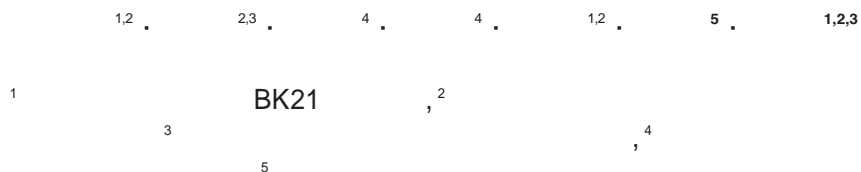


DICOM CD



The Development of DICOM CD Data Validation Toolkit

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= Abstract =

Since Korean government decided to reimburse for filmless full-PACS (Picture Archiving and Communications System) installation, a number of PACS installations had been rapidly increased. Currently, the number of large (> 500 beds) and small (< 500 beds) hospitals installing full-PACS are over 50 and 110, respectively. In case of patients who were referred to other hospitals, their image data which was the set of DICOM (Digital Imaging and Communications in Medicine) studies was transferred to referred hospitals. The DICOM studies were exported by available portable storage media such as a CD (Compact Disk). The DICOM images were imported from CD-ROM and stored to new PACS sever. In Yonsei University Medical Center, the number of referred patients is over 3,500 a day. Hospital ' PACS operators are trying to import the DICOM files to the server about 50 times a day and the number of the tasks is gradually increasing. However, many problems were occurred when the DICOM images were imported. For instance, some images could not be imported from the DICOM CD data. Although they were successfully imported, some of them were not able to display. After analyzing various CD Data from many hospital and PACS vendors, DICOM validation toolkit was developed to improve the compatibility between the DICOM CD data and PACS. The joint project was aiming at developing " DICOM CD validation toolkit ". This study reported the procedure which was to make " DICOM CD Recommended Data Guideline Document " and the result that we validated the DICOM data sets using the DICOM CD validation toolkit.

Key words: PACS, DICOM, Validation, DICOM CD

1. DICOM CD 가 10-20 , DICOM
 CD 가 가 가
 1990 PACS(Picture Archiving
 and Communication System) ,
 1999 PACS 가가 , PACS DICOM
 가 , 300 PACS 3.0 가
 PACS DICOM(Digital Imaging Communications
 in Medicine) 3.0 , ACR/NEMA 2.0
 PACS DICOM
 가 PACS
 가 (DB: Database)
 가 DB 가
 CD(Compact Disk) , (purity)
 CD DICOM 3.0 DICOM DB
 DICOM DICOMDIR DB
 DICOM CD 가
 PACS (import) DB 가 , DICOM

