Digital Imaging and Communications in Medicine (DICOM)

Supplement 226: Confocal Microscopy [WI2020-04-A]

Prepared by:

DICOM Standards Committee, Working Group 19
1300 N. 17th Street Suite 900
Rosslyn, Virginia 22209 USA

VERSION:
Status: Version 7
Developed pursuant to DICOM Work Item: 2020-04-A

Document History

2022/03/23	Version 7	LC	Added content and suggestion from WG06 most notably the definition of three separate IODs for simple, tiled pyramidal and multi-frame images
2022/01/11	Version 6	LC	Added new module table for tiled pyramidal, added new TID for ex-vivo stains, amalgamated the Skin Cancer Acquisition Contexts
2021/10/26	Version 5	LC	Added content informed by WG06 meeting
2021/08/31	Version 4	LC	Added informative context plus misc.
2021/06/08	Version 3	LC	Added topical treatments influencing RCM analysis to acquisition context
2021/06/08	Version 2	PH	Review and input
2021/06/01	Version 1	LC	First Draft

Open Issues

Commented [LC1]: OK to have Open Issues included in public comment.

1.	Do we need to encode Detector metadata? PH commented: I don't know if DICOM needs to store information about the detectors for any reason related to the storage, transmission and display of these images. Researchers may want to know what filter was in place between the light source and the detector to understand what emitted wavelengths may have been included or excluded… Do other imaging modalities include low-level information about the electro-mechanical components involved in the imaging path? If so, these "Detector" settings are simply referencing the filter in place, and any Gain/ "High Voltage" gain and black-level offset used in order to generate the pixels. Similar, I noticed in "Open Issues" you had listed "No" as to the answer to the need to store the immersion media. I suppose this is along similar lines. Researchers may certainly care about these things while diagnosticians will not.
2.	
3.	

Closed Issues

Commented [LC2]: Include for public comment

Commented [LC3R2]: Delete from closed issues where included in supplement. Keep where rationale is used.

1.	Does Confocal Microscopy require and Anatomical Regions Sequence? Yes, UI has an anatomical region avatar for users to enter the anatomical location.
2.	Do we need to encode Immersion media e.g. US Gel? No
3.	What shape (rectangle, round) is the Field of View? Square
4.	Depth (microns, mm) or anatomy (e.g. stratum spinosum, DEJ, dermis?) Depth -skin surface can be curved hence an image does not necessary contain of the anatomy in one plane

5.	Is optical magnification used? Hence can Optical Magnification Factor (0016,1005) 2 Optical magnification factor when the image was acquired. Optical magnification is achieved using the optics of the dermoscope **or microscope**. The number indicates the magnification factor in times (X). The size of an object (e.g., a skin lesion) would appear on the sensor n times larger than the object when imaged with a dermoscope **or microscope** using n X optical magnification. Yes, need to change description to add microscope
6.	
7.	Should we include specimen module in Confocal Microscopy IOD for ex vivo imaging? Does specimen come in a jar/container with a barcode. See http://dicom.nema.org/medical/dicom/current/output/chtml/part03/sect_C.7.6.22.html Ex vivo is performed at the bedside so normally does not have container/barcode but can. Include Specimen Module as U.
8.	Pregnancy status (0010,21C0) (0001 no pregnant; 0002 possibly pregnant; 0003 pregnant; 0004 unknown) Patient Study Module. Do we make patient study module M is pregnancy is required for all confocal microscopy studies? Not mandatory
9.	Reason for confocal imaging examination include margin mapping, or diagnosis, margin status, biopsy site selection, monitoring therapy, follow up Do we use (0040, 1002) Reason for Requested Procedure. VR=LO Note: (0040, 1002) Reason for Requested Procedure part of General Series Module (e.g. CT Image, NM Image, MR Image, is part of the (0040, 0275) Request Attributes Sequence Add to informative context
10.	Is the distance between images for a Z-Stack image the equi-distance? Yes equidistant (with distance defined by the operator)
11.	Should Z-stacks and mosaic stacks be encoded as multi-frame images? Z-stack and mosaic stacks are currently stored as discrete images. The metadata does include a framerate indicating that a multi-frame image could potentially be used. Z-stacks should be stored as single frame images Single frame as users prefer to mouse scroll through images at their own pace as opposed to a set frame rate.
12.	Are images always MONOCHROME? Always MONOCHROME. However, fluorescent and reflectance are displayed by specialty viewer with a pink or purple overlay. If you use a specialty viewer store reflectance and fluorescence separately. Possibly create a duplicate RGB for non-specialty viewers.

13.	Can we use Pixel Space (0028,0030) instead of Pixels per micron? Yes (confirmed by Paul Hemmer-CaliberID)
14	Do we use the attribute Referenced Image Sequence or Referenced Instance Sequence to reference macroscopic/dermoscopic image? Referenced Image Sequence. Referenced Instance Sequence is for non-image SOP instances.
15	How are series to be organised can multiple lesions be images in the one study? No Can there be multiple acquisition types (single image, Z-stack etc) of each lesion? Yes A "study" has always referred to a single lesion imaged at a single time point. Each study contains 1:N series and each series contains 1:N instances. Each acquisition (stack, block, snapshot, movie) is a unique series. Current series description corresponds to acquisition mode. How to arrange series for reflectance/fluorescence simultaneous? The user acquires a mosaic in combined r/f mode, our software implementation will save this as, say, "Mosaic #1" – this is one series and the folder on disc which stores it contains two sub-folders, one for each wavelength.
16	Do we need a REFLECTANCE, FLUORESCENCE, and REFLECTANCE + FLUORESCENCE mode? "or" is fine since both gray channels, even if imaged simultaneously, are stored as individual images.

17	Are all stains used in ex-vivo imaging in CID8112? WG06 First Read recommended creating a CID specifically for stains used in ex-vivo confocal microscopy. Hence, have created CID DDDD Specimen Stains for Confocal Microscopy JM commented The most popular ex-vivo stain is orange acridine but is probable that additional stains will be described. Some of the single agents used in ex-vivo CM are included in the SNOMED-RT and others not (DICOM CID 8112). In some protocols of stains in ex-vivo CM a combinations of single agent stains are involved. Combination of stains is also worked in pathology frequently. Finally, no specific immunostainings are codified in the list of the table for CID 8112. I elaborated a list of these stains that appear in the literature for ex-vivo CM. However, I guess that most of them evolved or just reproduce the method described in the lab of pathology. If these immunostainings are considered for DICOM I don't know. Single agent stain 1. Aluminium chloride 2. Acetic acid 3. Citric acid 4. Methylene blue 5. Toluidine blue 6. Fluorescein (seen in SNOMED-RT as " fluorescent stain") 7. Nile blue or Patent Blue V 8. Orange acridine Combination of stainings (protocols described in the literature- I suggest to work here with individual codification of multiple single agents) 9. Methylene blue + toluidine blue 10. Fluorescence proflavine + acetic acid + toluidine blue 11. Acetic acid + acridine orange Immunostaining (in SNOMED-RT not specified) 1. FITC, fluorescein isothiocyanate -labelled S-100A10, melan-A and anti-Ber-EP4 antibodies 2. NPs10@D1_ICF_Alexa647_DOTAGA Fe3+ 3. Fluorescent-labelled IgG and C3 antibodies 4. IgG, IgM, IgA, C3 and fibrinogen
18	Should correlated reflectance and fluorescent be reference each other using referenced image sequence? Frame of reference? Use frame of reference NOT SOP Instance because the SOP Instance is not known at time of acquisition.
19	Is an ex-vivo confocal microscopy acquisition context required? The Skin Cancer Acquisition Context may be used. However, specimen preparation including staining use TID 8001 Specimen Preparation which is invoked from Specimen Preparation Step Content Item Sequence in the Specimen Module should.

