

**Integrating the Healthcare Enterprise**



**IHE Radiation Oncology  
Technical Framework Supplement**

**Treatment Delivery Workflow (TDW)**

**Draft for Trial Implementation**

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## Foreword

This is a supplement to the IHE Radiation Oncology Technical Framework V2.2. Each supplement undergoes a process of public comment and trial implementation before being incorporated into the volumes of the Technical Frameworks.

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

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

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

General information about IHE can be found at: [www.ihe.net](http://www.ihe.net)

Information about the IHE Radiation Oncology may be found at:  
<http://www.ihe.net/Domains/index.cfm>

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

The current version of the IHE Technical Framework can be found at:  
[http://www.ihe.net/Technical\\_Framework/index.cfm](http://www.ihe.net/Technical_Framework/index.cfm)

## CONTENTS

Introduction.....	5
Profile Abstract .....	5
Open Issues and Questions .....	5
Closed Issues.....	5
Volume 1 – Integration Profiles.....	6
1.7 History of Annual Changes.....	6
1.n Copyright Permission.....	6
2.1 Dependencies among Integration Profiles .....	6
2.2.X Treatment Delivery Workflow Integration Profile.....	6
X Treatment Delivery Workflow Integration Profile .....	6
Treatment Completion.....	8
Profile Preconditions .....	8
X.1 Actors/ Transactions.....	8
X.2 Treatment Delivery Workflow Integration Profile Options .....	10
X.3 Treatment Delivery Workflow Process Flow.....	11
Treatment Completion.....	11
Profile Preconditions .....	12
X.4 Treatment Delivery Workflow Security Considerations.....	12
<Appendix A> Actor Summary Definitions.....	12
<Appendix B> Transaction Summary Definitions .....	12
Glossary .....	15
Volume 2 - Transactions .....	16
Y.1 TDW-RO-1: Worklist Query for Treatment Delivery.....	16
Y.1.1 Scope.....	16
Y.1.2 Use Case Roles .....	16
Y.1.3 Referenced Standards.....	17
Y.1.4 Interaction Diagram .....	17
Y.2 TDW-RO-2: Retrieve Static Treatment Delivery Input Instances from TMS .....	22
Y.2.1 Scope.....	22
Y.2.2 Use Case Roles .....	22
Y.2.3 Referenced Standards.....	22
Y.2.4 Interaction Diagram .....	23
Y.3 TDW-RO-3: Treatment Delivery in Progress .....	25
Y.3.1 Scope.....	25
Y.3.2 Use Case Roles .....	25
Y.3.3 Referenced Standards.....	25
Y.3.4 Interaction Diagram .....	26
Y.4 TDW-RO-4: Retrieve Dynamic Treatment Delivery Input Instances from TMS.....	27
Y.4.1 Scope.....	27
Y.4.2 Use Case Roles .....	27
Y.4.3 Referenced Standards.....	27
Y.4.4 Interaction Diagram .....	28
Y.5 TDW-RO-5: Treatment Delivery Progress Update .....	30
Y.5.1 Scope.....	30
Y.5.2 Use Case Roles .....	30

Y.5.3	Referenced Standards.....	30
Y.5.4	Interaction Diagram .....	31
Y.6	TDW-RO-6: Store Treatment Delivery Results to TMS.....	34
Y.6.1	Scope.....	34
Y.6.2	Use Case Roles .....	34
Y.6.3	Referenced Standards.....	34
Y.6.4	Interaction Diagram .....	35
Y.7	TDW-RO-7: Treatment Delivery Final Update .....	37
Y.7.1	Scope.....	37
Y.7.2	Use Case Roles .....	37
Y.7.3	Referenced Standards.....	38
Y.7.4	Interaction Diagram .....	38
Y.8	TDW-RO-8: Treatment Delivery Completed/Canceled.....	43
Y.8.1	Scope.....	43
Y.8.2	Use Case Roles .....	43
Y.8.3	Referenced Standards.....	43
Y.8.4	Interaction Diagram .....	44

## Introduction

This supplement defines the Treatment Delivery Workflow Profile (TDW). It adds information to Volumes 1 and 2 and the IHE Radiation Oncology Technical Frameworks to describe the profile and define the actors and transactions that are present in the profile.

## Profile Abstract

In this profile a single system, a Treatment Delivery Device (TDD) acquires delivery information from a Treatment Management System (TMS), and performs a treatment delivery using internal verification (see DICOM Supplement 74). Other optional activities such as verification image acquisition, registration, and patient positioning may be performed by this TDD, but these are not explicitly scheduled in this profile.

## Open Issues and Questions

*< List of open issues/ questions that need to be addressed prior to publishing of the Technical Framework >*

## Closed Issues

*< List of closed issues/ questions with their resolutions that have been addressed prior to publishing of the Technical Framework >*

# Volume 1 – Integration Profiles

## 1.7 History of Annual Changes

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

- **Treatment Delivery Workflow Profile:** In this profile a single system, a Treatment Delivery Device (TDD) acquires delivery information from a Treatment Management System (TMS), and performs a treatment delivery using internal verification (see DICOM Supplement 74). Other optional activities such as verification image acquisition, registration, and patient positioning may be performed by this TDD, but these are not explicitly scheduled in this profile.

## 1.n Copyright Permission

<Add information on any standards referenced in the profile that are not already addressed in the permission section.>

*Add the following to sections 1.n:*

## 2.1 Dependencies among Integration Profiles

*Add the following to Table 2-1*

<Profile Name>	<?>	<?>	<->
----------------	-----	-----	-----

*Add the following section to section 2.2*

### 2.2.X Treatment Delivery Workflow Integration Profile

The Treatment Delivery Workflow integration profile involves the flow of DICOM data necessary for treatment delivery between Treatment Management System (TMS) actors and Treatment Delivery Devices (TDDs). This profile grew out of work on the Integrated Positioning and Delivery Profile, where implementation was found to specify too many required elements for some delivery devices. A number of delivery machines either do not handle positioning interactions at all, or they are not externalized in significant or easily modifiable ways. This profile handles the interaction in workflow when the delivery device is largely only concerned with delivery scheduling.

*Add Section X*

## X Treatment Delivery Workflow Integration Profile

The Treatment Delivery Workflow integration profile involves the flow of DICOM data necessary for treatment delivery between Treatment Management System (TMS) actors and Treatment Delivery Devices (TDDs). This profile grew out of work on the Integrated Positioning

and Delivery Profile, where implementation was found to specify too many required elements for some delivery devices. A number of delivery machines either do not handle positioning interactions at all, or they are not externalized in significant or easily modifiable ways. This profile handles the interaction in workflow when the delivery device is largely only concerned with delivery scheduling.

The intention is to develop a progression of profiles that will implement workflow features in radiation oncology. The intended sequence of development for these profiles is as follows:

- **Phase 1:** Scheduled workflow for integrated patient positioning and delivery, treatment delivery, and discrete patient positioning and delivery.
- **Phase 2:** Scheduled workflow for remaining procedure step types in radiation oncology. These steps may include items such as simulation, planning, plan review, and treatment review, as well as other modes of positioning and delivery. At this stage, the profile will then cover the vast majority of cases in radiation therapy, and enable charge capture by the Treatment Management System or billing system.

Managed Workflow can be used to support a number of other common use case scenarios currently relevant in the clinic. For example, if a number of fractions are delivered, then subsequently the stored registration images and position registration results can be transmitted from the archive to a treatment planning system (TPS). The TPS could then correlate the images, deform the original structures onto the new 3D datasets, recalculate the doses to PTVs and organs at risk, and evaluate a potential need for replanning. These operations can be initiated by non-managed transfer of necessary data using Storage or Query/Retrieve, but ultimately the goal is to manage all departmental activities using Managed Workflow.

- **Phase 3:** ADT (admission, discharge, and transfer) support. This profile will enable a Treatment Management System to acquire patient demographic information from a Hospital Information System (via the HL7 protocol), based upon existing IHE patient registration profiles. This functionality has already been implemented in some commercially available products and this phase may potentially be combined with Phase 2.
- **Phase 4:** Non-managed workflow. Special cases such as emergency treatments may result in performed procedures that have no corresponding Unified Procedure Step. This profile will be concerned with updating the Treatment Management System to take this into account, so that the performed items are then recorded and billed through the normal processes. This phase may require the RT Course IOD being developed as part of DICOM WG7 work on second-generation RT objects.
- **Phase 5:** Partially-managed workflow and media archive. This profile will support situations where some procedures (e.g. CT acquisition and an initial plan) have not been performed under managed workflow, but the output objects from those procedures are introduced into the workflow environment via media archive. It will also support generation of media archives. This phase may require the RT Course IOD being developed as part of DICOM WG7 work on second-generation RT objects. *<Introductory Description/overview of Integration Profile. May be the same as 2.2.X if that's all it takes.>*

## Treatment Completion

An important use case associated with treatment delivery is that of treatment completion following a delivery interruption.

- If the delivery interruption is of a transient nature (e.g. a temporary issue with the delivery machine, or a patient position issue caused temporary interruption of the delivery), then the Performing Device may choose to manage the completion internally, and notify the TMS that the UPS has finally completed normally.
- If the delivery interruption leads to the UPS being moved to the ‘CANCELED’ state, this requires that a new UPS be scheduled (for example, if the completion requires replanning, or needs to be performed in a different time slot). The TMS shall then manage the new UPS, specify a Text Value of ‘CONTINUATION’ in the Scheduled Processing Parameters Sequence when returning a query result, and supply the Start Meterset of the continuation treatment in the Delivery Instruction.

