DICOM Correction Proposal

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Correction Number	CP-2270
Log Summary:	Support of Empty and Multiple Value Matching Query in DICOMWeb
Name of Standard	PS3.2, PS3.18 2023d

Rationale for Correction:

Supplement 233, Inventory and IOD Services, introduced Empty Value Matching and Multiple Value Matching Extended Negotiation to support Repository Queries in PS 3.4.

Much of the Repository Query functionality is supported in the DICOMWeb Search Transaction, however, for full Repository Query functionality, Empty and Multiple Value Matching are needed.

A summary is below:

PS3.4 C.6.4	**Currently supported in PS3.18**	**Proposed Change to PS3.18**
Status Codes (C.6.4.3)	8.3.4.4.1 “Paging behavior”: If (remaining > 0) return Warning header.	Use (0008,0429) “Maximum Number of Records” to compute the number of results returned.
Additional Keys for Repository Query	Origin server can interpret them as in Table C.6.4.1-1. Note: all attributes are optional in DICOMweb	Use (0008,0429) “Maximum Number of Records” to compute the number of results returned. For ‘offset’ value zero, this would result in exact same behavior in limiting responses as it does in C.6.4.
Empty Value Matching (C.2.2.2.7)	Not supported	See below
Multiple Value Matching (C.2.2.2.8)	Not supported	See below

This CP adds new parameters to PS3.18 Section 8.3.4 and PS3.2 Section N.5.3.2.4.1 “Search Query Parameters” to support Repository Queries. It also specifies result ordering if either (0008,014B) “Record Key” or (0008,014C) “Prior Record Key” are present in the query. The new parameters are modeled after the existing “Fuzzy Matching of Person Names”, which is included for reference.

This CP also includes a Capabilities Description example and corrects an incorrect reference in PS 3.18 Section 8.3.4.3.

Note: this CP adds the use of “Warning” header field (status code 299) as defined in RFC723 but made obsolete in RFC9111. cp2292 has been submitted to address this throughout PS3.18.

Modify PS3.2 Section N.5.3.2.4.1 *as follows:*

h User Agent

...

The Search Transaction user agent supports query parameters listed in Table N.5-83.

[Indicate the supported parameters and their supported Values. For detail on the implementation possibilities see PS3.18 Table 8.3.4-1. Fill in specific details of your implementation if available in the "Comments" column.]

Table N.5-83. Query Parameters for Search Transaction - User Agent

Query Parameter	Supported Values	Comments
match	Attribute Values to address the search (matching key). See the supported DICOM Attribute in the Table N.5-84	
includefield	Attributes to be included in the response (return key). See the supported DICOM Attributes in the Table N.5-84	
fuzzymatching	<<true false>>	
emptyvaluematching	**<<true** **false>>**	
multiplevaluematching	**<<true** **false>>**	
Limit		*[Maximum number of results the server returns.]*
Offset		*[Number of results the server skips before the first returned result.]*

Change content of PS 3.18 Section 8.3.4

8.3.4 Search Query Parameters

Table 8.3.4-1 contains the syntax for the names and values of search parameters, along with a reference to the section where their meaning is defined. Search transactions shall support these parameters. The ABNF for the various search parameters is:

Table 8.3.4-1. Query Parameter Syntax

Term	Value	Usage		Description
		User Agent	Origin Server	
search	= match / fuzzymatching / includefield / limit / offset **/ emptyvaluematching / multiplevaluematching**			
match	; See attribute matching rules below	O	M	Section 8.3.4.1
fuzzymatching	= "fuzzymatching" "=" true / false	O	M	Section 8.3.4.2
includefield	= "includefield" "=" 1#attribute / "all"	O	M	Section 8.3.4.3

Term	Value	Usage		Description
		User Agent	Origin Server	
limit	= "limit" "=" uint ; Maximum number of results	O	M	Section 8.3.4.4
offset	= "offset" "=" uint ; Number of skipped results	O	M	Section 8.3.4.4
emptyvaluematching	**= "emptyvaluematching" "=" true / false**	**O**	**O**	**Section 8.3.4.5**
multiplevaluematching	**= "multiplevaluematching" "=" true / false**	**O**	**O**	**Section 8.3.4.6**

The following sections describe these parameters in detail.