20	Confocal Microscopy is correlated to a macroscopic/dermoscopic image in the X,Y plane. Is this link referenced only the image? Or An X,Y co-ordinate? Linked to an X,Y co-ordinate in an image. Or a "rectangle" overlay on the macroscopic/dermoscopic image? Currently vendor Takes X,Y co-ordinate and then "builds" the rectangle representing the staged area based on FOV. Can we add X, Y co-ordinates to Reference Image Sequence? No XY co-ordinates should be encoded as a 3D Frame of reference used to correlate spatial information (e.g. X,Y co-ordinate with potentially Z as 0). The top left-hand pixel of the confocal image needs to identify the correlated co-ordinates on the macroscopic image. If it is a true 3D frame of reference with different depths for z-stack or mosaic stack.
21	Integers or floating numbers? Optical Section Thickness FD Field of View Dimensions FD Laser Wavelength INT Laser Power FD Z-depth FD Distance between images FD
22	A single FOV on the device is square. But if we encode a Mosaic, which can be rectangular and comprises many stitched FOVs, does "Field of View" refer the image (the whole mosaic) or just the FOV of the objective lens? Redundant if using pixel spacing
23	Mosaic images will use a pyramid encoding (similar to WSI). How is this represented in Supplement? **Replace mosaic with tiled pyramid **Add to Informative Context
24	Image Plane Module is used to contain correlation information between the macroscopic and confocal image. What is encoded in Image Orientation (Patient) (0020,0037) The direction cosines of the first row and the first column with respect to the patient? **Orientation is fixed, use existing volume co-ordinate system used US x,y are arbitrary with no reference to any real world orientation
25	
26	

Notes
Use hyphenation of IN-VIVO and EX-VIVO for consistency with existing DICOM parts
1 IOD to n SOP classes or n IODs to n SOP classes
Shall or may; shall not be

Commented [LC4]: Slice Thickness also exists??

Commented [LC5]: Remove before public comment

Table of Contents

Scope and Field of Application 9
Changes to NEMA Standards Publication PS 3.2 10
Part 2: Conformance 10
Part 3: Information Object Definitions 11
A.X Confocal Microscopy Image Information Object Definitions 13
A.X.1 Confocal Microscopy Image IOD 13
A.X.1.1 Confocal Microscopy Image IOD Description 13
A.X.1.2 Confocal Microscopy Image IOD Description Entity-Relationship Model 14
A.X.1.3 Confocal Microscopy Image IOD Module Table 14
A.X.2 Confocal Microscopy Tiled Pyramidal Image IOD 14
A.X.2.1 Confocal Microscopy Tiled Pyramidal Image IOD Description 14
A.X.2.2 Confocal Microscopy Tiled Pyramidal Image IOD Description Entity-Relationship Model 15
A.X.2.3 Confocal Microscopy Image IOD Module Table 15
A.X.3 Confocal Microscopy Multi-Frame Image IOD 16
A.X.3.1 Confocal Microscopy Multi-Frame Image IOD Description 16
A.X.3.2 Confocal Microscopy Multi-Frame Image IOD Description Entity-Relationship Model 16
A.X.3.3 Confocal Microscopy Multi-Frame Image IOD Module Table 16
A.X.4 Confocal Microscopy Image Information Object Definitions Content Constraints 17
A.X.4.1 Modality 17
A.X.4.2 Frame of Reference Module 17
A.X.4.3 Acquisition Context Module 17
A.X.4.4 ICC Profile Module 17
A.X.4.4 Image Plane Module 17
A.X.5 Confocal Microscopy Image Functional Group Macros 17
C.7.3.1.1 General Series Attribute Descriptions 18
C.7.3.1.1.1 Modality 18
C.8.XX Confocal Microscopy Image Modules 18
C.8.XX.1 Confocal Microscopy Image Module 18
C.8.XX.1.1 Confocal Microscopy Image Attribute Descriptions 22
C.8.XX.1.1.1 Image Type 22
C.8.XX.1.1.2 Referenced Image Sequence 22
C.8.XX.2 Confocal Microscopy Tiled Pyramidal Image Parameters Module 22
Part 4: Service Class Specifications 24
B.5 Standard SOP Classes 24
Part 6: Data Dictionary 25

Part 16 Content Mapping Resource 26
Annex B DCMR Context Groups (Normative) 26
CID BBBB Topical Substances 26
CID CCCC Lesion Color 26
CID DDDD Specimen Stains for Confocal Microscopy 27
CID 4405 ~~History of Non-Melanoma Skin Cancer~~ Skin Disorders 28
CID 4406 Patient Reported Lesion Characteristics 28
CID 4407 Lesion Palpation Findings 29
CID 4409 Skin Procedures 29
TID 8003 Specimen Staining 29
Annex D DICOM Controlled Terminology Definitions (Normative) 31
Part 17: Explanatory Information 32
Annex XXXX Confocal Microscopy (Informative) 32
XXXX.1 Confocal microscopy raw data 32
XXXX.2 Pre-rendered psuedo color images 32
XXXX.3 Correlation of macroscopic and confocal images 32
XXXX.4 Specimen Preparation 33
XXXX.6 Series Organization 34
XXXX.7 Encoding of Confocal Microscopsy Tiled Pyramidal Images 34

Scope and Field of Application

This Supplement to the DICOM Standard introduces three new IODs (Confocal Microscopy Image IOD, Confocal Microscopy Tiled Pyramidal Image IOD, Confocal Microscopy Multi-Frame IOD) and three corresponding SOP Classes for encoding and storing confocal microscopy images.

Confocal microscopy is a non-invasive imaging technique that allows examination of the skin at resolutions comparable to histology without performing biopsy. Confocal microscopy may be done on in-vivo or ex-vivo tissue.

In-vivo reflectance confocal microscopy (RCM) is used for the early diagnosis of a range of cutaneous diseases with an emphasis on melanoma and pigmented lesions. In-vivo RCM is most often used as an adjunct to clinical and dermoscopic imaging of skin lesion as opposed to a stand-alone imaging technique. In addition to diagnostic applications, in-vivo RCM may be used for the pre-operative mapping of margins of ill-defined tumors, which allows more accurate surgical plan and reduces surgical morbidity.

The confocal microscope uses a diode laser as a source of monochromatic and coherent light and scanning and focusing optical lens to penetrate the skin and illuminate a small tissue spot. Reflected light forms an image on a photodetector.

Ex-vivo confocal microscopy allows the microscopic examination of freshly excised tissue. The ex-vivo confocal microscopy can work in reflectance mode or fluorescence mode. When using the fluorescence mode, the entire surgical specimen is dipped in a solution of a fluorescent agent and subsequently rinsed to remove excess of fluorescent agent. In reflectance mode no staining is required.

A confocal microscope imaging study consists of different capture modes outlined in Figure 1. A confocal microscopy imaging study always images a single lesion.