## Profile Preconditions

The Treatment Delivery Workflow profile requires that the Treatment Management System (TMS) has previously received any information needed to effectively respond to queries issued by the Performing Devices that is not generated by the TMS itself. In particular, the TMS must know the SOP Instance UIDs of SOP Instances (such as an RT Plan instance) to be supplied in the Input Information Sequence. It is a precondition of the query transactions that such information has been supplied to the TMS where necessary. For this profile, such information is assumed to have been communicated in a way not covered by the profile. In future profiles, previously executed managed workflow steps will be used to communicate such data.

## X.1 Actors/ Transactions

The Treatment Delivery Workflow Profile involves the following activity:

- The Treatment Delivery Device (TDD) delivers the intended treatment. It may optionally perform other unscheduled activities such as verification image acquisition, registration, and positioning, but is not required to do so.

Figure 0-1 shows the Actors and Transactions involved in this profile.

**Figure 0-1 IHE Treatment Delivery Workflow Integration Profile**

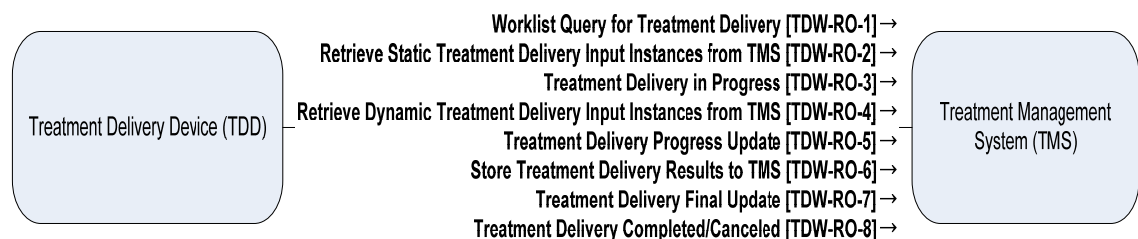




Table X.1-1 lists the transactions for each actor directly involved in the Treatment Delivery Workflow Profile. In order to claim support of this Integration Profile, an implementation must perform the required transactions (labeled “R”). Transactions labeled “O” are optional. A complete list of options defined by this Integration Profile and that implementations may choose to support is listed in Volume I, Section X.2.

**Table X.1-1. Treatment Delivery Workflow Integration Profile - Actors and Transactions**

Actors	Transactions	Optionality for Treatment Delivery Workflow Profile	Volume II section
<b>Treatment Management System (TMS)</b>	TDW-RO-1 Worklist Query for Treatment Delivery	R	Y.1
	TDW-RO-2 Retrieve Static Treatment Delivery Input Instances from TMS	R	Y.2
	TDW-RO-3 Treatment Delivery in Progress	R	Y.3
	TDW-RO-4 Retrieve Dynamic Treatment Delivery Input Instances from TMS	R	Y.4
	TDW-RO-5 Treatment Delivery Progress Update	R	Y.5
	TDW-RO-6 Store Treatment Delivery Results to TMS	R	Y.6
	TDW-RO-7 Treatment Delivery Final Update	R	Y.7
	TDW-RO-8 Treatment Delivery Completed/Canceled	R	Y.8
<b>Treatment Delivery Device (TDD)</b>	TDW-RO-1 Worklist Query for Treatment Delivery	R	Y.1
	TDW-RO-2 Retrieve Static Treatment Delivery Input Instances from TMS	R	Y.2
	TDW-RO-3 Treatment Delivery in Progress	R	Y.3
	TDW-RO-4 Retrieve Dynamic Treatment Delivery Input Instances from TMS	R	Y.4
	TDW-RO-5 Treatment Delivery Progress Update	R	Y.5

Actors	Transactions	Optionality for Treatment Delivery Workflow Profile	Volume II section
	TDW-RO-6 Store Treatment Delivery Results to TMS	R	Y.6
	TDW-RO-7 Treatment Delivery Final Update	R	Y.7
	TDW-RO-8 Treatment Delivery Completed/Canceled	R	Y.8

The following table illustrates the SOP Classes implemented by the above actors relative to PS3.17 Table Z.1-1 of DICOM Supplement 96. Note that the TMS is not required to support UPS Push, UPS Watch, or UPS Event for these profiles.

**Table X.1-2 SOP Classes for Workflow Actors**

SOP Classes	SCU				SCP			
	UPS Push	UPS Watch	UPS Event	UPS Pull	UPS Push	UPS Watch	UPS Event	UPS Pull
Worklist SCPs								
Worklist Manager: <b>TMS</b>								<b>X</b>
Performing SCUs								
Pull Performer: <b>TDD</b>				<b>X</b>				

## X.2 Treatment Delivery Workflow Integration Profile Options

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

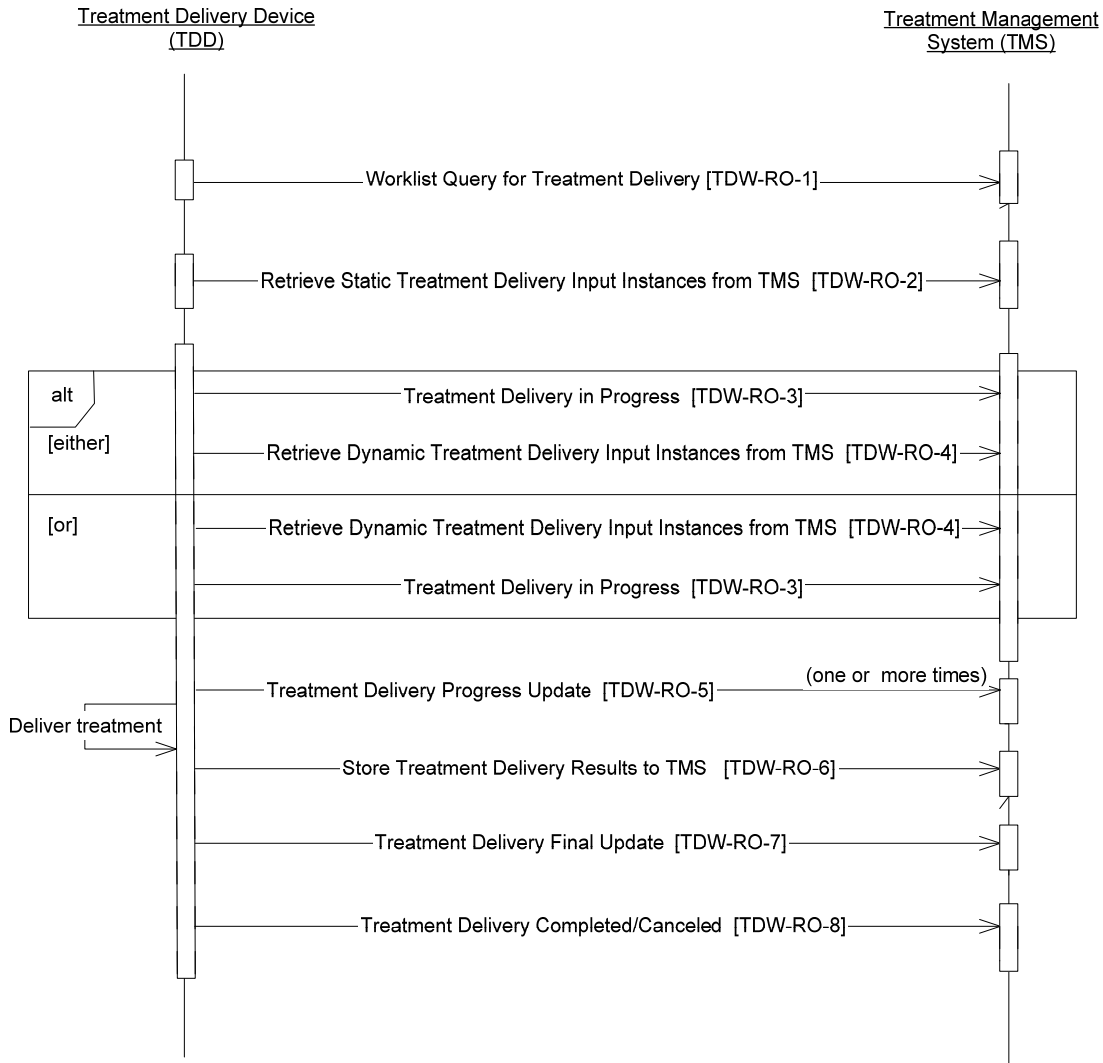
**Table X.2-1 Treatment Delivery Workflow - Actors and Options**

Actor	Options	Vol & Section
Treatment Delivery Device	<i>No options defined</i>	--
Treatment Management System	<i>No options defined</i>	--

## X.3 Treatment Delivery Workflow Process Flow

The process flow for the Treatment Delivery Workflow Integration Profile is shown in Figure X.3-1

**Figure X.3-1 IHE Treatment Delivery Workflow Integration Profile**



Note from Figure 0-1 above, transactions TDW-RO-3 and TDW-RO-4 may be performed in either order, as decided by the Treatment Delivery Device (TDD). One or other (but not both) of these options must be taken.

### Treatment Completion

An important use case associated with treatment delivery is that of treatment completion following a delivery interruption. See the Treatment Completion section in the introduction to this profile for a description of how treatment completion is handled in this profile.

## Profile Preconditions

This profile requires that the Treatment Management System (TMS) has previously received any information needed to effectively respond to queries issued by the Performing Devices that is not generated by the TMS itself. See the Profile Preconditions section in the introduction to this profile for a description of profile preconditions in this profile..

