Use of Radiology Procedure Codes in Health Care: The Need for Standardization and Structure

Kenneth C. Wang, MD, PhD
Jigar B. Patel, MD
Bimal Vyas, MD
Michael Toland, BS
Beverly Collins, PhD
Daniel J. Vreeman, DPT, MS
Swapna Abhyankar, MD
Eliot L. Siegel, MD
Daniel L. Rubin, MD, MS
Curtis P. Langlotz, MD, PhD

Radiology procedure codes are a fundamental part of most radiology workflows, such as ordering, scheduling, billing, and image interpretation. Nonstandardized unstructured procedure codes have typically been used in radiology departments. Such codes may be sufficient for specific purposes, but they offer limited support for interoperability. As radiology workflows and the various forms of clinical data exchange have become more sophisticated, the need for more advanced interoperability with use of standardized structured codes has increased. For example, structured codes facilitate the automated identification of relevant prior imaging studies and the collection of data for radiation dose tracking. The authors review the role of imaging procedure codes in radiology departments and across the health care enterprise. Standards for radiology procedure coding are described, and the mechanisms of structured coding systems are reviewed. In particular, the structure of the RadLex™ Playbook coding system and examples of the use of this system are described. Harmonization of the RadLex Playbook system with the Logical Observation Identifiers Names and Codes standard, which is currently in progress, also is described. The benefits and challenges of adopting standardized codes—especially the difficulties in mapping local codes to standardized codes—are reviewed. Tools and strategies for mitigating these challenges, including the use of billing codes as an intermediate step in mapping, also are reviewed. In addition, the authors describe how to use the RadLex Playbook Web service application programming interface for partial automation of code mapping.

© RSNA, 2017 • radiographics.rsna.org

Content Codes: HP IN

Introduction

Procedure codes are largely unseen by radiologists and other physicians, as they are primarily used internally within clinical information systems and at the interfaces between such systems. Yet these codes are a critical and ubiquitous part of most radiology processes; they help define the functionality of fundamental workflows such as ordering, scheduling, image interpretation, and billing. Consequently, the features of the coding system used can either limit or enhance these workflows. As one example, the ability of a picture...
archiving and communication system (PACS) to identify and display relevant prior imaging studies as part of an image display protocol (ie, hanging protocol) depends on whether the procedure codes provide information such as modality, body part, laterality, and indication. Codes that do not indicate laterality will not enable a PACS to display prior images of only a given side of the body or even identify which side is the one of interest. As another example, radiologist worklists, such as those displayed by PACS or reporting application systems, also depend on this kind of information to capture relevant images and exclude others. For instance, magnetic resonance (MR) images of the pelvis might be read by a body radiologist or musculoskeletal radiologist. Codes that do not distinguish the clinical indication or organ system of interest will not facilitate the routing of these studies to the proper worklists.

Historically, practices and departments have tended to use vendor-provided and locally developed procedure codes. Although these unstructured idiosyncratic codes were often sufficient for a specific task at a particular site, they could not be easily generalized. Such codes vary across sites, their use thwarts interoperability, and they may be incomplete. As the need for electronic exchange of clinical information grows, the support for standardized radiology procedure codes becomes stronger. In this article, we review the role of radiology procedure codes in the health care enterprise, current standards in radiology procedure coding, and the challenges of adopting standardized codes. We also provide guidance on how to adopt these codes.

### Teaching Points

- Different workflows have subtle but important differences in coding requirements. In particular, workflows may differ in terms of the level of anatomic granularity or other defining distinctions specified in the codes.
- For PACS applications, procedure codes are used to create worklists, select appropriate image display protocols, and display relevant prior images. For reporting applications, procedure codes are used to select reporting templates. In business intelligence platforms, these codes are used to provide operational analytics.
- Semantic interoperability is the ability to collect, process, analyze, or exchange comparable data elements on the basis of the meaning of the data.
- While there are several benefits to adopting standardized procedure codes, there are also important challenges. First and foremost, a fundamental task in the adoption of new codes is the mapping of existing local codes to standardized codes.
- If the associations between local procedure codes and CPT (ie, from the organization’s chargemaster) and between standardized codes and CPT are known, then CPT terms can serve as useful intermediate codes in the mapping process.

