IHE Radiation Oncology
Technical Framework Supplement

Treatment Planning – Plan Content Brachy
(TPPC-Brachy)

(Version 2 – Revision 26)

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Date: February 2023
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Foreword
This is a supplement to the IHE Radiation Oncology Technical Framework V. X.X. Each supplement undergoes a process of public comment and trial implementation before being incorporated into the volumes of the Technical Frameworks.

<For Public Comment:> This supplement is published on <Month XX, 201x> for Public Comment. Comments are invited and may be submitted at http://www.ihe.net/<domain>/comments.cfm. In order to be considered in development of the Trial Implementation version of the supplement, comments must be received by <Month XX, 201X>.

<For Trial Implementation:> This supplement is published on <Month XX, 201X> 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 <Domain Name> Technical Framework. Comments are invited and may be submitted at http://www.ihe.net/<domain>/comments.cfm.

This supplement describes changes to the existing technical framework documents.

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

Amend section X.X by the following:

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

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

Information about the IHE <Domain Name> domain can be found at: http://www.ihe.net/Domains/index.cfm.

Information about the organization of IHE Technical Frameworks and Supplements and the process used to create them can be found at: http://www.ihe.net/About/process.cfm and http://www.ihe.net/profiles/index.cfm.

The current version of the IHE <Domain name> Technical Framework can be found at: http://www.ihe.net/Technical_Framework/index.cfm.

<Comments may be submitted on IHE Technical Framework templates any time at http://ihe.net/ihetemplates.cfm. Please enter comments/issues as soon as they are found. Do not wait until a future review cycle is announced.

Rev. 2.26–2023-2-16

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Template Rev. 10.3
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Introduction to this Supplement

This content profile is motivated by medical physicists working with brachytherapy planning systems, who face an increasing demand from patient-care, data-quality and research perspectives to increase the usefulness, exchangeability and availability of clinical data across the various treatment planning systems.

The main role of this profile is to address a solution for such interoperability using the DICOM objects provided in its 1st generation.

The aim is to streamline the implementation of the DICOM objects in order to identify a common understanding and key reading of the standard. This supplement provides the guidelines to handle techniques that exist in brachytherapy that benefit from digital data storage. The involved actors are either producers or consumers of a DICOM RT Plan for brachytherapy.

History

<table>
<thead>
<tr>
<th>Date</th>
<th>Rev.</th>
<th>Author</th>
<th>Change Summary</th>
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</thead>
<tbody>
<tr>
<td>2023 February 3</td>
<td>25</td>
<td>Yury Niatsetki, Jim Percy</td>
<td>WG review Feb 2023</td>
</tr>
<tr>
<td>2023 February 16</td>
<td>26</td>
<td>Yury Niatsetki, Jim Percy</td>
<td>Version voted to Public Comment Feb 2023</td>
</tr>
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Open Issues for Public Comment

<table>
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<tr>
<th>#</th>
<th>Comment/Issue</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>For temporary LDR treatment plans, can we restrict to just 2 control points (CP’s) per channel like Permanent LDR?</td>
</tr>
</tbody>
</table>
### General Introduction

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

### Appendix A - Actor Summary Definitions

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

<table>
<thead>
<tr>
<th>Actor</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>HDR/PDR Structure Set Producer</td>
<td>A system capable of producing an HDR/PDR Structure Set</td>
</tr>
<tr>
<td>HDR/PDR Structure Set Consumer</td>
<td>A system capable of consuming an HDR/PDR Structure Set</td>
</tr>
<tr>
<td>LDR Structure Set Producer</td>
<td>A system capable of producing an LDR Structure Set</td>
</tr>
<tr>
<td>LDR Structure Set Consumer</td>
<td>A system capable of consuming an LDR Structure Set</td>
</tr>
<tr>
<td>HDR Treatment Plan Producer</td>
<td>A system capable of producing an HDR treatment plan.</td>
</tr>
<tr>
<td>HDR Treatment Plan Consumer</td>
<td>A system capable of consuming an HDR treatment plan.</td>
</tr>
<tr>
<td>PDR Plan Producer</td>
<td>A system capable of producing a PDR treatment plan.</td>
</tr>
<tr>
<td>PDR Plan Consumer</td>
<td>A system capable of consuming a PDR treatment plan.</td>
</tr>
<tr>
<td>LDR Permanent Plan Producer</td>
<td>A system capable of producing a permanent LDR treatment plan.</td>
</tr>
</tbody>
</table>
LDR Permanent Plan Consumer | A system capable of consuming a permanent LDR treatment plan
---|---
LDR Temporary Plan Producer | A system capable of producing a temporary LDR treatment plan.
LDR Temporary Plan Consumer | A system capable of consuming a temporary LDR treatment plan.
RT Ultrasound Producer | A system capable of producing an RT Ultrasound image.
RT Ultrasound Consumer | A system capable of consuming an RT Ultrasound image.

Appendix B - Transaction Summary Definitions

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

<table>
<thead>
<tr>
<th>Transaction</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>TPPC-BRACHY-01: HDR Plan Storage</td>
<td>An HDR Plan Producer stores a treatment plan to a HDR Plan Consumer.</td>
</tr>
<tr>
<td>TPPC-BRACHY-02: PDR Plan Storage</td>
<td>A PDR Plan Producer stores a treatment plan to a PDR Plan Consumer.</td>
</tr>
<tr>
<td>TPPC-BRACHY-03: LDR Permanent Plan Storage</td>
<td>An LDR Permanent Plan Producer stores a treatment plan to an LDR Permanent Plan Consumer.</td>
</tr>
<tr>
<td>TPPC-BRACHY-05 HDR/PDR Structure Set Storage</td>
<td>An HDR/PDR Structure Set Producer stores a structure set to an HDR/PDR Structure Set Consumer.</td>
</tr>
<tr>
<td>--------------------------------------------</td>
<td>-------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>TPPC-BRACHY-06 LDR Structure Set Storage</td>
<td>An LDR Structure Set Producer stores a structure set to an LDR Structure Set Consumer.</td>
</tr>
<tr>
<td>TPPC-BRACHY-07</td>
<td>An RT Ultrasound Producer stores an Ultrasound image series to an RT Ultrasound Consumer.</td>
</tr>
</tbody>
</table>