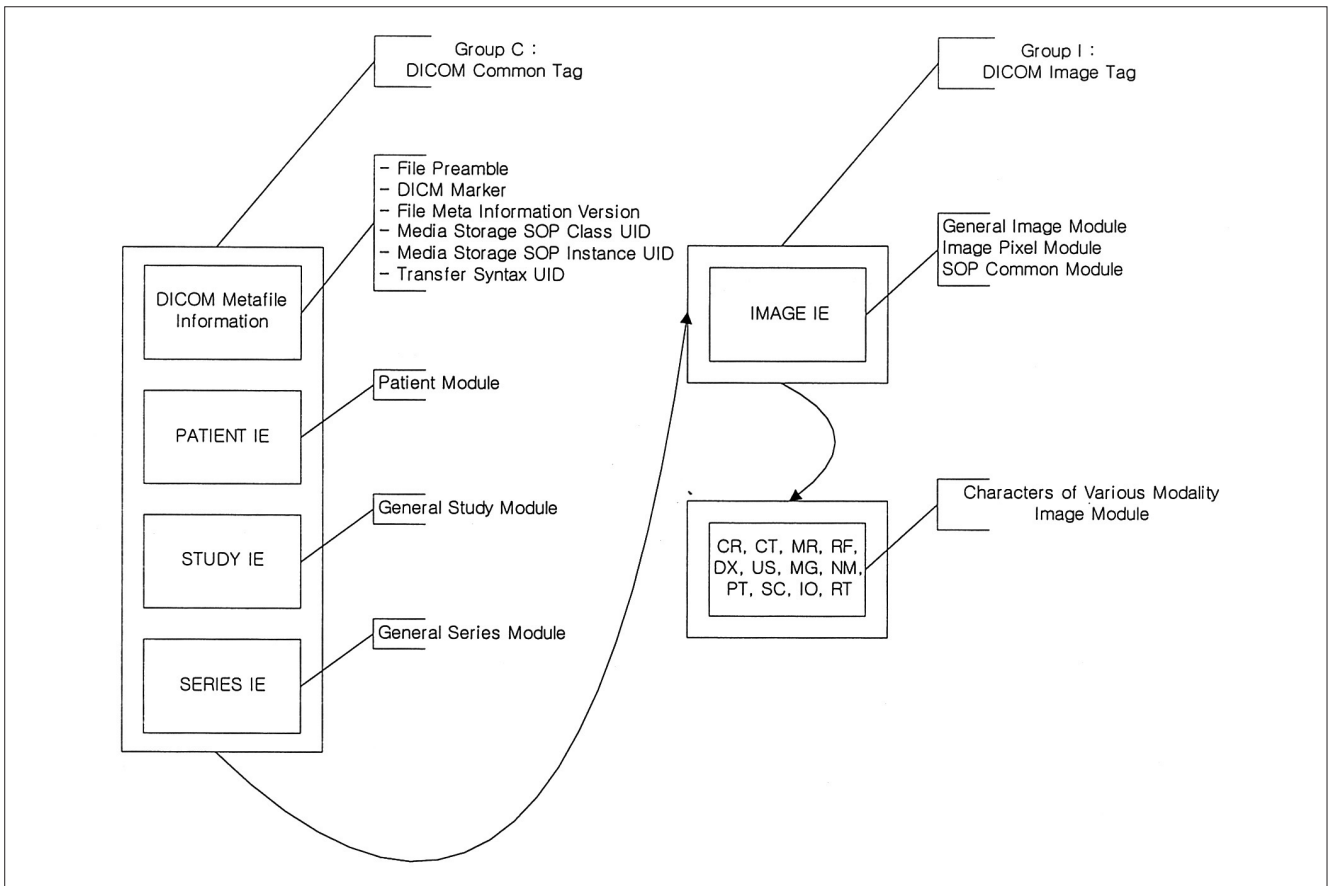


Fig. 1. Schematic diagram illustrating the structure of DICOM image data defined in the DICOM CD recommended guideline.

: DICOM CD

PACS . DICOM CD .

(export) DICOM CD .

DICOM CD DICOM CD .

DICOM CD DICOM CD .

(validation DICOM CD .

