

**Integrating the Healthcare Enterprise**



5

**IHE Radiology  
Technical Framework Supplement**

10

**Basic Image Review  
(BIR)**

**Public Comment**

15

Date: March 23, 2009  
Author: David Clunie  
Email: radiology@ihe.net

20

This is a supplement to the IHE Radiology Technical Framework Rev. 9.0.  
It is submitted for public comment between March 19, 2009 and May 1, 2009.  
Comments should be submitted within that period to <http://forums.rsna.org/>:

1. Select the “IHE” forum
- 25 2. Select Radiology Technical Framework
3. Select 2009 Supplements for Public Comment
4. Select Basic Image Review

Please use the Public Comment Template provided there when starting a New Thread.

30 General Information about IHE® may be found at: [www.ihe.net](http://www.ihe.net).

Information about the IHE Radiology domain may be found at:  
<http://www.ihe.net/domains/index.cfm>.

35 Information about the structure of IHE Technical Frameworks and Supplements may be found  
at: <http://www.ihe.net/about/process.cfm> and <http://www.ihe.net/profiles/index.cfm>.

The current version of the IHE Radiology Technical Framework may be found at:  
[http://www.ihe.net/technical\\_framework/index.cfm](http://www.ihe.net/technical_framework/index.cfm).

#### 40 **Editor’s Note**

This supplement describes the changes to the existing technical framework documents and where indicated amends text by addition (**bold underline**) or removal (~~**bold strikethrough**~~), as well as addition of large new sections introduced by editor’s instructions to “add new text” or similar, which is not bolded or underlined for readability.

45 "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>Replace Section X.X by the following:</i>
--

## CONTENTS

50	Editor's Note.....	1
	Introduction.....	3
	Profile Abstract .....	3
	Open Issues and Questions .....	3
55	Closed Issues.....	4
	Volume 1 – Integration Profiles.....	7
	Glossary .....	7
	1.7 Scope Additions for 2008-2009 .....	7
	2.1 Dependencies among Integration Profiles .....	7
60	2.1.13 Portable Data for Imaging (PDI).....	8
	2.2.x Basic Image Review .....	8
15	Portable Data for Imaging Integration Profile.....	8
	15.2 Portable Data for Imaging Integration Profile Options .....	9
	15.3 Portable Data for Imaging Process Flow.....	9
65	15.3.1 Use Cases.....	10
	15.3.2 Process Flow Description .....	10
	15.4 Media Content .....	11
	15.4.1 DICOM Content.....	12
	15.4.3 Other Content.....	12
70	15.5 Security and Privacy Aspects .....	12
	15.x Basic Image Review Option.....	13
	15.x.1 Platform Hardware and Software Requirements .....	13
	15.x.2 Security and Persistence Requirements .....	14
	15.x.3 Disclaimer Limitations.....	15
75	15.x.4 Localization Requirements .....	15
	15.x.5 Usability Requirements.....	15
	15.x.6 Performance Requirements.....	16
	X Basic Image Review Integration Profile.....	19
	X.1 Actors/ Transactions.....	20
80	X.2 Basic Image Review Integration Profile Options.....	21
	X.3 Basic Image Review Process Flow .....	22
	Volume 2 - Transactions.....	23

85 **Introduction**

<provide a brief overview of the volumes/ sections of the Technical Framework that get changed/ added by this profile>

**Profile Abstract**

90 It is common practice for imaging facilities to distribute images on CDs, and for receiving physicians to review those images using a viewer included on the CD. Physicians have increasingly expressed frustration that frequently:

- viewers do not run successfully,
- viewers do not load the images successfully,
- the viewer loads too slowly,

95

- the view claims to be "not of diagnostic quality,"
- functions critical to review are missing from the viewer or
- the various viewers encountered on CDs have unique graphical user interfaces that do not provide obvious access to basic functions.

100 The impact is delayed care, inaccessible information, repeat examination and irradiation, and poor use of valuable clinician time. Creators of CDs may be unaware of the problems encountered by received physicians and thus critical feedback about these issues is not communicated to the vendor of the system.

105 Working closely with representatives of the American Medical Association and the American Association of Neurological Surgeons, the IHE Radiology Technical Committee has developed this profile to define the appropriate baseline functionality and behaviors for image viewing software on CD.

**Open Issues and Questions**

#	Issue/ (Question)
1	Need to update the boilerplate text in the Foreword to recognize the participation and contribution of the AMA and AANS.
2	For usability it is important to define the direction of mouse movement effect for certain tools (window, scroll) – feedback is sought on whether or not the directions chosen are appropriate.
3	Feedback is sought on the appropriate default ordering for series of images (or multi-frame images), and whether or not a means of choosing a different sort order is required in a basic viewer.

#	Issue/ (Question)
4	Are other annotations required in the corner of the displayed images, particularly those that are modality-specific, or should this be left to the discretion of the implementer ? Do we need to review or repeat certification requirements, e.g., for CT and MR.
5	Need to describe or confirm icon choices for various tools.
6	Need to provide standard keyboard shortcuts for various tools.
7	Are the performance requirements, reference platform and the characteristics of a set of test images representative of real-world expectations, and achievable ?
8	Fusion (overlying of semi-opaque pseudo-colored PET images over CT images) is considered out of scope; is a “basic fusion mode” possible for the basic viewer, considering the complexity introduced by the need for separate windowing tools, opacity alpha value tools, the need for re-sampling if the field of view (pixel size) and/or slice thickness and reconstruction interval are different? However, side-by-side synchronized scrolling of the CT and PET series (without fusion) is required.
9	There is a strong desire to label on which side of the mid-line a sagittal is located; however, when only one side of the body has been imaged, it is well nigh impossible to define the true center line; this leads to the prospect of the medial sagittal of a left-sided temporal bone acquisition being labeled “right” ... is this feature unsafe in the general case?
10	The initial default tool is specified to be scrolling, on the assumption that scrolling will be more likely the first user action than say windowing. Is this a valid assumption?
11	Is an ability to display the contents of any report present on the media required ? Currently the proposal does not require this, largely due to the lack of agreement on the preferred format of reports. However, one could make a requirement to show whatever format was actually encoded on the media. One could also constrain the set of choices to plain text, XHTML, DICOM encapsulated PDF or DICOM SR IHE SINR, or some subset. One would then need to define the Report Reader Actor display behavior requirements in a transaction, but the Retrieve Reports or Retrieve Evidence Documents transactions do not include display requirements (unlike the analogous Retrieve Images), and the Distribute Imaging Information on Media also does not define Report Reader (nor Image Display) behavior.

### Closed Issues

#	Issue/ (Answer)
1	There is no requirement for a “DICOM header browser”, since the profile is for a tool for clinicians, not engineers or support staff.

#	Issue/ (Answer)
2	All basic tool functions are required to be displayed in a toolbar or panel that is visible by default, without resorting to drop downs from menus, secondary palettes or context-sensitive right mouse menus, with the exception of the cine tools which may be invoked as a group by a single button.
3	Separation of PD and T2 from dual-echo SE MR series into separate pseudo-series is required.
4	Toolbar icons for previous and next image (or next frame within a multi-frame image) are thought to be necessary despite the ability to scroll and cine within a viewport, if for no other reason than consistency, as well as to provide fine-grained control.
5	Whether multiple single frame images or a single multi-frame image is involved is made transparent to the user for scrolling and forward and reverse navigation.
6	A nuclear medicine clamped windowing mode is provided as an alternative tool.
7	A full set of cine functions are required for both multi-frame image or multiple images in a series (full set of play, stop, pause, rewind, reverse, forward and end), in order to support cardiac applications.
8	Flip and rotate are not necessary for cross-sectional images, but these are needed for display of projection radiographs and scanned film, which are often (unfortunately) not oriented correctly for viewing.
9	There is no requirement for a next/previous patient button, when used on media with a single patient, since there is no “reading worklist” to step through; however, for an Image Display not on media a patient selection tool is provided.
10	Implementation of an interactive 3D localizer mechanism is thought to be excessively burdensome relative to its usefulness in a basic viewer, and is not included.
11	There is no requirement to provide a user warning required when a non-supported SOP class is displayed.
12	Contrast and brightness controls for true color images are not required.
13	The list of required SOP Classes specifically excludes the retired NM and US and bi-plane XA objects, as well as the mammography, and the visible light family.
14	Presentation states and KOS objects are not included in the basic viewer, either on media or off; if support is required one can claim support for the CPI or KOS profile respectively.
15	Should the application be required to automatically display images immediately, or could this actually slow things down if the first study is not the one that is wanted, and it is large? Probably better not to require this.

#	Issue/ (Answer)
16	The performance test reference platform need not be the same as the minimal configuration (else performance would be disappointing).
17	Referring physician users prefer auto-run, unless the site or the user has explicitly taken steps to suppress auto-run.
18	Consensus seems to be that “mini-localizers” are undesirable, and that a localizer or orthogonal image can be displayed in the second series viewport, if necessary.
19	Keyboard modifiers of mouse movement initiated actions (window, scroll) are thought to be important for usability, but no specific mechanism (modifier key or movement rate detection) is required.