**Glossary**

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

<table>
<thead>
<tr>
<th>Glossary Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>HDR</td>
<td>High dose rate</td>
</tr>
<tr>
<td>PDR</td>
<td>Pulse dose rate</td>
</tr>
<tr>
<td>LDR</td>
<td>Low dose rate</td>
</tr>
<tr>
<td>Applicator</td>
<td>Device, consisting out of one or more catheters, holding the radioactive source(s) during brachytherapy</td>
</tr>
</tbody>
</table>
Volume 1 – Profiles

X Brachy Treatment Planning – Plan Content Integration (TPPC-Brachy) Profile

This integration profile involves the exchange of RT Plan information:
- Between treatment planning systems
- Between treatment planning systems and treatment management systems and/or treatment delivery systems.

The transactions revolve around the brachytherapy treatment specific workflows (e.g. specifying the process of transferring the treatment planning data to a treatment management system). On the basis of the planned technique for the treatment, the content of the DICOM object has an additional content specifications defined in chapter 7 in order to address the interoperability between different vendors.

The workflow description will make use of this content description defined in chapter 7.

This profile addresses the techniques that exist in Brachytherapy. The actors are either producers or consumers of a DICOM RT Plan.

X.1 TPPC-BRACHY Actors, Transactions, and Content Modules

In figure X.1-1 is showed how this content profile is used in the exchanging of DICOM plans between actors that are identified as producers and actors that are identified as consumers.

The DICOM objects that are exchanged between producers and consumers have to implement the requirements listed in this profile in order to be IHE compliant.
Figure X.1-1: TPPC-Brachy Actor Diagram

Transactions Overview:
Table X.1-1 lists the transactions for each actor directly involved in the TPPC-Brachy Profile. To claim compliance with this Profile, an actor shall support all required transactions (labeled “R”) and may support the optional transactions (labeled “O”).
### Table X.1-1: TPPC-Brachy Profile - Actors and Transactions

<table>
<thead>
<tr>
<th>Actors</th>
<th>Transactions</th>
<th>Optionality</th>
<th>Section in Vol. 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment Management System (TMS)</td>
<td>HDR Plan Storage</td>
<td>O</td>
<td>[TPPC-Brachy 01]</td>
</tr>
<tr>
<td>(See Note Below)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PDR Plan Storage</td>
<td>O</td>
<td></td>
<td>[TPPC-Brachy 02]</td>
</tr>
<tr>
<td>LDR Permanent Plan Storage</td>
<td>O</td>
<td></td>
<td>[TPPC-Brachy 03]</td>
</tr>
<tr>
<td>LDR Temporary Plan Storage</td>
<td>O</td>
<td></td>
<td>[TPPC-Brachy 04]</td>
</tr>
<tr>
<td>HDR/PDR Structure Set Storage</td>
<td>O</td>
<td></td>
<td>[TPPC-Brachy 05]</td>
</tr>
<tr>
<td>LDR Structure Set Storage</td>
<td>O</td>
<td></td>
<td>[TPPC-Brachy 06]</td>
</tr>
<tr>
<td>HDR Plan Producer</td>
<td>HDR Plan Storage</td>
<td>R</td>
<td>[TPPC-Brachy 01]</td>
</tr>
<tr>
<td>PDR Plan Producer</td>
<td>PDR Plan Storage</td>
<td>R</td>
<td>[TPPC-Brachy 02]</td>
</tr>
<tr>
<td>LDR Permanent Plan Producer</td>
<td>LDR Permanent Plan Storage</td>
<td>R</td>
<td>[TPPC-Brachy 03]</td>
</tr>
<tr>
<td>LDR Temporary Plan Producer</td>
<td>LDR Temporary Plan Storage</td>
<td>R</td>
<td>[TPPC-Brachy 04]</td>
</tr>
<tr>
<td>HDR Plan Consumer</td>
<td>HDR Plan Storage</td>
<td>R</td>
<td>[TPPC-Brachy 01]</td>
</tr>
<tr>
<td>PDR Plan Consumer</td>
<td>PDR Plan Storage</td>
<td>R</td>
<td>[TPPC-Brachy 02]</td>
</tr>
<tr>
<td>LDR Permanent Plan Consumer</td>
<td>LDR Permanent Plan Storage</td>
<td>R</td>
<td>[TPPC-Brachy 03]</td>
</tr>
<tr>
<td>LDR Temporary Plan Consumer</td>
<td>LDR Temporary Plan Storage</td>
<td>R</td>
<td>[TPPC-Brachy 04]</td>
</tr>
<tr>
<td>HDR/PDR Structure Set Producer</td>
<td>HDR/PDR Structure Set Storage</td>
<td>R</td>
<td>[TPPC-Brachy 05]</td>
</tr>
<tr>
<td>LDR Structure Set Producer</td>
<td>LDR Structure Set Storage</td>
<td>R</td>
<td>[TPPC-Brachy 06]</td>
</tr>
<tr>
<td>HDR/PDR Structure Set Consumer</td>
<td>HDR/PDR Structure Set Storage</td>
<td>R</td>
<td>[TPPC-Brachy 05]</td>
</tr>
<tr>
<td>LDR Structure Set Consumer</td>
<td>LDR Structure Set Storage</td>
<td>R</td>
<td>[TPPC-Brachy 06]</td>
</tr>
<tr>
<td>RT Ultrasound Producer</td>
<td>RT Ultrasound Storage</td>
<td>R</td>
<td>[TPPC-Brachy 07]</td>
</tr>
<tr>
<td>RT Ultrasound Consumer</td>
<td>RT Ultrasound Storage</td>
<td>R</td>
<td>[TPPC-Brachy 07]</td>
</tr>
</tbody>
</table>

Note: The TMS Integration Statement will indicate which transactions it is capable of supporting. In general, these will be grouped according to the overall functionality of the TMS actor. For example, a general TMS would likely support all transactions, while a Brachy only TMS may only support the brachy structure sets and brachy plans. In addition, for cases where there are insufficient actors for complete testing of the TMS, the TMS can pass the Connectathon by claiming those transactions it successfully completed.

