RadLex Playbook 2.4

User Guide

August 2017

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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.

RadLex 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.

Also, refer to Section 4 and Appendix 3 for important updates about work to harmonize RadLex Playbook with the LOINC system. The resulting harmonization is known as the LOINC/RSNA Radiology Playbook.

2 RadLex Playbook Structure

Each RadLex 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

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 RadLex Playbook Version 2.0

The RadLex 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 approximately 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	137
CT	103
US	102
MR	144
NM	102
MG	40
RF	82
RP	218
XA	50
PT	7
XR&RF	7
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 LOINC/RSNA Radiology 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 RadLex 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 RadLex Playbook Version 2.1

RadLex 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 LOINC/RSNA codes as provided in the RadLex 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.

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

4.3 RadLex Playbook Version 2.2

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

4.4 RadLex Playbook Version 2.3

RadLex Playbook version 2.3, released in November 2016, incorporates new mappings to the harmonized system in the radiography domain. Released mappings now cover the modalities XR, CT, MR, US and NM. These mappings correspond with LOINC version 2.58.

Also with version 2.3, we note that while RadLex Playbook makes use of several modality attribute values which indicate multiple imaging modalities (i.e. “PT&CT”, “NM&CT” and “XR&RF”), the harmonized LOINC/RSNA Radiology Playbook will treat such multi-modality exams in one of two ways. For some exams, a single “combined modality” attribute value is used. For others, each component modality is modeled independently.

4.5 RadLex Playbook Version 2.4

RadLex Playbook version 2.4, released in August 2017, incorporates new mappings to the harmonized system for fluoroscopy and mammography. The mappings correspond with LOINC version 2.61.

4.6 Evolution Strategy

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

1. Historical RadLex Playbook codes remain a part of the system, and will not be overwritten or deleted.
2. RadLex Playbook codes may now be assigned a status, one of `ACTIVE`, `DISCOURAGED`, `DEPRECATED` or `TRIAL`.
3. RadLex Playbook codes with status `TRIAL` are subject to change. Otherwise, changes to a code’s component attribute values will generally not be made, unless such a change is approved by the Playbook committee.
4. The creation of new codes will be conducted in the LOINC framework. New codes will not be mirrored in the RadLex Playbook system.

5. For codes migrated from the RadLex Playbook into the harmonized LOINC/RSNA 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 RadLex Playbook 2.0 release, and represents a streamlined subset of codes to simplify deployment. New features introduced with RadLex Playbook 2.0 include status tracking and mapping mechanisms. RadLex Playbook 2.1 introduced a web services interface to the codes. With versions 2.2, 2.3 and 2.4, mappings to the harmonized LOINC/RSNA system have been released, and now span the modalities XR, CT, MR, US, NM, FL and MG. Harmonization with the LOINC system brings Playbook content to a broader user community.

6 Release Notes

6.1 RadLex Playbook Version 2.3.1

- CPT mapping for RPID16 corrected to 71250.
- CPT mapping for RPID17 corrected to 71270.
- Correction to a LOINC mapping. RPID106 had previously been incorrectly mapped to LOINC 30626-1, now corrected to map to LOINC 30591-2.
- RPID6827 and RPID6654 updated to map to CPT 47531.
- RPID6654 removed from Core subset, mapped to RPID6827 and LOINC code 30647-2.
- RPID6224 removed from Core subset, mapped to RPID6707 and LOINC code 24902-9.
- RPID6244 removed from Core subset, mapped to LOINC code 24912-8.
- RPID6672 mapped to LOINC code 37568-3.
- RPID6233 removed from Core subset, mapped to RPID6710 and LOINC code 37572-5.
- Documentation of draft RadLex-LOINC harmonized model updated, as also published with LOINC version 2.58.

6.2 RadLex Playbook Version 2.4

- Clarifications and updates affecting the following codes:
    - RPID78
    - RPID5596
    - RPID5906
    - RPID5907
    - RPID5910
    - RPID5911
    - RPID5918
    - RPID6059
    - RPID6227
    - RPID6273
    - RPID6288
    - RPID6289
    - RPID6290
    - RPID6287
    - RPID6145
    - RPID6149
    - RPID6153
    - RPID6151
    - RPID6155
    - RPID6166
    - RPID6167
    - RPID6138
    - RPID6162
    - RPID6163
    - RPID6164
    - RPID6171

    - RPID6651
    - RPID6661
    - RPID6667
    - RPID6713
    - RPID6829
    - RPID6831
    - RPID6864
- Updates to LOINC mappings
- Updates to internal CPT mappings

7 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_4.csv`	Core Playbook exams, as outlined in Table 5.
`complete-playbook-2_4.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_4.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_4.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 LOINC/RSNA harmonization project described in Section 5.