110

# Volume 1 – Integration Profiles

## Glossary

*Add the following terms to the Glossary:*

<any glossary additions associated with the profile draft go here>

### 1.7 Scope Additions for 2008-2009

115

*Add the following bullet to the end of the bullet list in section 1.7*

120

This ~~document refers to Year X of the IHE initiative in~~ **supplement has been drafted in the 2008-2009 development cycle of** the Radiology Domain. It will be the basis for the testing ~~and exhibition process associated with the RSNA 2008 and HIMSS 2009 annual meetings at~~ **IHE Connectathons beginning in 2010**. The current IHE Technical Framework adds the following primary features to those of previous years:

- **Added the Basic Image Review Profile**

### 2.1 Dependencies among Integration Profiles

125

*Add the following section to Table 2-1. Integration Profile Dependencies in section 2.1.*

Integration Profile	Depends on	Dependency Type	Comments
...	...	...	...
Patient Information Reconciliation	Scheduled Workflow	Required for workflow/content to manage	Patient Information Reconciliation is an extension to this profile requiring that the workitems and/or content be updated.
Portable Data for Imaging	<i>None</i>	<i>None</i>	-
<b><u>Basic Image Review</u></b>	-	-	-
XDS for Imaging	XDS (ITI)	Document Consumer, Document Registry, and Document Repository actors from ITI XDS are required for XDS-I.	Document content types and metadata are specialized.
...	...	...	...

*Amend the following section as shown:*

### 2.1.13 Portable Data for Imaging (PDI)

130 The Portable Data for Imaging Integration Profile specifies actors and transactions that allow users to distribute imaging related information on interchange media. The intent of this profile is to provide reliable interchange of evidence objects and diagnostic reports for import, display or print by a receiving actor. A single physical transport means is specified that supports the multiple usage scenarios described in this profile. The CD format was chosen for supporting the described use cases.

135 **The Portable Data for Imaging Integration Profile also allows for viewers to be present on the media. The Basic Image Review Option requires such a viewer that is an Image Display Actor that supports the Basic Image Review Profile.**

*Add the following new subsection in section 2.2:*

### 140 2.2.x Basic Image Review

145 **The Basic Image Review Profile defines the basic capabilities Image Displays are expected to provide, and which attributes should be used to implement those capabilities. Though the Profile is potentially applicable to all Image Displays, it has specific requirements that pertain to the use of Image Displays included on PDI media, and is related to a named option for the PDI Profile.**

*Amend volume 1, section 15 PDI Profile to add options:*

## 15 Portable Data for Imaging Integration Profile

150 The Portable Data for Imaging Integration Profile specifies actors and transactions that provide for the interchange of imaging-related information on interchange media. The intent of this profile is to provide reliable interchange of image data and diagnostic reports for import, display or print by a receiving actor.

This profile addresses identification of the media content's source and the patient (where appropriate), reconciliation of data during import, and the structure of the media contents.

155 The central elements of the profile are:

- Reliable interchange of imaging-related information based on the DICOM standard
  - A Web Content Option, **that which** provides guidelines for including web-viewable content on media.
  - **A Basic Image Review Option, which requires that there be at least one viewer present on the media that implements the Basic Image Review Integration Profile**
- 160

The Web Content Option addresses the case of media containing both DICOM-encoded objects and objects in XHTML or JPEG derived from these DICOM-encoded objects.

## 15.2 Portable Data for Imaging Integration Profile Options

165 Options that may be selected for this Integration Profile are listed in table 15.2-1 along with the Actors to which they apply. Dependencies between options when applicable are specified in notes.

**Table 15.2-1: Portable Data for Imaging – Actors and Options**

Actor	Options	Vol & Section
Portable Media Creator	<i>Web Content</i>  <b><u>Basic Image Review</u></b>	RAD TF-1: 15.4.2 RAD TF-2: 4.47.4.1.2  <b><u>RAD TF-1: 15.n</u></b>
Portable Media Importer	<i>No options defined</i>	-
Image Display	<i>No options defined</i>	-
Report Reader	<i>No options defined</i>	-
Print Composer	<i>No options defined</i>	-
Display (ITI TF)	<i>No options defined</i>	-

170

## 15.3 Portable Data for Imaging Process Flow

This section describes the typical process flow related to the use of Interchange Media. The transaction covered is 47- Distribute Imaging Information on Media.

The following steps can be identified in this process flow:

- 175
- The source actor (Portable Media Creator) writes a group of image dataset(s) and/or the associated diagnostic report(s) onto a piece of interchange media. It is presumed that the Portable Media Creator has access to the data from a grouped actor, or another source outside the scope of IHE.
  - The media is physically transported to a destination where the imaging-related information contained on the media will be used.
  - The Portable Media Importer reads DICOM objects (images, presentation states, key image notes, evidence documents and reports) on the media and imports them into the local information space **or makes them available to the Image Display included on the media.** The Portable Media Importer reconciles the data as needed (e.g., to change the recorded Patient ID to the local Patient ID). If some classes of DICOM objects are present on the
- 180
- 185

media and cannot be imported, the Portable Media Importer actor notifies the operator of the studies and series affected and makes clear that they are not supported by the importing application.

- 190
- The Image Display (**which may be included on the media by the Portable Media Creator**), Report Reader, Display or Print Composer reads the objects it supports and renders them depending on the receiver's needs. If some objects are not supported by the reading application it notifies the operator that those objects are not supported.

The potential usage scenarios of the data are described in the use cases below.

### 15.3.1 Use Cases

195 This profile is not intended to provide an archival solution.

**Use Case 1 – Patient/Referring Physician Viewing:** Diagnostic and therapeutic imaging data, such as images and reports, is received on media potentially serving multiple use cases. The patient or the referring physician can view the data, either with a viewer application residing on the same media **or previously installed on their own equipment (either of which may be an Image Display implementing the Basic Image Review Profile)** or using a web browser. ~~This data is not necessarily intended as a basis for diagnostic or therapeutic processes, and may just be informative data.~~ For security and privacy reasons, media given to a patient would not contain data of other patients. Refer to section 15.5 for additional security considerations.

200

**Use Case 2 – Healthcare Enterprise Interchange:** One or more patients' data, such as images, reports or complete studies, is received on media to enable a diagnostic or therapeutic care process. Media data are imported at a different site, generally for the purpose of a "second read import" or "reference import".

205

- Second Read Import: Media data is imported to the Image Manager/Archive to be read/over read. In order to avoid data conflicts, key patient/study attributes may need to be reconciled with existing local data. Images and related presentation states can be sent to a Print Composer to be printed.
  - Reference Import: Media data is imported to the Image Manager/Archive and/or Report Repository to become part of the patient history. It may be used as "relevant prior" data for future reads. In order to avoid data conflicts, key patient/study attributes may need to be reconciled with existing local data.
- 210
- 215

**Use Case 3 – Operating Room Viewing:** Media data is used to enable diagnostic or therapeutic processes in environments without a reliable network connection. The volume of data can be very large and may contain image data, post-processing results and reports. In the operating room, the surgical staff receives the media and reads its contents using advanced viewing capabilities, which may include manipulating or processing images.

220

### 15.3.2 Process Flow Description

The use cases can be specified in terms of three media-related activities:

- Media Export
- Media Viewing
- 225 • Media Import

**A) Media Export (All Use Cases):**

The Portable Media Creator assembles the media content (DICOM and web-viewable content) and writes it to the physical medium.

The following sequence of activities will be performed during media creation:

- 230 • Export of DICOM data (FSC activity)
- Optionally, export of web-viewable data, which involves deriving easily accessible informative data from the DICOM data (Web Content Option).
- **Optionally, inclusion of a viewer that conforms to the Basic Image Review Integration Profile (Basic Image Review Option)**
- 235 • ~~Optionally, inclusion of additional content (e.g.: a DICOM Viewer or viewing software components on the media to access DICOM data)~~

**B) Media Viewing:**

**B1) Web (Use Case 1)** (care providers, other users and patients without DICOM viewing equipment or software):

- 240 Any web-viewable media content is received and displayed by a Display actor, which exists as a generally available resource (i.e. web browser). Note that the Portable Media Creator cannot rely on the presence of web-viewable content on all media since it will be included only on media created using the Web Content Option).

**B2) DICOM (Use Case 1 and 3)** (users with DICOM viewing equipment or software or media created with the Basic Image Review Option):

- 245 The DICOM portion of the media content is displayed using specialized applications pre-existing in the reading environment or included on the media itself. The variety of DICOM objects that an Image Display and/or Report Reader actor can process is indicated by its support of the corresponding content profiles. The Print Composer actor sends images from
- 250 the media to a Print Server for printing.

...

## 15.4 Media Content

- 255 The requirements on media content are intended to promote the reliable transfer of imaging data, including diagnostic reports, and to allow for the viewing of images and reports on general purpose computers.

The media content can be accessed via two “entry points” on the media: the DICOMDIR file for DICOM imaging information and optionally the INDEX.HTM file for web-viewable content.

Created media are required to contain DICOM data and may optionally include web-viewable data derived from it. This web-viewable data, if present, shall faithfully preserve the clinical intent of the original DICOM information.

#### 15.4.1 DICOM Content

The DICOM data shall be created by using the DICOM General Purpose Media Storage Application Profile. The DICOMDIR file shall reference all DICOM files stored on the media.

DICOM files shall not be placed in the root directory, but no constraints are placed on the name of directory that contains them.

...

#### 15.4.3 Other Content

**A viewer that conforms to the Basic Image Review Integration Profile (Basic Image Review Option) Viewing applications (for example a DICOM Media Viewer)** may optionally be included on the media. Such viewers may have launch links included in the HTML. ~~Including such viewers on the media is discouraged due to security issues discussed in the next section, as well as potential interoperability problems.~~

Additional data (e.g., a diagnostic report in non-DICOM format) may be also included on the media. Since the format of any such data is not specified by this profile, such data shall be placed in a separate directory on the media. If such data is referenced in the INDEX.HTM file, it shall be clearly indicated that this content was not generated in conformance with the IHE Radiology Technical Framework, and its reliable import has not been addressed.

