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**IHE Radiology
Technical Framework Supplement**

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**Digital Breast Tomosynthesis Extension
(DBT Extension)**

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Rev. 1.3 - Trial Implementation

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Please verify you have the most recent version of this document. See [here](#) for Trial Implementation and Final Text versions and [here](#) for Public Comment versions.

Foreword

30 This is a supplement to the IHE Radiology Technical Framework V15.0. 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 September 9, 2016 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
35 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.

<i>Amend Section X.X by the following:</i>
--

40 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.

45 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>.

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

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Introduction to this Supplement

100 The Digital Breast Tomosynthesis (DBT) Profile specifies the creation, exchange and use of DBT images. It defines basic display capabilities that Image Displays are expected to provide, especially simultaneous review of DBT and conventional 2D mammography images (FFDM). Within this supplement, two additional options are defined which address the creation, storage and display of Breast Projection X-Ray Images.

Open Issues and Questions

No open issues left

105 Closed Issues

1. *Should this supplement be a new profile or a named option for the Mammography Image Profile?*

110 Due to the complexity of this supplement and possible options for it (e.g., flagging key images) and in order to keep it aligned with MAMMO and SMI it was decided to create a new profile rather than an option.

2. *Is support for the Breast Projection X-Ray Image SOP classes needed?*

During our discussions with clinical users it was pointed out that due to the limited amount of time for reviewing screening mammography cases, the projection images are not reviewed; therefore their use will not be mandated in this supplement.

- 115 3. *Do we need to distinguish between generated 2D images and conventional 2D mammography images or can they be treated the same?*

Since there will be a transition period until clinical users are confident to just use the generated 2D images, it was decided to keep those separated for now.

4. *Should export to media and basic image reviewing be in the scope of this profile?*

120 No, there should not be any specific behavior defined in this profile, however in the section for Cross Profile Considerations some explanation should be given.

5. *Should this profile address 3D visualization (Volume Rendering, Multiplanar Reformatting ...)?*

125 No, this is a broader problem, which impacts multiple other modalities as well, and therefore, if necessary should be addressed in a general profile on 3D.

6. *Should the profile support flagging of key images?*

According to clinical users, this would be a helpful feature. Therefore two uses cases should be taken into account:

- 130 a) Screening review, when the user wants to start scrolling through the case and not directly go to the key images.
b) Review of key images only.

7. *Should lossless compression be supported?*

135 In order to fulfill performance requirements Acquisition Modalities, Evidence Creators and Image Display Actors should be free to decide whether they create/display images with lossless compression. However the Image Manager/Archive needs to support both, compressed and uncompressed images and needs to be able to convert on the fly when sending to the Image Display.

8. *How do we address different reconstructions of DBT images (e.g., slabs)?*

140 It was decided to add an Evidence Creator Actor, which can generate different reconstructions of the DBT image. It is possible to either group the Acquisition Modality or the Image Display with this actor. Furthermore, this actor can be a standalone workstation. For the latter scenario it is out of scope to define, how this workstation accesses the images.

9. *Are there use cases for printing DBT images?*

145 Clinical users are interested in printing key images only, not the complete DBT data set. True size, same size and printing of annotated images shall be supported.

10. *Do contrast adjustments need to be performed on a per frame basis or for the complete DBT data set?*

150 Window/Level and VOI LUTs can be applied on a frame by frame basis; therefore those attributes can either be in the Shared or the Per Frame Functional Groups Sequence.

11. *Are partial views relevant to tomosynthesis?*

Yes, they will be treated the same way as for conventional 2D mammography images.

12. *Is there a use case, which mandates the use of DICOM Concatenation?*

155 No, all images are needed prior to starting the review (e.g., in order to evaluate asymmetries), therefore splitting up data sets in order to allow for faster review is not necessary.

13. *How is this supplement best documented, using the current template (e.g., as done in the SMI Profile) or should it be defined as a pure content profile?*

160 Current decision is to follow the approach that was taken in the SMI Profile, however in future, if there is a template for DICOM Content Profiles this supplement may be re-written to follow that template.

14. *Shall Storage of Breast Projection X-Ray Images be a named option, or should we just reference it as an optional SOP Class?*

165 It was decided to make support for Breast Projection X-Ray Images a named option in order to address use cases for creating additional reconstructions based on these images, for review, for tomosynthesis CAD and for use in technical problem solving.

15. *What is a good name for synthetic images?*

It was decided to use generated 2D images.

170 16. *Do we need to add additional procedure codes for tomosynthesis studies to the [Rad 5] Query Modality Worklist Transaction? Or are studies including DBT still classified as “Screening Mammography”*

It was decided to add exam codes for combined 2D and 3D acquisitions:

- Bilateral FFDM combined with tomosynthesis diagnostic
- Bilateral FFDM combined with tomosynthesis screening
- 175 • Left FFDM combined with tomosynthesis diagnostic
- Left FFDM combined with tomosynthesis screening
- Right FFDM combined with tomosynthesis diagnostic
- Right FFDM combined with tomosynthesis screening

180 17. *Since the Breast Tomosynthesis Image IOD and the Breast Projection X-Ray Image IOD are well defined with regards to Attribute Type requirements, should we list those tables in Transaction [Rad-8] Modality Images Stored?*

It was decided to keep the detailed tables and list attribute requirements that are relevant in the context of the 1999 ACR Quality Control Manual for Mammography.

18. *How do we potentially address performance requirements?*

185 Some informative text was added in the use case section to state the importance of performance and what the goal would be (instantaneous scrolling/switching, between slices, images and cases)

190 19. *For the section on Image Orientation and Justification: Does the DBT image always consist of parallel slices or can they have different Image Orientation (Patient)(0020, 0037) in the Plane Orientation Sequence (0020,9116) values. If they are always parallel should we mandate the Plane Orientation Sequence to part of the Shared Functional Groups Sequence?*

Limit to just parallel slices for now and therefore mandate, that this information is stored in the Shared Functional Groups Sequence.

195 20. *What do we need to say about CAD? In theory one could perform CAD on DBT images and encode the results using SCOORD and the Referenced Frame number in the IMAGE in the existing Mammography CAD SR. Is this the way that tomosynthesis CAD will be defined or would it rather be done on the Projection Images and then ‘translated’ to the DBT image coordinate system using SCOORD3D and a reference Coordinate System?*