### Procedure Codes and Radiology Workflows

Codes are compact labels used by computer systems to identify unique concepts or pieces of information. With regard to imaging studies, there is an important distinction between procedure codes, which are identifiers for the type of examination, and accession numbers, which are identifiers for the specific instance of an examination. This review is focused only on the former, since the interchange of data depends on commonalities in examination type. Also, for each instance of an imaging examination, there is typically an associated procedure code in the Digital Imaging and Communications in Medicine (DICOM) metadata.

Most workflows in a radiology department depend critically on imaging procedure codes, and examination ordering is one such workflow. Although an ordering physician may see a descriptive name in an order entry system (eg, “XR chest PA and lateral”), such names are associated with codes that are communicated from the ordering application system to the Radiology Information System (RIS). After the examination has been completed, a bill, which also is based on codes, is generated. In the United States, medical billing is based primarily on the Current Procedural Terminology (CPT) system developed by the American Medical Association (1). Consequently, each examination code is associated with one or more CPT codes in a department’s “chargemaster,” which is a code translation table managed by the RIS or other billing system.

Although CPT is a widely used standard, it was designed for billing and is thus inadequate for many other purposes for which procedure codes are required. Different workflows have subtle but important differences in coding requirements. In particular, workflows may differ in terms of the level of anatomic granularity or other defining distinctions specified in the codes. Consider, for example, MR imaging of the extremities. Many institutions define radiologic examinations at the time of order entry and include information about the specific anatomy or region to be imaged (eg, “MRI shoulder without contrast”) in the definition. With use of CPT, however, the use of less specific codes (eg, CPT 73221: “magnetic resonance [eg, proton] imaging, any joint of upper extremity, without contrast material[s]”) is required to bill for such examinations. In addition to differing in anatomic granularity, ordering and billing workflows also differ with regard to other factors such as clinical indications and examination complexity. The need to interchange codes between workflows and systems gives rise to the creation of translation tables, or crosswalk tables, which map codes...
from one coding scheme to another. One such table, the chargemaster, translates procedure codes to CPT codes.

Examination laterality is another fundamental example of granularity differences between billing and other radiology workflows. Although no differentiation between an MR imaging examination of the right shoulder and an MR imaging examination of the left shoulder is needed to assign billing codes—as the charge is the same for both examinations—the image display protocol functionality of a PACS depends on laterality for determining which previously obtained images are relevant (eg, prior radiographs of the right shoulder to display during the interpretation of MR images of the right shoulder).

In addition, the practice of radiology is continuously evolving, with new imaging techniques advancing to clinical use over time. There may be an extended period between the emergence of a technique and the recognition of that technique as a billable procedure. Computed tomographic (CT) colonography, functional MR imaging, and CT perfusion imaging are examples of relatively new imaging techniques for which there are now corresponding CPT codes. On the other hand, dual-energy CT is an example of an examination that is in clinical use but for which there is currently no identifying CPT code. This discrepancy between what is done clinically and what may be billed is another important illustration of the differences in coding requirements between workflows.

Semantic Interoperability
In modern radiology departments, many applications involve the use of procedure codes for a variety of purposes. For PACS applications, procedure codes are used to create worklists, select appropriate image display protocols, and display relevant prior images. For reporting applications, procedure codes are used to select reporting templates. In business intelligence platforms, these codes are used to provide operational analytics. Those performing these tasks benefit from the semantic interoperability of data. Semantic interoperability is the ability to collect, process, analyze, or exchange comparable data elements on the basis of the meaning of the data. The grouping of one CT examination with another CT examination on the basis of the common modality is an example of semantic interoperability, because CT is part of the meaning shared by these examinations. This is in contrast to the complementary concept of syntactic interoperability, which refers to the technical ability of systems to communicate data (such as in relation to data formatting) without regard to the meaning of the data. This review is focused on semantic rather than syntactic interoperability. Using consistent codes across applications is a key (though incomplete) strategy for enabling semantic interoperability. A summary of radiology systems and workflows in which procedure codes are used and that are affected by semantic interoperability is provided in Table 1.

History of Codes Used in Imaging
There is a long history of standardized coding systems being used in medicine (2,3). One example is the International Classification of Diseases (ICD) coding system (4), which originated in the late 19th century. Although the ICD system includes imaging procedure codes, they are not widely used in radiology departments. While CPT facilitates a degree of standardization with regard to radiology procedure codes, this terminology is susceptible to the limitations of scope and granularity described earlier.

