



RadLex Playbook 2.2

User Guide

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Radiological Society of North America (RSNA)

Table of Contents

1	Introduction	3
2	Playbook Structure	3
2.1	Modality	3
2.2	Body Part	4
2.3	Contrast	4
2.4	Exam Names	5
2.5	Examples	5
3	Playbook Version 2.0	5
4	Current Initiatives and Future Directions.....	6
4.1	Harmonized RadLex-LOINC Playbook	6
4.2	Playbook Version 2.1.....	6
4.3	Playbook Version 2.2.....	7
4.4	Evolution Strategy.....	7
5	Conclusions	7
6	Appendix 1: Table Structure.....	8
6.1	core-playbook-2_2.csv.....	9
6.2	complete-playbook-2_2.csv	10
6.3	subset-table-playbook-2_2.csv	11
6.4	map-to-table-playbook-2_2.csv	11
7	Appendix 2: Web services interface	12
7.1	https://services.rsna.org/playbook/v1/playbook/core	12
7.2	https://services.rsna.org/playbook/v1/playbook/subset	12
7.3	https://services.rsna.org/playbook/v1/playbook/mapto	12
7.4	https://services.rsna.org/playbook/v1/playbook/radlexTerms	12
7.5	https://services.rsna.org/playbook/v1/playbook/complete/all	12
7.6	https://services.rsna.org/playbook/v1/playbook/complete/cpt/{CPTcode}	12
7.7	https://services.rsna.org/playbook/v1/playbook/complete/rpid/{RPIDcode}	12
7.8	https://services.rsna.org/playbook/v1/playbook/complete/modality/{ID}	12
8	Appendix 3: Harmonized RadLex-LOINC Playbook model (draft).....	13

1 Introduction

RadLex Playbook is a project of the Radiological Society of North America (RSNA), and constitutes a portion of the RadLex ontology. Playbook aims to provide a standard system for naming radiology procedures, based on the elements which define an imaging exam such as modality and body part. By providing standard names and codes for radiologic studies, Playbook is intended to facilitate a variety of operational and quality improvement efforts, including workflow optimization, chargemaster management, radiation dose tracking, enterprise integration and image exchange.

Historically, departments and institutions have adopted or developed idiosyncratic codes and names for radiology exams, which may have been internally generated or vendor-dependent. This approach led to limited exam interoperability. At its core, Playbook is a set of standardized codes and names which may be used in place of (or alongside) historical codes, in systems which track imaging procedures. Such systems include PACS, reporting applications, RIS, physician order entry systems and electronic medical records.

Playbook currently addresses imaging exams at the level of radiology orderables (i.e. studies which a referring physician may request through an order entry system). Depending on institutional practice, such orderables may be less specific than the exams actually performed. For example, “CT abdomen/pelvis with contrast” is less specific than “CT abdomen/pelvis with contrast, liver protocol.”

Access RadLex Playbook on the web at <http://playbook.radlex.org> where a graphical search interface is available, as well as a set of downloadable spreadsheets (see Appendix 1). Alternatively, RadLex Playbook content may also be accessed via web services, as described in Appendix 2.

2 Playbook Structure

Each Playbook procedure consists of a unique numerical code (RadLex Playbook identifier, or “RPID”), and a set of procedure names. Each such exam is defined by a set of elements, or attribute values, where each such attribute value describes one aspect (i.e. attribute) of the exam. Each attribute value is a RadLex term, with a corresponding RadLex identifier (“RID”). In addition, certain kinds of attributes may have more than one specific value, in which case more than one instance of that attribute may be used. For example, exams which image more than one portion of the body will have attributes `BODY_REGION` and `BODY_REGION_2`. The `MODALITY` attribute is one exception to this multiplicity rule, as detailed below. A few key types of attributes are described here. For a complete listing, please refer to Appendix 1: Table Structure.

2.1 Modality

Any radiologic procedure will have one (or more) modalities. Furthermore, specific modalities may have specialized subtypes (e.g. CT angiography), which are described using modality modifiers. Modality-related factors are specified in Playbook using the `MODALITY` and `MODALITY_MODIFIER` attributes. In the case of multiple modalities, the combinations are pre-defined (or, “pre-coordinated”), rather than listed in multiple modality attributes. However, if there are multiple modality modifiers, then more than one `MODALITY_MODIFIER` is specified (i.e. `MODALITY_MODIFIER`, `MODALITY_MODIFIER_2`, etc.).

The complete list of imaging modalities is shown in Table 1. Note that the modality `OT` (for “other”) was previously used in Playbook to denote interventional procedures. However, because the notion of

“other” as a modality implied a modality not otherwise available in the modality naming scheme (i.e. some modality not among those otherwise listed in Table 1), Playbook has moved to the modality `RP` which is now used to refer to the majority of interventional procedures. In general, `XA` refers to procedures done using fluoroscopy, and where the images are obtained for diagnosis; for other procedures `RP` is used. For example, “`XA Carotid Artery Bilateral`” refers to diagnostic carotid angiography, whereas “`RP Bone Biopsy with Imaging Guidance`” refers to image-guided bone biopsy.

Table 1: Playbook modalities

Abbreviation	Modality
XR	Radiography
CT	Computed tomography
US	Ultrasound
MR	Magnetic resonance imaging
NM	Nuclear medicine (non-PET)
MG	Mammography
RF	Fluoroscopy
RP	Radiology procedure
OT	Other
XA	Angiography (fluoroscopic)
PT	Positron emission tomography
XR&RF	Radiography and fluoroscopy
US&RF	Ultrasound and fluoroscopy
NM&CT	Nuclear medicine (non-PET) and computed tomography
PT&CT	Positron emission tomography and computed tomography

Examples of `MODALITY_MODIFIER` include: `ANGIOGRAPHY`, `ARTHROGRAPHY`, `CYSTOGRAPHY`, `DISCOGRAPHY` and `MYELOGRAPHY`. Note that not all modality modifiers will be relevant for all modalities.

2.2 Body Part

The body part(s) imaged by an exam are indicated through two attributes, `BODY_REGION` and `ANATOMIC_FOCUS`. There may be multiple instances of either of these attributes. `BODY_REGION` is the more general anatomic identifier. This attribute is used to indicate a broad portion of the body, rather than a specific organ. For example, `BODY_REGION` may take values such as `HEAD`, `CHEST`, `ABDOMEN` or `PELVIS`. `ANATOMIC_FOCUS`, on the other hand, is a more specific anatomic identifier, often indicating an organ or organ system. Examples include `BRAIN`, `LIVER`, `PANCREAS`, `AORTA` and `KNEE`.

2.3 Contrast

The use of contrast materials for imaging exams is indicated using the `PHARMACEUTICAL` attribute. Note that the type of agent is typically implied by the imaging modality, and so the attribute value often omits the class of contrast agent. On the other hand, the attribute values are often used to indicate the route of administration, and potentially the combination of pre-contrast and post-contrast image acquisition. Consequently, a CT of the abdomen and pelvis performed with intravenous contrast has the `PHARMACEUTICAL` value `WITH IV CONTRAST`, rather than `WITH IV IODINATED CONTRAST`.

Other examples of PHARMACEUTICAL values include: BILIARY CONTRAST, INTRAARTICULAR CONTRAST and INTRATHECAL CONTRAST. Note that this attribute is also selectively used to indicate the administration of particular radiotracers, medications or other diagnostic or therapeutic materials.

2.4 Exam Names

Playbook exams are also assigned up to six alphanumeric names as follows:

Table 2: Playbook exam names

Name	Comment
AUTOMATED_LONG_NAME	Automatically generated name.
AUTOMATED_SHORT_NAME	Automatically generated abbreviated name.
AUTOMATED_LONG_DESCRIPTION	Automatically generated sentence-form description.
LONG_NAME	Manually edited name, available for selected RPIDs.
SHORT_NAME	Manually edited abbreviated name, available for selected RPIDs.
LETTER CODE	Up to 10 characters long, available for selected RPIDs.