- 200 CAD is out of the scope of this profile. 2D CAD is addressed in the MAMMO Image Profile and therefore all references to CAD will be removed in this supplement
21. *Mammography Acquisition Workflow depends on Mammo Image for Content Creation and display. Should it depend on Mammo Image, DBT, or both?*
- 205 Since MAWF is still in Trial Implementation and not very well adapted, we stay silent about this issue at the moment
22. *We decided to allow storage of generated 2D images in both SOP Classes (Tomosynthesis and MG). Do we need to know, that two images are the same, if so, which attributes do we need to mandate, in order to make sure, that two images represent the same content, what values do they need to have?* (Section 4.8.4.1.2.7)
- 210 Both images will reference each other using the Reference Image Sequence and using Purpose of Reference Code Sequence (0040, A170) item shall have a value of (“121326, DCM, Alternate SOP Class Instance”).
- After additional discussions it was decided to only mandate storage using the Breast Tomosynthesis Image Storage SOP Class. Therefore nothing will be said about MG and potential references.
- 215
23. *What is the relationship between Image Type and Frame Type in the X-Ray 3D Frame Type Sequence (see Table 4.8.4.1.2.7-2)? Which one should we use: Image Type or Frame Type, if Frame Type should this be a shared value or a per frame value. If both are used should we state that they need to have the same value?*
- 220 We decided not to allow for different Frame Type values within one image instance and therefore to just use Image Type values to distinguish between different reconstruction types for tomosynthesis images.
24. *Should we add the table that defines the values of Image Type/Volumetric Properties/Volume Based Calculation Technique (Table 4.8.4.1.2.7-2) to be used for the various types of reconstructions in this chapter, currently it is in Section 4.16.4.2.2.1.3.5.2?*
- 225 An updated version of that table was generated and moved to Section 4.8.4.1.2.7. The table is solely based on Image Type values; Volumetric Properties and Volume Based Calculation Technique are not used.
- 230 25. *In Table 4.8.4.1.2.7-2 is the Relative X-Ray Exposure in the Per Projection Acquisition Sequence needed, or will we just display cumulative dose information and therefore remove this Sequence and the item?*
- It was decided to just use the cumulative values for tomosynthesis images.
- 235 26. *Since additional breast tomosynthesis images can be derived from either the FOR PROCESSING breast projection X-Ray images or from a thin slice breast tomosynthesis image, do we need to annotate them differently depending on the object type that was used to generate them? How would those be distinguished in the DICOM header (another item in the Contributing Sources Sequence, differences in the Image Type*

240 *attribute)? Can it be done based on Value 1 of Image Type (e.g., using ORIGINAL vs DERIVED)?*

It was decided that this is not relevant.

245 27. *In Section 4.16.4.2.2.1.3.5.2: Is the Primary Positioner Scan Start Angle what is really clinically relevant or would it rather be the ‘middle’- angle of the tomosynthesis acquisition? If so, how would this be derived, since this information is not in the DBT image?*

We decided to additionally mandate the use of the Primary Positioner Scan Arc so that the relevant angles can be calculated.

250 28. *In Table 4.8.4.1.2.7-2.1: Do we need Image Type/Frame Type for Breast Projection X-Ray Images at all? Do we make use of it, or should we just remove it, since we don’t use it in this profile?*

We decided to use Image Type Value 3 to mark images as projection images

255 29. *In Section 4.16.4.2.2.1.3: If a generated 2D image is available as both (tomosynthesis image and MG image), which one should be displayed, I assumed it would be the tomosynthesis images, is that true?*

The Image Display shall display one of the two images, it can decide which one.

Later it was decided to use only the Breast Tomosynthesis Image SOP Class for this profile.

30. *How should this profile be named?*

For now we decided on Digital Breast Tomosynthesis (DBT).

260 31. *We need to think about what to say about measurements and its accuracy on DBT images.*

265 Measurements performed on a 2D MG image based on Imager Pixel Spacing and Estimated Radiographic Magnification Factor slightly differ depending on where the measured object is located (next to the detector or next to the paddle) due to projection characteristics.

Measurements performed on a DBT slice based on Pixel Spacing are accurate and independent of the location of the measured object. (Pixel Spacing is the distance in the patient!)

270 32. *Are there any MQSA or other regulatory requirements that need to be taken into account? Are there any other international regulatory requirements?*

No additional requirements have been identified.

33. *To simplify the task of the image display and to provide sufficient technique information for DBT images to the users we decided to require the information that is common to all projections (e.g., aggregate exposure values) be encoded by the modality and not to*

- 275 *require per projection acquisition information for display purposes. Is this okay for all modality vendors?*
- Accumulated values are sufficient.
- 280 34. *In Table 4.8.4.1.2.7-4: Should JPEG-LS be supported by this profile. We also added support for lossy transfer syntaxes (JPEG 2000 lossy, JPEG Extended (Process 2 & 4) to this table. Is it appropriate to keep these?*
- Support for JPEG-LS is not needed in this profile; the other transfer syntaxes will be supported in this profile.
- 285 35. *Should we allow multi-pass perfusion studies in one tomosynthesis image instance or should we limit each tomosynthesis image instance to a single pass (i.e., should it be possible to have multiple slices at the same location within an image instance)? Closed only single pass*
- Only single pass studies are supported.
36. *Section 4.16.4.2.2.1.3.10 addresses display features for Projection images. Are all these features needed for use cases relevant to projection images?*
- 290 All features are supported except automatic scrolling (cine).
37. *Section 4.16.4.2.2.1.3.10: what do we need to say about scrolling, I assume mostly the Section 4.16.4.2.2.1.3.9 applies but it may have to be extended to address simultaneous scrolling between projection images and tomosynthesis slices, I assume this should be disabled. Is there anything specific that needs to be said to parallel display of*
- 295 *tomosynthesis slices with Projection Images?*
- Simultaneous scrolling between projection images and tomosynthesis slices and automatic scrolling (cine) of projection images are not supported by this profile. Otherwise the scrolling behavior is the same.
- 300 38. *Should the User Annotation Option/use case subsume key image use cases? Would a user flag a key image/frame without performing an annotation?*
- Both use cases have to be supported according to clinical user feedback.
39. *Should the functionality to flag key images/frames be an option or should it be baseline functionality?*
- It was decided to keep it as an option based on public comment feedback.
- 305 40. *We need a better term for „generated 2D images” as a name for mathematically derived 2D images from a tomosynthesis acquisition. Any suggestions?*
- We decided to use “generated 2D”.
41. *How do we best document support for specific transfer syntaxes?*
- Current text is okay, no changes are needed.

310 42. *In Table 4.8.4.1.2.7-2.1: For Breast Projection X-Ray Images dose information is stored in the X-Ray Dose Acquisition Sequence on a per frame basis as well as in the Enhanced Mammography Image Module as cumulative values. Do we need the per-frame information or do we just need the cumulative values?*

The decision was to use the information on a per frame basis.

315 43. *In Table 4.5-5 a set of codes for combination studies (tomosynthesis and conventional mammography) have been added. Do we also need codes for just tomosynthesis studies? Should we also transition to SNOMED or other standard codes rather than IHE specific codes?*

Table was updated to use LOINC or RadLex codes where available.

320 44. *Currently the Media Creator Option mandates that viewers copied on media need to provide display capabilities described in this supplement. However this might be too much for viewers on extern media. Shall we define a minimal set of requirements needed for these viewers?*

Section 4.16.4.2.2.1.3.11 was added to address a set of minimal viewer requirements.

325 45. *Table 4.8.4.1.2.7-1 was copied from a pre-approved version of DICOM CP 1299. The final version of this CP does not include this table anymore. However I think information like this is necessary to distinguish DBT images based on how they were derived. Therefore I kept this table and we can discuss how to modify it, that it meets our needs.*

330 We created an updated version of this table which matches DICOM CP 1342. When this CP is approved we need to make sure, that the table is aligned with the final version of that CP - DONE

46. *Should the Evidence Creator participate in the For Processing Breast Projection X-Ray Images Option? If so what transactions and functionality should it be required to support?*

- 335
- The current option text is written without involvement of the Evidence Creator Actor and we have not received any feedback regarding this issue yet.
 - These images are generated at the Modality and are the original data, which are used to generate the DBT slices. There is no need for an evidence creator to be involved.
 - If this functionality should be needed later on, it can be added via the CP process, since it does not change any mandatory behavior.
- 340

General Introduction

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

345 **Appendix A – Actor Summary Definitions**

Add the following actors to the IHE Technical Frameworks General Introduction list of actors:

There are no new actors in this supplement.

