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

*DICOM Supplement 250: 2D Total Body Photography*

*Prepared by:*

**DICOM Standards Committee, Working Group 19**

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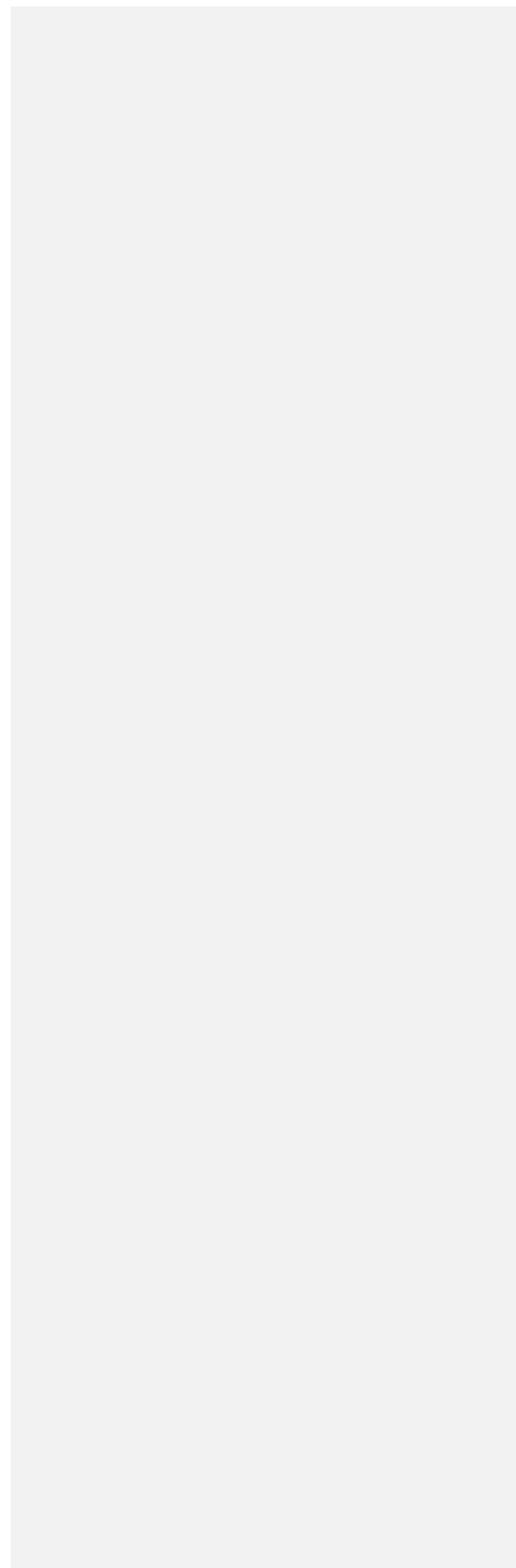
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# Scope and Field of Application

Total Body Photography (TBP) aims to image a person's entire skin surface. TBP is predominantly used for sequential screening for skin cancer diagnosis, in particular melanoma, but can also be used for the assessment of inflammatory skin diseases such as psoriasis. TBP may improve the accuracy of skin cancer diagnosis while reducing the number of biopsies of benign skin lesions.

TBP uses visible light imaging. TBP may be 2D or 3D. Camera movement may be manual or automatic. Image acquisition typically occurs with the patient in different positions.  Multiple regional images are acquired to image entire skin surface. TBP is often used in combination with dermoscopy.