2.5 Examples

Consider two examples to illustrate the structure of Playbook codes. First, CT of the abdomen and pelvis with intravenous contrast. This is defined with the MODALITY value CT (RID 10321), BODY_REGION value ABDOMEN (RID 56), BODY_REGION_2 value PELVIS (RID 2507) and PHARMACEUTICAL value WITH IV CONTRAST (RID 28769). This set of attribute values defines the given exam, which is assigned RPID 145 (as above, note the distinction between RID's, indicating specific attribute values, and RPID's, which represent Playbook exam codes). In tabular form, this appears as follows:

Table 3: Playbook example: CT abdomen and pelvis with IV contrast

RPID	SHORT_NAME	MODALITY	BODY_REGION	BODY_REGION_2	PHARMACEUTICAL
RPID145	CT Abd/Pelv w	CT (RID 10321)	ABDOMEN (RID 56)	PELVIS (RID 2507)	WITH IV CONTRAST (RID 28769)

As another example, consider MRI of the head without intravenous contrast. This is defined with MODALITY value MR (RID 10312), BODY_REGION value HEAD (RID 9080), ANATOMIC_FOCUS value BRAIN (RID 6434) and PHARMACEUTICAL value WITHOUT IV CONTRAST (RID 28768), leading to RPID 479. Or, in tabular form:

Table 4: Playbook example: MR brain without IV contrast

RPID	SHORT_NAME	MODALITY	BODY_REGION	ANATOMIC_FOCUS	PHARMACEUTICAL
RPID479	MR Head wo	MR (RID 10312)	HEAD (RID 9080)	BRAIN (RID 6434)	WITHOUT IV CONTRAST (RID 28768)

3 Playbook Version 2.0

The Playbook project has been active since 2011. Using the approach described in Section 2, several thousand Playbook codes were created, based on contributions from a number of institutions. Starting

in 2014, efforts to streamline the number of Playbook codes were undertaken to simplify the process of adoption. Specifically, the codes at one large academic medical center were used to develop a core subset of Playbook codes, with just over 1,000 codes. With the release of Playbook version 2.0, this subset is referred to as the Core Playbook. While this subset may not cover all of the exams performed at other sites, it represents a more tractable starting point for Playbook adoption. By modality, Core Playbook contains the following:

Table 5: Core Playbook by modality

Modality	Number of RPIDs
XR	139
CT	104
US	102
MR	146
NM	102
MG	48
RF	92
RP	220
XA	59
PT	7
XR&RF	4
NM&CT	2
PT&CT	6

As part of the Playbook 2.0 release, new mechanisms have been put in place to mark the status of codes (e.g. ACTIVE, DISCOURAGED or DEPRECATED). In addition, when a code has been marked as DISCOURAGED or DEPRECATED, a mapping may now be provided to a more appropriate code.

4 Current Initiatives and Future Directions

4.1 Harmonized RadLex-LOINC Playbook

In the fall of 2013, a collaboration began between RSNA and the Regenstrief Institute to harmonize RadLex Playbook with the radiology codes in the LOINC system. This effort, funded by the National Institute of Biomedical Imaging and Bioengineering (NIBIB), has led to a model which unifies Playbook with LOINC. See Appendix 3 for the current draft form of this harmonized model. This work brings Playbook content into a widely used and broadly recognized terminology standard. Harmonized codes based on Core Playbook are partially complete. The remainder of this harmonization work is scheduled for completion at the end of 2017.

4.2 Playbook Version 2.1

Playbook version 2.1, released in November 2015, introduces two new features. First, for CT codes in the Core Playbook set, there are now mappings to the harmonized RadLex-LOINC codes in the Playbook mapping table (see Appendix 1). These harmonized codes take the form of LOINC codes, and were released as part of the December 2015 LOINC release.

Playbook Version 2.1 also introduced a web services interface to Playbook content (see Appendix 2). These web services allow for programmatic access of Playbook metadata, and are intended to provide an additional means for interacting with Playbook codes beyond the website and downloadable spreadsheets.

4.3 Playbook Version 2.2

Playbook version 2.2, released in July 2016, incorporates new mappings to the harmonized RadLex-LOINC system across the modalities CT, MR, US and NM. These mappings correspond with LOINC version 2.56 (released in June 2016).

4.4 Evolution Strategy

In order to manage the evolution of Playbook, with on-going content refinement as well as the harmonization with LOINC, a series of policies governing Playbook have been adopted:

1. Historical Playbook codes remain a part of the Playbook system, and will not be overwritten or deleted.
2. Playbook codes may now be assigned a status, one of `ACTIVE`, `DISCOURAGED`, `DEPRECATED` or `TRIAL`.
3. Playbook codes with status `TRIAL` are subject to change. Otherwise, changes to a Playbook code's component attribute values will generally not be made, unless such a change is approved by the Playbook committee.
4. When a particular code has been migrated from the RadLex Playbook into the harmonized LOINC/Playbook system, any further modifications to this code (such as status updates) will be conducted within the LOINC framework. As of this writing, we expect such migration will be conducted on a per-modality basis. For any modalities not yet migrated, creation of new codes and modifications of pre-existing codes will be conducted in the RadLex Playbook framework. For modalities which have already been migrated to the harmonized LOINC/Playbook system, the creation of any new codes of that modality type will be conducted in the LOINC framework.
5. For codes migrated from the RadLex Playbook into the harmonized LOINC/Playbook system, a mapping will be provided from the RadLex Playbook code to the harmonized code.

5 Conclusions

RadLex Playbook defines a system for specifying names and codes for imaging procedures. These standard identifiers may be used to facilitate operations and quality improvement efforts through interoperability. Core Playbook is part of the Playbook 2.0 release, and represents a streamlined subset of codes to simplify Playbook deployment. New features introduced with Playbook 2.0 include status tracking and mapping mechanisms. Playbook 2.1 introduces a web services interface to Playbook content. Playbook 2.2 contains mappings to the harmonized RadLex-LOINC system, spanning the modalities CT, MR, US and NM. Harmonization with the LOINC system promises to bring Playbook content to a broader user base.

6 Appendix 1: Table Structure

RadLex Playbook is available as a series of four comma-separated value (CSV) spreadsheets, as follows:

Table 6: Playbook spreadsheets

Spreadsheet	Description
core-playbook-2_2.csv	Core Playbook exams, as outlined in Table 5.
complete-playbook-2_2.csv	The full set of Playbook codes, including Core Playbook as well as all historical Playbook exams. This table also includes all Playbook names (see Table 2), as well as all metadata pertaining to status tracking.
subset-table-playbook-2_2.csv	Metadata which describes membership of specific RPIDs in one or more groups. The sole initial such group is CORE, applied to RPIDs in Core Playbook.
map-to-table-playbook-2_2.csv	Metadata which describes available mappings, from DISCOURAGED or DEPRECATED codes to one or more preferred codes.

The following subsections describe the columns in each of these tables. Column names listed in **bold** constitute attributes used to define Playbook exams. Note that some ambiguity in the use of these attributes has occurred over time. Work to resolve these issues has been conducted in the context of the RadLex-LOINC harmonization project described in Section 4.