## X.4 Treatment Delivery Workflow Security Considerations

*<Description of the Profile specific security considerations. This should include the outcomes of a risk assessment. This likely will include profile groupings, and residual risks that need to be assigned to the product design, system administration, or policy.>*

## <Appendix A> Actor Summary Definitions

**Treatment Delivery Device (TDD)** – A system that delivers therapeutic radiation to a correctly positioned patient. It may perform other functions such as verification image acquisition, registration, and positioning, but is not required to do so. The TDD fulfills the role of a UPS-Pull ‘Pull Performer’ SCU as described in DICOM Supplement 96 Part 17 Table Z.1-1. Note that the TDD actors in other IHE-RO profiles have functionality that is different from that described in this profile.

**Treatment Management System (TMS)** – An information system that manages oncology information and is responsible for the scheduling of radiotherapy activities (i.e. is a workflow manager). The TMS fulfills the role of a UPS-Pull ‘Worklist Manager’ SCP as described in DICOM Supplement 96 Part 17 Table Z.1-1. Note that in this profile the TMS fulfills the role of an Archive for the data objects, in which case the supplied AE Title in Input and Output Sequences is an AE Title managed by the TMS. Note that the TMS actors in other IHE-RO profiles have functionality that is different from that described in this profile.

## <Appendix B> Transaction Summary Definitions

### TDW-RO-1: Worklist Query for Treatment Delivery

A TDD requests and receives a treatment delivery worklist from a TMS.

### TDW-RO-2: Retrieve Static Treatment Delivery Input Instances from TMS

A TDD requests and receives from the TMS any ‘static’ SOP Class Instances required for performing desired procedure steps returned by a previous query. Each SOP instance must have been supplied in the Input Information Sequence of one or more of the returned worklist items. These instances are of a persistent nature, specifically the RT Plan input instance.

### TDW-RO-3: Treatment Delivery in Progress

A TDD signals to the TMS that responsibility has been taken for the performing of the selected work item.

#### **TDW-RO-4: Retrieve Dynamic Treatment Delivery Input Instances from TMS**

A TDD requests and receives requests and receives SOP Class instances from the TMS, in order to support execution of the requested work item. These requested instances are of a “transient” nature, specifically the RT Beams Delivery Instruction. Note that this transaction shall be present either before or after TDW-RO-3, but not both.

#### **TDW-RO-5: Treatment Delivery Progress Update**

A TDD signals to the TMS changes in the progress of the work item that is currently in progress. This transaction may occur more than once in this profile, as the delivery status changes.

#### **TDW-RO-6: Store Treatment Delivery Results to TMS**

When a workitem has been completed by a TDD, the results of the workitem are stored to the TMS. These results may subsequently be referenced in the Output Information Sequence of the corresponding Unified Procedure Step.

#### **TDW-RO-7: Treatment Delivery Final Update**

A TDD signals to the TMS changes in the properties of the work item that is currently in progress, prior to the UPS being signaled as completed or canceled.

#### **TDW-RO-8: Treatment Delivery Completed/Canceled**

A TDD signals to the TMS that the selected work item has either been completed or canceled.

The following table (**Table 0-1**) shows which transactions are used in which Integration Profiles.

**Table 0-1 IHE-RO Profile Transactions**

<b>Transactions</b>	<b>Treatment Delivery Workflow</b>
TDW-RO-1 Worklist Query for Treatment Delivery	X
TDW-RO-2 Retrieve Static Treatment Delivery Input Instances from TMS	X
TDW-RO-3 Treatment Delivery in Progress	X
TDW-RO-4 Retrieve Dynamic Treatment Delivery Input Instances from TMS	X
TDW-RO-5 Treatment Delivery Progress Update	X
TDW-RO-6 Store Treatment Delivery Results to TMS	X
TDW-RO-7 Treatment Delivery Final Update	X
TDW-RO-8 Treatment Delivery Completed/Canceled	X

## Glossary

*Add the following terms to the Glossary:*

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

# Volume 2 - Transactions

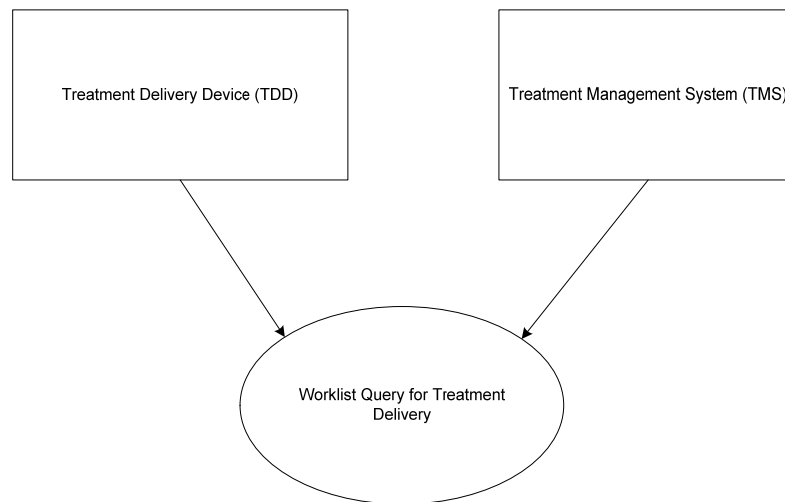
Add section Y

## Y.1 TDW-RO-1: Worklist Query for Treatment Delivery

### Y.1.1 Scope

In the Worklist Query for Treatment Delivery transaction, a TDD requests and receives a treatment delivery worklist from a TMS.

### Y.1.2 Use Case Roles



**Actor:** *Treatment Management System*

**Role:** Responds to a worklist query and send a scheduled treatment delivery worklist to a *TDD*.

**Actor:** *Treatment Delivery Device ('Performing Device')*

**Role:** Queries a *TMS* and receives a scheduled treatment delivery worklist.

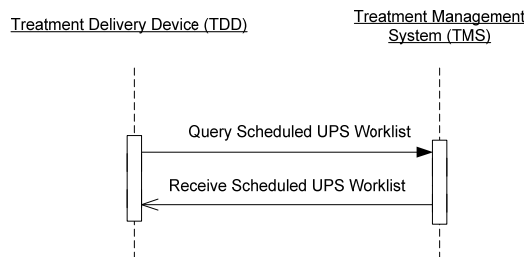


### Y.1.3 Referenced Standards

DICOM Supplement 74 (Frozen Draft): Utilization of Worklist in Radiotherapy Treatment Delivery

DICOM Supplement 96: Unified Worklist and Procedure Step

### Y.1.4 Interaction Diagram



#### Y.1.4.1 Query Scheduled UPS Worklist Message

This is the worklist query message sent to the Treatment Management System.

##### Y.1.4.1.1 Trigger Events

The user of the TDD, in order to deliver a treatment, requests that the TMS send a scheduled treatment delivery worklist.

##### Y.1.4.1.2 Message Semantics

The Performing Device uses the C-FIND request of the DICOM Unified Procedure Step – Pull SOP Class to query the worklist from the TMS. The Performing Device performs the SCU role, and the TMS performs the SCP role. Note that the UPS-Pull SOP Class is negotiated as the abstract transfer syntax, and used as the Affected SOP Class in the C-FIND request (see DICOM Supplement 96, Part 4, Section F.X.3.8.1.2.1).

##### Y.1.4.1.2.1 Matching Keys and Return Keys for Display

In the query to the TMS, the Performing Device (SCU) is required to query for matching on the attributes as shown in the 'Query Keys Matching' SCU column in Table 1-1 Worklist Query for Treatment Delivery. The SCP is required to return the values for these keys. All other potential query keys may be optionally supplied as described in DICOM Supplement 96. It is anticipated that Patient's Name (0010,0010), Patient ID (0010,0020), and Scheduled Station Name Code Sequence (0040,4025) would be optional matching query key attributes that would be commonly supplied.

In the query to the TMS, the Performing Device (SCU) is required to query for return on the attributes as shown in the 'Query Keys Return' SCU column in Table 1-1 Worklist Query for Treatment. The SCP is required to return the values for these keys. All other potential return keys may be optionally supplied as described in DICOM Supplement 96.

**Table 1-1 Worklist Query for Treatment Delivery**

Attribute Name	Tag	Query Keys Matching		Query Keys Return	
		SCU	SCP	SCU	SCP
Specific Character Set	(0008,0005)	-	-	O*	RC
SOP Class UID	(0008,1016)	-	-	O*	R
SOP Instance UID	(0008,0018)	-	-	O*	R
Unified Procedure Step State	(0074,1000)	R+* (Note 1)	R	-	-
Procedure Step Label	(0074,1204)	-	-	R+	R+
Scheduled Station Name Code Sequence	(0040,4025)				
>Code Value	(0008,0100)	O+* (Note 2)	R	R+*	R
>Coding Scheme Designator	(0008,0102)	O+* (Note 3)	R	R+*	R
>Code Meaning	(0008,0104)	-	-	R+	R (Note 4)
Scheduled Procedure Step Start Date and Time	(0040,4005)	R+* (Note 5)	R	-	-
Scheduled Workitem Code Sequence	(0040,4018)	R+* (Note 6)	R	-	-
>Code Value	(0008,0100)	R+*	R	-	-
>Coding Scheme Designator	(0008,0102)	R+*	R	-	-
>Code Meaning	(0008,0104)	-	-	O	R
Scheduled Processing Parameters Sequence	(0074,1210)	-	-	R+* (Note 7)	R
Input Information Sequence	(0040,4021)	-	-	R+*	R+ (Note 8)
Study Instance UID	(0020,000D)	-	-	R+*	R+ (Note 9)
Patient's Name	(0010,0010)	O	R	R+	R
Patient ID	(0010,0020)	O	R	R+	R
All other attributes	As described in DICOM Supplement 96				

**Note 1:** A Unified Procedure Step State of 'SCHEDULED' shall be supplied.

**Note 2:** Code Value for the Scheduled Station Name shall contain the string used to definitively match the Performing Device instance with its representation on the TMS. It is not necessarily human-readable.