Appendix B – Transaction Summary Definitions

350

Add the following transactions to the IHE Technical Frameworks General Introduction list of Transactions:

There are no new transactions in this supplement.

Glossary

Add the following glossary terms to the IHE Technical Frameworks General Introduction Glossary:

355

Volume 1 – Profiles

Add the following to the IHE Technical Frameworks General Introduction Copyright Section:

NA

Domain-specific additions

None

360

Modify Section 37 as indicated below...

37 Digital Breast Tomosynthesis (DBT)

365 The Digital Breast Tomosynthesis (DBT) Profile specifies the creation, exchange and use of
DBT images. It defines basic display capabilities that Image Displays are expected to provide,
especially simultaneous review of DBT and conventional 2D mammography images (FFDM).

The Digital Breast Tomosynthesis Profile is designed to provide faithful storage and retrieval of
DBT images. Furthermore, sufficient display functionality to allow adequate review of current
and prior studies consisting of DBT and/or conventional 2D mammography images is defined.
The support for CAD is out of the scope for this profile.

370 ...

Modify Section 37.1.1.1 as indicated below...

37.1.1.1 Acquisition Modality

375 The Acquisition Modality-~~Actor~~ acquires breast projection X-Ray images and generates
tomosynthesis images. **Storage of the breast projection X-Ray images for tomosynthesis is
optional.**

380 The Acquisition Modality can optionally acquire conventional 2D mammography images or
generate a 2D image mathematically from tomosynthesis data. Creation and storage of
conventional 2D mammography images is facilitated by grouping the Acquisition Modality in
the DBT Profile with an Acquisition Modality from the Mammography Image Profile (see RAD
TF-1: 19).

In order to generate and store additional derived tomosynthesis reconstructions (e.g., slabs), the
Acquisition Modality can be grouped with an Evidence Creator-~~Actor~~.

385

Modify Section 37.1.1.2 as indicated below...

37.1.1.2 Image Manager/Archive

390 The Image Manager/Archive-~~Actor~~ receives breast tomosynthesis images, conventional 2D
mammography images, 2D images generated mathematically from tomosynthesis data, **and
optionally breast projection X-Ray images for tomosynthesis** from the Acquisition Modality
or an Evidence Creator-~~Actor~~, responds to query requests, and stores requested image data to an
Image Display.

395 *Modify Section 37.2 as indicated below...*

37.2 DBT Actor Options

Table 37.2-1: DBT - Actors and Options

Actor	Option Name	TF Reference
Acquisition Modality	Partial View	RAD TF-1: 37.2.2
	<u>For Presentation Breast Projection X-Ray Images</u>	<u>RAD TF-1:3 7.2.3</u>
	<u>For Processing Breast Projection X-Ray Images</u>	<u>RAD TF-1: 37.2.4</u>
	Media Creation	RAD TF-1: 37.2.6
Evidence Creator	No options defined	--
Image Manager/Archive	Key Images	RAD TF-1: 37.2.1
	<u>For Presentation Breast Projection X-Ray Images</u>	<u>RAD TF-1: 37.2.3</u>
	<u>For Processing Breast Projection X-Ray Images</u>	<u>RAD TF-1: 37.2.4</u>
	User Annotation	RAD TF-1: 37.2.5
Image Display	Key Images	RAD TF-1: 37.2.1
	Partial View	RAD TF-1: 37.2.2
	<u>For Presentation Breast Projection X-Ray Images</u>	RAD TF-1: 37.2.3
	User Annotation	RAD TF-1: 37.2.5
	Media Creation	RAD TF-1: 37.2.6
Print Composer	No options defined	--
Print Server	No options defined	--

400

37.2.1 Key Images Option

The Key Images Option enables users to mark key images or frames of a breast tomosynthesis image by attaching a Key Image Note and provide them for display. The functionality is defined in the Key Image Note Profile (RAD TF-1:8); therefore this functionality is achieved by

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- Image Displays that support creation of Key Image Notes shall be grouped with an Evidence Creator in the Key Image Note Profile and shall be able to create and store Key Image Notes for one or more of the SOP classes in RAD TF-2: Table 4.16.4.1.3.7-1.
- Image Displays that support rendering of Key Image Notes shall be grouped with an Image Display-Actor in the Key Image Note Profile and shall be able to query, retrieve and render Key Image Notes for one or more of the SOP classes in RAD TF-2: Table 4.16.4.1.3.7-1.

410

- Image Manager/Archives that support storage and retrieval of Key Image Notes shall be grouped with an Image Manager/Archive ~~Actor~~ in the Key Image Note Profile to enable storage/retrieval of the Key Object Selection Document.

37.2.2 Partial View Option

The Partial View Option addresses the creation and display of mosaic images.

It defines additional attributes which the Acquisition Modality includes in the image headers in order to indicate whether an image is part of a mosaic and which part of the set the image represents as defined in RAD TF-2: 4.8.4.1.2.7.1 Partial View Option.

Furthermore, it defines how Image Displays ~~Actors~~ make use of this information to annotate the images in the viewport as defined in RAD TF-2: 4.16.4.2.2.1.3.7 Partial View Option.

Insert Section 37.2.3 and 37.2.4

37.2.3 For Presentation Breast Projection X-Ray Images Option

The For Presentation Breast Projection X-Ray Images Option addresses the creation, retrieval and display of breast projection X-Ray images acquired for the purpose of tomosynthesis to identify the source of image quality issues, such as patient motion.

Acquisition Modalities and Image Manager/Archives that support this option shall implement the requirements for creation and storage of breast projection X-Ray images as defined in RAD TF-2: 4.8.4.1.2.7.2 Breast Projection X-Ray Images Options.

Image Displays that support this option shall implement the requirements for retrieval and display of breast projection X-Ray images as defined in RAD TF 2: 4.16.4.2.2.1.3.10.

37.2.4 For Processing Breast Projection X-Ray Images Option

The For Processing Breast Projection X-Ray Images Option addresses the creation and retrieval of breast projection X-Ray images acquired for the purpose of tomosynthesis in order to create retrospective reconstructions of tomosynthesis slices from projection images.

Acquisition Modalities and Image Manager/Archives that support this option shall implement the requirements for creation and storage of breast projection X-Ray images as defined in RAD TF-2: 4.8.4.1.2.7.2 Breast Projection X-Ray Images Options.

...

445 **37.4 DBT Overview**

The Digital Breast Tomosynthesis (DBT) Profile specifies the creation, exchange and use of DBT images. It defines basic display capabilities that Image Displays are expected to provide, especially simultaneous review of DBT and conventional 2D mammography images (FFDM).

...

450 *Modify Section 37.4.2.1.1 as indicated below*

37.4.2.1.1 DBT Screening Use Case Description

455 This use case encompasses a group of scenarios which vary in the number and type of images that are created at the modality and whether a current study only or a current and a prior are reviewed. Each study, current or prior can include one or multiple views of each breast, where one view may contain a set of:

- Tomosynthesis slices
- **Tomosynthesis projection images**
- Tomosynthesis slabs
- 460 • Conventional 2D mammography images
- Generated 2D images derived from tomosynthesis data

During the review of a study the radiologist can utilize the available display options, such as contrast adjustments, image sizing changes, etc.