6.1 core-playbook-2_2.csv

Table 7: Structure of core-playbook-2_2.csv

Column Name	Description
RPID	Unique Playbook identifier, of the form “RPIDxxx” where “xxx” is a positive integer.
LETTER_CODE	Unique character code. Up to 10 characters in length. Available for selected RPIDs only.
SHORT_NAME	A manually edited abbreviated string name.
LONG_NAME	A manually edited verbose string name.
MODALITY	Character modality code, as listed in Table 1.
PLAYBOOK_TYPE	Generally taking the value RADIOLOGY ORDERABLE.
POPULATION	An exam is presumed to pertain to adult patients, unless this field takes a value such as NEONATAL, INFANT or PEDIATRIC.
BODY_REGION	Indicates which broad portion(s) of the body are to be imaged by a given procedure. Multiplicity of this attribute (see Section 2) may be specified using columns BODY_REGION_2 through BODY_REGION_5.
MODALITY_MODIFIER	Indicates subtypes of an imaging modality (e.g. ANGIOGRAPHY for CT angiography exams). Multiplicity may be specified using MODALITY_MODIFIER_2 and MODALITY_MODIFIER_3.
PROCEDURE_MODIFIER	Indicates certain aspects of procedural technique (e.g. TRANSJUGULAR for biopsies by that route). Multiplicity may be specified using PROCEDURE_MODIFIER_2.
ANATOMIC_FOCUS	Secondary indicator of the imaged area, more specific than BODY_REGION and often referring to an organ or organ system. Multiplicity may be specified using ANATOMIC_FOCUS_2.
LATERALITY	Where applicable, may take any of the following values: RIGHT, LEFT, BILATERAL, UNILATERAL.
REASON_FOR_EXAM	May refer to a specific indication (e.g. SCREENING) or a specific goal of the exam (e.g. BIOPSY). Multiplicity may be specified using REASON_FOR_EXAM_2 and REASON_FOR_EXAM_3.
TECHNIQUE	Refers to technical factors in image acquisition (e.g. DUAL ENERGY CT, RECTAL COIL).
PHARMACEUTICAL	Indicates administration of contrast including route of administration, as well as the use of other diagnostic or therapeutic materials. Multiplicity may be specified using PHARMACEUTICAL_2.
VIEW	Patient positions and maneuvers, most commonly pertaining to radiography (e.g. CROSS TABLE LATERAL, DECUBITUS). Multiplicity may be specified using VIEW_2 through VIEW_4.
RIDS	Concatenation of all the attribute values (i.e. RadLex identifiers, or RIDs) used to define the exam (i.e. those fields marked bold in this table). The RIDs are listed in this field and separated by the pipe character “ ”.

6.2 complete-playbook-2_2.csv

Table 8: Structure of complete-playbook-2_2.csv

Column Name	Description
RPID	See Table 7.
LETTER_CODE	See Table 7.
SHORT_NAME	See Table 7.
LONG_NAME	See Table 7.
AUTOMATED_SHORT_NAME	An automatically generated abbreviated string name.
AUTOMATED_LONG_NAME	An automatically generated verbose string name.
AUTOMATED_LONG_DESCRIPTION	An automatically generated sentence-form exam description.
STATUS	Enumerated field indicating the current status of the given RPID, taking one of the following values: ACTIVE, DISCOURAGED, DEPRECATED, TRIAL.
STATUS_REASON	For exams with status DISCOURAGED or DEPRECATED, this field may contain an indicator explaining the status. This indicator is one of: AMBIGUOUS, DUPLICATE, ERRONEOUS.
STATUS_TEXT	For exams with status DISCOURAGED or DEPRECATED, this field may contain narrative text explaining why the exam was assigned its status.
CHANGE_TYPE	Enumerated field indicating the type of the most recent alteration to the code, taking one of the following values: ADD (referring to a newly added code), NAM (referring to a change to one of the exam names or descriptions), SEMANTIC (referring to an attribute value change).
EXPORTED_TO_LOINC	Either TRUE, FALSE or blank (synonymous with FALSE). When TRUE, the exam has been transferred to the LOINC framework. Any further changes to the exam will be made in the LOINC framework, not the RadLex Playbook framework.
CHANGE_REASON_PUBLIC	Narrative text explaining changes, such as updates to exam names or descriptions.
MODALITY	See Table 7.
PLAYBOOK_TYPE	See Table 7.
POPULATION	See Table 7.
BODY_REGION	See Table 7.
MODALITY_MODIFIER	See Table 7.
PROCEDURE_MODIFIER	See Table 7.
ANATOMIC_FOCUS	See Table 7.
LATERALITY	See Table 7.
REASON_FOR_EXAM	See Table 7.
TECHNIQUE	See Table 7.
PHARMACEUTICAL	See Table 7.
VIEW	See Table 7.
RIDS	See Table 7.

6.3 subset-table-playbook-2_2.csv

Table 9: Structure of subset-table-playbook-2_2.csv

Column Name	Description
RPID	See Table 7.
SUBSET_CODE	Enumerated field indicating membership of the given RPID in a group of Playbook exams. Note that any given RPID may be assigned to multiple such groups. Currently, the only such group is CORE, referring to the Core Playbook described in Section 3. In the future, other values such as RESEARCH may be used.
COMMENT	Narrative text related to the assignment of the given subset code.

6.4 map-to-table-playbook-2_2.csv

Table 10: Structure of map-to-table-playbook-2_2.csv

Column Name	Description
RPID	See Table 7.
MAP_TO	For the given RPID, the MAP_TO field provides a suggested alternative code (e.g. an alternate RPID). Note that any given RPID may be assigned multiple such mappings. It is up to the user to decide which, if any, of these mappings is most appropriate in a given situation.
COMMENT	Narrative text related to the assignment of the given mapping.
TARGET_SYSTEM	For the value listed in the MAP_TO field, the TARGET_SYSTEM field contains an Object Identifier (OID) indicating the coding system of the mapping target. Currently, the TARGET_SYSTEM field may take on one of the following: <p style="text-align: center;"> 2.16.840.1.113883.6.1 LOINC 2.16.840.1.113883.6.256 RadLex (i.e. Playbook) </p> That is, when the TARGET_SYSTEM value is the former, then the target listed in MAP_TO is a LOINC code. When the TARGET_SYSTEM value is the latter, then the target listed in MAP_TO is a RadLex Playbook code.

7 Appendix 2: Web services interface

The following web services provide programmatic access to Playbook content, returning results in XML. While typically accessed programmatically, please note that interactive viewing of these XML results in a browser may require the user to view page source.

7.1 <https://services.rsna.org/playbook/v1/playbook/core>

Result mirrors the content of the core-playbook-2_1.csv downloadable file (see Appendix 6.1).

7.2 <https://services.rsna.org/playbook/v1/playbook/subset>

Result mirrors the content of the subset-table-playbook-2_1.csv downloadable file (see Appendix 6.36.1).

7.3 <https://services.rsna.org/playbook/v1/playbook/mapto>

Result mirrors the content of the subset-table-playbook-2_1.csv downloadable file (see Appendix 6.46.1).

7.4 <https://services.rsna.org/playbook/v1/playbook/radlexTerms>

Returns all current possible values for each Playbook attribute.

7.5 <https://services.rsna.org/playbook/v1/playbook/complete/all>

Result mirrors the content of the complete-playbook-2_1.csv downloadable file (see Appendix 6.2).

7.6 <https://services.rsna.org/playbook/v1/playbook/complete/cpt/{CPTcode}>

Accepts a single CPT code in the {CPTcode} field, and returns zero, one or more suggested Playbook codes corresponding to the given CPT.

7.7 <https://services.rsna.org/playbook/v1/playbook/complete/rpid/{RPIDcode}>

Accepts a single Playbook code in the {RPIDcode} field (of the form “RPIDxxx” where “xxx” is a positive integer. Returns all of the attribute values which define the given RPID.

7.8 <https://services.rsna.org/playbook/v1/playbook/complete/modality/{ID}>

Accepts a single modality identifier (ID), and returns all Playbook codes of that modality type. The following constitute valid modality identifiers:

ID	Description
1	MRI
2	CT
3	XR
10	US
11	NM
12	IR
13	RF
14	MG
15	OT

ID	Description
16	XA
17	US&RF
18	XR&RF
19	NM&CT
20	PT&CT
21	US&FL
22	PT
23	RP

8 Appendix 3: Harmonized RadLex-LOINC Playbook model (draft)

The following pages contain the current draft version of the harmonized RadLex-LOINC information model.