#### X.1.1 Actor Descriptions and Actor Profile Requirements

For all Brachytherapy Content Producers and Consumers, the display requirements for dwell time and total dose contributions are not sufficiently met by just presenting the DICOM data. It must be converted as described in the notes in this section. An actor does not adhere to the profile unless the system provides the output in the prescribed format.
AIDS shall display total times and dwell times at the reference date and time of the plan (including time zone used) and not Cumulative Time Values.

X.2 TPPC-Brachy Transaction Options
None

X.3 Required Actor Groupings
None

X.4 Use Cases
None
X.5 TPPC-Brachy Overview

X.5.1 Concepts

This profile enhances the content of the DICOM plan objects as regard the brachytherapy scope. This is fulfilled by providing specialized actors for each technique and role (producer or consumer).

Typically, a Treatment Planning System (TPS) is expected to implement one or more of the “producer” actors.

A TPS that is intended to be able to perform a re-planning based on the output of another TPS is expected to adhere to one or more of the “consumers” actors.

The transactions included in this profile provide the guidelines that indicate how the DICOM object shall be filled focusing in the content description rather than in the workflow description.

The most important attributes that have to be properly included in the DICOM object in order to avoid ambiguities and safety implications on interpreting the object have been identified in the transactions.

X.5 TPPC-Brachy Security Considerations

None

X.6 TPPC-Brachy Cross Profile Considerations
Volume 2 – Transactions

3.Y1 HDR Plan Storage [TPPC-Brachy 01]

3.Y1.1 Scope
In the HDR Plan Storage transaction, a Producer of an RT Plan that incorporates the brachytherapy technique identified in TPPC-Brachy-01: HDR Plan Storage stores the plan to an HDR Plan Consumer. In this example, we diagram a DICOM C-Store, but other forms of transmission are acceptable for this content profile.

3.Y1.2 Actor Roles

<table>
<thead>
<tr>
<th>Actor:</th>
<th>HDR Plan Producer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Role:</td>
<td>Creates a HDR plan for a treatment that shall be delivered using a treatment delivery system and stores it to an HDR Plan Consumer.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Actor:</th>
<th>HDR Plan Consumer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Role:</td>
<td>Accepts and stores the RT Plan from the HDR Plan Producer</td>
</tr>
</tbody>
</table>

3.Y1.3 Referenced Standards
DICOM 2021c Edition. PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.Y1.4 Interaction Diagram
None provided

3.Y1.4.1.1 Trigger Events
The HDR Plan Producer transfers the plan to a storage or HDR Plan Consumer once the plan is created and the dose calculation is finished.
3.Y1.4.1.2 Message Semantics

The HDR Plan Producer may create a new series containing the plan or may use an existing series, where previous plan(s) are contained.

The study where the series of the plan is contained shall be the same study as the one containing the structure set referenced in the plan.

The requirements for the content of the RT Plan are specified in section 7.3.2.1.3 RT Plan IOD for Brachytherapy respectively.

3.Y1.4.1.3 Expected Actions

The HDR Plan Consumer stores the RT Plan.
3.Y2 PDR Plan Storage [TPPC-Brachy 02]

3.Y2.1 Scope

In the PDR Plan Storage transaction, a Producer of an RT Plan that incorporates the brachytherapy technique identified in TPPC-Brachy-XX: PDR Plan Storage stores the plan to an HDR Plan Consumer. In this example, we diagram a DICOM C-Store, but other forms of transmission are acceptable for this content profile.

3.Y2.2 Actor Roles

<table>
<thead>
<tr>
<th>Actor:</th>
<th>Role:</th>
</tr>
</thead>
<tbody>
<tr>
<td>PDR Plan Producer</td>
<td>Creates an PDR plan for a treatment that shall be delivered using a treatment delivery system and stores it to a PDR Plan Consumer.</td>
</tr>
<tr>
<td>PDR Plan Consumer</td>
<td>Accepts and stores the RT Plan from the PDR Plan Producer</td>
</tr>
</tbody>
</table>

3.Y2.3 Referenced Standards

DICOM 2021c Edition. PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.Y2.4 Interaction Diagram

None Provided

3.Y2.4.1 PDR Plan Storage

3.Y2.4.1.1 Trigger Events

The PDR Plan Producer transfers the plan to a storage or PDR Plan Consumer once the plan is created and the dose calculation is finished.
3.Y2.4.1.2 Message Semantics
The PDR Plan Producer may create a new series containing the plan or may use an existing series, where previous plan(s) are contained.

The study where the series of the plan is contained shall be the same study as the one containing the structure set referenced in the plan.

The requirements for the content of the RT Plan are specified in section 7.3.2.1.3.

3.Y2.4.1.3 Expected Actions
The PDR Plan Consumer stores the RT Plan and its RT Structure Set.
3.Y3 LDR Permanent Plan Storage [TPPC-Brachy 03]

3.Y3.1 Scope
In the LDR Permanent Plan Storage transaction, a Producer of an RT Plan that incorporates the brachytherapy technique identified in TPPC-Brachy-03: LDR Permanent Plan Storage stores the plan to an LDR Permanent Plan Consumer. In this example, we diagram a DICOM C-Store, but other forms of transmission are acceptable for this content profile.

