Why do you need metadata? Finding the right patient data fast !

A quick user guide for clinicians

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About the usage of metadata in accessing imaging information

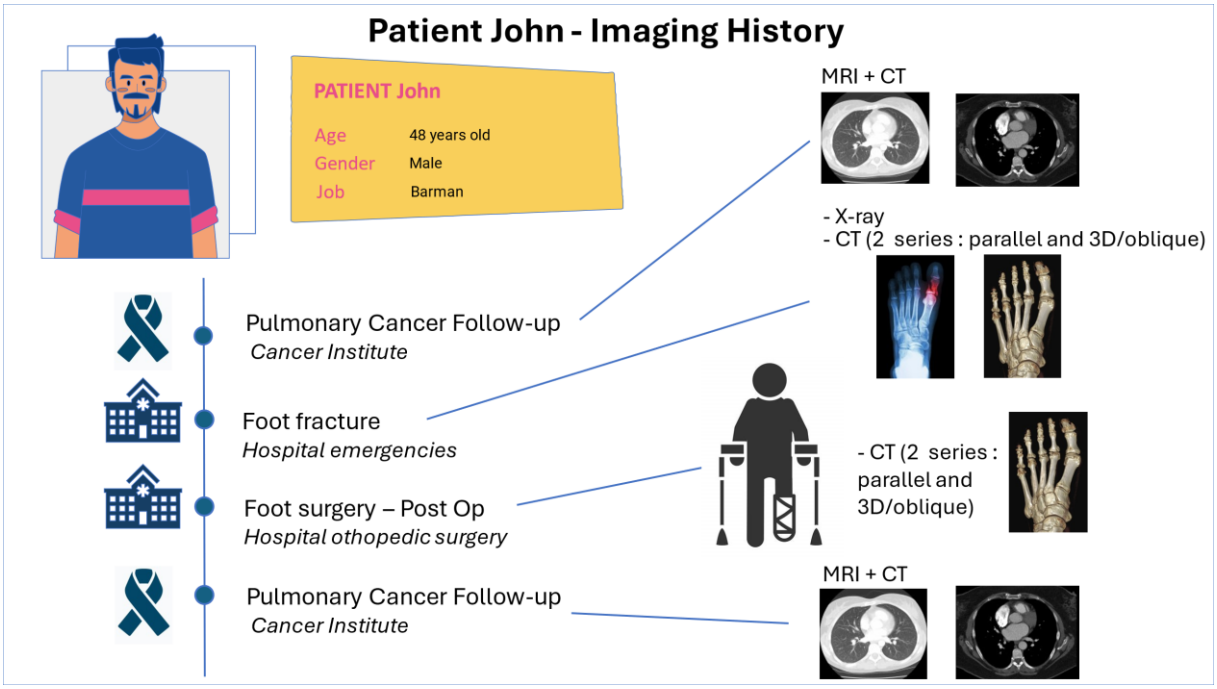
When searching for a book in a library, each book is represented by a “library card” that contains only key information about the book it represents: the title of the book, the name of the author, the publication data, type of book (novel, history, scientific paper, etc.), the number of pages, the location of the book in the library, etc. Such information is called under a generic name of “metadata”. Different objects may be associated with a “search card” that contains different metadata, for example metadata about seeds in a plant nursery.

In this quick guide, we will speak of metadata associated with search cards for clinical documents or objects that need to be shared such as medical images, or medication notices.

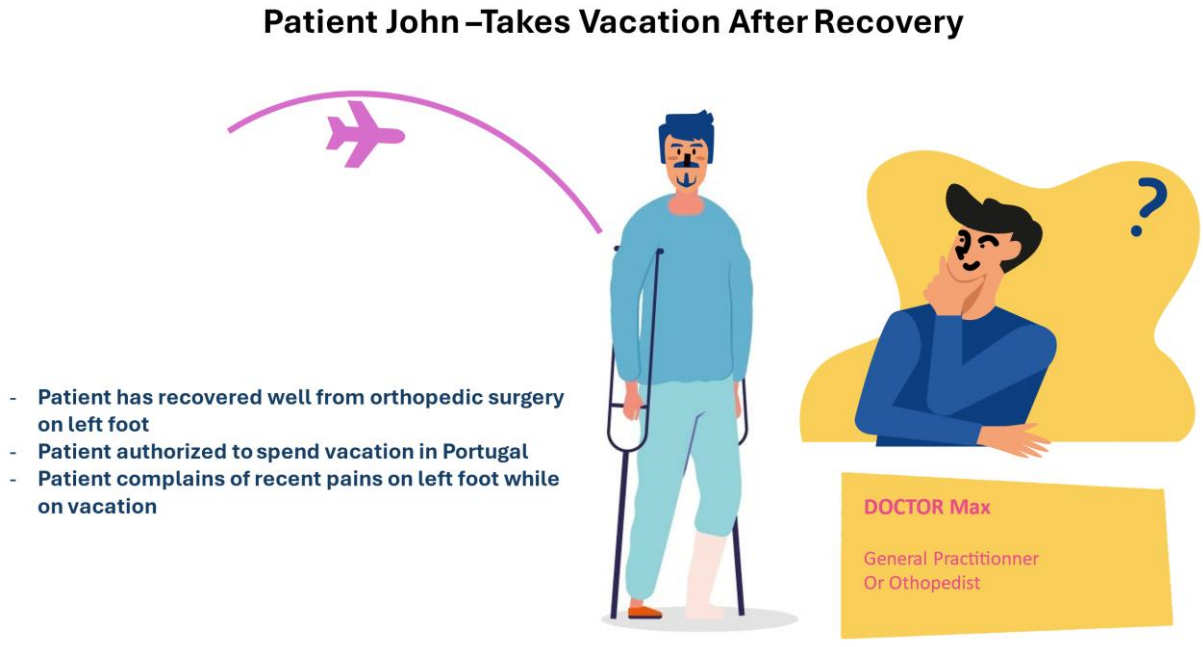
Health professionals need to understand the information elements that are recorded in a patient record, using such search cards, to assist in filtering information objects, such as radiology reports, patient summaries, or laboratory reports. This will help health professionals being efficient in filtering out those documents that are not relevant in order to keep only those that are likely relevant. This user guide also provides guidance on ensuring simple and reliable creation of metadata related to imaging studies and imaging reports.