Commented [LC6]: Increase font size
Add IODs

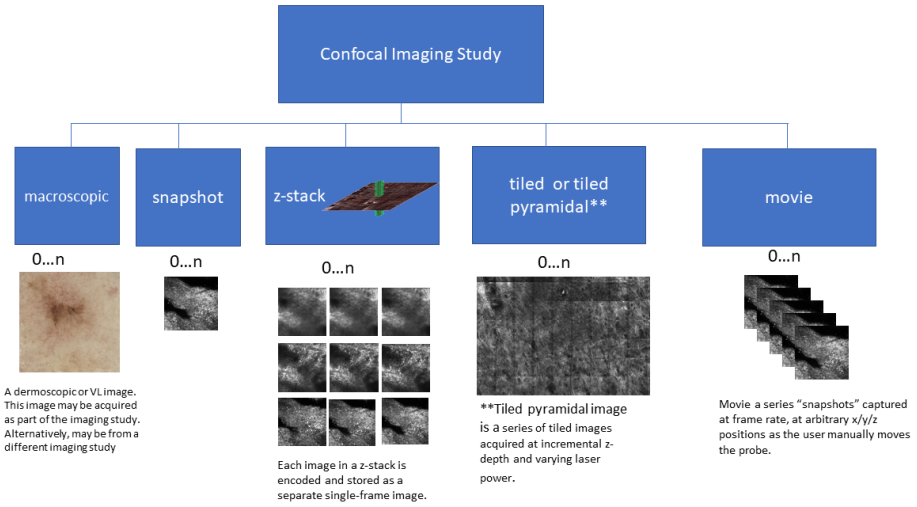

Figure 1 Capture modes for a confocal microscopy imaging study.

Changes to NEMA Standards Publication PS 3.2

Digital Imaging and Communications in Medicine (DICOM)

Part 2: Conformance

Item: Add to table A.1-2 categorizing SOP Classes:

The SOP Classes are categorized as follows:

Table A.1-2
UID VALUES

UID Value	UID NAME	Category
…	…	…
1.2.840.10008.x.x.x	**Confocal Microscopy Image Storage**	**Transfer**
1.2.840.10008.y.y.y	**Confocal Microscopy Tiled Pyramidal Image Storage**	**Transfer**
1.2.840.10008.z.z.z	**Confocal Microscopy Multi-Frame Image Storage**	**Transfer**
…	…	…

Changes to NEMA Standards Publication PS 3.3

Digital Imaging and Communications in Medicine (DICOM)

Part 3: Information Object Definitions

Modify PS3.3

Add [list IODs] to Table A.1-1c

A.1.4 Overview of the Composite IOD Module Content

Table A.1-1c. Composite Information Object Modules Overview - More Images

Commented [LC7]: Needs updating

Commented [LC8R7]: Get rid of this table

IODs **Modules**	**VL PH**	**DMS PH**
Patient	M	**M**
Clinical Trial Subject	U	**U**
General Study	M	**M**
Patient Study	U	**U**
Clinical Trial Study	U	**U**
General Series	M	**M**
Clinical Trial Series	U	**U**
Segmentation Series		
Whole Slide Microscopy Series		
Intravascular OCT Series		
Frame of Reference		**U**
Synchronization		
Cardiac Synchronization		

General Equipment	M	**M**
Enhanced General Equipment		**M**
VL Photographic Equipment	**U**	**U**
General Image	M	**M**
General Reference	**U**	**U**
Image Pixel	M	**M**
Supplemental Palette Color Lookup Table		
Enhanced Contrast/Bolus		
Cine		
Multi-frame		
Multi-frame Functional Groups		
Multi-frame Dimension		
Device	U	**U**
Specimen	C	**C**
VL Image	M	**M**
VL Photographic Acquisition	**U**	**U**
Slide Coordinates		
Whole Slide Microscopy Image		
Optical Path		
Multi-Resolution Navigation		
Slide Label		
Dermoscopic Image		**U**

Intravascular OCT Image		45
Intravascular OCT Acquisition Parameters		
Intravascular OCT Processing Parameters		
Intravascular Image Acquisition Parameters		
Segmentation Image		
Overlay Plane	U	
Common Instance Reference	U	**U**
Acquisition Context	M	**M**
ICC Profile	U	**U**
SOP Common	M	**M**
Frame Extraction		

A.X Confocal Microscopy Image Information Object Definitions

The Confocal Microscopy Image Information Object Definitions specify images that are acquired by means of a confocal microscope. The confocal microscopy may be performed in-vivo or ex-vivo imaging in reflectance or fluorescence mode.

Confocal images may be tiled or simple (non-tiled). Simple confocal images may be encoded as single-frame image. Tiled images may use pyramidal encoding. A single pyramidal SOP Instance may contain a single tile image (single frame), or a single SOP Instance may contain multi-resolution, multi-focal depth acquisition (multiple frames). A simple movie acquisition may be encoded as multi-frame cine image.

Separate IODs have been defined for single-frame, tiled or tiled pyramidal images, and multi-frame images confocal microscopy images.

A.X.1 Confocal Microscopy Image IOD

A.X.1.1 Confocal Microscopy Image IOD Description

The Confocal Microscopy Photography Image IOD specifies the Attributes of Single-frame Confocal Microscopy Images.

A.X.1.2 Confocal Microscopy Image IOD Description Entity-Relationship Model

The Confocal Microscopy Photography Image IOD uses the DICOM Composite Instance IOD Entity-Relationship Information Model defined in Section A.1.2, with only the Image IE below the Series IE.

A.X.1.3 Confocal Microscopy Image IOD Module Table

Table A.X.1.3-1 specifies the Modules of the Confocal Microscopy Image IOD.

Table A.X.1.3-1

CONFOCAL MICROSCOPY IMAGE IOD MODULES

IE	Module	Reference	Usage
Patient	Patient	C.7.1.1	M
	Clinical Trial Subject	C.7.1.3	U
	Specimen	C.7.6.22	C-Required if the Imaging Subject is a Specimen
Study	General Study	C.7.2.1	M
	Patient Study	C.7.2.2	U
	Clinical Trial Study	C.7.2.3	U
Series	General Series	C.7.3.1	M
	Clinical Trial Series	C.7.3.2	U
Frame of Reference	Frame of Reference	C.7.4.1	U
Equipment	General Equipment	C.7.5.1	M
	Enhanced General Equipment	C.7.5.2	M
Image	General Image	C.7.6.1	M
	General Reference	C.12.4	U
	Image Plane	C.7.6.2	U
	Image Pixel	C.7.6.3	M
	Acquisition Context	C.7.6.14	M
	Confocal Microscopy Image	C.X.X.X	M
	Optical Path	C.8.12.5	M
	ICC Profile	C.11.15	U
	SOP Common	C.12.1	M
	Common Instance Reference	C.12.2	U

Commented [LC9]: Consider including Acquisition Context IE (See CP 2135)

Commented [LC10]:

Commented [LC11]: Check?

A.X.2 Confocal Microscopy Tiled Pyramidal Image IOD

Commented [LC12]:

A.X.2.1 Confocal Microscopy Tiled Pyramidal Image IOD Description

The Confocal Microscopy Tiled Pyramidal Image IOD specifies the Attributes of Tiled Pyramidal Confocal Microscopy Images.

A.X.2.2 Confocal Microscopy Tiled Pyramidal Image IOD Description Entity-Relationship Model

The Confocal Microscopy Tiled Pyramidal Image IOD uses the DICOM Composite Instance IOD Entity-Relationship Information Model defined in Section A.1.2, with only the Image IE below the Series IE.

A.X.2.3 Confocal Microscopy Tiled Pyramidal Image IOD Module Table

Table A.X.2.3-1 specifies the Modules of the Confocal Microscopy Tiled Pyramidal Image IOD.

