Integrating the Healthcare Enterprise

IHE

IHE Radiation Oncology (RO)
Technical Framework Supplement

Exchange of Radiotherapy Summaries (XRTS)

For review and comment only.

DO NOT implement this public comment version.

HL7® FHIR® R4

Using Resources at FMM Level 1-N

Revision 1.0 – Draft for Public Comment

Date: November 23, 2022

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Foreword

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

This supplement is published on November 23, 2022 for Public Comment. Comments are invited
and can be submitted at https://www.ihe.net/Radiation_Oncology_Public_Comments. In order to
be considered in development of the Trial Implementation version of the supplement, comments
must be received by January 2, 2023.

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 IHE.

Information about the IHE Radiation Oncology domain can be found at IHE Domains.

Information about the organization of IHE Technical Frameworks and Supplements and the
process used to create them can be found at Profiles and IHE Process

The current version of the Radiation Oncology Technical Framework can be found at Radiation
Oncology Technical Framework.

CONTENTS

Introduction to this Supplement

195 Whenever possible, IHE profiles are based on established and stable underlying standards. However, if an IHE domain determines that an emerging standard has high likelihood of industry adoption, and the standard offers significant benefits for the use cases it is attempting to address, the domain may develop IHE profiles based on such a standard. During Trial Implementation, the IHE domain will update and republish the IHE profile as the underlying standard evolves.

200 Product implementations and site deployments may need to be updated in order for them to remain interoperable and conformant with an updated IHE profile.

This Technical Framework Supplement incorporates content from Release 4 of the HL7® FHIR® specification. HL7 describes FHIR Change Management and Versioning at https://www.hl7.org/fhir/versions.html.

205 HL7 provides a rating of the maturity of FHIR content based on the FHIR Maturity Model (FMM): level 0 (draft) through N (Normative). See http://hl7.org/fhir/versions.html#maturity.

The FMM levels for FHIR content used in this profile are:

FHIR Content (Resources, ValueSets, etc.	FMM Level
Patient	N
Procedure	3
BodyStructure	1
ServiceRequest	2

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This Technical Framework Supplement builds on the CodeX™ Radiation Therapy Implementation Guide (http://hl7.org/fhir/us/codex-radiation-therapy/STU1/) which derives from 215 the mCODE FHIR Implementation Guide STU2 (http://hl7.org/fhir/us/mcode/STU2/group-treatment.html#radiotherapy).

Note for reviewers: Updates of the referenced Implementation Guides are still expected.

- For mCODE there will be an updated version to contain final SNOMED codes that were not available at the time of releasing mCODE STU2. This supplement already references 220 the final codes.

- For CodeX RT the permanent STU1 link will only work after release of CodeX RT STU1. This will include some minor changes to the Sep 2022 ballot version, mainly to address ballot findings. The latest version can always be found here http://build.fhir.org/ig/HL7/codex-radiation-therapy/branches/master/index.html.

225   In the Radiation Oncology domain, large amounts of data are captured routinely across several clinical systems over the course of a patient's treatment. The electronic health record (EHR) is typically used to document clinical data that include demographic information, medical history, medications, laboratory test results, and radiology reports. The Radiation Oncology Information System (ROIS) and treatment planning systems (TPS) are utilized by radiation oncology based

230   clinical users for managing the patient's radiotherapy episode of care and treatment delivery where the DICOM treatment plan, images, dose, structure set, and dose-volume information are stored in the TPS/ROIS. This profile is tailored to address specific clinical needs and pain points with transfer of radiation treatment summary information from the ROIS to the electronic medical record system and making it easier for Radiation Oncology clinicians to include this

235   information in their routine clinical notes such as on-treatment visit and end of treatment summary notes.

This profile is a combination of workflow and content modules.

Open Issues and Questions

#	Introduced in	Description
1	0.3.3	Cybersecurity Considerations: Should POST be used for searches rather than GET to avoid having parameters in the URL? A more thorough explanation of this risk might be helpful, including mitigating factors: (1) when using HTTPS, parameters are encrypted in transit; (2) logging capabilities are usually configurable so that query strings may be omitted if they are sensitive; (3) users who are authorized to access these logs may reasonable be expected to be authorized to view patient-identifying information in the course of their job duties.
2	0.3.3	The scope of this profile is limited to transfer of treatment summary information only. In future versions of this profile the XRTS committee will attempt to structure the transfer of prescription and treatment intent details with FHIR based data standards and cover the full scope of the CodeX RT Implementation Guide.
3	0.3.3	The following elements discussed in earlier XRTS drafts are not covered yet: • Concurrency, Role in combination with other treatments such as adjuvant, neoadjuvant. • Summary of Prescription (for Course, Phase, and single Plans). • Accessories • General Methods • Related Chemotherapy, Related Surgery, Concurrent Therapy Comment • Protocol
4	0.3.3	More examples of the http calls should be added to Volume 2 Transactions.

#	Introduced in	Description
5	0.4.0	Finding from Technical Committee discussion Oct 12, 2022: Consider having unique identifiers for all summary resources, potentially with a predefined scheme how they can be generated uniquely. This could be similar or the same as DICOM UIDs. Is this needed or is it sufficient to require one standard FHIR business identifier that has the system url defined under which it is unique?

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Closed Issues

None

IHE Technical Frameworks General Introduction

The [IHE Technical Frameworks General Introduction](#) is shared by all of the IHE domain technical frameworks. Each technical framework volume contains links to this document where appropriate.

9 Copyright Licenses

IHE technical documents refer to, and make use of, a number of standards developed and published by several standards development organizations. Please refer to the IHE Technical Frameworks General Introduction, [Section 9 - Copyright Licenses](#) for copyright license information for frequently referenced base standards. Information pertaining to the use of IHE International copyrighted materials is also available there.

10 Trademark

IHE® and the IHE logo are trademarks of the Healthcare Information Management Systems Society in the United States and trademarks of IHE Europe in the European Community. Please refer to the IHE Technical Frameworks General Introduction, [Section 10 - Trademark](#) for information on their use.

IHE Technical Frameworks General Introduction Appendices

260 The [IHE Technical Framework General Introduction Appendices](#) are components shared by all of the IHE domain technical frameworks. Each technical framework volume contains links to these documents where appropriate.

265
> *Update the following appendices to the General Introduction as indicated below. Note that these are **not** appendices to this domain's Technical Framework (TF-1, TF-2, TF-3 or TF-4) but rather, they are appendices to the IHE Technical Frameworks General Introduction located [here](#).*

[Appendix A](#) – Actors

270

> *Add the following **new or modified** actors to the [IHE Technical Frameworks General Introduction Appendix A](#):*

New (or modified) Actor Name	Definition
Treatment Summary Provider	A system that provides the summary of an ongoing or completed radiotherapy treatment.
Treatment Observer	A system that retrieves the latest radiotherapy treatment summary information exposed through FHIR APIs.
RO Resource Repository	A system that stores radiotherapy-related contents that are received and exposed through FHIR APIs.

275 ## [Appendix B](#) – Transactions

> *Add the following **new or modified** transactions to the [IHE Technical Frameworks General Introduction Appendix B](#):*

New (or modified) Transaction Name and Number	Definition
Provide or Update Treatment Summary [XRTS-01]	A *Treatment Summary Provider* stores or updates a treatment summary on an *RO Resource Repository*.
Retrieve Treatment Summary [XRTS-02]	A *Treatment Observer* receives a treatment summary from an *RO Resource Repository*.

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New (or modified) Transaction Name and Number	Definition
Subscribe for Treatment Summary Updates [XRTS-03]	A *Treatment Observer* subscribes with an *RO Resource Repository* to receive notifications when a treatment summary is updated on the *RO Resource Repository*.
Notify of Treatment Summary Update [XRTS-04]	An RO Resource Repository notifies a Treatment Observer that a treatment summary has been updated on the *RO Resource Repository*.

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Appendix D – Glossary

*Add the following **new or modified** glossary terms to the IHE Technical Frameworks General Introduction Appendix D:*

New (or modified) Glossary Term	Definition
Radiotherapy Course	In Radiotherapy, a *course* of treatment is a grouping that collects all radiation therapy treatments needed to treat a specific illness. A course is conceptually divided into one or more *phases*.
Radiotherapy Fraction	In Radiotherapy, *fractions* are the equivalent parts into which the delivery of a *phase* or specific *treatment plan* is subdivided.
Radiotherapy Phase	In Radiotherapy, a *phase* is a conceptual series of treatments, composed of one or more related treatment plans that focus on one set of target volumes with the same modality and technique. A single course of treatment is composed of one or more related phases.
Radiotherapy Phase Fraction	In Radiotherapy, one or more treatment plans may belong to a phase, a *phase fraction* is the combination of plan fractions delivered during a given session.
Radiation Oncology Information System (ROIS)	A system used to electronically manage the planning and administration of radiation therapy.
Radiotherapy Session	A *session* is the period between when the patient enters the treatment room and when they leave it. A course consists of a series of sessions.

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Volume 1 – Profiles

Add new Section X

290

X Exchange of Radiotherapy Summaries (XRTS) Profile

In the Radiation Oncology domain, large amounts of data are captured routinely across several clinical systems over the course of a patient's treatment. The electronic health record (EHR) is typically used to document clinical data that include demographic information, medical history,
295   medications, laboratory test results, and radiology reports. The Radiation Oncology Information System (ROIS) and treatment planning systems (TPS) are utilized by clinical users for managing the patient's radiotherapy episode of care where the DICOM treatment plan, images, dose, structure set, and dose-volume information are stored in the TPS/ROIS. This profile is tailored to address specific clinical needs and pain points with transfer of radiation treatment summary
300   information from the ROIS to the electronic medical record system and making it easier for Radiation Oncology clinicians to include this information in their routine clinical notes such as on-treatment visit and end of treatment summary notes.

This profile is a combination of workflow and content modules.

X.1 XRTS Actors, Transactions, and Content Modules

305   This section defines the actors, transactions, and/or content modules in this profile. General definitions of actors are given in the Technical Frameworks General Introduction Appendix A. IHE Transactions can be found in the Technical Frameworks General Introduction Appendix B. Both appendices are located at https://profiles.ihe.net/GeneralIntro/index.html.

Figure X.1-1 shows the actors directly involved in the XRTS Profile and the relevant
310   transactions between them.

It also depicts possible grouping of RO Resource Repository and integration with existing HIE Central Infrastructure in case it contains a FHIR server which would then be used for the storage and retrieval of RO Treatment Summary resources.
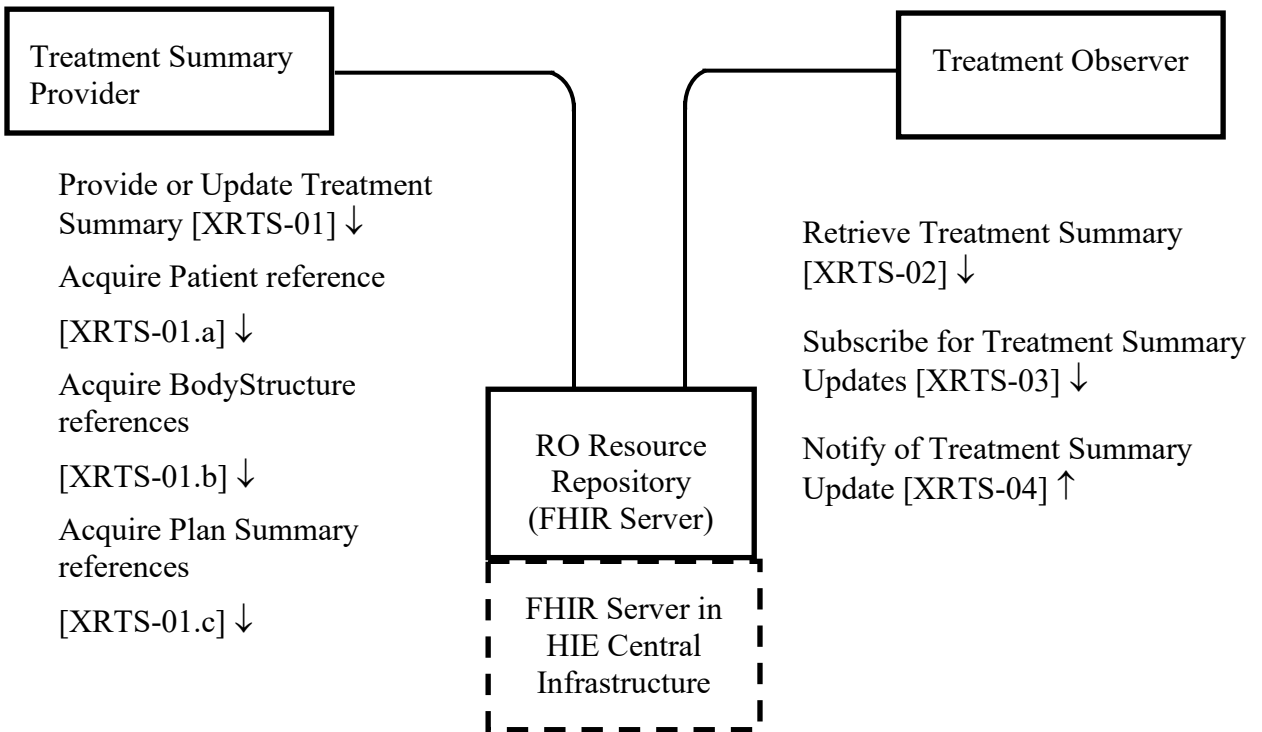
Figure X.1-1: XRTS Actor Diagram

315
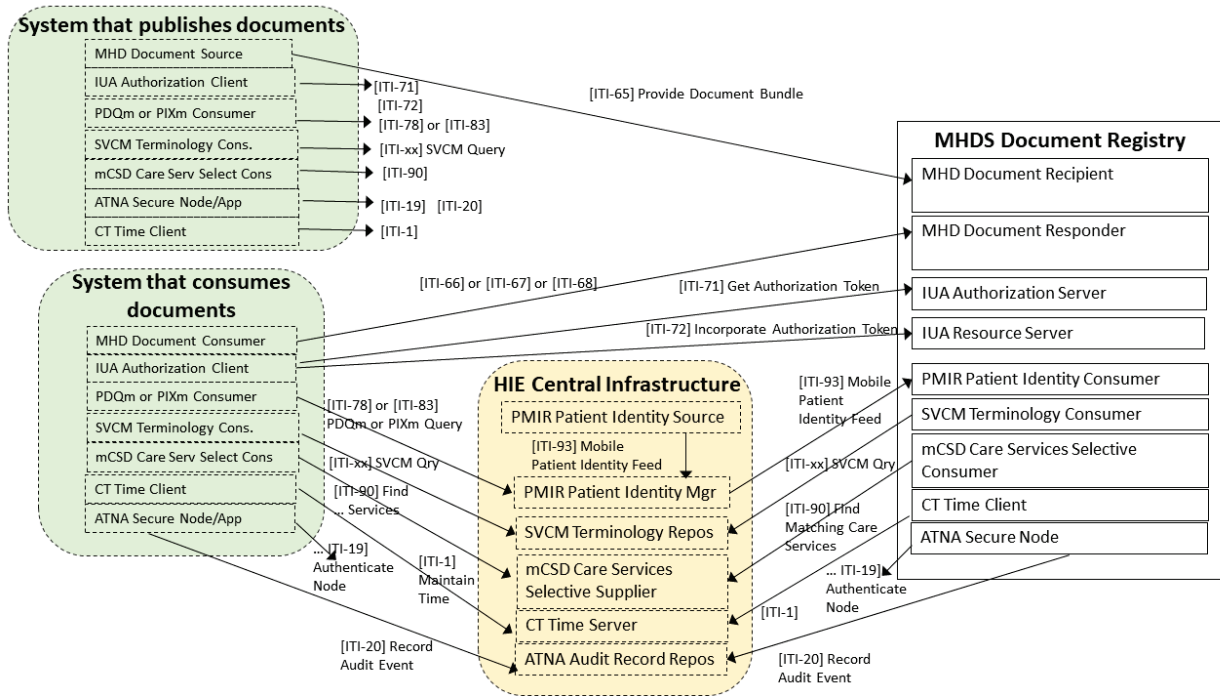
320

Figure X.1-2: MHDS Actor Diagram

The Figure X.1.2 depicts the Mobile Health Document Sharing (MHDS) Document Registry Actor, which is also a FHIR server and thus provides functionality to host and provide access to FHIR resources generally. The MHDS Profile is designed with a goal to be used by other profiles that are compatible with MHDS but are not required by the MHDS Profile. If bundled with an MHDS Document Registry, then the system implementing combined actors can provide patient identity lookup by demographics or identity, and to receive create and update of patient identity from Treatment Summary Provider.

