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Digital Imaging and Communications in Medicine (DICOM)

Supplement 194: RESTful Non-Patient Instance Storage

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20 **DICOM Standards Committee**

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1 Scope and Field of Application

This supplement defines Restful Services (RS) for retrieving, storing, and searching for non-patient-related IODs such as hanging protocols, color palettes, procedure protocols, etc.

85 The transactions defined for this service are like those defined for the RS Studies Service. They allow a user agent to retrieve, store, and search for non-patient-related IODs from an origin server in DICOM Media Types.

Generic Web security mechanisms are fully compatible with Restful Services. PS3.14 discusses security.

90 Since image IODs incorporate the patient/study hierarchy, images of phantoms, QC targets, doorknob swab photos, etc., are expected to be handled as pseudo-patients rather than Non-Patient Instances. Pseudo patient identities will be created to track phantoms, QC targets, etc.

Add the following section to Part 18, Section 6:

6.X RS Non-Patient Instance (NPI) Storage

95 The RS Non-Patient Instance (NPI) Storage Services define a set of RESTful transactions that enable a user agent to retrieve, store, and search an origin server for instances that are not related to a patient.

An NPI Service manages a collection of resources belonging to the categories specified in 6.X.1. All NPI Storage Service origin servers shall support the Retrieve Capabilities, Retrieve, and Search transactions. Support for the Store transaction is optional. All NPI Storage Service user agents one or more of the Retrieve Capabilities, Retrieve, Store, or Search transactions.

100 6.X.1 Resources

An NPI Service manages resources from the same NPI Category. The target resource URIs have the following templates:

```
{npi-name}
{npi-name}/{uid}
```

105 Where

```
npi-name = "color-palettes"
          / "defined-procedure-protocols"
          / "hanging-protocols"
          / "implant-templates"
```

110 uid ; is the Unique Identifier of an NPI Instance

Table 6.X.1-1 contains the templates for the NPI Resource Categories. It also includes the PS3.3 Section in which the corresponding IOD is defined.

Table 6.X.1-1: Resource Categories, URI Templates and Descriptions

Resource Category	URI Template and Description	IOD	Storage Class	Information Model
Color Palette	/color-palettes{/uid}	PS3.3 A.58	PS3.4 GG	PS3.4 X.1.3
Defined Procedure Protocol	/defined-procedure-protocols{/uid}	PS3.3 A.82	PS.3.4 GG	PS3.4 BB.1.3
Hanging Protocol	/hanging-protocols{/uid}	PS3.3 A.44	PS3.4 GG	PS3.4 U.1.3
Implant Template	/implant-templates{/uid}	PS3.3, A.61	PS3.4 GG	PS3.4 HH.1.3

The NPI SOP Classes are listed in PS3.4, Table GG.3-1.

115 **6.X.2 General Query Parameters**

The Query Parameters in this section can be used with all NPI transactions.

6.X.2.1 Accept

The origin server shall support the Accept query parameter for all NPI transactions. See Section 6.1.1.5.

6.X.2.2 Character Set

120 The origin server shall support the Charset query parameter for all NPI transactions. See Section 6.1.2.2.

6.X.3 Transactions

The NPI Service defines the transactions listed in the following table:

Table 6.X.3-1: NPI Service Transactions

Transaction	Method	Resource	Payload		Description
			Request	Response	
Retrieve Capabilities	OPTIONS	/	N/A	Capabilities Description	Retrieves a description of the capabilities of the NPI Service, including transactions, resources, query parameters, etc.
Retrieve	GET	/{npi-name}/{uid}	N/A	Instance and/or Status Report	Retrieves an Instance, specified by the target resource in an Acceptable DICOM Media Type.
Store	POST	/{npi-name}/{uid}	Instance(s)	Status Report	Stores one or more DICOM Instances in a DICOM media type, contained in the request payload, in the location referenced by the target resource URL.
Search	GET	/{npi-name} ?{params*}	N/A	Result(s) and/or Status Report	Searches the target resource for Instances that match the search parameters and returns a list of matches in an Acceptable DICOM Media Type.

The npi-name specifies the type of resource(s) contained in the payload.

125 Table 6.X.3-2 shows the target resources permitted for each transaction.

Table 6.X.3-2 Resources by Transaction

Resource	URI	Retrieve	Store	Search	Capabilities
NPI Service	/				X
All Instances	/{npi-name}		X	X	
Instance	/{npi-name}/{uid}	X	X		

6.X.3.1 Retrieve Capabilities Transaction

130 The Retrieve Capabilities transaction retrieves a machine-readable description of the NPI service implemented by an origin server. The response contains a machine-readable Capabilities Description. The Capabilities Description describes the transactions, resources, representations, etc. that are supported by the service(s).

An origin server implementation of an NPI Service shall support the Retrieve Capabilities transaction.