In the field of medical imaging, DICOM is one of the most advanced and widely adopted technology standards. Although DICOM is not a coding standard per se, it includes standardized terminology for coding purposes. It includes, for example, an extensive list of codes for identifying imaging modalities (5). Also, DICOM represents an important example of syntactic interoperability in that it facilitates the transmission of imaging data.

In practice, many hospitals and radiology groups historically have used unstructured codes, consisting of a combination of vendor-provided codes and customized local codes, for imaging examinations. While these codes, which are nonstandardized solutions, can be used to meet the requirements of specific workflows locally, they do not support semantic interoperability beyond a given department, hospital, or enterprise. This limitation often presents challenges at the time of implementation of a new clinical application, new enterprise integration, enrollment in regional or national data registries, or other processes involving the exchange of health information.

Even within their native environment, vendor-provided and local procedure codes often have limited semantic capability owing to their lack of formal structure. The meanings associated with such codes are often expressed primarily or solely in the associated examination name or examination description, and as such, these codes may be considered unstructured. Consider hypothetical codes 1234, with the examination name XR Chest PA and Lateral, and 5678, with the examination name CT Chest without Contrast. Examinations with the code 1234 could be interoperated with other examinations of the same code. This would
be akin to an “apples-to-apples” comparison. However, in the absence of information other than the code and its name, semantic interoperability between these two codes, such as that to find relevant prior studies, would be challenging. With use of unstructured codes, even if they were consistent or standardized, the ability to achieve more sophisticated interoperability between codes 1234 and 5678 (consider an “apples-to-pears” or “apples-to-fruit” analogy) would depend on the use of rules developed by a person who knew that these examinations were related or perhaps the use of natural language processing to extract the word chest from each examination name and equate the examinations on that basis. Both approaches are error prone, difficult to maintain, and likely to fail over time. These limitations arise because the assigned names are intended for human readers. Such names are less readily understood by machines, and the information included in these names cannot be easily processed by machines.

**Structured Codes**

Structured coding systems address the lack of computable information in codes with use of components or parts to define code meanings. Consider the ICD, Tenth Revision, Clinical Modification (ICD-10-CM), which is a structured classification system for coding diagnoses and reasons for health care visits. As such, ICD-10-CM is used in radiology workflows to code indications for imaging examinations. This is a structured coding system by virtue of its hierarchical organization. For example, the ICD-10-CM diagnostic code R50.83 has several computable components. First, the R in this code indicates that this is a type of sign, symptom, or abnormal finding. Next, the 50 indicates that this is a type of fever. And finally, the 83 indicates that this code refers to fever occurring after a vaccination. These components facilitate semantic interoperability—for example, for analysis of this specific fever aggregated with other types of fever. The use of structured codes addresses the described limitations of unstructured codes and facilitates greater intelligence and robustness in radiology workflows such as those to identify relevant prior imaging studies, track departmental productivity, and manage subspecialty worklists across expanding enterprises.

**RadLex Playbook and Logical Observation Identifiers Names and Codes**

The RadLex™ Playbook is an initiative of the Radiological Society of North America (RSNA) (6,7). This project represents a structured system for specifying imaging examination codes that is based on the RSNA RadLex lexicon (8,9), which
is a set of standard imaging concepts (or terms) and their relationships with one another. The RadLex Playbook is based on a system of attributes, such as MODALITY, MODALITY_MODIFIER, BODYREGION, ANATOMIC_FOCUS, and PHARMACEUTICAL, that are used to define imaging examinations. Examples and definitions of these attributes are provided in Table 2. Each attribute value is specified by a RadLex term and its associated RID. A unique set of attribute values defines a particular Playbook code.

