Integrating the Healthcare Enterprise

IHE Radiology
Technical Framework Supplement

Stereotactic Mammography Image (SMI)

Rev. 1.2 – Trial Implementation

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Foreword

This is a supplement to the IHE Radiology Technical Framework V17.0. Each supplement undergoes a process of public comment and trial implementation before being incorporated into the volumes of the Technical Frameworks.

This supplement is published on July 27, 2018 for trial implementation and may be available for testing at subsequent IHE Connectathons. The supplement may be amended based on the results of testing. Following successful testing it will be incorporated into the Radiology Technical Framework. Comments are invited and can be submitted at http://www.ihe.net/Radiology_Public_Comments.

This supplement describes changes to the existing technical framework documents.

"Boxed" instructions like the sample below indicate to the Volume Editor how to integrate the relevant section(s) into the relevant Technical Framework volume.

Amend Section X.X by the following:

Where the amendment adds text, make the added text **bold underline**. Where the amendment removes text, make the removed text **~~bold strikethrough~~**. When entire new sections are added, introduce with editor's instructions to "add new text" or similar, which for readability are not bolded or underlined.

General information about IHE can be found at www.ihe.net.

Information about the IHE Radiology domain can be found at ihe.net/IHE_Domains.

Information about the organization of IHE Technical Frameworks and Supplements and the process used to create them can be found at http://ihe.net/IHE_Process and http://ihe.net/Profiles.

The current version of the IHE Radiology Technical Framework can be found at http://www.ihe.net/Technical_Frameworks.

CONTENTS

Introduction to this Supplement

Stereotactic Mammography Image Profile is a content profile that specifies how DICOM®[1] stereotactic breast projection x-ray images are created, exchanged and used. It describes how Acquisition Modalities transfer the images, and how Image Displays retrieve and make use of the images. It defines the basic display capabilities Image Displays are expected to provide, and which attributes should be used to implement those capabilities.

This supplement proposes changes to both Volume 1 and 2 of the IHE Radiology Technical Framework.

Managing the process of creating, storing and using Stereotactic Mammography Image content is similar to workflow for other image content (e.g., see Scheduled Workflow, Mammography Acquisition Workflow, Mammography Image Profiles).

The Stereotactic Mammography Image Profile is designed to provide faithful and complete storage and retrieval of stereotactic breast projection x-ray imaging data, and sufficient display capability to allow optimal visualization of images for the purpose of consultation or second opinion. It does not address the use of other modalities appropriate for breast imaging such as MR or US.

Open Issues and Questions

None

Closed Issues

An Image Display should be required to support calibration as described in DICOM GSDF, in order to maintain visual consistency for the consulting physician of the breast tissue imaged and targeted for biopsy.

Hanging protocols should be configurable such that the chest wall is displayed at the top or bottom of the viewport, with the axilla or lateral on the left or right as clarified in RAD TF-2: 4.16.4.2.2.1.2.1 Image Orientation.

The specifications are sufficiently clear for an Image Display claiming compliance with both the Mammography Image Profile and Stereotactic Mammography Image Profile to know which behaviors to apply.

The Acquisition Modality should populate the Referenced Image Sequence for stereotactic image sets (pair or triplet) such that each image references the respective images in the set, with Purpose of Reference Code Sequence populated accordingly, as clarified in RAD TF-2: Table 4.8.4.1.2.6-1.

[1] DICOM is the registered trademark of the National Electrical Manufacturers Association for its standards publications relating to digital communications of medical information.

An IM/IA of the Modality Images Stored transaction is required to provide Level 2 conformance as a DICOM Store SCP, so it is not necessary to make any additional statements regarding maintaining the Referenced Image Sequence item attribute values.

125 CP-1269 LB clarified the reference coordinate system for the values of Calculated Target Position and added Displayed Z Value, to resolve the question regarding “depth”.

General Introduction

Update the following Appendices to the General Introduction as indicated below. Note that these are not appendices to Volume 1.

Appendix A – Actor Summary Definitions

No new actors.

Actor	Definition

Appendix B – Transaction Summary Definitions

No new transactions.

Transaction	Definition

Glossary

No new glossary terms.