6.X.3.1.1 Request

The Retrieve Capabilities request uses the OPTIONS method and has the following format:

```

135  OPTIONS SP / SP version CRLF
    Accept: 1#media-type CRLF
    *(header-field CRLF)
    CRLF
    
```

6.X.3.1.1.1 Resource

The target URL shall reference the Base URI ("/") of the service.

140 6.X.3.1.1.2 Query Parameters

There are no additional Query Parameters.

6.X.3.1.1.3 Request Header Fields

Table 6.X.3-3 shows the most common Mandatory, Conditional, and Optional header fields for this transaction.

Table 6.X.3-3: Request Header Fields

Header Fields	Value	Usage	Description
Accept	media-range	M	See PS3.18 6.1.1.7.
Accept-Charset	1#charset	O	See PS3.18 6.1.2.3.

145 6.X.3.1.1.4 Request Payload

The request has no payload.

6.X.3.1.2 Behavior

The origin server shall return a machine-readable description of its capabilities in an Acceptable Media Type.

6.X.3.1.3 Response

150 The format of the response is as follows:

```

version SP status-code SP reason-phrase CRLF
Content-Type: media-type CRLF
*(header-field CRLF)
CRLF
155 payload

```

6.X.3.1.3.1 Status Codes

A success response shall have a status code of 200 (OK) or 204 (No Content).

A failure response shall have a 400 or 500 level status code.

6.X.3.1.3.2 Response Header Fields

160

Table 6.X.3-4: Response Header Fields

Header Field	Value	Usage	Requirements
Content-Type	media-type	M	
Content-Length	uint	C	Shall be present if no transfer coding has been applied. Shall be absent otherwise.
Transfer-Encoding	encoding	C	Shall be present if a transfer coding has been applied. Shall be absent otherwise.
ETag	entity-tag	C	Shall be present if the response status code is 200.

6.X.3.1.3.3 Response Payload

A success response shall have a payload containing a Capabilities Description in the Selected Media Type.

A failure response shall have a payload describing the error.

6.X.3.2 Retrieve Transaction

165 The Retrieve transaction retrieves the target NPI resource in a DICOM Media Type.

6.X.3.2.1 Request

The Retrieve request has the following syntax:

```

GET SP /{npi-name}/{uid} SP version CRLF
170 Accept: 1#dicom-media-type CRLF
[If-None-Match: entity-tag CRLF]

```

*(header-field CRLF)
CRLF

6.X.3.2.1.1 Resources

The target URL shall reference one of the resources shown in Table 6.X.3-5.

175 An origin server shall specify all supported npi-names in its Conformance Statement and in its response to the Retrieve Capabilities transaction.

Table 6.X.3-5: Resources and URI Templates

Resource	URI Template
Instance	/{"npi-name"}/{uid}

6.X.3.2.1.2 Query Parameters

There are no additional query parameters.

180 **6.X.3.2.1.3 Request Header Fields**

Table 6.X.3-6 shows the most common Mandatory, Conditional, and common Optional header fields for this transaction.

Table 6.X.3-6: Request Header Fields

Header Field	Value	Usage
Accept	dicom-media-type	M

6.X.3.2.1.4 Request Payload

185 The request shall have no payload.

6.X.3.2.2 Behavior

The origin server shall try to locate the target resource and if found, return it in an Acceptable DICOM Media Type.

6.X.3.2.3 Response

The response has the following syntax:

190 version SP status-code SP reason-phrase CRLF
Content-Type: dicom-media-type CRLF
[ETag: entity-tag CRLF]
[Last-Modified: HTTP-date CRLF]
*(header-field CRLF)
195 CRLF
Payload

6.X.3.2.3.1 Status Codes

The response shall have an appropriate status code. Table 6.X.3-7 contains the most common status codes for this transaction.

200 **Table 6.X.3-7: Status Codes**

Code	Description
200 (OK)	Indicates that the instance was successfully retrieved.
304 (Not Modified)	Indicates that the user agent's current representation is up to date, so no payload was returned. This status code shall only be returned for a Conditional Retrieve request containing an If-None-Match header field.
400 (Bad Request)	Indicates that the origin server did not store any of the representations contained in the request payload because of errors in the request message. For example, an invalid Query Parameter or an invalid SOP instance.
404 (Not Found)	Indicates that the origin server did not find a current representation for the target resource or is not willing to disclose that one exists. For example, an unsupported IOD, or SOP Instance not on server.

406 (Unsupported Media Type)	Indicates that the origin server does not support any of the Acceptable Media Types.
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See [RFC7231, Section 6<<https://tools.ietf.org/html/rfc7231#section-6>>].