1 - Introduction to the usage of metadata in filtering queries for searching relevant imaging studies.

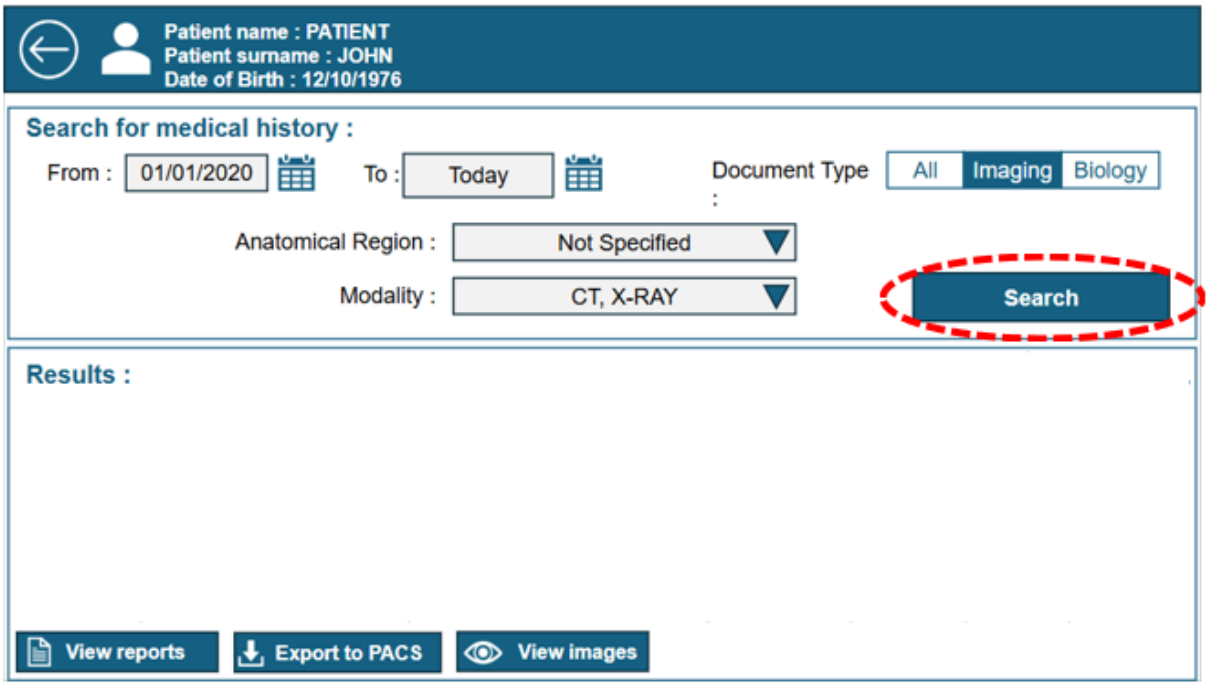
This basic example of metadata usage starts with a patient and his imaging history summarized in the figure below.