Glossary Term	Definition

Volume 1 – Profiles

Copyright Licenses

N/A

Domain-specific additions

Add the new profile to Section 2 dependencies table

Table 2-1: Integration Profiles Dependencies

Integration Profile	Depends on	Dependency Type	Comments
…	…	…	…
Stereotactic Mammography Image	***None***	***None***	-
…	…	…	…

Add the new profile to Section 2.1

2.1 Integration Profiles Overview

Add the following to the IHE Technical Frameworks Integration Profiles Overview section:

2.1.32 Stereotactic Mammography Image

Stereotactic Mammography Image (SMI) is designed to provide faithful and complete storage from Acquisition Modalities to Image Managers/Image Archives and retrieval by Image Displays of DICOM stereotactic breast projection x-ray image data, with sufficient display capability to allow optimal visualization of images for the purpose of consultation or second opinion.

2.5 Product Implementations

N/A

32 Stereotactic Mammography Image (SMI) Profile

Stereotactic Mammography Image is a Content Profile that is designed to provide faithful and complete storage from Acquisition Modalities to Image Managers/Image Archives and retrieval by Image Displays of DICOM stereotactic breast projection x-ray image data, with sufficient

display capability to allow optimal visualization of images for the purpose of consultation or second opinion.

32.1 SMI Actors, Transactions, and Content Modules

Figure 32.1-1 shows the actors directly involved in the SMI Profile and the relevant transactions between them.

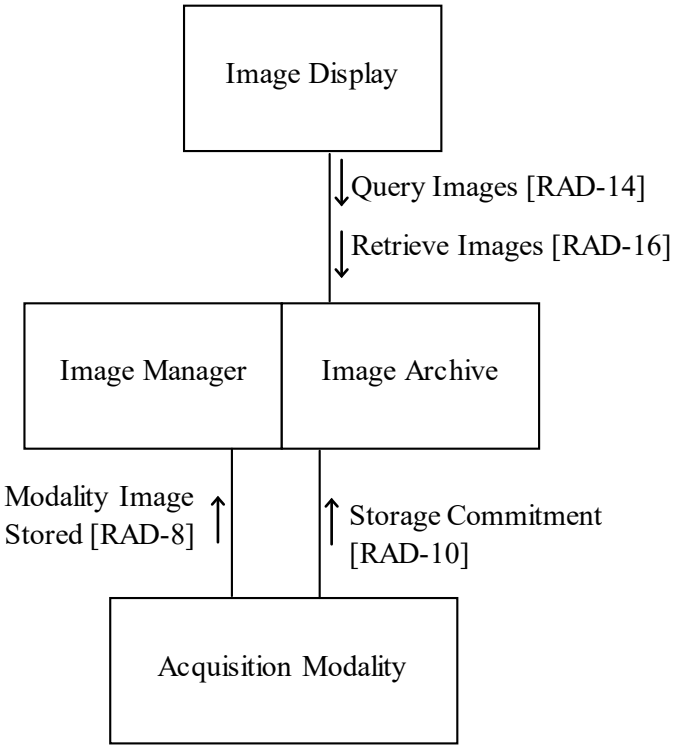

Figure 32.1-1: SMI Actor Diagram

Table 32.1-1 lists the transactions for each actor directly involved in the SMI Profile. In order to claim support of this Profile, an implementation of an actor must perform the required transactions (labeled "R") and may support the optional transactions (labeled "O").

Table 32.1-1: SMI Profile - Actors and Transactions

Actors	Transactions	Optionality	TF Reference
Acquisition Modality	Modality Images Stored [RAD-8]	R	RAD TF-2: 4.8
	Storage Commitment [RAD-10]	R	RAD TF-2: 4.10
Image Display	Query Images [RAD-14]	R	RAD TF-2: 4.14
	Retrieve Images [RAD-16]	R	RAD TF-2: 4.16
Image Manager/Image Archive	Modality Images Stored [RAD-8]	R	RAD TF-2: 4.8
	Storage Commitment [RAD-10]	R	RAD TF-2: 4.10

Actors	Transactions	Optionality	TF Reference
	Query Images [RAD-14]	R	RAD TF-2: 4.14
	Retrieve Images [RAD-16]	R	RAD TF-2: 4.16

32.1.1 Actor Descriptions and Actor Profile Requirements

N/A

32.2 SMI Actor Options

Options that may be selected for this profile are listed in Table 32.2-1 along with the actors to which they apply. Dependencies between options when applicable are specified in notes.