<table>
<thead>
<tr>
<th>Playbook Attribute</th>
<th>Definition</th>
<th>Example Values*</th>
</tr>
</thead>
<tbody>
<tr>
<td>MODALITY</td>
<td>Type of imaging</td>
<td>XR (RID10345)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CT (RID10321)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MR (RID10312)</td>
</tr>
<tr>
<td>MODALITY_MODIFIER</td>
<td>Imaging modality subtype used to indicate specific methods that target particular anatomic sites</td>
<td>ANGIOGRAPHY (RID10371)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ARTHROGRAPHY (RID10373)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MYELOGRAPHY (RID10380)</td>
</tr>
<tr>
<td>PROCEDURE_MODIFIER</td>
<td>Indicator of an examination factor, such as factors related to billing</td>
<td>WITH INDEPENDENT WORKSTATION (RID36021)</td>
</tr>
<tr>
<td>POPULATION</td>
<td>Patient group</td>
<td>PEDIATRIC (RID34492)</td>
</tr>
<tr>
<td>BODY_REGION</td>
<td>Broad area of the body imaged</td>
<td>HEAD (RID9080)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NECK (RID7488)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CHEST (RID1243)</td>
</tr>
<tr>
<td>ANATOMIC_FOCUS</td>
<td>Specific site of interest, such as a particular organ or joint</td>
<td>LIVER (RID58)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SHOULDER (RID1852)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TEMPORAL BONE (RID9361)</td>
</tr>
<tr>
<td>LATERALITY</td>
<td>Anatomic side of the examination, where applicable</td>
<td>LEFT (RID5824)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RIGHT (RID5825)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>UNILATERAL (RID3893)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BILATERAL (RID5771)</td>
</tr>
<tr>
<td>REASON_FOR_EXAM</td>
<td>Information about the clinical indication for the examination</td>
<td>CALCULUS (RID4994)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TORSION (RID4813)</td>
</tr>
<tr>
<td>TECHNIQUE</td>
<td>Technical factors of image acquisition</td>
<td>RECTAL COIL (RID10809)</td>
</tr>
<tr>
<td>PHARMACEUTICAL</td>
<td>Indicates administration of contrast material and/or other diagnostic or therapeutic materials and includes route of administration</td>
<td>WITHOUT IV CONTRAST (RID28768)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WITH IV CONTRAST (RID28769)</td>
</tr>
<tr>
<td>VIEW</td>
<td>Patient positions and maneuvers, most commonly pertaining to radiography</td>
<td>PA (RID43594)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LATERAL (RID43591)</td>
</tr>
</tbody>
</table>

Note.—The RadLex Playbook system for using radiologic examination codes consists of a series of attributes that define imaging procedures. The allowable values for each such attribute are terms in the larger RadLex lexicon, and each value has its own RadLex identifier (RID). A unique set of attribute values defines a particular Playbook code.

*IV = intravenous, PA = posterior-anterior, XR = radiography.
RadLex Playbook example codes. Each RadLex Playbook code, or RPID, is defined by using a unique set of attribute values; the RID is shown in italics. See Table 2 for a list of RadLex Playbook attributes. (a) In certain instances, more than one value for a given attribute may be specified, such as for RPID145 (“CT Abd/Pelv w”). In this case, two body regions are specified by using the attributes BODY_REGION and BODY_REGION_2, as shown. (b) In other instances, a more specific anatomic area of interest may be specified, such as in the code RPID959 (“MR Prostate w”). Here, the attribute BODY_REGION is assigned the value PELVIS, and the attribute ANATOMIC_FOCUS is used to indicate the more specific organ PROSTATE.

Other Coding Systems

Other systems for coding radiologic examinations exist. ICD-10, discussed earlier, includes a procedural component known as ICD-10-PCS (15). These procedure codes are used to classify inpatient hospital procedures such as imaging examinations and image-guided interventions. Consider the ICD-10-PCS code B030ZZZ (“MR Brain Without Contrast”). The B indicates that this is an imaging procedure. The first 0 (in the second position) indicates that the body system is the central nervous system. The third position specifies the type of imaging procedure, with 3 indicating “magnetic resonance imaging (MRI).” The second 0 (in the fourth position) signifies that
Figure 2. Structured procedure codes consisting of components, or attributes, that facilitate semantic interoperability. Consider the RadLex Playbook codes shown, with corresponding examination names and selected attributes. For each attribute value, the RID is shown in italics. (a) All of these examinations represent chest imaging studies by virtue of their shared body region value, CHEST (RID1243, dark gray). (b) Among these examinations, the CT examinations of the chest consist of procedures with the codes RPID16, RPID18, RPID147, and RPID6001 by virtue of the additional shared modality value, CT (RID10321). (c) Among these examinations, the contrast material–enhanced CT examinations of the chest consist of procedures with the codes RPID18 and RPID147 by virtue of the additional shared pharmaceutical value, WITH IV CONTRAST (RID28769). The key observation is that with use of structured codes, groups of codes may be computed by virtue of their attributes rather than derived by using error-prone rules or text parsing.
Figure 3. Examples of harmonized codes in the LOINC/RSNA Radiology Playbook. The LOINC/RSNA Radiology Playbook model, which is currently in draft form (Table 3), is an update of the RadLex Playbook attribute model to improve semantics. In the harmonized model, RPsIDs are matched with LOINC codes, and attributes continue to be assigned values from the RadLex lexicon. (a) In some instances, such as the case of code RPID5959, corresponding to LOINC code 36244–2 (“MR Prostate w”), the harmonized code is quite similar to the original RadLex Playbook code (see Fig 1b). Note that the harmonized model includes subattributes (7), which are the basis for the multiple values for the attributes ANATOMIC_LOCATION and PHARMACEUTICAL. (b) In other instances, the harmonized code differs from the original RadLex Playbook code in that it enables a hierarchical structure of attribute values, as in the code RPID2512, corresponding to LOINC code 83021–6 (“XR C-Spine 2-3V+Flex/Ext”). This structure makes clear that a portion of the examination consists of two to three views and another portion consists of additional views with flexion and extension maneuvers.