### 15.5 Security and Privacy Aspects

Portable Media Creator actors shall ensure that no malicious software (viruses, etc.) is present on created media.

The automatic launch of applications from media poses a risk that malicious software could be started ~~and it is recommended that media reading actors not allow automatic launching. Portable Media Creators should therefore also avoid using automatic launching. This includes not automatically launching a DICOM media viewer that may be present on the media.~~ **Despite these risks, many recipients prefer the convenience of auto-run. It is the site's responsibility to suppress auto-run if required.**

Furthermore, if a DICOM media viewer is present, security issues are minimized by:

- working under normal (restricted) user privileges and not requiring the user to work with administrator or root privileges and
- not needing software installed on the computer where the media is used.

Audit trails to track export/import/viewing activities are addressed in ITI TF-2: 3.20 and RAD TF-3: 5.1. Portable Media Creator and media reading actors that claim support of the Audit Trail and Node Authentication Integration Profile shall generate such audit trail entries.

295 Encryption of data and other access controls to media content are not addressed in this profile. Media created using this profile should be considered to be unlocked information (e.g., like paper records). Such media should be handled according to appropriate site policies (e.g., do not give a patient a disk containing data from other patients, do not leave disks where they can be taken by unauthorized persons, etc.).

300 For many Use Cases it is not appropriate to place data from multiple patients on a single media for Security and Privacy Reasons.

## **15.x Basic Image Review Option**

**A Media Creator that claims the Basic Image Review Option shall be able to include a viewer on the media. That viewer shall support the Basic Image Review Profile as an Image Display Actor.**

305 **Additional requirements beyond the Basic Image Review Profile are required by the Basic Image Review Option. They are appropriate for the Physician Viewing use case in Section 15.3.1, particularly when the receiving user has no pre-existing relationship with the sender, is unfamiliar with any viewer included on the media, has no pre-installed local Image Display, and has little control over a relatively basic hardware and software environment. Many of these additional requirements are not necessary or appropriate for an Image Display that supports the Basic Image Review Profile in a networked or pre-installed environment. The requirements for the support of SOP Instances on the Media are specified in Rad TF-2: 4.16.4.1.3.3.1.1.**

310

### **15.x.1 Platform Hardware and Software Requirements**

315 **The Basic Image Review Option requires that the Image Display included on the media working under normal user privileges and not require software installation. Specifically, the Image Display application shall be executable:**

- **from the PDI media**
- **on the following minimum hardware and software**
  - 320 • **one x86 (Intel or AMD) processor or core**
  - **Windows XP Home Edition and Windows Vista Home Basic Edition**
  - **512MB RAM for XP and 1024 MB RAM for Vista**
  - **graphics hardware and a single monitor of any type supported by Windows at 1024x768 resolution in 24 bit RGB color**
  - 325 • **a mouse or other pointing device with a single button**
  - **one drive that supports reading CD-R media**

- a consumer-grade ink-jet printer
- without requiring installation of, or the pre-installed presence of, or permission to install, applications, frameworks (such as Java or .NET), device or graphics drivers or software other than those shipped with the basic operating system
- without requiring the presence of a network connection (for download of software, licensing or registration or exchange of any other information whether via the Internet or local area network)

335 These requirements are not intended to discourage the presence of applications that support multiple platforms, either in a single application or through the presence of multiple applications. Nor are they intended to endorse the suitability of any hardware or software platform for this purpose, only to recognize what is realistic to maximize the probability that a user will be able to use the viewer on the media.

340 The prohibition on requiring the presence of pre-installed platforms such as Java or .NET is not intended to prevent potentially improved performance if they are present and installed, but rather to recognize that many users do not have the ability to perform such installations, either through lack of expertise or through local security policy restricting their access rights. It is known to be possible to execute such platforms directly from the media if necessary, hence that is established as the baseline requirement without preventing optimization.

345 Similarly, accelerated graphics performance, more memory and more processors or cores can be used if available, but the application is required to be able to work without them.

The application shall tolerate the presence of multiple monitors of different resolutions, though it is not required to be able to make use of multiple monitors.

350 The option does not specify requirements for the support of portrait rather than landscape, or grayscale rather than color monitors, though it is recommended that the application be usable with portrait and grayscale monitors in addition to landscape and color monitors.

355 The option does not require that the application provides a means of calibration (to the DICOM GSDF as required in the CPI Profile), but does not preclude providing such a capability from within the application, or providing, or taking advantage of, an external means of calibration.

360 The option requires the application to support single-button pointing devices, but does not preclude it from taking advantage of multiple buttons, if present, including a middle scroll wheel. If a middle scroll wheel is present, then it is required to be supported by the application at least for the purpose of scrolling between multiple slices of cross-sectional images.

### 15.x.2 Security and Persistence Requirements

The Basic Image Review Option does not require that the Image Display included on the media support the ATNA Profile, but it is not precluded from doing so.

365 **The Basic Image Review Option requires that the Image Display automatically launches if permitted.**

**The Basic Image Review Option shall execute all the required functions without requiring write access to local persistent storage (e.g., the C: drive), but it is not precluded from doing so.**

### 370 **15.x.3 Disclaimer Limitations**

**The Basic Image Review Option requires that the Image Display application shall not present the user with a disclaimer that either the images on the media are not for diagnostic use, nor that the application itself is not for diagnostic use. It is however permitted to present a disclaimer that the provider of the media and the application on the**  
375 **media have no control over the display hardware or state of display calibration or any other aspect of the viewing environment, and that this alone may affect the suitability of the displayed images for diagnostic use.**

**This requirement is present because the ordering physicians or radiologists who receive the media may indeed be making decisions about the patients management, that this**  
380 **constitutes diagnostic use even though it may not be the intent to perform the primary radiological interpretation, and that it is inappropriate and unsafe to provide either degraded images or an application that degrades them for display.**

### **15.x.4 Localization Requirements**

**The Basic Image Review Option requires that the Media Creator include an Image Display application that shall be localizable in local languages. Specifically this includes:**  
385

- **user interface elements with text in the local language, e.g., for menus, tool tips, messages and button labels**
- **display of localized patient names if encoded within the DICOMDIR and DICOM SOP Instances using the Specific Character Set (0008,0005)**

390 **It is beyond the scope of IHE to specify which local languages are required, and which values of Specific Character Set should be supported since this is dependent on the geographic extent within which the PDI media is intended to be shared. A National Extension may specify which languages are required to be supported.**

### **15.x.5 Usability Requirements**

395 **The application shall be started by clicking on a file in the root directory named VIEWER.BAT or VIEWER.EXE.**

**The application shall automatically run when the media is inserted unless the configuration of the machine has been specifically set up to prevent it (or the user holds the SHIFT key down when inserting the media). I.e., there shall be an AUTORUN.INF file present in the**  
400 **root directory that executes the viewer.**

**Note that there may be multiple viewers, in which case the initially executed application shall allow the user to select which one to proceed with.**

**When starting the application:**

- 405 • **it shall provide the user with the option of immediately terminating (e.g., to allow a pre-installed already executing viewer to be used instead)**
- **it shall provide immediate feedback to the user when it is invoked, e.g. through a dialog box or splash screen or appropriate cursor change when they double-click the application icon**
- 410 • **it shall terminate with a clear unambiguous error message to the user if the hardware or software requirements of the platform are insufficient to execute**
- **it shall provide a display or listing of the media contents (patients, studies and series) to the user automatically, without requiring any further user initiated action, since the goal is to be able to view the contents of the media (not images from other sources)**
- 415 • **it may, though it is not required to, after selecting a study, automatically display an appropriate sub-set of the content of the images (e.g., the first image or the first series, or a key image defined by a Key Image Note, etc.)**

420 **The application is not required to be able to be invoked multiple times; only one instance of the application should be executing at any one time, and the application should be robust in the face of attempts by the user to execute multiple copies (e.g., if they double-click the application icon multiple times in frustration whilst waiting for the first invocation to actually run).**

**The user shall have the ability to close the application using the ordinary window decoration icon for this purpose, typically an iconic “X” in the top right of the window.**

425 **The application shall be “closable” even if the media has been physically removed, without prompting the user to re-insert the media.**

**It is not a requirement that the viewer continue to execute after the media has been physically removed, nor that the contents of new media that is inserted be read.**

430 **The need to be able to close and reopen additional studies on the media is addressed in the Basic Image Review Profile requirements, which require the user to be able to select any series from any study for display and to change what is selected.**

**For all activities that take significant time, including startup and reading of images from the media, some indication of the relative progress towards completion and the time remaining until completion is required.**

### **15.x.6 Performance Requirements**

435 **Recognizing the limitations of the speed of reading software and large images or numbers of images from physical media like CD, users must have reasonable expectations of performance. That said, users have observed significant variation amongst viewers in this**

440 **respect. Accordingly, in order to satisfy the users expectations, benchmarks for specific activities are defined for a reference platform and reference set of images and modalities. Support of the Basic Image Review Option requires demonstrating that these benchmarks can be achieved or surpassed.**

**The following test conditions are defined:**

- 445 • **targets are defined in seconds between action initiation and desired response, with a target to be achieved within 75 % of invocations**
- **caches are to be cleared between invocations of tests, to prevent intermediate cached data rather than data retrieved from media being used (e.g., by rebooting)**
- **targets assume that the media in the drive is spinning (many drives spin down after a period of inactivity); an additional 5 seconds may be added to the target times if a delay for the media to spin up is unavoidable, since this may be beyond the viewers control**