The goal for this use case is to support fast reading of the data, which includes:

- 465
- Instantaneous scrolling through slices
 - Instantaneous switching between images (different views, different image types, prior images)
 - Instantaneous switching to the next case.

...

470

Modify Section 37.4.2.3.1 as indicated below

37.4.2.3.1 DBT in Diagnostic Mammography Use Case Description

475 Based on findings (e.g., suspected mass, asymmetry) in a conventional 2D mammography or DBT screening study or a palpable finding in the patient, a DBT diagnostic study may be

ordered. Exaggerated, rolled, 90-degree (LM, ML) and/or spot compression views are acquired using DBT acquisition or combination 2D/DBT acquisition.

The diagnostic study may contain one or more diagnostic views of a single breast or both breasts, each of which may include a set of:

- 480 • Tomosynthesis slices
- **Tomosynthesis projection images**
- Tomosynthesis slabs
- Conventional 2D mammography images
- Generated 2D images derived from tomosynthesis data

485 During the review of a study the radiologist can utilize the available display options, such as contrast adjustments, image sizing changes, etc.

...

<i>Insert Section 37.4.2.7 and subsection</i>

490 **37.4.2.7 Use Case #7: Additional reconstructions based on Projection Images**

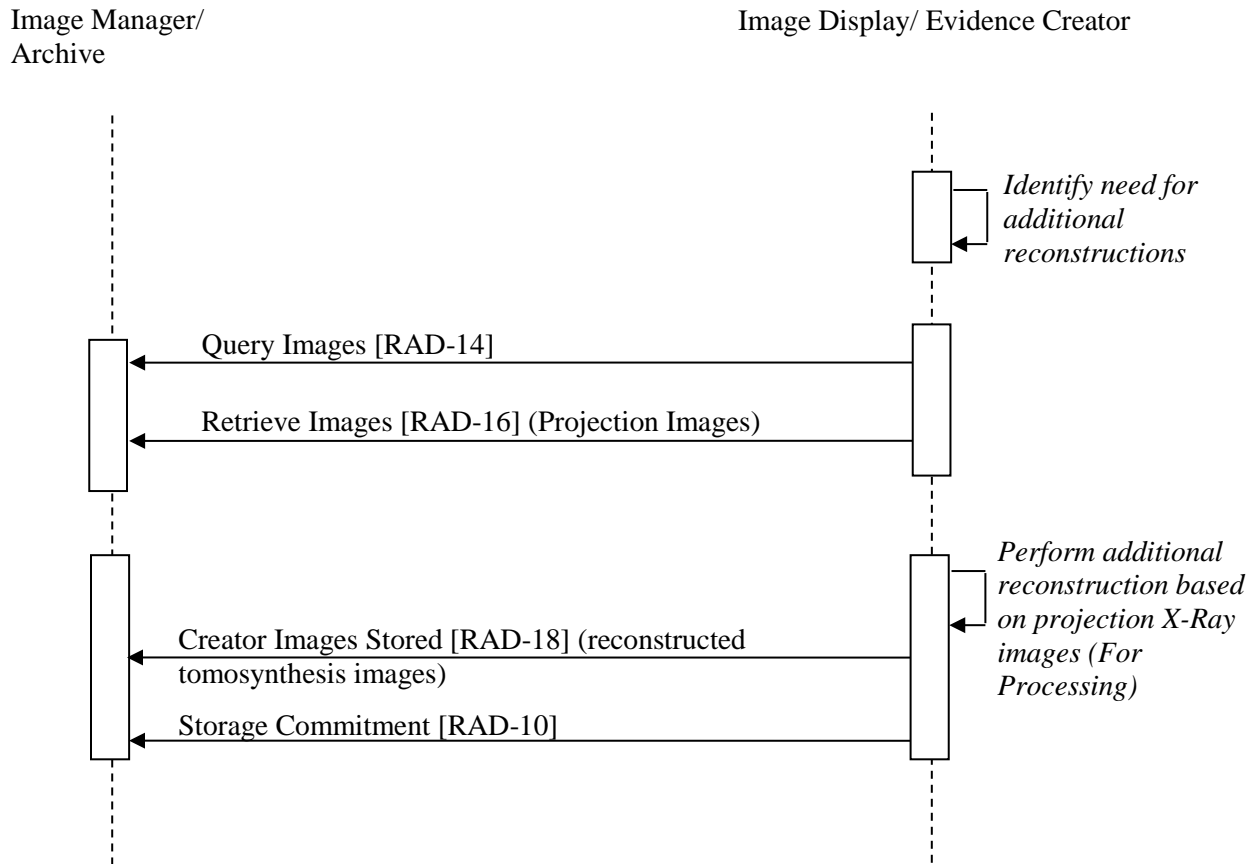
This use case addresses the workflow to generate additional tomosynthesis reconstructions based on breast projection X-Ray images for tomosynthesis, for systems supporting both Breast Projection X-Ray Images Options.

37.4.2.7.1 Additional reconstructions based on Projection Images Description

495 The radiologist reviews the tomosynthesis images at a workstation and detects technical problems with the reconstruction. Therefore she/he loads the source breast projection X-Ray images (For Presentation) and reviews them. She/he decides that the problem could be solved by using different reconstruction parameters. The Evidence Creator which is grouped with the Image Display performs the additional reconstruction, provides the images for display and stores
500 them to the Image Manager/Archive.

Note: Handling rejection of previous reconstructions is addressed in Section 37.6 Cross Profile Consideration in the context of the Mammography Acquisition Workflow Profile.

37.4.2.7.2 Additional reconstructions based on Projection Images Process Flow



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Figure 37.4.2.7.2-1: Process Flow in Additional Reconstructions based on Projection Images Use Case

Insert Section 37.4.2.8 and subsection

510

37.4.2.8 Use Case #8: Review of Projection Images

This use addresses reviewing the breast projection X-Ray images for tomosynthesis in addition to the tomosynthesis reconstructions and the conventional 2D mammography images for systems supporting the For Presentation Breast Projection X-Ray Images Option.