1 DICOM CD (guideline)

2 DICOM 3.0 DICOM

DICOMDIR tag[1] tag

DICOM CD 가

2.1. DICOM CD

PACS DICOM CD (, 4 - 5) , PACS

PACS (head -

, 2003 7 31 er) . DICOM CD

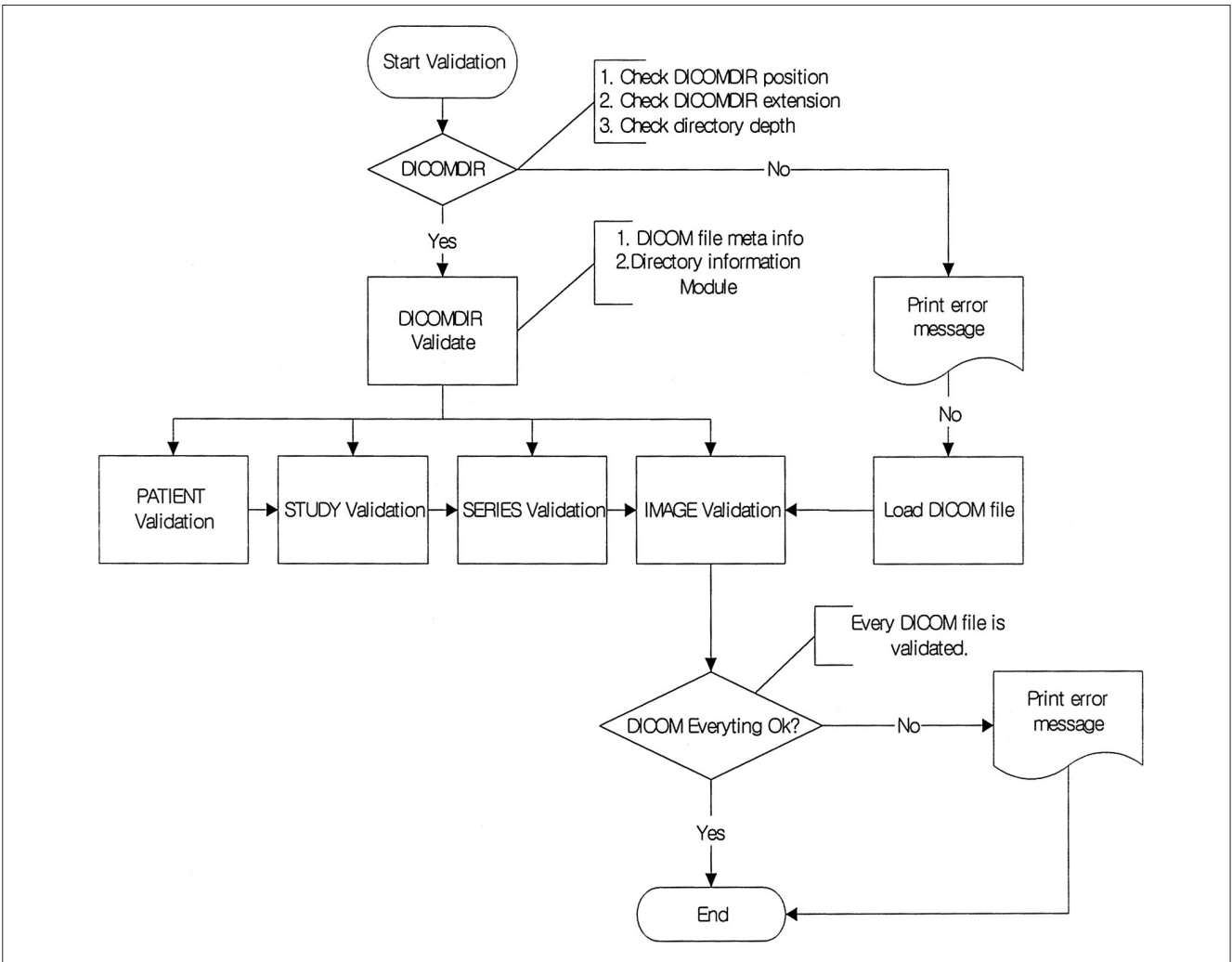


Fig. 2. Flow chart of DICOM CD data evaluation utilized in the designing of DICOM CD validation toolkit.

(Microsoft Inc, Seattle, U.S.A.) DICOM
(library)

3.

2.4. DICOM CD DICOM CD DICOM 3.0 tag
 , DICOM CD 가
 DICOM CD DICOM CD
 DICOM CD PACS
 PACS DICOM CD DICOM CD PACS
 DICOM CD 25 22 PACS
 23 CD 2 Group B tag
 CD , CR(Computed Radiography) UID (Unique Identifier), date, time, date time, age,
 series 94 , CT(Computed Tomography) series 143 Name tag DICOM
 , ES(Endo Scope) series 7 , SC(Secondary PS3.5:6.2
 Capture) series 34 , US(Ultra Sound) series Group C tag DICOM PS3.10:7.1
 5 , MR(Magnetic Resonance) series 101 , XA/RF DICOM File Meta Info tag DICOM PS3.3: C7.21
 (X - ray Angio/Radio Fluoroscopy) series 17 , Patient IE(Information Entities), Study IE,
 PT(PET) series 10 , NM(Nuclear Medicine) Series IE
 series 5 , IO(Intra Oral) series 5 , 421 Group I DICOM PACS (viewer)
 series DICOM CD IE DICOM PS3.3: C7.6.1
 DICOM CD . Figure general image module DICOM PS3.3: C7.6.3
 3 DICOM CD Modality image pixel module DICOM PS3.3: C12.1
 series . SOP common module