Table 3: Draft Attribute Model of the LOINC/RSNA Radiology Playbook

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>MODALITY</td>
<td>Type of imaging examination</td>
</tr>
<tr>
<td>ANATOMIC_LOCATION</td>
<td>Anatomic site(s) of the imaging examination</td>
</tr>
<tr>
<td>VIEW</td>
<td>Information about the orientation of the patient during the examination</td>
</tr>
<tr>
<td>TIMING</td>
<td>Used in conjunction with the MANEUVER and PHARMACEUTICAL attributes to indicate whether and when maneuvers and pharmaceutical agents are used</td>
</tr>
<tr>
<td>MANEUVER</td>
<td>A challenge presented to a patient, often with the goal of elucidating or testing some dynamic aspect of either the anatomy or a physiologic feature</td>
</tr>
<tr>
<td>PHARMACEUTICAL</td>
<td>Contrast agents, radiopharmaceutical agents, medications, and other clinically relevant agents used during the imaging examination</td>
</tr>
<tr>
<td>REASON_FOR_EXAM</td>
<td>Information about the clinical indication, patient diagnosis, clinical status (eg, postoperative), an intended measurement, altered anatomy (eg, endograft), or some other purpose of the study (eg, screening)</td>
</tr>
<tr>
<td>GUIDANCE</td>
<td>Used to describe image-guided interventions</td>
</tr>
<tr>
<td>SUBJECT</td>
<td>Used to distinguish between the patient and the target of the imaging study, such as in the case of fetal ultrasonography</td>
</tr>
</tbody>
</table>

Note.—This harmonized system, scheduled for completion this fall, streamlines the attribute structure of the RadLex Playbook model for improved semantics, combines the imaging expertise of Playbook with the maturity of the LOINC system, and formalizes the governance of these imaging codes.

the body part imaged is the brain. The first Z (in the fifth position) designates "no contrast." The last two character positions (ZZ in this example) are qualifier fields that are not used in this case. It should be noted that surgical codes with a leading 0 are used in conjunction with imaging codes to indicate interventional radiology procedures. The ICD-10-PCS component contains 2934 imaging codes and 463 nuclear medicine codes. The use of these codes, as compared with CPT, facilitates more granularity but is largely confined to billing applications. A variety of anatomic locations (eg,
internal auditory canal), imaging techniques (eg, perfusion imaging), and clinical indications (eg, pulmonary embolism) are commonly referred to in radiology workflows but remain unaddressed in the ICD-10-PCS codes.

ACR Common is another coding system, which was developed by the ACR. This system is designed to support clinical decision support applications based on the ACR Appropriateness Criteria, among other services. ACR Common is not intended to compete with other standards development efforts (16), and RSNA and ACR are cooperating on interoperability between RadLex Playbook and ACR Common.

**Challenges of Adopting Standardized Codes**

While there are several benefits to adopting standardized procedure codes, there are also important challenges. First and foremost, a fundamental task in the adoption of new codes is the mapping of existing local codes to standardized codes. For each local code, the goal is to select an appropriate matching standardized code. This work is usually based on a given site’s chargemaster, or some other master procedure list, which can range in size from several hundred to several thousand entries. Historically, this mapping work has been performed manually; consequently, it has been a tedious, time-consuming, and error-prone process. Even with the best automated approaches available, human review is still required (17,18).