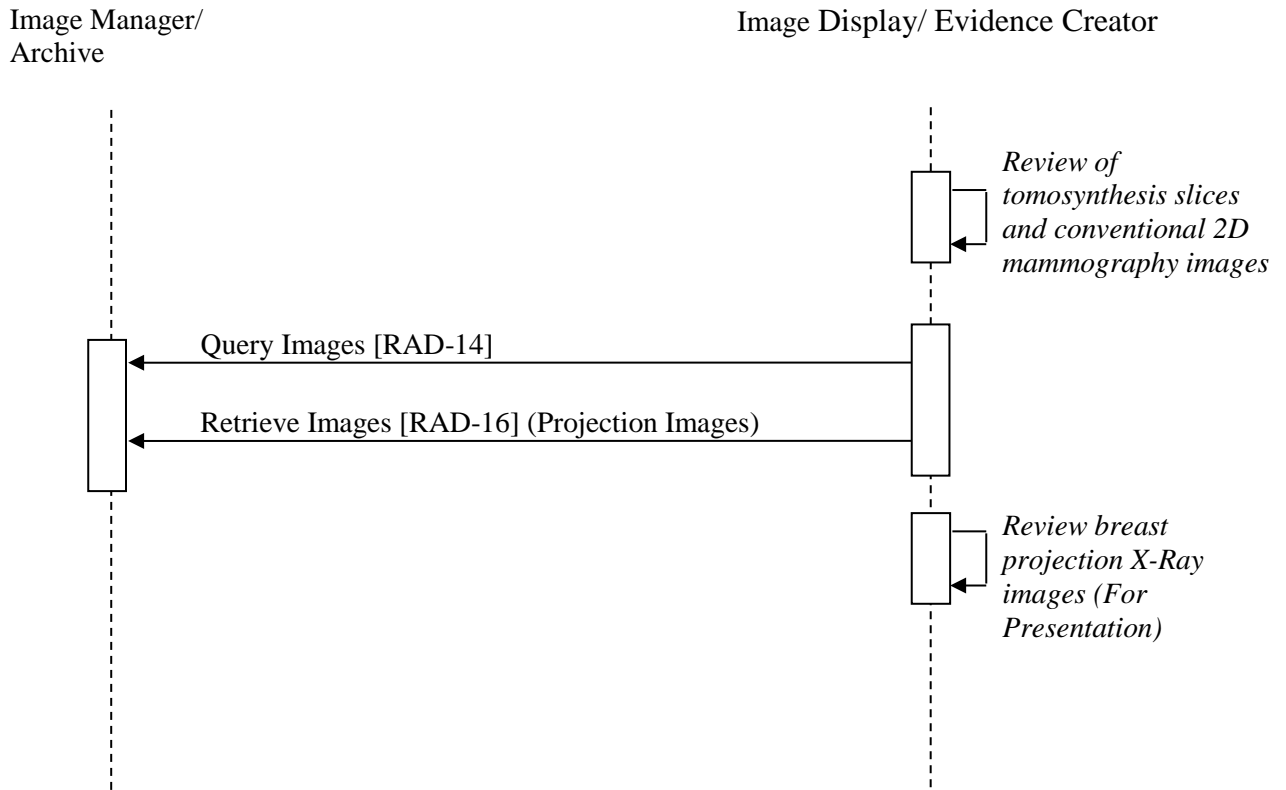
37.4.2.8.1 Review of Projection Images Use Case Description

515

The radiologist reviews the breast tomosynthesis images at a workstation and detects some problems with the images. Therefore she/he loads the source breast projection X-Ray images

(For Presentation) and reviews them for diagnostic purposes or to check for quality issues such as patient motion.

37.4.2.8.2 Review of Projection Images Use Case Process Flow



520

Figure 37.4.2.8.2-1: Process Flow in Review of Projection Images Use Case

Modify Section 37.6 as indicated below

525 37.6 DBT Cross Profile Considerations

SWF – Scheduled Workflow

The main focus of the Digital Breast Tomosynthesis Profile is to define creation and review of digital breast tomosynthesis studies including DBT images, **and** conventional 2D mammography images **and breast projection X-Ray images**. The scheduling workflow is addressed in the

530

MAWF - Mammography Acquisition Workflow

535 The main focus of the Digital Breast Tomosynthesis Profile is to define creation and review of digital breast tomosynthesis studies including DBT images, ~~and~~ conventional 2D mammography images **and breast projection X-Ray images**. The workflows addressing exception handling scenarios, e.g., converting a screening procedure into a diagnostic procedure, are defined in the Mammography Acquisition Workflow Profile. The workflows defined in that profile are independent of the type of images acquired and therefore apply to studies including DBT images as well.

BIR - Basic Image Review

540 The Basic Image Review Profile clearly states that specialty viewing (like Mammography) is outside the scope of that profile. Therefore review of DBT images in the BIR Profile is confined to partial (display – only) support. Specific viewer requirements are addressed in Section 37.2.6.

Appendices

545 No new appendices.

Volume 2 – Transactions

Modify Section 4.8 as indicated below

4.8 Modality Images Stored

...

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4.8.4.1.2.7 Storage of Digital Breast Tomosynthesis Images

The Acquisition Modality in the Digital Breast Tomosynthesis Profile shall support the DICOM^{®1} Breast Tomosynthesis Image Storage SOP Class and the additional attributes specified in Table 4.8.4.1.2.7-2 and Table 4.8.4.1.2.7-3.

555 If conventional 2D mammography images are acquired, the Acquisition Modality shall support the Digital Mammography X-Ray Image Storage - For Presentation and For Processing SOP Classes and the additional attributes specified in Table 4.8.4.1.2.3-1.

560 **The Acquisition Modality that supports the For Presentation Breast Projection X-Ray Images Option shall support the Breast Projection X-Ray Image For Presentation SOP Class and the additional attributes specified in Table 4.8.4.1.2.7-2 and Table 4.8.4.1.2.7.2-1.**

The Acquisition Modality that supports the For Processing Breast Projection X-Ray Images Option shall support the Breast Projection X-Ray Image For Processing SOP Class and the additional attributes specified in Table 4.8.4.1.2.7-2 and Table 4.8.4.1.2.7.2-1.

565 **Note 1: These requirements are consistent with those for conventional 2D mammography images defined in Table 4.8.4.1.2.3-1, but specialized to account for the encoding of multiple frames in a single image instance and the use of multi-frame functional groups. The convention used in the CT/MR Perfusion Imaging with Contrast (PERF) Profile is used to indicate nesting within a functional group sequence.**

570 **Note 2: Unlike the Digital Mammography X-Ray Image IOD, the Breast Tomosynthesis Image and Breast Projection X-Ray Image IODs use the Enhanced General Equipment Module, which already makes various equipment-related attributes mandatory, but these are repeated here for clarity.**

Note 3: Since support for the Breast Projection X-Ray Image IOD is optional, additional requirements to include acquisition information in the Breast Tomosynthesis Image instances are to preserve the technique information for quality control.

575 Acquisition Modalities capable of creating generated 2D images mathematically from tomosynthesis data (e.g., by Maximum Intensity Projection) shall encode them using the Breast Tomosynthesis Image Storage SOP Class.

The Acquisition Modality is not required to use Stacks, or the Multi-frame Dimensions Module, but is not prohibited from doing so. Concatenations are forbidden. In order to distinguish the

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

580 different types of tomosynthesis images, the Image Type (0008,0008) attribute shall be populated according to Table 4.8.4.1.2.7-1.

Table 4.8.4.1.2.7-1: Image Type in Breast Tomosynthesis Images

Type of tomosynthesis image	Image Type Value 1	Image Type Value 3	Image Type Value 4
Thin Slices	ORIGINAL/DERIVED	TOMOSYNTHESIS	NONE
Thick Slices (Slabs)	DERIVED	TOMOSYNTHESIS	e.g., MAXIMUM, MEAN
Tomosynthesis Generated 2D	DERIVED	TOMOSYNTHESIS	GENERATED_2D

Note: This table is adapted from DICOM CP 1342 and will be finalized after CP 1342 is approved.

585 **Table 4.8.4.1.2.7-2: Required additional attributes for DBT Reconstruction Images common to DBT Reconstruction and Projection Images**

Attribute	Tag	Tomo	Proj	Rationale
Patient's Name	(0010,0010)	R+	R+	Used for identification during display
Patient ID	(0010,0020)	R+	R+	Used for identification during display
Patient's Birth Date	(0010,0030)	R+	R+	Used for identification during display
Patient's Age	(0010,1010)	R+	R+	Used for identification during display
Operators' Name	(0008,1070)	R+	R+	Used for identification during display
Manufacturer	(0008,0070)	R	R	Used for quality control display
Institution Name	(0008,0080)	R+	R+	Used for identification during display
Institution Address	(0008,0081)	R+	R+	Used for quality control display
Manufacturer's Model Name	(0008,1090)	R	R	Used for quality control display
Device Serial Number	(0018,1000)	R	R	Used for quality control display
Station Name	(0008,1010)	R+	R+	Used for identification of the system that acquired the images during display

...