Modify PS 3.18 Section 8.3.4.3 as follows:

8.3.4.3 Attributes Included in the Response

A parameter specifies the Attributes that should be included in the response. The value is either a comma-separated list of attributes, or the single keyword "all", which means that all available attributes of the object should be included in the response.

```
includefield = *("includefield" "=" (1#attribute / "all") )
```

The request may contain one or more include parameters; however, if a parameter with the value of "all" is present, then other includefield parameters shall not be present. If an attribute is a value of an includefield parameter, it is equivalent to C-FIND Universal matching for that attribute. See Section C.2.2.2.3 in PS3.4.

If an include parameter represents a Private Data Element a corresponding Private Creator Element shall be specified as an additional match parameter (see Section 7.8.1 in PS3.5).

The includefield Query Parameter corresponds to DIMSE Return Keys. ~~**See Section K.2.2.1.2 in PS3.4**~~

Note

Acceptable values are specified in the Information Model for the SOP Classes referenced in other Sections of this Part.

Modify PS3.18 Section 8.3.4.4 and 8.3.4.4.1 as follows:

8.3.4.4 Response Pagination

The following two parameters can be used to paginate a search response that might contain more matches than can readily be handled.

```
offset = "offset" "=" uint
```

A single parameter specifies the number of matches the origin server shall skip before the first returned match. The "offset" parameter value is an unsigned integer (uint). If this Query Parameter is not present, its value defaults to 0.

```
limit = "limit" "=" uint
```

A single parameter specifies the maximum number of matches the origin server shall return in a single response. The "limit" parameter value is an unsigned integer. If this parameter is not present, its value is determined ~~**by origin server.**~~ **as specified in Section 8.3.4.4.1.**

8.3.4.4.1 Paging Behavior

The search requests shall be idempotent, that is, two separate search requests with the same Target Resource, Query Parameters, and header fields shall return the same ordered list of matches, if the set of matches on the origin server has not changed.

Given the following definitions:

`offset`	the value of the "offset" query parameter.
`limit`	the value of the "limit" query parameter. **For a Repository Query, this is the value of Maximum Number of Records (0008,0429).**
`maxResults`	the maximum number of results the origin server allows in a single response **(i.e., system limit).**
`matches`	the number of matches resulting from the search. **If Prior Record Key (0008,041C) is provided in the query, then the value will be the number of matches after the record identified by the attribute value.**
`results`	the number of results returned in the response. It is equal to the minimum of: • The maximum of zero and the value of matches - offset • The value of maxResults • The value of limit
`remaining`	the number of matches that were not yet returned.

The results returned in the response are determined as follows:

- If (results <= 0) then there are no matches, and a 204 (No Content) response shall be returned with an empty payload.
- Otherwise, a 200 (OK) response shall be returned with a payload containing the results.
- If (remaining > 0) the response shall include a Warning header field (see [RFC7234] Section 5.5) containing the following:

```
Warning: 299 <service>: There are <remaining> additional results that can be
requested
```

The response may include a payload containing an appropriate Status Report.

If the set of matching results has changed due to changes in the origin server contents, then the ordered list of results may be different for subsequent transactions with identical requests, and the results of using the "offset" and "limit" parameters may be inconsistent.

Add the following sections before PS3.18 Section 8.3.5:

Note to reviewers: these sections are modeled after 8.3.4.2, which is included for reference below.

8.3.4.5 Empty Value Matching

A single parameter specifies whether Empty Value Matching is to be performed.

This parameter is optional for the user agent.

This parameter is optional for the origin server.

If this parameter is not present its value is "false".

```
emptyvaluematching = "emptyvaluematching" "=" ("true" / "false")
```

If the value is "false", then the search shall be performed without Empty Value Matching.