450

**Table 15.n.6-1 Basic Image Review Option – Performance Reference Platform**

<u>Component</u>	<u>Specification</u>
<u>Processor</u>	<u>One Intel Core 2 Duo 2.33 GHz single processor dual core with 4MB Level 2 cache, 1333FSB</u>
<u>RAM</u>	<u>2 GB DDR2 800MHz SDRAM</u>
<u>Hard drive</u>	<u>500 GB 7200 RPM SATA Hard Drive</u>
<u>CD drive</u>	<u>24X CD read DVD-ROM drive</u>
<u>Video</u>	<u>Integrated Intel® GMA X4500HD Graphics</u>
<u>Operating System</u>	<u>Windows XP Professional SP3</u>

**Table 15.n.6-2 Basic Image Review Option – Performance Reference Image Sets**

<u>Type</u>	<u>Source</u>	<u>Selected Contents</u>
<u>Large dataset</u>	<u>CDFORBIRPERFORMANCE.iso</u>	<u>Entire ISO image contents, including two spine MR studies for comparison, one PET/CT study, one Chest CT study, digital x-rays of the chest, cervical and thoracic spine, and one nuclear medicine study.</u>
<u>Small dataset</u>	<u>CDFORBIRPERFSMALL.iso</u>	<u>One MR spine study from 20070613.</u>

455

**Table 15.n.6-3 Basic Image Review Option – Performance Benchmarks**

<b>Benchmark</b>	<b>Definition</b>	<b>Time on Large Dataset</b>	<b>Time on Small Dataset</b>
<u>Start-up to ready to select</u>	<u>With auto-run disabled, time from double-clicking the Image Display application icon displayed in the Windows Explorer viewing the root directory of the PDI media, until the entire contents of the DICOMDIR are displayed to the user for patient, study and series selection (possibly with placeholders for series thumbnails)</u>	<u>60 seconds in 75%</u>	<u>30 seconds in 75%</u>
<u>Start-up to all series thumbnail displayed</u>	<u>With auto-run disabled, time from double-clicking the Image Display application icon displayed in the Windows Explorer viewing the root directory of the PDI media, until thumbnails are displayed for all series for all series on the media (and not placeholders)</u>	<u>5 seconds in 75%</u>	<u>5 seconds in 75%</u>
<u>Series thumbnail select to first image of first series displayed</u>	<u>The time from the user selecting the thumbnail of any series to the display of the first image of that series, as measured after the DICOMDIR has been read, but nothing previously selected.</u>	<u>2 seconds in 75%, for any series</u>	<u>2 seconds in 75%, for any series</u>
<u>Series thumbnail select to last image of series displayed</u>	<u>The time from the user selecting the thumbnail of any series to the display of the last image of that series [may be difficult to measure if this requires two user actions, select, then scroll/jump to last]</u>	<u>20 seconds in 75%, for 311 slice PET/CT CT series</u>	<u>10 seconds in 75%, for 21 slice MR localizer series</u>
<u>Select different series</u>	<u>When one series is already displayed, the time after selecting a different series thumbnail until the first image of the new series is displayed</u>	<u>2 seconds in 75%, for any series</u>	<u>2 seconds in 75%, for any series</u>
<u>CT scroll frame rate</u>	<u>The maximum unaccelerated rate at which 512x512x12 bit uncompressed CT slices can be scrolled without skipping frames, once all frames have been loaded</u>	<u>30 slices/per second in 75%, for 311 slice PET/CT CT series</u>	<u>n.a.</u>

<u>Benchmark</u>	<u>Definition</u>	<u>Time on Large Dataset</u>	<u>Time on Small Dataset</u>
<u>MR scroll frame rate</u>	<u>The maximum unaccelerated rate at which 256x256x16 bit uncompressed MR slices can be scrolled without skipping frames, once all frames have been loaded</u>	<u>30 slices/per second in 75%, for</u>	<u>30 slices/per second in 75%, for</u>
<u>CR or DX zoom time</u>	<u>The time from the user initiating a zoom command by a factor of 2 applied to a 2k CR or DX image fitted to the full size display of single series window with only one window displayed to the screen being refreshed with a stable (unchanging) magnified image.</u>	<u>0.5 seconds in 75%, for 1880 x 2016 DX PA Chest 20051208</u>	<u>n.a.</u>
<u>Window center and width change response time.</u>	<u>The time from the user initiating a windowing command to a 2k CR or DX image fitted to the full size display of single series window with only one window displayed to the screen being refreshed with a stable (unchanging) windowed image.</u>	<u>0.1 seconds in 75%, for 1880 x 2016 DX PA Chest 20051208</u>	<u>n.a.</u>

Add Section X

## **X Basic Image Review Integration Profile**

460 The Basic Image Review Profile defines the basic display capabilities Image Displays are expected to provide, and which attributes should be used to implement those capabilities.

465 The Basic Image Review Profile is designed to provide sufficient display functionality to allow adequate review of images for the purpose of clinical decision-making by ordering physicians. It does not address application or modality specific requirements, such as may be needed for primary interpretation of mammography by radiologists, or primary interpretation of nuclear medicine image, which are addressed by other profiles.

The Basic Image Review Profile is intended to provide for:

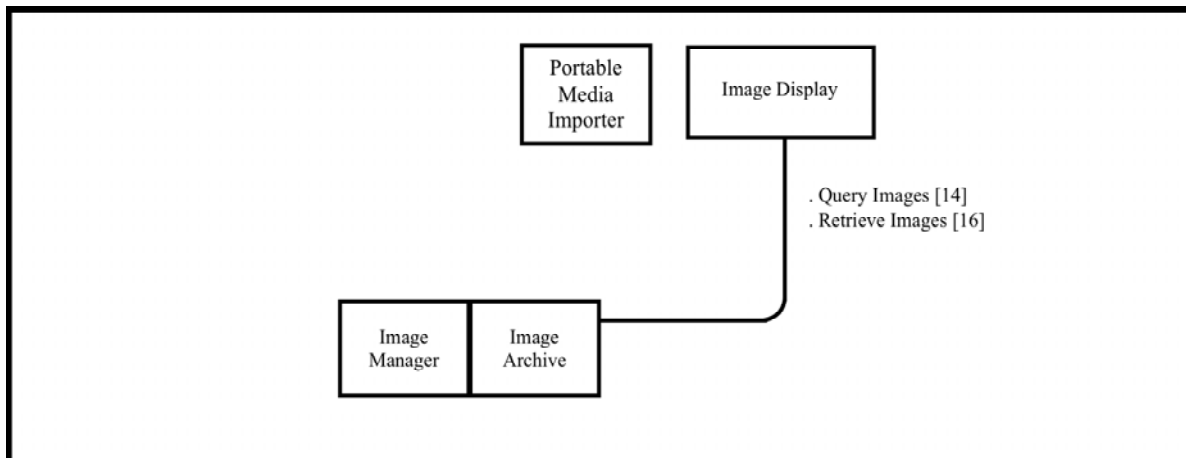
- display of grayscale and color images from any modality, including cross-sectional modalities like CT, MR and PET, projection radiography modalities like CR, DX, XA and XRF, as well as ultrasound and nuclear medicine, though it is not limited to any particular modality
- 470

- basic grayscale or color rendering of the images as encoded, without additional image processing like pseudo-coloring, multi-planar reconstruction, volume or surface rendering, or multi-modality fusion
- 475 • visual navigation of the available series of images through the use of thumbnails
- side-by-side comparison of at least two sets of images, whether they be Series from the same Study, or different Studies, with synchronized scrolling, panning and zooming in the case of cross-sectional modalities
- annotation of laterality, orientation as well as spatial localization of cross-sectional images for anatomic reference
- 480 • annotation of demographics, management and basic technique information to provide for safe identification and usage
- simple measurements of linear distance and angle as used by clinicians for change detection and treatment planning
- 485 • cine capability intended to allow review of images that involve cardiac motion (e.g., cardiac US, XA, CT or MR)

## X.1 Actors/ Transactions

<Actor/ Transaction diagram and Actor/ Transaction table. >

490 Figure X.1-1 shows the actors directly involved in the Basic Image Review Integration Profile and the relevant transactions between them. Other actors that may be indirectly involved due to their participation in <other related profiles>, etc. are not necessarily shown.



**Figure X.1-1. Basic Image Review Actor Diagram**

495 Table X.1-1 lists the transactions for each actor directly involved in the Basic Image Review Profile. In order to claim support of this Integration Profile, an implementation must perform the required transactions (labeled “R”). Transactions labeled “O” are optional. A complete list of

options defined by this Integration Profile and that implementations may choose to support is listed in Volume I, Section X.2.

500

**Table X.1-1. Basic Image Review Integration Profile - Actors and Transactions**

Actors	Transactions	Optionality	Section in Vol. 2/3
Image Manager/Archive	Query Images [RAD-14]	R	4.14
	Retrieve Images [RAD-16]	R	4.16
Image Display	Query Images [RAD-14]	R	4.14
	Retrieve Images [RAD-16]	R	4.16

Note: When an Image Display is grouped with a Portable Media Importer, there is no network activity, and only the display requirements of the RAD-16 Retrieve Images is applicable. This is the case, for example, for the Image Display Actor that is included on media when the Basic Image Review Option of the Portable Data for Imaging Integration Profile is supported by the Portable Media Creator.

505

## X.2 Basic Image Review Integration Profile Options

Options that may be selected for this Integration Profile are listed in the Table X.2-1 along with the Actors to which they apply. Dependencies between options when applicable are specified in notes.