Modify Section 4.8.4.1.2.7.1

4.8.4.1.2.7.1 Partial View Option

590 Acquisition Modalities supporting the Partial View Option in the Digital Breast Tomosynthesis Profile shall fulfill all requirements listed in Section 4.8.4.1.2.3.1 for tomosynthesis reconstructions, **and** 2D images generated mathematically from tomosynthesis data, **and projection images (if one of the Breast Projection X-Ray Images Options is supported).**

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*Insert Section 4.8.4.1.2.7.2***4.8.4.1.2.7.2 Breast Projection X-Ray Images Options**

600 The Acquisition Modality and Image Manager/Archive supporting the For Presentation Breast Projection X-Ray Images Option of the Digital Breast Tomosynthesis Profile shall additionally support the Breast Projection X-Ray Image For Presentation SOP Class as specified in Table 4.8.4.1.2.7-2 and in Table 4.8.4.1.2.7.2-1.

605 The Acquisition Modality and Image Manager/Archive supporting the For Processing Breast Projection X-Ray Images Option of the Digital Breast Tomosynthesis Profile shall additionally support the Breast Projection X-Ray Image For Processing SOP Class as specified in Table 4.8.4.1.2.7-2 and in Table 4.8.4.1.2.7.2-1.

Table 4.8.4.1.2.7.2-1: Required Additional Attributes for Breast Projection X-Ray Images

Attribute	Tag	Proj	Rationale
Acquisition DateTime	(0008,002A)	R	Used for identification during display
Image Type	(0008,0008)	R	Used to indicate projection images
Detector ID	(0018,700A)	R+	Used for quality control display
Date of Last Detector Calibration	(0018,700C)	R+	Used for quality control display
Number of Frames	(0028,0008)	R	Used for display during scrolling
Patient Orientation	(0020,0020)	RC	Used for hanging protocol configuration- Pixel data orientation of the most representative frame
KVP	(0018,0060)	R	Used for display of the kVp technical factor
X-Ray Tube Current in mA	(0018,9330)	R+	Used for display of the mA technical factor
Exposure in mAs	(0018,9332)	R+	Used to display cumulative Exposure parameters
Exposure Time in ms	(0018,9328)	R+	Used to display cumulative Exposure parameters
Entrance Dose in mGy	(0040,8302)	R	Used for display of the collective total skin dose technical factor
Organ Dose	(0040,0316)	R	Used for the display of the collective total glandular dose technical factor
Anode Target Material	(0018,1191)	R	Used for display of the target technical factor
Compression Force	(0018,11A2)	R	Used for display of the compression force technical factor
Body Part Thickness	(0018,11A0)	R	Used for display of the compressed breast thickness technical factor

Attribute	Tag	Proj	Rationale
Pixel Padding Value	(0028,0120)	RC+	Required if background air suppression has been performed by replacing the pixels with a value not used within the breast tissue, so that pixels with this value can be excluded from contrast transformations. May be present otherwise. See Section 4.8.4.1.2.3.2
Pixel Padding Range Limit	(0028,0121)	RC+	Required if Pixel Padding Value (0028,0120) is present and the padding values are a range rather than a single value. See Section 4.8.4.1.2.3.2
Breast Implant Present	(0028,1300)	R	Used to control hanging and processing; not identical to Implant Displaced value for View Modifier Code Sequence, since an implant may be present but not displaced
X-Ray Filter Macro (could either be in Per-frame Functional Groups Sequence (5200,9230) or in Shared Functional Groups Sequence (5200,9229))			
X-Ray Filter Sequence	(0018,9556)	R+	Type 1 in Type U X-Ray Filter Macro
>Filter Material	(0018,7050)	R+	Used for display of the filter technical factor
Breast X-Ray Acquisition Dose Macro (could either be in Per-frame Functional Groups Sequence (5200,9230) or in Shared Functional Groups Sequence (5200,9229))			
X-Ray Acquisition Dose Sequence	(0018,9542)	R	
>Exposure in mAs	(0018,9332)	R	Used for display of the mAs technical factor
>Exposure Time in ms	(0018,9328)	R	Used for display of the exposure time technical factor
>Relative X-Ray Exposure	(0018,1405)	R+	Used for the display of the relative exposure technical factor
>Entrance Dose in mGy	(0040,8302)	R	Used for display of the estimated skin dose technical factor
>Organ Dose	(0040,0316)	R	Used for the display of the estimated mean glandular dose technical factor
Frame VOI LUT With LUT Functional Macro (could either be in Per-frame Functional Groups Sequence (5200,9230) or in Shared Functional Groups Sequence (5200,9229))			
Frame VOI LUT Sequence	(0028,9132)	R	
>VOI LUT Sequence	(0028,3010)	C	Required if Window Center and Width not present
>>LUT Explanation	(0028,3003)	RC+	Required if more than one sequence item or at least one sequence item and window center/width pair is present in order to allow Image Display to present to the user a selection of LUTs or windows described by the explanation
>Window Center	(0028,1050)	C	Required if VOI LUT Sequence is not present
>Window Width	(0028,1051)	C	Required if VOI LUT Sequence is not present

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Attribute	Tag	Proj	Rationale
>Window Center and Width Explanation	(0028,1055)	RC+	Required if more than one VOI LUT Sequence item or window center/width pair and at least one VOI LUT Sequence item is present in order to allow Image Display to present to the user a selection of LUTs or windows described by the explanation
>VOI LUT Function	(0028,1056)	RC+	Required if Window Center and Width are not intended to be interpreted as parameters of a linear function in order to allow Image Display to perform appropriate contrast transformation. Enumerated Values LINEAR or SIGMOID
Breast X-Ray Positioner Macro (could either be in Per-frame Functional Groups Sequence (5200,9230) or in Shared Functional Groups Sequence (5200,9229))			
Positioner Position Sequence	(0018,9405)	R	
>Positioner Primary Angle	(0018,1510)	R	Used for display of the degree of obliquity technical factor
>Positioner Primary Angle Direction	(0018,9559)	R	Used for display of the degree of obliquity technical factor
Breast X-Ray Geometry Functional Macro (could either be in Per-frame Functional Groups Sequence (5200,9230) or in Shared Functional Groups Sequence (5200,9229))			
X-Ray Geometry Sequence	(0018, 9476)	R	
>Estimated Radiographic Magnification Factor	(0018,1114)	R	Used to adjust Imager Pixel Spacing (0018,1164) to account for geometric magnification for normal and magnified views when making distance measurements and displaying or printing calipers
X-Ray Frame Pixel Data Properties Functional Group Macro (could either be in Per-frame Functional Groups Sequence (5200,9230) or in Shared Functional Groups Sequence (5200,9229))			
Frame Pixel Data Properties Sequence	(0018,9443)	R	
>Imager Pixel Spacing	(0018,1164)	R+	Used for measurements
Frame Anatomy Functional Group Macro (shall be in Shared Functional Groups Sequence (5200,9229))			
Frame Anatomy Sequence	(0020,9071)	R	
>Frame Laterality	(0020,9072)	R	Used to describe which breast is imaged; all frames share the same value
Derivation Image Macro could either be in Per-frame Functional Groups Sequence (5200,9230) or in Shared Functional Groups Sequence (5200,9229))			
Derivation Image Sequence	(0008,9124)	RC	Type 2 in Type C Derivation Image Macro

Attribute	Tag	Proj	Rationale
>Source Image Sequence	(0008,2112)	RC+	Used in “For Presentation” images to reference the corresponding “For Processing” images; shall have item(s) if “For Processing” images are produced as DICOM SOP instances

610 The Acquisition Modality shall be capable of sending all supported SOP Classes to multiple destinations.

The Breast Projection X-Ray Image “For Presentation” instances shall contain a reference to the SOP Instance UID of the corresponding “For Processing” image in Source Image Sequence (0008,2112), if any.