Several other factors may complicate the mapping process. To conform to standardized examination names, site personnel may choose to update procedure naming conventions as part of the mapping process. However, there may be limitations regarding examination name length or formatting for some radiology applications, and this can complicate naming updates. Furthermore, even within a single radiology department, versions of the procedure name list may exist in several places (eg, in RIS, PACS, reporting application systems, and modality consoles). Some applications involving the use of radiology procedure codes (eg, electronic health records) may be managed at the enterprise rather than department level. Maintaining the accuracy and consistency of these lists across all systems can be technically and organizationally challenging.

As the use of codes expands beyond a single department or hospital to the enterprise level, additional factors will come into play. The harmonization of codes across facilities within an enterprise will introduce challenges that arise from local variability in ordering and protocol patterns. In particular, different sites often have different perspectives regarding issues such as examination granularity, inclusion of the clinical indication in the code name (eg, “CT abdomen/pelvis with IV contrast” vs “CT abdomen/pelvis with IV contrast for liver mass status post transarterial chemoembolization”), and specification of laterality in the code set (eg, “XR Ankle” vs “XR Ankle Left” and “XR Ankle Right”). On the other hand, the potential benefits of harmonizing radiology procedure codes across an enterprise include worklist integration (eg, subspecialty interpretation across an enterprise, regardless of the imaging location) and the availability of a unified set of orderables (eg, so that ordering physicians can request the same imaging studies across the enterprise).

Codes may be standardized outside of an enterprise for participation in a regional health information organization or enrollment in quality improvement programs. This type of code deployment may be less onerous than enterprise-level integration, because there may be no need to integrate the standardized codes into routine radiology systems. Rather, the standardized codes used for this purpose often exist solely in a code translation table on a dedicated machine (or edge server), which communicates with external systems.

**Getting Started**

Implementing a standardized set of radiology procedure codes is a complex project. When contemplating whether and when to embark on such a project, it is important to take several preparatory steps. First, review your organization’s goals for workflow improvement and the scope of these goals (eg, department, hospital, or enterprise wide; or as part of an external network). Within a department, such goals might include improved hanging protocol functionality. Within a hospital, the objective might be to facilitate more targeted clinical decision support. Across an enterprise, the intent might be to provide enterprise-wide subspecialty worklists so that subspecialty radiologists at one location can review the results of examinations performed throughout the enterprise. For external integration, the goal might be enrollment in a national data registry. Second, understand the hierarchy of information technology (IT) systems within your organization and the current use of procedure codes within these systems. Third, anticipate upcoming IT system upgrades that might represent opportunities for coding changes. Finally, plan maintenance strategies to keep up with changes in local examination lists and new versions of the standardized codes (19).

In light of these factors, the decision to proceed should involve a variety of stakeholders, including the departmental leadership, clinical radiologists, and the technical specialists who manage the IT systems. Other potential participants include
Figure 4. Use of the RadLex Playbook Web service application programming interface to map local procedure codes to standardized codes. CPT codes from a local chargemaster can serve as useful intermediary codes in the mapping of local codes to standardized codes. (a) In this example, a single entry from a chargemaster (top) shows the association of local code 1010 (“CT BRAIN WITHOUT CONTRAST”) with CPT code 70450 (yellow). Using this CPT code with the RadLex Playbook Web service call (7) (dotted box) yields the (excerpted) XML (xml) result shown (shadowed box). This XML result contains any matching RPIDs and associated metadata (selected elements shown in green), which can then be used to populate new fields in the chargemaster to map the local code to the standardized code (bottom). In this case, a single matching RPID is found (RPID22). In general, a given CPT code may map to multiple RPIDs, and multiple local codes may be associated with a single CPT code, so this approach does not facilitate fully automated mapping. Even so, using CPT codes as intermediary codes in this way can narrow the list of possible matches. Note also that the associated attribute values such as modality and body region may be stored and used to facilitate various workflows. (b) In this example, the chargemaster entry (top) for local code 1082 (“MRI SHOULDER WITHOUT CONTRAST”) is shown with its associated CPT code, 73221 (yellow). In this case, the RadLex Playbook Web service call (dotted box) yields four matching RPIDs (shadowed box); the XML is further excerpted as compared with that in (a). Manual inspection leads to the correct match, RPID525 (bottom), from these four RPIDs.

representatives from referring clinical services and leaders from the enterprise-level IT organization. For such a project to succeed, those entities that govern the IT systems in question need to be involved. Collaborations among departmental and enterprise-level IT organizations are often already established at large institutions, since the stewardship of radiology data is only one of many types of IT governance across an enterprise. Leveraging or developing such collaborations as part of a project to update imaging procedure codes will serve to expand the potential benefits to be gained from
deploying standardized codes. For example, while a department may be able to adopt standardized codes internally—that is, within its own applications for its own purposes—engaging with hospital or enterprise IT systems to extend such codes to electronic medical records will create new opportunities for workflow improvement.