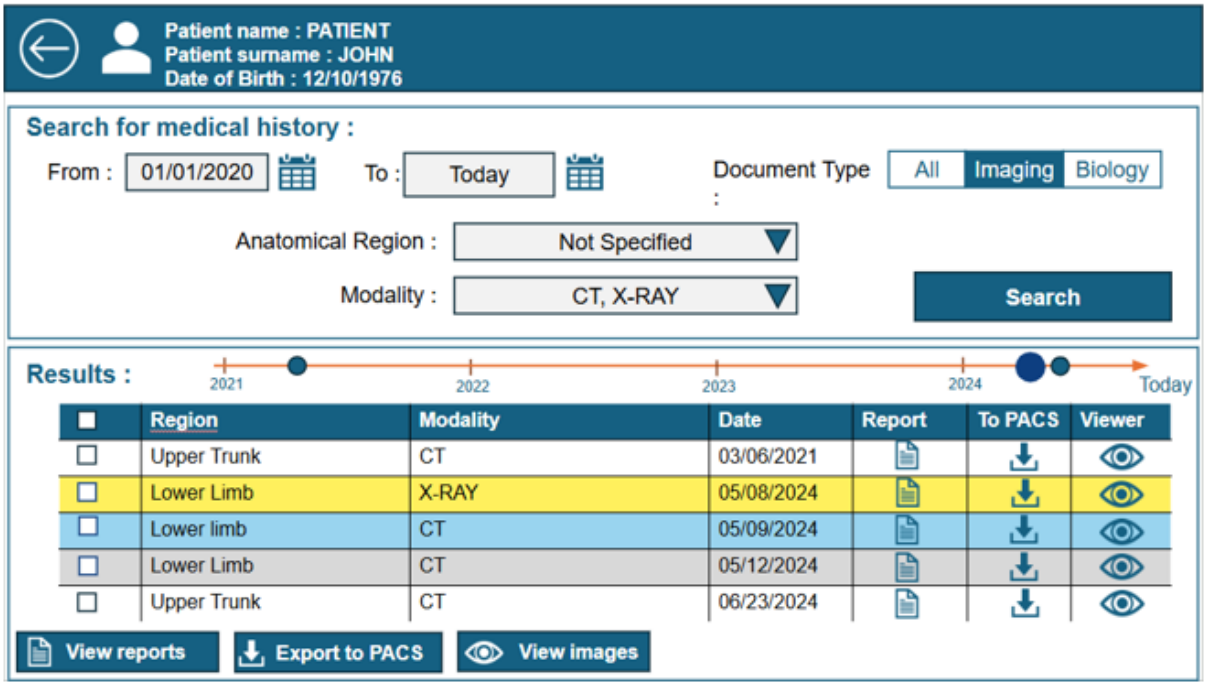
This patient, while on vacation, visits a doctor (general practitioner or orthopedist). The clinician needs access to John's imaging history to understand his recent foot surgery.



As an example, Dr Max, an Orthopedist may have a screen dedicated to imaging studies and reports navigation such as:



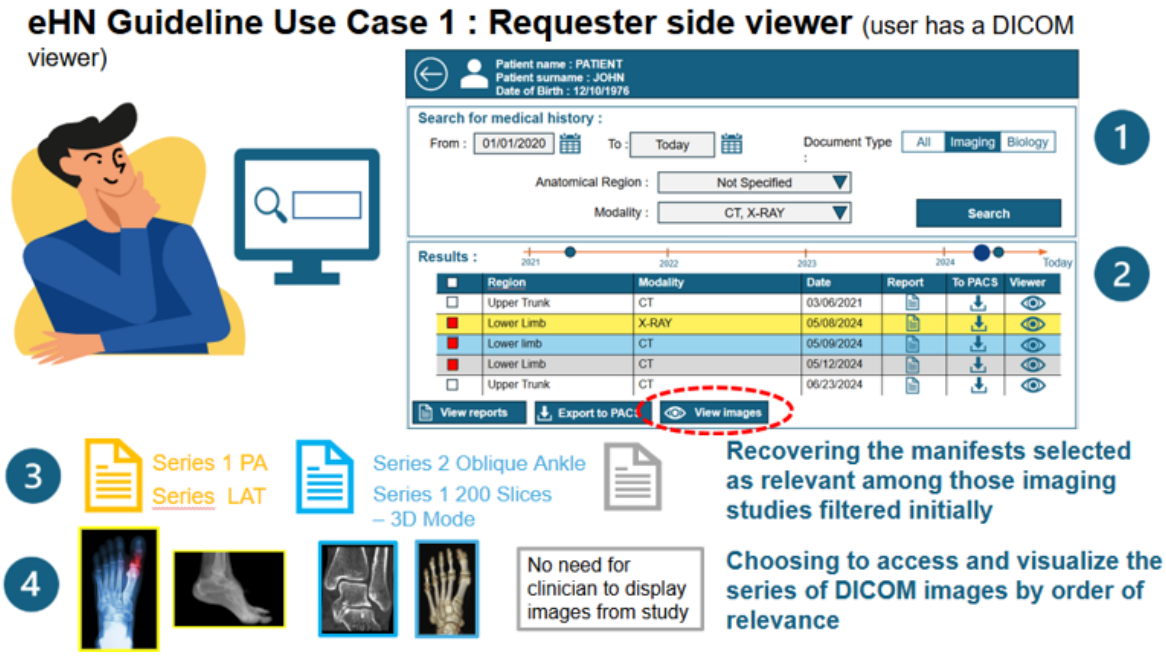
Having chosen the required query criteria (query keys), Dr Max clicks the Search button to initiate the query. The following search results are shown:



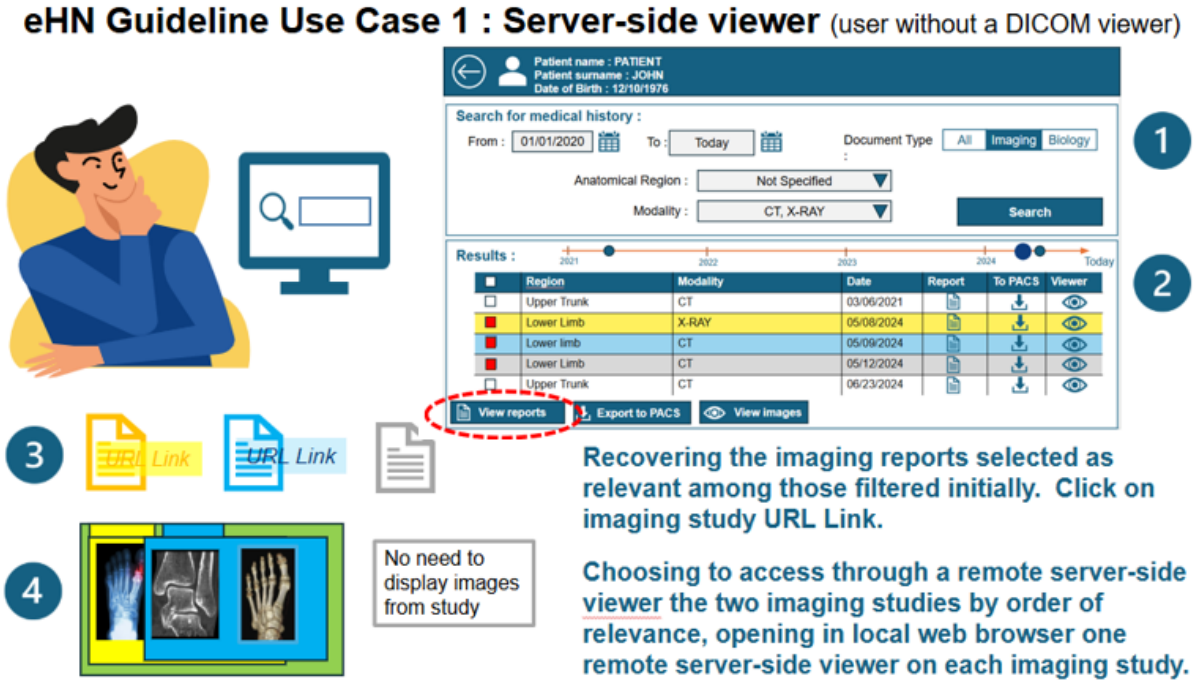
There are now two known variants depending on the clinical need/capability:

1. The clinician is used to handle imaging studies and has access to advanced imaging software such as a DICOM Viewer (orthopedist, radiologist, etc.).

   Dr Max selects the relevant prior imaging studies (step 2 below), retrieves the study summary information (step 3) and finally retrieves the relevant imaging studies (step 4). This is termed “requester-side viewing” as:



2. The clinician prefers to access and review the relevant imaging reports (steps 2 and 3 below). He may choose to click on a web link to view some of the studies (step 4) despite not having access to advanced imaging software (general practitioner, etc.). This is termed “server-side viewing” as:



In this basic example and its two variants, one highlights how the filtering of relevant imaging studies is performed, essentially by using filters that exclude non relevant imaging studies (first eliminating modalities not typically used) and once a list of a the filtered subset of imaging studies is displayed, the clinician may further select among those only those of interest (pertaining to the lower extremities).

Such a process should ensure that only non-relevant studies are weeded out.

2 - Demonstrating the usage of metadata through radiology use cases

2.1 Radiological exam with referral:

In 2018, patient X falls off his bike and goes to the emergency room (ER) in hospital A. Breathing is very painful, and ER doctor A orders a chest X-ray. He's diagnosed with a number of bruised ribs.

Years later, in 2023, patient X experiences persistent fatigue and visits his General Practitioner (GP). Considering X's medical history, including the bike accident, the GP orders blood tests and a chest X-ray at hospital A. The blood tests are normal, but this time, the radiologist at hospital A finds a concerning nodule on the X-ray that requires further investigation.

The GP refers patient X to a pulmonologist. Due to long wait times at hospital A, X chooses to see pulmonologist B at hospital B.

> Pulmonologist B, queries for imaging studies by filtering on:
> - Date range: Today - 10 years
>
> which returns studies among which the chest X-ray's from both 2018 and 2023.