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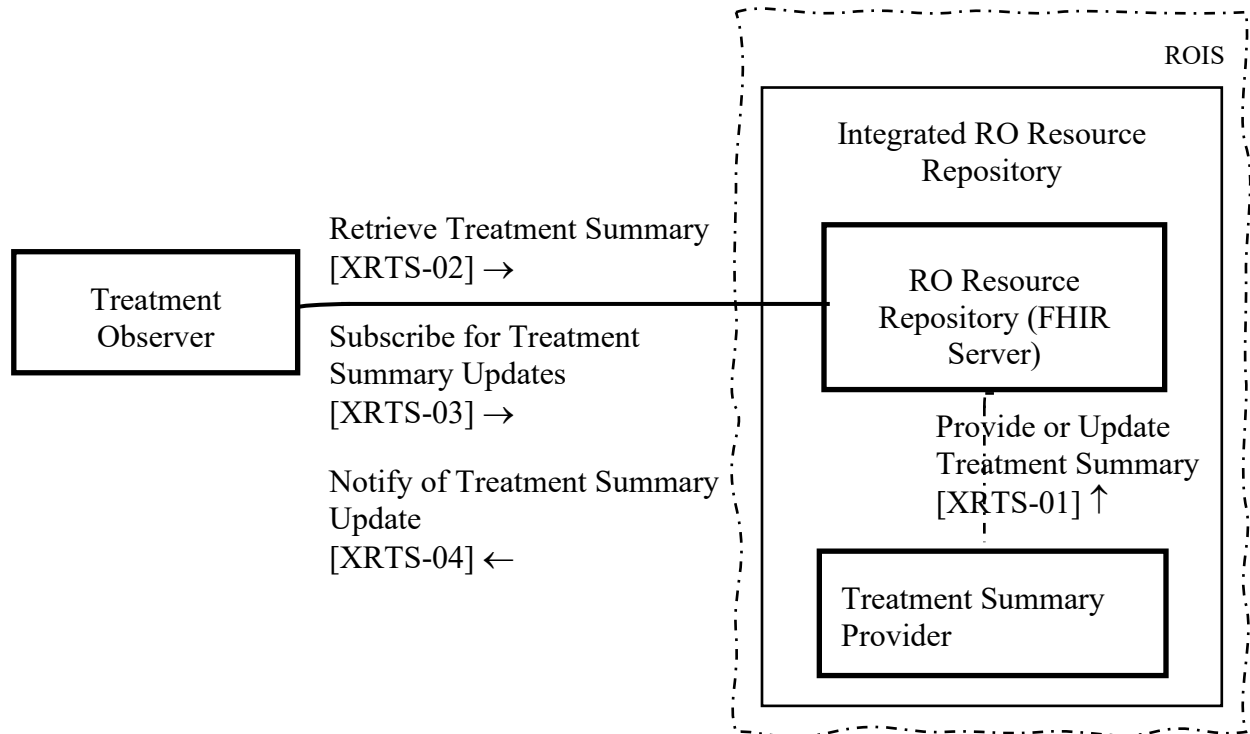
Figure X.1-3: XRTS Integrated RO Resource Repository Actor Diagram

Figure X.1-3 depicts a system which implements both Treatment Summary Provider and RO
335 Resource Repository Actors. This combined actor is called Integrated RO Resource Repository.
In this case Provide or Update Treatment Summary [XRTS-01] transaction is internal between
the combined actors within the system and is not required but can optionally be exposed
externally to other Treatment Summary Provider Actors.

Table X.1-1 lists the transactions for each actor directly involved in the XRTS Profile. To claim
340 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: XRTS Profile - Actors and Transactions

Actors	Transactions	Initiator or Responder	Optionality	Reference
Treatment Summary Provider	Provide or Update Treatment Summary [XRTS-01]	Initiator	R	
Treatment Summary Provider	Acquire Patient reference [XRTS-01.a]	Initiator	R (See Note 1)	

Actors	Transactions	Initiator or Responder	Optionality	Reference
Treatment Summary Provider	Acquire BodyStructure references [XRTS-01.b]	Initiator	R (See Note 1)	
Treatment Summary Provider	Acquire Plan Summary references [XRTS-01.c]	Initiator	R (See Note 1)	
Treatment Observer	Retrieve Treatment Summary [XRTS-02]	Initiator	R	
Treatment Observer	Subscribe for Treatment Summary Updates [XRTS-03]	Initiator	O	
Treatment Observer	Notify of Treatment Summary Update [XRTS-04]	Responder	O	
RO Resource Repository	Provide or Update Treatment Summary [XRTS-01]	Responder	R	
RO Resource Repository	Retrieve Treatment Summary [XRTS-02]	Responder	R	
RO Resource Repository	Subscribe for Treatment Summary Updates [XRTS-03]	Responder	O	
RO Resource Repository	Notify of Treatment Summary Update [XRTS-04]	Initiator	O	
Integrated RO Resource Repository	Retrieve Treatment Summary [XRTS-02]	Responder	R	
Integrated RO Resource Repository	Provide or Update Treatment Summary [XRTS-01]	Responder	O (See Note 2)	
Integrated RO Resource Repository	Subscribe for Treatment Summary Updates [XRTS-03]	Responder	O	
Integrated RO Resource Repository	Notify of Treatment Summary Update [XRTS-04]	Initiator	O	

Note 1: The parts of transaction [XRTS-01] that are separately listed as [XRTS-01.a], [XRTS-01.b] and [XRTS-01.c] are generically required but may be optional within multiple execution of the [XRTS-01] transaction for the given Treatment Summary.

Note 2: If the RO Resource Repository is combined with a Treatment Summary Provider, then Provide or Update Treatment Summary transaction can be implemented internally between the co-located actors. For an analogous case, see Integrated Document Repository in XDS (https://wiki.ihe.net/index.php/Cross-Enterprise_Document_Sharing)

X.2 XRTS Actor Options

None

X.3 XRTS Required Actor Groupings

None

X.4 XRTS Overview

X.4.1 Concepts

355

The electronic health record (EHR) is used to document clinical data that typically include demographic information, medical history, medications, laboratory test results, and radiology reports. For each patient receiving radiotherapy treatment, the clinical documentation typically includes (a) a detailed initial consultation note, (b) a simulation note describing the treatment

360 simulation procedure, (c) a treatment planning note documenting the prescription and proposed treatment plan, (d) a weekly on-treatment visit (OTV) note from the staff physician documenting a review of the patient's treatment progress and any acute side effects, (e) an end-of-treatment summary (EOTS) or survivorship care plan for the patient and referring physician at the completion of therapy, and (f) routine follow-up notes tracking disease outcomes and any late

365 toxicities. The treatment planning data including the radiotherapy treatment plan, images, dose, structure set, and dose-volume information from the treatment planning system (TPS) are in structured formats (DICOM-RT). Additionally, the Radiation Oncology Information System (ROIS) contains information regarding the radiation treatment delivery, fractions, visits, delivered dose till date etc. The OTV and EOTS notes must contain components of information

370 about the patient and disease (age, gender, diagnosis and RT indication), **radiation treatment elements** (RT course start and end date, anatomic target, treatment modality [e.g., photons, protons, HDR], technique [e.g., 3DCRT, IMRT], dose and schedule), patient experience (side effects and management), and the follow-up plan. Currently, the **radiation treatment elements** are often siloed in the ROIS. To address this interoperability problem the profile enables the

375 seamless transfer of these elements from the ROIS to the EHR. **Combining the radiotherapy treatment elements with the elements from other information systems (patient experience, follow-up etc.) in the EOTS and OTV notes is out of scope of this profile.**

X.4.2 Use Cases

X.4.2.1 Use Case #1: Transfer of End of Treatment Summary

380 This use case encompasses a patient being treated with radiotherapy. The radiation treatment elements required for the End of Treatment Summary (EOTS) are retrieved from the Radiation Oncology Information System (ROIS) to the EHR.

X.4.2.1.1 Use Case Description

The patient is treated with radiotherapy, and the radiation treatment elements are stored in the

385 ROIS. The treatment team, consisting of a radiation oncologist, dosimetrists and physicists, will complete the treatment course in the ROIS after the final treatment is delivered. In the EHR, physicians will be able to retrieve the treatment summary elements from the ROIS for inclusion in their EOTS notes.

X.4.2.1.2 Process Flow

390   In the use case, the ROIS plays the role of the Treatment Summary Provider. The EHR plays the role of the Treatment Observer and the FHIR server will play the role of RO Resource Repository.

Main flow:

1.   When a course of radiotherapy is completed by the treatment team, the Treatment
395   Summary Provider pushes the up-to-date treatment summary information to the RO Resource Repository [XRTS-01]. The status of the course summary is complete.

2.   If the Treatment Observer has subscribed to the Repository for Treatment Summary Updates, the Treatment Observer will be notified of the update on the treatment summary information from the RO Resource Repository. [XRTS-03]

400   3.   The Treatment Observer is able to retrieve the latest end of treatment summary information from the RO Resource Repository. [XRTS-02]
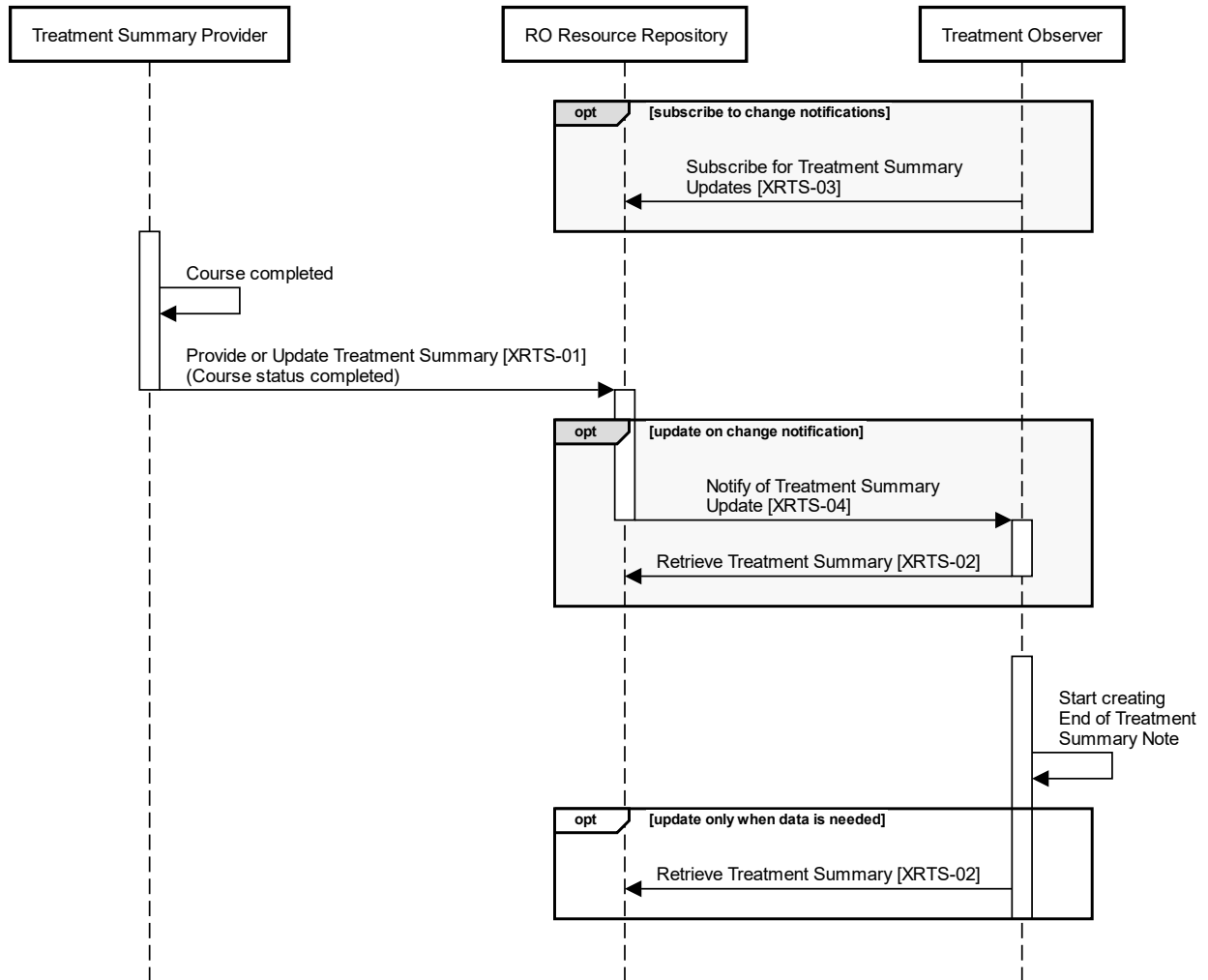
Figure X.4.2.1.2-1: Process Flow Transfer End of Treatment Summary

405

X.4.2.2 Use Case #2: On Treatment Visit Monitoring of Treatment Progress

This use case encompasses a patient being treated with radiotherapy. The radiation treatment elements required for the treatment progress documentation (on-treatment visits) are retrieved from the ROIS to EHR.

410   ### X.4.2.2.1 Use Case Description

The patient is treated with radiotherapy, and the radiation treatment elements are stored in the ROIS. The treatment team, consisting of a radiation oncologist, dosimetrists and physicists, will treat the patient on the machine. After each session the treatment progress information is updated

in the ROIS. In the EHR, physicians will be able to retrieve the up-to-date treatment summary
415   elements from the ROIS for inclusion in their OTV notes.

X.4.2.2.2 Process Flow

In the use case, the ROIS plays the role of the Treatment Summary Provider. The EHR plays the role of the Treatment Observer and the FHIR server will play the role of RO Resource Repository.

420   Main flow:

1. After the completion of treatment delivery for the treatment session, the Treatment Summary Provider pushes the up-to-date treatment summary information to the RO Resource Repository. [XRTS-01]

2. If the Treatment Observer has subscribed to the Repository for Treatment Summary
425   Updates, the Treatment Observer will be notified of the update on the treatment summary information from the RO Resource Repository. [XRTS-04]

3. The Treatment Observer is able to retrieve the latest treatment progress information from the RO Resource Repository. [XRTS-02]
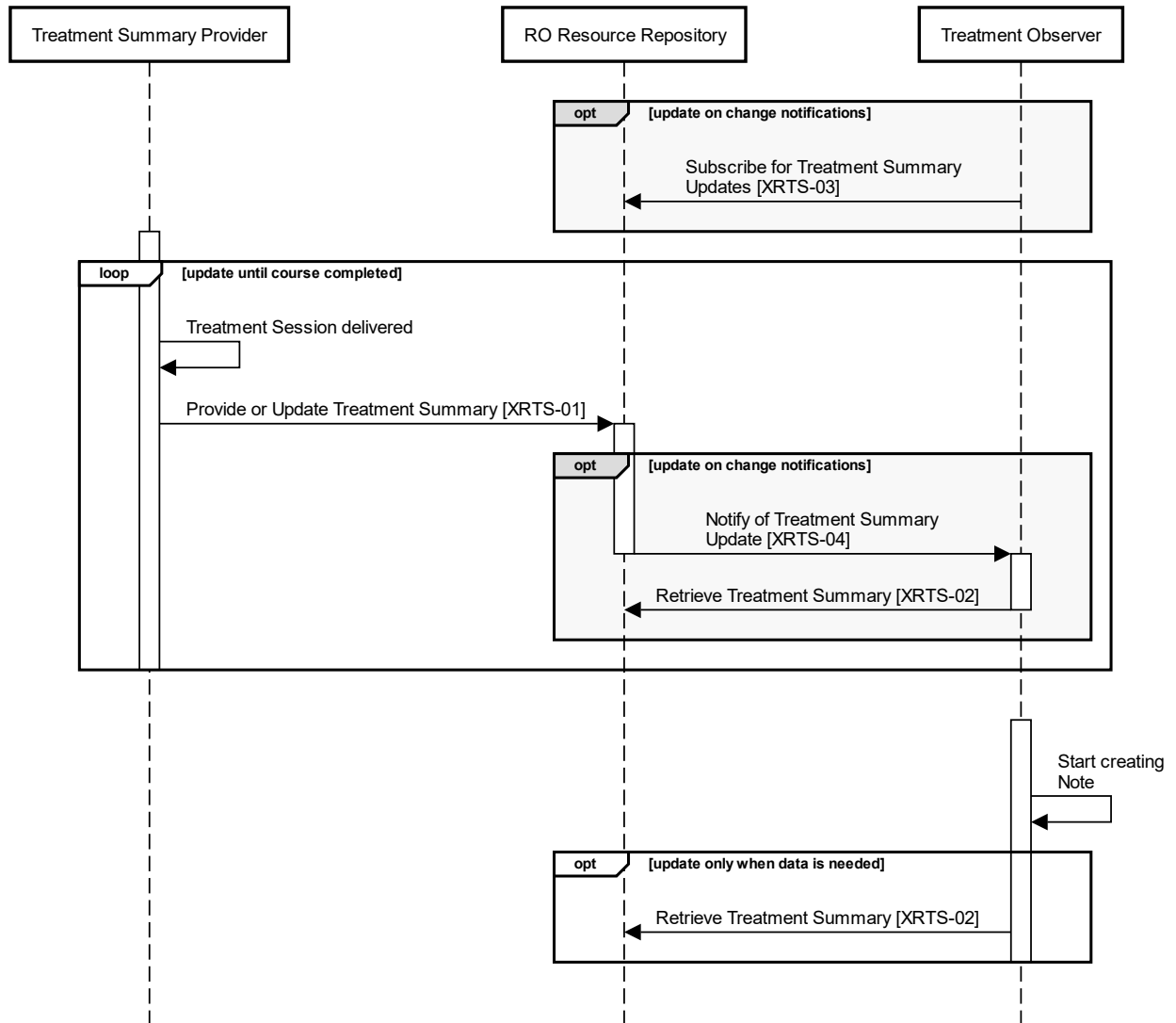
430

Figure X.4.2.2.2-1: Process Flow On Treatment Visit Monitoring of Treatment Progress

X.4.2.3 Use Case #3: External System Monitoring of Treatment Progress for Dose Tracking

435   The use case encompasses the tracking of radiation treatment progress by an external system that is not participating directly in the treatment of a patient (e.g., independent QA, machine learning system, multiple OIS environments etc.). This use case is very similar to the use case #2 where treatment progress is tracked in OTV notes.