Once the decision to move forward is made and the scope and objectives of the project are clearly defined, the challenges of mapping local procedure codes to standardized codes can be mitigated by using a combination of techniques. First, by separating the master examination list into smaller sections (eg, by modality or subspecialty), one can divide the work into more manageable tasks. Second, making use of CPT as a common coding target can help simplify the mapping task. That is, if the associations between local procedure codes and CPT (ie, from the organization’s chargemaster) and between standardized codes and CPT are known, then CPT terms can serve as useful intermediate codes in the mapping process (17). Third, departments and enterprises should make use of the tools provided by the organizations that publish terminologies. The RadLex Playbook may be queried through a Web-based application programming interface (API), which provides programmatic access to RPIDs, the associated code attributes, and any LOINC mappings released as part of the LOINC/RSNA Radiology Playbook project (20). One portion of this API also enables a CPT-based search for RadLex Playbook codes. With this interface, the use of CPT terms as intermediate mapping codes may be partially automated, as shown in Figure 4. The Regenstrief Institute provides two tools for browsing and mapping local codes to LOINC codes: the RELMA (Regenstrief LOINC mapping assistant), which is a desktop mapping program, and the LOINC Web search tool (21). Fourth, by using text searching methods to analyze procedure names, one can partially automate the process of finding specific target codes, as described by Mabotuwana et al (22). Finally, third-party consultants also provide mapping services.

Looking ahead, more widespread adoption of standardized radiology procedure codes may be driven by several factors in the future. The first factor is the trend toward consolidation of physician practices and hospitals. As networks expand, the benefits of cross-enterprise data interchange with use of standardized procedure codes will become greater. The second factor is the growing role of data registries, such as those hosted at the ACR National Radiology Data Registry (23). Such registries depend on interoperability, and registry enrollment will move institutions toward the use of standardized coding systems. A third factor is related to laws and regulations such as the Protecting Access to Medicare Act (24), under which quality improvement activities (eg, clinical decision support) are required. Standardized procedure codes are an important part of such activities.

Conclusion

Procedure codes are a critical part of radiology workflows. Historically, unstructured coding systems have had limited semantic capability; however, new standards for structured coding of imaging procedures enable broader interoperability. The involvement of several key stakeholders is required to adopt these structured codes. The challenges of mapping local procedure codes to standardized codes can be mitigated by using a variety of mapping techniques.

Acknowledgments.—The authors gratefully acknowledge the National Institutes of Health and U.S. Department of Defense for funding support; Clem McDonald, MD, National Library of Medicine, Bethesda, Md, for his efforts in initiating and coordinating this work; and technical support from Katie Allen, Jamalyne Deckard, and John Hook, Regenstrief Institute, Indianapolis, Ind; Katy Holck, JP Systems, Clifton, Va; and Scott Steingall, Siemens Healthineers, Malvern, Pa.

Disclosures of Conflicts of Interest.—K.C.W. Activities related to the present article: disclosed no relevant relationships. Activities not related to the present article: co-founder of DexNote. Other activities: disclosed no relevant relationships. D.J.V. Activities related to the present article: disclosed no relevant relationships. Activities not related to the present article: personal fees from Icahn School of Medicine at Mt. Sinai for consulting on U.S. National Library of Medicine grant, and grant from U.S. National Library of Medicine for development, maintenance, and distribution of LOINC. C.P.L. Activities related to the present article: disclosed no relevant relationships. Activities not related to the present article: personal and consulting fees, and travel reimbursement from Montage Healthcare Solutions for founder, shareholder, and board member activities; compensation from the RSNA as Informatics advisor. Other activities: disclosed no relevant relationships.

References

17. Vreeman DJ, McDonald CJ. Automated mapping of local radiology terms to LOINC. AMIA Annu Symp Proc 2005;769–773.