510

**Table X.2-1 Basic Image Review - Actors and Options**

Actor	Options	Vol & Section
Image Archive/Manager	<i>No options defined</i>	--
Image Display	<i>No options defined</i>	--

### X.3 Basic Image Review Process Flow

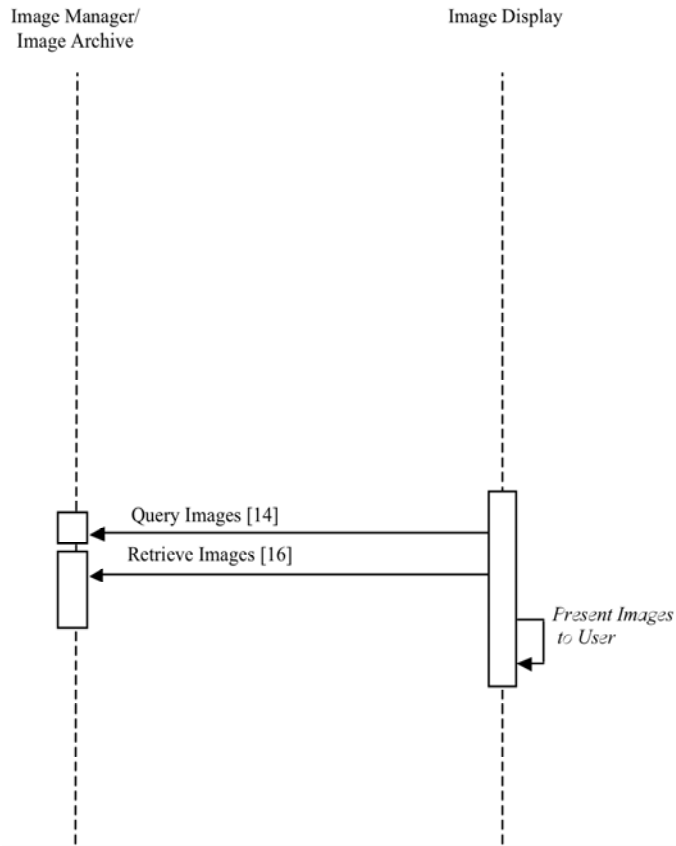


Figure nn.3-1. Basic Process Flow in Basic Image Review Profile

515

## Volume 2 - Transactions

520 **Amend section 4.16 to add Basic Image Review Profile to the Retrieve Images Transaction:**

### **4.16.4.1.3.3 Basic Image Review Profile**

#### **4.16.4.1.3.3.1 Basic Image Review Profile SOP Class Support**

##### **4.16.4.1.3.3.1.1 SOP Class Support for PDI Media**

525 **An Image Display actor supporting the Basic Image Review Profile that has been included on PDI media with the Basic Image Review Option shall support all of the DICOM SOP Classes of all Images included on that media. It is not required to support any other DICOM SOP Classes.**

##### **4.16.4.1.3.3.1.2 SOP Class Support other than for PDI Media**

530 **An Image Display actor supporting the Basic Image Review Profile that has not been included on PDI media (i.e., without the Basic Image Review Option) shall support all the SOP Classes specified in Table 4.16.4.1.3.3-1.**

**Table 4.16.4.1.3.3-1. SOP Classes for Basic Image Review Profile**

<b><u>SOP Class UID</u></b>	<b><u>SOP Class Name</u></b>
<b><u>1.2.840.10008.5.1.4.1.1.1</u></b>	<b><u>Computed Radiography Image Storage</u></b>
<b><u>1.2.840.10008.5.1.4.1.1.2</u></b>	<b><u>CT Image Storage</u></b>
<b><u>1.2.840.10008.5.1.4.1.1.1.1</u></b>	<b><u>Digital X-Ray Image Storage – For Presentation</u></b>
<b><u>1.2.840.10008.5.1.4.1.1.4</u></b>	<b><u>MR Image Storage</u></b>
<b><u>1.2.840.10008.5.1.4.1.1.7.2</u></b>	<b><u>Multi-frame Grayscale Byte Secondary Capture Image Storage</u></b>
<b><u>1.2.840.10008.5.1.4.1.1.7.3</u></b>	<b><u>Multi-frame Grayscale Word Secondary Capture Image Storage</u></b>
<b><u>1.2.840.10008.5.1.4.1.1.7.1</u></b>	<b><u>Multi-frame Single Bit Secondary Capture Image Storage</u></b>
<b><u>1.2.840.10008.5.1.4.1.1.7.4</u></b>	<b><u>Multi-frame True Color Secondary Capture Image Storage</u></b>
<b><u>1.2.840.10008.5.1.4.1.1.20</u></b>	<b><u>Nuclear Medicine Image Storage</u></b>
<b><u>1.2.840.10008.5.1.4.1.1.128</u></b>	<b><u>Positron Emission Tomography Image Storage</u></b>
<b><u>1.2.840.10008.5.1.4.1.1.7</u></b>	<b><u>Secondary Capture Image Storage</u></b>
<b><u>1.2.840.10008.5.1.4.1.1.6.1</u></b>	<b><u>Ultrasound Image Storage</u></b>
<b><u>1.2.840.10008.5.1.4.1.1.3.1</u></b>	<b><u>Ultrasound Multi-frame Image Storage</u></b>
<b><u>1.2.840.10008.5.1.4.1.1.12.1</u></b>	<b><u>X-Ray Angiographic Image Storage</u></b>
<b><u>1.2.840.10008.5.1.4.1.1.12.2</u></b>	<b><u>X-Ray Radiofluoroscopic Image Storage</u></b>

- 535 **There is no explicit requirement to support other DICOM SOP Classes (unless these are present on PDI media), since at this time these are either thought to be beyond the capability of basic image review (e.g., the Enhanced family of objects), or are specifically addressed by other profiles (e.g., mammography), or are outside the domain of radiology (e.g., visible light in general, ophthalmology, slide microscopy, dentistry).**
- 540 **All Image Display actor supporting the Basic Image Review Profile shall be able to display any SOP Instance with the following characteristics, regardless of SOP Class, even if it does not support any other requirements for this transaction:**
- **Pixel Data (7FE0,0010) data element present**
  - **Bits Allocated (0028,0100) of 8 or 16**

545

  - **Bits Stored (0028,0101) values of 1 or 8 for Bits Allocated (0028,0100) of 8**
  - **Bits Stored (0028,0101) values of 9 to 16 inclusive, for Bits Allocated (0028,0100) of 16**
  - **High Bit (0028,0102) of one less than Bits Stored (0028,0101) (i.e., in the low bits of the word, without packing)**
  - **Samples Per Pixel (0028,0002) of 1 or 3**

550

  - **Photometric Interpretation (0028,0004) of MONOCHROME1, MONOCHROME2, RGB, PALETTE COLOR, and any the appropriate value for any multi-component compressed transfer syntaxes that are supported (e.g., YBR\_FULL\_422 for JPEG)**
  - **Planar Configuration (0028,0006) of 0 or 1 for RGB Photometric Interpretation (0028,0004) (i.e., color-by-pixel or color-by-plane)**

555

  - **Pixel Representation (0028,0103) of 0 or 1 for MONOCHROME1 and MONOCHROME2 Photometric Interpretation (0028,0004) (i.e., signed or unsigned)**
  - **Number of Frames (0028,0008) absent or with any value (i.e., single or multi-frame images)**
- 560 **These additional requirements allow any single or multi-frame image to be rendered in a viewport, scrolled, windowed, panned and zoomed, regardless of SOP Class, though spatial location, acquisition timing and technique annotation, localization, measurement and cross-referencing may not be available for display to the user.**

*Amend Section 4.16.4.2:*

#### 565 **4.16.4.2 View Images**

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

##### **4.16.4.2.1 Trigger Events**

The Image Display or Imaging Document Consumer is requested to be capable to display the images.

570 **4.16.4.2.2 Invocation Semantics**

This is a local invocation of functions at the Image Display or Imaging Document Consumer.

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

575 For the “For Presentation” variant of the Digital X-Ray Image, the Digital Mammography 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 in the DX Image Module as selected by the user from the choices available (e.g., guided by Window Center/Width Explanation (0028,1055) or LUT Explanation(0028,3003).

580 If VOI LUT Function (0028,1056) is absent, then Window Width (0028,1051)/Window Center (0028,1050) shall be assumed to be the parameters of a linear window operation. VOI LUT Function (0028,1056) values of “SIGMOID” and “LINEAR” shall be supported.

585 The Image Display or Imaging Document Consumer shall support the application of LUT Data (0028,3006) in items of the VOI LUT Sequence (0028,3010) regardless of the Value Representation (i.e., the DICOM standard allows either OW or US Value Representation).

The Image Display or Imaging Document Consumer actor must also support pixel rendering according to the Grayscale Standard Display Function (GSDF) defined in DICOM 2008 PS 3.14, because the output values of these images are always P-Values.

590 If the DICOM image is referenced by other DICOM composite objects, such as Grayscale Softcopy Presentation States, it is optional for the Image Display or Imaging Document Consumer to actually retrieve and display/apply these objects.

**4.16.4.2.2.1.1 Display of Digital Mammography Images**

The contents of this section are required for Image Display claiming the Mammography Image Profile.

595 ...

**4.16.4.2.2.2 Display of Localizer Lines**

Image Display or Imaging Document Consumer actors that want to show the localizer lines, if visible, will be able to calculate the position of these lines of intersection based on the information recorded in the images by the Acquisition Modality actor (See 4.8.4.1.2.1).

600 **4.16.4.2.2.3 Display of NM Images**

The contents of this section are required for Image Displays claiming the NM Image Profile.

...

#### 4.16.4.2.2.4 Display of Results Screens

The contents of this section are required for Image Displays claiming the NM Image Profile....

605 ...