6.X.3.2.3.2 Response Header Fields

Table 6.X.3-8: Request Header Fields

Header Field	Value	Usage	Requirements
Content-Type	dicom-media-type	M	
Content-Length	uint	C	Shall be present if no transfer coding has been applied. Shall be absent otherwise.
Transfer-Encoding	encoding	C	Shall be present if a transfer coding has been applied. Shall be absent otherwise.
ETag	entity-tag	C	Shall be present if the response status code is 200 or 204.

6.X.3.2.3.3 Response Payload

205 A success response shall have a payload containing the DICOM instance specified by the target resource.

A failure response shall have a payload describing the error.

6.X.3.3 Store Transaction

This transaction requests that the origin server store the representations of the NPIs contained in the request payload so that they may be retrieved in the future using the Instance UIDs.

210 6.X.3.3.1 Request

Transactions in this service use the POST method. The request syntax is:

```
POST SP /{npi-name} {/uid} SP version CRLF
Content-Type: dicom-media-type CRLF
*(header-field CRLF)
215 CRLF
    payload
```

6.X.3.3.1.1 Resources

The target URL shall reference one of the resources shown in Table 6.X.3-9.

220 An origin server shall specify all supported npi-names in its Conformance Statement and in its response to the Retrieve Capabilities transaction.

Table 6.X.3-9: Resources and URI Templates

Resource	URI Template	Description
All Instances	/{npi-name}	Stores representations of a set of Instances.
Instance	/{npi-name} {/uid}	Stores a representation of a single Instance with a UID equal to uid.

6.X.3.3.1.2 Query Parameters

There are no additional Query Parameters.

6.X.3.3.1.3 Request Header Fields

225 **Table 6.X.3-10: Store Request Header Fields**

Header Field	Value	Usage	Requirements
Content-Type	dicom-media-type	M	
Accept	dicom-media-type	M	
Content-Length	uint	C	Shall be present if no transfer coding has been applied. Shall be absent otherwise.
Transfer-Encoding	encoding	C	Shall be present if a transfer coding has been applied. Shall be absent otherwise.

6.X.3.3.1.4 Request Payload

The request payload shall be present and shall contain one or more representations in the DICOM Media Type specified by the Content-Type header field of the message, or for multipart payloads the Content-Type header field of each part.

230 **6.X.3.3.2 Behavior**

The origin server stores the representations contained in the request payload so that they may be retrieved later using the Retrieve transaction.

Before storing the representations, the origin server may coerce data elements.

235 If any element is coerced, the Original Attribute Sequence (0400,0561) (see PS3.3, Section C.12.1) shall be included in the stored DICOM instances. Both the Original Attribute Sequence and the response shall describe the modifications.

6.X.3.3.3 Response

The response shall have the following syntax:

240 version SP status-code SP reason-phrase CRLF
 *(header-field CRLF)
 CRLF
 [Status Report]

6.X.3.3.3.1 Status Codes

245 The response shall have an appropriate status code. Table 6.X.3-11 contains the most common status codes for this transaction.

Table 6.X.3-11: Common Status Codes

Status Code	Description
200 (OK)	Indicates that the origin server successfully stored or created at least one of the representations contained in the request payload and is returning a response payload.
201 (Created)	Indicates that the origin server successfully created at least one of the representations contained in the request payload and may be returning a response payload.
202 (Accepted)	Indicates that the origin server successfully validated the request message, but has not yet stored or created the representations in the request payload. The origin server may or may not have validated the payload. The user agent can use a Query or Retrieve transaction later to determine if the request has completed.
204 (No Content)	Indicates that the origin server successfully stored all the representations contained in the request payload without any modifications and is not returning a response payload.
400 (Bad Request)	Indicates that the origin server did not store any of the representations contained in the request payload because of errors in the request message. For example, an invalid Query Parameter or an invalid SOP instance.
404 (Not Found)	Indicates that the origin server did not find a current representation for the target resource or is not willing to disclose that one exists. For example, an unsupported IOD, or SOP Instance not on server.
409 (Conflict)	Indicates that the request could not be completed due to a conflict with the current state of the target resource.
415 (Unsupported Media Type)	Indicates that the origin server does not support the media type specified in the Content-Type header field of the request, and none of the representations contained in the request were processed or stored.

6.X.3.3.3.2 Response Header Fields

Table 6.X.3-12: Store Response Header Fields

Header Field	Value	Usage	Requirements
Content-Type	dicom-media-	M	

	type		
Content-Length	uint	C	Shall be present if no transfer coding has been applied. Shall be absent otherwise.
Transfer-Encoding	encoding	C	Shall be present if a transfer coding has been applied. Shall be absent otherwise.

6.X.3.3.3 Response Payload

250 If the origin server failed to store or modified any representations in the request payload, the response payload shall contain a Status Report describing any additions, modifications, or deletions to the stored representations. The Status Report may also describe any warnings or other useful information.