X.4.2.3.1 Use Case Description

440 The patient is treated with radiotherapy, and the radiation treatment elements are stored in the ROIS. The treatment team, consisting of a radiation oncologist, dosimetrists and physicists, will treat the patient on the machine. After each session the treatment progress information is updated in the ROIS. The external system will be able to retrieve the up-to-date treatment summary elements from the ROIS.

445 ### X.4.2.3.2 Process Flow

In the use case, the ROIS plays the role of the Treatment Summary Provider. The external system plays the role of the Treatment Observer and the FHIR server will play the role of RO Resource Repository.

Main flow:

450 1. After each treatment delivery, the Treatment Summary Provider pushes the up-to-date treatment summary information to the RO Resource Repository. [XRTS-01]

2. If the Treatment Observer has subscribed to the Repository for Treatment Summary Updates, the Treatment Observer will be notified of the update on the treatment summary information from the RO Resource Repository. [XRTS-03]

455 3. The Treatment Observer is able to retrieve the latest treatment progress information from the RO Resource Repository. [XRTS-02]

The Process Flow is the same as in Use Case #2 shown in Fig X.4.2.2-1.

X.5 XRTS Security Considerations

Implementers are expected to follow best practices for information security so that patients' data
460 are protected in compliance with regulations and organizational policies.

Patient data should not be exchanged between systems without authentication. For this profile, authentication using OAuth is expected. Consult the FHIR specification chapter 6.1.0, "FHIR Security" (https://hl7.org/fhir/security.html), for a full discussion of this need, and the HL7 SMART on FHIR Implementation Guide
465 (https://hl7.org/fhir/uv/bulkdata/authorization/index.html) for a specific profile of OAuth for use in web-based FHIR applications. For this profile, the SMART on FHIR authentication model most appropriate is "backend services", which provides for access control between software systems that interact autonomously. This mode of integration is appropriate for this profile since no particular user needs to authenticate at the time when communication will occur and because
470 the scope of access for the communicating systems can be defined at the system level. Note that applications may in practice impose additional requirements for authentication beyond those profiled in SMART on FHIR.

475 Consult IHE ITI TF-2 Appendix Z.8, "Mobile Security Considerations", for additional guidance about authentication, auditing, and protection of data in transit (e.g., using encryption) and at rest (e.g., access control for logs and other audit records).

X.6 XRTS Cross Profile Considerations

None

Appendices to Volume 1

480 Not applicable.

Volume 2 – Transactions

Add Sections 3.Y1, 3.Y2, 3.Y3, 3.Y4

3.Y1 Provide or Update Treatment Summary [XRTS-01]

3.Y1.1 Scope

485 This transaction is used to provide the summary of a radiotherapy treatment to a repository or update the summary on the repository if a previous version already exists.

3.Y1.2 Actor Roles

Table 3.Y1.2-1: Actor Roles

Actor:	Treatment Summary Provider
Role:	Provides or updates resources representing the summary of a radiotherapy treatment.
Actor:	RO Resource Repository
Role:	Receives and persists resources representing the summary of a radiotherapy treatment.

490 ### 3.Y1.3 Referenced Standards

- HL7 FHIR R4

- CodeX™ Radiation Therapy Implementation Guide STU1 (http://hl7.org/fhir/us/codex-radiation-therapy/STU1/)

  Temporary CodeX RT url before release:
495 http://build.fhir.org/ig/HL7/codex-radiation-therapy/branches/master/index.html

- minimal Common Oncology Data Elements (mCODE) Implementation Guide STU2 (http://hl7.org/fhir/us/mcode/STU2)

3.Y1.4 Messages

Provide or Update Treatment Summary [XRTS-01] (1/2)

Treatment Summary Provider | Resource Repository | HIE Central Infrastructure

Acquire Patient reference XRTS-01.a

Patient registered

GET [base]/Patient?<search-parameters>

alt [Patient has been registered]

HTTP 200: Body: Patient resource

[Patient not found in RO Resource Repository]

HTTP 200: Body: Empty Bundle, patient not found

GET [base]/Patient?<search-parameters>

alt [HIE Infrastructure exists and patient found]

HTTP 200: Body: Patient resource

POST [base]/Patient Body: {Patient: { link->other: URL(central patient), link->type: refers }}

HTTP 201: Created

[Patient centrally not found]

HTTP 200: Body: Empty Bundle, patient not found

POST [base]/Patient Body: {Patient: { link: null }}

HTTP 201: Created

save FHIR Patient reference internally for further use

Detect 1st therapy occasion of patient treatment of given Intent/Prescription

fetch FHIR Patient resource Reference

Acquire BodyStructure references XRTS-01.b

loop [for any BodyStructure required in Treatment Summary]

GET [base]/BodyStructure? identifier=<volume unique identifier>

HTTP 200 : Body: { Bundle { BodyStructure(identifier=<volume_id>, patient[pid] } }

find in result Bundle the matching BodyStructures relevant to Treatment Summary

opt [if Volume has not been created]

Radiotherapy Volume:
POST [base]/BodyStructure Body: {BodyStructure { **identifier=<volume_id>**, patient: [base]/Patient/<pid> } }

HTTP 201: Created

save FHIR BodyStructure reference(s) internally for further use

500

Provide or Update Treatment Summary [XRTS-01] (2/2)

Treatment Summary Provider | Resource Repository

Acquire Plan Summary (Planned Course and Planned Phase) references XRTS-01.c

loop [for any Planned Course and Planned face that will be referenced from Course Summary and Treated Phase]

GET [base]/ServiceRequest?identifier=<Planned Course or Planned Phase business identifier>

HTTP 200 : Body: { Bundle { ServiceRequest(identifier=<business identifier >, patient/[pid], category=**http://snomed.info/sct|108290001** } }

find matching Planned Course or Planned Phase in result bundle

opt [if the Planned Course or Planned Phase was not found]

Planned Course:
POST [base]/ServiceRequest Body: {ServiceRequest { **identifier=<Planned Course business identifier>** patient: [base]/Patient/<pid>, code=**http://snomed.info/sct|1217123003**} }

HTTP 201: Created

Planned Phase:
POST [base]/ServiceRequest Body: {ServiceRequest { **identifier=<Planned Phase business identifier>** patient: [base]/Patient/<pid>, code=**http://snomed.info/sct|1222565005**} }

HTTP 201: Created

save FHIR ServiceRequest reference(s) internally for further use

Create Course Summary:
POST [base]/Procedure Body: {Procedure { subject: [base]/Patient/<pid>, code=**http://snomed.info/sct|1217123003** , basedOn=/ServiceRequest/[course_plan_id]/_history/<v_id>}} }

HTTP 201 Headers: Location: [base]/Procedure/[id_course]/_history/<v_id>

Create Treated Phase:
POST [base]/Procedure Body: {Procedure { subject: [base]/Patient/<pid>, code=**http://snomed.info/sct|1222565005**, partOf=/Procedure/[id_course]/_history/<v_id>, basedOn=/ServiceRequest/[phase_plan_id]/_history/<v_id>} }

HTTP 201 Headers: Location: [base]/Procedure/[id_phase]/_history/<v_id>

save FHIR Procedure reference(s) internally for further use

Detect N-th therapy occasion of patient treatment of given Intent/Prescription

recalculate summary data

Update Course Summary:
PUT [base]/Procedure/[id_course] Body: {Procedure { subject: [base]/Patient/<pid>, code=**http://snomed.info/sct|1217123003** , basedOn=/ServiceRequest/[course_plan_id]/_history/<v_id>}} }

HTTP 200 Headers: Location: [base]/Procedure/[id_course]/_history/<v_id>

Update Treated Phase:
PUT [base]/Procedure/[id_phase] Body: {Procedure { subject: [base]/Patient/<pid>, code=**http://snomed.info/sct|1222565005**, partOf=/Procedure/[id_course]/_history/<v_id>, basedOn=/ServiceRequest/[phase_plan_id]/_history/<v_id>} }

HTTP 200 Headers: Location: [base]/Procedure/[id_phase]/_history/<v_id>

Figure 3.Y1.4-1: XRTS-01

3.Y1.4.1 General Provisions

This section contains general provisions for all messages used in this transaction.

The RO Resource Repository shall support both XML and JSON mime-type Options.

Note that the order of the FHIR resources in JSON is not guaranteed to be maintained and must
not be significant. The order of treatments that are represented by Course Summaries or Treated
Phases is defined by their time stamps.

Updates of FHIR resources on the RO Resource Repository SHALL be version aware, using a
combination of ETag and If-Match parameters as described in the FHIR standard, Section 3.1.0.5
Managing Resource Contention (https://hl7.org/fhir/http.html#concurrency).

3.Y1.4.2 Acquire Patient reference XRTS-01.a

This is an optional preparatory transaction where Treatment Summary Provider acquires the
URL to the FHIR Patient resource that is going to be used for the subject reference in Treatment
Summary messages related to the given patient.

If the patient reference has been already acquired for this Treatment Summary resource and
saved in the system for internal uses, it can be skipped.

3.Y1.4.2.1 Trigger Events

Not defined by this profile. Typically this transaction should occur when the patient is registered
in the Treatment Summary Provider system, or when the [XRTS-01] transaction for a given
Treatment Summary resource is executed for the first time.

3.Y1.4.2.2 Message Semantics

FHIR Patient search operation (https://www.hl7.org/fhir/search.html).

3.Y1.4.2.3 Expected Actions

The Treatment Summary Provider shall be configured to fetch the Patient resource URL from the
RO Resource Repository. If the Patient has not yet been created in the RO Resource Repository,
Treatment Summary Provider shall create the patient at the RO Resource Repository FHIR
server.

Following fields must be provided in search and must match exactly in order for the Patient
resource to be considered as valid and to be used as a reference in Treatment Summary
resources.

1. primary patient identifier (search parameter name 'identifier', format *system|value*)

2. last name (search parameter name 'family:exact')

3. first name (search parameter name 'given:exact')

535

4. birth date (search parameter name 'birthDate')

5. gender (search parameter name 'gender')

Optionally, if the healthcare enterprise has Document Sharing Health Information Exchange (HIE) Infrastructure established or can provide any other means (e.g., PDQm, PIXm) that expose FHIR endpoint to Patient registry, then the Treatment Summary Provider fetches URL to the

540   shared Patient resource by search using available identifiers and demographics data.

The created Patient resource shall have link element populated:

link.other	full URL to the central Patient resource
link.type	refers

3.Y1.4.3 Acquire BodyStructure references XRTS-01.b

This is an optional preparatory transaction where the Treatment Summary Provider acquires the

545   URL to the FHIR BodyStructure resources that are going to be used for the *Procedure:mcode-radiotherapy-dose-delivered-to-volume* reference in Treatment Summary messages that it is going to send for a given patient.

Every instance in *mcode-radiotherapy-dose-delivered-to-volume* of a Treatment Summary resource shall have the *extension:volume* reference set to a BodyStructure resource in the RO

550   Resource Repository.

If the BodyStructure references have already been created and acquired for this Treatment Summary resource and saved in the system for internal uses, it can be skipped.

3.Y1.4.3.1 Trigger Events

Not defined by this profile. These resources can be created during patient treatment planning or

555   when the [XRTS-01] transaction for a given Treatment Summary resource is executed for the first time.

3.Y1.4.3.2 Message Semantics

FHIR BodyStructure search operation based on BodyStructure.identifier, which is always known by the Treatment Summary Provider. It is a unique identifier that will reliably identify the same

560   volume in different requests and procedures. Refer to Section 11.2.6 Irradiated Volumes.

3.Y1.4.3.3 Expected Actions

Treatment Summary Provider shall parse the bundle with a single BodyStructure resource.

If the BodyStructure needed to be referenced from Treatment Summary resource was not found, the Treatment Summary Provider shall create the BodyStructure on the RO Resource Repository FHIR server.

```
POST [base]/BodyStructure?format=[mime-type]
```

The message body contains the BodyStructure resource according to the Radiotherapy Volume (Target or OAR) (see Section 11.2.6 Irradiated Volumes).

3.Y1.4.4 Acquire Plan Summary references XRTS-01.c

This is an optional preparatory transaction where the Treatment Summary Provider acquires the URL to the FHIR ServiceRequest resources that represent the Treatment Plans summed up over each Phase and over the complete Course. These ServiceRequests are going to be used for the *Procedure:basedOn* reference in Treatment Summary messages that will be sent for a given patient.

The Course Summary references the corresponding Planned Course. Each Treated Phase references the corresponding Planned Phase in the RO Resource Repository.

If the ServiceRequest references have already been created and acquired for these Treatment Summary resources and saved in the system for internal use, acquiring these references can be skipped.

3.Y1.4.4.1 Trigger Events

Not defined by this profile. These resources that represent Treatment Plans (Planned Course and Planned Phase) have to be created before they can be referenced from Procedure resources, for example, when the Treatment Plans are approved or only when the [XRTS-01] transaction for a given Treatment Summary resource is executed for the first time.

3.Y1.4.4.2 Message Semantics

FHIR ServiceRequest search operation based on ServiceRequest.identifier (business identifier), that is always known by the Treatment Summary Provider. It is a unique identifier that will reliably identify the same Planned Course or Planned Phase in different requests and procedures. Refer to Section 11.2.7 Planned Course and Section 11.2.8 Planned Phase.

Course Summary has a *basedOn* reference to a Planned Course resource and Treated Phase has a *basedOn* reference to one or more Planned Phase resources.

3.Y1.4.4.3 Expected Actions

The Treatment Summary Provider shall parse the bundle with a single ServiceRequest resource.

If the ServiceRequest needed to be referenced from Treatment Summary resource was not found, the Treatment Summary Provider shall create the ServiceRequest on the RO Resource Repository FHIR server.

```
POST [base]/ServiceRequest?format=[mime-type]
```

The message body contains the ServiceRequest resource according to the profiles Planned Course (see Section 11.2.7) and Planned Phase (see Section 11.2.8).

Depending on whether the Plan Summary is at the Course level or the Phase level, the *ServiceRequest:code* is specified accordingly:

- Radiotherapy Planned Course

    o code= http://snomed.info/sct|1217123003 "Radiotherapy course of treatment (regime/therapy)"

- Radiotherapy Planned Phase

    o http://snomed.info/sct|1222565005 "Radiotherapy treatment phase (regime/therapy)"

The Treatment Summary Provider shall fetch the resource URL from the Location header and save it in the system to be used in setting the reference in the Treatment Summary resource.