If the value is "true" and the origin server supports Empty Value Matching, then the search shall be performed with Empty Value Matching Attributes as specified in Section C.2.2.2.7 in PS3.4 and shall be documented in the Conformance Statement and, if the service supports it, the Retrieve Capabilities response.

If the value is "true" and the origin server does not support Empty Value Matching, then:

- The search shall be performed without Empty Value Matching.
- The response shall include the following HTTP Warning header (see [RFC7234] Section 5.5):

```
Warning: 299 <service>: The emptyvaluematching parameter is not supported.
Empty Value Matching has not been performed.
```

where <service> is the base URI for the origin server. This may be a combination of scheme, authority, and path.

- The response may include a payload containing an appropriate Status Report.

8.3.4.6 Multiple Value Matching

A single parameter specifies whether Multiple Value Matching is to be performed.

This parameter is optional for the user agent.

This parameter is optional for the origin server.

If this parameter is not present its value is "false".

```
multiplevaluematching = "multiplevaluematching" "=" ("true" / "false")
```

If the value is "false", then the search shall be performed without Multiple Value Matching.

If the value is "true" and the origin server supports Multiple Value Matching, then the search shall be performed with Multiple Value Matching Attributes as specified in Section C.2.2.2.8 in PS3.4 and shall be documented in the Conformance Statement and, if the service supports it, the Retrieve Capabilities response.

If the value is "true" and the origin server does not support Multiple Value Matching, then:

- The search shall be performed without Multiple Value Matching.
- The response shall include the following HTTP Warning header (see [RFC7234] Section 5.5):

```
Warning: 299 <service>: The multiplevaluematching parameter is not supported.
Multiple Value Matching has not been performed.
```

where <service> is the base URI for the origin server. This may be a combination of scheme, authority, and path.

- The response may include a payload containing an appropriate Status Report.

Section 8.3.4.2 is included for reference only:

8.3.4.2 Fuzzy Matching of Person Names

A single parameter specifies whether Fuzzy Matching of Person Names is to be performed.

This parameter is optional for the user agent.

This parameter is optional for the origin server.

If this parameter is not present its value is "false".

```
fuzzymatching = "fuzzymatching" "=" ("true" / "false")
```

If the value is "false", then the search shall be performed without Fuzzy Matching.

If the value is "true" and the origin server supports Fuzzy Matching, then the search shall be performed with Fuzzy Matching of Person Name Attributes as specified in Section C.2.2.2.1.1 in PS3.4 and shall be documented in the Conformance Statement and, if the service supports it, the Retrieve Capabilities response.

If the value is "true" and the origin server does not support Fuzzy Matching, then:

- The search shall be performed without Fuzzy Matching.
- The response shall include the following HTTP Warning header (see [RFC7234] Section 5.5) :

  ```
  Warning: 299 <service>: The fuzzymatching parameter is not supported. Only
  literal matching has been performed.
  ```

  where <service> is the base URI for the origin server. This may be a combination of scheme, authority, and path.
- The response may include a payload containing an appropriate Status Report.

Modify PS3.18 Section 10.6.1.2.1 as follows:

10.6.1.2.1 Attribute/Value Pair Requirements

DICOM Attribute/Value pairs included as Query Parameters in the request shall satisfy the requirements in Section 8.3.4.1.

The user agent may include the following Attributes in the request:

- Patient IE Attributes (see Section 10.6.1.2.3)
- Study IE Attributes (only allowed if the resource is All Studies, All Series, All Instances)
- Series IE Attributes (only allowed if the resource is Study's Series, All Series, Study's Instances, or All Instances)
- Composite Instance IE Attributes (only allowed if the resource is Study's Instances, Study Series' Instances, or All Instances)
- Additional Query/Retrieve Attributes (see Section C.3.4 in PS3.4)
- Private Data Element Tags and their corresponding Private Creator Element Tags
- Timezone Offset From UTC (0008,0201)
- **Repository Query Attributes (see Section 10.6.1.2.4)**