**Note 3:** Coding Scheme Designator for the Scheduled Station Name is a private coding scheme, and is not used explicitly in this profile.

**Note 4:** Coding Meaning for the Scheduled Station Name shall contain the human-readable description of the Station Name, and shall be displayed on the Performing Device. Note that this attribute is required by IHE-RO in this profile, but is not required in DICOM Supplement 96.

**Note 5:** A 'reasonable' date time range (such as the rest of the current day) shall be supplied to limit the size of the returned result set. If operating in a mode where the patient is selected on the TMS, the TMS is permitted to over-filter the result set based upon this selection and return just the worklist items for the selected fraction.

**Note 6:** Scheduled Workitem Code Sequence (0040,4018) Code Value shall be supplied with a equal to '121726' (RT Treatment with Internal Verification), and Coding Scheme Designator shall be equal to 'DCM'.

**Note 7:** Scheduled Processing Parameters Sequence shall be specified as an empty (null) sequence

**Note 8:** Input Information Sequence shall contain all the input objects that will ultimately be needed to perform the specified procedure step, and no others. This allows the Performing Device to determine whether or not the instances are available prior to starting the procedure, and avoids the need for an additional N-GET on the UPS. If the Performing Device considers that the Input Information Sequence contains inadequate or inconsistent information, then it shall address any such inconsistencies in a safe manner before performing the Requested Procedure.

**Note 9:** Study Instance UID must be supplied by the TMS (SCP) if performance of the procedure step is expected to create composite SOP Instances as output. The supplied Study Instance shall be used by the SCU in creation of such SOP Instances (see transaction TDW-RO-6: Store Treatment Delivery Results to TMS).

In the query to the TMS, the Performing Device (SCU) is required to query for matching on the attributes shown as “R”, “R+” or “R+\*” in the ‘Query Keys Matching SCU’ column in Table 1-1 Worklist Query for Treatment Delivery. All other potential query keys may be optionally supplied as described in DICOM Supplement 96. It is anticipated that Patient’s Name (0010,0010), Patient ID (0010,0020), and Scheduled Station Name Code Sequence (0040,4025) would be optional matching query key attributes that would be commonly supplied.

In the query to the TMS, the Performing Device (SCU) is required to supply return keys within the Scheduled Processing Parameters Sequence as shown in “Query Keys Return SCP” column of **Error! Reference source not found.** All other potential return keys for display may be optionally supplied as described in DICOM Supplement 96. The SCU is NOT required to display items marked with an asterisk.

**Table 1-2 Required Query Keys Returned within the Scheduled Processing Parameters Sequence**

Attribute Name	Tag	Query Keys Return
		SCP
Scheduled Processing Parameters Sequence	(0074,1210)	
>Value Type	(0040,A040)	R+* (Note 1)
>Concept Name Code Sequence	(0040,A043)	R+*
>>Code Value	(0008,0100)	R+* (Note 2)
>>Coding Scheme Designator	(0008,0102)	R+* (Note 3)
>>Code Meaning	(0008,0104)	R+* (Note 4)
>Text Value	(0040,A160)	R+ (Note 5)

**Note 1:** A Value Type of ‘TEXT’ shall be supplied.

**Note 2:** Code Value supplied for the Concept Name Code Sequence shall be ‘2008001’.

**Note 3:** Coding Scheme Designator supplied for the Concept Name Code Sequence shall be ‘99IHERO2008’.

**Note 4:** Code Meaning supplied for the Concept Name Code Sequence shall be ‘Treatment Delivery Type’.

**Note 5:** A Text Value of ‘CONTINUATION’ shall be supplied for scheduled treatment delivery procedures that complete a previously interrupted UPS (that ended in the ‘CANCELED’ state). Otherwise, a Text Value of ‘TREATMENT’ shall be supplied.

The TMS replies to the query with a set of zero or more UPS C-FIND responses containing scheduled treatment delivery worklist items, followed by a C-FIND final response.

#### **Y.1.4.1.3 Expected Actions**

The TMS retrieves the matching scheduled procedures, and sends the DICOM UPS Worklist responses to the requesting Performing Device.

#### **Y.1.4.2 Receive Scheduled UPS Worklist Message**

This is the message that the TMS sends to the Performing Device as a reply containing DICOM UPS information.

For the Worklist Query for Treatment Delivery transaction exactly one Unified Procedure Step (UPS C-FIND response in the ‘pending’ state) shall be returned for each matching treatment session. For each response:

- Scheduled Workitem Code Sequence (0040,4018) Code Value shall be equal to ‘121726’ (RT Treatment with Internal Verification), and Coding Scheme Designator shall be equal to ‘DCM’. The Input Information Sequence (0040,4021) shall contain reference to at least the following items (additional items may be supplied for continuation procedures or other reasons, but are not required):
  1. The RT Plan SOP Instance to be delivered. Its specified location shall be an AE Title managed by the TMS (i.e. composing part of the TMS Actor). This AE Title may be different from the AE Title responding to the initial workflow query (C-FIND request) described by the current transaction. The AE Title specified for the RT Plan SOP Instance item in the Input Information Sequence shall be the same for C-FIND responses across all queries.
  2. An RT Beams Delivery Instruction SOP Instance. Its specified location shall be an AE Title managed by the TMS (i.e. composing part of the TMS Actor). This AE Title may be different from the AE Title responding to the initial workflow query (C-FIND request) described by the current transaction. The AE Title specified for the RT Beams Delivery Instruction SOP Instance item in the Input Information Sequence shall be the same for C-FIND responses across all queries.

There shall be a maximum of two AE Titles in the TMS Actor, i.e. the AE Titles for the RT Plan SOP instance and the RT Beams Delivery Instruction SOP instance shall not both be different from the C-FIND AE title unless they are the same as each other.

Any additional items present but not required by this profile (such as treatment records) shall specify the same AE Title as that specified for the RT Plan SOP Instance.

- As stated in Note 5 of Table 1-2, the Scheduled Processing Parameters Sequence (0074,1210) shall contain a Text Value (0040,A160) of ‘CONTINUATION’ for scheduled treatment delivery procedures that complete a previously interrupted UPS (that ended in the ‘CANCELED’ state), and a Text Value of ‘TREATMENT’ otherwise. The same value shall be encoded in the Treatment Delivery Type (300A,00CE) attribute of the RT Beams Delivery Instruction instance referenced in the Input Information Sequence of the UPS response item.

In the case of a ‘CONTINUATION’, the attributes describing the continuation as documented in DICOM Supplement 74 shall also be present. This change proposal specifies that in the case of

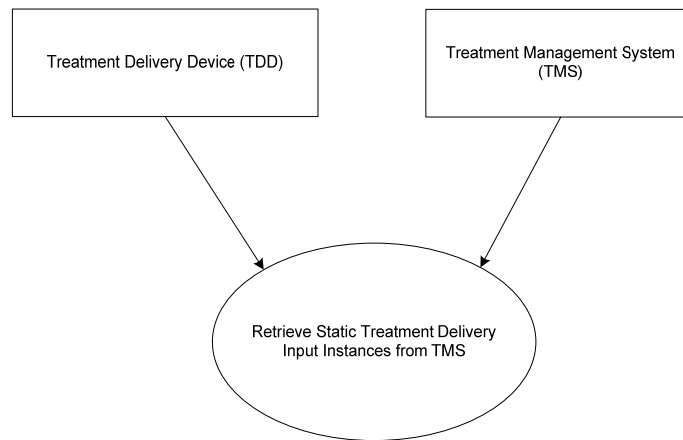
‘CONTINUATION’ treatments, Primary Dosimeter Unit (300A,00B3), Continuation Start Meterset (0074,0120), and Continuation End Meterset (0074,0121) shall be supplied in the RT Beams Delivery Instruction. Note that the Value Representation for Continuation Start Meterset and Continuation End Meterset is ‘FD’ (double-precision floating point).

## Y.2 TDW-RO-2: Retrieve Static Treatment Delivery Input Instances from TMS

### Y.2.1 Scope

In the Retrieve Static Treatment Input Instances from TMS transaction, a TDD requests and receives from the TMS any 'static' SOP Class Instances required for performing desired Scheduled Treatment Delivery procedure steps returned by a previous query. Each SOP instance must have been supplied in the Input Information Sequence of one or more of the returned worklist items.

### Y.2.2 Use Case Roles



**Actor:** *Treatment Management System*

**Role:** Sends requested DICOM objects to the *TDD*.

**Actor:** *Treatment Delivery Device ('Performing Device')*

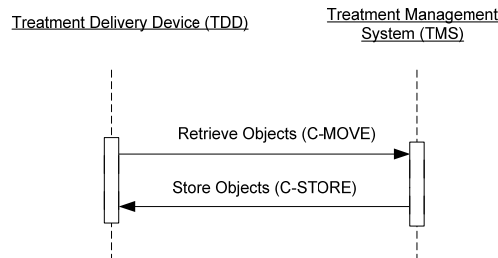
**Role:** Receives requested DICOM objects from the *TMS*.