This supplement introduces TBP Regional Image Information Object Definition (IOD) for imaging of a skin region.
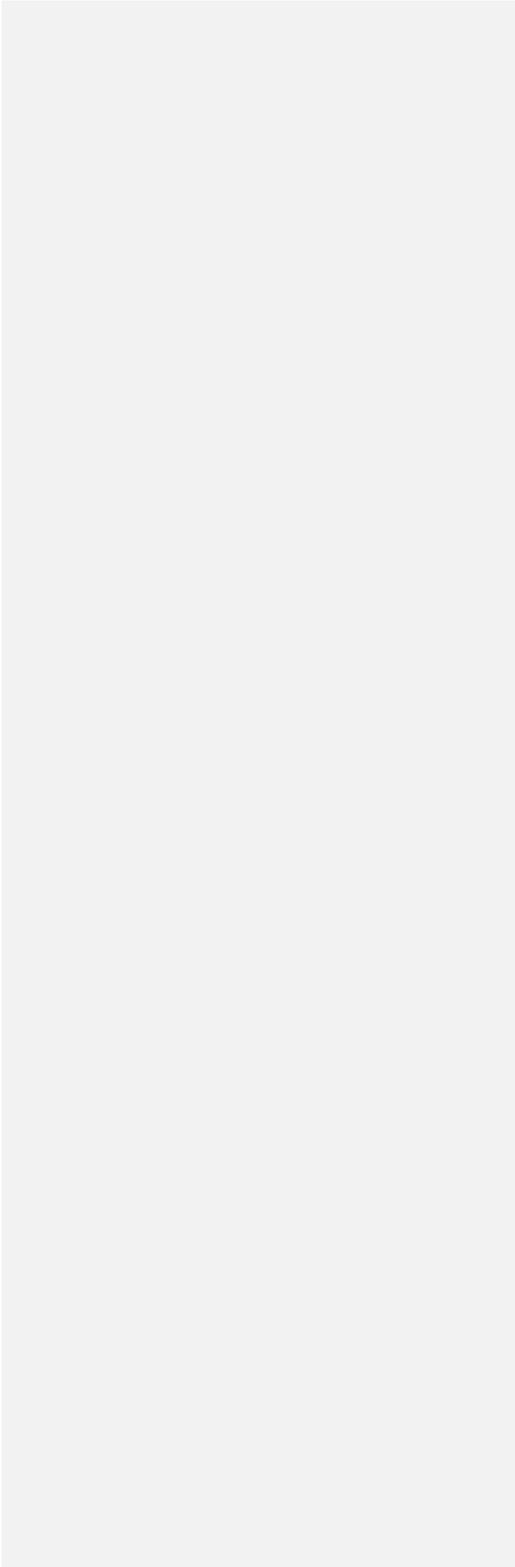
12          **Changes to NEMA Standards Publication PS 3.2**

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

14                          **Part 2: Conformance**

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

15

16   The SOP Classes are categorized as follows:

17                     **Table A.1-2 UID VALUES**

| UID Value | UID Name | Category |
|---|---|---|
| 1.2.840.10008.xxxx | TBP Regional Image IOD | Transfer |

18

19
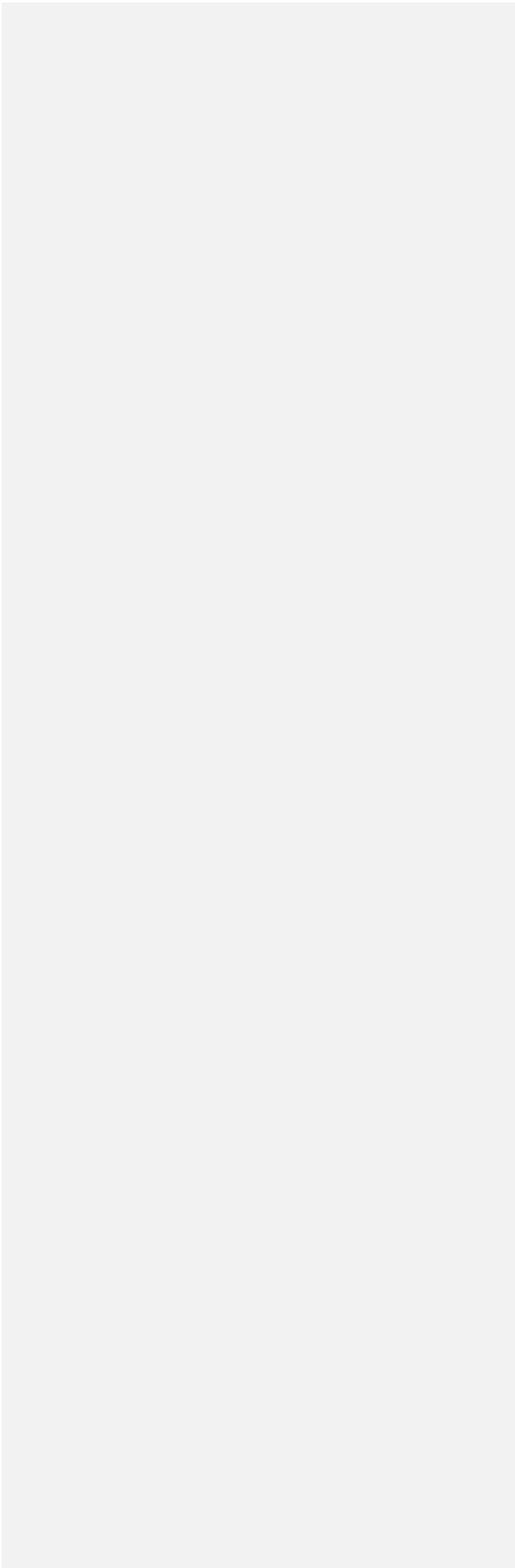
20        **Changes to NEMA Standards Publication PS 3.3**