If the Treatment Plan changes, the Treatment Summary Provider shall update the Planned Phase resources of all Phases that include this plan and update the Planned Course resource in the RO Resource Repository. It shall also fetch the created version identifier returned in the response of the transaction. The version number shall be used in *Procedure:basedOn* references from Treatment Summary resources.

3.Y1.4.5 Provide Treatment Summary

3.Y1.4.5.1 Trigger Events

Typically, this is triggered when a Treatment Session of a Treatment Course of the patient is completed. In case of reporting an end-of-treatment summary, the transaction may be triggered by the treatment of the last session or by completion of the Treatment Course. Alternatively, updates may be performed by a periodically scheduled data export.

3.Y1.4.5.2 Message Semantics

FHIR create - https://www.hl7.org/fhir/http.html#create

```
POST [base]/Procedure{?format=[mime-type]}
```

The server creates the logical id of the resource and returns it on successful creation. The id can be stored for further use (as the other acquired resource references to Patient etc.), or found again through query business identifier when needed.

The request body contains a Procedure resource according to the Radiotherapy Course Summary or Treated Phase resource profiles.

The Treatment Summary Provider shall first send the Course Summary resource, and then optionally the Treated Phase resources affected by the Treatment Session. Multiple Phases are affected by the same Session only if Plans from overlapping Phases are treated. The Treated Phase references the Course Summary resource through the *Procedure:partOf* element.

The URL to the Course Summary resource shall be version-specific and copied from the Location header of the response. This is an important patient hazard mitigator for Treatment Observer to avoid the risk of data mix-up. Earlier versions of the Treated Phase reference earlier versions of the Course Summary through the partOf reference.

Retrieving the proper version of the Course Summary may require an additional *_history* query (http://hl7.org/fhir/http.html#history) based on timestamp matching (by using the *_at* parameter).

"partOf": [{ "reference": "<base>/Procedure/id-course/_history/v1" }]

Patient Reference in *Procedure.subject* shall contain the relative URL to the patient resource, acquired in Get Patient Reference message of this transaction [XRTS-01.a].

If references to Planned Course or Planned Phase are provided, those shall be set in the *Procedure:basedOn* property and contain the relative URL to the ServiceRequest resource acquired in the Get Treatment Plan Reference message of this transaction [XRTS-01.c].

The URLs to the Planned Course and Planned Phase resource shall be version specific and copied from the Location header of the response of [XRTS-01.c] message when Plan resource is created or updated.

3.Y1.4.5.3 Expected Actions

RO Resource Repository shall create the first version of Course Summary and optionally Radiotherapy Phase resources and return a Location header with full URL of the created resources.

The Treatment Summary Provider shall fetch the resource URL from Location header and save it in the system for further update messages.

3.Y1.4.6 Update Treatment Summary

3.Y1.4.6.1 Trigger Events

This update may be triggered when the next treatment session of a Treatment Course of the patient is completed, or it may be triggered according to a configured schedule in the system.

3.Y1.4.6.2 Message Semantics

FHIR update - https://www.hl7.org/fhir/http.html#update.

Create a new version of resource with given ID.

660
```
PUT [base]/Procedure/[id]?format=[mime-type]
```

The request body contains an updated Procedure resource according to the Radiotherapy Course Summary and Treated Phase resource profiles.

The Treatment Summary Provider shall first send an updated Course Summary resource and then the Treated Phase resource (that affected the Course Summary update), which refers to the
665   Course Summary resource through the *Procedure:partOf* element.

If the session that triggered the update of Course Summary was the first delivered during the given Phase, then the Treated Phase resource is created (see Section 3.Y1.4.5) and not updated.

The URL to the Course Summary resource shall be version specific and the version is copied from the ETag header (see Section 3.Y.1.3.3) of the response.

670   "partOf": [{ "reference": "<base>/Procedure/id-course/_history/versionN" }]

The Patient reference in *Procedure.subject* shall contain the URL acquired in the Get Patient Reference message of this transaction.

3.Y1.4.6.3 Expected Actions

FHIR update - https://www.hl7.org/fhir/http.html#update

675   The RO Resource Repository shall create a new version of the Radiotherapy Course Summary and Treated Phase resources for the given ID and return an ETag header with the newly created version ID of the updated resource.

The Treatment Summary Provider fetches the version ID and saves it in the system for internal use and to construct version specific references (Procedure:partOf) between related resources.

680   ## 3.Y2 Retrieve Treatment Summary [XRTS-02]

The general provisions of [XRTS-01] (Section 3.Y1.4.1) also apply to this transaction.

3.Y2.1 Scope

This transaction is used by a Treatment Observer to retrieve the summary of a radiotherapy treatment from an RO Resource Repository.

685   ### 3.Y2.2 Actor Roles

Table 3.Y2.2-1: Actor Roles

Actor:	Treatment Observer
Role:	Retrieves resources representing the summary of a radiotherapy treatment.
Actor:	RO Resource Repository

Role:	Provides resources representing the summary of a radiotherapy treatment.

3.Y2.3 Referenced Standards

See transaction [XRTS-01], Section 3.Y1.3.

690   ### 3.Y2.4 Messages

Retrieve Treatment Summary [XRTS-02]

Treatment Observer / **Resource Repository**

Handle request for Treatment Summary status for a Patient

Patient reference acquisition

GET [base]/Patient?<search-parameters> or POST /_search?

exact match of search parameters

HTTP 200 : Body: {Bundle { total:1, [resourceType:Patient, id:[id] } }

alt [Search for both Course Summaries and Treated Phases]

GET [base]/Procedure?**category**=http://snomed.info/sct|108290001&subject:Patient/[id] or POST /_search?

[Search for Course summaries]

GET [base]/Procedure?**code**=http://snomed.info/sct|1217123003&subject:Patient/[id] or POST /_search?

[Search for Radiotherapy Phase summaries]

GET [base]/Procedure?**code**=http://snomed.info/sct|1222565005&subject:Patient/[id] or POST /_search?

HTTP 200 : Body: {Bundle { [Procedure[i].meta.versionId: vN] } }

Select one or multiple Treatment Summaries in the returned bundle from Patient query response and cache their resource id:s [id]

Handle request for Treatment Summary current version of selected Treatment Course or Phase

Fetch current version of the Treatment Summary
GET [base]/Procedure/[id]

HTTP 200 : Body: { Procedure/[id] }

Retrieve referenced Radiotherapy Volumes

GET [base]/BodyStructure/<volume_id> - for each reference in Procedure resource

HTTP 200 : Body: {BodyStructure}

Retrieve referenced Treatment Plans

GET [base]/ServiceRequest/<plan_id>/<v_id> - for basedOn reference in Procedure resource

HTTP 200 : Body: {ServiceRequest}

Handle request for treatment progress history

GET [base]/Procedure/[id]/_history

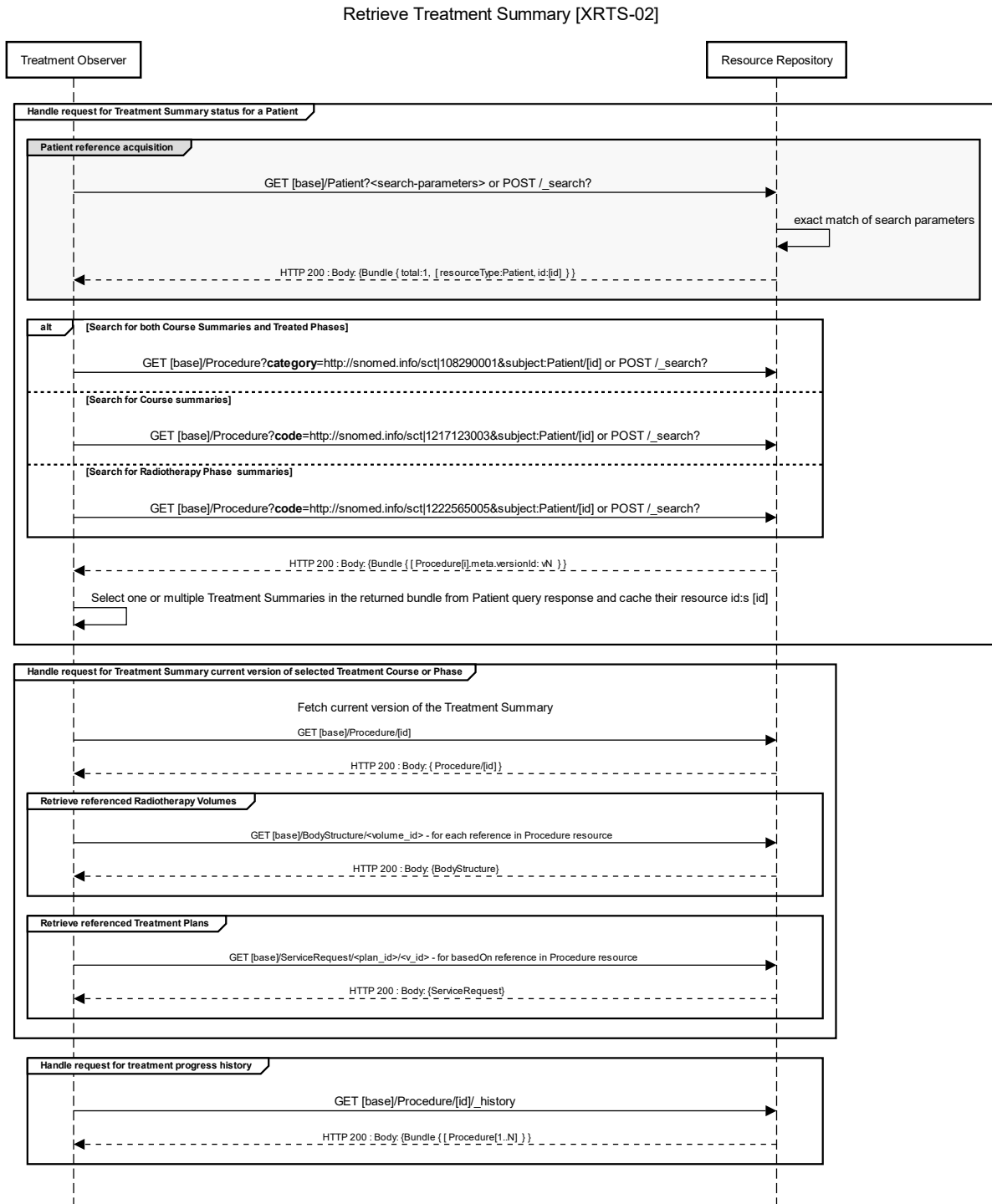HTTP 200 : Body: {Bundle { [Procedure[1..N]] } }

Figure 3.Y2.4-1: XRTS-02

3.Y2.4.1 Get Patient Reference

695 This is a preparation message where Treatment Observer acquires the URL to the FHIR Patient resource that is going to be used for the subject reference in the Treatment Summary messages that are going to be sent for a given patient.

3.Y2.4.1.1 Trigger Events

Not defined by this profile but typically when the patient is registered in the Treatment Observer
700 system

3.Y2.4.1.2 Message Semantics

FHIR Patient search operation

The following fields are required to be provided in search and match exactly for the Patient resource to be found by the RO Resource Repository and returned to the Treatment Observer.

705   1. primary patient identifier (search parameter name 'identifier', value *system|value*)

    2. last name (search parameter name 'family:exact')

    3. first name (search parameter name 'given:exact')

    4. birth date (search parameter name 'birthdate')

    5. gender (search parameter name 'gender')

710 ### 3.Y2.4.1.3 Expected Actions

If there is exactly one match, RO Resource Repository returns a Bundle with a single Patient resource.

The Treatment Observer shall fetch the local id of the Patient resource and use it in subsequent requests for Treatment Summary resources.

715 If there is no matching resource, the count in the Bundle is 0 and the transaction shall not continue.

If there are more than one matching resource, then the count in the Bundle is >1.

This shall be considered an error situation and requires RO Resource Repository maintenance. In this case, the Treatment Observer system shall not assume validity of any Patient resource and
720 the transaction shall not continue.

3.Y2.4.2 Request Treatment Summaries for a Patient

3.Y2.4.2.1 Trigger Events

The transaction is triggered at the Treatment Observer when a patient summary is needed, for example, when the user decides to view the patient summary to get an overview or write a
725 summary letter.

3.Y2.4.2.2 Message Semantics

FHIR Procedure search operation https://www.hl7.org/fhir/http.html#search.

The required parameters are:

1. **code** if the Treatment Observer wants to find only Course or only Phase level resources. The **code** shall contain one of the fixed values:

   a. http://snomed.info/sct|1217123003 "Radiotherapy course of treatment (regime/therapy)"

   b. http://snomed.info/sct|1222565005 "Radiotherapy treatment phase (regime/therapy)"

2. **category** if the Treatment Observer wants to find both Course or Phase level resources. The **category** shall contain the fixed value http://snomed.info/sct|108290001 "Radiation oncology AND/OR radiotherapy (procedure)" (can be omitted if code is given)

3. **subject** which shall contain the logical id (https://www.hl7.org/fhir/resource-definitions.html#Resource.id) of a Patient resource as a search parameter. The Treatment Observer shall have acquired the patient resource id as defined in 3.Y1.4.1 Get Patient Reference.

Optional parameters are:

1. **status** which shall hold one of the values from code system http://hl7.org/fhir/event-status (in-progress, completed, entered-in-error etc.)

2. **_lastUpdated** which can be used to search Treatment summaries based on the last time they were changed. This parameter is of type Date/DateTime and thus shall be given according to https://www.hl7.org/fhir/search.html#date. In order to search for Treatment summaries in a specific range, the parameter shall be provided twice (for lower and upper boundary)

3. **_format** – "json" or "xml"

```
GET [base]/Procedure?category=http://snomed.info/sct|108290001
                &subject:Patient=[id]
                {&_format=[mime-type]}}


POST [base]/Procedure/_search

Content-Type: application/x-www-form-urlencoded

category: http://snomed.info/sct|108290001

code: http://snomed.info/sct|1217123003

subject:Patient: [id]
```

760
```
status: completed

_lastUpdated: <startdate>

_lastUpdated: <enddate>

_format: [mime-type]
```

3.Y2.4.2.3 Expected Actions

765

The RO Resource Repository shall match search parameters to the Treatment Summary
resources.

The Patient is matched with the local Patient resource, that must have been created or secured
previously by [XRTS-01] transaction.

770 The RO Resource Repository shall support all parameters, including optional parameters listed in
3.Y2.4.1.2 Message Semantics.

The RO Resource Repository shall return a Bundle with list of entries that contain current
versions of the matching Treatment Summary resources.

The Treatment Observer shall parse the bundle, and either programmatically or by user
775 interaction select one Treatment Summary from the bundle. Treatment Observer shall fetch and
cache the resource ID of the selected Treatment Summary and use it in direct messages to fetch
the status or history of a Treatment. (See Section 3.Y2.4.2 Request Treatment Summary status of
selected Treatment Course.)

3.Y2.4.3 Request Treatment Summary current version of selected Treatment
780 Course or Phase

3.Y2.4.3.1 Trigger Events

The Treatment Observer has previously obtained the resource Id of a Treatment Summary
resource by patient search and by programmatic or user interactive selection. The Treatment
Observer needs to access the latest reported status update of the Treatment Summary.

785 ### 3.Y2.4.3.2 Message Semantics

FHIR Procedure read operation - https://www.hl7.org/fhir/http.html#read

```
GET [base]/Procedure/[id]{?format=[mime-type]}
```

[id] is the logical resource ID of the Treatment Summary (Procedure) instance at the RO Resource Repository.

3.Y2.4.3.3 Expected Actions

RO Resource Repository shall return a single Procedure resource in the format specified by the _format parameter. If this parameter is not sent by the Treatment Observer, it is up to the RO Resource Repository to choose its default format.

The returned resource is the latest version of this Treatment Summary sent by the [XRTS-01] transaction.

3.Y2.4.4 Request Treatment Summary progress history of selected Treatment Course or Phase

3.Y2.4.4.1 Trigger Events

The Treatment Observer has previously obtained the resource ID of a Treatment Summary resource by patient search and by programmatic or user interactive selection. Treatment Observer needs to access all or some progress update information of this Treatment Course or Phase.