Table 32.2-1: Stereotactic Mammography Image - Actors and Options

Actor	Options	TF Reference
Acquisition Modality	*No options defined*	- -
Image Display	*No options defined*	- -
Image Manager/Image Archive	*No options defined*	- -

32.3 SMI Required Actor Groupings

N/A

32.4 SMI Overview

The Stereotactic Mammography Image Profile specifies how DICOM stereotactic breast projection x-ray images are created, exchanged and used. It describes how Acquisition Modalities transfer the images, and how Image Displays would retrieve and make use of the images. It defines the basic display capabilities Image Displays are expected to provide, and which attributes should be used to implement those capabilities.

32.4.1 Concepts

The Mammography Image Profile requirements in the Modality Images Stored and Retrieve Images transactions are not sufficient to accommodate the desired workflow with stereotactic breast projection x-ray images, on occasions when they are reviewed on non-modality workstations some time after the imaging procedure is completed. Additional requirements are defined for these transactions for the Stereotactic Mammography Image Profile.

32.4.2 Use Case #1: Breast Biopsy

A patient undergoes a Stereotactic Breast Biopsy procedure, the outcome of which is later reviewed by a consulting radiologist.

32.4.2.1 Breast Biopsy Use Case Description

A patient is scheduled for a Stereotactic Breast Biopsy procedure for the extraction of a suspect mammographic abnormality (e.g., microcalcifications). During the procedure, the technologist acquires stereotactic paired digital mammography projection x-ray images on the Acquisition Modality at prescribed plus and minus angles to a scout image. The radiologist utilizes these images on the Acquisition Modality to determine the location coordinates for introduction of a biopsy instrument and extraction of tissue from the site of abnormality.

Additional stereo paired images are obtained to confirm needle positioning, subsequent placement of a tissue marker, and documentation of successful extraction of the targeted tissue. These single images and image pairs are commonly referred to as “Scout”, “Pre-fire Plus / Minus”, “Post-fire Plus / Minus”, “Post-biopsy Plus / Minus”, “Post-marker Plus / Minus”, and single Post-biopsy or Post-marker images. After the procedure is completed the images are archived.

If there is subsequent question as to the accuracy of removal of the targeted abnormality, a radiologist needs to be able to view these images on a non-modality workstation (Image Display) for problem-solving and/or second opinion. This requires that the Acquisition Modality record the information identifying the stereotactic images (“Scout”, “Pre-fire Plus / Minus”, “Post-fire Plus / Minus”, “Post-biopsy Plus / Minus”, “Post-marker Plus / Minus”, “Post-biopsy”, “Post-marker”) and the correct patient orientation in the images. In addition, the modality will record the targeting information and include image enhancements applied at the modality.

The Image Display will use the information provided in the stored image instances for automatic hanging (including orientation) of stereo paired images, and display of targeting information and applied image enhancements.

32.4.2.2 Breast Biopsy Process Flow

For all images acquired during the Breast Biopsy procedure, the Acquisition Modality, as specified in the Modality Images Stored transaction, records the information identifying the stereotactic images (e.g., “Scout”, “Pre-fire Plus / Minus”, etc.), the correct patient orientation of the pixel data, the targeting information, and includes image enhancements applied at the modality.

After the Breast Biopsy procedure is completed, the images are stored by the Acquisition Modality to the Image Manager/Archive using the Modality Images Stored transaction.

Using the Query Images and Retrieve Images transactions, the Image Display obtains the images and uses the information provided in the retrieved image instances for automatic hanging (including orientation) of stereo paired images, and display of targeting information and applied image enhancements.