### Y.2.3 Referenced Standards

DICOM 2009 PS 3.4: Storage Service Class

DICOM 2009 PS 3.4: Query/Retrieve Service Class

## Y.2.4 Interaction Diagram



### Y.2.4.1 Retrieve Objects

The Retrieve (Study Root – MOVE) SOP Class shall be supported. SCP implementations shall support the instance-level mode of operation in which specific SOP Instances are retrieved from the TMS using the Study Root – MOVE SOP Class. Refer to DICOM 2009 PS 3.4, Annex C, for detailed descriptive semantics.

A Performing Device shall be capable of issuing a Study Root C-MOVE at the instance level for the RT Plan SOP Instance that is specified in the Input Information Sequence. A Performing Device may also be capable of retrieving other instances, but this is not required. Other mechanisms for obtaining the data (such as C-STORE or restoring from a DICOM medium) shall not be permitted.

A Performing Device may receive SOP Instances in the Input Information Sequence for which it determines that it cannot perform the Procedure Step safely. In such cases:

- If the Procedure Step is not yet “IN PROGRESS”, the resolution is out of the scope of this profile.
- If the Procedure Step is already “IN PROGRESS”, the Performing Device shall cancel the Procedure Step, providing an explanation in the Reason For Cancellation in the N-ACTION command.

#### Y.2.4.1.1 Trigger Events

The TDD, in order to perform a treatment delivery, requests one or more of the referenced objects in the Input Information Sequence (0040,4021) of the selected work item.

#### Y.2.4.1.2 Message Semantics

The message semantics are defined by the DICOM Query/Retrieve SOP Classes and the DICOM Object Storage SOP Classes.

A C-MOVE Request from the DICOM Study Root Query/Retrieve Information Model – MOVE SOP Class shall be sent from the Performing Device (SCU) to the TMS.

The TDD is required to issue a C-MOVE request for at least one instance of an RT Plan IOD supplied in the Input Information Sequence of one or more returned UPS instances. It may also

request other input instances (such as CT data sets, structure sets, dose, etc), but is not required to do so. It may not request instances that are not supplied in the Input Information Sequence of one or more returned UPS instances.

A participating TMS shall support this transaction for at least the RT Plan IOD. Support of other IODs is permitted (e.g. RT Beams Treatment Record Storage SOP instances from previous deliveries).

It is assumed that any requested objects have been placed in the TMS by a means outside the scope of this IHE-RO profile. Typically C-STORE operations from a Treatment Planning System would have been performed to achieve this goal.

In implementations where the Performing Device manages DICOM objects itself, it may well have prefetched and processed the required objects, in which case the UUIDs supplied in the Input Information Sequence (0040,4021) of the selected work items will be sufficient to locate the necessary data, and no retrievals would be necessary. However, in this profile the RT Plan Instance must be retrieved using C-MOVE.

#### **Y.2.4.1.3 Expected Actions**

The TMS receives the C-MOVE request, establishes a DICOM association with the requesting actor, and uses the appropriate DICOM Object SOP Classes to transfer the requested objects.

The requesting Performing Device is then expected to use the requested objects in the performing of the selected work items. In cases where the Performing Device manages DICOM objects itself, this may be limited to ensuring that the supplied RT Plan instance is consistent with internally stored data.

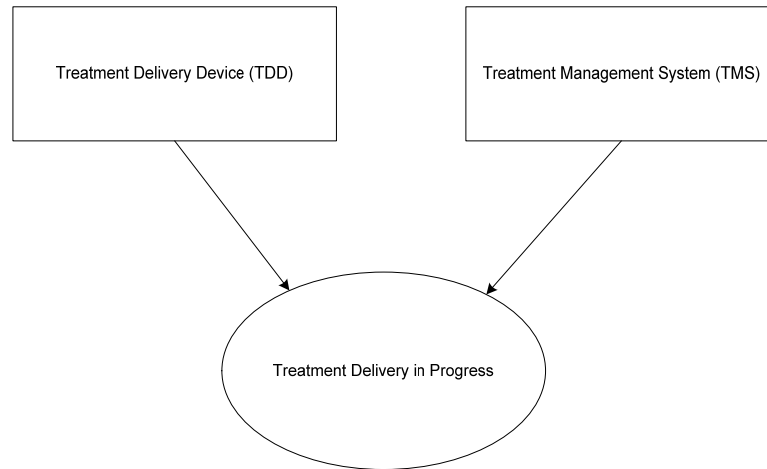


## Y.3 TDW-RO-3: Treatment Delivery in Progress

### Y.3.1 Scope

In the Treatment Delivery in Progress transaction, a TDD signals to the TMS that responsibility has been taken for the performing of the selected work item.

### Y.3.2 Use Case Roles



**Actor:** *Treatment Management System*

**Role:** Responds to a UPS N-ACTION and recognizes the specified Unified Procedure Step as in progress, thereby preventing other *Actors* from performing the step.

**Actor:** *Treatment Delivery Device ('Performing Device')*

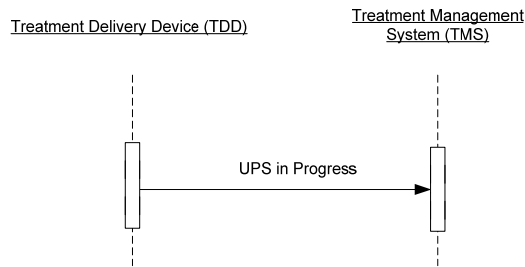
**Role:** Signals using UPS N-ACTION that the selected work item is in progress.

### Y.3.3 Referenced Standards

DICOM Supplement 74 (Frozen Draft): Utilization of Worklist in Radiotherapy Treatment Delivery

DICOM Supplement 96: Unified Worklist and Procedure Step

### Y.3.4 Interaction Diagram



#### Y.3.4.1 UPS in Progress Message

The Performing Device uses the UPS N-ACTION service to inform the TMS that the specified Unified Procedure Step has been started and is in progress. Note that the UPS-Pull SOP Class is negotiated as the abstract transfer syntax, but the UPS-Push SOP Class is used as the SOP Class of an UPS in all subsequent DIMSE messaging (see DICOM Supplement 96, Part 4, Section F.X.4).

##### Y.3.4.1.1 Trigger Events

The Performing Device has successfully queried and selected a suitable work item. It may also have retrieved 'dynamic' input instances using TDW-R0-4 prior to this step.

The Performing Device shall not be permitted to perform this transaction on a UPS for which the RT Plan instance supplied in its Input Instance sequence has not previously been obtained using TDW-RO-2.

##### Y.3.4.1.2 Message Semantics

The message semantics are defined in DICOM Supplement 96. The value of the Unified Procedure Step State (0074,1000) shall be 'IN PROGRESS'.

##### Y.3.4.1.3 Expected Actions

The TMS receives the N-ACTION request and sends an N-ACTION response.

If the requested work item is still available for performing, the TMS shall send an N-ACTION response with a Unified Procedure Step State (0074,1000) of 'IN PROGRESS' and a status code of 0000H (success). The TMS shall then be ready to receive UPS N-SET or UPS N-ACTION commands. A unique value for the Transaction UID (0008,1195) shall be supplied by the TMS, and used subsequently by the TMS in authorizing further UPS requests (which must supply the Transaction UID first returned in this transaction).

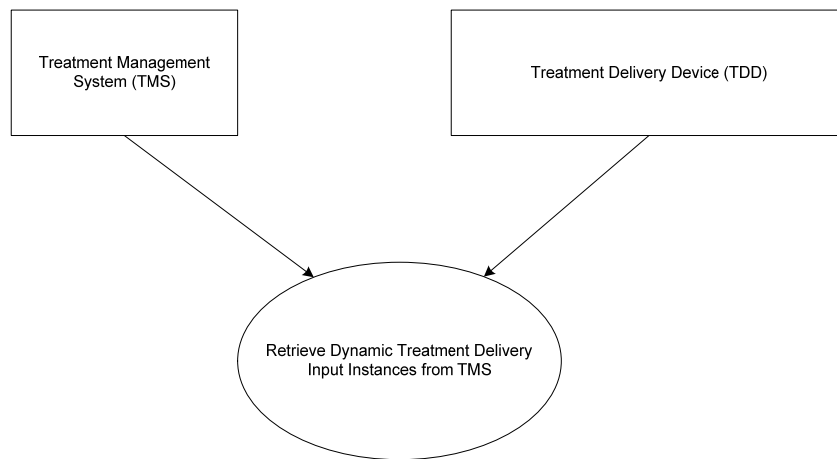
If the requested work item cannot be performed because the Unified Procedure Step is already IN PROGRESS, or for any other reason, then an N-ACTION response with a status code as described in DICOM Supplement 96 Table F.X.3.1-2 shall be returned. The TMS shall then be capable of accepting further UPS N-ACTION requests or worklist queries.

## Y.4 TDW-RO-4: Retrieve Dynamic Treatment Delivery Input Instances from TMS

### Y.4.1 Scope

In the Retrieve Dynamic Treatment Input Instances from TMS transaction, the TDD requests and receives requests and receives SOP Class instances from the TMS, in order to support execution of the requested work item. These requested instances are of a “transient” nature, typically generated ‘on-the-fly’ by the TMS.