6.X.3.4 Search Transaction

255 The Search transaction searches the collection of NPI Instances contained in the target resource. The search criteria are specified in the query parameters. Each match includes the default and requested attributes from the matching Instance. A successful response returns a list describing the matching Instances.

6.X.3.4.1 Request

The Search transaction uses the GET method and has the following syntax:

```
260 GET SP /{npi-name} {?parameter*} SP version CRLF
    Accept: 1#dicom-media-type CRLF
    *(header-field CRLF)
    CRLF
```

6.X.3.4.1.1 Resources

The target URL shall reference one of the resources shown in Table 6.X.3-13.

265 An origin server shall specify all supported npi-names in its Conformance Statement and in its response to the Retrieve Capabilities transaction.

Table 6.X.3-13: Resources and URI Templates

Resource	URI Template	Description
All Instances	/{npi-name}	Searches a collection of NPI Instances

6.X.3.4.1.2 Query Parameters

270 The parameters in the query component of the target URL specify the matching criteria, the attribute values to be returned, and the results to be returned. The URI template for the query parameters is:

```
{?parameter*} = "?" {&match*} {&include*} {&offset} {&limit}
```

See Section 6.7.1.1 for a description of the syntax of Search Query Parameters.

6.X.3.4.1.2.1 Attributes and Behaviors

275 For each Resource Category the origin server supports, it shall support the behaviors and matching key attributes specified in the corresponding sections in Table 6.X.3-13.

Table 6.X.3-13: NPI Resource Search Attributes

Resource Category	Defined Attributes and Matching Key Types
Color Palette	PS3.4 X.6.1.2
Defined Procedure Protocol	PS3.4 HH.6.1.2
Hanging Protocol	PS3.4 U.6.1.2
Implant Template	PS3.4 BB.6.1.2

6.X.3.4.1.3 Request Header Fields

Table 6.X.3-14: Search Request Header Fields

Header Field	Value	Usage
Accept	dicom-media-type	M

280 **6.X.3.4.1.4 Request Payload**

The request has no payload.

6.X.3.4.2 Behavior

285 The origin server shall perform the search indicated by the request, using the matching behavior specified in Section 6.7.1.2 and in the corresponding sections in Table 6.X.3-13, and return a response containing the search results, or an appropriate Status Report.

The rules for search results are specified in Section 6.7.1.2.

6.X.3.4.3 Response

A success response shall have a status code of 200 (OK) and a payload containing the search results in the Selected Media Type.

290 A failure response shall contain a Status Report describing the error(s) encountered.

6.X.3.4.3.1 Status Codes

The response shall have an appropriate status code. Table 6.X.3-14 contains the most common status codes for this transaction.

Table 6.X.3-14: Common Status Codes

Status Code	Description
200 (OK)	Indicates that the origin server found and returned at least one resource matching the request.
400 (Bad Request)	Indicates that the origin server did not return any search results because of errors in the request message.
404 (Not Found)	Indicates that the origin server did not find any resources matching the request, or is not willing to disclose that any exist.
406 (Unsupported Media Type)	Indicates that the origin server does not support any of the Acceptable Media Types.
409 (Conflict)	Indicates that the request could not be completed due to a conflict with the current state of the target resource.

295 **6.X.3.4.3.2 Response Header Fields**

Table 6.X.3.15: Search Response Header Fields

Header Field	Value	Usage	Requirement
Content-Type	dicom-media-type	M	
Content-Length	uint	C	Shall be present if no transfer coding has been applied. Shall be absent otherwise.
Transfer-Encoding	encoding	C	Shall be present if a transfer coding has been applied. Shall be absent otherwise.

6.X.3.4.3.3 Response Payload

A success response payload shall contain Search results.

A failure response payload shall contain a Status Report describing any failures, warnings or other useful information.

300 **6.X.4 Media Types**

The origin server shall support the media types listed as Default or Required in Table 6.X.4-1 for all NPI transactions.

Table 6.X.4-1: Default, Required, and Optional Media Types

Media Type	Usage
application/dicom	Required
application/dicom+json	Default

multipart/related; type="application/dicom+xml"	Optional
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6.X.5 Conformance

The origin server shall support the transactions listed as Required in Table 6.X.5-1.

305

Table 6.X.5-1 Required and Optional Transactions

Transaction	Support	Section
Retrieve Capabilities	Required	6.X.3.1
Retrieve	Required	6.X.3.2
Store	Optional	6.X.3.3
Search	Required	6.X.3.4

Implementations shall specify in their Conformance Statement (see PS3.2) and the Capabilities Description (see Section 6.8.1.2):

- The implementations role: origin server, user agent, or both
- The supported resources (IODs) for each role

310

In addition, for each supported transaction they shall specify:

- The supported Query Parameters, including optional attributes, if any
- The supported DICOM Media Types
- The supported character sets (if other than UTF-8)