Code value |
| >(0008/0102): JJ1017P | # Coding scheme designator |
| >(0008/0103): 1.0 | # Coding scheme version |
| >(0008/0104): Chest | # Code meaning |
| >(FFFE/E000) | # Item Tag |
| >(0008/0100): G-5200 | # Code value |
| >(0008/0102): JJ1017D/SNM3 | # Coding scheme designator |
| >(0008/0103): 1.0 | # Coding scheme version |
| >(0008/0104): Anterior to posterior | # Code meaning |
| "Dynamic contrast-enhanced CT for abdomen" | |
| (0040/0008) | # Scheduled action Item code sequence |
| >(FFFE/E000) | # Item Tag |
| >(0008/0100): CT02.01.01 | # Code value |
| >(0008/0102): JJ1017T/HMU | # Coding scheme designator |
| >(0008/0103): 1.0/1.0 | # Coding scheme version |
| >(0008/0104): CT.Contrast-enhanced_CT.Angiography.Dynamic_CT | # Code meaning |
| >(FFFE/E000) | # Item Tag |
| >(0008/0100): 25.1.250 | # Code value |
| >(0008/0102): JJ1017P | # Coding scheme designator |
| >(0008/0103): 1.0 | # Coding scheme version |
| >(0008/0104): Abdomen | # Code meaning |

is performed, the character string shall be followed by an arbitrary character string after the "/" as in "JJ1017P/HMU" to identify the facility at which the extension was performed and the version number. Although use of a code that has already been used locally is permitted, at this time the code identifier shall be in the format "L/HMU," whereas "L" indicates the local code, and the character string after the "/" indicates the facility. It is recommended that the code meaning (character string) be used to send not only the local code but the order contents at the same time. With regard to the direction code, SNOMED code that can be used in DICOM is defined as SNM3, and therefore the code corresponding to it should be searched first. If the corresponding code is not found, the "JJ1017D" code shall be used.

## RESULTS: IMPLEMENTATION TEST IN CYBERRAD

Interconnection using this code was shown at the CyberRAD theme exhibition, which was held jointly by the Japan Radiological Society, the Japanese Society of Radiological Technology, and JIRA, in Kobe from April 5 to 7, 2001.

In the exhibition, an image study was accepted in the HIS and RIS, the order information was sent to the imaging equipment using Worklist Management, and the performed procedure was received by the picture archiving and communication system (PACS). In this, no disadvantage has been observed all through preparation to demonstration. In this demonstration, Fujitsu, Teijin Systems, Shimadzu, and Hitachi Medical Corporation participated for the HIS and RIS; Canon DR, Konica CR, Fuji Film Medical CR, Phillips MR, and Shimadzu X-ray TV participated for the imaging equipment; and ARRAY, Teijin Systems, Fujitsu, Toshiba, and Yokogawa participated for PACS. Using this code, connections across different companies were made possible (Fig 1). Locally, HIS made a work report of the ordered examinations, sorting with this code.

All through this implementation demonstration, JJ1017 codes have been used, which means

**Fig 1. HIS, RIS – Modality – PACS Integration Demo at JMCP 2001, where hetero vendor interconnections are realized, using JJ1017 guidelines and codes.**

that there may have been some extra overload added to the DICOM header. Because JJ1017 codes themselves are flat, single-depth code tables, codes themselves adds no virtual extra load. Making full use of multiaxial "code sequence" will add extra load, compared with using one composite code. However, it is not because of JJ1017 extension.

LOINC code (http://www.regenstrief.org/loinc/) can be used alternatively for detailed examination order. Its multiaxial definition can put all the 3 contents (modality, region, and direction) into a code. Although the LOINC database has all 3 axis, the LOINC code itself is a composite one code. Using the LOINC database as multiaxis source will require the same overload to the header, and the LOINC database vocabulary is not complete for the use in Japan.

## AFTER WORDS

The complete JJ1017 guidelines and code tables can be accessed at the following Web sites: "JAHIS: http://www.jahis.jp/" and "JIRA: http://www.jira-net.or.jp." Any expansion of codes or fine categories should be reported to the JJ1017 Committee via either JAHIS or JIRA. Through such cooperation, common terms can be numbered quickly for new modalities.

Although this code originally was generated for exchanging image study order information and performed procedures between RIS and modalities based on the JJ1017 guidelines, other use of this code is welcome.

We view with pleasure any use of this code that helps to advance computerization of image studies and promotes interfacility information communication.

## ACKNOWLEDGMENTS

The authors wish to thank the JJ1017 Committee members of JAHIS and JIRA. The work is partially supported by Ministry of Health and Welfare Research Fund.

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