7.1 core-playbook-2_4.csv

Table 7: Structure of core-playbook-2_4.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 "|".

7.2 complete-playbook-2_4.csv

Table 8: Structure of complete-playbook-2_4.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, such as ERRONEOUS or NON-PREFERRED SEMANTICS.
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), DEL (referring to a code moved to status DEPRECATED), 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.

7.3 subset-table-playbook-2_4.csv

Table 9: Structure of subset-table-playbook-2_4.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 4. In the future, other values such as RESEARCH may be used.
COMMENT	Narrative text related to the assignment of the given subset code.

7.4 map-to-table-playbook-2_4.csv

Table 10: Structure of map-to-table-playbook-2_4.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: 2.16.840.1.113883.6.1 LOINC 2.16.840.1.113883.6.256 RadLex (i.e. Playbook) 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.

8 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.

8.1 https://services.rsna.org/playbook/v1/playbook/core

Result mirrors the content of the core-playbook-2_1.csv downloadable file (see Appendix 8.1).

8.2 https://services.rsna.org/playbook/v1/playbook/subset

Result mirrors the content of the subset-table-playbook-2_1.csv downloadable file (see Appendix 8.38.1).

8.3 https://services.rsna.org/playbook/v1/playbook/mapto

Result mirrors the content of the subset-table-playbook-2_1.csv downloadable file (see Appendix 8.48.1).

8.4 https://services.rsna.org/playbook/v1/playbook/radlexTerms

Returns all current possible values for each Playbook attribute.

8.5 https://services.rsna.org/playbook/v1/playbook/complete/all

Result mirrors the content of the complete-playbook-2_1.csv downloadable file (see Appendix 8.2).

8.6 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.

8.7 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.

8.8 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

9 Appendix 3: Harmonized LOINC/RSNA Radiology Playbook Information Model (draft)

The following pages contain the current draft version of the harmonized LOINC/RSNA Radiology Playbook information model, as also published with LOINC version 2.61.

Annex LOINC/RSNA Radiology Playbook User Guide

1 Introduction

Welcome to the LOINC/RSNA 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.Modality type*
  - *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*
- *Timing*
- *Maneuver*
  - *Maneuver.Maneuver type*

- *Pharmaceutical*
    - *Pharmaceutical.Substance Given*
    - *Pharmaceutical.Route*
- *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.

1.1 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]

2 Syntax

1 http://dicom.nema.org/Dicom/News/oct2013/docs_oct2013/sup121_pc.pdf, Accessed 14 May 2016.

2.1 Operators

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

2.1.1 "." (Dot)

Used to specify refinement of a given attribute or attribute component. For example, the dot operator may be used with the *Imaging focus* component of the *Anatomic Location* attribute to specify a more granular focus (e.g. **Ribs.lower**). For modality subtypes, it is used to indicate a certain type of imaging technique (e.g. "**CT.angio**").

2.1.2 "+" (Plus)

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

2.1.3 ">" (Greater than)

Used exclusively to separate the *Region Imaged* from the anatomic *Imaging Focus.*

2.1.4 "&" (Ampersand)

Used to separate *Region imaged* and *Imaging focus* pairs when more than one anatomic location across more than one region is imaged. May alternatively be used as a low-precedence AND, such as in the *Timing* attribute **WO & W**, which has a combined "before and after" notation.

2.1.5 "^" (Carat)

Used primarily to separate the *Maneuver* attribute from the *View* attribute.

2.1.6 "()" (Parentheses)

Used to indicate bindings between *Maneuver* and *View* values when more than one *View.Aggregation* and/or *View. View type* exists and the maneuver(s) only applies to a subset of the *View* values.

2.1.7 "&or" (AmpersandOr)

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.

2.1.8 "&&" (Double ampersand)

Used to indicate parallelism in cases where the relationships between values across multiple attributes needs to be specified. In earlier versions the "&" was used for parallelism, but since we started using "&" to separate *Region imaged* and *Imaging focus* pairs, we created a new delimiter for parallelism in order to distinguish the two concepts.

2.1.9 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 (either blood or lymphatic 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. Mammography **tomosynthesis** *Subtype*: This *Subtype*, also known as digital breast tomography (DBT), is a type of digital mammography that is distinct from the concept of **full field digital**. **MG. tomosynthesis** is used for 3-dimensional imaging, while typical digital mammography is 2-dimensional. Digital 2D mammograms may also be reconstructed into 3D images, but these would not be classified under **MG.tomosynthesis**.

3. Obsolete mammography subtypes: We originally included **MG.analog** and **MG.full field digital**

2 http://dicom.nema.org/medical/dicom/current/output/pdf/part03.pdf, Accessed 14 May 2016.