RadLex-LOINC Radiology Playbook User Guide

Welcome to the RadLex-LOINC Radiology Playbook User Guide. This work is the result of a multi-year collaboration between Regenstrief Institute and the Radiological Society of North America (RSNA), supported by the National Institute of Biomedical Imaging and Bioengineering (NIBIB). The participants have developed a model that combines and unifies the useful aspects of LOINC Radiology and the RSNA RadLex Playbook. Both of these terminology initiatives are designed to represent concepts of radiology orderables and results and their attributes.

Each term in the unified Playbook model has a name (a.k.a. description), and takes on a number of attributes. This guide is intended to describe the semantics, syntax, and proper usage of those attributes. Within the terminology, these attributes are used as building blocks to construct several types of standard names, including a fully specified name, long name, and short name.

A list of the Playbook attributes is shown below. Attributes are organized according to attribute groups, consisting of the major bullet headings below, and by more specific sub-attributes, shown in the minor bullets below and denoted by a dot after the attribute group, such as *Pharmaceutical.Route*.

- *Modality*
 - *Modality.Subtype*
- *Anatomic Location*
 - *Anatomic Location.Region Imaged*
 - *Anatomic Location.Imaging Focus*
 - *Anatomic Location.Laterality.Presence*
 - *Anatomic Location.Laterality*
- *View*
 - *View.Aggregation*
 - *View.View type*
 - *View.View type.Maneuver*
- *Pharmaceutical*
 - *Pharmaceutical.Substance Given*
 - *Pharmaceutical.Route*
 - *Pharmaceutical.Timing*
- *Reason for Exam*
- *Guidance*
 - *Guidance for.Presence*
 - *Guidance for.Approach*
 - *Guidance for.Action*
 - *Guidance for.Object*
- *Subject*

The chapters that follow provide a guide to the usage of each of the above attributes.

Codes and workflows

Radiology procedure codes impact a variety of workflows in the health care enterprise, including ordering, scheduling, billing, protocol specification, image acquisition, and image interpretation, among others. In each case, the codes serve specific purposes in identifying imaging exams. While there is a great deal of overlap between these workflows, there are also important differences. For example, radiology billing is often concerned with a less detailed description of an imaging exam, while the radiology ordering process often involves more information about the requested study.

The Playbook work has been primarily focused on addressing the needs of the radiology ordering workflow. The semantic model described in this document is intended principally to characterize radiology “orderables.” This then raises the question of what constitutes an orderable exam, an issue which is complicated by at least two factors. First, different institutions may expose different levels of granularity at the point of radiology order entry. While one may consider “CT abdomen / pelvis with contrast” to be an appropriate option in an order entry system, another institution may wish to provide the choice “CT abdomen / pelvis with contrast, liver mass.” Second, in certain circumstances, what is actually done to satisfy an imaging request may not match the ordered procedure precisely. For example, image-guided interventions often entail procedural modifications at the time of the exam. In such cases, modified or additional orderables may be entered, even though these may not have been exposed in the clinical ordering interface.

The model aims to allow for this type of variation, so as to broadly fulfill the needs of radiology ordering workflows at a variety of institutions. Note that related work, at a more granular level addressing the technical factors in image acquisition, is being done by the DICOM Standards Committee [1].

1 CONTENTS

2	SYNTAX.....	18
2.1	OPERATORS.....	18
2.1.1	"."	18
2.1.2	"+"	18
2.1.3	">"	18
2.1.4	"&"	18
2.1.5	"&or"	18
2.1.6	Precedence	18
2.2	PARALLELISM.....	18
3	MODALITY.....	19
3.1	DEFINITIONS.....	19
3.2	USAGE NOTES.....	19
3.3	ALLOWED MODALITY/SUBTYPE COMBINATIONS.....	20
4	ANATOMIC LOCATION.....	22
4.1	DEFINITIONS.....	22
4.2	SYNTAX AND MODELING PRINCIPLES.....	23
4.2.1	Specifying region(s) imaged without an imaging focus.....	23
4.2.2	Imaging foci that cross body regions.....	23
4.2.3	Specifying multiple anatomic locations.....	23
4.2.4	Broad region combined with a specific focus.....	24
4.2.5	Specifying terms without an anatomic location.....	24
4.2.6	Operator precedence.....	24
4.2.7	Parallelism.....	24
4.2.8	Region imaged as grouper +/- coarse-grained descriptor.....	24
4.2.9	Laterality.....	25
4.2.10	Subject.....	25
4.2.11	Ectopic Anatomy.....	25
4.2.12	Anatomic terminology in the extremities.....	25
4.2.13	Singular vs. Plural.....	26
4.2.14	Singular vs. Plural in the context of Vasculature.....	26
5	VIEW.....	27
5.1	DEFINITIONS.....	27
5.2	USAGE NOTES.....	27
5.3	EXAMPLES.....	28
6	PHARMACEUTICAL.....	30
6.1	DEFINITIONS.....	30
6.2	SYNTAX.....	30
6.3	EXAMPLES.....	30
6.4	SPECIFYING MORE THAN ONE PHARMACEUTICAL.....	30

6.5	USAGE NOTES.....	31
6.5.1	Preference for Generic Names	31
6.5.2	Route.....	31
6.5.3	Intra versus Via.....	31
6.5.4	Existence versus Absence	31
6.5.5	Relationship to View.Maneuver sub-attribute	31
6.6	ISSUES.....	32
7	REASON FOR EXAM	33
7.1	DEFINITIONS	33
7.2	EXAMPLES	34
7.3	NOTES.....	34
8	GUIDANCE	35
8.1	DEFINITIONS	35
8.2	USAGE NOTES.....	35
8.2.1	Guidance for.Approach.....	35
8.2.2	Guidance for.Action	35
8.2.3	Anatomic Location and Guidance for.Object	36
8.2.4	Modality attribute.....	36
8.2.5	Specifying more than one procedure	36
8.3	EXAMPLES	37
9	SUBJECT.....	38
9.1	DEFINITIONS	38
10	REFERENCES.....	39

2 SYNTAX

2.1 OPERATORS

The model uses several logical operators (".", "+", ">", "&", "&or") to express combinations of atoms.

2.1.1 "."

Used to specify refinement of a given attribute or attribute component. For example, the dot operator may be used with the *View type* component of the *View* attribute to specify a *Maneuver* sub-component (e.g. "lateral.flexion"). For modality subtypes, it is used to indicate a certain type of imaging technique (e.g. "CT.angio").

2.1.2 "+"

Used to combine atoms, such as Anatomy atoms or View atoms, with AND semantics.

2.1.3 ">"

Used exclusively to separate the body region from the anatomic imaging focus.

2.1.4 "&"

Used to separate atoms for parallelism, such as in Anatomy or View. May alternatively be used as a low-precedence AND, such as in the *Pharmaceutical.Timing* attribute WO&W, which has a combined "before and after" notation. This is the lowest-precedence of all the operators in the model.

2.1.5 "&or"

Used to join two atoms via logical (inclusive) disjunction. For example, *fine needle aspiration &or core needle biopsy* means that either or both procedures were done.

2.1.6 Precedence

Operator precedence, from greatest to least is as follows: ".", "+", ">", "&", "&or"

2.2 PARALLELISM

In selected circumstances, it is necessary to specify multiple values for two or more specific attributes or components. In such cases, the correspondences between values across attributes or components may be modeled by maintaining a consistent ordering of values. For example, a radiographic exam of the ribs often includes a radiograph of the chest. The specific views may include an AP view of the chest, and an oblique view of the ribs. Multiplicity of the *Anatomic Location* attribute as well as the *View* attribute is modeled using parallelism and the "&" operator. That is, with *Anatomic Location* "Chest & Ribs" and *View* "AP & Oblique" the appropriate correspondence between "Chest" and "AP" as well as between "Ribs" and "Oblique" is maintained by virtue of the relative positions of the atoms (i.e. both "Chest" and "AP" are listed first in their respective attributes).