3.Y3.2 Actor Roles

<table>
<thead>
<tr>
<th>Actor:</th>
<th>LDR Permanent Plan Producer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Role:</td>
<td>Creates an LDR Permanent plan for a treatment that shall be delivered using a treatment delivery system and stores it to an LDR Permanent Plan consumer</td>
</tr>
<tr>
<td>Actor:</td>
<td>LDR Permanent Plan Consumer</td>
</tr>
<tr>
<td>Role:</td>
<td>Accepts and stores the RT Plan from the LDR Permanent Plan Producer</td>
</tr>
</tbody>
</table>

3.Y3.3 Referenced Standards
DICOM 2021c Edition. PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.Y3.4 Interaction Diagram
None provided

3.Y3.4.1 LDR Permanent Plan Storage

3.Y3.4.1.1 Trigger Events
The LDR Permanent Plan Producer transfers the plan to a storage or LDR Permanent Plan Consumer once the plan is created and the dose calculation is finished.

3.Y3.4.1.2 Message Semantics
The LDR Permanent Plan Producer may create a new series containing the plan or may use an existing series, where previous plan(s) are contained.
The study where the series of the plan is contained shall be the same study as the one containing the structure set referenced in the plan.

The requirements for the content of the RT Plan are specified in section 7.3.2.1.3.

3.4.1.3 Expected Actions

The LDR Permanent Plan Consumer stores the RT Plan.
3.Y4 LDR Temporary Plan Storage [TPPC-Brachy 04]

3.Y4.1 Scope
In the LDR Temporary Plan Storage transaction, a Producer of an RT Plan that incorporates the brachytherapy technique identified in TPPC-Brachy-04: LDR Temporary Plan Storage stores the plan to an LDR Temporary Plan Consumer. In this example, we diagram a DICOM C-Store, but other forms of transmission are acceptable for this content profile.

3.Y4.2 Actor Roles

<table>
<thead>
<tr>
<th>Actor:</th>
<th>LDR Temporary Plan Producer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Role:</td>
<td>Creates an LDR Temporary plan for a treatment that shall be delivered using a treatment delivery system and stores it to an LDR Temporary Plan Consumer</td>
</tr>
<tr>
<td>Actor:</td>
<td>LDR Temporary Plan Consumer</td>
</tr>
<tr>
<td>Role:</td>
<td>Accepts and stores the RT Plan from the LDR Temporary Plan Producer</td>
</tr>
</tbody>
</table>

3.Y4.3 Referenced Standards
DICOM 2021c Edition. PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.Y4.4 Interaction Diagram
None provided

3.Y4.1 LDR Temporary Plan Storage

3.Y4.1.1 Trigger Events
The LDR Temporary Plan Producer transfers the plan to a storage or LDR Temporary Plan Consumer once the plan is created and the dose calculation is finished.
3.Y4.4.1.2 Message Semantics

The LDR Temporary Plan Producer may create a new series containing the plan or may use an existing series, where previous plan(s) are contained.

The study where the series of the plan is contained shall be the same study as the one containing the structure set referenced in the plan.

The requirements for the content of the RT Plan are specified in section 7.3.2.1.3.

3.Y4.4.1.3 Expected Actions

The LDR Temporary Plan Consumer stores the RT Plan.
3.Y5 HDR/PDR Structure Set Storage [TPPC-Brachy-05]

3.Y5.1 Scope

In the HDR/PDR Structure Set Storage transaction for Brachy, a producer of a Structure Set that incorporates the contours identified as necessary for an HDR or PDR treatment plan, stores the structure set to an HDR/PDR Structure Set Consumer.

3.Y5.2 Actor Roles

<table>
<thead>
<tr>
<th>Actor:</th>
<th>HDR/PDR Structure Set Producer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Role:</td>
<td>Creates an HDR/PDR Structure Set and stores it to an HDR/PDR Structure Set Consumer</td>
</tr>
<tr>
<td>Actor:</td>
<td>HDR/PDR Structure Set Consumer</td>
</tr>
<tr>
<td>Role:</td>
<td>Accepts and stores the HDR/PDR Structure Set from the HDR/PDR Structure Set Producer</td>
</tr>
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</table>

3.Y5.3 Referenced Standards

DICOM 2021c Edition. PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.Y5.4 Interaction Diagram

None

3.Y5.4.1 HDR/PDR Structure Set Storage

3.Y5.4.1.1 Trigger Events

The HDR/PDR Structure Set Producer transfers the structure set to an HDR/PDR Structure Set Consumer once the HDR or PDR plan is created.
3.Y5.4.1.2 Message Semantics

The HDR/PDR Structure Set Producer may create a new series containing the structure set or may use an existing series, where previous structure set(s) are contained.

The requirements for the content of the RT Structure Set and RT Plan are specified in section 7.3.4.1.3 RT Structure Set for Brachytherapy.

3.Y5.4.1.3 Expected Actions

The HDR/PDR Structure Set Consumer stores the RT Structure Set.

3.Y6 LDR Structure Set Storage [TPPC-Brachy-06]

3.Y6.1 Scope

In the LDR Structure Set Storage transaction for Brachy, a producer of a Structure Set that incorporates the contours identified as necessary for an LDR Permanent or LDR Temporary treatment plan, stores the structure set to an LDR Structure Set Consumer.