Table A.X.2.3-1

CONFOCAL MICROSCOPY TILED PYRAMIDAL IMAGE IOD MODULES

IE	Module	Reference	Usage
Patient	Patient	C.7.1.1	M
	Clinical Trial Subject	C.7.1.3	U
	Specimen	C.7.6.22	C-Required if the Imaging Subject is a Specimen
Study	General Study	C.7.2.1	M
	Patient Study	C.7.2.2	U
	Clinical Trial Study	C.7.2.3	U
Series	General Series	C.7.3.1	M
	Clinical Trial Series	C.7.3.2	U
Frame of Reference	Frame of Reference	C.7.4.1	U
Equipment	General Equipment	C.7.5.1	M
	Enhanced General Equipment	C.7.5.2	M
Image	General Image	C.7.6.1	M
	General Reference	C.12.4	U
	Image Plane	C.7.6.2	U
	Image Pixel	C.7.6.3	M
	Multi-frame Functional Groups	C.7.6.16	M
	Multi-frame Dimension	C.7.6.17	M
	Acquisition Context	C.7.6.14	M
	Confocal Microscopy Image	C.X.X.X	M
	Confocal Microscopy Tiled Pyramidal Image Parameters	C.Y.Y.Y	M
	Optical Path	C.8.12.5	M
	ICC Profile	C.11.15	U
	SOP Common	C.12.1	M

Commented [LC13]: Acquisition Context IE

Commented [LC14]: Check closest related IOD e.g. WSI or endoscopic video for MF and pattern modules on these. ? Is ICC profile redundant if Optical Path is present?

Commented [LC15]: Remove? Check with David

	Common Instance Reference	C.12.2	U

A.X.3 Confocal Microscopy Multi-Frame Image IOD

A.X.3.1 Confocal Microscopy Multi-Frame Image IOD Description

The Confocal Microscopy Multi-Frame Image IOD specifies the Attributes of s simple movie acquisitions that are encoded as multi-frame cine image

A.X.3.2 Confocal Microscopy Multi-Frame Image IOD Description Entity-Relationship Model

The Confocal Microscopy Multi-Frame Image IOD uses the DICOM Composite Instance IOD Entity-Relationship Information Model defined in Section A.1.2, with only the Image IE below the Series IE.

A.X.3.3 Confocal Microscopy Multi-Frame Image IOD Module Table

Table A.X.3.3-1 specifies the Modules of the Confocal Microscopy Multi-Frame Image IOD.

Table A.X.3.3-1

CONFOCAL MICROSCOPY MULTI-FRAME IMAGE IOD MODULES

IE	Module	Reference	Usage
Patient	Patient	C.7.1.1	M
	Clinical Trial Subject	C.7.1.3	U
	Specimen	C.7.6.22	C-Required if the Imaging Subject is a Specimen
Study	General Study	C.7.2.1	M
	Patient Study	C.7.2.2	U
	Clinical Trial Study	C.7.2.3	U
Series	General Series	C.7.3.1	M
	Clinical Trial Series	C.7.3.2	U
Frame of Reference	Frame of Reference	C.7.4.1	U
Equipment	General Equipment	C.7.5.1	M
	Enhanced General Equipment	C.7.5.2	M
Image	General Image	C.7.6.1	M
	General Reference	C.12.4	U
	Image Plane	C.7.6.2	U
	Image Pixel	C.7.6.3	M
	Cine	C.7.6.5	M
	Multi-frame	C.7.6.6	M
	Acquisition Context	C.7.6.14	M
	Confocal Microscopy Image	C.X.X.X	M
	Optical Path	C.8.12.5	M

Commented [LC16]: AC IE

	ICC Profile	C.11.15	U
	SOP Common	C.12.1	M
	Common Instance Reference	C.12.2	U

Commented [LC17]: ?ICC Profile redundant if you have Optical Path Module

A.X.3.1 Confocal Microscopy Image Information Object Definitions Content Constraints

Commented [LC18]: Replicate in each IOD
Check Level of heading in existing standard

A.X.3.1.1 Modality

The value of Modality (0008,0060) shall be CFM.

A.X.4.2 Frame of Reference Module

Commented [LC19]: Check numbering

The frame of reference module may be used if multiple successive images are acquired during a single acquisition. All images in a Series share the same Frame of Reference UID are spatially related to each other. The same frame of reference identifier may be used for all images in a z-stack. The same frame of reference identifier may be used for ex-vivo imaging in reflectance and fluorescent mode.

Commented [LC20]: Move to PS3.17

A.X.4.3 Acquisition Context Module

For Acquisition Context Sequence (0040,0555) the Defined TID is TID 8300 “Skin Imaging Acquisition Context” which encodes information related to Skin Imaging.

A.X.4.4 ICC Profile Module

Commented [LC21]: ?Delete this section if

The ICC Profile Module may be present for color images. If the color space to be used is not calibrated (i.e., a device-specific ICC Input Profile is not available), then an ICC Input Profile specifying a well-known space (such as sRGB) may be specified. The ICC Profile Module shall not be present for tiled pyramidal images.

Commented [LC22]: Goes into the Tiled Pyramidal Only

A.X.4.4 Image Plane Module

The image plane module may be present to encode the spatial correlation between a macroscopic image (used as a localizer) and a confocal microscopy image.

Commented [LC23]: Move to P3.17

A.X.5 Confocal Microscopy Image Functional Group Macros

Commented [LC24]: Add to Tiled Pyramidal IOD only See A.36 Multi-Frame MR A.32.8.4 WSI

Table A.X.5-1 Confocal Microscopy Image Functional Group Macros

Functional Group Macro	Section	Usage
Pixel Measures	C.7.6.16.2.1	M
Optical Path Identification	C.8.12.6.2	C - Required if Dimension Organization Type (0020,9311) is not TILED_FULL; may be present otherwise.

Add to PS3.3 C.7.3.1.1.1 Modality

C.7.3.1.1 General Series Attribute Descriptions

C.7.3.1.1.1 Modality

Defined Terms:

…

CFM Confocal Microscopy

…

Add the following new subsection in PS3.3 C.8 Modality Specific Modules

C.8.XX Confocal Microscopy Image Modules

C.8.XX.1 Confocal Microscopy Image Module

Table C.8.XX.1-1 specifies the Attributes that describe confocal microscopy images.

Table C.8.XX.1-1. Confocal Microscopy Image Module Attributes

Attribute Name	Tag	Type	Attribute Description
Image Type	(0008,0008)	1	Image identification characteristics. See Section C.8.12.1.1.6 for specialization.
Photometric Interpretation	(0028,0004)	1	Specifies the intended interpretation of the pixel data. See Section C.8.12.1.1.1 for specialization of this Attribute.
~~Number of Frames~~	~~(0028,0008)~~	~~1~~	~~Number of frames in a Multi-frame Image. See Section C.7.6.6.1.1 for further explanation.~~
Bits Allocated	(0028,0100)	1	Number of bits allocated for each pixel sample. Each sample shall have the same number of bits allocated. See Section C.8.12.1.1.2 for specialization of this Attribute. See PS3.5 for further explanation.
Bits Stored	(0028,0101)	1	Number of bits stored for each pixel sample. Each sample shall have the same number of bits stored. See Section C.8.12.1.1.2 for specialization of this Attribute. See PS3.5 for further explanation.
High Bit	(0028,0102)	1	Most significant bit for pixel sample data. Each sample shall have the same high bit. See Section C.8.12.1.1.2 for specialization of this Attribute. See PS3.5 for further explanation.
Pixel Representation	(0028,0103)	1	Data representation of the pixel samples. Each sample shall have the same pixel representation. See Section C.8.12.1.1.3 for specialization of this Attribute.
Samples per Pixel	(0028,0002)	1	Number of samples (planes) per image. See Section C.8.12.1.1.4 for specialization of this Attribute.