3.Y2.4.4.2 Message Semantics

FHIR Procedure history operation - https://www.hl7.org/fhir/http.html#history

```
GET [base]/Procedure/[id]/_history{?_format=[mime-type]}}
```

[id] is the logical resource ID of the Treatment Summary (Procedure) instance at RO Resource Repository.

3.Y2.4.4.3 Expected Actions

The RO Resource Repository shall return a Bundle resource that contains entries, where each entry is one version of the Treatment Summary (Procedure) resource that has been created by the RO Resource Repository as part of the [XRTS-01] transaction.

The entries in the bundle are sorted oldest version last and the current version first as defined by the FHIR standard.

3.Y2.4.5 Request Updated Treatment Summaries

3.Y2.4.5.1 Trigger Events

The transaction is triggered at the Treatment Observer when the RO Resource Repository has notified the Treatment Observer about new or updated Treatment Summary resources

3.Y2.4.5.2 Message Semantics

820 FHIR Procedure search operation https://www.hl7.org/fhir/http.html#search

Required parameters are:

1. **category** which shall hold fixed value http://snomed.info/sct|108290001 ""Radiation oncology AND/OR radiotherapy (procedure)" (can be omitted if code is given)

2. **_lastUpdated** which can be used to search Treatment summaries based on the last time
825 they were changed. This parameter is of type Date/DateTime and thus shall be given according to https://www.hl7.org/fhir/search.html#date. To search for Treatment summaries in a specific range, the parameter shall be provided twice (for lower and upper boundary)

Optional parameters are:

830 1. **code** which shall hold one of the fixed values;

   a. http://snomed.info/sct|1217123003 "Radiotherapy course of treatment (regime/therapy)"

   b. http://snomed.info/sct|1222565005 "Radiotherapy treatment phase (regime/therapy)"

2. **_format – "json" or "xml"**

3.Y2.4.5.3 Expected Actions

835 The RO Resource Repository shall match search parameters to the Treatment Summary resources.

The RO Resource Repository shall return a Bundle with a list of entries that contain the current versions of the matching Treatment Summary resources.

840 Treatment Observer shall parse the bundle and identify new and updated resources. Based on the patient reference in each resource, the Treatment Observer shall update the local copy of the included treatment data.

3.Y2.4.6 Request Referenced Radiotherapy Volumes

3.Y2.4.6.1 Trigger Events

845 The observer retrieved a Radiotherapy Course Summary that references a Radiotherapy Volume and needs more properties of the Volume than the display name which is included in the summary itself.

3.Y2.4.6.2 Message Semantics

The Radiotherapy Course Summary contains references to BodyStructure resources that
850 represent the Radiotherapy Volumes to which dose is summarized. The display name of the Radiotherapy Volume is contained in the Course Summary itself as element Reference.display.

For any other details of the Radiotherapy Volume such as type, anatomic location, UID, the respective BodyStructure resource has to be retrieved from the RO Resource Repository.

FHIR Read operation https://www.hl7.org/fhir/http.html#read

855 There are no required parameters in this request.

Optional parameters are: **_format** – "json" or "xml"

The Procedure resource contains a ready to use local reference to the BodyStructure.

The base URL shall be same as the parent Procedure resource.

Example:

860
```
GET [base]/BodyStructure/id1
```

3.Y2.4.6.3 Expected Actions

RO Resource Repository shall return the referenced BodyStructure resource.

3.Y2.4.7 Request Referenced Plan Summaries

3.Y2.4.7.1 Trigger Events

865 The Treatment Observer retrieved a Radiotherapy Course Summary or Treated Phase, that references a ServiceRequest that describes what is planned for the Course or Phase (Planned Course or Planned Phase respectively). The Treatment Observer needs Plan information to compare the plan with treatment outcome, in particular to assess the current progress when the treatment Course is still ongoing.

870 ### 3.Y2.4.7.2 Message Semantics

The Planned Course and Planned Phase resources summarize the Treatment Plans that were planned for a certain Course or Phase. The Planned Course and Planned Phase resources are of type ServiceRequest (intent=filler-order). They are referenced from the Course Summary and Treated Phase Procedures by the "basedOn" references and can be retrieved using these
875 references. The elements contained in the referenced ServiceRequest resources summarize the Treatment Plans following the Planned Course and Planned Phase profiles. By comparing the Plan information such as planned dose and planned number of fraction elements with the delivered Procedures, e.g., delivered dose and number of fraction elements, the progress overview can be created when the treatment is in progress.

880 FHIR Read operation https://www.hl7.org/fhir/http.html#read.

There are no required parameters in this request.

Optional parameters are: **_format** – json or xml.

The Procedure resource contains a ready-to-use local version-specific reference to the ServiceRequest resource.

885 The base URL shall be same as the parent Procedure resource.

Example:

```
GET [base]/ServiceRequest/<id>/<vid>
```

3.Y2.4.7.3 Expected Actions

The RO Resource Repository shall return the requested version of the referenced ServiceRequest
890 resource.

3.Y3 Subscribe for Treatment Summary Updates [XRTS-03]

The general provisions of [XRTS-01] (Section 3.Y1.4.1) also apply to this transaction.

3.Y3.1 Scope

This transaction is used by a Treatment Observer to subscribe to an RO Resource Repository for
895 notification when a treatment summary changes.

3.Y3.2 Actor Roles

Table 3.Y3.2-1: Actor Roles

Actor:	Treatment Observer Provider
Role:	Subscribes to changes in the summary of a radiotherapy treatment.
Actor:	RO Resource Repository
Role:	Establishes subscription to notify an observer in case of changes to the summary of a radiotherapy treatment.

3.Y3.3 Referenced Standards

900 See transaction [XRTS-01], Section 3.Y1.3.

3.Y3.4 Messages
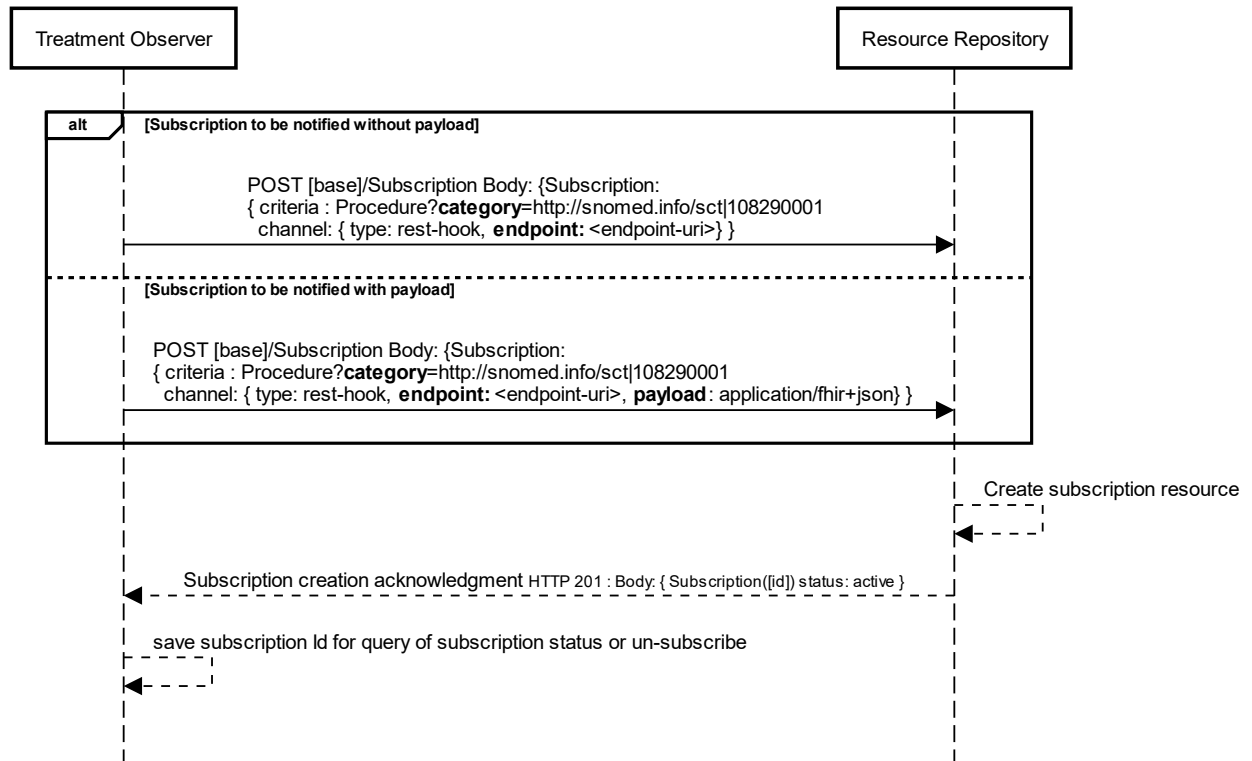
Subscribe for Treatment Summary Updates [XRTS-03]

Figure 3.Y3.4-1: XRTS-03

3.Y3.4.1 Subscription Creation

3.Y3.4.1.1 Trigger Events

The transaction is triggered at the Treatment Observer when notifications about new and updated Treatment summary information are requested, for example, when the Treatment observer system architecture prefers push communication over polling.

3.Y3.4.1.2 Message Semantics

The Treatment Observer creates and posts a FHIR Subscription resource to the RO Resource Repository.

FHIR create - https://www.hl7.org/fhir/http.html#create.

Create a new version of resource with given Id.

```
POST [base]/Subscription
```

The Body contains a Subscription resource according to https://www.hl7.org/fhir/subscription.html.

Besides elements required by the resource definition, the following elements shall be specified according to below:

Subscription.criteria

To be notified for any Treatment Summary procedure resource change, including creation of new and update of existing resources.

```
Procedure?category=http://snomed.info/sct|108290001
```

Note that this criterion matches both Treatment Course Summary and Treated Phase resource creation and updates. It is also possible to extend the criteria to match only one of these types, by adding another parameter:

- &code= http://snomed.info/sct|1217123003 to retrieve only Course Summaries

- &code= http://snomed.info/sct|1222565005 to retrieve only Phase Summaries

Subscription.channel.type

"rest-hook"

Subscription.channel.endpoint

The url owned by Treatment Observer system that describes the actual endpoint to which a notification HTTP request messages is sent.

If different subscriptions based on summary code (with additional *&code* criteria parameter) are registered and payload is also expected (see below), then the endpoint shall also differ in these subscriptions. Otherwise, the Treatment Observer is not able to distinguish which criteria triggered the notification.

Subscription.channel.payload

Can be specified if Treatment Observer prefers that the matched resource is copied and pushed as part of the notification call.

Example

```
{
  "resourceType": "Subscription",
  "id": "ihe-ro-xrts-subscription-1",
  "status": "requested",
  "reason": "Monitor Radiation Therapy progress",
  "criteria": "Procedure?category=http://snomed.info/sct|108290001
```

```
    "channel": {
      "type": "rest-hook",
950   "endpoint": "{{endpointUrl}}/radiation-therapy-summary-update",
      "payload": "application/fhir+json"  // Optional
    }
  }
```

3.Y3.4.1.3 Expected Actions

955 The RO Resource Repository is ready to match any newly created or updated Treatment Summary resource (normally by [XRTS-01] transaction) with the *Subscription.criteria* and notify the given *Subscription.channel.endpoint* when an update occurs.

3.Y4 Notify of Treatment Summary Update [XRTS-04]

960 The general provisions of [XRTS-01] (Section 3.Y1.4.1) also apply to this transaction.

3.Y4.1 Scope

This transaction is used by an RO Resource Repository to notify Treatment Observer when a treatment summary has been updated.

### 3.Y4.2 Actor Roles

965 **Table 3.Y4.2-1: Actor Roles**

Actor:	RO Resource Repository
Role:	Notifies a Treatment Observer that a treatment summary has been updated on the *RO Resource Repository*.
Actor:	Treatment Observer
Role:	Receives a notification from the *RO Resource Repository* that a treatment summary has been updated on the *RO Resource Repository*.

3.Y4.3 Referenced Standards

See transaction [XRTS-01], Section 3.Y1.3.

970 **3.Y4.4 Messages**

3.Y4.4.1 Notification of Updates

Notify of Treatment Summary Update [XRTS-04]
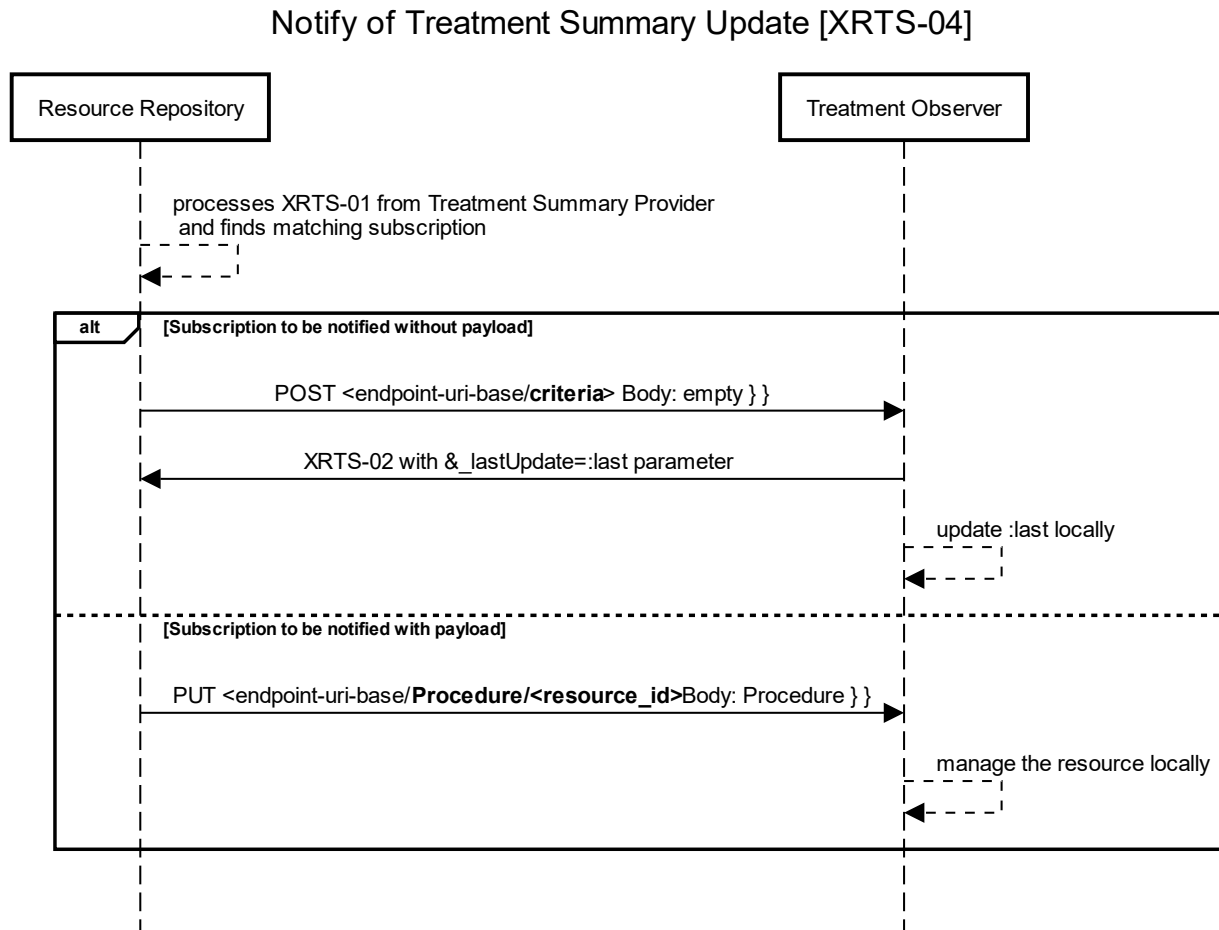
Figure 3.Y4.4.1-1: XRTS-04

975 **3.Y4.4.1.1 Trigger Events**

When a new or updated Treatment Summary resource is received by RO Resource Repository
(normally by [XRTS-01] transaction).

Note, both phase-level and course-level Treatment Summary resources trigger the notification.

3.Y4.4.1.2 Message Semantics

980 The message that the RO Resource Repository sends depends on *Subscription.channel.payload*

Payload is missing

RO Resource Repository sends a POST request with no body to the nominated URL specified in matching *Subscription.channel.endpoint*.

Payload is specified

985 RO Resource Repository sends a PUT request to the nominated URL specified in matching *Subscription.channel.endpoint*. The request body contains the copy of the Procedure resource that triggered this notification in the format specified in *Subscription.channel.payload.*

3.Y4.4.1.3 Expected Actions

Treatment Observer receives POST request to the subscription endpoint.