3.Y6.2 Actor Roles

LDR Structure Set Producer

Role: Creates an LDR Structure Set and stores it to an LDR Structure Set Consumer

LDR Structure Set Consumer

Role: Accepts and stores the LDR Structure Set from the LDR Structure Set Producer

3.Y6.3 Referenced Standards

DICOM 2021c Edition. PS 3.3: RT Modules, PS 3.4: Storage Service Class.
3.Y6.4 Interaction Diagram
None

3.Y6.4.1 LDR Structure Set Storage

3.Y6.4.1.1 Trigger Events
The LDR Structure Set Producer transfers the structure set to an LDR Structure Set Consumer once the LDR plan is created.

3.Y6.4.1.2 Message Semantics
The LDR Structure Set Producer may create a new series containing the structure set or may use an existing series, where previous structure set(s) are contained.

The requirements for the content of the RT Structure Set and RT Plan are specified in section 7.3.4.1.3 RT Structure Set for Brachytherapy.

3.Y6.4.1.3 Expected Actions
The LDR Structure Set Consumer stores the RT Structure Set.

3.Y7 LDR RT Ultrasound Storage [TPPC-Brachy-07]

3.Y7.1 Scope
In the RT Ultrasound Storage transaction for Brachy, a Producer of an RT Ultrasound set of images that incorporates the image plane details identified as necessary for an RT Ultrasound plan, stores the RT Ultrasound image series to an RT Ultrasound Consumer.

3.Y7.2 Actor Roles

3.Y8 LDR RT Ultrasound Imaging [TPPC-Brachy-08]

3.Y8.1 Scope
In the RT Ultrasound Imaging transaction for Brachy, a Producer of an RT Ultrasound set of images that incorporates the image plane details identified as necessary for an RT Ultrasound plan, transfers the RT Ultrasound image series to an RT Ultrasound Consumer.

3.Y8.2 Actor Roles

RT Ultrasound Producer

RT Ultrasound Consumer

RT Ultrasound Storage
3.Y7.3 Referenced Standards
DICOM 2021c Edition. PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.Y7.4 Interaction Diagram
None

3.Y7.4.1 LDR Structure Set Storage

3.Y7.4.1.1 Trigger Events
The RT Ultrasound Producer transfers the RT Ultrasound images series to an RT Ultrasound Consumer once the image set is created.

3.Y7.4.1.2 Message Semantics
The RT Ultrasound Producer will create a new series containing the images.

The requirements for the content of the RT Ultrasound images are specified in section 7.4.6.3 RT Ultrasound Image for Brachytherapy.

3.Y7.4.1.3 Expected Actions
The RT Ultrasound Consumer stores the RT Ultrasound images.
Volume 3 – Content Modules

6. Content Modules
No Content Modules defined.

7. DICOM Content Definition

7.1 Conventions

<table>
<thead>
<tr>
<th>Key to IHE-RO Column of requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>- R+ = The requirement is an IHE extension of the DICOM requirements and needs to be displayed (note: when consumed!, not produced)</td>
</tr>
<tr>
<td>- R* = The attribute is required to be there but not required to be displayed</td>
</tr>
<tr>
<td>- R+* = The Requirement is an IHE extension of the DICOM requirements, but it is NOT required to be displayed</td>
</tr>
<tr>
<td>- O+ = The attribute is optional but if there, it must be displayed.</td>
</tr>
<tr>
<td>- -* = The DICOM usage applies but the value does not need to be displayed</td>
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</table>
7.3.2 Plan IODs

7.3.2.1.3 RT Plan for Brachytherapy

7.3.2.1.3.1 Referenced Standards

DICOM 2021c Edition. PS 3.3

7.3.2.1.3.2 IOD Definition
<table>
<thead>
<tr>
<th>IE</th>
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<th>Reference</th>
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<th>IHE-RO Usage</th>
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<td>M</td>
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<td>Clinical Trial Subject</td>
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<td>Clinical Trial Study</td>
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<td>C.8.8.1</td>
<td>M</td>
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Rev. 2.26– 2023-2-16

: IHE International, Inc.
Template Rev. 10.3
### 7.3.3 Image IODs

#### 7.3.3.3 US Image

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: IHE International, Inc.

Template Rev. 10.3
<table>
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<th>Usage</th>
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<td>US Region Calibration</td>
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<td>Common Instance Reference</td>
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</table>

### 7.3.4 RT Structure Set IOD

#### 7.3.4.1.3 RT Structure Set for Brachytherapy

In the IHE-RO Usage column, the specific content required by Brachytherapy, is indicated; otherwise the Base Content is referenced.

<table>
<thead>
<tr>
<th>IE</th>
<th>Module</th>
<th>Reference</th>
<th>Usage</th>
<th>IHE-RO Usage</th>
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See Section Error! Reference source not found.7.4.1.1.1 (Base Content)
<table>
<thead>
<tr>
<th>IE</th>
<th>Module</th>
<th>Reference</th>
<th>Usage</th>
<th>IHE-RO Usage</th>
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<td>RT ROI Observation</td>
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<td>R</td>
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<td></td>
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<td>See relevant section for the type of plan being generated HDR/PDR 7.4.8.1.3, LDR 7.4.8.1.4</td>
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<td>Common Instance</td>
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<td>C.12.2</td>
<td>U</td>
<td>C – Required if reference information is available</td>
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<tr>
<td>Reference</td>
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</table>
7.3.5 Dose IODs

This section is present only to convey the envisioned section numbering.

7.3.6 Treatment Record IODs

7.3.6.1 Technique Specific RT Treatment Record

This section is present only to convey the envisioned section numbering.

7.3.6.2 RT Treatment Record for General Use

This section is present only to convey the envisioned section numbering.