(FFD) in the list of allowed **MG** *Subtypes* to specify analog mammography and digital mammography, respectively, while **MG** without a *Subtype* signified a procedure that could be done with digital or analog equipment. However, given that over the past several years digital mammography has become standard practice, we recommend that moving forward, **FFD** does not need to be specified as a subtype of **MG.** Instead, the generic **MG** LOINC codes should be used for 2D mammography, which in most cases will be digital images but may also include analog images.

4. 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.

5. **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.

6. **Portable** indicates whether the device is movable or whether the patient will come to the radiology department for imaging.

7. **SPECT** will be represented as a *Modality subtype* of the **NM** *Modality* (**NM.SPECT**) rather than using ST, the DICOM modality code for SPECT.

8. Because there is no DICOM modality code for DEXA, **DXA** will be adopted as the *Modality* code.

9. 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

10. 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 harmonized model and in LOINC to separate the values of each attribute, including *Modality*, to maintain parallelism across attributes, e.g., **XR && RF**. However, note that in the Radiology Lexicon (RadLex) imaging modality hierarchy, such *Modalities* that are commonly performed consecutively are represented as a single entity under the combined modalities node using a "+", e.g., **XR+RF**.

11. Precedence of operators is ".", "+", "&&" (the other delimiters are not used in the *Modality* attribute).

12. 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*.

13. 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 Reason for Exam section.

14. *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.tomosynthesis
    - MG.stereotactic
- MR
    - MR.angio
    - MR.functional
    - MR.spectroscopy
- NM
    - NM.dosimetry
    - NM.SPECT
    - NM.SPECT+CT
- PT
    - PT.perfusion
    - PT+CT
- 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.

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 gland**, **Kidney**, 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 Section 4.2.1). We will also constrain *Region Imaged* to the following short list of regions:

- **Head**
- **Neck**
- **Chest**
- **Breast**
- **Abdomen**
- **Pelvis**
- **Extremity**
- **Upper extremity**
- **Lower extremity**
- **Whole body** (used when the *Imaging focus* exists throughout the body and is being imaged in its entirety, such as **Bones** or **Bone marrow**)
- **Unspecified** (represented in LOINC as **XXX**, used when the *Imaging focus* exists in multiple parts of the

body but only one specific instance is being imaged, such as a **Blood vessel**)

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
```

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
```

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 Parallelism

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

```
Chest && Chest>Ribs.Right          Views 2 PA+Lateral && Views 4 Right oblique
```

4.2.7 Operator precedence

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

```
Head+Neck > Pharynx
```

is equivalent to

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

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. The 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 - Laterality). 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*

This chapter describes the *View* attribute, which 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). **Portable** is specified as part of the *Modality* attribute rather than the *View*.

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**, **MG**, and **NM**, and **Multisection** for **MR**, **CT**, **US**, **NM.SPECT**, **PT**, and **XR.tomography**.

5.1 Definitions

The *View* attribute includes optional sub-attributes, including *Aggregation* and *View type*.

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* is an indicator of the orientation of the patient in an image, often carrying an implication of passive positioning (i.e. positioning which is not unduly onerous for the patient). This may reflect a combination of patient position and imaging direction (e.g. x-ray beam direction), and may be captured in a named or eponymous term (e.g. **Norgaard view**). The positioning involved in view types is designed to permit visualization of specific anatomic targets or particular orientations (e.g. open mouth odontoid view, swimmer's view). Note that this positioning is usually not passive in the strict sense (i.e. performed by someone else), but rather passive in the sense that it is neither onerous for the patient, nor intended as a challenge to the patient. We considered creating a separate attribute for patient position, however, given that relatively few terms would include this attribute, we decided to include it within the *View type*.

5.2 Syntax

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

```
<Aggregation> <View type>
```

For example, for a cervical spine X-ray with AP and lateral views, the *View* would be specified as:

```
Views AP + lateral
```

5.2.1 *Aggregation*

As stated above, the *Aggregation* attribute is optional and, when included, specifies the extent of imaging performed in qualitative or quantitative terms. Qualitative descriptors include concepts such as **Limited**, **Complete**, and **Multiple days**. Quantitative aggregation values can specify a fixed number or range of views. The syntax for representing greater than or equal to and less than or equal to a specific number of views is "GE <#>" and "LE <#>, respectively. All of the following are examples of *Aggregation*:

```
Views multiple areas

Views 2 or 3

Views GE 5
```

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)

5.2.2 *View type*

In studies that specify a *View type*, one or more values can be specified, separated by a "+". For example:

```
View lateral

Views PA + lateral

Views PA + lateral + R-oblique + L-oblique
```

5.2.2.1 Eponymous view types

Eponymous views imply patient position and beam direction, as well as anatomic focus. Anatomic focus will continue to be specified separately as described in the previous chapter, recognizing this redundancy.