615

Amend Section 4.8.4.1.3.1:

4.8.4.1.3.1 DICOM Image Storage SOP Classes

The DICOM Standard (~~2007~~) defines a number of image specific storage SOP classes. It is expected that Image Archive will support multiple storage SOP classes as defined in Table 4.8-1 below.

620

Table 4.8-1: Suggested Image SOP Classes

SOP Class UID	SOP Class Name
1.2.840.10008.5.1.4.1.1.1	Computed Radiography Image Storage
1.2.840.10008.5.1.4.1.1.2	CT Image Storage
1.2.840.10008.5.1.4.1.1.4	MR Image Storage
1.2.840.10008.5.1.4.1.1.20	Nuclear Medicine Image Storage
1.2.840.10008.5.1.4.1.1.128	Positron Emission Tomography Image Storage
1.2.840.10008.5.1.4.1.1.481.1	RT Image Storage
1.2.840.10008.5.1.4.1.1.7	Secondary Capture Image Storage
1.2.840.10008.5.1.4.1.1.6.1	Ultrasound Image Storage
1.2.840.10008.5.1.4.1.1.3.1	Ultrasound Multi-frame Image Storage
1.2.840.10008.5.1.4.1.1.12.1	X-Ray Angiographic Image Storage
1.2.840.10008.5.1.4.1.1.12.2	X-Ray Radiofluoroscopic Image Storage
1.2.840.10008.5.1.4.1.1.1.1	Digital X-Ray Image Storage – For Presentation
1.2.840.10008.5.1.4.1.1.1.1.1	Digital X-Ray Image Storage – For Processing
1.2.840.10008.5.1.4.1.1.1.2	Digital Mammography X-Ray Image Storage – For Presentation
1.2.840.10008.5.1.4.1.1.1.2.1	Digital Mammography X-Ray Image Storage – For Processing
1.2.840.10008.5.1.4.1.1.13.1.3	Breast Tomosynthesis Image Storage
1.2.840.10008.5.1.4.1.1.13.1.4	Breast Projection X-Ray Image Storage – For

SOP Class UID	SOP Class Name
	<u>Presentation</u>
<u>1.2.840.10008.5.1.4.1.1.13.1.5</u>	<u>Breast Projection X-Ray Image Storage – For Processing</u>
1.2.840.10008.5.1.4.1.1.1.3	Digital Intra-oral X-Ray Image Storage – For Presentation
1.2.840.10008.5.1.4.1.1.1.3.1	Digital Intra-oral X-Ray Image Storage – For Processing
1.2.840.10008.5.1.4.1.1.77.1.1	VL Endoscopic Image Storage
1.2.840.10008.5.1.4.1.1.77.1.2	VL Microscopic Image Storage
1.2.840.10008.5.1.4.1.1.77.1.3	VL Slide-Coordinates Microscopic Image Storage
1.2.840.10008.5.1.4.1.1.77.1.4	VL Photographic Image Storage

...

Modify Table 4.8-5 as indicated below and add the notes below the table

625

Table 4.8-5: Digital Breast Tomosynthesis SOP Classes for Acquisition and Archival

SOP Class UID	SOP Class Name	Optionality (Acq. Mod)	Optionality (IM/IA)
1.2.840.10008.5.1.4.1.1.13.1.3	Breast Tomosynthesis Image Storage	R	R
1.2.840.10008.5.1.4.1.1.1.2	Digital Mammography X-Ray Image Storage – For Presentation	O	R
1.2.840.10008.5.1.4.1.1.1.2.1	Digital Mammography X-Ray Image Storage – For Processing	O	R
<u>1.2.840.10008.5.1.4.1.1.13.1.4</u>	<u>Breast Projection X-Ray Image Storage – For Presentation (Note 1)</u>	<u>O</u>	<u>O</u>
<u>1.2.840.10008.5.1.4.1.1.13.1.5</u>	<u>Breast Projection X-Ray Image Storage – For Processing (Note 2)</u>	<u>O</u>	<u>O</u>

Note 1: The Breast Projection X-Ray Image Storage – For Presentation SOP Class is required for Acquisition Modalities and Image Manager/Archives if the For Presentation Breast Projection X-Ray Image Option is supported.

630

Note 2: The Breast Projection X-Ray Image Storage – For Processing SOP Class is required for Acquisition Modalities and Image Manager/Archives if the For Processing Breast Projection X-Ray Image Option is supported.

...

Amend Section 4.16 Retrieve Images

635 **4.16 Retrieve Images**

...

Modify Section 4.16.4.1.3.7 as indicated below

4.16.4.1.3.7 Digital Breast Tomosynthesis Profile

640 Image Display and Image Manager/Image Archive Actors in the Digital Breast Tomosynthesis Profile shall support retrieval of the SOP Classes with the optionality specified in Table 4.16.4.1.3.7-1.

Table 4.16.4.1.3.7-1: DBT SOP Classes for Retrieval

SOP Class UID	SOP Class Name	Optionality (Image Display)	Optionality (IM/IA)
1.2.840.10008.5.1.4.1.1.13.1.3	Breast Tomosynthesis Image Storage	R	R
1.2.840.10008.5.1.4.1.1.1.2	Digital Mammography X-Ray Image Storage – For Presentation	R	R
1.2.840.10008.5.1.4.1.1.1.2.1	Digital Mammography X-Ray Image Storage – For Processing	O	R
<u>1.2.840.10008.5.1.4.1.1.13.1.4</u>	<u>1.1.1.1.1.1 Breast Projection X-Ray Image Storage – For Presentation (Note 1)</u>	<u>1.1.1.1.1.2 O</u>	<u>1.1.1.1.3 O</u>
<u>1.2.840.10008.5.1.4.1.1.13.1.5</u>	<u>1.1.1.1.1.4 Breast Projection X-Ray Image Storage – For Processing (Note 2)</u>	<u>1.1.1.1.1.5 O</u>	<u>1.1.1.1.6 O</u>

645 **Note 1: Support for Breast Projection X-Ray Image Storage – For Presentation SOP Class is required if the For Presentation Breast Projection X-Ray Image Option is supported.**

Note 2: Support for Breast Projection X-Ray Image Storage –For Processing SOP Classes is required if the For Processing Breast Projection X-Ray Image Option is supported.

Image Displays may support the transfer syntaxes listed in Table 4.8.4.1.2.7-4.

650 Image Displays are only expected to support a single traversal of a volume stored in a Breast Tomosynthesis Image Storage instance (i.e., Image Position (Patient) (0020, 0032) has a different value for each frame).

Image Manager/ Image Archives participating in the Digital Breast Tomosynthesis Profile shall support the compression transfer syntaxes as listed in Table 4.8.4.1.2.7-4 for retrieval.