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

22              **Part 3: Information Object Definitions**

23

24   *Amend PS3.3 Section A.1.4 Overview of the Composite IOD Module Content to include new IODs.*

25

26   *Add to PS3.3*

27

## A.X.X TBP Regional Image IOD

### A.X.X.1 TBP Regional Image IOD Description

The TBP Regional Image IOD specifies images that are acquired using visible light imaging. TBP regional images are acquired of an area or region of the skin surface. Multiple regional images are acquired during a TBP skin examination for coverage of the entire skin surface. The TBP Regional Image IOD proposed Information Object Definition (IOD) is an extension of the existing Visible Light (VL) Photographic Image IOD.

### A.X.X.2 TBP Regional Image IOD Description Entity-Relationship Model

The TBP Regional Image IOD uses the DICOM Composite IOD Entity-Relationship Information Model defined in Section A1.2, with only the Image IE below the Series IE.

### A.X.X.3 TBP Regional Image IOD Module Table

**Table A.X.X.3-1 TBP REGIONAL IMAGE IOD MODULES**

| IE | Module | Reference | Usage |
|---|---|---|---|
| Patient | Patient | C.7.1.1 | M |
| | Clinical Trial Subject | C.7.1.3 | U |
| 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 | M |
| Equipment | General Equipment | C.7.5.1 | M |
| | Enhanced General Equipment | C.7.5.2 | M |
| | VL Photographic Equipment | C.8.12.10 | U |
| Acquisition | General Acquisition | C.7.10.1 | M |
| Image | General Image | C.7.6.1 | M |
| | General Reference | C.12.4 | U |
| | Image Pixel | C.7.6.3 | M |
| | Image Plane | C.7.6.2 | U |
| | TBP Regional Image Module | C.X.X | M |
| | VL Image | C.8.12.1 | M |
| | VL Photographic Acquisition | C.8.12.11 | U |
| | VL Photographic Equipment | C.8.12.10 | U |
| | VL Image Calibration | C.X.Y | U |
| | Overlay Plane | C.9.2 | U |
| | Acquisition Context | C.7.6.14 | U |
| | ICC Profile | C.11.15 | U |
| | SOP Common | C.12.1 | M |
| | Common Instance Reference | C.12.2 | U |

41

42    **A.X.X.4 Total Body Photography IOD Content Constraints**

43    **A.X.X.4.1 Modality**

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

45    **A.X.X.4.2 Acquisition Context Module**

46    The Defined TID for Acquisition Context Sequence (0040,0555) is TID 8300 "Skin Imaging Acquisition
47    Context".

48    **A.X.X.4.3 Referenced Image Sequence**

49    In TBP the Referenced Image Sequence (0008,1140) may be used to identify the SOP instance of a
50    Dermoscopic, or Visible Light image correlated to the TBP regional image. The Purpose of Reference
51    Code Sequence (0040,A170) shall have the value (121311, DCM, "Localizer").