Table 2. Definition of Group I in DICOM CD guideline

Info. En.	Mo.	No.	Tag	Attribute Name	Value	Reference
Image IE	General	I-001	(0008,0023)	Content Date	#B-002	PS 3.3:C7.6.1
	Image Module	I-002	(0008,0033)	Content Time	#B-003	
		I-003	(0020,0013)	Instance Number (Image Number)		
Image Pixel Module	Image Pixel Module	I-004	(0028,0002)	Samples per Pixel	1, 3, 4	PS 3.3:C7.6.3
		I-005	(0028,0004)	Photometric Interpretation	MONOCHROME1, ...	
		I-006	(0028,0010)	Rows		
		I-007	(0028,0011)	Columns		
		I-008	(0028,0100)	Bits Allocated		
		I-009	(0028,0101)	Bits Stored		
		I-010	(0028,0102)	High Bit		
		I-011	(0028,0103)	Pixel Representation	0000H, 0001H	
		I-012	(7FE0,0010)	Pixel Data		
	SOP Common Module	SOP Common Module	I-013	(0008,0016)	SOP Class UID	
I-014			(0008,0018)	SOP Instance UID	#B-001	

: DICOM CD

, DICOM PS3.3 CR(Computed Radiography), CT(Computed Tomography), MRI (Magnetic Resonance Imaging), US(Ultrasound/US multi-frame Imaging), SC(Secondary Capture), XA(X-ray Angiographic/Radiofluoroscopic Imaging), DX (Digital X-ray), MG(Digital Mammography), IO(Intra-oral Imaging) tag I (image tag) media storage SOP class UID (0002, 0002)

DICOMDIR IOD IE tag ' SUCCEED ' ' ERROR ' DICOM DICOM CD group C(common tag) group

Figure 4 DICOM CD

DICOM CD
 DICOMDIR
 DICOM CD CR DICOMDIR
 DICOM CD

Table 3. Status of DICOMDIR used in validation of the DICOM CD data.

DICOMDIR	Number
DICOMDIR	7
DICOMDIR Error가	11
DICOMDIR	28

Table 4. Validation results of DICOMDIR files.

Tag with Error	Tag	Number of Error.
Group Length	(0002,0000)	10
File Meta Information	(0002,0001)	10
Media Storage SOP Instance UID	(0002,0003)	11
File-Set Consistency Flag	(0004,1212)	11
Record In-use Flag	(0004,1410)	10
Reference File ID	(0004,1500)	10
Transfer Syntax UID	(0004,1512)	10
Referenced File ID	(0004,1500)	2