#### 4.16.4.2.2.5 Display of Images for Basic Image Review

The contents of this section are required for all Image Displays claiming the Basic Image Review Profile. Additional requirements for Image Displays on PDI media are described in the Basic Image Review Option of the Portable Data for Imaging Integration Profile.

##### 610 4.16.4.2.2.5.1 Simple Restricted Feature Set

The Basic Image Review Profile defines a specific, simplified set of functions to be made available to the user, making use of the prescribed user interface elements only.

This shall be the default presentation.

615 Additional features may be present, but in order to reduce confusion these shall not be displayed to the user, unless the user specifically selects a tool to trigger advanced functionality.

##### 4.16.4.2.2.5.2 Layout

The initial default layout shall include:

- 620 • navigation tools in the form of a strip or panel of Series thumbnails (see 4.16.4.2.2.5.3 Navigation)
- one or more viewports open, each populated with an appropriate default image from a default Series (e.g., the first or middle image of the first series) appropriately windowed (see 4.16.4.2.2.5.4 Windowing and Rendering) and appropriately decorated with annotations (see 4.16.4.2.2.5.8 Annotation of Demographics, Location, Timing and Technique)
- 625 • a set tools in the form of icons contained within a toolbar or palette of tools or panel (see 4.16.4.2.2.5.11 Tool Icons), the set being constrained to only the functions described in the Basic Image Review Profile, with one additional tool to trigger a change in layout to “advanced” functionality

630 For modalities that have multiple Series of spatially correlated information (e.g., multiple transverse MR Series), the default shall be a side-by-side display of two Series. If such a multiple Series presentation is the initial default and the Series share the same DICOM Frame of Reference UID, they shall by default

- be synchronized with respect to scrolling (see 4.16.4.2.2.5.5 Scrolling),
- 635 • be synchronized with respect to panning and zooming (see 4.16.4.2.2.5.6 Zooming and Panning),

- have cross-referencing active (see 4.16.4.2.2.5.7 Laterality and Spatial Cross-Referencing)

Which two Series to choose for the default is at the discretion of the implementer.

640 Tools shall be provided to allow the user to select the number and arrangement of the viewports, and the tiled layout of images within each viewport. At least 2 viewports, and at least 2x2 tiles within a viewport shall be supported.

645 The Image Display shall provide tools to rotate the image displayed in the viewport by 90 degree increments, and to flip it horizontally, in order to be able to display projection X-Ray images that have been acquired or scanned upside down, rotated or back to front.

#### 4.16.4.2.2.5.3 Navigation

The Image Display shall provide the user with the ability to:

- select more than one Series of images for display in separate windows or panels (to allow for side-by-side comparison)
- 650 • select Series from different Studies for display simultaneously (to allow for comparison of different modalities or current or prior Studies)

655 It is required that Series for multiple Patients shall not be displayed simultaneously. Though it is possible that the same patient may have slightly different identifying attributes in different DICOM images performed at different sites or on different occasions, it is expected that such differences shall have been reconciled prior to the images being provided to the Image Display (e.g., in the Image Manager/Archive or by the Portable Media Creator).

660 For contexts in which a selection needs to be made between different Patients for display (e.g., when the Image Display is communicating with an Image Archive), then a means of selecting the single Patient to display shall be provided. No other requirements are specified for this function. For contexts in which only one Patient is available (e.g., when the Image Display is executed from PDI media on which data for only a single Patient is recorded), there need be no such Patient selection mechanism.

665 The requirement is for two Series to be comparable side-by-side; it is desirable, though not required, that more than two be displayable at the user's discretion.

The user shall also be provided with the ability to display only a single Series, in order to take advantage of limited monitor real estate.

670 When multiple Studies are available for the same Patient, some means of selecting (manually, or automatically based on similarity rules) a sub-set of Studies for which to provide Series thumbnails may be provided.

Thumbnails shall be provided for each Series for the purpose of providing a Gestalt overview of all Series available for all Studies for the same Patient, and allowing the user to select (navigate to) a particular Series for display. These thumbnails shall:

- be of sufficient size to be recognizable (no less than 128x128 pixels)
- 675 • be representative of the image content of the Series (e.g., down-sampled from the central image of a Series)
- decorated with text describing the Series Date (or if absent, Study Date), Modality and Series Description derived from the standard DICOM attributes, and a count of the number of images in the Series
- 680 • arranged within a scrolling strip or panel which is visible by default (though optionally a mechanism may be provided for the user to hide the thumbnail strip or panel to minimize encroachment on available screen real estate for display)
- the scrolling strip or panel shall be sorted by temporal order of Study, and then temporal or Series Number within a Study

685 The thumbnail navigation and selection capability shall allow the user to:

- double-click over a thumbnail to load the corresponding Series for display in the currently selected viewport (replacing any Series already displayed)
- CTRL-click discontinuous thumbnails to allow selection of two (or optionally, more) Series for display in the currently open viewports, or newly opened viewports (see also  
690 Layout)
- SHIFT-click contiguous thumbnails to allow selection of two (or optionally, more) Series for display in the currently open viewports, or newly opened viewports (see also  
695 Layout)

695 Other mechanisms, such as drag-and-drop, may be provided at the implementer's discretion.

In addition to the thumbnail navigation, specific toolbar icons shall be provided for:

- previous and next Study
- previous and next Series
- previous and next Image
- 700 • previous and next Frame

For the specific case of dual-echo MR images, in which slices of different acquisition contrast (PD and T2) may be interleaved within the same Series, the images shall be separate by Echo Number into two separate "pseudo-Series" for the purpose of showing them as separate thumbnails, selecting them for display and displaying them in a viewport.

705 Within a displayed Series (or multi-frame image), cross-sectional images shall be sorted by anatomical spatial position, then time of acquisition, and other images shall be sorted by Instance Number or sequential frame order.

#### **4.16.4.2.2.5.4 Windowing and Rendering**

710 **The default display when a Series of grayscale images is selected for display in a viewport shall use the first set of VOI LUT or window values supplied in the DICOM attributes. If VOI LUT or window values are absent, either a default based on statistical analysis of pixel values, or a modality-specific appropriate preset such as soft tissue preset for CT images shall be used.**

715 **For grayscale images, a tool shall be provided to select the use of the mouse to window the images in the currently selected Series. This support shall include:**

- **a tool that selects a mode of operation of the mouse with the left (or only) mouse button held down**
- **acceleration of the rate of windowing by a keyboard modifier or detection of the rate of mouse movement**

720 **When that tool is selected:**

- **horizontal movement of the mouse to the right will widen the window width (flatten the perceived contrast)**
- **vertical movement of the mouse upwards will lower the window center (increase the perceived brightness)**

725 **For grayscale images, another windowing mode shall be provided to clamp the bottom of the window to a rescaled pixel value of 0, such that vertical movement upward shall lower the upper limit of the window (increase the perceived brightness); this is a mode of windowing often preferred for nuclear medicine images. This mode shall be the default for NM and PET images. When this mode is selected (or is the initial default), if the DICOM provided or currently applied lower limit of the window is not zero, it shall be set to zero.**

730

**There is no requirement to synchronize windowing between different viewports.**

**The currently applied window center and width shall be displayed to the user, either in a status bar or in an overlaid corner annotation.**

735 **Window selection by the user (whether by default, preset or manual adjustment) shall be preserved when scrolling through images in a series, and scrolling frames within a multi-frame image and for display of multiple tiles in a viewport.**

**For CT images in Hounsfield Units, user-selectable window presets shall be provided which shall include presets for soft tissue, brain, lung and bone, in addition to others at the implementer's discretion.**

740 **For other modalities for which the pixel intensity does not correspond to a defined range of physical units, and hence for which no user-selectable window presets can be defined, a default derived from the statistical characteristics of the image (or series) shall be available that makes use of the range of actual pixel values in the image to apply a window that results in a usable display. For PET and NM images, this statistically-derived default shall**

745 **have a lower level of zero. The default, preset and user selected windowing shall be**

**applicable to grayscale images any bit depth greater than one with any signedness (including 8 bit images). The window range shall be able to be extended beyond the pixel value range.**

750 **There is no requirement to be able to apply a pseudo-color palette to grayscale images (those with a Photometric Interpretation of MONOCHROME1 or MONOCHROME2), but this ability may be included at the implementer's discretion.**

755 **On a color monitor, the Image Display shall be able to display color images (those with a Photometric Interpretation of RGB or PALETTE COLOR), and images that have a Planar Configuration of 0 or 1. There is no requirement to be able to control the contrast or brightness of a color image.**

**The grayscale rendering pipeline shall be appropriate to the SOP Class and Modality. If Rescale Slope and Rescale Intercept are present in the image for MR and PET and XA/XRF images, they shall be ignored from the perspective of applying window values, which for those SOP Classes shall be applied to the stored pixel values without rescaling.**

760 **If VOI LUT tables or functions are specified in the DICOM images, then the requirements of 4.16.4.2.2.1 Display of Digital X-Ray, Mammo and Intra-Oral Images shall apply; the Basic Image Review Profile does not waive those requirements; further, the Basic Image Review Profile extends these requirements to be applicable to any SOP Class with VOI LUT tables or functions, including CR images.**

765 **Stored pixel values between Pixel Padding Value and Pixel Padding Range inclusive shall be suppressed, always displayed as black and not windowed.**

**Display shutters encoded in the image shall be applied. There is no requirement to provide new or adjustable display shutters.**

770 **An invert grayscale tool shall be provided. It shall invert the displayed pixels but not the pixel padding background or shutters.**

#### **4.16.4.2.2.5.5 Scrolling**

**Support for scrolling between images when multiple images are present in a Series, or between frames when multiple frames are present in a single image, shall be provided.**