### Y.4.2 Use Case Roles



**Actor:** *Treatment Management System*

**Role:** Sends requested DICOM objects to the *TDD*.

**Actor:** *Treatment Delivery Device ('Performing Device')*

**Role:** Receives requested DICOM objects from the *TMS*.

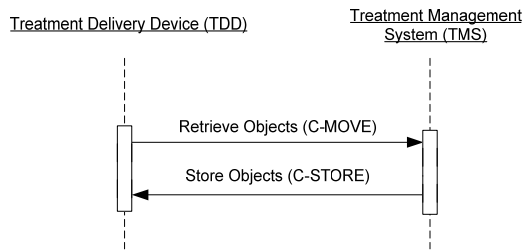
### Y.4.3 Referenced Standards

DICOM 2009 PS 3.4: Storage Service Class

DICOM 2009 PS 3.4: Query/Retrieve Service Class

DICOM Supplement 74 (Frozen Draft): Utilization of Worklist in Radiotherapy Treatment Delivery

## Y.4.4 Interaction Diagram



### Y.4.4.1 Retrieve Objects

The Retrieve (Study Root – MOVE) SOP Class shall be supported, with Instance-level support. Implementations shall support a mode of operation in which specific SOP Instances (rather than entire studies) are retrieved from the TMS using the Study Root – MOVE SOP Class. Refer to DICOM 2009 PS 3.4, Annex C, for detailed descriptive semantics.

A Performing Device shall be capable of issuing Study-Root C-MOVE for the RT Beams Delivery Instruction Storage SOP Instance that is specified in the Input Information Sequence. A Performing Device may also be capable of retrieving other instances, but this is not required. Other mechanisms for obtaining the data (such as C-STORE or restoring from a DICOM medium) shall not be permitted.

A Performing Device may receive SOP Instances in the Input Information Sequence for which it determines that it cannot perform the Procedure Step safely. In such cases:

- If the Procedure Step is not yet “IN PROGRESS”, the resolution is out of the scope of this profile.
- If the Procedure Step is already “IN PROGRESS”, the Performing Device shall cancel the Procedure Step, providing an explanation in the Reason For Cancellation in the N-ACTION command.

#### Y.4.4.1.1 Trigger Events

The Performing Device has successfully queried and selected a suitable work item. It may also have set the UPS in progress using TDW-R0-3 prior to this step.

The Performing Device shall not be permitted to perform this transaction on a UPS for which the RT Plan instance supplied in its Input Instance sequence has not previously been obtained using TDW-RO-2.

#### Y.4.4.1.2 Message Semantics

The message semantics are defined by the DICOM Query/Retrieve SOP Classes and the DICOM Object Storage SOP Classes.

A C-MOVE Request from the DICOM Study Root Query/Retrieve Information Model – MOVE SOP Class, instance-level shall be sent from the Performing Device (SCU) to the Treatment Management System.

The TDD is required to issue a C-MOVE request for at the instance of the RT Beams Delivery Instruction Storage IOD supplied in the Input Information Sequence of the UPS instance. It may also request other input instances, but is not required to do so. It may not request instances that were not supplied in the Input Information Sequence of the UPS instance.

The TMS shall be capable of supplying at least the following SOP Class:

**Table 4-1 Required SOP Class Support for TMS C-MOVE**

<b>SOP Class Name</b>	<b>SOP Class UID</b>
RT Beams Delivery Instruction Storage	1.2.840.10008.5.1.4.34.1 (see DICOM Supplement 74)

The specific attribute contents of the retrieved objects are not specified in IHE-RO profiles. It is assumed that the object contents will be specific to the particular combination of Performing Device and TMS, and are not specified by IHE-RO.

#### **Y.4.4.1.3 Expected Actions**

The TMS receives the C-MOVE request, establishes a DICOM association with the requesting Performing Device, and uses the appropriate DICOM SOP Classes to transfer the requested objects.

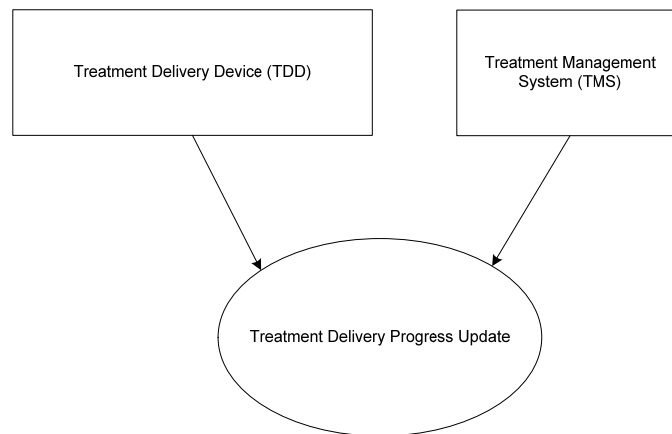
The requesting actor is then expected to use the requested objects in the performing of the selected work item.

## Y.5 TDW-RO-5: Treatment Delivery Progress Update

### Y.5.1 Scope

In the Treatment Delivery Progress Update transaction, a TDD signals to the TMS any changes in the progress of the work item that is currently in progress.

### Y.5.2 Use Case Roles



**Actor:** *Treatment Management System*

**Role:** Responds to a UPS N-SET and updates attributes in the specified Unified Procedure Step.

**Actor:** *Treatment Delivery Device ('Performing Device')*

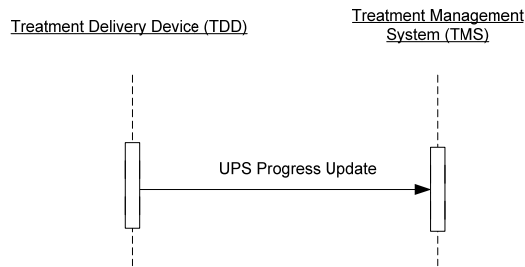
**Role:** Signals using UPS N-SET that that progress related to the selected work item has changed.

### Y.5.3 Referenced Standards

DICOM Supplement 74 (Frozen Draft): Utilization of Worklist in Radiotherapy Treatment Delivery

DICOM Supplement 96: Unified Worklist and Procedure Step

## Y.5.4 Interaction Diagram



### Y.5.4.1 UPS Progress Update Message

The Performing Device uses the UPS N-SET service to inform the TMS that progress relating to the specified Unified Procedure Step has changed. Note that the UPS-Pull SOP Class is negotiated as the abstract transfer syntax, but the UPS-Push SOP Class is used as the SOP Class of an UPS in all subsequent DIMSE messaging (see DICOM Supplement 96, Part 4, Section F.X.4).

#### Y.5.4.1.1 Trigger Events

The Performing Device is in the process of performing the work item, and wishes to notify the TMS of changes in the progress of the work item. Specifically:

- The Performing Device has fetched necessary input data, and notifies the TMS that work is about to start on treatment delivery by indicating progress of 0% and indicating the Referenced Beam Number in Progress.
- The Performing Device is in the process of performing the work item, and notifies the TMS that work has advanced by indicating progress of between 0% and 100%, and indicating the Referenced Beam Number in Progress.

#### Y.5.4.1.2 Message Semantics

The message semantics are defined in DICOM Supplement 96.

Minimum requirements for SCUs using the UPS N-SET command for this transaction are detailed in Table 5-1. Note that at least one of the N-SET commands issued for a given UPS must contain the UPS Performed Procedure Sequence (0074,1216). The Final State requirements of the UPS are ultimately met by TDW-RO-7: Treatment Delivery Final Update.

**Table 5-1 UPS N-SET Attribute Requirements for Treatment Delivery Progress Update Transaction**

<b>Attribute Name</b>	<b>Tag</b>	<b>Type</b>	<b>IHE-RO Additional Requirements on SCU</b>
Transaction UID	(0008,1195)	(See DICOM Supp 96 F.X.3.6.3)	
<b>Unified Procedure Step Progress Information Module</b>			
UPS Progress Information Sequence	(0040,4003)	3	Required by IHE-RO in all instances of this transaction.
>Unified Procedure Step Progress	(0040,4010)	1	
>Unified Procedure Step Discontinuation Reason Code Sequence	(0074,100e)	3	Not required to be supplied for this profile.
<b>Unified Procedure Step Performed Procedure Information Module</b>			
UPS Performed Procedure Sequence	(0074,1216)	1	
>Performed Processing Parameters Sequence	(0074,1212)	3	Required by IHE-RO in all instances of this transaction
>>Value Type	(0040,A040)	1	'TEXT'
>>Concept Name Code Sequence	(0040,A043)	1	
>>>Code Value	(0008,0100)	1	'121700'
>>>Coding Scheme Designator	(0008,0102)	1	'DCM'
>>>Code Meaning	(0008,0104)	1	'Referenced Beam Number in Progress'
>>Text Value	(0040,A160)	1	Integer string equal to the value of Referenced Beam Number (300C,0006)
>Output Information Sequence	(0040,4033)	2	Shall be empty
>Non-DICOM Output Information Sequence	(0040,4032)	2	Shall be empty

#### **Y.5.4.1.3 Expected Actions**

The TMS receives the N-SET request and sends an N-SET response. The Transaction UID (0008,1195) shall always be supplied.



If the requested work item has been successfully updated, the TMS shall send an N-SET response with a status code of 0000H (success). The Treatment Management System shall then be ready to receive further N-SET or N-ACTION commands.

If the requested work item was not successfully updated, the TMS shall send an N-SET response with a failure (non-zero) status code. The TMS shall then be ready to receive further N-SET or N-ACTION commands.