52    **A.X.X.4.4 Anatomic Region Sequence**

53    For Anatomic Region Sequence (0008,2218) BCID 4029 "Dermatology Anatomic Site" may be used. For
54    Anatomic Region Modifier Sequence (0008,2220) BCID 245 "Laterality with Median" may be used.

55

56    **C.8.12 VL Modules and Functional Group Macros**

57    *Add the following new subsection in PS3.3 C.8*

58

59    **C.8.12.X VL Image Calibration Module**

60    This section describes VL Image Calibration Module. This module contains photogrammetry attributes
61    that can calibrate photographic images.

62    Table C8.12.X-1 contains IOD Attributes that describe photogrammetry calibration.

63                              **Table C8.12.X Image Calibration Module Attributes**

| Attribute | Tag | Type | Attribute Description |
|---|---|---|---|
| **>Photogrammetric Lens Sequence** | **(ggg1,eee1)** | **1** | **Describes a lens and its connected sensor.** **One or more Items shall be present.** **The first Sequence Item must define the main lens.** |
| **>>Horizontal and Vertical Focal Length in Pixel Units** | **(ggg1,eee2)** | **1** | **Horizontal focal length Fx followed by the vertical focal length Fy in pixel** |

| | | | units as defined by the underlying camera model (e.g., pinhole model). |
|---|---|---|---|
| >>Principal Point Coordinates | (ggg1,eee3) | 1 | The intersection of the optical ray through the center of the image plane. Values are stored as pixel coordinates Cx followed by Cy. |
| >>Lens Distortion Parameters (Radial) | (ggg1,eee4) | 2 | Dimensionless polynomial parameters that describe radial lens distortion in the VL image given by three parameters in the order k1, k2 and k3. $$x_{distorted} = x(1 + k_1r^2 + k_2r^4 + k_3r^6)$$ $$y_{distorted} = y(1 + k_1r^2 + k_2r^4 + k_3r^6)$$ (x, y) = undistorted image coordinates, r = radius as Euclidean distance to image center |
| >>Lens Distortion Parameters (Tangential) | (ggg1,eee5) | 2 | Dimensionless polynomial parameters that describe tangential lens distortion in the VL image given by the two parameters p1 followed by p2. $$x_{distorted} = x + [2p_1xy + p_2(r^2 + 2x^2)]$$ $$y_{distorted} = y + [p_1(r^2 + 2y^2) + 2p_2xy]$$ (x, y) = undistorted image coordinates, r = radius as Euclidean distance to image center |
| >>Relative Camera Translation | (ggg1,eee6) | 1C | Translation vector between the subsequent camera position relative to the first camera. Required if Number of Frames (0028,0008) has a value greater than 1. |
| >>Relative Camera Orientation | (ggg1,eee7) | 1C | Relative camera orientation with respect to the first camera. Required if Number of Frames (0028,0008) has a value greater than 1. The orientation is represented as a 3x3 rotation matrix, which transforms the subsequent camera after the translation is applied. |

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66    *Modify PS3.3 C.8 Modality Specific Modules*

67

### C.8.12.10 VL Photographic Equipment Module

**Table C.8.12.10-1. VL Photographic Equipment Module Attributes**

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| …. | | | |
| **Focus Breathing** | **(0016, eee1)** | **3** | **Lens characteristic where a geometric change in field-of-view occurs when changing focus distance.**<br><br>**Enumerated Values:**<br><br>**YES**<br><br>**NO** |

### C.8.12.11 VL Photographic Acquisition Module

**Table C.8.12.11-1. VL Photographic Acquisition Module Attributes**

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| …. | | | |
| **Focus Distance** | **(0016,eee2)** | **3** | **Distance between the lens and the subject at which the image is sharply focused in meters.** |
| **Viewpoint LookAt Point** | **(0070,1604)** | **3** | **The direction in which the camera is pointing using a 3D vector.** |
| **Viewpoint Up Direction** | **(0070,1605)** | **3** | **The direction which is up for the camera using a 3D vecgor.** |