**This support shall include:**

- 775
- **a tool that selects a mode of operation of the mouse with the left (or only) mouse button held down**
  - **acceleration of the rate of scrolling by a keyboard modifier**
  - **scrolling via the middle scrollwheel on a mouse if present on the hardware, regardless of the left mouse button tool selection**

780 **Unaccelerated scrolling shall not skip frames.**

**Vertical movement of the mouse upwards for cross-sectional images shall scroll to slices physically behind the current slice, that is:**

- **scroll towards the patient's head for transverse images viewed from inferiorly**
- **scroll towards the patient's posterior for coronal images viewed from anteriorly**
- 785 • **scroll towards the patient's right for sagittal images viewed from the left**

**Vertical movement of the mouse upwards for other images shall:**

- **scroll towards earlier frames of a multi-frame images**
- **scroll towards lower Instance Numbers in a Series of single frame images**

790 **For cross-sectional images in the same DICOM Frame of Reference, scrolling shall be synchronized between viewports based on three-dimensional location. Note that this means that if the slice intervals are different in different Series in the same plane, the scrolling may not appear to be at a uniform rate in different viewports. Interpolation between slices is not required by this profile, but may be included at the implementer's discretion.**

795 **Synchronization between viewports shall apply whether one image is displayed or the viewport is tiled.**

**The user shall be able to unlock synchronization between viewports, scroll one and then relock to a new synchronized position (e.g., if the patient has moved between Series within the same nominal DICOM Frame of Reference).**

800 **For cross-sectional images in the same orientation not in the same DICOM Frame of Reference, the user shall be able to scroll them (if needed) to align them, and then lock them for subsequent scrolling.**

**When two cross-sectional images in the same orientation are displayed in different viewports, they shall default to the "locked" state if they have the same DICOM Frame of Reference, otherwise they shall default to the "unlocked" state.**

805 **There is no requirement to provide more than one synchronized set.**

#### **4.16.4.2.2.5.6 Zooming and Panning**

**Support for continuous (not stepped) zooming and panning of an image displayed in a viewport shall be provided.**

810 **A tool shall be provided to select the use of the mouse to zoom the selected viewports. Vertical movement of the mouse upwards shall increase the magnification factor (i.e., "zoom in").**

**A tool shall be provided to select the use of the mouse to pan the selected viewports, left or right or up or down or diagonally in the direction of the mouse movement.**

815 **Interpolation for display shall be continuous (e.g. bicubic or better) and not by nearest neighbor replication.**

**Both magnification and minification shall be supported.**

**Zooming shall be synchronized across all spatially cross-referenced images, even if they are in different orientations. Panning shall be synchronized across all spatially cross-referenced images in the same orientation.**

820 **The initial state shall be to scale the image size of the first Series to fit its viewport size (without distortion of the pixel aspect ratio). For cross-sectional images in the same DICOM Frame of Reference displayed in other viewports, the same center three-dimensional location and magnification as the first viewport shall be applied (this provides an appropriate initial state for subsequent synchronized zooming, panning and scrolling).**

825 **The user shall be able to unlock synchronization of panning and zooming between viewports, pan one and then relock to a new synchronized position (e.g., if the patient has moved between Series within the same nominal DICOM Frame of Reference).**

**For images that are not spatially cross-referenced, the default state shall be unlocked zooming and panning.**

#### 830 **4.16.4.2.2.5.7 Laterality and Spatial Cross-Referencing**

**The laterality (the side of a paired body part unless unpaired or both parts displayed) shall be displayed in the overlaid annotations (see 4.16.4.2.2.5.8), and the value shall be obtained from Frame Laterality, Image Laterality or Laterality as appropriate for the SOP Class.**

835 **The orientation of the rows and columns as derived from Image Orientation (Patient) or explicitly specified in Patient Orientation shall be annotated on the right and bottom sides of the viewport (and may also be annotated on the left and top side).**

840 **For cross-sectional slices in the same DICOM Frame of Reference, if multiple viewports are displayed and the slices in the viewports are of different orientations, then the 3D location of the slices in the currently selected viewport shall be displayed as a localizer line on the other viewports, but there shall be no localizer line displayed in the currently selected viewport. These requirements for the Basic Image Review Profile supersede the general requirements for all Image Displays described in 4.16.4.2.2.2 Display of Localizer Lines.**

845 **Another mode of cross-referencing shall be to display a cross-hair consisting of a horizontal and vertical line segment (that may or may not span the full extent of each viewport), indicating the location of a point that is in the same plane. When multiple viewports with cross-sectional images in the same orientation are displayed, and those images are locked (either because they are in the same DICOM Frame of Reference or if they have been locked by the user), then clicking on a pixel location within one image shall cause a crosshair to be displayed at the equivalent location on the other locked image.**

850

**The behavior for non-orthogonal or non-parallel images is unspecified.**

**A tool shall be provided to toggle the cross-referencing to be either turned on or off.**

855 **The ability to display the location on an orthogonal image serves to indicate on what side of the body a sagittal slice is located by reference to a corresponding transverse slice. That said, the Image Display shall also annotate sagittal images with a specific textual indication of whether or not a sagittal image is to the left of center or to the right of center (this can be computed by the viewer from Image Position (Patient) and Rows, Columns \* Pixel Spacing relative to origin of entire volume of all series).**

860 **4.16.4.2.2.5.8 Annotation of Demographics, Management, Location, Timing and Technique**

**The Image Display shall annotate the content of selected DICOM attributes appropriate to the SOP Class as text in the corners of the viewport (and/or top window decoration of the view port). The information required includes, but is not limited to:**

- 865 • **Patient's Name, ID, Date of Birth, Sex**
- **Institution Name**
- **Study ID (for correlation with Study described in the report)**
- **Series Number (for correlation with Series described in the report)**
- **Series Description**
- **Acquisition Date and Acquisition Time (if present, else Content, Series or Study)**
- 870 • **Instance Number (for correlation with slices described in the report)**
- **Slice Location (or Table Position, or if not present a value derived from Image Position (Patient))**
- **Slice Thickness**
- **IV Contrast used or not (C+/-)**
- 875 • **Lossy Compression and Ratio (if used, per FDA guidance)**
- **currently applied Window Center and Width (or Window Top and Bottom for clamped mode)**

880 **Annotations that are common to all viewports or tiles need not be displayed in every viewport or tile. The Image Display shall provide a tool to suppress the display of the annotations, and to minimize the annotations to just display patient's name and date of study (e.g., using a 3-way toggle)**

**4.16.4.2.2.5.9 Cine**

885 **The Image Display shall provide a cine function for the currently selected multi-frame image or currently selected Series of single frame images (of the same size, i.e., the same values for Rows and Columns), which allows the user to:**

- **play the frames as a continuously cycling loop, either forward or reverse, fast or slow**
- **stop, pause, step one frame, rewind (skip to first frame) and skip to last frame**

890 **The Image Display shall provide an ability to control the frame rate (frames displayed per second), e.g., with a slider bar. The default shall be the frame rate specified in the DICOM attributes, if present.**

**The cine tools may be invoked as a group by a single tool button, rather than all visible by default on the main tool bar or panel.**

895 **Cine of multiple viewports simultaneously is not required, but may be provided (e.g., for cardiac applications, in which synchronization by cardiac cycle position may also be useful).**

**Cine of a tiled viewport (“snaking cine”) is not required.**

**4.16.4.2.2.5.10 Measurements**


900 **The Image Display shall provide a tool to measure distance in a straight line between two points (using Pixel Spacing, Image Pixel Spacing, Nominal Scanned Pixel Spacing or Region Calibration as appropriate for the SOP Class of the image).**

**The Image Display shall provide a tool to measure the angle between two straight lines, which do not necessarily share a common vertex.**




905 **Regardless of the cursor (mouse) mode, the scaled pixel value (physical unit) corresponding to the current cursor location shall be reported to the user (e.g., in the status bar). For example, the Hounsfield Unit value of a CT voxel or the SUVbw value of a PET voxel would be displayed. The appropriate scale factors are SOP Class specific. Additional information (such as the 3D voxel location) may also be displayed, but is not required.**

**4.16.4.2.2.5.11 Tool Icons and Actions**





910 **Table 4.16.4.2.2.5.11-1. Tool Icons Appearance and Action**

Tool	Icon Symbol	Icon Ref.	Default State	Key	Action	Comments
Select Patient		IEC 60878-2003 5663 “Next person”			Pressing this button shall bring up a mechanism to select which patient to display, in those contexts in which multiple patient information is available.  Shall be grayed out or absent if there is only a single patient	





IHE Radiology Technical Framework Supplement - Basic Image Review (BIR)




Tool	Icon Symbol	Icon Ref.	Default State	Key	Action	Comments
					(e.g., on interchange media).	
Previous Study					Pressing this button shall cause the selected viewport to display the first frame of the first image of the first series of the previous study, if any, and highlight the thumbnail of the newly selected series as highlighted.	Shall be grayed out if no previous study.
Next Study					Pressing this button shall cause the selected viewport to display the first frame of the first image of the first series of the next study, if any, and highlight the thumbnail of the newly selected series as highlighted.	Shall be grayed out if no next study.
Previous Series or Multi-frame Image			Not applicable		Pressing this button shall cause the selected viewport to display the first frame of the first image of the previous series of the current study, or multi-frame image of the current series, if any, and highlight the thumbnail of the newly	Shall be grayed out if no previous series (or multi-frame image).