Figure 3

DICOM

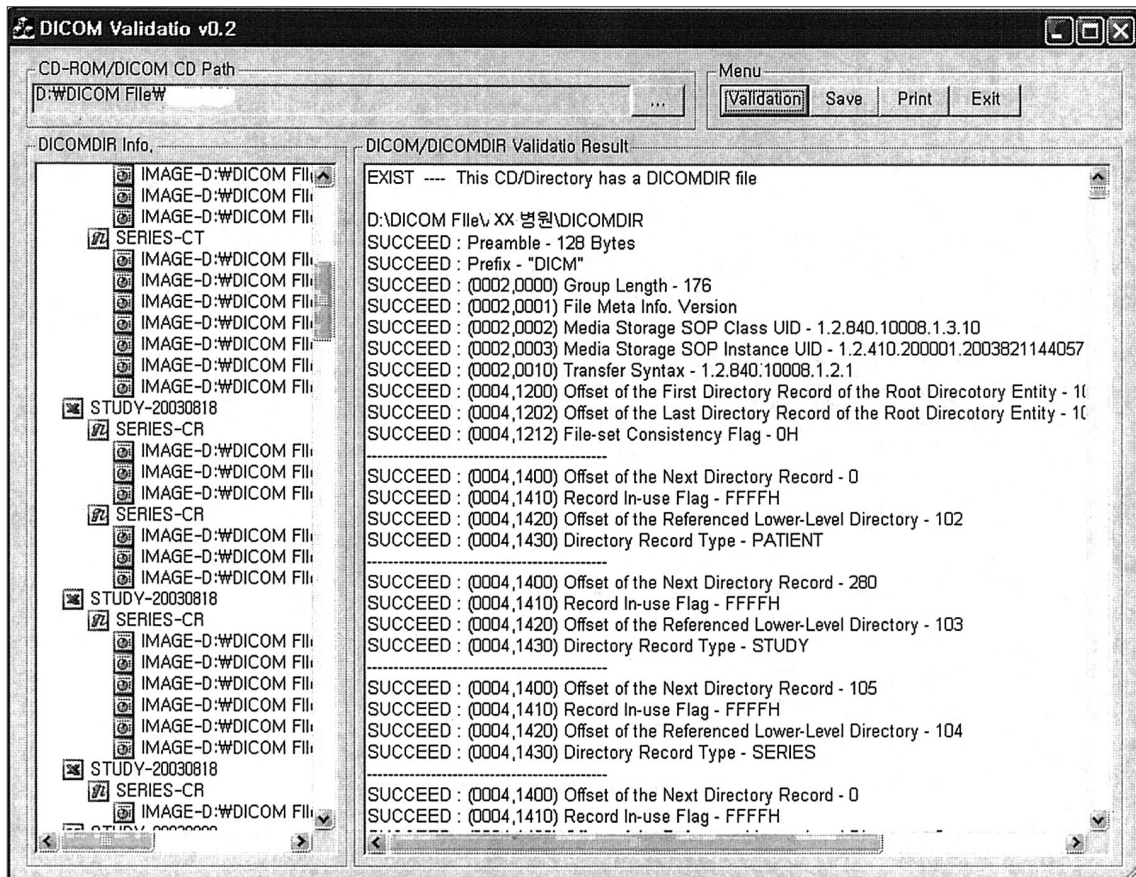


Fig. 4. Screen illustrating the validation results of the DICOMDIR of DICOM CD data using the DICOM validation toolkit.

DICOM CD

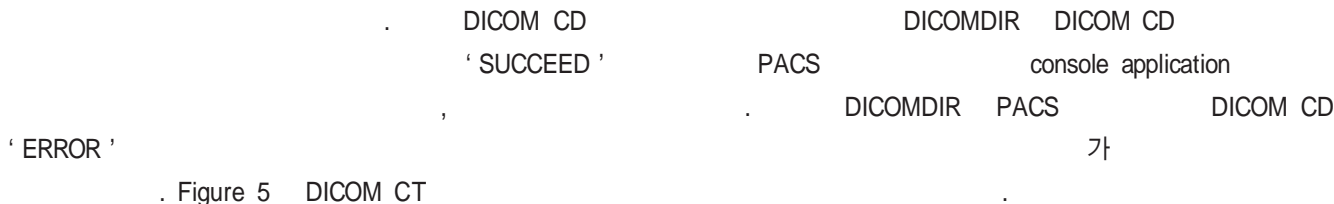


Figure 5 DICOM CT

Table 5. Validation results of Common IE occurring the import errors.