75 | *Add the following new subsection in PS3.3 C.8*

76

## C.8.X.X TBP Regional Image Module

78 Table C.8.X.X-1 specifies the Attributes that describe total body photography regional images.

79 **Table C.8.X.X-1. TBP Regional Image Module Attributes**

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| Recognizable Visual Features | (0028,0302) | 1 | Indicates whether or not the image contains sufficiently recognizable visual features to allow the image or a reconstruction from a set of images to identify the Patient.<br><br>Enumerated Values:<br><br>YES<br>NO |
| Light Source Polarization | (0016,1001) | 2 | Polarization of the dermoscope light source.<br><br>Enumerated Values:<br><br>POLARIZED<br><br>NON_POLARIZED |
| Emitter Color Temperature | (0016,1002) | 2 | Color temperature of dermoscope light source in Kelvin. |
| Partial View | (0028,1350) | 3 | Indicates whether this image is a partial view, that is a subset of a single view of a skin lesion.<br><br>Enumerated Values:<br><br>YES<br><br>NO<br><br>If this Attribute is absent, then the image may or may not be a partial view. |
| Partial View Description | (0028,1351) | 3 | Free text description of the portion of the skin surface captured in a partial view image. |

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81  **Changes to NEMA Standards Publication PS 3.6**

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

83                       **Part 6: Data Dictionary**

84  *Add to PS3.6 Annex A*
85

| UID Value | UID NAME | UID TYPE | Part |
|---|---|---|---|
| 1.2.840.10008.xxx | TBP Regional Image IOD | SOP Class | PS3.4 |

86

87  *Add to PS3.6 the following Data Elements to Section 6, Registry of DICOM data elements:*
88

| Tag | Name | Keyword | VR | VM |
|---|---|---|---|---|
| (ggg1,eee1) | Photogrammetric Lens Sequence | PhotogrammetricLensSequence | SQ | 1-n |
| (ggg1,eee2) | Horizontal and Vertical Focal Length in Pixel Units | HorizontalandVerticalFocal LengthinPixel Units | FL | 2 |
| (ggg1,eee3) | Principal Point Coordinates | PrincipalPointCoordinates | FL | 2 |
| (ggg1,eee4) | Lens Distortion Parameters (Radial) | LensDistortionRadial | FL | 1-n |
| (ggg1,eee5) | Lens Distortion Parameters (Tangential) | LensDistortionTangential | DS | 1-n |
| (ggg1,eee6) | Relative Camera Translation | RelativeCameraTranslation | FL | 3 |
| (ggg1,eee7) | Relative Camera Orientation | RelativeCameraOrientation | FL | 9 |
| (0016,eee1) | Lens Breathing | LensBreathing | CS | 1 |
| (0016,eee2) | Focus Distance | FocusDistance | FL | 1 |