IHE Radiology Technical Framework Supplement - Basic Image Review (BIR)






Tool	Icon Symbol	Icon Ref.	Default State	Key	Action	Comments
					selected series.	
Next Series or Multi-frame Image		IEC 60878-2003 5628 “Functional movement, stepwise mode”	Not applicable		Pressing this button shall cause the selected viewport to display the first frame of the first image of the next series of the current study, or multi-frame image of the current series, if any, and highlight the thumbnail of the newly selected series.	Shall be grayed out if no next series (or multi-frame image).
Previous Image (or Frame within a multi-frame image)					Pressing this button shall cause the selected viewport to display the previous image of the current series, or frame of the current multi-frame image, if any.	Shall be grayed out if no previous image (or frame).
Next Image (or Frame within a multi-frame image)					Pressing this button shall cause the selected viewport to display the next image of the current series or frame of the current multi-frame image, if any.	Shall be grayed out if no next image (or frame).
Zoom		IEC 60878-2003 1125 “Camera Zoom Adjustment”	Not selected		Selecting this tool shall change the function of the left (or only) mouse button when held during mouse movement to change the	The effect of horizontal movement of the mouse when this tool is selected is undefined.

IHE Radiology Technical Framework Supplement - Basic Image Review (BIR)



Tool	Icon Symbol	Icon Ref.	Default State	Key	Action	Comments
					magnification factor.	
Pan		IEC 60878-2003 0493 “Movement in Four Directions”	Not selected		Selecting this tool shall change the function of the left (or only) mouse button when held during mouse movement to cause a zoomed image to move with respect to the viewport.	
Window		IEC 60878-2003 5435 “Brightness/Contrast”	Not selected		Selecting this tool shall change the function of the left (or only) mouse button when held during mouse movement to adjust the windowing parameters.	
Window Center/Width or Clamped					Clicking this button shall change the mode of windowing behavior between changing the window center and width, or adjustment of the upper value of the window with the lower limit clamped to zero.	
Window Presets		IEC 60878-2003 5722 “Grey scale”	Defaults to first setting encoded in the image, or auto if none.		Pressing this button shall present a drop down of window presets, which when the user makes a choice, shall apply to all selected	Amongst the defaults shall be a choice for whatever settings are encoded in the image (which may be multiple), and a default

Tool	Icon Symbol	Icon Ref.	Default State	Key	Action	Comments
					viewports	computed from the properties of the pixels ("auto"). Additionally, for CT, presets for soft tissue, bone, lung and brain shall be provided at minimum.
Invert Grayscale		IEC 60878-2003 5411 "Reversal black-to-white"	Not inverted		Clicking this button shall toggle the inversion state.	
Scroll		IEC 60878-2003 5023 "Movement in both directions" (but rotated 90 degrees)	Selected		Selecting this tool shall change the function of the left (or only) mouse button when held during mouse movement to cause the frame or image displayed in the viewport to be scrolled to an earlier or later frame or image.	
Select		IEC 60878-2003 0022 "Engaging"	Not selected		Selecting this tool shall cause the function of the left (or only) mouse button to toggle the selection state of the entire viewport in which the cursor is currently placed (regardless of whether or not there are multiple tiles within the viewport).	Multiple discontinuous viewports may be selected by holding the CTRL key; multiple adjacent viewports may be selected by holding the SHIFT key.








IHE Radiology Technical Framework Supplement - Basic Image Review (BIR)






Tool	Icon Symbol	Icon Ref.	Default State	Key	Action	Comments
Cross-referencing		IEC 60878-2003 5738 “Alignment of the target position”	Localizer line		Selecting this tool shall toggle the display of localization information on or off.	
Lock/unlock translation synchronization	 	IEC 60878-2003 5569 IEC 60878-2003 5570	Locked (If same DICOM Frame of Reference, unlocked if different DICOM Frame of Reference?)		Pressing this button shall toggle the synchronization of the currently selected viewport from participating in synchronization of scrolling and zooming and panning.	
Annotation		IEC 60878-2003 5664 “Person identification”	Full annotation		Selecting this tool shall toggle the activation state of posting text in the corners of each viewport containing annotations of demographics, management, location, timing and technique.	There may be a binary state of no annotations and full annotations, or there may be intermediate states with less than full annotation.
Print		IEC 60878-2003 2027 “Print screen; hard copy”	Not applicable		Pressing this button shall cause the currently selected viewports (one or more), to be printed using the operating system printer, with the current windowed appearance, scroll position, zoom and pan state and annotation state (including both the corner annotations and	This is intended for printing reference images on consumer grade printers through the ordinary operating system printer drivers, not DICOM printers, and not for producing diagnostic quality prints.

IHE Radiology Technical Framework Supplement - Basic Image Review (BIR)

Tool	Icon Symbol	Icon Ref.	Default State	Key	Action	Comments
					any measurement tools that have been applied).	
Layout within viewport		IEC 60878-2003 5291 “Picture-in-picture mode”	1x1		<p>Pressing this button shall present a drop down of selected grid sizes to use within a single viewport, to indicate whether or not the layout should be 1x1 (stack mode) or 2x2 (tiled mode) or other layouts.</p> <p>Shall be grayed out if selected multi-frame image has only one frame, or series of single frame images has only one image.</p>	Other layouts than 1x1 and 2x2 may optionally be provided at the discretion of the implementer.
Layout of multiple viewports		IEC 60878-2003 5517 “Multi-picture display”	1x1		<p>Pressing this button shall present a drop down of selected grid sizes for multiple viewports, to indicate whether or not the layout should be 1x1 (only one viewport of a multi-frame image, or series of single frame images) or 1x2 (two viewports side-by-side) or 2x1 (one viewport above the other).</p>	Other layouts than 1x1 and 1x2 and 2x1 may optionally be provided at the discretion of the implementer, if support of simultaneous display of more than two Series is implemented

IHE Radiology Technical Framework Supplement - Basic Image Review (BIR)

Tool	Icon Symbol	Icon Ref.	Default State	Key	Action	Comments
Display Reset		IEC 60878-2003 5495 "Return to an initial state"	Not applicable		Pressing this button shall reset the selected viewports to their default zoom and pan state (fit image to viewport), without any rotation or flip, the window values to the initial default and will remove any measurements that have been made.	The scroll position shall not change when this button is pressed.
Distance Measurement		IEC 60878-2003 5658 "Distance Measurement"	Not selected			
Angle Measurement			Not selected			
Rotate 90 degrees clockwise		IEC 60878-2003 5772 "Rotation", modified to be single direction	Unrotated		Pressing this button shall rotate the displayed image 90 degrees clockwise.	Successive button presses will rotate a further 90 degrees.
Flip Horizontally		IEC 60878-2003 5408 "Reversal right-to-left"	No flip		Pressing this button shall flip the displayed image horizontally, i.e., about the vertical display axis.	A second button presses will flip the image back to its previous state.
Cine Tools		IEC 60878-2003 1123 "Cine radiographic exposure"	Not active		Pressing this button will make available the cine controls.	
Cine Play		IEC 60878-2003 5107B "Normal run"			Pressing this button shall play forwards at a normal rate.	
Cine Stop	Z					

Tool	Icon Symbol	Icon Ref.	Default State	Key	Action	Comments
Cine Pause						
Cine Rewind	<					
Cine Review		IEC 60878-2003 5630B "Run with visualization: review"			Pressing this button shall play backwards at a fast rate.	
Cine Forward		IEC 60878-2003 5470B "Run with visualization: cue"			Pressing this button shall play forwards at a fast rate.	
Cine Next Frame		IEC 60878-2003 5471 "Frame by frame, general"			Pressing this button shall step one frame forwards.	
Cine End	>					
Help		IEC 60878-2003 5289 "Application assistance"	Not applicable		Pressing this button shall provide access to a manual describing the use of the Image Display.	
Advanced Mode		IEC 60878-2003 5511 "Menu"			Pressing this button shall toggle a change to a different user interface providing advanced functionality	Optional (i.e., if there is no such advanced functionality)

*Amend Section 4.47:*

**4.47.4.1.2.2.3.1 DICOM Media Viewer and Basic Image Review Option**

**When the Portable Media Creator supports the Basic Image Review Option, then a viewer shall be included on the media that supports the Basic Image Review Integration Profile.**

915

If a DICOM media viewer is present on the media, it is recommended that:

- the media viewer be capable of correctly rendering all DICOM objects stored on the medium.
- a user manual in PDF format be included on the medium, in the root directory.
- a short manual in hardcopy be provided within the ~~CD jewel case~~ **physical media packaging**.

920

- **if the viewing software is not capable of executing properly (e.g., wrong OS version, insufficient memory, insufficient display resolution), the software should terminate with an error message explaining the problem in human understandable form (e.g., not “exception 0xf800” or “sys12345.dll is missing”) and without negatively affecting other programs or the operating system (i.e. the software should not crash the machine)**

#### 4.47.4.1.2.2.4 Media Identification

The Portable Media Creator actor shall support a user in adding human-readable identification information on the outside of the physical medium. The method of media marking is outside the scope of this integration profile.

- 930 It is recommended that the Patient Name, patient ID, birthdate, media creation date, the study dates for the studies on the medium and the name of the originating institution be marked on the medium. It is also recommended that the type of content (“DICOM ONLY” or “DICOM PLUS WEB”) be marked on the medium.

935 **If the Basic Image Review Option is used by the Portable Media Creator, then the label shall include an indication that an IHE Basic Image Review viewer is present (e.g. “IHE PDI + BIR Viewer”).**

...

#### **4.47.4.1.5 Basic Image Review Option**

940 **A Portable Media Creator that supports the Basic Image Review Option shall include on the Media executable software that implements the Image Display Actor as defined in the Basic Image Review Integration Profile.**

**The hardware and software requirements for the viewer are defined in the Basic Image Review Integration Profile**

945