655

Modify Section 4.16.4.2 as indicated below

4.16.4.2 View Images

This transaction relates to the “View Images” event of the above interaction diagram.

...

660 4.16.4.2.2.1 Display of Digital X-Ray, Mammo, DBT and Intra-Oral Images

For the Breast Tomosynthesis Image, the “For Presentation” variant of the Digital X-Ray Image, the Digital Mammography X-Ray Image, **the Breast Projection X-Ray Image**, and the Digital Intra-oral X-Ray Image, the Image Display or Imaging Document Consumer-~~Actor~~ shall have both the capability to apply all the transformations specified by the VOI LUT Sequence (0028,3010) and the capability to apply all the transformations specified by the Window Width (0028,1051)/Window Center (0028,1050)/VOI LUT Function (0028,1056) attributes as selected by the user from the choices available (e.g., guided by Window Center/Width Explanation (0028,1055) or LUT Explanation(0028, 3003)). These attributes may be nested in a Functional Groups Sequence depending on the SOP Class,

670 ...

<i>Modify Section 4.16.4.2.2.1.3 as indicated below</i>

4.16.4.2.2.1.3 Display of DBT Images

675 Image Displays ~~Actors~~ participating in the Digital Breast Tomosynthesis Profile shall fulfill all requirements listed in Section 4.16.4.2.2.1.1 for the display of Digital Mammography X-Ray Image instances in addition to requirements listed in this section.

In the Digital Breast Tomosynthesis Profile, since current and prior studies may be performed with either conventional 2D mammography or DBT or both, and since DBT images may consist of tomosynthesis reconstructions alone, **or together with either the projection images (if the For Presentation Breast Projection X-Ray Images Option is supported)** or generated 2D images or both, the Image Display shall be capable of displaying combinations of screening views (typically left and right CC and MLO) from a current and prior set of a pair of any of the following types of acquisition:

- Tomosynthesis slices
- 685 • **Tomosynthesis projection images (if the For Presentation Breast Projection X-Ray Images Option is supported)**
- Tomosynthesis slabs
- Conventional 2D mammography images
- Generated 2D images derived from tomosynthesis data

690 I.e., Assuming an eight viewport layout, Image Displays shall be at minimum capable of displaying the following combinations based on the user preferences:

- Up to four views of current and prior study of the same acquisition type (e.g., current and prior DBT slices, or current and prior conventional 2D mammography images).
- 695 • Up to four views of current study of one acquisition type compared with the same views of current exam of a different acquisition type (e.g., current conventional 2D mammography images and current DBT slices).
- Up to four views of current study of one acquisition type compared with the same views of a prior of a different acquisition type (e.g., current DBT slices with prior conventional 2D mammography images).

700 Furthermore, the user shall be provided with a means to toggle between the available conventional 2D mammography images, tomosynthesis slices, **tomosynthesis projection images (if the For Presentation Breast Projection X-Ray Images Option is supported)** and generated 2D image for the views currently displayed without affecting the display layout.

705 Image Displays 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.

...

710 *Modify Section 4.16.4.2.2.1.3.7 as indicated below*

4.16.4.2.2.1.3.7 Partial View Option

715 Image Displays supporting the Partial View Option in the Digital Breast Tomosynthesis Profile shall fulfill all requirements listed in Section 4.16.4.2.2.1.1 for tomosynthesis slices, **projection images (if the For Presentation Breast Projection X-Ray Images Option is supported)** and generated 2D images.

...

Insert Section 4.16.4.2.2.1.3.10

4.16.4.2.2.1.3.10 For Presentation Breast Projection X-Ray Images Option

720 Image Displays supporting the For Presentation Breast Projection X-Ray Images Option shall fulfill the requirements defined in the following subsections for breast projection X-Ray images:

- Section 4.16.4.2.2.1.3.1 Background Air Suppression
- Section 4.16.4.2.2.1.3.2 Image Orientation and Justification

725 For breast projection X-Ray images, the Image Display shall use the View Code Sequence (0054,0220), View Modifier Code Sequence (0054,0222) and Frame Laterality (0020,9072) in the Frame Anatomy Sequence (0020,9071) of the Shared Functional

730 Groups Sequence (5200,9229) together with Image Orientation (Patient) (0020,0037) in the Plane Orientation Sequence (0020,9116) of the Shared Functional Groups Sequence (5200,9229) to display images according to the preferred hanging protocol of the current user.

- Section 4.16.4.2.2.1.3.3 Image Size
For breast projection X-Ray images, size information shall be obtained from Imager Pixel Spacing (0018,1164) and Estimated Radiographic Magnification Factor (0018,1114).
- Section 4.16.4.2.2.1.3.4 Image Contrast Adjustments
- 735 • Section 4.16.4.2.2.1.3.5 Annotation of Image Information including Section 4.16.4.2.2.1.3.5.3 Annotation of View Information
- Section 4.16.4.2.2.1.1.5.1 Annotation of Identification Information, using Acquisition DateTime (0008,002A)
- 740 • Section 4.16.4.2.2.1.1.5.2 Annotation of Technical Factor Information using the attributes defined in Table 4.16.4.2.2.1.3.10-1:

Table 4.16.4.2.2.1.3.10-1: Technique Attributes for Display

Attribute	Tag	Note
KVP	(0018,0060)	
X-Ray Acquisition Dose Sequence	(0018,9542)	Located either in Per-frame Functional Groups Sequence (5200,9230) or in Shared Functional Groups Sequence (5200,9229)
>Exposure in mAs	(0018,9332)	
>Exposure Time in ms	(0018,9428)	
>Entrance Dose in mGy	(0040,8302)	
>Organ Dose	(0040,0316)	
X-Ray Filter Sequence	(0018,9556)	Located either in Per-frame Functional Groups Sequence (5200,9230) or in Shared Functional Groups Sequence (5200,9229)
>Filter Material	(0018,7050)	
Anode Target Material	(0018,1191)	
Compression Force	(0018,11A2)	
Body Part Thickness	(0018,11A0)	
Positioner Position Sequence	(0018, 9405)	Located either in Per-frame Functional Groups Sequence (5200,9230) or in Shared Functional Groups Sequence (5200,9229)
>Positioner Primary Angle	(0018,1510)	

Attribute	Tag	Note
>Positioner Primary Angle Direction	(0018,9559)	
Image Type	(0008,0008)	Used to display a human readable value of Value 3 to indicate projection images.

- Section 4.16.4.2.2.1.3.5.4 Annotation of Frame Information

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- Section 4.16.4.2.2.1.3.6 Annotation of Size Information

For breast projection X-Ray images, size information shall be obtained from Imager Pixel Spacing (0018,1164) in the Frame Pixel Data Properties Sequence (0018,9443) of the Shared Functional Groups Sequence (5200,9229) or Per-frame Functional Groups Sequence (5200,9230) and Estimated Radiographic Magnification Factor (0018,1114) in the X-Ray Geometry Sequence (0018,9476) of the Shared Functional Groups Sequence (5200,9229) or Per-frame Functional Groups Sequence (5200,9230).

750

Breast projection X-Ray images are multi-frame rather than single-frame and therefore the user shall be provided with manual scrolling as defined in Section 4.16.4.2.2.1.3.9 Scrolling through Multi-frame Tomosynthesis Images; automatic scrolling (cine) is not required. Scrolling through breast projection X-Ray images shall be independent from scrolling through tomosynthesis frames.

755