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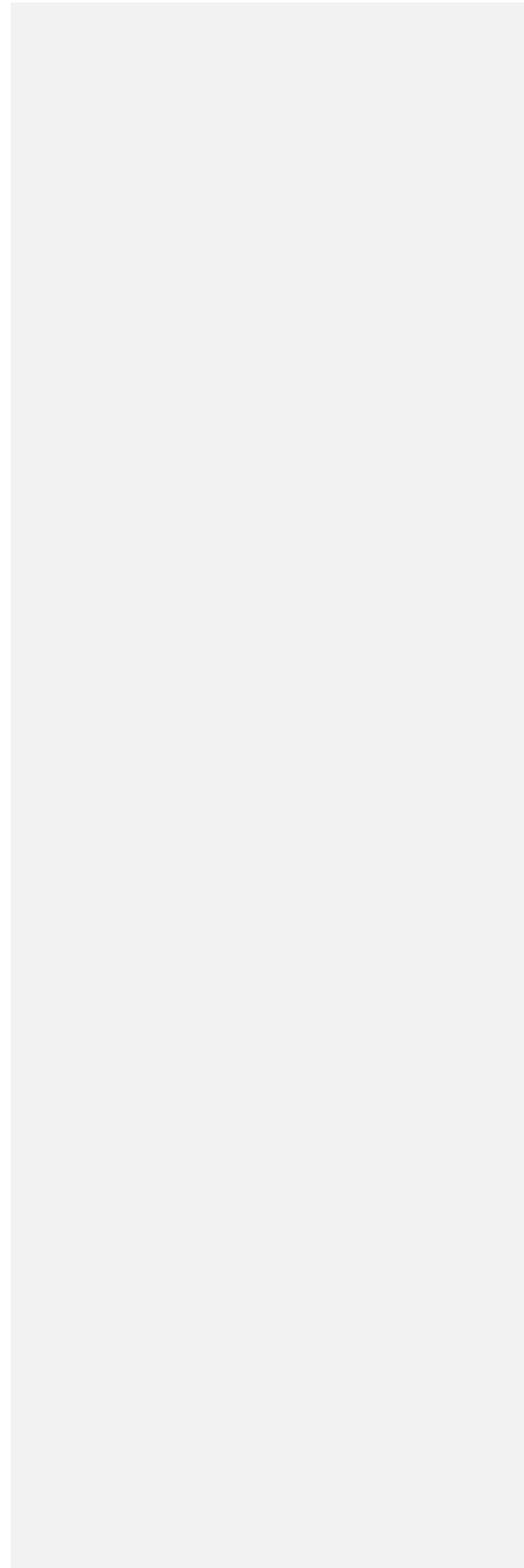
94          **Changes to NEMA Standards Publication PS 3.17**

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

96              **Part 17: Explanatory Information**

97   *Add to PS3.17 Annex XXXX*

98

## 99   Annex XXXX 2D Total Body Photography (Informative)

**100   XXXX.1 Basic Structed Display IOD for visualization of images withing a 2D TBP**

**101   imaging examination**

102   TBP regional images within a 2D TBP imaging examination are typically displayed in a matrix format
103   which each acquisition position (e.g. anterior, right side, posterior left side) displayed as in columns and
104   the rows being in corresponding head-to-toe. (See Figure XXXX.1-1). A Basic Structured Display IOD
105   may be used to encode a specific layout and intended display of images within an imaging study. The
106   Basic Structured Display IOD as a scope limited to the display on a single screen.



> **Kommentiert [LC1]:** Need a vendor to supply similar graphic and permission to publish in standard

107

108          **Figure XXXX.1 -1 Display of 2D TBP imaging study**

109

110   The Basic Structured Display IOD module table included a Structured Display Image Box. Figure XXX.1-2
111   is a graphical representation of the Structured Display Image Box module.

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113
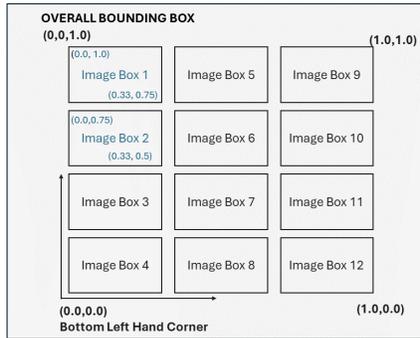
**Figure XXXX.1 -2 Representation of a Structed Display Image Box used to display Figure**

**XXX.1-1**

Table XXX.1-1 is an example encoding of the Structured Display Image Box (Figure

XXX.1-2). Image annotations via referenced Presentation State objects and simple text

labels on the screen, e.g., for image box labeling or study identification can also be

encoded using the Basic Structured Display IOD.