990 In order to retrieve new or updated Treatment Summary resources, the Treatment Observer shall perform a search operation on the RO Resource Repository endpoint.

```
GET [base]/{Subscription.channel.endpoint}/{Subscription.channel.criteria}
?_lastUpdated=gt[:last]
```

995 where [:last] is replaced by the time at which the Treatment Observer last checked. In this way it can fetch all new relevant Treatment Summary resources.

RO Resource Repository returns a Bundle that contains Treatment Summary resources created or updated since *:last* timestamp. The processing of the result is expected to be same as in [XRTS-02] transaction *3.Y2.4.4 Request Updated Treatment Summaries*.

1000 **NOTE:** Because both Course Summary and related Treated Phase resources are created in the same [XRTS-01] transaction, multiple notifications are sent by the RO Resource Repository. It is the responsibility of the Treatment Observer to correlate and filter these notifications and arrange synchronous fetch of the updated resources.

Treatment Observer is expected to save the *:last* timestamp to be used when next update
1005 notification is received.

Treatment Observer receives PUT request to the subscription endpoint.

Treatment Observer shall fetch the copy of Treatment Summary resource from the response body.

Treatment Observer is expected to handle it in similar manner as response body from [XRTS-02]
1010 3.*X.1.2 Request Treatment Summary current version of selected Treatment Course or Phase.*

Appendices to Volume 2

None

1015

Volume 3 – Content Modules

11 RO HL7 FHIR Content Modules

11.1 Conventions

1020 HL7 FHIR Conventions are defined in Appendix Z to the *IHE Technical Frameworks Volume 2*. The following sections contain additional conventions for this supplement.

11.1.1 Optionality (OPT)

The optionality of elements is specified according to the conventions in Appendix Z.10. Some requirements on optionality are inherited from base profiles. This section defines the resulting
1025 optionality from base profiles combined with additional requirements of the supplement. This resulting optionality is compared to the FHIR standard itself. For example, R+ means that an element is not required by FHIR, but XRTS or any of the base profiles require this element.

11.1.2 Display Requirements

If a requirement is annotated with *, then that attribute is not required to be displayed.

1030 ### 11.1.3 Must Support

FHIR has the concept of 'Must Support' as an indication that an element must be supported for a given use case.

See https://www.hl7.org/fhir/conformance-rules.html#mustSupport.

11.1.4 Binding strength of ValueSets

1035 For data elements with coded types, FHIR defines binding strengths.
http://hl7.org/fhir/R4/terminologies.html#strength

Profiles can define for coded elements which ValueSets are suggested or required by indicating the ValueSet and a binding strength. As with other profile requirements, profiles can increase the binding strength of base profiles or FHIR itself but not decrease it.

1040 Note in particular that the binding strength 'required' means that only values from the referenced ValueSet are allowed. Implementations that cannot map values to a required ValueSet cannot expose this element compliant with the profile because other values would violate the profile. However, it is mostly allowed to expose additional codes from other CodingSystems in elements of type CodeableConcept.

1045 For example, the treatment technique must be exposed along the required Value Set by mCODE.

http://hl7.org/fhir/us/mcode/ValueSet/mcode-radiotherapy-technique-vs

Implementations that work with other codes or annotations of technique must provide a mapping to this ValueSet. Otherwise, the technique cannot be exposed in a structured way. However, the original technique code or any additionally mapped code of the system can be exposed in
1050 addition to a code from the required ValueSet. Additionally, a CodeableConcept.text is available

in FHIR to convey text descriptions where a concept cannot be fully captured by the required and alternative codes.

http://hl7.org/fhir/R4/datatypes.html#codeableconcept

11.2 Content Modules

1055 This section defines each IHE-RO HL7 FHIR Content Module in detail, specifying the standards used and the information defined.

<The content of Section 6.3 comes directly from the text of the Technical Framework Supplement template.>

11.2.1 Base Profiles

1060 The following table shows the specifications on which the FHIR resource profiles in this supplement are based. The first column defines the labels by which the profiles are referenced in the subsequent sections for brevity.

Some requirements and restrictions are defined by the FHIR standard itself and others are added by the profiles, which define more restrictive multiplicities, more restrictive bindings for coded
1065 values, or defining elements as 'Must Support'. https://www.hl7.org/fhir/profiling.html

FHIR itself has no resources specific to radiotherapy. XRTS mainly builds on selected profiles by mCODE, which added various Extensions and ValueSets specifically for Radiotherapy in STU2. mCODE in turn depends on US Core Profiles.

Label	Version	Depends on	Specification	Comments
FHIR	R4 (4.0.1)	-	http://hl7.org/fhir/R4/	Elements and constraints labeled as 'FHIR' are defined by the FHIR standard itself.
US Core	3.1.0 STU3 Update	FHIR	http://hl7.org/fhir/us/core/STU3.1	The dependency to US Core and the specific version of US Core is given by mCODE.
mCODE	STU2 (update for final codes required)	Some profiles based on US Core. Some profiles directly based on FHIR.	http://hl7.org/fhir/us/mcode/STU2/	Only some profiles of mCODE. See detailed XRTS resource profiles for dependencies.

Label	Version	Depends on	Specification	Comments
CodeX RT	1.0.0 STU1	mCODE	http://hl7.org/fhir/us/codex-radiation-therapy/STU1/ Temporary url before release http://build.fhir.org/ig/HL7/codex-radiation-therapy/branches/master/index.html	

1070

Profiles can add requirements but not loosen requirements of base profiles or the FHIR standard.

This supplement does not require implementation of all resource profiles covered in mCODE or US Core. It makes use of selected resource profiles where applicable to the XRTS use cases.

11.2.2 Data Model

1075 The data model used in this supplement was developed in the CodeX Radiation Therapy (RT) Implementation Guide.

http://hl7.org/fhir/us/codex-radiation-therapy/STU1

Temporary url before release:

http://build.fhir.org/ig/HL7/codex-radiation-therapy/branches/master/index.html

1080

Most model concepts and definitions were already introduced in the mCODE IG STU2, from which CodeX RT derives.

http://hl7.org/fhir/us/mcode/STU2/group-treatment.html

1085 For concept definitions, please refer to the mCODE STU2 Glossary

http://hl7.org/fhir/us/mcode/STU2/glossary.html and the IHE Glossary.

Only the following radiotherapy resource profiles are in scope of the current XRTS version.

To document what was delivered over the complete Course and per Phase:

- Radiotherapy Course Summary

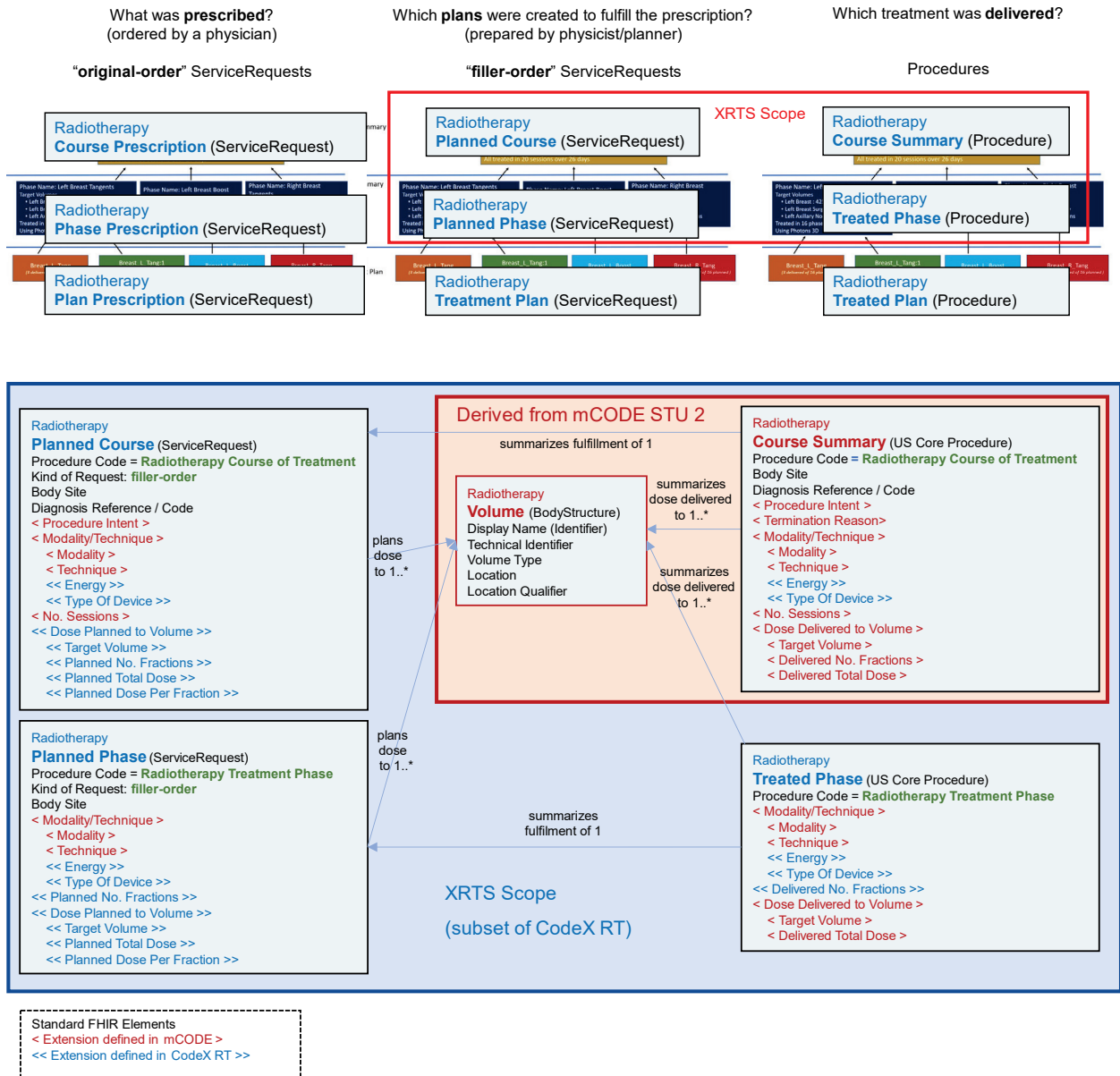1090 - Radiotherapy Treated Phase

To document what was planned over the complete Course and per Phase:

- Radiotherapy Planned Course

- Radiotherapy Planned Phase

To document the radiotherapy target volumes that are referenced from plan summaries, treatment delivery summaries, and in future versions from prescriptions:

1095

- Radiotherapy Volume

1100

**Figure 11.2.2-1: XRTS Data Model Overview (incl. prescription and plan level resources,
which are currently not in scope)**

The following figure shows how the radiotherapy resources based on ServiceRequest and
Procedure reference each other.

1105   Note that there is no element 'partOf' for resource type ServiceRequest. The element 'basedOn'
is used to point from a smaller scope request to a larger scope request that is partly fulfilled by
the smaller scope request, for example, to point from Treated Phase to Treated Plan.

See the CodeX RT resource profiles for defined slices on basedOn and partOf.
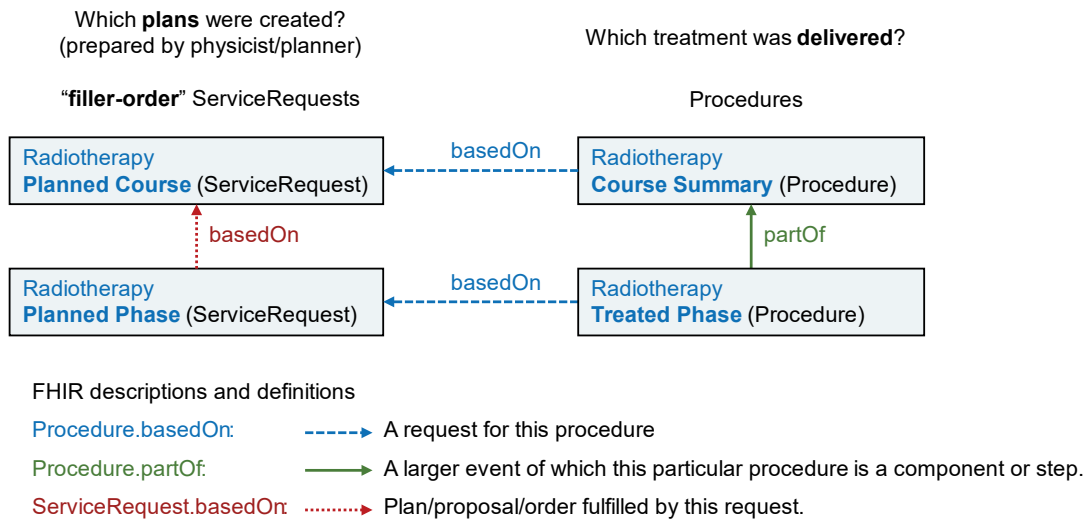
1110

**Figure 11.2.2-2: References between Radiotherapy ServiceRequests and Procedures**

The summary of delivered Radiotherapy treatment is modelled with profiles based on the
resource type Procedure. The treatment summary for one Course consists of multiple Procedure
1115   resources: One high level Course Summary and one or multiple Treated Phases (External Beam
or Brachytherapy). See also http://hl7.org/fhir/us/mcode/STU2/StructureDefinition-mcode-
radiotherapy-course-summary.html.

The irradiated volumes can be target volumes or, in the future, Organs at Risk. These irradiated
volumes are referenced from summaries of delivered treatment (Course Summary, Treated
1120   Phase), from summaries of plans (Planned Course, Planned Phase), and in the future also from
Prescriptions (Prescribed Course, Prescribed Phase). Therefore, the Radiotherapy Volumes are
modelled as separate FHIR resources. The Radiotherapy Volume corresponds to the Conceptual
Volume in DICOM. See also http://hl7.org/fhir/us/mcode/STU2/StructureDefinition-mcode-
radiotherapy-volume.html#usage.

1125
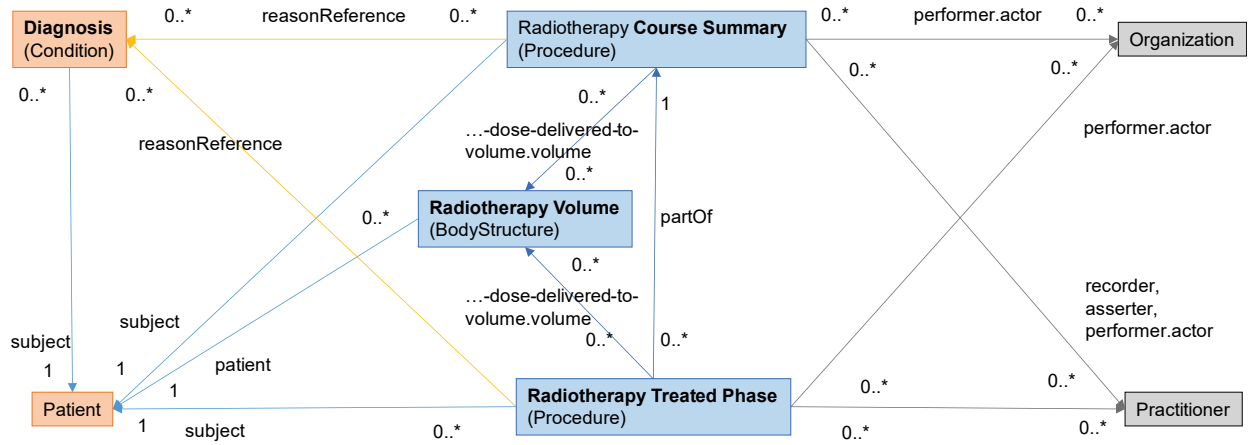
Figure 11.2.2-3: XRTS resources for Treatment Summary (blue) and main related resources

1130 This model follows the FHIR principle of modelling separate concerns as separate resources, which leads to smaller and simpler resources with some effort to manage their relations, but on the other hand avoids complex and nested resources with mixed responsibilities. Comprehensive datasets that cover multiple FHIR resources can still be implemented by defining Documents, Messages or Bundles that specify which resources are transmitted together.

Volume 2 – Transactions specify which resources are transferred and in which sequence.

1135 Unless otherwise stated, a Radiotherapy treatment summary consists of resources listed in the following table. The table also lists the profiles of CodeX RT and the respective base profiles of mCODE and US Core that the resources SHALL conform with.