Upon selecting and viewing the study from 2023 the pulmonologist confirms the nodule. She also sees what appears to be a faint scar on the lung. Concerned that the scar tissue might actually be a lesion related to the nodule, she orders a chest CT scan for a more detailed examination. The Radiology department processes this order by selecting on its RIS a chest CT imaging procedure. The RIS automatically assigns for this study the corresponding Modality "CT" and the Anatomical Region "UPPER TRUNK" derived from the selected imaging procedure through a RIS configured mapping table (See Chapter 4 of this guide). This study is performed.

> Radiologist B at hospital B assesses the chest CT scan and queries for prior relevant imaging studies by filtering on:
> - Date range: Today - 10 years
> - Bodypart : UPPER TRUNK - Thoracic segment of the trunk
> - Modality : CT, CR, DR
>
> which returns studies among which the chest X-ray's from both 2018 and 2023.

The radiologist imports the study from 2018 to compare it to the recent CT study. This comparison is crucial: it reveals that what initially appeared to be a concerning lesion is actually just scar tissue from the old rib injuries. This is good news, as it means the newly discovered nodule is an isolated finding, potentially improving the prognosis.

With this crucial information, pulmonologist B makes a diagnosis and, given the single nodule, decides on a treatment plan involving targeted radiotherapy.

After completing treatment and a recovery period, patient X feels much better. At a follow-up appointment with pulmonologist B, a new chest X-ray is taken.

Radiologist B again queries for prior relevant imaging studies by filtering on:

- Date range: Today - 10 years
- Bodypart : UPPER TRUNK - Thoracic segment of the trunk
- Modality : CT, CR, DR

which returns studies among which the chest X-ray's from both 2018 and 2023 as well as the most recent CT study ordered by pulmonologist B.

When comparing the new chest X-ray with these previous studies from hospitals A and B the pulmonologist can confirm that the nodule has disappeared. Patient X is discharged, his successful journey highlighting the importance of sharing imaging study data in providing comprehensive and accurate care.

2.2 Urgent Consult

The world tilted, then blurred. One moment, Mr. X was sipping his morning coffee, the next, his face felt strangely numb. He tried to speak, but the words came out garbled, his tongue a clumsy weight in his mouth. This was not right. This was very wrong.

His wife, eyes wide with fear, rushes him to the Emergency Room of the hospital A.

Neurologist A in the ER suspects a brain hemorrhage or infarction. A CT scan is made and assessed by radiologist A. He immediately gives an oral report, which shows a suspicion of a cerebral infarction.

A CT Angiographic scan is then ordered. The Radiology department processes this order and selects on its RIS a CT Angiographic imaging procedure. The RIS automatically assigns the corresponding Modality "CT" and the Anatomical Region "HEAD AND NECK" for this study (See Chapter 4 of this guide). This study is performed and shows that a blood vessel in the brain is blocked.

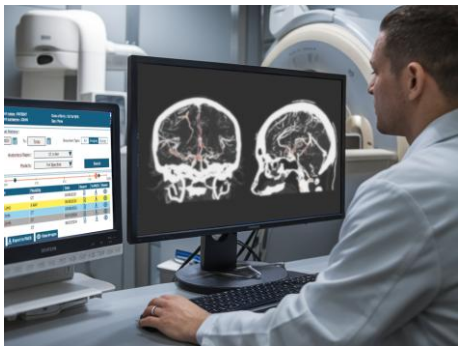
After consulting with radiologist A, neurologist A decides that patient X may benefit from an IAT treatment (intra-arterial thrombectomy) that can be performed in hospital B.

He calls neurologist B in the ER of hospital B. Neurologist B calls the on-call interventional radiologist at hospital B. Interventional radiologist B consults the “imaging timeline”:

Radiologist B queries for prior relevant imaging studies by filtering on:

- Date range: Today - 1 year
- Bodypart : HEAD ANDNECK - Structure of head and/or neck
- Modality : CT, DR, CR

which returns studies among which the recent CT scan performed in the ER at hospital A and the CT Angio Scan both ordered by neurologist A. No other head studies are returned.



The interventional radiologist B views the CT Angio scan of patient X from hospital A. He concludes that the infarction can be treated with IAT which he conveys to Neurologist B.

Neurologist B calls neurologist A, indicates that IAT is indicated and can be performed in hospital B. Patient X leaves hospital A for hospital B by ambulance.

In hospital B, the interventional radiology room is prepared. The treatment team prepares themselves based on the CT Angiogram from hospital A:

From the intervention room, Interventional Radiologist B queries again for prior relevant imaging studies by filtering on:

- Date range: Today
- Bodypart : HEAD AND NECK - Structure of head and/or neck
- Modality : CT

He selects among the two returned CT studies, the CT Angio Scan ordered by neurologist A at hospital A.

Upon arrival of patient X at the ER in hospital B, he goes directly to the intervention room where interventional radiologist B has reviewed the CT Angio scan and is ready and performs the IAT treatment.