Commented [LC26R25]: Remove

Commented [LC25]: Type 1 Multi-frame Functional Group Module

Pixel Spacing	(0028,0030)	1	Physical distance in the patient between the center of each pixel, specified by a numeric pair - adjacent row spacing (delimiter) adjacent column spacing in mm. See Section 10.7.1.3 for further explanation.
Planar Configuration	(0028,0006)	1C	Indicates whether the pixel data are encoded color-by-plane or color-by-pixel. Required if Samples per Pixel (0028,0002) has a value greater than 1. See Section C.8.12.1.1.5 for specialization of this Attribute.
Lossy Image Compression	(0028,2110)	2	Specifies whether an Image has undergone lossy compression (at a point in its lifetime). Enumerated Values: 00 Image has NOT been subjected to lossy compression. 01 Image has been subjected to lossy compression. Once this value has been set to 01 it shall not be reset. See Section C.7.6.1.1.5
Referenced Image Sequence	(0008,1140)	1C	A Sequence that references other images significantly related to this image. One or more Items are permitted in this Sequence.
>Include Table 10-3 "Image SOP Instance Reference Macro Attributes"			
>Purpose of Reference Code Sequence	(0040,A170)	1C	Describes the purpose for which the reference is made. Zero or one Item shall be included in this Sequence.
>>Include Table 8.8-1 "Code Sequence Macro Attributes"			*DCID 7201 "Referenced Image Purposes of Reference".*
Window Center	(0028,1050)	1C	Window Center for display. See Section C.11.2.1.2 for further explanation. Meaningful only if Photometric Interpretation (0028,0004) is MONOCHROME2.
Window Width	(0028,1051)	1C	Window Width for display. See Section C.11.2.1.2 for further explanation. Required if Window Center (0028,1050) is present.

Image Laterality	(0020,0062)	3	Laterality of (possibly paired) body part (as described in Anatomic Region Sequence (0008,2218)) examined. Enumerated Values: R right L left U unpaired B both left and right Shall be consistent with any laterality information contained in Primary Anatomic Structure Modifier Sequence (0008,2230), Anatomic Region Modifier Sequence (0008,2220), and/or Laterality (0020,0060), if present. Note 1. Laterality (0020,0060) is a Series level Attribute and must be the same for all Images in the Series, hence it must be absent if Image Laterality (0020,0062) has different values for Images in the same Series. 2. There is no value for median, for which Primary Anatomic Structure Modifier Sequence (0008,2230) or Anatomic Region Modifier Sequence (0008,2220) may be used instead.
Anatomic Region Sequence	(0008,2218)	1C	Sequence that identifies the anatomic region of interest in this image (i.e., external anatomy, surface anatomy, or general region of the body). Only a single Item shall be included in this Sequence. Required if Number of Frames (0028,0008) is present and Specimen Description Sequence (0040,0560) is absent. May be present otherwise.
>Include Table 8.8-1 "Code Sequence Macro Attributes"			*DCID 4040 "Endoscopy Anatomic Regions" is defined for the Video Endoscopic IOD.* *BCID 4029 "Dermatology Anatomic Sites" is defined for the VL Photographic Image IOD**, **Dermoscopic Photography Image IOD, and Confocal Microscopy Image IODs** for dermatology applications.* *BCID is CID 4031 "Common Anatomic Regions" for humans and CID 7483 "Common Anatomic Regions for Animals" for animals.*
>Anatomic Region Modifier Sequence	(0008,2220)	3	Sequence of Items that modifies the anatomic region of interest of this image One or more Items are permitted in this Sequence.

>>Include Table 8.8-1 "Code Sequence Macro Attributes"			*BCID 2 "Anatomic Modifier".* *BCID 245 "Laterality with Median" is defined for the VL Photographic Image IOD, Dermoscopic Photography Image IOD,* ***and Confocal Microscopy Image IODs*** *for dermatology applications*
Include Table 10-8 "Primary Anatomic Structure Macro Attributes"			*No CID is defined. These Type 3 Attributes are not appropriate when Specimen Description Sequence (0040,0560) is present, as it includes the Primary Anatomic Structure Macro for each specimen in the image.*
Optical Magnification Factor	(0016,1005)	2	Optical magnification factor when the image was acquired. Optical magnification is achieved using the optics of the dermoscope **or microscope**. The number indicates the magnification factor in times (X). The size of an object (e.g., a skin lesion) would appear on the sensor n times larger than the object when imaged with a dermoscope **or microscope** using n X optical magnification.
Slice Thickness	(0018,0050)	2	Nominal slice thickness, in mm.
Confocal Mode	(aaaa,aaaa)	1	Whether the images were acquired by the confocal microscope in reflectance or fluorescence mode. Enumerated Values REFLECTANCE FLUORESCENCE
Tissue Location	(bbbb,bbbb)	1	Whether the tissue that is the subject of the image is in the body (i.e., in-vivo) or an excised tissue sample (i.e., ex-vivo). Enumerated Values INVIVO EXVIVO
Laser Wavelength	(dddd,dddd)	1	The wavelength of the imaging laser in nanometers (nm).
Laser Power	(eeee,eeee)	1	The heat output of the imaging laser beam measured in milliwatts (mW).
Depth From Skin Surface	(ffff,ffff)	2	The depth of the image acquisition from the skin surface in millimeters (mm).
Spacing Between Slices	(0018,0088)	2	The spacing between z-stack images in millimeters (mm).

Commented [LC27]: Look for existing illumination attributes in the Optical Path Module may be able to reuse existing attributes

Commented [LC28]: Bbbb group name
All other of CM specific attributes aaaa

Commented [LC29]: Also check to reuse (check Optical Path module)

Commented [LC30]: ? Depth from Tissue Surface - corresponding to Stratum Corneum- first cellular layer

Add diagram for raised lesion and sub-dermal lesion. Add diagram below Table Confocal Microscopy Image Module Attributes

Tracking ID	(0062,0020)	1C	A text label used for tracking a finding or feature, potentially across multiple reporting objects, over time. This label shall be unique within the domain in which it is used. Required if Tracking UID (0062,0021) is present. Note: This Attribute allows linkage to Content Items in SR instances with observation context (112039, DCM, "Tracking Identifier") having the same value.
Tracking UID	(0062,0021)	1C	A unique identifier used for tracking a finding or feature, potentially across multiple reporting objects, over time. Required if Tracking ID (0062,0020) is present. Note: This Attribute allows linkage to Content Items in SR instances with observation context (112040, DCM, "Tracking Unique Identifier") having the same value.

C.8.XX.1.1 Confocal Microscopy Image Attribute Descriptions

C.8.XX.1.1.1 Image Type

Commented [LC31]: Add at this level the diagram for raised skin lesion / subdermal skin lesion Figure

Image Type (0008,0008) is specified to be Type 1 with the following constraints:

Value 1 shall have a value of ORIGINAL or DERIVED

Value 2 shall have a value of PRIMARY

Value 3 shall have a value of VOLUME

Value 4 (Derived pixel) shall have the Defined Terms specified in Table C.8.XX.1.1.1-1

Table C.8.XX.1.1.1-1

CONFOCAL MICROSCOPY DERIVED PIXELS

NONE	No derivation of pixels (original)
RESAMPLED	Pixels were derived by down sampling a higher resolution image

C.8.XX.1.1.2 Referenced Image Sequence

In in-vivo confocal microscopy the Referenced Image Sequence (0008,1140) may be used to identify the SOP instance of a Dermoscopic or Visible Light image correlated to the Confocal Microscopy acquisition. The Purpose of Reference Code Sequence (0040,A170) shall have the value (121311, DCM, Localizer).