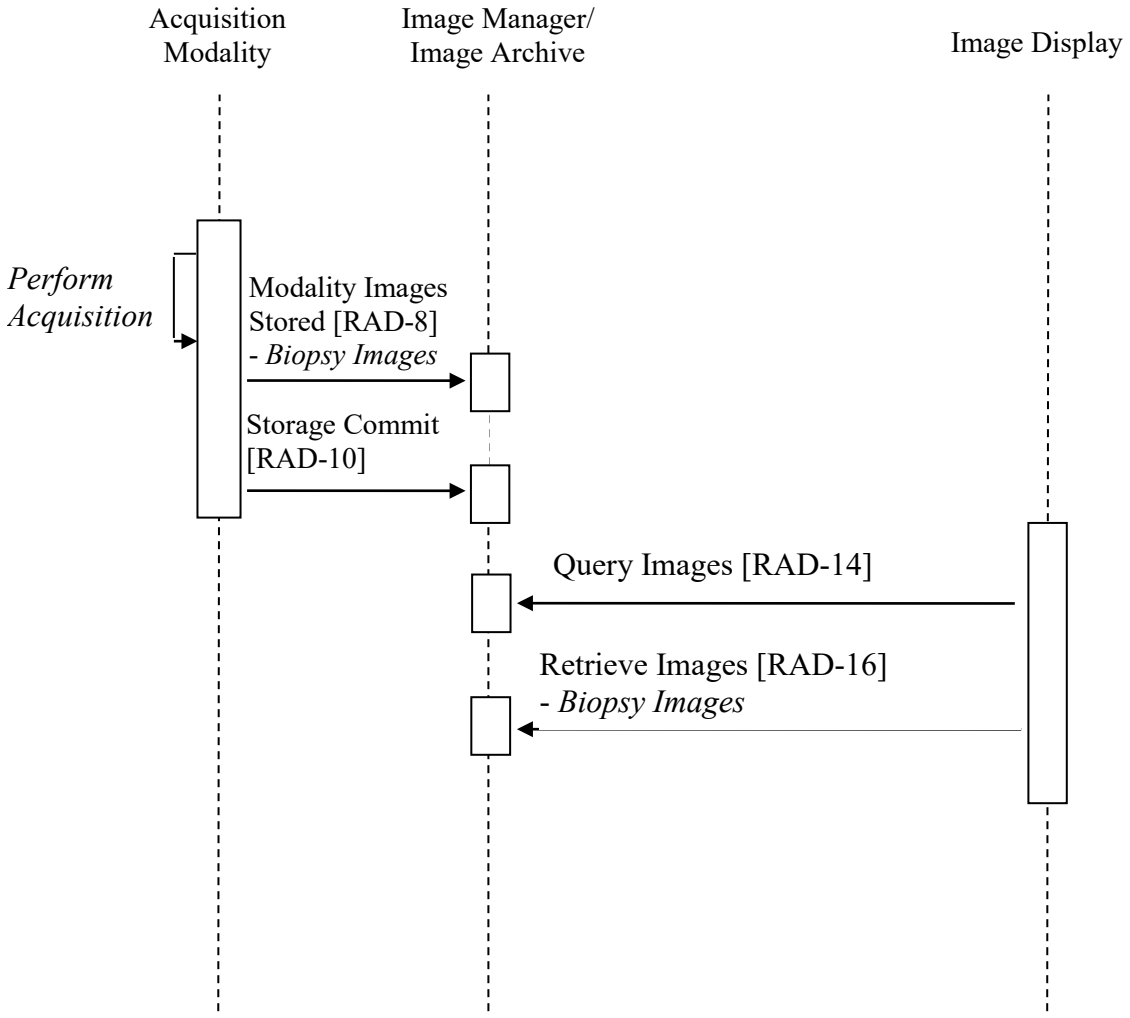

Figure 32.4.2.2-1: Basic Process Flow in SMI Profile

32.5 SMI Security Considerations

N/A

32.6 SMI Cross Profile Considerations

MAMMO - Mammography Image

An Image Display that claims compliance with both the Mammography Image Profile and the Stereotactic Mammography Image Profile will have distinct behavior for the display of stereotactic mammography images based on value 3 of Image Type (0008,0008).

Volume 2 – Transactions

Modify Section 4.8 Modality Images Stored

4.8 Modality Images Stored

…

Add a new Section 4.8.4.1.2.6

4.8.4.1.2.6 Storage of Stereotactic Mammography Images

The Acquisition Modality in the Stereotactic Mammography Image Profile that creates stereotactic mammography projection x-ray images, including scout images, shall use the DICOM Digital Mammography X-Ray Image IOD, and shall support the attributes with the additional requirements presented in Table 4.8.4.1.2.3-1: Required Additional Attributes in Mammography Images.