	Tag with Error	Tag	Number of NULL Value	Number of Empty Tag
Common tag	Accession Number	(0008,0050)	28	2
	Series Number	(0020,0011)	6	2
	Patient name	(0010,0010)	5	1
	Patient Birthday	(0010,0030)	19	3
	Patient's Sex	(0010,0040)	2	2
	Patient's ID	(0010,0020)	0	2
	Study Instance UID	(0020,000D)	0	2
	Series Instance UID	(0020,000E)	0	3
	Group Length	(0002,0000)	0	3
	File Meta Information	(0002,0001)	0	3
	Media Storage SOP Instance UID	(0002,0003)	0	1
	Media Storage SOP Class UID	(1.2.840.113619.4.2)가	0	1

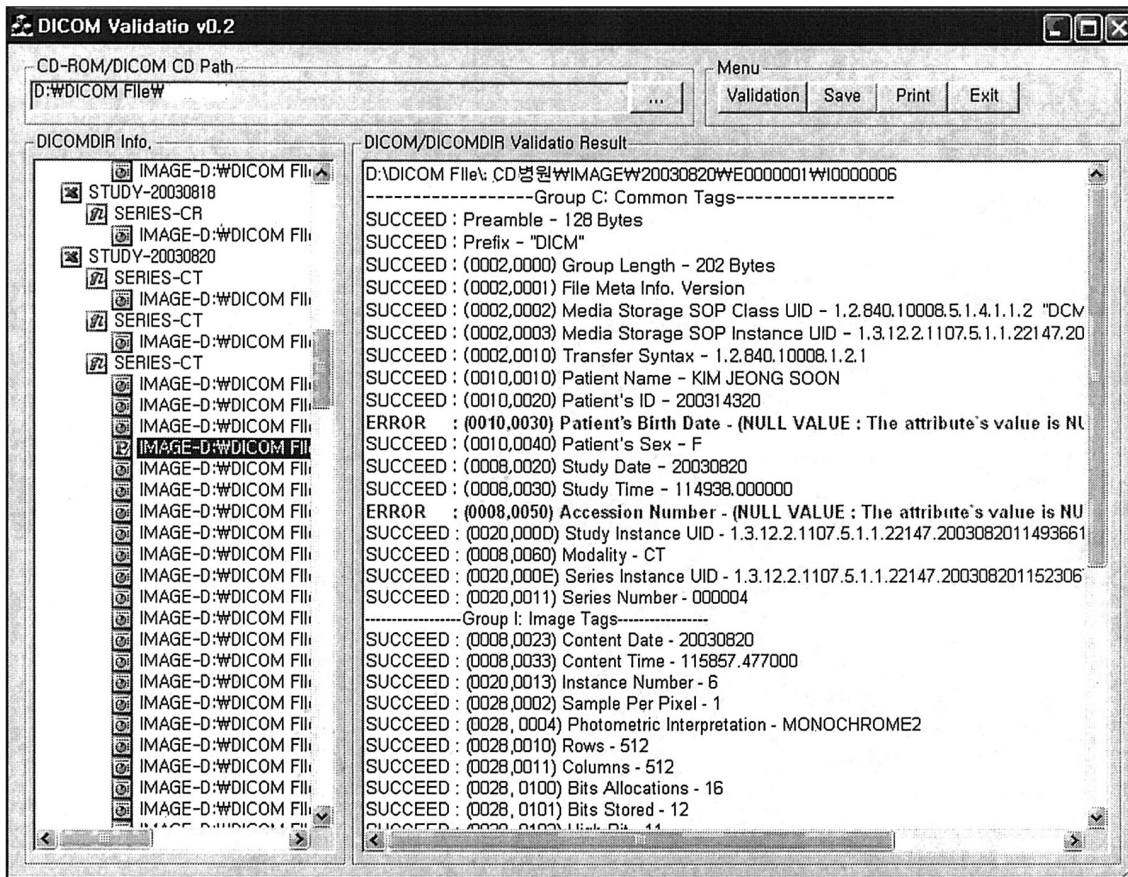


Fig. 5. Screen illustrating the validation results of the CT DICOM CD data using the DICOM validation toolkit.