7.3.6.3 RT Brachy Treatment Records

7.3.6.3.1 RT Brachy Treatment Record

7.3.6.3.1.1 Referenced Standards

DICOM 2021c Edition. PS 3.3

7.3.6.3.1.2 IOD Definition

7.4 Module Definitions

7.4.1 General Modules

7.4.1.3 General Series Module

7.4.1.3.4 General Series Module Brachy Content

<table>
<thead>
<tr>
<th>Attribute Name</th>
<th>Tag</th>
<th>DICOM usage</th>
<th>IHE-RO usage</th>
<th>Attribute Description</th>
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<tbody>
<tr>
<td>Series Instance UID</td>
<td>(0020,000E)</td>
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<td>Series Date</td>
<td>(0008,0021)</td>
<td>3</td>
<td>R*</td>
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<tr>
<td>Series Time</td>
<td>(0008,0031)</td>
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<td>R*</td>
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<td>Operators’ Name</td>
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7.4.1.5 Equipment Module

7.4.1.5.21 General Equipment Module Content

7.4.1.5.1.3 General Equipment Module Brachy Content

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<th>IHE-RO usage</th>
<th>Attribute Description</th>
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<tbody>
<tr>
<td>Manufacturer</td>
<td>(0008,0070)</td>
<td>R+</td>
<td>IHE requires that this element be present, and should contain the manufacturer of the equipment creating the image, structure set, plan, or dose.</td>
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<tr>
<td></td>
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<td></td>
<td>If the equipment is storing and forwarding information, the value of this element shall be preserved. If a new plan is created from a previous plan, the</td>
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<td></td>
<td></td>
<td>manufacturer of the equipment producing the new plan shall insert their identifier in this element. If a new structure set is created from a previous</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>structure set, the manufacturer of the equipment producing the new structure set shall insert their identifier in this element.</td>
</tr>
<tr>
<td>Manufacturer's Model Name</td>
<td>(0008,1090)</td>
<td>R+</td>
<td>If an application resamples or adds data and re-exports a series of CT or US images, or modifies an instance then this element must be present, and</td>
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<tr>
<td></td>
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<td></td>
<td>must contain the model name of the equipment doing the resampling or additions.</td>
</tr>
<tr>
<td>Software Versions</td>
<td>(0018,1020)</td>
<td>R+</td>
<td>Must be present. If images are edited, this is the Software Versions of the system that made the changes.</td>
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</tbody>
</table>
7.4.1.6 SOP Common Module

7.4.1.6.2 SOP Common Module Brachy Content

7.4.1.6.2.1 Referenced Standards
DICOM 2021c Edition PS 3.3

7.4.1.6.2.2 Module Definition

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<td>Shall be present. If an image has been modified for planning purposes, the Date shall be when the modifying system created the instance.</td>
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<td>(0008,0018)</td>
<td>1</td>
<td>R*</td>
<td>If an image has been modified for planning purposes, the UID shall be updated and contain the root of the manufacturer of the updated image.</td>
</tr>
</tbody>
</table>

7.4.3.3.3 RT Fraction Scheme Module for Brachy

Rev. 2.26– 2023-2-16

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Template Rev. 10.3
### Attribute

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Tag</th>
<th>Presence</th>
<th>Specific Rules</th>
</tr>
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<tbody>
<tr>
<td>Fraction Group Sequence</td>
<td>(300A,0070)</td>
<td>R+*</td>
<td>Shall have only a single item in the sequence.</td>
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<tr>
<td>&gt; Referenced Dose Reference Sequence</td>
<td>(300C,0050)</td>
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<tr>
<td>&gt;&gt; Referenced Dose Reference Number</td>
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<td></td>
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<tr>
<td>&gt; Number of Fractions Planned</td>
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<td>R+</td>
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<tr>
<td>&gt; Number of Beams</td>
<td>(300A,0080)</td>
<td>R+*</td>
<td>Shall be 0.</td>
</tr>
<tr>
<td>&gt; Number of Brachy Application Setups</td>
<td>(300A,000A)</td>
<td>R+*</td>
<td>Shall be equal to the number of items under &quot;Application Setup Sequence&quot; (300A,0230)</td>
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<tr>
<td>&gt; Referenced Brachy Application Setup Sequence</td>
<td>(300C,000C)</td>
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<td></td>
</tr>
<tr>
<td>&gt;&gt; Brachy Application Setup Dose Specification Point</td>
<td>(300A,00A2)</td>
<td></td>
<td></td>
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<tr>
<td>&gt;&gt; Brachy Application Setup Dose</td>
<td>(300A,00A4)</td>
<td>R+*</td>
<td>If the plan contains multiple Application Setups, the sum of the Brachy Application Setup Doses represents the dose per fraction for the plan.</td>
</tr>
<tr>
<td>&gt;&gt; Referenced Dose Reference UID</td>
<td>(300A,0083)</td>
<td>R+*</td>
<td>Identifies the Dose Reference specified by Dose Reference UID (300A,0013) in the Dose Reference Sequence (300A,0010) in the RT Prescription Module which specifies the primary target for the current Application Setup. If present shall have a value that is present in the Dose Reference Sequence.</td>
</tr>
</tbody>
</table>
### 7.4.4 Plan-Related Modules in Planning

#### 7.4.4.6 RT Brachy Application Setups

#### 7.4.4.6.1 RT Application Setup Module for HDR Plan and PDR Plan

**Key to IHE-RO Column of requirements**

- **R+** = The requirement is an IHE extension of the DICOM requirements and needs to be displayed (note: when consumed!, not produced)
- **R* =** The attribute is required to be there but not required to be displayed
- **R+* =** The Requirement is an IHE extension of the DICOM requirements, but it is NOT required to be displayed
- **O+ =** The attribute is optional but if there, it must be displayed.
- **- =** The DICOM usage applies but the value does not need to be displayed