3 MODALITY

3.1 DEFINITIONS

Modality is used to represent the device used to acquire imaging information. Modalities consist predominantly of a subset of the two-letter DICOM modality codes. DICOM modality codes are listed in PS3.3, Section C.7.3.1.1.1 in the 2016 release of the DICOM standard [2]. In addition, the modality code "RP" is used to indicate image-guided procedures for which the specific type of imaging is not explicitly modeled.

A *Modality subtype* may be listed, separated by a ".", to signify a particularly common or evocative configuration of the modality.

Note that when such modality subtypes are specified, the given type of technique is *included* in a study, although this does not necessarily imply that the study consists *exclusively* of that subtype of imaging. For example, an exam with modality and subtype US.doppler does not mean that only Doppler imaging was performed. On the other hand, XR.portable generally does indicate that only portable images were obtained.

3.2 USAGE NOTES

1. Subtype *angio*. This subtype is used for procedures designed to give angiographic images of the vessels. This should not be used for US; Doppler should be used instead. *Angio* is not a synonym for contrast administration because some angiographic MR studies do not require intravenous contrast administration.
2. Subtype *full field digital* and *analog* for MG. *MG.analog* indicates an analog mammogram. *MG.full field digital* signifies a digital mammogram only. MG without a subtype signifies a procedure that can be done with digital or analog equipment.
3. CR (computed radiography) vs DX (digital radiography) vs RG (radiographic imaging/conventional film screen): XR will be adopted generically to signify orders for planar radiography. When the images are acquired, the imaging modality may wish to insert a more specific modality code in the DICOM files.
4. Doppler subtype vs DICOM modality codes DD (duplex Doppler) and CD (color flow Doppler). *US.Doppler* will be used as the attribute of the orderable procedure. When the images are acquired, the imaging modality may wish to insert a more specific modality code in the DICOM files.
5. *Portable* indicates whether the device is movable or whether the patient will come to the radiology department for imaging.
6. The *SPECT* modality will be represented as a subtype of the NM modality (*NM.SPECT*) rather than using ST, the DICOM modality code for SPECT.
7. Because there is no DICOM modality code for DEXA, DXA will be adopted as the modality code.
8. When an imaging study involves more than one imaging modality, "+" is used to concatenate the two modalities, such as "PT+CT" or "NM.SPECT+CT". The modality listed first corresponds to the departmental area where the device is typically located. E.g. PT+CT, not CT+PT

9. For studies with two modalities that have separate attributes and are performed consecutively (e.g., RF Upper GI with XR abdomen), "&" is used in the value of each attribute, including Modality, to maintain parallelism across attributes.
10. Precedence of operators is ".", "+", "&" (">" is not used in the Modality attribute)
11. The *perfusion* modality subtype indicates the study is intended to measure tissue perfusion; if the study is designed to image the vessels, use the *angio* modality subtype.
12. 3D is an image processing step, and can be performed on images from a variety of modalities. Its use is discouraged. If adopted locally, it may be used as shown in the Chapter on Reason for Exam.
13. Modality RP (radiology procedure) is used to refer to image-guided procedures, where the particular type of imaging used is not specified in the orderable. For example, liver biopsies may be performed under ultrasound or CT guidance, although the particular modality used may be at the discretion of the operator. In such cases, RP indicates image guidance not further specified.

3.3 ALLOWED MODALITY/SUBTYPE COMBINATIONS

- CT
 - CT.angio
 - CT.scanogram
 - CT.densitometry
 - CT.perfusion
 - CT.portable
- DXA
 - DXA.densitometry
- MG
 - MG.full field digital
 - MG.analog
 - MG.tomosynthesis
 - MG.stereotactic
- MR
 - MR.angio
 - MR.functional
 - MR.spectroscopy
- NM
 - NM.dosimetry
 - NM.SPECT
- PT
 - PT.perfusion
- RF
 - RF.angio
 - RF.video
 - RF.portable
- US
 - US.densitometry

- US.Doppler
 - US.portable
- XR
 - XR.tomography
 - XR.portable
- RP

4 ANATOMIC LOCATION

This chapter describes how anatomic terms are used to identify the body region and anatomic focus of imaging. It also specifies the syntax to be used when more than one anatomy term applies to a given exam code, and delineates how laterality should be specified when necessary.

Please note: as of the June 2016 LOINC release (v2.56), most of the *Region imaged* and *Imaging focus* values have been specified in the LOINC System part (which corresponds to the Playbook *Anatomic Location* attribute) according to the syntax described below with two major exceptions. First, the Upper Extremity and Lower Extremity Regions imaged have not yet been explicitly modeled for most of the extremity terms that have a specific Imaging focus. Second, the syntax for specifying multiple Anatomic Locations as described in Section 4.2.3 and 4.2.4 is not yet implemented. We anticipate that both of these exceptions will be addressed in the December 2016 LOINC release.

4.1 DEFINITIONS

The *Anatomic Location* attribute specifies the body part or body region that is imaged and includes the sub-attributes, *Region imaged* and *Imaging focus*. The most specific anatomic structure should be specified. Multiple *Anatomic Locations* may be specified using the syntax specified below and should be specified only when necessary to distinguish the code from other codes. *Anatomic Location* terms are generally drawn from the RadLex anatomic hierarchy.

Region imaged is used in two ways. First, as a coarse-grained descriptor of the area imaged **and** a grouper for finding related imaging exams. Or it is used just as a grouper. For example, when an abdominal CT focuses on the liver, it images the abdomen as a whole and also would be a relevant comparison for other abdominal CT exams (e.g. renal CT), thus making abdomen a coarse-grained descriptor as well as a grouper. Similarly, a head CT focusing on the brain may also be a relevant comparison for other head CT exams (e.g. orbit CT), making it both a descriptor and grouper. Alternatively, for most studies with upper extremity or lower extremity as the *Region imaged* and a specific *Imaging focus*, such as wrist or knee, the *Region imaged* is a grouper only, because the entire extremity is typically not imaged.

Imaging focus is defined as a more fine-grained descriptor of the specific target structure of an imaging exam. In many areas, the focus should be a specific organ. For example, in the *Region imaged* abdomen, the *Imaging focus* might be liver, pancreas, adrenal glands, kidneys, etc. In other areas, the *Imaging focus* will simply be a more specific area within a given region. For example, in the *Region imaged* upper extremity, the *Imaging focus* might be shoulder, upper arm, elbow, forearm, wrist, hand, etc.

Our goals are to populate both the *Region imaged* and *Imaging focus* sub-attributes for all terms, except where the *Region imaged* is the focus of the study (see 4.2.1). We will also constrain *Region imaged* to the following short list of regions: head, neck, chest, breast, abdomen, pelvis, upper extremity, lower extremity.

Exceptions to the short list of *Regions imaged* include cases in which the *Imaging focus* exists throughout the body and is being imaged in its entirety, such as bones or bone marrow. In these cases,

the *Region imaged* is whole body, e.g. Whole body>Bone marrow. In contrast, when the *Imaging focus* exists in multiple parts of the body but only one specific instance is being imaged, the *Region imaged* is unspecified, which is given as "XXX" in LOINC, e.g. XXX>Bone.

Pathologic entities may not serve as an anatomic location (e.g. renal tumor). If there is a need to specify a pathologic entity to distinguish to exam codes, the pathologic entity should be specified with the *Reason for Exam* attribute or *Guidance for Object* sub-attribute.