XRTS defines requirements for which elements in the related Patient resource are required. Other related resources, such as Condition (Diagnosis), Practitioner, and Organization should be
1140 applied as per FHIR standard and may be further profiled in other Implementation Guides. They are not restricted by this supplement.

Entity	Resource Type	Profiles	Comment
Patient	Patient	US Core Patient	Dependency on mCODE requires that also the referenced Patients comply with the US Core Patient Profile. No additional requirements are needed because US Core requires the patient identifying information needed for XRTS.

Entity	Resource Type	Profiles	Comment
Radiotherapy Course Summary	Procedure	CodeX RT Radiotherapy Course Summary based on mCODE Radiotherapy Course Summary based on US Core Procedure	
Radiotherapy Treated Phase	Procedure	CodeX RT Radiotherapy Treated Phase based on US Core Procedure	
Radiotherapy Planned Course	ServiceRequest	CodeX RT Radiotherapy Planned Course	
Radiotherapy Planned Phase	ServiceRequest	CodeX RT Radiotherapy Planned Phase	
Radiotherapy Volume (Target or OAR)	BodyStructure	CodeX RT Radiotherapy Volume based on mCODE Radiotherapy Volume	Currently only for target volumes but kept neutral to also cover Organs at Risk in the future
Diagnosis	Condition	none	Referenced by XRTS but XRTS does not impose requirements in addition to the FHIR standard.
Practitioner	Practitioner	none	Referenced by XRTS but XRTS does not impose requirements in addition to the FHIR standard.
Organization	Organization	none	Referenced by XRTS but XRTS does not impose requirements in addition to the FHIR standard.

11.2.3 General Provisions for all Resources exchanged in XRTS Transactions

11.2.3.1 Time Zone of dateTime elements

FHIR requires for the dateTime data type that if hours and minutes are specified, a time zone SHALL be populated.

XRTS additionally requires that for dateTime elements that are part of the clinical contents, the producing system SHALL annotate the time zone in which the clinical contents was created. The consuming systems SHOULD display the time in the same time zone as annotated in the FHIR dateTime element, i.e., the same time zone that the users saw on the system that produced the data. The consuming systems SHALL show the time zone in which the time is displayed.

This affects the following dateTime elements:

- ServiceRequest.occurrencePeriod.start

- ServiceRequest.occurrencePeriod.end

- Procedure.performedPeriod.start

- Procedure.performedPeriod.end

11.2.4 Patient

XRTS focuses on radiotherapy-specific contents.

1160 The patient requires the identifying information as specified in this section. Other aspects of patient management are not in scope of XRTS.

XRTS requires Patient resources to comply to the US Core Patient profile.

http://hl7.org/fhir/us/core/STU3.1/StructureDefinition-us-core-patient.html

The dependency on US Core Patient is inherited from mCODE Procedure and it fulfils the
1165 requirements of XRTS.

This section lists all R+ elements of the US Core Patent Profile. See US Core Patient definition for additional Must Support elements (R2, not R+). Here, Must Support elements of US Core are only listed if required by XRTS.

Data Element	OPT	FHIR Element	FHIR Data Type	Card.	Must Support by	Binding Profile (strength) ValueSet	Comment
Name	R+	name	HumanName	1..*	US Core	Name	Invariant us-core-8 Patient.name.given or Patient.name.family or both SHALL be present
>First Name	R2	>given	string	0..*	US Core		
>Last Name	R2	>family	string	0..1	US Core		
Patient Identifier	R+	identifier	Identifier	1..*	US Core		
>Patient ID	R+	>value	string	1..1	US Core		The primary identifier shall be declared by use = 'usual'
>Identifier System	R+*	>system	uri	1..1	US Core		
Birth Date	R2	birthDate	date	0..1	US Core		
Administrative Gender	R2	gender	code	1..*	US Core	FHIR (required) http://hl7.org/fhir/ValueSet/administrative-gender	male | female | other | unknown

Data Element	OPT	FHIR Element	FHIR Data Type	Card.	Must Support by	Binding Profile (strength) ValueSet	Comment
Sex at Birth	O	us-core-birthsex	code	0..*	US Core	US Core (required) http://hl7.org/fhir/us/core/ValueSet/birthsex	codes F|M|UNK

1170

11.2.5 Course Summary

http://hl7.org/fhir/us/codex-radiation-therapy/STU1/StructureDefinition/codexrt-radiotherapy-course-summary

1175   Temporary url before release:

http://build.fhir.org/ig/HL7/codex-radiation-therapy/branches/master/StructureDefinition-codexrt-radiotherapy-course-summary.html

1180   As opposed to Treated Phase, Course Summary summarizes all Modalities and Techniques, fractions and doses delivered in a Course of treatment and, potentially, multiple Phases.

Elements in **bold font** show differences in the Course Summary profile compared to the Treated Phase profile.

Data Element	OPT	FHIR Element	FHIR Data Type	Card.	Must Support by	Binding Profile (strength) ValueSet	Comment
Patient	R	subject	Reference(us-core-patient)	1..1	US Core		Requires US Core Patient because the Procedure profile is derived from us-core-procedure
Provider	O	performer.actor	Reference(Organization)	0..*	-		
Course Identifier	O	identifier	Identifier	0..*	-		SHOULD contain an identifier with identifier.use = 'usual' that is the preferred display name for the **Course**.

Data Element	OPT	FHIR Element	FHIR Data Type	Card.	Must Support by	Binding Profile (strength) ValueSet	Comment
Reference to Plan Summary	R2*	basedOn	Reference(ServiceReq uest | CarePlan)	0..*	XRTS		If the summary of what is planned is available on FHIR as **Radiotherapy Planned Course** resource, this shall be referenced here. However, it is not forbidden to reference other ServiceRequests or CarePlans. Therefore not formally restricted.
Treatment Intent	R2	mcode-procedure-intent	CodeableC oncept	0..1	mCODE	mCODE (required) http://hl7.org/fhi r/us/mcode/Stru ctureDefinition/ mcode-procedure-intent	
Treatment Termination Reason	R2	mcode-treatment-termination-reason	CodeableC oncept	0..1	mCODE	mCODE (required) http://hl7.org/fhi r/us/mcode/Valu eSet/mcode-treatment-termination-reason-vs	
Category of Procedure	R+*	category	CodeableC oncept	1..1	US Core	mCODE (fixed code) http://snomed.info /sct|108290001 "Radiation oncology AND/OR radiotherapy"	
Type of Procedure	R+	code	CodeableC oncept	1..1	US Core	mCODE (fixed code) http://snomed.info /sct|1217123003 "Radiotherapy course of treatment (regime/therapy)"	The display SHALL clearly label that this summary covers the complete Course. An explicit display of the code is not required.

Data Element	OPT	FHIR Element	FHIR Data Type	Card.	Must Support by	Binding Profile (strength) ValueSet	Comment
Status	R	status	code	1..1	FHIR (*1)	FHIR(required) http://hl7.org/fhir/ValueSet/event-status	In XRTS only the following status values are allowed: in-progress | not-done | on-hold | stopped | completed Status values preparation | unknown | entered-in-error not expected in the XRTS use cases.
Modality (Photons, Protons, etc.)	R2	mcode-radiotherapy-modality (contained in mcode-radiotherapy-modality-and-technique)	CodeableConcept	0..*	mCODE	mCODE (required) http://hl7.org/fhir/us/mcode/ValueSet/mcode-radiotherapy-modality-vs	**All modalities used in the Course. See phases for associating modalities with fractions.**
Technique	R2	mcode-radiotherapy-technique (contained in mcode-radiotherapy-modality-and-technique)	CodeableConcept	0..*	mCODE	mCODE (required) http://hl7.org/fhir/us/mcode/ValueSet/mcode-radiotherapy-technique-vs	**All techniques used in the Course. See phases for associating techniques with fractions.**
Actual Number of Sessions	R2	**mcode-radiotherapy-sessions**	**unsignedInt**	**0..1**	**mCODE**		**http://hl7.org/fhir/us/mcode/StructureDefinition/mcode-radiotherapy-sessions**
Target locations	R2	bodySite	CodeableConcept	0..*	mCODE	mCODE (required) http://hl7.org/fhir/us/mcode/ValueSet/mcode-radiotherapy-treatment-location-vs	Anatomy of all target volumes in the Course. For details of each target and non-target volume, see the Radiotherapy Volumes referenced in mcode-dose-delivered-to-volume

Data Element	OPT	FHIR Element	FHIR Data Type	Card.	Must Support by	Binding Profile (strength) ValueSet	Comment
Diagnosis Reference	O	reasonReference	Reference(Condition)	0..*	mCODE		*<Discussed in TC Aug 03, 2021 that XRTS does not add requirements on Diagnosis contents. It is a crucial element for context but not scope of this profile.>*
Diagnosis Code	R2	reasonCode	CodeableConcept	0..*	mCODE		
Diagnosis Staging		n/a					N/A in Procedure. See referenced Condition resource for staging.
Start Date	R+	performedPeriod.start	dateTime	0..1	US Core		The date and time when the first therapeutic radiation was delivered. XRTS restricts type to Period.
End Date	C	performedPeriod.end	dateTime	0..1	US Core		An end date is expected if the status is 'stopped' or 'completed'
Dose to Volume	R2	mcode-radiotherapy-dose-delivered-to-volume	complex	0..*	mCODE		Dose to this volume from **Course (all Phases)**
>Volume	R+	>volume	Reference(RadiotherapyVolume)	1..1	mCODE		Specification of the volume including identifiers is contained in the referenced RadiotherapyVolume.
>Total Dose	R2	>totalDoseDelivered	Quantity	0..1	mCODE		Dose to this volume from **Course (all Phases)**

Data Element	OPT	FHIR Element	FHIR Data Type	Card.	Must Support by	Binding Profile (strength) ValueSet	Comment
>Fractions Delivered	R2	>fractionsDelivered	unsignedInt	0..1	mCODE		**Number of Fractions delivered to this volume. This is only a summary over the Course. Fractions may come from different Phases and therefore differ in treatment method and dose. See details in Treated Phases.**

(*1) FHIR itself does not specify 'Must Support' but requires some elements by defining minimum Cardinality 1.

1185

11.2.6 Treated Phase

> http://hl7.org/fhir/us/codex-radiation-therapy/STU1/StructureDefinition/codexrt-radiotherapy-treated-phase

1190

Temporary url before release:

http://build.fhir.org/ig/HL7/codex-radiation-therapy/branches/master/StructureDefinition-codexrt-radiotherapy-treated-phase.html

1195   As opposed to Course Summary, which can summarize over any combination of fractionations, Modalities and Techniques, the Treated Phase resources covers a single Series of Fractions treated with a single Modality and Technique and one number of Fractions.

Implementations may even create a dedicated Phase for each Target Volume, but the profile supports multiple Target Volumes in a Phase. (See descriptions in mCODE.)

1200   Elements in **bold** font show differences to compared to the Course Summary resource profile.

Data Element	OPT	FHIR Element	FHIR Data Type	Card.	Must Support by	Binding Profile (strength) ValueSet	Comment
Patient	R	subject	Reference(us-core-patient)	1..1	US Core		Requires US Core Patient because the Procedure profile is derived from us-core-procedure
Provider	O	performer.actor	Reference(Organization)	0..*	-		
Phase Identifier	R2	identifier	Identifier	0..*	XRTS		SHOULD contain an identifier with identifier.use = 'usual' that is the preferred display name for the **Phase.**
Reference to Plan Summary	R2*	basedOn	Reference(ServiceRequest | CarePlan)	0..*	XRTS		If the summary of what is planned is available on FHIR as **Radiotherapy Planned Phase** resource, this shall be referenced here. However, it is not forbidden to reference other ServiceRequests or CarePlans. Therefore not formally limited.
Course Reference	**R+**	**partOf**	**Reference(Radiotherapy CourseSummary)**	**0..1**	**XRTS**		**References the summary of the complete Course of which this Phase fulfills a part.**
Category of Procedure	R+*	category	CodeableConcept	1..1	US Core	mCODE (fixed code) http://snomed.info/sct|108290001 "Radiation oncology AND/OR radiotherapy"	
Type of Procedure	**R+***	**code**	**CodeableConcept**	**1..1**	**US Core**	**mCODE (fixed code) http://snomed.info/sct|1222565005 "Radiotherapy treatment phase (regime/therapy)"**	

Data Element	OPT	FHIR Element	FHIR Data Type	Card.	Must Support by	Binding Profile (strength) ValueSet	Comment
Status	R	status	code	1..1	FHIR (*1)	FHIR(required) http://hl7.org/fhir/ValueSet/event-status	In XRTS only the following status values are allowed: in-progress | not-done | on-hold | stopped | completed Status values preparation | unknown | entered-in-error are not expected in the XRTS use cases.
Modality (Photons, Protons, etc.)	R2	mcode-radiotherapy-modality (contained in mcode-radiotherapy-modality-and-technique)	CodeableConcept	0..1	mCODE	mCODE (required) http://hl7.org/fhir/us/mcode/ValueSet/mcode-radiotherapy-modality-vs	**The modality used in this Phase.**
Technique	R2	mcode-radiotherapy-technique (contained in mcode-radiotherapy-modality-and-technique)	CodeableConcept	0..1	mCODE	mCODE (required) http://hl7.org/fhir/us/mcode/ValueSet/mcode-radiotherapy-technique-vs	**The technique used in this Phase.**

Data Element	OPT	FHIR Element	FHIR Data Type	Card.	Must Support by	Binding Profile (strength) ValueSet	Comment
Delivered Number of Fractions	**R2**	**mcode-radiotherapy-sessions**	**unsignedInt**	**0..1**	**mCODE**		For Treated Phases, the number of Fractions is on top level, not per Target. If the Phase covers multiple Targets, the treatment parameters and number of fractions are the same for all those targets. **http://hl7.org/fhir/us/mcode/StructureDefinition/mcode-radiotherapy-fractions-delivered**
Targeted locations	R2	bodySite	CodeableConcept	0..*	mCODE	mCODE (required) http://hl7.org/fhir/us/mcode/ValueSet/mcode-radiotherapy-treatment-location-vs	Anatomy of all target volumes in the course. For details of each target and non-target volume, see the Radiotherapy Volumes referenced in mcode-dose-delivered-to-volume
Diagnosis Reference	O	reasonReference	Reference(Condition)	0..*	mCODE		
Diagnosis Code	R2	reasonCode	CodeableConcept	0..*	mCODE		
Diagnosis Staging		n/a					N/A in Procedure. See referenced Condition resource for staging.
Start Date	R+	performedPeriod.start	dateTime	0..1	US Core		The date and time when the first therapeutic radiation was delivered. XRTS restricts type to Period.
End Date	C	performedPeriod.end	dateTime	0..1	US Core		An end date is expected if the status is 'stopped' or 'completed'

Data Element	OPT	FHIR Element	FHIR Data Type	Card.	Must Support by	Binding Profile (strength) ValueSet	Comment
Dose to Volume	R2	mcode-radiotherapy-dose-delivered-to-volume	complex	0..*	mCODE		Dose to this volume from this Phase.
>Volume	R+	>volume	Reference(Radiotherapy Volume)	1..1	mCODE		Specification of the volume including identifiers is contained in the referenced RadiotherapyVolume.
>Total Dose	R2	>totalDoseDelivered	Quantity	0..1	mCODE		Dose to this volume from this Phase.

(*1) FHIR itself does not specify 'Must Support' but requires some elements by defining minimum Cardinality 1.