5.2.2.2 Laterality in the view

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.

5.2.3 Specifying Aggregation and View type

In many cases, both an *Aggregation* and one or more *View type* values are specified. If the *Aggregation* value includes the specified *View types*, the two values will not be separated by a delimiter. However, if the *View types* are in addition to the number of views specified in the *Aggregation* value, the two values are separated by a "+".

For example, 2 views including an oblique view is represented as:

```
Views 2 oblique
```

And 2 views and an additional oblique view is given by:

```
Views 2 + oblique
```

5.2.4 Parallelism

Sometimes, parallelism is required to show which attributes are associated with which views. As described earlier, the double ampersand ("&&") is used to show parallelism. For example, an exam that includes a PA view of the chest and at least three rib views would be modeled with the following *View* and *Anatomic location* attributes:

```
Views GE 3 && View PA          Chest>Ribs && Chest
```

That is, the atoms **Chest>Ribs** and **Views GE 3** form one group, and **Chest** and **View PA** another group. Note that this parallelism relies on a consistent ordering of atoms to maintain proper groupings.

6 Timing

The *Timing/Existence* attribute may be used in conjunction with both the *Maneuver and Pharmaceutical attributes.* This attribute specifies the existence of a *Maneuver* or a *Pharmaceutical*, or, in some cases, the existence of one *Maneuver* (or *Pharmaceutical*) and the absence of another, for example, views of the thoracolumbar spine without and with lateral bending.

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
```

7 Maneuvers

7.1 Definitions

Maneuvers relate to a challenge presented to a patient, often with the goal of elucidating or testing some dynamic aspect of anatomy or physiology. Maneuvers often carry an implication of patient exertion (e.g. Valsalva maneuver), although some maneuvers do not involve patient exertion (e.g. pharmacologic cardiac stress). *Timing/Existence* specifies the existence of that *Maneuver*, or, in some cases, the existence of one *Maneuver* and the absence of another. For example, flexion and extension views of the cervical spine are used to detect instability as indicated by changes in spinal alignment. Similarly, views of the thoracolumbar spine without and with lateral bending may be done to evaluate scoliosis. Inspiratory and expiratory maneuvers as part of chest imaging may be used to evaluate the lungs. *Maneuvers* may occur in pairs (e.g. **Flexion** and **Extension**). As above, 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**) as described in the *View* definitions section, rather than with a maneuver.

In general, *Maneuver* values, when included, are specified together with a *Timing* attribute value, such as **W** or **WO**, similar to Pharmaceuticals as defined in the next chapter. If no maneuver is specified, it is assumed that the patient is at rest.

7.2 Syntax

Maneuvers are separated from the *View* attribute by "^" (a carat or a "hat"). By default, the specified *Maneuver(s)* applies to all of the *Aggregation* and *View types* preceding the carat, and vice versa. For example, in the first example below, **W standing** applies to the **Lateral** *View*, and in the second, to both the **AP** and **Lateral** *Views*. In the third, **Standing** and **Flexion** both apply to the **PA** *View*:

```
View lateral^W standing

View AP+lateral^W standing

Views PA^W standing+W flexion
```

7.2.1 *Maneuvers* that only apply to a subset of the *Aggregation* and/or *View types*

In some cases, a given *Maneuver* or set of *Maneuvers* will only apply to some of the *Aggregation* or *View types* that are specified. In such cases, parentheses are used to indicate which *Aggregation* or *View type(s)* the *Maneuver* is related to. For example, a study that includes 2 views plus one or more unspecified views with standing is given by:

```
(Views 2) + (views^W standing)
```

A more complicated example is a study that has two sets of *Maneuvers*, each of which is related to a different *View type*:

```
(Views AP^W R-bending + W L-bending) + (view lateral^W flexion + W extension)
```

8 *Pharmaceutical*

8.1 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.

8.2 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.

8.3 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
```

8.4 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
```

8.5 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
```

8.5.1 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**).

8.5.2 *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**.

8.5.3 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 an 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 a device or anatomic space into the separate anatomic space being visualized. For example:

```
W contrast via catheter

W contrast via urethra
```

8.5.4 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.

8.5.5 Relationship to *View.Maneuver* sub-attribute

Like the physical maneuvers described in the section 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
```

8.6 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

9 Reason For Exam

9.1 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.

9.2 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

9.3 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.

10 *Guidance*

10.1 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.

10.2 Usage Notes

10.2.1 *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**).

10.2.2 *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**.

10.2.3 *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").

10.2.4 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").

10.2.5 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:

```
Guidance for fine needle aspiration &or core needle biopsy
```

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.

10.3 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

11 *Subject*

11.1 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.