4.2 SYNTAX AND MODELING PRINCIPLES

The syntax used to describe the *Anatomic Location* attribute is as follows:

```
<body region imaged> ">" <imaging focus>
```

For example, for an abdominal CT with a focus on the liver, the *Anatomic Location* would be specified as:

```
Abdomen>Liver
```

As noted in the introduction to this chapter, the June 2016 LOINC release does not reflect this syntax for most of the existing terms that would be expected to have Upper extremity or Lower extremity as the *Region imaged*. For example, the *Anatomic Location* for wrist is still represented as Wrist rather than Upper extremity>Wrist.

4.2.1 Specifying region(s) imaged without an imaging focus

If there is a single anatomic context associated with a code, it should be specified as <body region imaged> without an <imaging focus>, for example, for an abdominal CT, the *Anatomic Location* would be specified as:

```
Abdomen
```

When multiple regions are imaged without an imaging focus, such as CT of the head and neck, the two regions are separated by a "+":

```
Head+Neck
```

4.2.2 Imaging foci that cross body regions

Certain imaging foci cross multiple body regions, such as Pharynx, which is included in both the Head and Neck imaging regions. In this case, the regions will be separated by a "+" as follows:

```
Head+Neck>Pharynx
```

4.2.3 Specifying multiple anatomic locations

When more than one anatomic location is imaged, where each location has a different *Region imaged* and *Imaging focus* pair, they are separated by an "&" according to the syntax:

```
<body region imaged A> ">" <imaging focus A> "&" <body region imaged B> ">" <imaging focus B>
```

For example, a study of the chest and abdomen focused on the lung and liver would be specified as follows:

```
Chest>Lung & Abdomen>Liver
```

Note – this is a change from the previous version of Playbook and will be implemented in LOINC starting with the December 2016 release. The June 2016 release contains terms modeled according to the previous model, where multiple locations were specified by grouping the *Regions imaged* together, separated by a "+", and grouping the *Imaging foci* together, also separated by a "+", with the *Regions imaged* and *Imaging foci* groups separated by ">". So the example above in the previous model (and current LOINC release) is specified as:

```
Chest+Abdomen>Lung+Liver
```

4.2.4 Broad region combined with a specific focus

In other situations, a specific *Imaging focus* in one *Region imaged* may be imaged at the same time as a different *Region imaged* without a focus. Consider an MRI examination of the face and neck. Face is an *Imaging focus* of the *Region imaged* head. Neck is an additional *Region imaged*. In such situations, the lower precedence of the "&" compared to the ">" operator is used to combine these areas as follows:

```
Head>Face & Neck
```

4.2.5 Specifying terms without an anatomic location

In some cases, such as fluoroscopic guidance codes, a specific *Anatomic Location* may not be relevant, in which case we use the general unspecified *Region imaged*.

4.2.6 Operator precedence

The precedence of operators is ".", "+", ">", "&". For example:

```
Head+Neck > Pharynx
```

is equivalent to

```
(Head+Neck) > Pharynx
```

4.2.7 Parallelism

In rare instances, a complex study may require parallelism to model correctly. In this instance, an ampersand is used to separate the elements of the study. For example, a study that consists of a PA and lateral views of the chest plus 4 oblique views of the right ribs could be represented as follows:

```
XR Chest&Ribs.Right 2 views & 4 views including PA+Lateral & Right oblique
```

4.2.8 Region imaged as grouper +/- coarse-grained descriptor

The nature of the study should make it clear whether the *Region imaged* is functioning as both a coarse-grained descriptor of the area imaged and a grouper or as a grouper only. Following are additional guidelines to help users make that determination:

1. In general, when the *Region imaged* is the head, neck, chest, abdomen or pelvis, it is both a coarse-grained descriptor and a grouper;
2. For spine studies, the *Region imaged* is typically a grouper only (this is an exception to rule #1). For example, a C-spine exam will have the *Anatomic location* specified as Neck>Spine.cervical, but typically the exam would focus on the spine and not include general imaging of the neck;
3. When the Region imaged is upper extremity or lower extremity, it typically functions as a grouper only.

4.2.9 Laterality

Many exams require laterality to be specified in order to be performed. These exams will be signified with an *Anatomic Location.Laterality.Presence* attribute set to *True*. For terms with *Laterality.Presence = True*, the *Laterality* attribute must not be null. Valid values of the *Laterality* attribute are:

- *Left*
- *Right*
- *Bilateral*
- *Unilateral*
- *Unspecified*

The recommended practice is to specify one of *Left*, *Right*, or *Bilateral* for *Anatomic Location.Laterality* whenever *Anatomic Location.Laterality.Presence = True*. If the *Laterality.Presence* attribute is *False*, the *Laterality* attribute must be null. Laterality applies to the most specific anatomic part associated with the exam code.

4.2.10 Subject

Some exams are relevant only to a Fetus or a Gestation. This distinction will be represented when necessary by the Subject attribute.

4.2.11 Ectopic Anatomy

Ectopic anatomy, such as a transplanted kidney, if needed to distinguish an exam code, should be specified as a Reason for Exam, not as an Anatomic Location. Anatomic Location corresponds to where the transplanted kidney is located, e.g., Pelvis.

4.2.12 Anatomic terminology in the extremities

In the upper extremity, the term "upper arm" is preferred over the term "arm." Even though these are technically equivalent, the redundancy of "upper arm" provides for greater clarity. "Upper arm" is also preferred over "humerus" for this area, as the latter is bone-specific and could be construed as excluding soft tissues. Similarly, in the lower extremity, "lower leg" is preferred over "leg," "calf" and "tibia / fibula."

4.2.13 Singular vs. Plural

The singular form of an anatomic structure is typically used, except in a few specific cases that primarily apply to vasculature, as noted below.

4.2.14 Singular vs. Plural in the context of Vasculature

For the set of vessels associated with a particular region, organ or a specific group of vessels, we use the plural "Vessels", "Veins" and "Arteries" to mean "set of", for example, "Adrenal vessels" or "Cerebral arteries." One use case for such pre-coordination is angiography, for example, CT angiography of the renal vessels would have the following Anatomic location:

Abdomen >Renal vessels

The plural form does not imply laterality, which is still specified using the laterality attribute (see 4.2.9). For example, "Abdomen>Renal vessels.right" means the set of renal vessels supplying the right kidney.

Specific named vessels use the singular form, e.g., "Femoral vein" and "Superior mesenteric artery."

When vessels in an extremity are imaged for a specific reason, such as varicose vein treatment, and there are different CPT codes for treatment of a single vessel and treatment of multiple vessels, we use the plural form to mean multiple and also created a singular form to represent treatment of a single vessel even though that vessel is not named, i.e., "extremity veins" and "extremity vein."

5 VIEW

5.1 DEFINITIONS

The *View* attribute is used to indicate the orientation of the patient in the image. This may reflect a combination of patient position and x-ray beam direction, or may alternatively be captured in a named, or eponymous, view. While this most commonly refers to radiography (e.g. a lateral radiograph of the chest), it may also be used with other modalities (e.g. prone CT of the chest).

In many instances, the *View* attribute will not be specified at all (e.g. MRI of the brain) in the Playbook model. However, note that in the LOINC model, the Component part of all radiology terms specifies the type of image acquired based on the modality: "Views" for XR, MAM, and NM, and "Multisection" for MR, CT, US, NM.SPECT, PT, and XR.tomography.

When *View* is specified in Playbook, three optional components may be used:

<Aggregation> <View type>.<Maneuver>

The *Aggregation* component is used to describe the extent of the imaging performed, whether in quantitative terms (e.g. "3 or more views") or subjective terms (e.g. "complete"). The use of "Follow-up" as a value of the aggregation attribute is replaced by the value "Limited."