C.8.XX.2 Confocal Microscopy Tiled Pyramidal Image Module

Table C.8.XX.2-1 specifies the Attributes that describe confocal microscopy tiled pyramidal image parameters.

Table C.8.XX.2-1. Confocal Microscopy Tiled Pyramidal Image Attributes

Attribute Name	Tag	Type	Attribute Description
Image Orientation (Slide)	(0048, 0102)	1	The direction cosines of the first row and the first column of the total pixel matrix with respect to the Slide Coordinate System Frame of Reference. See Section C.8.12.4.1.4
Imaged Volume Width	(0048,0001)	1	Width of total imaged volume (distance in the direction of rows in each frame) in mm.
Imaged Volume Height	(0048,0002)	1	Height of total imaged volume (distance in the direction of columns in each frame) in mm.
Imaged Volume Depth	(0048,0003)	1	Depth of total imaged volume (distance in the Z direction of focal planes) in µm.
Total Pixel Matrix Columns	(0048,0006)	1	Total number of columns in pixel matrix; i.e., width of total imaged volume in pixels.
Total Pixel Matrix Rows	(0048,0007)	1	Total number of rows in pixel matrix; i.e., height of total imaged volume in pixels.
Total Pixel Matrix Focal Planes	(0048,0303)	1C	Total number of focal planes (Z locations) in the pixel matrix; i.e., depth of total imaged volume in pixels. See Section C.8.12.4.1.3 Required if Dimension Organization Type (0020,9311) is present with a value of TILED_FULL. May be present otherwise.
Volumetric Properties	(0008,9206)	1	Indication if geometric manipulations are possible with frames in the SOP Instance. See C.8.16.2.1.2. Enumerated Value: VOLUME - pixels represent the volume specified for the image, and may be geometrically manipulated

Commented [LC32]: Double with David. Check if um or mm

Use mm for everything. When in doubt use mm. Check rest of supplement.

Commented [LC33]: Check that Z is capital for consistency with rest of standard

171 **Digital Imaging and Communications in Medicine (DICOM)**

172 **Part 4: Service Class Specifications**

173

174 *Add to PS3.4 Annex B.5.*

175 ## B.5 Standard SOP Classes

176 **Table B.5-1**
177 **STANDARD SOP CLASSES**

SOP Class Name	SOP Class UID	IOD (See PS 3.3)
Confocal Microscopy Image Storage	1.2.840.10008.X.X.X	Confocal Microscopy Image IOD
Confocal Microscopy Tiled Pyramidal Image Storage	1.2.840.10008.Y.Y.Y	Confocal Microscopy Tiled Pyramidal Image IOD
Confocal Microscopy Multi-Frame Image Storage	1.2.840.10008.Z.Z.Z	Confocal Microscopy Multi-Frame Image IOD

178

179

180

181

182

Digital Imaging and Communications in Medicine (DICOM)

Part 6: Data Dictionary

Add to PS3.6 Annex A

UID Value	UID NAME	UID TYPE	Part
1.2.840.10008.X.X.X	Confocal Microscopy Image Storage	SOP Class	PS 3.4
1.2.840.10008.Y.Y.Y	Confocal Microscopy Tiled Pyramidal Image Storage	SOP Class	PS 3.4
1.2.840.10008.Z.Z.Z	Confocal Microscopy Multi-Frame Image Storage	SOP Class	PS 3.4

Add to PS3.6 the following Context Group UIDs:

Context UID	Context Identifier	Context Group Name	Comment
…			
1.2.840.10008.B.B.B	CID BBBB	Topical Substances	
1.2.840.10008.C.C.C	CID CCCC	Lesion Color	
1.2.840.10008.D.D.D	CID DDDD	Specimen Stains for Confocal Microscopy	

Add to PS3.6 the following Data Elements to Section 6, Registry of DICOM data elements:

Tag	Name	Keyword	VR	VM
(aaaa,aaaa)	Confocal Mode	ConfocalMode	CS	1
(bbbb,bbbb)	Tissue Location	TissueLocation	CS	1
(cccc,cccc)	Optical Section Thickness	OpticalSectionThickness	FD	1
(dddd,dddd)	Laser Wavelength	LaserWavelength	US	1
(eeee,eeee)	Laser Power	LaserPower	FD	1
(ffff,ffff)	Depth From Skin Surface	DepthFromSkinSurface	FD	1
(gggg,gggg)	Distance between images	DistanceBetweenImages	FD	1

Commented [LC34]: Check if we have used in Optical Path attributes making new attributes redundant.

Commented [LC35]: Check Naming

Changes to NEMA Standards Publication PS 3.16

Digital Imaging and Communications in Medicine (DICOM)

Part 16 Content Mapping Resource

Add to PS3.16 Annex B

Annex B DCMR Context Groups (Normative)

CID BBBB Topical Treatments

Resources: HTML| FHIR JSON|FHIR XML|IHE SVS XML

Type: Extensible
Version: 2022XXXX
UID: 1.2.840.10008.B.B.B

Table CID BBBB Topical Treatments

Coding Scheme Designator	Code Value	Code Meaning	SNOMED-RT ID	UMLS Concept Unique ID
SCT	372558009	Immunomodulators		C1527392
SCT	373219008	Antifungals		C0003308
SCT	255631004	Antibiotic		C0003232
SCT	116566001	Steroid		C0038317
SCT	373526007	Cytotoxic agent		C0304497
SCT	280906005	Keratolytic agent		C0022585
SCT	372681003	Hemostatic agent		C0019120
SCT	387305002	Tretinoin		C0040845
SCT	43706004	Ascorbic acid		C0003968
SCT	273944007	Aluminum hydroxide		C0002371

Commented [LC36]: Changed to treatments – Check rest of supplement

CID CCCC Lesion Color

Resources: HTML| FHIR JSON|FHIR XML|IHE SVS XML
Type: Extensible
Version: 2022XXXX
UID: 1.2.840.10008.C.C.C

Table CID CCCC Lesion Color

Coding Scheme Designator	Code Value	Code Meaning	SNOMED-RT ID	UMLS Concept Unique ID
SCT	371240000	Red		C1260956
SCT	371242008	Orange		C1313858
SCT	371243003	Pink		C0332585
SCT	371244009	Yellow		C0221205
SCT	371250004	Purple		C0439542
SCT	371251000	White		C0220938
SCT	371252007	Black		C0439541
SCT	371253002	Gray		C1269776

SCT	371254008	Brown		C0678579
SCT	405738005	Blue		C1260957

CID DDDD Specimen Stains for Confocal Microscopy

Resources: HTML| FHIR JSON|FHIR XML|IHE SVS XML
Type: Extensible
Version: 2022XXXX
UID: 1.2.840.10008.D.D.D

Table CID DDDD. Specimen Stains for Confocal Microscopy

Coding Scheme Designator	Code Value	Code Meaning	SNOMED-RT ID	UMLS Concept Unique ID
SCT	387372003	aluminum chloride		C0102840
SCT	85596006	fluorescein stain		C0060520
SCT	255800009	immunofluorescent stain	C-22817	C0183489
SCT	7539900	citric acid		C0055819
SCT	9010006	methyl blue stain	C-22907	C0303897
SCT	29522004	toluidine blue stain	C-22951	C0040380
SCT	77073008	nile blue stain	C-22941	C0068765
SCT	48540004	patent blue V sodium salt stain	C-22885	C0116465
SCT	29252006	acridine orange stain	C-22A08	C0001185
SCT	2869004	Acetic acid	C-21624	C0000983