3 Details on the complete list of metadata related to imaging use cases

An “imaging timeline” is an overview of imaging examinations of a single patient, compiled from the information elements: examination data, image(s), and report(s). It may be filtered, if desired, based on key metadata elements such as date span, modality anatomical regions. These information elements and associated metadata are made available by potentially all care delivery entities in a region, country or even cross-border (e.g. MyHealth@EU), through a query.

The timeline or any filtered list of zero or more radiological examinations of a patient, is made available by the healthcare institutions where the patient is or has been treated. It is available to the attending physician or imaging specialist (e.g. radiologist) per patient within their own work environment as offered by each healthcare institution (e.g. in RIS, PACS, Patient Record System, or by access to a health professional portal). The information elements of a patient (e.g., patient number, name, date of birth) are of course used, but are not described here to focus on the imaging specific aspects.

An imaging examination belongs to one patient. Multiple examinations from various imaging specialties (radiology, cardiology, endoscopy, etc) can take place for one patient. An imaging examination is a set of imaging reports, images and other evidence from imaging studies. These information elements are detailed below.

3.1 Metadata Information Elements used to query/search and select.

This section offers a more comprehensive analysis in order to completely specify all metadata elements that should be attached to imaging reports and imaging studies.

3.1.1 Common key information about Imaging Reports and imaging Studies

Key information or search metadata is associated with each report or imaging study, allowing a healthcare provider to quickly filter them in issuing a query request, are also used for selecting among multiple matching response to assess their relevance. It is necessary for simplicity and accuracy to focus only on critical and uniform information for filtering reports and imaging studies of likely interest. This is information that an attending physician or radiologist wants to know in order to determine whether there are any potentially relevant previous examinations to include in the care process. This is what we call “imaging metadata” and most of it, is applicable to both imaging reports and imaging studies.

The table below provides an overview of the metadata as used above and recommended by MCWG. **Bolded metadata attributes are suitable for initial search queries** as their values are few and reliable to search upon (coded not free text). The non-bolded metadata elements are important to perform a further selection, before deciding what imaging reports and imaging studies will be retrieved.

Metadata element	Description	Type of value
Class of document (classCode)	**The class of document (e.g. "report" or "image").** This supports situations such as where only the imaging report is of interest or other cases where only the imaging study is. Combined with "practice setting codes" in most queries.	Coded with a coarse level of granularity. No specialty embedded. https://wiki.ihe.net/index.php/XDS_classCode_Metadata_Coding_System
Producing Specialty (practiceSettingCode)	**The producing specialty, such as radiology, dentistry, endoscopy, etc.** This is the responsible medical specialty for performing the examination. A uniform coding system is easy to establish if kept above subspecialties (see MCWG recommendation for 88 values from SNOMED-CT).	A uniform coding system is easy to establish if kept above subspecialties (see MCWG recommendation for 88 values from SNOMED-CT). Covers: radiology, cardiology, endoscopy, surgery, emergency, intensive care, etc (SNOMED-CT)
Service Date and Time of Study: - Start of Service Period - End of Service Period	**Date/time the service** during which the examination was performed and the report or imaging study were created.	**Start Time Period is required. End time period is optional.** Allows to select a range**.**
Anatomical Regions (eventCodeList)	**Anatomical region(s) or body part(s)** targeted by the imaging study. A "coarse grain" set of codes is strongly recommended by MCWG.	MCWG specifies 10 values from SNOMED-CT for major body parts and systems (head/neck, upper extremities, cardiovascular, etc.). See Table below.
Modalities (eventCodeList)	**Study-level Modalit(ies) used for image acquisition of the study.** Set by RIS per each imaging procedure code	Category of acquisition device (DICOM CID 29) used for main imaging information acquisition.
Study Instance UID (referenceIdList)	**Imaging Study Unique Identifier** Identifiers related to the examination (with registration authority to be globally unique)	Helps finding all imaging reports produced on a specific imaging study
Accession number (referenceIdList)	**Imaging procedure request identifier**. RIS generated with registration authority to be globally unique.	Finding all imaging reports and imaging studies resulting from a specific internal imaging activity order