In addition, the Acquisition Modality shall support the following additional attributes with requirements specified in Table 4.8.4.1.2.6-1. See Section 2.2 DICOM Usage Conventions.

Table 4.8.4.1.2.6-1: Required Additional Attributes in Stereotactic Mammography Images

Attribute	Tag	MG	Rationale
Image Type	(0008,0008)	R+	Value 3 shall contain the corresponding stereotactic mammography identifier per DICOM PS 3.3, Table C.8-74a of C.8.11.7.1.4, used for identification during display. Note: The relevant table in C.8.11.7.1.4 has been extended by DICOM CP-1250, final text.
Referenced Image Sequence	(0008,1140)	RC+	Required for a set (pair or triplet) of images (e.g., minus/plus, scout/minus, scout/plus, minus/scout/plus), for each image to reference the respective images in the set, for use in arranging the images for display.
>Purpose of Reference Code Sequence	(0040,A170)	R+	Required with an Item value of (121312, DCM, "Biopsy localizer") for reference to a scout image or (121315, DCM, "Other image of stereoscopic pair") for reference to a minus or plus image.
Derivation Code Sequence	(0008,9215)	RC+	One or more items are required if the stored pixel data incorporates user applied image enhancements (e.g., sharpening, smoothing).
Patient Orientation	(0020,0020)	R	Included for emphasis that the values shall represent the orientation of the stored pixel data with respect to the patient, for use in arranging the images for display.
View Code Sequence	(0054,0020)	R	Included for emphasis that the item shall

Attribute	Tag	MG	Rationale
			represent the approach used to acquire the image (e.g., lateral-medial, medial-lateral, inferior-superior, superior-inferior), used for identification during display.
>View Modifier Code Sequence	(0054,0220)	R+	One or more items shall be present to identify view modifier(s), if applicable (e.g., spot compression), used for identification during display.
Biopsy Target Sequence	(0018,2041)	RC+	Required if one or more targets were applied to a pair of images at the modality, one item per target, for display purposes.

The Acquisition Modality shall provide the opportunity to store image pixel data as DICOM Digital Mammography X-Ray Image – For Presentation that incorporates user applied image enhancements (e.g., sharpening, smoothing).

The Acquisition Modality shall support Section 4.8.4.1.2.3.2 Background Air Suppression for stereotactic mammography images that contain a defined breast skin line.

Add the following text to the end of Section 4.8.4.1.3.1 DICOM Image Storage SOP Classes.

4.8.4.1.3.1 DICOM Image Storage SOP Classes

...

Acquisition Modalities and Image Manager/Image Archives claiming the Stereotactic Mammography Image Profile are required to support the SOP Class listed in Table 4.8-6 below.

Table 4.8-6: Stereotactic Mammography SOP Class for Acquisition and Archival

SOP Class UID	SOP Class Name
1.2.840.10008.5.1.4.1.1.1.2	Digital Mammography Image Storage – For Presentation

…

Modify Section 4.16 Retrieve Images

4.16 Retrieve Images

…

Add a new Section 4.16.4.1.3.6

4.16.4.1.3.6 Stereotactic Mammography Image Profile

Image Manager/Image Archive Actors supporting the Stereotactic Mammography Image Profile shall support the SOP Class specified in Table 4.16.4.1.3.6-1.

Image Display Actors supporting the Stereotactic Mammography Image Profile shall support the SOP Class specified in Table 4.16.4.1.3.6-1.

Table 4.16.4.1.3.6-1: Stereotactic Mammography SOP Class for Display

SOP Class UID	SOP Class Name
1.2.840.10008.5.1.4.1.1.1.2	Digital Mammography Image Storage – For Presentation

…

Add a new Section 4.16.4.2.2.1.2

4.16.4.2.2.1.2 Display of Stereotactic Mammography Images

Stereotactic mammography images are digital mammography images, but special requirements apply. Therefore, Image Displays supporting the Stereotactic Mammography Image Profile shall support the applicable set of the Mammography Image Profile requirements defined in this section.