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<th>Presence</th>
<th>HDR and PDR Technique Specific Rules</th>
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<tr>
<td>Brachy Treatment Technique</td>
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<td><strong>R+</strong>*</td>
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<td><strong>R+</strong></td>
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<tr>
<td>Treatment Machine Sequence</td>
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</tr>
<tr>
<td>&gt;Treatment Machine Name</td>
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<tr>
<td>&gt;Institution Name</td>
<td>(0008,0080)</td>
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<tr>
<td>&gt;Institution Address</td>
<td>(0008,0081)</td>
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<td>&gt;Institutional Department Name</td>
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<tr>
<td>&gt;Device Serial Number</td>
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<tr>
<td>&gt;Source Model ID</td>
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<td>&gt;Source Description</td>
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<td>Specific Rules</td>
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<td>&gt;Material ID</td>
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<td>&gt;Source Encapsulation Nominal</td>
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<td>Thickness</td>
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<tr>
<td>&gt;Source Encapsulation Nominal</td>
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<td>Transmission</td>
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<tr>
<td>&gt;Source Isotope Name</td>
<td>(300A,0226)</td>
<td>1</td>
<td>R+ Representation of the Source shall be in the form used by SNOMED: &lt;Element&gt;-&lt;number of nucleons&gt; e.g. Iridium-192</td>
</tr>
<tr>
<td>&gt;Source Isotope Half Life</td>
<td>(300A,0228)</td>
<td>1</td>
<td>-*</td>
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<tr>
<td>&gt;Source Strength Units</td>
<td>(300A,0229)</td>
<td>1C</td>
<td>R+ Shall have a value without constraint for gamma-emitting source. Measurement unit of Source Strength. Enumerated Values: AIR_KERMA_RATE Air Kerma Rate DOSE_RATE_WATER Dose Rate in Water</td>
</tr>
<tr>
<td>&gt;Reference Air Kerma Rate</td>
<td>(300A,022A)</td>
<td>1</td>
<td>R+ Required if source is calibrated in Air-Kerma-Rate. If not, value shall be 0</td>
</tr>
<tr>
<td>&gt;Source Strength</td>
<td>(300A,022B)</td>
<td>1C</td>
<td>R+ Source strength used to calculate the dwell times. Required if source is calibrated in Dose Rate in water. If not, attribute shall not be present.</td>
</tr>
<tr>
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<tr>
<td>&gt;Source Strength Reference Time</td>
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<td>R+* Number of items shall be 1.</td>
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### Attribute

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<tr>
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<th>Tag</th>
<th>HDR and PDR Technique</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Presence</td>
</tr>
</tbody>
</table>

- **>>>Channel Shield Nominal Transmission**
  - (300A,02BA) 3 -
- **>>>Referenced ROI Number**
  - (3006,0084) 2 -
- **>>Referenced Source Number**
  - (300C,000E) 1 -
- **>>Number of Control Points**
  - (300A,0110) 1 -
- **>>Final Cumulative Time Weight**
  - (300A,02C8) 1C R+ As described in section X.1.1, display the final dwell time value
- **>>Brachy Control Point Sequence**
  - (300A,02D0) 1 -
- **>>>Control Point Index**
  - (300A,0112) 1 -
- **>>>Cumulative Time Weight**
  - (300A,02D6) 2 R+ As described in section X.1.1, display the dwell time spent at each location
- **>>>Control Point Relative Position**
  - (300A,02D2) 1 -
- **>>>Control Point 3D Position**
  - (300A,02D4) 3 R+* If present it has to be consistent with the related information in the structure. The structure is defined by the Referenced ROI Number (3006,0084).
- **>>>Control Point Orientation**
  - (300A,0412) 3 R+* Shall be consistent with the related information in the structure. The structure is defined by the Referenced ROI Number (3006,0084)
- **>>>Brachy Referenced Dose Reference Sequence**
  - (300C,0055) 3 R+ Mandatory for the last Control Point, see DICOM PS 3.3 C.8.8.15.11.
- **>>>>Referenced Dose Reference Number**
  - (300C,0051) 1 -
- **>>>>Cumulative Dose Reference Coefficient**
  - (300A,010C) 1 -

---

Note 1: As a minimum, the dose contribution from each Channel and all Channels to all Dose References shall be displayed.

### 7.4.4.6.2 RT Application Setup Module for LDR Permanent Plan

**Key to IHE-RO Column of requirements**

- **R+** = The requirement is an IHE extension of the DICOM requirements and needs to be displayed (note: when consumed!, not produced)
- **R** = The attribute is required to be there but not required to be displayed
- **R+*** = The Requirement is an IHE extension of the DICOM requirements, but it is NOT required to be displayed
- **O+** = The attribute is optional but if there, it must be displayed.
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</tr>
<tr>
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<td>(300A,0202)</td>
<td>1 R+</td>
</tr>
<tr>
<td>Treatment Machine Sequence</td>
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<td>1 -</td>
</tr>
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<td>Source Sequence</td>
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</tr>
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<td>&gt;Source Serial Number</td>
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</tr>
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<td>&gt;Source Model ID</td>
<td>(300A,021B)</td>
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</tr>
<tr>
<td>&gt;Source Description</td>
<td>(300A,021C)</td>
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<td>&gt;Source Isotope Half Life</td>
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<td>&gt;Source Strength Units</td>
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<td>&gt;Reference Air Kerma Rate</td>
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<td>&gt;Source Strength</td>
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R+ = Required
R+* = Required and Display
- = Not mandatory
- * = The DICOM usage applies but the value does not need to be displayed.

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Note 1: As a minimum, the dose contribution from all Channels to all Dose References shall be displayed.

### 7.4.4.6.3 RT Application Setup Module for LDR Temporary Plan

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Restricted Information and Basic Personal Data
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* As described in section X.1.1, display the dwell time spent at each location.

* Mandatory for the last Control Point, see DICOM PS 3.3 C.8.8.15.11.

See Note 1 for display requirement.
Note 1: As a minimum, the dose contribution from each Channel and all Channels to all Dose References shall be displayed.