Placer Order number (referenceIdList)	**Order Identifier from ordering module** EHRher/EMR with registration authority to be globally unique.	Finding all imaging reports and imaging studies resulting from an external request (within or outside the performing institution).
Study Requester ID (referenceIdList)	**National identifier of the requesting clinician** with registration authority.	Finding all imaging reports and imaging studies resulting from studies ordered by the same requesting clinician.
Procedure Code	Description of the imaging procedure or the examination performed (e.g., CT thorax, MRI knee, breast ultrasound, X-ray foot). Set by RIS per each performed procedure code Note: to filter examinations it is suggested to use modality and anatomical region (basic body parts), which are always uniformly coded.	Ideally there is a standardized table of procedures (nationally or beyond). At a minimum there is a display name for locally defined procedures.
typeCode	The code specifies the precise kind of document (local practice dependent coding)	e.g., Pulmonary History and Physical, Discharge Summary, Ultrasound Report, Imaging Study Manifest.
Author	Name of the author who authorized the report and/or the sharing of the imaging study. It contains the following sub-attributes: author Institution (where the author practices), the author Role and, the author Specialty.	
Type of Healthcare Facility (healthcareFacilityTypeCode)	**Type of the healthcare institution or organization where the radiological examination was performed.** Country specific.	e.g.: general hospital, regional hospital, specialty hospital, clinic, imaging center, etc.)
Availability Status	**Availability Status of the report and imaging study,** which shows whether they have been approved for sharing or have been deprecated (e.g. following an correction that resulted in an updated report).	Approved is the default, but allows access to deprecated documents if necessary.

In addition to the examination data, which is important for the care process, other data may be needed internally for a healthcare institution to realize the examination and to manage the diagnostics process. These are not mentioned here.

The table below lists the Anatomical region(s) or body part(s) targeted by the imaging study, that can be used to filter (one or more values) in an initial query.

SNOMED CT Code	Patient Friendly Name*	Display name in English
63337009	Lower trunk	Abdominopelvic segment of trunk
38266002	Whole body	Entire body as a whole
53120007	Arm	Upper limb structure
61685007	Leg	Lower limb structure
67734004	Upper trunk	Thoracic segment of trunk
774007	Head and neck*	Structure of head and/or neck
113257007	Cardiovascular system	Structure of cardiovascular system
80891009	Heart	Heart
76752008	Breast	Breast structure
737561001	Spine*	Structure of vertebral column and/or spinal cord

3.1.2 Imaging Report(s)

The report is a document that describes the content assessment by the imaging specialist (e.g. radiologist). For the filtering query or timeline as well as use in the care process, the report is considered as a whole and not a collection of separate information elements. The report can be modified by updating it with an addendum or a rectification.

3.1.3 Image(s) in imaging study(ies)

The images are of diagnostic quality and contain data for identification between different image storage systems (such as date, time, source, format) and for reference (such as modality, settings, protocol, properties, etc.) so that technically and functionally images from different examinations can be compared with each other. Because all healthcare institutions in almost all countries use the same international standard for imaging (DICOM) when creating, storing and sending images. A reference to this standard is sufficient here. A functional description of information elements could never be as accurate and complete as the standard already is.

4 How to make the creation of metadata related to imaging studies simple and reliable.

The creation metadata related to imaging studies is integral to the quality assurance process of any imaging department. Indeed, incorrect metadata could lead to clinical errors resulting from missing in query responses clinically relevant imaging studies. For example, an incorrect anatomical region for an imaging study may prevent its discovery by a clinician that queries on such an anatomical region for its patient's previous imaging studies.

This chapter provides guidance in approaches to reduce the need for manual entry of several metadata elements, increasing their reliability and simplifying the tasks of imaging department staff. It is also important guidance for vendors of RIS and PACS systems to build such automation wherever possible and clinically safe. With the deployment of larger sharing domains, regions, nations and soon cross-border, the application of such a robust methodology, ensures a shared common understanding between clinicians and imaging specialists that practice in different institutions and may rarely interact directly, although they share the responsibility for these metadata creation quality processes. This is critical to build trust.

The table of the key metadata elements introduced in the previous chapter, is reused in this chapter with an additional column "source" that provides guidance on the best approach to generate the right value for each metadata element of any imaging study. It is important that every value be filled to offer the best visibility to the remote health professional who is searching for relevant imaging studies in the course of the treatment of its patient.

> **Bolded metadata attributes are suitable for initial search queries** as their values are few and reliable to search upon (coded, not free text). The non-bolded metadata elements are important to perform a further selection, before deciding what imaging reports and imaging studies will be retrieved.