The following are examples of Search URIs with valid Attribute/value pairs:

```
/studies?PatientID=11235813
/studies?PatientID=11235813&StudyDate=20130509
/studies?00100010=SMITH*&00101002.00100020=11235813&limit=25
/studies?00100010=SMITH*&OtherPatientIDsSequence.00100020=11235813
/studies?PatientID=11235813&includefield=00081048,00081049,00081060
/studies?PatientID=11235813&includefield=00081048&includefield=00081049&includefield=0
0081060
/studies?PatientID=11235813&StudyDate=20130509-20130510
/studies?StudyInstanceUID=1.2.392.200036.9116.2.2.2.2162893313.1029997326.94587,1.2.39
2.200036.9116.2.2.2.2162893313.1029997326.94583
/studies?00230010=AcmeCompany&includefield=00231002&includefield=00231003
/studies?00230010=AcmeCompany&00231001=001239&includefield=00231002&includefield=00231
003
```

Add the following section before PS3.18 Section 10.6.1.3:

10.6.1.2.4 Optional Repository Query Attributes

The origin server may support the matching Repository Query Attributes in Table 10.6.1.2.4-1 (see Section C.6.4.2 in PS3.4).

Table 10.6.1.2.4-1. Optional Matching Attributes

IE Level	Attribute Name	Tag
Study	Prior Record Key	(0008,041C)

IE Level	Attribute Name	Tag
	Maximum Number of Records	(0008,0429)
Series	Prior Record Key	(0008,041C)
	Maximum Number of Records	(0008,0429)
Instance	Prior Record Key	(0008,041C)
	Maximum Number of Records	(0008,0429)

Update PS18 Section 10.6.3.3 as follows:

10.6.3.3.1 Study Resource

For each matching Study, the origin server response shall contain Attributes in accordance with Table 10.6.3-3. The "Type" column in the table below refers to the Query/Retrieve Attribute Types defined in Section C.2.2.1 “Attribute Types” in PS3.4. The unique key for a Study resource Search response is the Study Instance UID (0020,000D).

Table 10.6.3-3. Study Resource Search Response Payload

Attribute Name	Tag	Type	Condition
Study Date	(0008,0020)	R	
Study Time	(0008,0030)	R	
Accession Number	(0008,0050)	R	
Instance Availability	(0008,0056)	C	Shall be present if known
Modalities in Study	(0008,0061)	R	
Referring Physician's Name	(0008,0090)	R	
Timezone Offset From UTC	(0008,0201)	C	Shall be present if known
Retrieve URL	(0008,1190)	C	Shall be present if the Instance is retrievable by the Retrieve transaction
Patient's Name	(0010,0010)	R	
Patient ID	(0010,0020)	R	
Patient's Birth Date	(0010,0030)	R	
Patient's Sex	(0010,0040)	R	
Study Instance UID	(0020,000D)	U	
Study ID	(0020,0010)	R	
Number of Study Related Series	(0020,1206)	R	
Number of Study Related Instances	(0020,1208)	R	

*Note**s***

- *While some of the above Attributes are optional in Table C.6-1 “Patient Level Attributes for the Patient Root Query/Retrieve Information Model” in PS3.4, Table C.6-2 “Study Level Attributes for the Patient Root Query/Retrieve Information Model” in PS3.4, and Table C.6-5 “Study Level Attributes for the Study Root Query/Retrieve Information Model” in PS3.4, they are consistent with those required in [IHE RAD TF Vol2] Table 4.14-1.*
- ***If either Prior Record Key (0008,041C) or Record Key (0008,041B) is present in the request and the Origin Server supports these attributes, then the responses are ordered as defined in PS3.4 C.6.4 “Repository Query SOP Class”.***

In addition, the response shall contain:

- All other Study level Attributes passed as match or includefield parameters in the request that are supported by the origin server.
- If the includefield parameter has been specified in the request, and its value is "all", all Study Level Attributes specified as Optional Keys in PS3.4 Section C.6.1.1.2, PS3.4 Section C.6.1.1.3 and PS3.4 Section C.6.2.1.2 that are supported by the Origin Server.

- If a Private Data Element has been specified as an include parameter and it is supported by the origin server, the Private Data Element and its corresponding Private Creator Element.