Modify tables in PS3.16 Annex B

CID 29 Acquisition Modality

Resources: HTML | FHIR JSON | FHIR XML | IHE SVS XML

Type: Extensible

Version: 20YYMMDD

UID: 1.2.840.10008.6.1.19

Table CID 29. Acquisition Modality

Coding Scheme Designator	Code Value	Code Meaning
…		
DCM	CFM	Confocal Microscopy

Commented [LC37]: New use of SCT code

Commented [LC38]: New use of SCT code

Commented [LC39]: New use of SCT code

Commented [LC40]: Change version to rest of document

CID 4405 ~~History of Non-Melanoma Skin Cancer~~ Skin Disorders

Resources: HTML| FHIR JSON|FHIR XML|IHE SVS XML
Type: Extensible
Version: 20201115
UID: 1.2.840.10008.6.1.1350

Commented [LC41]: Correction needed to DICOM standard

Table CID 4405 ~~History on Non-Melanoma Skin Cancer~~ Skin Disorders

Coding Scheme Designator	Code Value	Code Meaning	SNOMED-RT ID	UMLS Concept Unique ID
SCT	43982006	Solar degeneration	D0-40100	C0546380
SCT	254819008	Atypical mole syndrome	D0-F1017	C0013403
SCT	782823001	Telangiectasia, cutaneous, cancer syndrome, familial		C5190630
SCT	69408002	Gorlin syndrome	D4-01046	C0004779
SCT	722859001	PTEN hamartoma tumor syndrome		C1959582
SCT	721904001	Rombo syndrome		C1867147
SCT	**398909004**	**Rosacea**		**C0035854**
SCT	**43116000**	**Eczema**		**C0013595**
SCT	**9014002**	**Psoriasis**		**C0033860**
SCT	**200936003**	**Lupus erythematosus**		**C0409974**
SCT	**24079001**	**Atopic dermatitis**		**C0011615**
SCT	**201101007**	**Actinic keratosis**		**C0022602**

CID 4406 Patient Reported Lesion Characteristics

Resources: HTML| FHIR JSON|FHIR XML|IHE SVS XML
Type: Extensible
Version: 20201115
UID: 1.2.840.10008.6.1.1351

Table CID 4406 Patient Reported Lesion Characteristics

Coding Scheme Designator	Code Value	Code Meaning	SNOMED-RT ID	UMLS Concept Unique ID
SCT	418363000	Itching	F-A21A7	C0033774
SCT	247441003	Erythema	F-4410C	C4552417
SCT	162499001	Symptom has changed	R-20A12	C0436317
NCIt	**C94522**	**New lesion**		**C2986548**
SCT	**271767006**	**Peeling**		**C0237849**
SCT	**297968009**	**Bleeding skin**		**C0574741**
SCTG	**403598008**	**Painful skin**		**C2032737**

Note

The concept "Symptom has changed" is intended to indicate that a skin lesion has changed in size, color or shape.

CID 4407 Lesion Palpation Findings

Resources: HTML| FHIR JSON|FHIR XML|IHE SVS XML
Type: Extensible
Version: 20201115
UID: 1.2.840.10008.6.1.1352

Table CID 4407 Lesion Palpation Findings

Coding Scheme Designator	Code Value	Code Meaning	SNOMED-RT ID	UMLS Concept Unique ID
DCM	130485	Firm skin lesion		
DCM	130486	Raised skin lesion		C0748816
DCM	**EEEE**	**Mobile skin lesion**		**C2071496**

Commented [LC42]: Using NEWCODE1, NEWCID1, NEWTID1, NEWCODEN

Check rest of supplement

CID 4409 Skin Procedures

Resources: HTML| FHIR JSON|FHIR XML|IHE SVS XML
Type: Extensible
Version: 20201115
UID: 1.2.840.10008.6.1.1354

Table CID 4409 Skin Procedures

Coding Scheme Designator	Code Value	Code Meaning	SNOMED-RT ID	UMLS Concept Unique ID
SCT	302396003	Cryotherapy to skin lesion	P1-40C19	C0411410
SCT	240977001	Biopsy of skin	P1-031C8	C0150866
SCT	428604001	Photodynamic therapy of skin	P0-05E3D	C1998192
SCT	24977001	Topical chemotherapy for malignant neoplasm	P2-67017	C0199946
SCT	**440258006**	**Excision of skin**		**C0191322**
SCT	**445907001**	**Laser procedure on skin**		**C1955835**
SCT	**879916008**	**Radiofrequency ablation**		**C0850292**

Modify tables in PS3.16 Annex C

TID 8003 Specimen Staining

Commented [LC43]: Left justify all cells

Type: Extensible
Order: Significant
Root: No

Table TID 8003. Specimen Staining

	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
1	CODE	EV (121139, DCM, "Modality")	1	U		DCID 29 "Acquisition Modality"
~~1~~ 2	CODE	DT (424361007, SCT, "Using substance")	1-n	MC	IF Row ~~2~~3 not present	IF Row 1 = "CFM" DCID DDDD "Specimen Stains for Confocal Microscopy" ELSE DCID 8112 "Specimen Stains"
~~2~~ 3	TEXT	DT (424361007, SCT, "Using substance")	1	MC	IF Row ~~1~~2 not present	

TID 8300 Skin ~~Cancer~~ Imaging Acquisition Context

Commented [LC44]: Need to fix PS3.3 A.32.11.4.3

This Template provides defines an Acquisition Context Template for Skin **Imaging** ~~Cancer~~. The attributes in this template represent values known at the time of image acquisition. Hence, these values may subsequently change.

Type: **Extensible**
Order: **Non-Significant**
Root: **No**

Table TID 8300. Skin ~~Cancer~~ Imaging Acquisition Context

Row Number	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint
…						
17	CODE	DT (DDDD, DCM, "Skin lesion color")	1-n	U		DCID CCCC "Lesion Color"
18	CODE	DT (386439008, SCT, "Skin care topical treatments")	1-n	U		DCID BBBB "Topical treatments"

Content Item Descriptions

Row 18	Topical treatments used in the two weeks prior to imaging.

Add the following definitions to Part 16 Annex D DICOM Controlled Terminology Definitions (Normative) – Modify Table D-1

Annex D DICOM Controlled Terminology Definitions (Normative)

Table D-1. DICOM Controlled Terminology Definitions (Coding Scheme Designator "DCM" Coding Scheme Version "01")

Code Value	Code meaning	Definition	Notes
…			
CFM	**Confocal Microscopy**	**An acquisition device, process or method that performs imaging of the surface of the skin using a confocal microscope**	
DDDD	**Skin Lesion Color**	**The visual coloration of a skin lesion**	
EEEE	**Mobile Skin Lesion**	**A skin lesion that is mobile on palpation**	

Digital Imaging and Communications in Medicine (DICOM)
Part 17: Explanatory Information

Add to PS3.17 Annex XXXX

Annex XXXX Confocal Microscopy (Informative)

XXXX.1 Confocal microscopy raw data

Confocal Microscopy Tiled Pyramidal images are an amalgamation of image tiles, ribbons or strips. Individual tiles, ribbons or strips are not for display and may be encoded using the Raw Data IOD.