Metadata element	Description	Type of value	Source of value
Class of document (classCode)	**The class of document (e.g. "report" or "image").** This supports situations such as where only the imaging report is of interest or other cases where only the imaging study is. Combined with "practice setting codes" in most queries.	Coded with a coarse level of granularity. No specialty embedded. https://wiki.ihe.net/index.php/XDS_classCode_Metadata_Coding_System	Internally generated by the document publisher systems based on local information (often linked to the Document Type): - for an imaging report ➔ "REPORT" - for an imaging study manifest ➔ "IMAGE"
Producing Specialty (practiceSettingCode)	**The producing specialty, such as radiology, dentistry, endoscopy, etc.** This is the responsible medical specialty for performing the examination. A uniform coding system is easy to establish if kept above subspecialties (see MCWG recommendation for 88 values from SNOMED-CT).	A uniform coding system is easy to establish if kept above subspecialties (see MCWG recommendation for 88 values from SNOMED-CT). Covers: radiology, cardiology, endoscopy, surgery, emergency, intensive care, etc (SNOMED-CT)	Internally generated by the document publisher systems based on the producing specialty assigned to the Imaging Report (often linked to the Document Type of the Imaging Report): - Radiology Report ➔ RADIOLOGY - Dentistry Report ➔ DENTISTRY -
Service Date and Time of Study: - Start of Service Period - End of Service Period	**Date/time the service during which the examination was performed and the report or imaging study were created.**	**Start Time Period is required. End time period is optional.** Allows to select a range.	May be automatically generated from the Date/Time in study level attributes of images. This requires that the modality equipment date and time are well configured. May also reuse the value used in the imaging report metadata by the RIS.
Anatomical Regions (eventCodeList)	**Anatomical region(s) or body part(s) targeted by the imaging study.** A "coarse grain" set of codes is strongly recommended by MCWG.	MCWG specifies 10 values from SNOMED-CT for major body parts and systems (head/neck, upper extremities, cardiovascular, etc.). See Table below.	Automatically generated by the RIS, by mapping the RIS assigned Procedure Code to the corresponding anatomical region. The same value (more than one value permitted) shall be used in the imaging study and the imaging report.
Modalities (eventCodeList)	**Study-level Modalit(ies) used for image acquisition of the study.** Set by RIS per each imaging procedure code	Category of acquisition device (DICOM CID 29) used for main imaging information acquisition.	Automatically generated by the RIS, by mapping the RIS assigned Procedure Code to the corresponding modality. The same value shall be used in the imaging study and the imaging report.
Study Instance UID (referenceIdList)	**Imaging Study Unique Identifier**	Helps finding all imaging reports produced on a specific imaging study	Automatically assigned by the RIS when the imaging order received from the

	Identifiers related to the examination (with registration authority to be globally unique)		order placing system was processed as imaging requests
Accession number (referenceIdList)	**Imaging procedure request identifier**. RIS generated with registration authority to be globally unique.	Finding all imaging reports and imaging studies resulting from a specific internal imaging activity order	Automatically assigned by the RIS when the imaging order received from the order placing system was processed as imaging requests to which the accession number is attached.
Placer Order number (referenceIdList)	**Order Identifier from ordering module** EHR/EMR with registration authority to be globally unique.	Finding all imaging reports and imaging studies resulting from an external request (within or outside the performing institution).	Automatically assigned by the order placing system when the imaging order was created. Shall be the same as the one recorded by the imaging report(s) associated to the imaging study.
Study Requester ID (referenceIdList)	**National identifier of the requesting clinician** with registration authority.	Finding all imaging reports and imaging studies resulting from studies ordered by the same requesting clinician.	Automatically assigned by the order placing system when the imaging order was created.
Procedure Code	Description of the imaging procedure or the examination performed (e.g., CT thorax, MRI knee, breast ultrasound, X-ray foot). Set by RIS per each performed procedure code Note: to filter examinations it is suggested to use modality and anatomical region (basic body parts), which are always uniformly coded.	Ideally there is a standardized table of procedures (nationally or beyond). At a minimum there is a display name for locally defined procedures.	Manually assigned on the RIS when the imaging order received from the order placing system was processed as imaging request(s). Procedure Codes shall be mapped to Anatomical Regions and Modalities through a locally configured table. In some cases, the anatomical regions need manual entry if the RIS procedure code is too generic.
typeCode	The code specifies the precise kind of document (local practice dependent coding)	e.g., Pulmonary History and Physical, Discharge Summary, Ultrasound Report, Imaging Study Manifest.	For the imaging report, it may be assigned automatically by the RIS when the imaging order received from the order placing system was processed. For the imaging study it is a fixed value (imaging manifest)
Author	Name of the author who authorized the report and/or the sharing of the imaging study. It		For an imaging report, it is the reporting physician as tracked by the RIS. For the

	contains the following sub-attributes: author Institution (where the author practices), the author Role and, the author Specialty.		Imaging Manifest, it is assigned to the device that created the imaging manifest (from the images of the study)
Type of Healthcare Facility (healthcareFacilityTypeCode)	**Type of the healthcare institution or organization where the radiological examination was performed.** Country specific.	e.g.: general hospital, regional hospital, specialty hospital, clinic, imaging center, etc.)	Internally generated by the document publisher systems based on the type of health care facility where the RIS or PACS system is installed.
Availability Status	**Availability Status of the report and imaging study,** which shows whether they have been approved for sharing or have been deprecated (e.g. following an correction that resulted in an updated report).	Approved is the default, but allows access to deprecated documents if necessary.	Automatically updated (for example if an imaging study receives an additional series the current manifest may be deprecated and the replacement made active).

Note: In most cases, the imaging study metadata element should convey the same value (s) as the Imaging Report, as they are closely related. In some deployment and workflows, when the imaging study(ies) publication is triggered by the imaging report(s) validation, it might be useful to copy the imaging report metadata generated by the RIS, as the imaging study manifest metadata.