DICOM Correction Proposal

<table>
<thead>
<tr>
<th>STATUS</th>
<th>Assigned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date of Last Update</td>
<td>2022/09/15</td>
</tr>
<tr>
<td>Person Assigned</td>
<td>Ulrich Busch (<a href="mailto:ulrich.busch@varian.com">ulrich.busch@varian.com</a>)</td>
</tr>
<tr>
<td>Submitter Name</td>
<td></td>
</tr>
<tr>
<td>Submission Date</td>
<td>2013/07/01</td>
</tr>
</tbody>
</table>

Correction Number CP-1319

Log Summary: Declaration of Frame Of Reference Reliability

Name of Standard
PS 3.3 2015
PS 3.6 2015

Rationale for Correction:
The usage of the FOR (Frame of Reference) in the DICOM standard assumes that the FOR is always accurate and well-defined. In fact, this is correct for e.g. spatial positions of DICOM objects, such as image positions. However, since the content of e.g. images is the relevant information, it may happen that although the spatial / temporal relation is correctly defined, the spatial or temporal content is not well defined and therefore not correctly related.

Several IODs (e.g. Spatial Fiducial) rely on the usage of the Frame of Reference UID in order to use spatial coordinates. If those IODs are based on unreliable administration on frame of references, they are unsafe.

The following describes a representative example of a case where Frame of Reference UID itself is not sufficient:

- A modality creates the image series (Set1 and Set2) which share the same FOR (FOR1). However, the content of the images slightly differ (because the patient might have moved in-between scans).
- A contourer creates a segmentation object Object1 based on the images in Set1. The Object1 uses the FOR of Set1 to define the spatial position of Object1.
- Another system displays Object1 together with Set2.
- Since the content of Set1 and Set2 slightly differ in spatial position the Object1 is displayed on a wrong position in Set2.

Therefore is important, that objects can declare on which set of other objects they are based on. E.g. in above’s scenario, Object1, which may be a Segmentation or Structure Set SOP Instance need a facility to reference Set1 selectively.

The current standard supports referencing the underlying objects by reference Sequences like Source Image Sequence, Reference Image Sequence etc. However, the semantics of what those references mean is not explicitly specified.

The CP adds such specifications where indicated.

Correction Wording:
### Table C.20.2-1. Spatial Registration Module Attributes

<table>
<thead>
<tr>
<th>Attribute Name</th>
<th>Tag</th>
<th>Type</th>
<th>Attribute Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>...</td>
<td></td>
<td></td>
<td>...</td>
</tr>
<tr>
<td>Registration Sequence</td>
<td>(0070,0308)</td>
<td>1</td>
<td>A sequence of registration items. Each item defines a spatial registration of the images referenced in that item to the Registered RCS established by this SOP instance. All referenced images are in the same spatial frame of reference or atlas. One or more Items shall be included in this sequence.</td>
</tr>
<tr>
<td>&gt;Frame of Reference UID</td>
<td>(0020,0052)</td>
<td>1C</td>
<td>Identifies the Frame of Reference of the referenced data, that may or may not be an image set (e.g., atlas or physical space). See Section C.7.4.1.1.1 for further explanation. Required if Referenced Image Sequence (0008,1140) is absent. May be present otherwise.</td>
</tr>
<tr>
<td>&gt;Referenced Image Sequence</td>
<td>(0008,1140)</td>
<td>1C</td>
<td>Identifies the set of images of the referenced data, registered in this sequence item. One or more Items shall be included in this sequence. Required if Frame of Reference UID (0020,0052) is absent. May be present otherwise. <strong>See C.20.2.1.X Referenced Image Sequence</strong></td>
</tr>
</tbody>
</table>

>&gt;Include Table 10-3 “Image SOP Instance Reference Macro Attributes”

| ...                     |              |      | ...                                                                                                                                                                                                                   |

---

**C.20.2.1 Registration Module Attribute Descriptions**

**C.20.2.1.1 Frame of Reference Transformation Matrix**

... 

**C.20.2.1.X Referenced Image Sequence**

The Referenced Image Sequence (0008,1140) is used to reference Image SOP Instances in order to declare that the content of the referenced SOP instances are spatially and temporally consistent and that the Registration Applies to all referenced Items in a consistent manner. Temporally refers to a time period in which consistency is clinically acceptable, but does not suggest any specific implications to any content conveyed by the Synchronization Module, if present. No statement is implied about other SOP instances of the same Frame of Reference, which are not included in this sequence.

No assumptions should be made by navigating ‘upwards’ and further to other SOP instances, which directly or indirectly reference the current SOP Instance.
The semantics of the referenced SOP Instances does not include any advice for displaying information, neither to limit the use of other SOP instances in the referenced Frame of Reference in general.