7.4.5 Plan-Related Modules in Delivery

7.4.5.1 RT Beams

This section is present only to convey the envisioned section numbering.

7.4.5.2 RT Tolerance Table

This section is present only to convey the envisioned section numbering.

7.4.5.3 RT Patient Setup Module

7.4.5.3.1 RT Patient Setup Module for Treatment Delivery

This section is present only to convey the envisioned section numbering.

7.4.6 Image-related Modules in Planning

7.4.6.3 RT Ultrasound Image for Brachytherapy

7.4.6.3.1 Referenced Standard

DICOM 2021c

7.4.6.3.2 Image Module Brachy Content

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### 7.4.7 Image-related Modules in Delivery

*This section is present only to convey the envisioned section numbering.*

### 7.4.8 Image-related Modules in Delivery

*This section is present only to convey the envisioned section numbering.*

#### 7.4.8 Segment Modules

#### 7.4.8.1 ROI Observations Module

#### 7.4.8.1.1 ROI Observations Base Content

*This section is present only to convey the envisioned section numbering.*

#### 7.4.8.1.2 ROI Observations Base TBD

*This section is present only to convey the envisioned section numbering.*

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### 7.4.8.1.3 ROI Observations In HDR/PDR Brachy

Multiple RT Plans may reference the same RT Structure Set instance. For brachytherapy this means that the RT Structure Set can contain brachytherapy channel contours from multiple plans. Base content applies except where noted below.

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<td>ORGAN</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>CONTRAST_AGENT</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>CAVITY</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>BRACHY SRC APP</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>BRACHY CHNL SHLD</td>
</tr>
<tr>
<td>&gt;RT ROI Interpreted Type</td>
<td>(3006,00A4)</td>
<td></td>
<td>R++</td>
<td>If referenced ROI has associated contours of type POINT, the content consumer must accept at minimum the following values:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>MARKER</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>REGISTRATION</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ISOCENTER</td>
</tr>
<tr>
<td>&gt;&gt;ROI Physical Property</td>
<td>(3006,00B2)</td>
<td></td>
<td>R++</td>
<td>If referenced ROI has associated contours of type OPEN_NONPLANAR, the content consumer must accept at minimum the following values:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>BRACHY CHANNEL</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>See Note 1.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Only the following shall be supported:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>REL, MASS, DENSITY</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>REL, ELEC, DENSITY</td>
</tr>
</tbody>
</table>
Note 1. The ROI with value ‘BRACHY_CHANNEL’ as the RT ROI Interpreted Type (3006,00A4) shall contain a single item in the Contour Sequence (3006,0040) and the Number of Contour Points (3006,0046) shall be two or greater. The points in the Contour Data (3006,0050) shall start from the distal end of the channel (the point furthest from the after-loader). See also Figure C.8.8.15-1 in DICOM standard part 3.

7.4.8.1.4 ROI Observations for LDR Permanent Brachy

No special Brachy requirements. Sources are not to be modeled as structures. Base requirements apply.

7.4.8.1.4 ROI Observations for LDR Temporary Brachy

No special Brachy requirements. Sources are not to be modeled as structures. Base requirements apply.

7.4.8.2 ROI Contour Module

7.4.8.2.1 ROI Contour Base Content

This section is present only to convey the envisioned section numbering.

7.4.8.2.2 ROI Contour Offslice

This section is present only to convey the envisioned section numbering.

7.4.8.2.3 ROI Contour In HDR/PDR Brachy

The Base content of tags apply unless superseded by the definitions below.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Tag</th>
<th>Type</th>
<th>Attribute Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROI Contour Sequence</td>
<td>(3006,0039)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;&gt; Contour Geometric Type</td>
<td>(3006,0042)</td>
<td>R+*</td>
<td>OPEN_PLANAR shall not be used.</td>
</tr>
</tbody>
</table>

7.4.8.2.4 ROI Contour in LDR Brachytherapy

Base Applies; no special Brachy requirements.

7.4.8.3 RT Structure Set Module

7.4.8.3.3 RT Structure Set Module in-Brachy Content

The Base content of attributes apply unless superseded by the definitions below.
7.4.6.2 Image Plane Module

7.4.6.2 Image Plane Brachy Content

7.4.13.3.2.1 Referenced Standard
DICOM 2021a Edition PS 3.3

7.4.6.2.2 Module Content

The Base content of tags apply unless superseded by the definitions below.

<table>
<thead>
<tr>
<th>Attribute Name</th>
<th>Tag</th>
<th>Type</th>
<th>IHE-RO Usage</th>
<th>Attribute Description</th>
</tr>
</thead>
</table>
| Image Orientation (Patient)     | (0020,0037) | 1    | R+*          | This element shall NOT be restricted to TRANSVERSE patient orientation only.  
The IOP (patient) shall create a cuboid dose pattern. That is, the frame shall be square or rectangular, the normal to the IOP shall point in the same direction and be in alignment.  
All frames shall have the same X and Y pixel sizes and a uniform Grid Frame Offset Vector (3004,000C) |

7.4.13.3 RT Dose Module

7.4.13.3.1 RT Dose Module Base Content

7.4.13.3.2 RT Dose Module Brachy Content

RT Dose Module Base Content applies unless otherwise noted below.
<table>
<thead>
<tr>
<th>Attribute Name</th>
<th>Tag</th>
<th>Type</th>
<th>IHE-RO Usage</th>
<th>Attribute Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bits Allocated</td>
<td>(0028,0100)</td>
<td>1C</td>
<td>R+*</td>
<td>Shall be present and equal to 32</td>
</tr>
<tr>
<td>Dose Type</td>
<td>(3004,0004)</td>
<td>1</td>
<td>R+</td>
<td>Shall be PHYSICAL</td>
</tr>
</tbody>
</table>

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615 Not applicable.