11.2.7 Irradiated Volumes

1205 http://hl7.org/fhir/us/codex-radiation-therapy/STU1/StructureDefinition/codexrt-radiotherapy-volume

Temporary url before release:

http://build.fhir.org/ig/HL7/codex-radiation-therapy/branches/master/StructureDefinition-
1210 codexrt-radiotherapy-volume.html

Data Element	OPT	FHIR Element	FHIR Data Type	Card.	Must Support by	Binding Profile (strength) ValueSet	Comment
Identifier	R+	identifier	Identifier	1..*	mCODE		SHALL contain at least one DICOM UID to reliably identify the same volume in different requests and procedures. For example, the Conceptual Volume UID or Dose Reference UID if available. The system for this identifier SHALL be 'urn:dicom:uid'. The volume SHOULD contain additionally an identifier with identifier.use = 'usual' as human readable display name for overviews or summaries.
Description	R2	description	string	0..1	mCODE		Additional description of volume properties that are not captured in a structured way; e.g., how the volume was constructed with margins etc. For a short display name see identifier.
Volume Type	R2	morphology	CodeableConcept	0..1	mCODE	mCODE (extensible) http://hl7.org/fhir/us/mcode/ValueSet/mcode-radiotherapy-volume-type-vs	
Anatomic site	R2	location	CodeableConcept	0..1	mCODE	mCODE (required) http://hl7.org/fhir/us/mcode/ValueSet/mcode-radiotherapy-treatment-location-vs	*<HL7 CodeX RT submitted a finding to FHIR to extend this to support multiple anatomy codes per target.>*

Data Element	OPT	FHIR Element	FHIR Data Type	Card.	Must Support by	Binding Profile (strength) ValueSet	Comment
Anatomic site qualifier	R2	locationQualifier	CodeableConcept	0..*	mCODE	mCODE (extensible) http://hl7.org/fhir/us/mcode/ValueSet/mcode-radiotherapy-treatment-location-qualifier-vs	E.g., left, right

11.2.8 Planned Course

1215 For the resource profile Radiotherapy Planned Course, see directly the CodeX RT IG. The extensions and bindings are the same as documented above for the Radiotherapy Course Summary.

```
http://hl7.org/fhir/us/codex-radiation-therapy/STU1/StructureDefinition/codexrt-radiotherapy-planned-course
```

1220 Temporary url before release:

http://build.fhir.org/ig/HL7/codex-radiation-therapy/branches/master/StructureDefinition-codexrt-radiotherapy-planned-course.html

11.2.9 Planned Phase

1225 For the resource profile Radiotherapy Planned Phase, see directly the CodeX RT IG. The extensions and bindings are the same as documented above for Radiotherapy Treated Phase.

```
http://hl7.org/fhir/us/codex-radiation-therapy/STU1/StructureDefinition/codexrt-radiotherapy-planned-phase
```

1230 Temporary url before release:

http://build.fhir.org/ig/HL7/codex-radiation-therapy/branches/master/StructureDefinition-codexrt-radiotherapy-planned-phase.html

11.3 RO Value Sets

1235   All required Value Sets are defined in CodeX RT or the respective base profiles on which CodeX RT is based. *<To be defined where Value Sets from base profiles are not sufficient.>*

Appendices to Volume 3

Not applicable.

1240

Volume 4 – National Extensions

This supplement defines no National Extensions.

Supplement Only – Not added to Technical Framework

1245

The content of this part is temporarily added during development of the supplement. It is not expected to be added to the Technical Framework.

Appendix A – Sources for Sequence Diagrams

1250 This Appendix contains the sources for the sequence diagrams of Volumes 1 and 2.

The definitions can be copy pasted to https://sequencediagram.org/ to generate the figures.

Volume 1: Figure X.4.2.1.2-1: Process Flow Transfer End of Treatment Summary

1255

```
participant "Treatment Summary Provider" as TSP
participant "RO Resource Repository" as RRR
participant "Treatment Observer" as TO

opt #lightgray subscribe to change notifications
TO->RRR: Subscribe for Treatment Summary\nUpdates [XRTS-03]
end
activate TSP
TSP->TSP : Course completed
TSP->RRR : Provide or Update Treatment Summary [XRTS-01]\n(Course status
completed)
deactivate TSP
activate RRR
opt #lightgray update on change notification
RRR->TO: Notify of Treatment Summary\nUpdate [XRTS-04]
deactivate RRR
activate TO
TO->RRR : Retrieve Treatment Summary [XRTS-02]
deactivate TO
end
space
activate TO
TO->TO : Start creating\nEnd of Treatment\nSummary Note
opt update only when data is needed
TO->RRR : Retrieve Treatment Summary [XRTS-02]
end
deactivate TO
```

Volume 1: Figure X.4.2.2.2-1: Process Flow On Treatment Visit Monitoring of Treatment Progress

```
1285    participant "Treatment Summary Provider" as TSP
        participant "RO Resource Repository" as RRR
        participant "Treatment Observer" as TO

        opt #lightgray subscribe to change notifications
1290    TO->RRR: Subscribe for Treatment Summary\nUpdates [XRTS-03]
        end
        activate TSP
        loop update until course completed
        TSP->TSP : Treatment Session delivered
1295    TSP->RRR : Provide or Update Treatment Summary [XRTS-01]
        activate RRR
        opt #lightgray update on change notification
        RRR->TO: Notify of Treatment Summary\nUpdate [XRTS-04]
        deactivate RRR
1300    activate TO
        TO->RRR : Retrieve Treatment Summary [XRTS-02]
        deactivate TO
        end
        end
1305    deactivate TSP
        space
        activate TO
        TO->TO : Start creating\nNote
        opt update only when data is needed
1310    TO->RRR : Retrieve Treatment Summary [XRTS-02]
        end
        deactivate TO
```

Volume 2: Figure 3.Y1.1-1: XRTS-01

1315

```
Title Provide or Update Treatment Summary [XRTS-01] (1/2)

participant Treatment Summary Provider
participant Resource Repository
participant #green HIE Central Infrastructure
```

1320

```
group #lightgray Acquire Patient reference XRTS-01.a #black

Treatment Summary Provider ->Treatment Summary Provider : Patient registered
Treatment Summary Provider -> Resource Repository : GET [base]/Patient?<search-
```

1325

```
parameters>

alt Patient has been registered
Resource Repository -->Treatment Summary Provider : HTTP 200: Body: Patient
resource
```

1330

```
else Patient not found in RO Resource Repository
Resource Repository -->Treatment Summary Provider : HTTP 200: Body: Empty
Bundle, patient not found
Treatment Summary Provider ->HIE Central Infrastructure : GET
```

1335

```
[base]/Patient?<search-parameters>

alt HIE Infrastructure exists and patient found

HIE Central Infrastructure -->Treatment Summary Provider : HTTP 200: Body:
```

1340

```
Patient resource

Treatment Summary Provider ->Resource Repository: POST [base]/Patient Body:
{Patient: { link->other: URL(central patient), link->type: refers }}
Resource Repository -->Treatment Summary Provider: HTTP 201: Created
```

1345

```
else Patient centrally not found

HIE Central Infrastructure -->Treatment Summary Provider : HTTP 200: Body:
Empty Bundle, patient not found
```

1350

```
Treatment Summary Provider ->Resource Repository: POST [base]/Patient Body:
{Patient: { link: null }}
Resource Repository -->Treatment Summary Provider: HTTP 201: Created
end
```

1355

```
end // Patient not registered

Treatment Summary Provider ->Treatment Summary Provider : save FHIR Patient
reference internally for further use
end // group
```

1360

```
Treatment Summary Provider->Treatment Summary Provider: --**Detect 1st therapy
occasion of patient treatment of given Intent/Prescription
Treatment Summary Provider -->Treatment Summary Provider : fetch FHIR Patient
resource Reference
```

1365

```
group #lightgray Acquire BodyStructure references XRTS-01.b #black
loop for any BodyStructure required in Treatment Summary
```

```
Treatment Summary Provider -> Resource Repository : GET [base]/BodyStructure?
identifier=<volume unique identifier>
Resource Repository --> Treatment Summary Provider : --HTTP 200 : Body: {
Bundle { BodyStructure( identifier=<volume_id>, patient[pid] } }

Treatment Summary Provider -->Treatment Summary Provider : find in result
Bundle the matching BodyStructures relevant to Treatment Summary
opt if Volume has not been created
Treatment Summary Provider->Resource Repository: **Radiotherapy Volume:**\nPOST
[base]/BodyStructure Body: {BodyStructure { **identifier=<volume_id>**,
patient: [base]/Patient/<pid> } }
Resource Repository -->Treatment Summary Provider: HTTP 201: Created
end
end // for each BodyStructure
Treatment Summary Provider ->Treatment Summary Provider : save FHIR
BodyStructure reference(s) internally for further use
end // group

Title Provide or Update Treatment Summary [XRTS-01] (2/2)

participant Treatment Summary Provider
participant Resource Repository

group #lightgray Acquire Plan Summary (Planned Course and Planned Phase)
references XRTS-01.c #black
loop for any Planned Course and Planned face that will be referenced from
Course Summary and Treated Phase

Treatment Summary Provider -> Resource Repository : GET
[base]/ServiceRequest?identifier=<Planned Course or Planned Phase business
identifier>
Resource Repository --> Treatment Summary Provider : --HTTP 200 : Body: {
Bundle { ServiceRequest( identifier=<business identifier >,\npatient/[pid],
category=**http://snomed.info/sct|108290001** } }

Treatment Summary Provider -->Treatment Summary Provider : find matching
Planned Course or Planned Phase in result bundle
opt if the Planned Course or Planned Phase was not found
Treatment Summary Provider->Resource Repository: **Planned Course:**\nPOST
[base]/ServiceRequest Body: {ServiceRequest { **identifier=<Planned Course
business identifier>**,\npatient: [base]/Patient/<pid>,
code=**http://snomed.info/sct|1217123003**} }
Resource Repository -->Treatment Summary Provider: HTTP 201: Created
Treatment Summary Provider->Resource Repository: **Planned Phase:**\nPOST
[base]/ServiceRequest Body: {ServiceRequest { **identifier=<Planned Phase
```

```
business identifier>**,\npatient: [base]/Patient/<pid>,
code=**http://snomed.info/sct|1222565005**} }
Resource Repository -->Treatment Summary Provider: HTTP 201: Created
end
Treatment Summary Provider ->Treatment Summary Provider : save FHIR
ServiceRequest reference(s) internally for further use
end // for each Planned Course and Planned Phase
end // group

Treatment Summary Provider->Resource Repository: **Create Course
Summary:**\nPOST [base]/Procedure Body: {Procedure { subject:
[base]/Patient/<pid>,\ncode=**http://snomed.info/sct|1217123003**,\nbasedOn=/Se
rviceRequest/[course_plan_id]/_history/<v_id>}} }

Resource Repository-->Treatment Summary Provider: --HTTP 201 Headers: Location:
[base]/Procedure/[id_course]/_history/<v_id>

Treatment Summary Provider->Resource Repository: **Create Treated
Phase:**\nPOST [base]/Procedure Body: {Procedure { subject:
[base]/Patient/<pid>,\ncode=**http://snomed.info/sct|1222565005**,
partOf=/Procedure/[id_course]/_history/<v_id>,\nbasedOn=/ServiceRequest/[phase_
plan_id]/_history/<v_id>} }

Resource Repository-->Treatment Summary Provider: --HTTP 201 Headers: Location:
[base]/Procedure/[id_phase]/_history/<v_id>

Treatment Summary Provider ->Treatment Summary Provider : save FHIR Procedure
reference(s) internally for further use

Treatment Summary Provider->Treatment Summary Provider: --**Detect N-th therapy
occasion of patient treatment of given Intent/Prescription

Treatment Summary Provider->Treatment Summary Provider: recalculate summary
data

Treatment Summary Provider->Resource Repository: **Update Course
Summary:**\nPUT [base]/Procedure/[id_course] Body: {Procedure { subject:
[base]/Patient/<pid>,\ncode=**http://snomed.info/sct|1217123003**,\nbasedOn=/Se
rviceRequest/[course_plan_id]/_history/<v_id>}} }

Resource Repository-->Treatment Summary Provider: --HTTP 200 Headers: Location:
[base]/Procedure/[id_course]/_history/<v_id>

Treatment Summary Provider->Resource Repository: **Update Treated Phase:**\nPUT
[base]/Procedure/[id_phase] Body: {Procedure { subject:
[base]/Patient/<pid>,\ncode=**http://snomed.info/sct|1222565005**,
partOf=/Procedure/[id_course]/_history/<v_id>,\nbasedOn=/ServiceRequest/[phase_
plan_id]/_history/<v_id>} }

Resource Repository-->Treatment Summary Provider: --HTTP 200 Headers: Location:
[base]/Procedure/[id_phase]/_history/<v_id>
```

Volume 2: Figure 3.Y2.1-1: XRTS-02

```
Title Retrieve Treatment Summary [XRTS-02]

participant Treatment Observer
participant Resource Repository

group Handle request for Treatment Summary status for a Patient

group #lightgray Patient reference acquisition #black

Treatment Observer -> Resource Repository :  GET [base]/Patient?<search-
parameters> or POST /_search?
Resource Repository ->Resource Repository : exact match of search parameters
Resource Repository -->Treatment Observer : --HTTP 200 : Body: {Bundle {
total:1,  [ resourceType:Patient, id:[id]  } }
end // group

alt Search for both Course Summaries and Treated Phases
Treatment Observer->Resource Repository: GET
[base]/Procedure?**category**=http://snomed.info/sct|108290001&subject:Patient/
[id] or POST /_search?
else Search for Course summaries
Treatment Observer->Resource Repository: GET
[base]/Procedure?**code**=http://snomed.info/sct|1217123003&subject:Patient/[id
] or POST /_search?

else Search for Radiotherapy Phase  summaries
Treatment Observer->Resource Repository: GET
[base]/Procedure?**code**=http://snomed.info/sct|1222565005&subject:Patient/[id
] or POST /_search?

end
Resource Repository-->Treatment Observer: --HTTP 200 : Body: {Bundle { [
Procedure[i].meta.versionId: vN  } }

Treatment Observer ->Treatment Observer: Select one or multiple Treatment
Summaries in the returned bundle from Patient query response and cache their
resource id:s [id]

end //group

group Handle request for Treatment Summary current version of selected
Treatment Course or Phase

Treatment Observer->Resource Repository: Fetch current version of the Treatment
Summary\n\n--GET [base]/Procedure/[id]
Resource Repository-->Treatment Observer: --HTTP 200 : Body: { Procedure/[id] }

group Retrieve referenced Radiotherapy Volumes
Treatment Observer->Resource Repository: --GET [base]/BodyStructure/<volume_id>
- for each reference in Procedure resource
Resource Repository-->Treatment Observer: --HTTP 200 : Body: {BodyStructure}
end //group
```

1520
```
group Retrieve referenced Treatment Plans
Treatment Observer->Resource Repository: --GET
[base]/ServiceRequest/<plan_id>/<v_id> - for basedOn reference in Procedure
resource
Resource Repository-->Treatment Observer: --HTTP 200 : Body: {ServiceRequest}
```
1525
```
end //group

end //group

group Handle request for treatment progress history
```
1530
```
Treatment Observer->Resource Repository: GET [base]/Procedure/[id]/_history
Resource Repository-->Treatment Observer: --HTTP 200 : Body: {Bundle { [
Procedure[1..N]  } }
```
1535
```
end // group
```

Volume 2: Figure 3.Y3.4-1: XRTS-03

1540
```
Title Subscribe for Treatment Summary Updates [XRTS-03]

participant Treatment Observer
participant Resource Repository

alt Subscription to be notified without payload
```
1545
```
Treatment Observer -> Resource Repository: POST [base]/Subscription Body:
{Subscription: \n{ criteria :
Procedure?**category**=http://snomed.info/sct|108290001 \n  channel: { type:
rest-hook, **endpoint:** <endpoint-uri>} }
```
1550
```
else Subscription to be notified with payload

Treatment Observer -> Resource Repository:POST [base]/Subscription Body:
{Subscription: \n{ criteria :
```
1555
```
Procedure?**category**=http://snomed.info/sct|108290001 \n  channel: { type:
rest-hook, **endpoint:** <endpoint-uri>, **payload**: application/fhir+json} }

end
```
1560
```
Resource Repository -->Resource Repository : Create subscription resource

Resource Repository-->Treatment Observer: Subscription creation acknowledgment
--HTTP 201 : Body: { Subscription([id]) status: active }
```
1565
```
Treatment Observer -->Treatment Observer : save subscription Id for query of
subscription status or un-subscribe
```

1570   Volume 2: Figure 3.Y4.4-1: XRTS-04

```
Title Notify of Treatment Summary Update [XRTS-04]

Resource Repository -->Resource Repository: processes XRTS-01 from Treatment
Summary Provider \n and finds matching subscription

alt Subscription to be notified without payload

Resource Repository ->Treatment Observer : POST <endpoint-uri-
base/**criteria**> Body: empty } }
Treatment Observer ->Resource Repository: XRTS-02 with &_lastUpdate=:last
parameter

Treatment Observer-->Treatment Observer: update :last locally

else Subscription to be notified with payload
Resource Repository ->Treatment Observer : PUT <endpoint-uri-
base/**Procedure/<resource_id>** Body: Procedure } }
Treatment Observer-->Treatment Observer: manage the resource locally
end
```