DICOM CD DICOMDIR , 가 DICOMDIR
 media storage SOP instance UID file - set DICOM
 consistency flag 가 ‘ PACS CD Data format guideline ’ Common
 referenced file ID가 DICOM CD IE Image IE IE
 PACS . Table 5 Common IE
 가 Table 6 Image IE . PACS
 가 . Table 3,4 DICOM CD Image IE tag 가 PACS

Table 6. Validation results of Image IE occurring the import errors

	Tag with Error	Tag	Number of NULL Value	Number of Empty Tag
Image IE	Instance Number	(0020,0013)	0	2
	Sample Per Pixel	(0028,0002)	0	3
	Photometric Interpretation	(0028,0004)	0	2
	Rows	(0028,0010)	0	2
	Columns	(0028,0011)	0	2
	Bits Allocated	(0028,0100)	0	2
	Bits Stored	(0028,0101)	0	2
	High Bit	(0028,0102)	0	2
	Pixel Representation	(0028,0103)	0	3
	Content Date	(0008,0023)	0	14
	Content Time	(0008,0033)	0	14
	SOP Class UID	(0008,0016)	0	1
	SOP Instance UID	(0008,0018)	0	1

Table 7. Validation results of DICOM CD data occurring the import errors.

Modality	Tag with Error	Tag	Number of NULL Value	Number of Empty Tag
CR	View Position	(0018,5101)	11	0
	Body Part Examined	(0018,0015)	0	1
CT	Rescale Intercept	(0028,1052)	1	4
	Rescale Slope	(0028,1053)	1	4
	Conversion Type	(0008,0054)	0	1
	Frame of Reference UID	(0020,0052)	0	2
	Patient Position	(0018,5100)	0	2
	Slice Thickness	(0018,0050)	0	2
	Image Position	(0020,0032)	0	2
	Image Orientation	(0020,0037)	0	2
	Study Time	(0008,0030)	1	0
	Pixel Spacing	(0028,0030)	0	1
Image Type	(0008,0008)	0	1	
SC	Conversion Type	(0008,0054)	1	0
US	Curve Number	(0020,0024)	0	4
	Curve Dimension	(5000,0005)	0	4
	Number of Points	(5000,0010)	0	4
	Type of Data	(5000,0020)	0	4
	Data Value Representation	(5000,0103)	0	4
	Curve Data	(5000,3000)	0	4
MR	Slice Thickness	(0018,0050)	1	0
	Patient Position	(0018,5100)	1	0
	Sequence Variant	(0018,0021)	1	1
	Scanning Sequence	(0018,0020)	1	0
XA	Frame Time Vector	(0018,1065)	1	1

가 Content Date(0008,0023),
Content Time(0008,0033) tag가 가
PACS tag

Region Sequence (0008,2218), Positioner Type
(0018,1508) tag

4.

Table 7 DICOM
CR(Computed Radiography) View
Position (0018,5101) null
Body Part Examined (0018,001) tag가
CT 143 30
Rescale
Intercept (0028,1052), Rescale Slope (0028,1053)
Null tag 가
SC Conversion Type
(0008,0054)
US Curve Number (0020,0024), Curve Dimension
(5000,0005), Number of Points(5000,0010), Type of Data
(5000,0020), Data Value Representation (5000,0103),
Curve Data (5000,3000) tag MR
Slice Thickness (0018,0050), Patient Position
(0018,5100) tag Null
Sequence Variant (0018,0021) tag가
XA Frame Time Vector
(0018,1065)가 Null 가 , tag 가
NM, PT, IO
NM Series Number
(0020,0011), Content Date (0008,0023), Content Time
(0008,0033)가 null Detector Vector
(0054,0020) tag가 PT
Series Number (0020,0011)가 null Pixel
Aspect Ratio (0028,0034) tag가
Image Orientation (0028,0037) Image Position
(0028,0032) DICOM VM=3, VM=6
IO Image
Laterality (0008,0062), Patient Orientation (0020,0020),
Burned in Annotation (0028,0031), Intensity Relationship
sign (0028.1040), Rescale Type (0028,1054), Lossy
Image Compression(0028,2110), Presentation LUT Shape
(2050,0020), Image Pixel Spacing (0018,1164), Anatomic

DICOM CD
CD
가 가 , DICOM 3.0
DICOM, DICOMDIR
DICOM CD DICOM CD 가
DICOM 3.0
PACS DB PACS
DICOM CD PACS
DICOM CD
“
”
CD
PACS

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