Series or Instance Level Attributes contained in includefield parameters shall not be returned.

10.6.3.3.2 Series Resources

For each matching Series, the origin server shall return all Attributes listed in Table 10.6.3-4. The "Type" column in the table below refers to the Query/Retrieve Attribute Types defined in Section C.2.2.1 “Attribute Types” in PS3.4. The unique key for a Series resource Search response is the Series Instance UID (0020,000E).

Table 10.6.3-4. Series Resources Search Response Payload

Attribute Name	Tag	Type	Condition
Modality	(0008,0060)	R	
Timezone Offset From UTC	(0008,0201)	C	Shall be present if known
Series Description	(0008,103E)	C	Shall be present if known
Retrieve URL	(0008,1190)	R	Shall be present if the Instance is retrievable by the Retrieve transaction
Series Instance UID	(0020,000E)	U	
Series Number	(0020,0011)	R	
Number of Series Related Instances	(0020,1209)	R	
Performed Procedure Step Start Date	(0040,0244)	C	Shall be present if known
Performed Procedure Step Start Time	(0040,0245)	C	Shall be present if known
Request Attributes Sequence	(0040,0275)	C	Shall be present if known
>Scheduled Procedure Step ID	(0040,0009)	R	
>Requested Procedure ID	(0040,1001)	R	

Notes

- *While some of the above Attributes in are optional in Table C.6-3. Series Level Attributes for the Patient Root Query/Retrieve Information Model in PS3.4, they are consistent with the those required in [IHE RAD TF Vol2] Table 4.14-1.*
- ***If either Prior Record Key (0008,041C) or Record Key (0008,041B) is present in the request and the Origin Server supports these attributes, then the responses are ordered as defined in PS3.4 C.6.4 “Repository Query SOP Class”.***

In addition, the response shall contain:

- All other Series Level Attributes passed as match Query Parameters, or Series or Study Level Attributes passed as includefield parameters in the request that are supported by the origin server.
- If the "includefield" parameter has been specified in the request and its value is "all", include all Series Level Attributes specified as Optional Keys in PS3.4 Section C.6.1.1.4 that are supported by the Origin Server.
- If the Target Resource is All Series, then include all Study Level Attributes specified in Section 10.6.3.3.1.
- If a Private Data Element has been specified as an include parameter and it is supported by the origin server, the Private Data Element and its corresponding Private Creator Element.

Instance Level Attributes contained in includefield parameters shall not be returned.

10.6.3.3.3 Instance Resources

For each matching Instance, the origin server shall return all Attributes listed in Table 10.6.3-5, if present in the Instance. The Type column in the table below refers to the Query/Retrieve Attribute Types defined in Section C.2.2.1 “Attribute Types” in PS3.4. The unique key for an Instance resource search response is the SOP Instance UID (0008,0018).

Table 10.6.3-5. Instance Resources Search Response Payload

Attribute Name	Tag	Type	Condition
SOP Class UID	(0008,0016)	R	
SOP Instance UID	(0008,0018)	U	
Instance Availability	(0008,0056)	C	Shall be present if known
Timezone Offset From UTC	(0008,0201)	C	Shall be present if known
Retrieve URL	(0008,1190)	R	Shall be present if the Instance is retrievable by the Retrieve transaction
Instance Number	(0020,0013)	R	
Rows	(0028,0010)	C	Shall be present if known
Columns	(0028,0011)	C	Shall be present if known
Bits Allocated	(0028,0100)	C	Shall be present if known
Number of Frames	(0028,0008)	C	Shall be present if known

*Note**s***

- *While some of the above Attributes in are optional in Table C.6-4. Composite Object Instance Level Keys for the Patient Root Query/Retrieve Information Model in PS3.4, they are consistent with the those required in [IHE RAD TF Vol2] Table 4.14-1.*
- ***If either Prior Record Key (0008,041C) or Record Key (0008,041B) is present in the request and the Origin Server supports these attributes, then the responses are ordered as defined in PS3.4 C.6.4 "Repository Query SOP Class".***