XXXX.2 Pre-rendered pseudo color images

An Ex-vivo Confocal Microscopy imaging examination may be acquired in both reflectance and fluorescent mode. The reflectance and fluorescent images are acquired simultaneously and are exactly spatially correlated. Both the reflectance and fluorescent images are encoded and stored as grey scale images. Speciality Confocal Microscopy image viewers display reflectance and fluorescent images using different color overlays and allow the user to toggle between reflectance and fluorescence images. A vendor may choose to also encode a duplicate of the reflectance and fluorescence images as RGB images to allow for non-specialty viewers to display the reflectance and fluorescent confocal microscopy images in a similar way to speciality viewers. The color images would be encoded as a Visible Light Image IOD or a Secondary Capture Image IOD, as they are designed only for non-specialty viewers e.g. EMRs

XXXX.3 Correlation of macroscopic and confocal images

In-Vivo confocal microscopy imaging acquisition method

An adhesive tissue window is attached to the patient's skin centered over the lesion. Initially, the macroscopic camera is clipped into the adhesive tissue window and a macroscopic image acquired. The macroscopic camera is then unclipped from the adhesive tissue window. The adhesive tissue window remains in place.

The confocal microscope is positioned, orientated, and clipped into the same adhesive tissue window, thus centering the two otherwise unrelated images which have different fields of view (FOV). The FOV of each image is encoded in Field of View Dimensions (0018,1149).

Using the confocal microscope interface the user "draws" a region of interest over the macroscopic image where they wish to acquire a confocal microscopy mosaic image. The rectangle will be converted to stage co-ordinates which are used to direct the confocal microscope. The confocal microscopy can image up to an 8mm square area.

The macroscopic image and the confocal microscopy image have a common frame of reference which is encoded and Frame of Reference UID (0020,0052)

The macroscopic and the confocal image need to be correlated at both image level and spatial co-ordinate level.

At image level, Referenced Image Sequence (0008,1140) shall be used to identify the SOP instance of the macroscopic image correlated to the confocal microscopy image. The macroscopic image will be acquired first. Hence, the Referenced Image Sequence (0008,1140) needs to be encoded in confocal microscopy image. The Purpose of Reference Code Sequence (0040, A170) shall have the value (121311, DCM, Localizer).

Spatial information is encoded in the Image Position (Patient) (0020,0032) which encodes the x, y, and z coordinates of the upper left-hand corner of staged area. See Figure 1 The z co-ordinate encodes depth which may be 0.

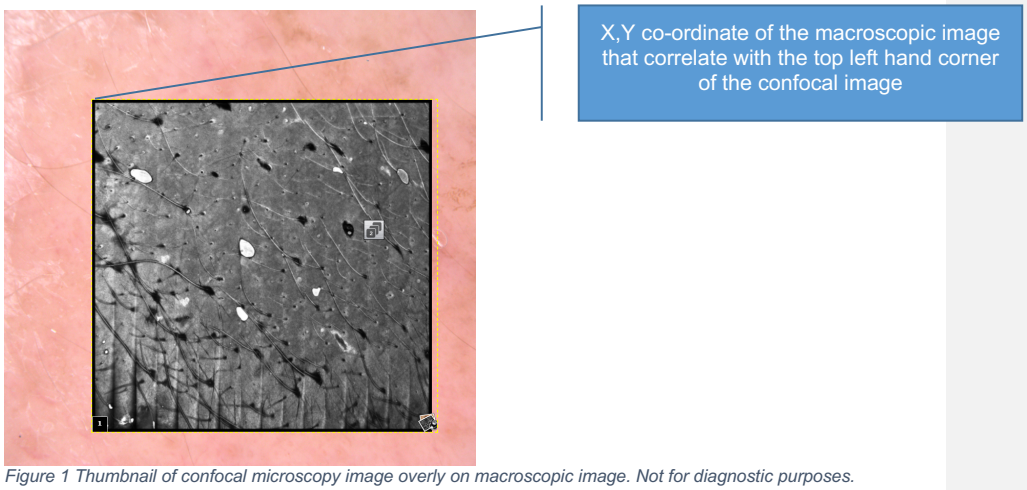

Figure 1 Thumbnail of confocal microscopy image overly on macroscopic image. Not for diagnostic purposes.

Ex-Vivo confocal microscopy imaging acquisition method

Ex-Vivo image acquisition is conceptually the same. Both macroscopic camera and confocal microscope are mounted inside the same housing. The stage positions the slide firstly centered over the macroscopic camera and then centered over the confocal microscope.

XXXX.4 Specimen Preparation

To encode specimen preparation including staining TID 8001 Specimen Preparation may be used and is invoked from Specimen Preparation Step Content Item Sequence in the Specimen Module.

For example:

```
(0040,0612)      SpecimenPreparationStepContentItemSequence
   (0040,A040)   ValueType     TEXT
   (0040,A043)   ConceptNameCodeSequence
    >(0008,0100) CodeValue     121041
    >(0008,0102) CodingSchemeDesignator     DCM
    >(0008,0104) CodeMeaning   Specimen Identifier
   (0040,A160)   TextValue     TCGA-GR-7351-01Z

   (0040,A040)   ValueType     CODE
   (0040,A043)   ConceptNameCodeSequence
```

```
>(0008,0100)  CodeValue     111701
>(0008,0102)  CodingSchemeDesignator     DCM
>(0008,0104)  CodeMeaning   Processing type
(0040,A168)   ConceptCodeSequence
>(0008,0100)  CodeValue     127790008
>(0008,0102)  CodingSchemeDesignator     SCT
>(0008,0104)  CodeMeaning   Staining

(0040,A040)   ValueType     CODE
(0040,A043)   ConceptNameCodeSequence
>(0008,0100)  CodeValue     121139
>(0008,0102)  CodingSchemeDesignator     DCM
>(0008,0104)  CodeMeaning   Modality
(0040,A168)   ConceptCodeSequence
>(0008,0100)  CodeValue     XXXX
>(0008,0102)  CodingSchemeDesignator     DCM
>(0008,0104)  CodeMeaning   CFM

(0040,A040)   ValueType     CODE
(0040,A043)   ConceptNameCodeSequence
>(0008,0100)  CodeValue     424361007
>(0008,0102)  CodingSchemeDesignator     SCT
>(0008,0104)  CodeMeaning   Using substance
(0040,A168)   ConceptCodeSequence
>(0008,0100)  CodeValue     9010006
>(0008,0102)  CodingSchemeDesignator     SCT
>(0008,0104)  CodeMeaning   methyl blue stain

0040,A040)    ValueType     CODE
(0040,A043)   ConceptNameCodeSequence
>(0008,0100)  CodeValue     424361007
>(0008,0102)  CodingSchemeDesignator     SCT
>(0008,0104)  CodeMeaning   Using substance
(0040,A168)   ConceptCodeSequence
>(0008,0100)  CodeValue     29522004
>(0008,0102)  CodingSchemeDesignator     SCT
>(0008,0104)  CodeMeaning   toluidine blue stain
```

XXXX.6 Series Organization

It is recommended that:

- Each acquisition mode (e.g., z-stack, snapshot, tiled pyramidal) is encoded as a separate series.
- Dermoscopic or Visible Light Photography images within an imaging study are in a different series to the Confocal Microscopy images.

XXXX.7 Encoding of Confocal Microscopsy Tiled Pyramidal Images

The encoding of Confocal Microscopy Tiled Pyramidal Images replicates the way the Whole Slide Imaging. A description of the encoding is contained in the Scope and Forward of Supplement 145.

Commented [LC45]: Can the Scope and Forward of Supplement 145 be included in Part 17?