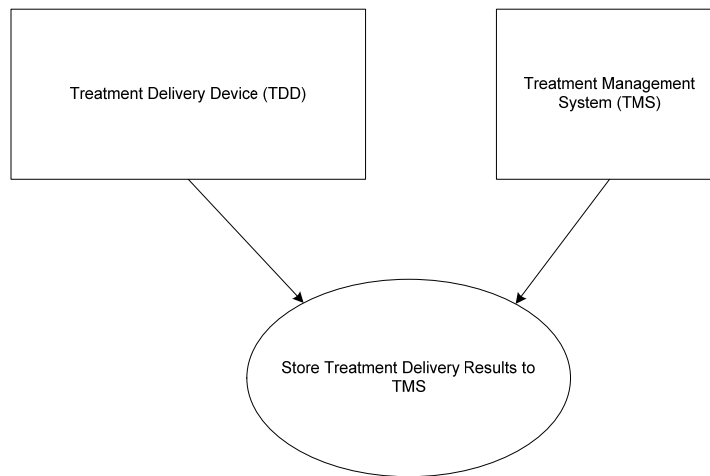
If the requested work item cannot be updated because the Unified Procedure Step is not IN PROGRESS, or for any other reason, then an N-SET response with a status code as described in DICOM Supplement 96 Table F.X.3.1-2 shall be returned. The TMS shall then remain in the state it was in before the N-SET was received.

## Y.6 TDW-RO-6: Store Treatment Delivery Results to TMS

### Y.6.1 Scope

In the Store Treatment Delivery Results to TMS transaction, when a treatment delivery workitem has been completed by a TDD, the results of the treatment delivery operation are stored to the TMS. These results may subsequently be referenced in the Output Information Sequence of the corresponding Unified Procedure Step.

### Y.6.2 Use Case Roles



**Actor:** *Treatment Management System*

**Role:** Responds to a C-STORE request and stores the transmitted objects.

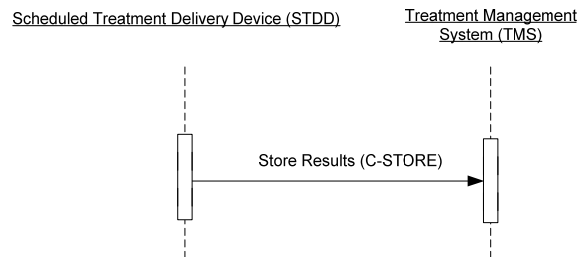
**Actor:** *Treatment Delivery Device ('Performing Device')*

**Role:** Stores the output of the treatment delivery operation to the *TMS*.

### Y.6.3 Referenced Standards

DICOM 2009 PS 3.4: Storage Service Class

## Y.6.4 Interaction Diagram



### Y.6.4.1 Store Results

The C-STORE Service shall be supported. The DICOM Object Storage SOP Classes will be supported by the TMS as an SCP. Refer to DICOM 2009 PS 3.4, Annex C, for detailed descriptive semantics.

#### Y.6.4.1.1 Trigger Events

The Performing Device has completed a treatment delivery and wishes to store the generated results of the delivery operation.

#### Y.6.4.1.2 Message Semantics

The message semantics are defined by the DICOM Object Storage SOP Classes.

A C-STORE Request shall be sent from the Performing Device to the TMS. An instance of the following IOD shall be stored to the same AE Title from which the RT Plan SOP Instance was obtained in TDW-RO-2:

**Table 6-1 Required SOP Class Support for Performing Device (SCU)**

SOP Class Name	SOP Class UID
RT Beams Treatment Record Storage	1.2.840.10008.5.1.4.1.1.481.4

In addition instances of other IODs may be stored. However, the SCU is not required to support such transactions in this profile.

The specific attribute contents of the generated object are not specified in IHE-RO profiles. It is assumed that the object contents will be specific to the particular combination of Performing Device and TMS, and is not specified by IHE-RO.

Any stored objects shall contain the Study Instance UID (0020,000D) supplied by the TMS in the UPS C-FIND response of RO-27 Worklist Query for Treatment Delivery.

A participating TMS must support this transaction for the object listed in Table 6-2 Required SOP Class Support for TMS (SCP).

**Table 6-2 Required SOP Class Support for TMS (SCP)**

SOP Class Name	SOP Class UID
----------------	---------------

RT Beams Treatment Record Storage	1.2.840.10008.5.1.4.1.1.481.4
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In addition instances of other IODs may be stored. However, the SCP is not required to support such transactions in this profile.

#### **Y.6.4.1.3 Expected Actions**

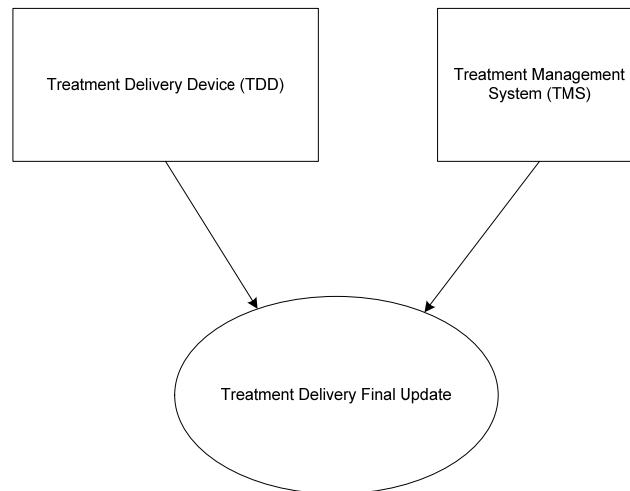
The TMS receives the C-STORE request, establishes a DICOM association with the requesting actor, and uses the appropriate DICOM Object Storage SOP Class to receive the requested object and store it.

## Y.7 TDW-RO-7: Treatment Delivery Final Update

### Y.7.1 Scope

In the Treatment Delivery Final Update transaction, a TDD signals to the TMS any changes in the properties of the work item that is currently in progress, prior to the UPS being signaled as completed or canceled.

### Y.7.2 Use Case Roles



**Actor:** *Treatment Management System*

**Role:** Responds to a UPS N-SET and updates attributes in the specified *Unified Procedure Step*.

**Actor:** *Treatment Delivery Device ('Performing Device')*

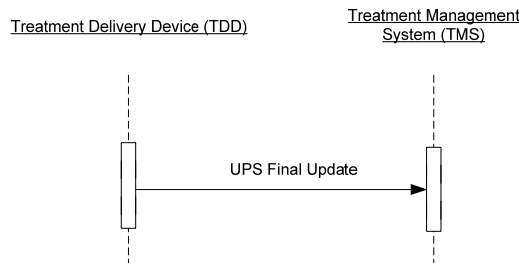
**Role:** Signals using UPS N-SET that that certain attributes related to the selected work item have changed.

### Y.7.3 Referenced Standards

DICOM Supplement 74 (Frozen Draft): Utilization of Worklist in Radiotherapy Treatment Delivery

DICOM Supplement 96: Unified Worklist and Procedure Step

### Y.7.4 Interaction Diagram



#### Y.7.4.1 UPS Final Update Message

The Performing Device uses the UPS N-SET service to inform the TMS that certain attributes relating to the specified Unified Procedure Step have changed.

##### Y.7.4.1.1 Trigger Events

The Performing Device is in the process of performing the work item, and wishes to notify the TMS of changes in certain attributes related to the work item. This may include an update to the completion progress of the work item.

##### Y.7.4.1.2 Message Semantics

The message semantics are defined in DICOM Supplement 96. Note that the UPS-Pull SOP Class is negotiated as the abstract transfer syntax, but the UPS-Push SOP Class is used as the SOP Class of an UPS in all subsequent DIMSE messaging (see DICOM Supplement 96, Part 4, Section F.X.4).

Requirement for SCUs using the UWPS N-SET command are detailed in Table 7-1: UPS N-Set Final State Attribute Requirements. The table contains only those attributes having a Final State requirement of 'R' (required if procedure is COMPLETED or CANCELED) or 'X' (required if procedure is COMPLETED). Of particular note is the last column which indicates the attributes that must be supplied by the SCU in the N-SET command in order to satisfy the Final State requirements. Note that IHE-RO is more restrictive than DICOM Supplement 96 in that a number of attributes are required to be set for all UPS N-SET commands. DICOM Supplement 96 only requires that the attributes have been set by any N-SET or N-ACTION message prior to the procedure step being moved into the COMPLETED or CANCELED state.

The Performing Device shall send at least one item in the Performed Workitem Code Sequence (0040,4019). Other items may be sent representing other unscheduled activities performed by the Performing Device, but these may be ignored by the TMS.

The required item shall have a Code Value equal to '121726' (RT Treatment with Internal Verification), and Coding Scheme Designator shall be equal to 'DCM'.

**Table 7-1: UPS N-Set Final State Attribute Requirements**

Attribute Name	Tag	Req. Type N-SET (SCU/SCP)	Final State	IHE-RO Additional Notes/Requirements on SCU
Transaction UID	(0008,1195)	(See DICOM Supp 96 F.X.3.6.3)	R	
<b>SOP Common Information Module</b>				
Specific Character Set	(0008,0005)	1C/1C (Required if extended or replacement character set is used)	Set if required	Only ISO-IR 100 (Latin-1) shall be supported.
SOP Class UID	(0008,0016)	Not allowed	R	Affected SOP Class (0000,0002) is always 'UPS-Push' SOP Class
SOP Instance UID	(0008,0018)	Not allowed.	R	Affected SOP Instance (0000,1000) supplied by C-FIND responses of UPS query
<b>Unified Procedure Step Progress Information Module</b>				
Unified Procedure Step State	(0074,1000)	Not Allowed. Use N- ACTION	R	
<b>Unified Procedure Step Scheduled Procedure Information Module</b>				
Scheduled Procedure Step Priority	(0040,4003)	3/1	R	Supplied implicitly by TMS – not required in N-SET.
Scheduled Procedure Step Modification Date and Time	(0040,4010)	-/1 SCP will use time of SET	R	Supplied implicitly by TMS – not required in N-SET.
<b>Unified Procedure Step Performed Procedure Information Module</b>				
UPS Performed Procedure Sequence	(0040,eee8)	3/2	X	Supplied by this transaction in IHE-RO, if UPS was not 'CANCELED'
>Actual Human Performers Sequence	(0040,4035)	3/1	RC	Shall be provided if known. Not required to be known in IHE-RO.
>>Human Performer Code Sequence	(0040,4009)	3/1	RC	Shall be provided if known. Not required to be known in IHE-RO.
>>Human Performer's Name	(0040,4037)	3/1	RC	Shall be provided if known. Not required to be known in IHE-RO.
>Performed Station Name Code Sequence	(0040,4028)	3/2	R	Supplied by this transaction in IHE-RO.
>>Code Value	(0008,0100)	1/1		Name of machine performing UPS. Supplied by this transaction in IHE-RO.
>>Coding Scheme Designator	(0008,0102)	1/1		Any private coding scheme designator. Supplied by this transaction in IHE-RO.