120

**Table XXXX.1-1 Example encoding of the Structured Display Image Box (Figure XXX.1-2)**

| Attribute | Tag | Type | Description | Value |
|---|---|---|---|---|
| Structured Display Image Box Sequence | (0072,0422) | 1 | | |
| Item | (FFFE,E000) | | | |
| >Display Environmental Spatial Position | (0072,0108) | 1 | Top Left-Hand Corner and Bottom Right-Hand Corner of the Image Box relative the OVERALL BOUNDING BOX | 0.0\1.0\ 0.33\ 0.75 |
| >Image Box Number | (0072,0108) | 1 | An integer that is unique across all Items of the Structured Display Image Box Sequence (0072,0422) that identifies the Image Box. | 1 |
| >Image Box Layout Type | (0072,0304) | 1 | | TILED |

| | | | | |
|---|---|---|---|---|
| >Image Box Tile Horizontal Dimension | (0072,0306) | 1C | Positive integer defining the horizontal Image Box tile dimension; the number of columns.<br><br>Required if (0072,0304) = TILED | 4000 |
| >Image Box Tile Horizontal Dimension | (0072,0306) | 1C | Positive integer defining the horizontal Image Box tile dimension; the number of rows.<br><br>Required if (0072,0304) = TILED | 3000 |
| >Referenced Image Sequence | (008,1140) | 2C | SOP instance of the image to be displayed in Image Box 1 | 1.2.3.450.789.2212234577 |
| >Referenced Presentation State Sequence | (008,9237) | 2C | SOP instance of Softcopy Presentation State | |
| Item Delimitation Item | (FFFE,E00D) | | | |
| Item | (FFFE,E000) | | | |
| >Display Environmental Spatial Position | (0072,0108) | 1 | Top Left-Hand Corner and Bottom Right Hand Corner of the Image Box relative the OVERALL BOUNDING BOX | 0.0 \0.75\ 0.33\ 0.5 |
| >Image Box Number | (0072,0108) | 1 | An integer that is unique across all Items of the Structured Display Image Box Sequence (0072,0422) that identifies the Image Box. | 2 |
| >Image Box Layout Type | (0072,0304) | 1 | | TILED |
| >Image Box Tile Horizontal Dimension | (0072,0306) | 1C | Positive integer defining the horizontal Image Box tile dimension; the number of columns.<br><br>Required if (0072,0304) = TILED | 4000 |

| >Image Box Tile Horizontal Dimension | (0072,0306) | 1C | Positive integer defining the horizontal Image Box tile dimension; the number of rows.<br><br>Required if (0072,0304) = TILED | 3000 |
|---|---|---|---|---|
| >Referenced Image Sequence | (008,1140) | 2C | SOP instance of the image to be displayed in Image Box 1 | 1.2.3.450.789.222369874 |
| >Referenced Presentation State Sequence | (008,9237) | 2C | SOP instance of Softcopy Presentation State | |
| ……… | | | | |

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## XXXX.2 Series Organization

It is recommended that each TBP regional image acquired as part of 2TBP imaging examination is a encoded in the same series. Dermoscopic or Visible Light macroscopic images within the imaging study are in a different series to the regional images.

## XXXX.3 Camera Orientation

The orientation of the camera can be described using two 3D vectors. The first is the Camera View Vector (i.e., the direction in which the camera is pointing) denoted as ($view_x$, $view_y$, $view_z$) in the figure below. This is encoded in Viewpoint LookAt Point (0070,1604) attribute.

The second is the camera up vector (i.e., the direction which is up for the camera) denoted by as ($up_x$, $up_y$, $up_z$) in the diagram and encoded in Viewpoint Up Direction (0070,1605)
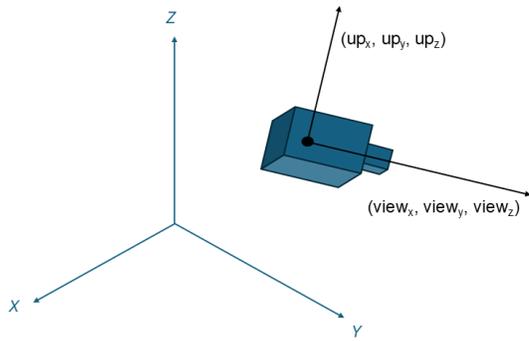
**Figure XXXX.3 -1 Camera position vectors**