An Image Display that supports the Stereotactic Mammography Image Profile shall support calibration as described in the DICOM Grayscale Standard Display Function (GSDF). The minimum and maximum luminance of the display shall be configurable by the site, within the gamut of the device, for the purpose of conforming to local, regional or national regulatory and other requirements for luminance settings throughout the organization. For example, a site may require that all Image Displays used for consultation be calibrated to the same minimum and maximum luminance.

Image Displays shall support Section 4.16.4.2.2.1.1.1 Background Air Suppression.

Image Displays shall support Section 4.16.4.2.2.1.1.4 Image Contrast Adjustment.

Image Displays shall support Section 4.16.4.2.2.1.1.5 Annotation of Image Information.

In addition to the requirements of Section 4.16.4.2.2.1.1.5.3 Annotation of View Information, unless otherwise overridden by nationally specific extensions, Image Displays shall append as a suffix to the view the specific abbreviations defined for Image Type (0008,0008) value 3 in DICOM PS 3.3, Table C.8-74a of C.8.11.7.1.4 (e.g., "RSMLPRF+").

Note: The relevant table in C.8.11.7.1.4 has been extended by DICOM CP-1250, final text.

Image Displays shall support Section 4.16.4.2.2.1.1.6 Annotation of Size Information.

4.16.4.2.2.1.2.1 Image Orientation

Image Display Actors shall not assume that the pixel data is encoded with an orientation that is suitable for direct display to the user without flipping or rotating into the correct orientation.

The Image Display shall use the values of Image Laterality (0020,0062), View Code Sequence (0054,0220), View Modifier Code Sequence (0054,0222), Patient Orientation (0020,0020), Image Type (0008,0008) Value 3 and Referenced Image Sequence (0008,1140) to display images according to the preferred hanging protocol of the current user, rather than depend on descriptive attributes such as Series Description (0008,103E).

All of the images within a stereotactic mammography procedure have the same laterality, view and view modifier(s). The Image Display shall be able to distinguish and display the images separately or as pairs based on the values of Image Type (0008,0008) value 3 and the respective values of the items in the Referenced Image Sequence (0008,1140).

The Image Display shall allow the user to select or configure hanging protocols such that given a set of images containing these attributes, the placement of images relative to one another, the required orientation of the images, and the sequence of layouts displayed can be defined.

The Image Display shall allow the side-by-side display of user selected pairs of images, and accommodate preferences to display the more positive (e.g., "plus" or scout) image on the left and the more negative image (e.g., scout or "minus") on the right, or vice versa.

The Image Display shall display a pair of images in the same orientation.

The Image Display shall allow the user to select or configure hanging protocols such that the chest wall is displayed a) at the top of the viewport with the axilla or lateral on the left for right breast, and with the axilla or lateral on the right for left breast, or b) at the bottom of the viewport with the axilla or lateral on the right for right breast, and with the axilla or lateral on the left for left breast.

4.16.4.2.2.1.2.2 Image Size

Image Displays shall support Section 4.16.4.2.2.1.1.3 Image Size with respect to the use of Imager Pixel Spacing (0008,1164) and Estimated Radiographic Magnification Factor (0008,1114).

Image Displays shall support Section 4.16.4.2.2.1.1.3.3 View Actual Pixels.

Image Displays are not required to support Section 4.16.4.2.2.1.1.3.1 Same Size or Section 4.16.4.2.2.1.1.3.2 True Size.

The Image Display shall be capable of displaying multiple images such that each image is sized to fit the viewport.

4.16.4.2.2.1.2.3 Annotation of Target Information

The Image Display shall make the user aware when biopsy target information is available for display. It shall be possible to turn on or off the display of biopsy target information at the user's discretion.

For each target identified in Biopsy Target Sequence (0018,2041), the Image Display shall be capable of applying on the displayed image the Localizing Cursor Position (0018,2043). The form of the localizing cursor position rendering is out of the scope of this profile to define.

For each target identified by Target UID (0018,2042), the Image Display shall be capable of displaying the Calculated Target Position (018,2044) and Displayed Z Value (0018,2046) for a pair of images per Referenced Image Sequence (0008,1140). The form of the rendering is out of the scope of this profile to define.

For each target identified, the Image Display shall be capable of displaying the Target Label (0018,2045), if present, in conjunction with each Calculated Target Position (0018,2044) and Displayed Z Value (0017,2046) for a pair of images.