>>Code Meaning	(0008,0104)	1/1		Value shall be 'Performed Station Name'. Supplied by this transaction in IHE-RO.
>Performed Processing Applications Code Sequence	(0040,4007)	3/2	RC	Shall be provided if known. Not required to be known in IHE-RO.
>Performed Procedure Step Start Date	(0040,0244)	3/1	R	Supplied by this transaction in IHE-RO
>Performed Procedure Step Start Time	(0040,0245)	3/1	R	Supplied by this transaction in IHE-RO
>Performed Workitem Code Sequence	(0040,4019)	3/1	R	Supplied by this transaction in IHE-RO. See Y.3.4.1.2.
>>Code Value	(0008,0100)	1/1		Performed work item code value. Supplied by this transaction in IHE-RO.
>>Coding Scheme Designator	(0008,0102)	1/1		Value shall be 'DCM'. Supplied by this transaction in IHE-RO.
>>Code Meaning	(0008,0104)	1/1		Value shall be consistent with Code Value as described in Supplement 74 PS 3.16 Annex B. Supplied by this transaction IHE-RO.
>Performed Procedure Step End Date	(0040,0250)	3/1	X	Supplied by this transaction in IHE-RO
>Performed Procedure Step End Time	(0040,0251)	3/1	X	Supplied by this transaction in IHE-RO.
>Output Information Sequence	(0040,4033)	2/2	X	Supplied by this transaction IHE-RO. May be empty (null) in N-SET if no output objects are created.
>>Study Instance UID	(0020,000D)	1/1	R	Supplied by this transaction in IHE-RO
>>Referenced Series Sequence	(0008,1115)	1/1	R	Supplied by this transaction in IHE-RO
>>>Series Instance UID	(0020,000E)	1/1	R	Supplied by this transaction in IHE-RO
>>>Retrieve AE Title	(0008,0054)	2C/2	RC	Supplied by this transaction for IHE-RO (File Media Set not supported)
>>>Storage Media File-Set ID	(0088,0130)	2C/2	RC	Never supplied for IHE-RO (File Media Set not supported)
>>>Storage Media File-Set UID	(0088,0140)	2C/2	RC	Never supplied for IHE-RO (File Media Set not supported)
>>>Referenced SOP Sequence	(0008,1199)	1/1	R	Supplied by this transaction in IHE-RO
>>>>Referenced SOP Class UID	(0008,1150)	1/1	R	Supplied by this transaction in IHE-RO. See transaction <b>Error! Reference source not found.</b> for permitted SOP Classes.
>>>>Referenced SOP Instance UID	(0008,1155)	1/1	R	Supplied by this transaction in IHE-RO

>Non-DICOM Output Code Sequence	(0040,4032)	2/2	X	Empty value always supplied by this transaction in IHE-RO
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#### **Y.7.4.1.3 Expected Actions**

The TMS receives the N-SET request and sends an N-SET response. The Transaction UID (0008,1195) shall always be supplied.

If the requested work item has been successfully updated, the TMS shall send an N-SET response with a status code of 0000H (success). The Treatment Management System shall then be ready to receive further N-SET or N-ACTION commands.

If the requested work item was not successfully updated, the TMS shall send an N-SET response with a failure (non-zero) status code. The TMS shall then be ready to receive further N-SET or N-ACTION commands.

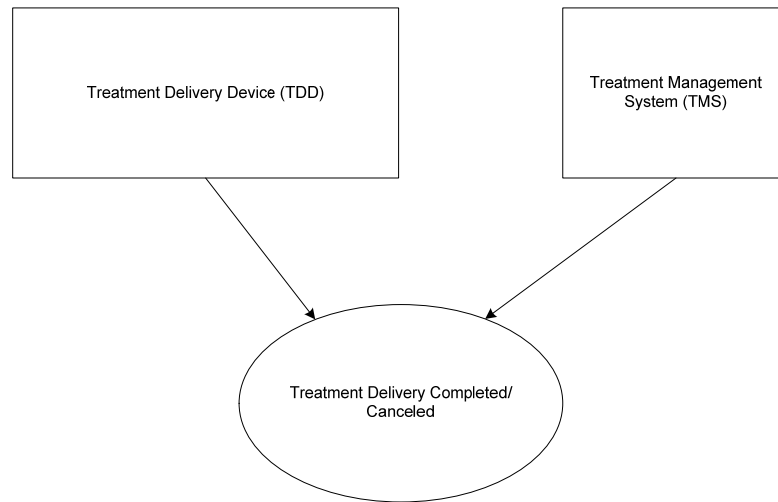
If the requested work item cannot be updated because the Unified Procedure Step is not IN PROGRESS, or for any other reason, then an N-SET response with a status code as described in DICOM Supplement 96 Table F.X.3.1-2 shall be returned. The TMS shall then remain in the state it was in before the N-SET was received.

## Y.8 TDW-RO-8: Treatment Delivery Completed/Canceled

### Y.8.1 Scope

In the Treatment Delivery Completed/Canceled transaction, a TDD signals to the TMS that the selected work item has either been completed or canceled.

### Y.8.2 Use Case Roles



**Actor:** *Treatment Management System*

**Role:** Responds to a UPS N-ACTION and sets the specified Unified Procedure Step as completed or canceled.

**Actor:** *Treatment Delivery Device ('Performing Device')*

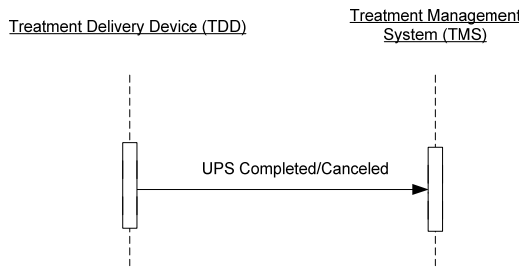
**Role:** Signals using UPS N-ACTION that the selected work item is completed or canceled.

### Y.8.3 Referenced Standards

DICOM Supplement 74 (Frozen Draft): Utilization of Worklist in Radiotherapy Treatment Delivery

DICOM Supplement 96: Unified Worklist and Procedure Step

## Y.8.4 Interaction Diagram



### Y.8.4.1 UPS Completed/Canceled Message

The Performing Device uses the UPS N-ACTION service to inform the TMS that the specified Unified Procedure Step has been completed or canceled. Note that the UPS-Pull SOP Class is negotiated as the abstract transfer syntax, but the UPS-Push SOP Class is used as the SOP Class of an UPS in all subsequent DIMSE messaging (see DICOM Supplement 96, Part 4, Section F.X.4).

#### Y.8.4.1.1 Trigger Events

The Performing Device has successfully completed the work item, or has not been able to complete the work item and has determined that processing should be stopped and the Treatment Management System notified.

#### Y.8.4.1.2 Message Semantics

The message semantics are defined in DICOM Supplement 96. The value of the Unified Procedure Step State (0074,1000) shall be 'COMPLETED' or 'CANCELED'.

#### Y.8.4.1.3 Expected Actions

The TMS receives the N-ACTION request and sends an N-ACTION response. The Transaction UID (0008,1195) shall always be supplied.

If the requested work item has been successfully completed (i.e. the received Unified Procedure Step State (0074,1000) has a value of 'COMPLETED'), the TMS shall send an N-ACTION response echoing a Unified Procedure Step State (0074,1000) of 'COMPLETED', a Procedure Step Progress of 100%, and a status code of 0000H (success). The Treatment Management System shall then be ready to receive new worklist queries.

If the requested work item was not successfully completed (i.e. the received Unified Procedure Step State (0074,1000) has a value of 'CANCELED'), the TMS shall send an N-ACTION response echoing a Unified Procedure Step State (0074,1000) of 'CANCELED', a Procedure Step Progress of between 0% and 100%, and a status code of 0000H (success). The TMS shall then be ready to receive new worklist queries. The TMS is not required to signal the cancellation with an N-EVENT-REPORT in this transaction. Note that if the requested work item was retrieved and locked, but never started (e.g. the user abandoned delivery, or the Performing Device determined that the retrieved plan was not deliverable), then Procedure Step Progress shall be set at 0%.

If the requested work item cannot be marked as completed or canceled because the Unified Procedure Step is not IN PROGRESS, or for any other reason, then an N-ACTION response with a status code as described in DICOM Supplement 96 Table F.X.3.1-2 shall be returned. The TMS shall then remain in the state it was in before the N-ACTION was received.

DICOM Supplement 96 Section F.X.3.4.1.1 outlines the final state requirements for the UPS N-ACTION command, i.e. the attributes which must be valued before the procedure step is allowed to pass into the COMPLETED or CANCELED state. The stated requirements for TDW-RO-5: Treatment Delivery Progress Update, TDW-RO-3: Treatment Delivery in Progress and TDW-RO-7: Treatment Delivery Final Update to ensure that these conditions are met.