In addition, the response shall contain:

- All other Instance Level Attributes passed as match parameters, or Study, Series, or Instance Level Attributes passed as includefield parameters that are supported by the origin server.
- If the "includefield" parameter has been specified in the request and its value is "all", Attribute include all Instance Level Attributes specified as Optional Keys in PS3.4 Section C.6.1.1.5 that are supported by the Origin Server.
- If the Target Resource is All Instances, then include all Study level Attributes specified in Section 10.6.3.3.1.
- If the Target Resource is All Instances or Study's Instances, then include all Series level Attributes specified in Section 10.6.3.3.2.
- If a Private Data Element has been specified as an include parameter and it is supported by the origin server, the Private Data Element and its corresponding Private Creator Element.

The response may optionally include:

- the Available Transfer Syntax UID (0008,3002) to describe the Transfer Syntaxes that the origin server can assure will be supported for retrieval of the SOP Instance. See Section C.6.1.1.5.2 in PS3.4 .

Modify PS3.18 Section 10.6.5 as follows:

10.6.5 Conformance Statement

An implementation shall declare in its Conformance Statement whether it plays the role of origin server or user agent, or both.

An implementation playing the role of origin server shall declare the maximum number of matches supported for a single query.

An implementation playing the role of origin server shall declare its support for the following in its Conformance Statement:

- Whether it is a native or proxy implementation
- Fuzzy Matching

- **Empty Value Matching**
- **Multiple Value Matching**
- Optional resources supported
- Optional Attributes supported

Add the following example to PS3.18 Section B Examples (Informative):

B.26 WADL Method Definition of a Capabilities Description for an Origin Server Supporting Studies Search

```
<method id="searchForStudies" name="GET">
        <request>
                <param   default="multipart/related;   type=application/dicom+xml"   name="Accept"
style="header">
                        <option value="multipart/related; type=application/dicom+xml"/>
                        <option value="application/json"/>
                </param>
                <param name="limit" style="query" type="xs:int">
                        <doc>maximum number of records</doc>
                </param>
                <param name="offset" style="query" type="xs:int">
                        <doc>skipped results</doc>
                </param>
                <param name="StudyDate" style="query"/>
                <param name="00080020" style="query"/>
                <param name="StudyTime" style="query"/>
                <param name="00080030" style="query"/>
                <param name="AccessionNumber" style="query"/>
                <param name="00080050" style="query"/>
                <param name="ModalitiesInStudy" style="query"/>
                <param name="00080061" style="query"/>
                <param name="ReferringPhysicianName" style="query"/>
                <param name="00080090" style="query"/>
                <param name="PatientName" style="query"/>
                <param name="00100010" style="query"/>
                <param name="PatientID" style="query"/>
                <param name="00100020" style="query"/>
                <param name="StudyInstanceUID" repeating="true" style="query"/>
                <param name="0020000D" repeating="true" style="query"/>
                <param name="StudyID" style="query"/>
                <param name="00200010" style="query"/>
                <param name="includefield" repeating="true" style="query" type="xs:string">
                        <option value="all"/>
                        <doc>include fields</doc>
                </param>
                <param name="fuzzymatching" style="query" type="xs:boolean">
                        <option value="true"/>
                        <option value="false"/>
                        <doc>additional fuzzy semantic matching</doc>
                </param>
                        <param name="emptyvaluematching" style="query" type="xs:boolean">
                        <option value="true"/>
                        <option value="false"/>
                        <doc>additional fuzzy semantic matching</doc>
                </param>
                <param name="multiplevaluematching" style="query" type="xs:boolean">
                        <option value="true"/>
                        <option value="false"/>
                        <doc>additional fuzzy semantic matching</doc>
                </param>
        </request>
        <response status="200 204 299">
                <representation mediaType="multipart/related; type=application/dicom+xml"/>
                <representation mediaType="application/json"/>
        </response>
        <response status="400 403 500 503"/>
</method>
```

Note

This example depicts support for the Fuzzy Matching and Repository Query options.