View type is used to name specific views, such as "lateral" or "prone." *View type* may optionally have an additional *Maneuver* sub-component. *Maneuver* is used to indicate an action taken with the goal of elucidating or testing a dynamic aspect of the anatomy. For example, flexion and extension views of the cervical spine are used to detect instability as indicated by changes in spinal alignment. Similarly, inspiratory and expiratory views of the chest may be used to detect changes in lung volume. Maneuvers imply an element of patient exertion, and may occur in pairs (e.g. "flexion" and "extension"). These factors distinguish maneuvers from patient actions used purely to gain a desired perspective. For example, the cross-table lateral radiograph of the hip requires the patient to be lying supine with the contralateral leg bent and raised, though the purpose of this is to obtain a lateral angle on the hip rather than to test stability or dynamic change. In such cases, the patient position is embodied in the named view type (e.g. "Danelius Miller") rather than with a maneuver.

5.2 USAGE NOTES

1. Views may be aggregated in groups. Sometimes these groups may be further specified by naming specific views (e.g. "PA + lateral"), in which case the semantics are that the group *includes* the named views. In some cases the views are specified numerically (e.g. "4 views"). Other times the constituent views of a group may be unspecified (e.g. "complete").
2. The naming of specific views is optional.
3. The use of an aggregation term is optional.
4. Eponymous views imply patient position and beam direction, as well as anatomic focus. Anatomic focus will continue to be specified separately as described above, recognizing this redundancy.

5. Maneuvers may be specified on a per-view basis (e.g. "Lateral.flexion + Lateral.extension").
6. If no maneuver is specified, it is assumed that the patient is at rest.
7. Laterality may optionally be specified in certain views (e.g. "Lateral," "Right lateral" or "Left lateral"). The laterality specified in this case indicates patient position relative to the beam, not the side of the patient being imaged, and is thus independent of the *Anatomic Location.Laterality* sub-attribute.
8. Portable is specified as a Modality subtype instead of a View.
9. The large majority of exams will have no view specified at all. In the RSNA Core Playbook, 29 exams use views out of 1031 exams, and all of these are XR exams.
10. When the number of views is specified for a bilateral exam, the number refers to the number of views per side (e.g., XR Knee Bilateral 2 Views specifies 2 views of each knee)
11. Time-related factors, such as "48 hours post", are modeled with the Pharmaceutical attribute.
12. Sometimes, parallelism is required to show which attributes are associated with which views. The ampersand is used to show parallelism. For example, a combined exam with chest and rib views would be modeled as:

XR Chest&Ribs.Right 2 views & 4 views including PA+Lateral & Right oblique

That is, the atoms "Chest" "2 views" and "PA+Lateral" form one group, and the atoms "Ribs.Right" "4 views" and "Right oblique" form another group. Note that this parallelism relies on a consistent ordering of atoms to maintain proper groupings.

13. If the views for the second anatomic location are unspecified, the unspecified views will be modeled as "XXX". For example:

XR&RF Chest&Diaphragm 2 views & XXX

XR&RF Abdomen&UGI Tract 1 view & XXX

5.3 EXAMPLES

		<View(s)>
XR	Chest	PA
XR	Chest	L decubitus
CT	Chest	
CT	Chest	Supine
XR	Hand, bilateral	Ball catcher
XR	Abdomen	AP

		<Aggregation> including <View(s)>
XR	Chest	2 views {PA + Lateral}
XR	Ankle	Complete
XR	Shoulder	3 views {Axillary}
XR	Hip	2 views {Cross table lateral}

XR	C-spine	4 views	{Right oblique + Left oblique}
XR	Abdomen	2 views	{Supine + Upright}
XR	C-spine	4 views	{Lateral.flexion + Lateral.extension}
XR	Foot	3 views	{Lateral.weight-bearing}
XR	Knee.Bilat	4 views	{Right oblique + Left oblique}
CT	Chest	2 views	{Supine.inspiration + Supine.expiration}
CT	Colon	2 views	{Supine + Prone}

6 PHARMACEUTICAL

6.1 DEFINITIONS

The *Pharmaceutical* attribute specifies the presence or absence of chemical agents relevant to the imaging procedure. We use this attribute to specify administered contrast agents, radiopharmaceuticals, medications, or other clinically important agents and challenges during the imaging procedure.

6.2 SYNTAX

The syntax used to describe the *Pharmaceutical* attribute specifies several optional components:

<timing/existence><substance given><route>

Only the components required for specifying the pharmaceutical at a clinically important level are included in the attribute value.

The **<timing/existence>** attribute can be either simultaneous:

- WO
- W

A combined “before and after” notation that denotes separate sets of images:

- WO & W

Or describing an image taken at a specified time after administration of the pharmaceutical:

- 48H post

6.3 EXAMPLES

Using this syntax, a common contrast specification of without then with IV contrast would be denoted:

```
WO & W contrast IV
```

In other cases, the time delay is a key component:

```
48H post contrast PO
```

6.4 SPECIFYING MORE THAN ONE PHARMACEUTICAL

The syntax above can also be used to specify more than one pharmaceutical that may be influence the imaged physiology. For example, a nuclear medicine cardiac stress test may involve administration of a radiopharmaceutical and a stress agent such as Adenosine, Dobutamine, or Regadenoson. The attribute value list will contain only single pharmaceuticals. We specify multiple instances of the pharmaceutical attribute by combining them with “+”:

```
W adenosine + W radionuclide IV
```

W dipyridamole + W Tc-99m Sestamibi

6.5 USAGE NOTES

Some pharmaceuticals will be more fully specified than others. For example, some may specify the specific substance:

W Tc-99m Sestamibi IV

whereas others name a more generic class:

W radionuclide IV
W anesthesia

6.5.1 Preference for Generic Names

We use the generic name of a pharmaceutical, not the brand name, e.g. Tc-99m Sestamibi, not Cardiolite. We will usually include the brand or trade names as synonyms. In rare cases, we use the brand name when a generic form does not exist (e.g., Theraspheres).

6.5.2 Route

Where possible, we denote the route of administration by abbreviations for medication routes (Table 6 of the LOINC Users' Guide). An oral route of administration would be denoted by "PO," an intravenous route by "IV."

6.5.3 Intra versus Via

When describing administration of contrast into specific spaces for which abbreviations do not exist, the space is spelled out in full, and preceded by "intra" or "via" according to these guidelines.

We use "intra" when the contrast injected goes directly into this anatomic space, and this space is what is visualized in the study. For example:

W contrast intra lymphatic

We use "via" when the contrast injected goes through this device (e.g., catheter) and into the anatomic space being visualized. For example:

W contrast via colostomy

6.5.4 Existence versus Absence

The <existence> component of the pharmaceutical attribute allows specification of whether or not the imaging occurs in the presence of the agent where existence is denoted W, WO, or WO & W. The existence of WO & W denotes separate images, without and with the pharmaceutical.

6.5.5 Relationship to View.Manuever sub-attribute

Like the physical maneuvers described in the chapter on the View attribute, pharmaceutical agents are also intended to test a dynamic aspect of the anatomy, with similarities in how these are modeled. In some cases, an exam may use one or the other that are intended to produce a similar anatomic response (e.g., W exercise or W adenosine). Where needed, they can also be used together as different

attributes of the overall term model. For example, in defecography, both a maneuver and contrast are specified:

W contrast PR & during defecation

6.6 ISSUES

- [Decision: YES] LOINC to change order (WO then W) pattern
- [Decision: NO] Should the existence convention be changed to the more redundant but more clear full expression:
 - WO contrast IV & W contrast IV
- [Decision: No] Should the combination pharmaceuticals be items in the attribute value list?
- Is there a more up to date specification of Routes? Not really. FHIR uses this same table. Some were added in 2.3.1
- [Decision: YES] Should we remove the amount sub-attribute?
- Intra articular -> IS (Intrasynovial)
- We will use quotes for keeping together separate words within an attribute. We'll look for naming conventions to eliminate the need for this. We will convert WO & W to WO&W.
- Include the Modifiers from Views:
 - Deprecate usage of "1 phase" in LOINC (it is implied unless stated as 3 phase)
 - 3 Phase
 - 30M post
 - 45M post
 - Delayed
 - Runoff

7 REASON FOR EXAM

7.1 DEFINITIONS

Reason for exam is used to describe a clinical indication or a purpose for the study. This may refer to a patient diagnosis, a clinical indication, a clinical status (e.g. "post op"), an intended measurement, altered anatomy (e.g. "endograft"), or some other indicator of the purpose of the exam (e.g. "screening").

The terms "diagnostic" and "screening" are used as values of the *Reason for exam* attribute, and these are potentially confusing for two reasons. First, "diagnostic" is often thought of as complementary to "screening," in which case the terms refer to the patient's clinical status (i.e. asymptomatic patients undergo "screening" exams, whereas symptomatic patients undergo "diagnostic" exams). However, "diagnostic" is also frequently used in the context of mammography, in which case it is an indicator of the views to be obtained (specifically, that additional non-standard views may be performed), not an indicator of the patient's symptom status. In both cases, "diagnostic" refers to an exam being performed for the purpose of further work-up. Here we have chosen to model these terms as part of the *Reason for exam* semantics, rather than the *View* semantics.

Second, the question of screening and diagnostic exams "for what" may be another source of confusion. Here, we take the position that the answer is typically understood: Screening mammography screens for breast cancer; screening colonography screens for colon cancer. Further, note that the use of the terms "diagnostic" and "screening" is intended to be limited to those exams where these are needed to distinguish from some other type of study.

We also use the *Reason for exam* attribute to distinguish studies that are primarily done in the pediatric domain. For example, the codes for bilateral hip ultrasound and cranial ultrasound both have the *Reason for exam* specified as "for pediatrics".

We do not create separate codes with pediatrics as the *Reason for exam* in cases where the same study is commonly done in both the adult and pediatric population. For example, "Head CT" will be used for both pediatric and adult studies.

Also note that "3D post processing" is included here as a value of the *Reason for exam* attribute. This refers to image rendering done after image acquisition. Some facilities bill for such renderings, which may be used for surgical planning or other purposes. As a result, these renderings (at least sometimes) constitute an end-product of the exam, and we have thereby chosen to model such processing as a reason for performing the exam. While 3D post processing may also be used simply as a diagnostic tool in image interpretation (and thus not technically a reason for performing the study), we have elected to simply model any description of 3D post processing here.

7.2 EXAMPLES

		<Reason (s)>
XR	Eye	Foreign body
MG	Breast	Diagnostic
MG	Breast	Diagnostic + Call back
US		Pregnancy + Less than 14 weeks
US		Multiple gestation + Greater than 14 weeks
NM	Stomach	Liquid gastric emptying
CT	Heart	Calcium score

7.3 NOTES

1. 10/17/14: Values removed - "mass," "obstruction," "patency," "pre op"
2. 10/17/14: Values added - "intra op," "endograft"
3. 10/17/14: "Twin pregnancy" replaced with "multiple gestation."
4. "Call back" is only to be used in relation to mammography.

8 GUIDANCE

8.1 DEFINITIONS

The *Guidance* attribute is used to describe image-guided interventions. Such procedures may range from the very general (e.g. “CT guided needle placement”) to the very specific (e.g. “fluoroscopy guided lumbar vertebroplasty, with bone biopsy, additional level”). Some procedures may also be ambiguous (e.g. “image guided fine needle aspiration and/or core biopsy”).

Imaging guidance for procedures is modeled with three sub-attributes:

<Approach> <Action> <Object>

Approach refers to the primary route of access used, such as percutaneous, transcatheter, or transhepatic. *Action* indicates the intervention performed, such as biopsy, aspiration, or ablation. *Object* is used to specify the target of the action, such as mass, abscess or cyst. For complex procedures, operators may be used to combine instances of the *Guidance* attribute.

8.2 USAGE NOTES

8.2.1 Guidance for.Approach

The approach sub-attribute will generally be included in the formal code specification. For some procedures like needle biopsy, the percutaneous route is the “default” and often assumed route. Local procedure names will often not include the word “percutaneous” in the name. For purposes of modeling, we will include percutaneous in the attribute specification. But, to avoid extraneous “clutter”, the display name for the pre-coordinated term will only include the approach if we have two variants, one with percutaneous and one with some other route.

In some cases, “percutaneous” may be part of the overall route used for a procedure (e.g. “percutaneous transhepatic”). In such cases, the primary, or most evocative, route will be used (e.g. “transhepatic”).

8.2.2 Guidance for.Action

The action sub-attribute will generally be required to adequately specify an image-guided procedure. Examples include: placement of; replacement/exchange of; removal of; repositioning of; retrieval of; infusion of; injection of; localization of; check of.

8.2.3 Anatomic Location and Guidance for.Object

For a given procedure, the body region or organ of interest is specified outside of the *Guidance* attribute, using the *Anatomic Location* attribute. On the other hand, when there is a specific site of pathology targeted by an intervention, this is modeled using the *Guidance for.Object* sub-attribute. The expectation is that when normal anatomic specifiers such as “liver” or “abdomen” are used, these are modeled using *Anatomic Location*. When a site of disease such as “mass” or “abscess” is described, this is modeled using *Guidance for.Object*. Alternatively, the object of a procedure may be a device (e.g. “central venous catheter”).

Note that the object sub-attribute is optional. Some procedures will not specify a particular pathologic lesion (e.g. “CT guided liver biopsy”) whereas others will (e.g. “CT guided liver mass biopsy”). In some cases, neither *Anatomic Location* nor *Guidance for.Object* will be specified (e.g. “US guided fine needle aspiration”).

8.2.4 Modality attribute

The *Guidance* attribute will generally be used in conjunction with the *Modality* attribute. Recall that the modality code “RP” is used for image-guided procedures where the particular imaging modality is not specified (e.g. “image guided liver biopsy”).

8.2.5 Specifying more than one procedure

Although uncommon, the syntax above can also be used to specify more than one procedure by repeating the triplet of sub-attributes.

As defined in the Syntax section (2.1), use of “+” to join two procedures means logical conjunction (i.e. both procedures were done). Use of “&or” to join two procedures means logical (inclusive) disjunction (i.e. either or both procedures were done).

For example:

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Guidance for fine needle aspiration &or core needle biopsy
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This term illustrates how the more generic concept of a “needle biopsy” (including both aspiration and core needle) could be represented. Both procedures in the pair could use whichever sub-attributes of the triplet were appropriate.

8.3 EXAMPLES

	<Anatomic Loc>	<Approach>	<Action>	<Object>
CT	Liver	Percutaneous	Core biopsy	
CT	Liver	Percutaneous	Core biopsy	Mass
RP		Percutaneous	Placement	Drain
RP		Percutaneous	Drainage	Abscess
RP	Gallbladder	Transhepatic	Placement	Drain
US		Percutaneous	Placement	Non-tunneled CVC
RP		Percutaneous	Fine needle aspiration &or Core needle biopsy	
US	Pleural space	Percutaneous	Drainage	
US	Thyroid	Percutaneous	Fine needle aspiration	
RP		Percutaneous	Exchange	Gastrojejunal tube

9 SUBJECT

9.1 DEFINITIONS

The *Subject* attribute is intended for use when there is a need to distinguish between the patient associated with an imaging study, and the target of the study. This situation may occur for pregnant patients undergoing prenatal imaging exams. The potential for multiple gestation further motivates the need for the *Subject* attribute, as an exam may be targeted at a particular one of multiple fetuses. The *Subject* attribute may also be used in cases of surgical specimens, such as specimen radiographs at lumpectomy.

10 REFERENCES

1. http://dicom.nema.org/Dicom/News/oct2013/docs_oct2013/sup121_pc.pdf, Accessed 14 May 2016.
2. <http://dicom.nema.org/medical/dicom/current/output/pdf/part03.pdf>, Accessed 14 May 2016.