



**HAL**  
open science

# Indexing Imaging Reports for Data Sharing: A Study of Mapping Using RadLex Playbook and LOINC

Pierre Lemordant, Fleur Mougin, Sandie Cabon, Yves Gandon, Guillaume Bouzillé, Marc Cuggia

► **To cite this version:**

Pierre Lemordant, Fleur Mougin, Sandie Cabon, Yves Gandon, Guillaume Bouzillé, et al.. Indexing Imaging Reports for Data Sharing: A Study of Mapping Using RadLex Playbook and LOINC. *Studies in Health Technology and Informatics*, 2022, 294, pp.312-316. 10.3233/SHTI220465 . hal-03689920

**HAL Id: hal-03689920**

**<https://hal.science/hal-03689920>**

Submitted on 7 Jun 2022

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution - NonCommercial 4.0 International License

# Indexing Imaging Reports for Data Sharing: A Study of Mapping Using RadLex Playbook and LOINC

Pierre LEMORDANT<sup>a,b,1</sup>, Fleur MOUGIN<sup>c</sup>, Sandie CABON<sup>a</sup>, Yves GANDON<sup>d</sup>,  
Guillaume BOUZILLÉ<sup>a</sup> and Marc CUGGIA<sup>a</sup>  
<sup>a</sup>Univ Rennes, CHU Rennes, Inserm, LTSI - UMR 1099, F-35000 Rennes, France  
<sup>b</sup>Enovacom, Marseille, France  
<sup>c</sup>Univ. Bordeaux, INSERM, BPH, U1219, Bordeaux, France  
<sup>d</sup>CHU Pontchaillou, F-35000 Rennes, France

**Abstract.** New use cases and the need for quality control and imaging data sharing in health studies require the capacity to align them to reference terminologies. We are interested in mapping the local terminology used at our center to describe imaging procedures to reference terminologies for imaging procedures (RadLex Playbook and LOINC/RSNA Radiology Playbook). We performed a manual mapping of the 200 most frequent imaging report titles at our center (i.e. 73.2% of all imaging exams). The mapping method was based only on information explicitly stated in the titles. The results showed 57.5% and 68.8% of exact mapping to the RadLex and LOINC/RSNA Radiology Playbooks, respectively. We identified the reasons for the mapping failure and analyzed the issues encountered.

**Keywords.** RadLex, LOINC, Mapping, Imaging, Clinical Data Warehouse

## 1. Introduction

The secondary use of imaging data, with AI methods, requires large scale data pooling and consequently interoperability in order to allow sharing data from different sources.

Healthcare data are defined using Interface Terminologies (ITs). In the biomedical field, an IT is commonly defined as “a systematic collection of healthcare related phrases (terms) that supports clinicians’ entry of patient-related information into computer programs” [1]. However, the semantic interoperability in multi-center studies requires common, semantically defined terminologies. These Reference Terminologies (RTs) are defined as “terminologies designed to provide exact and complete representations of a given domain’s knowledge, including its entities and ideas, and their interrelationships, and are typically optimized to support the storage, retrieval, and classification of clinical data” [2].

In a previous work, we proposed a pipeline to allow the integration, indexing and presentation of imaging data in our Clinical Data Warehouse (CDW) eHOP [3] via their metadata. These data come from the Picture Archiving and Communication System

---

<sup>1</sup> Corresponding Author, Pierre Lemordant, Univ Rennes 1, Inserm, LTSI UMR 1099, Rennes, France;  
E-mail: pierre.lemordant@univ-rennes1.fr.

(PACS). Now, we want to map our imaging data to RTs to allow data sharing among different centers. We consider the RTs of RadLex and LOINC, whose coverage of ITs has been the subject of several studies [4-6].

In this work, we describe the details of mapping these local exam labels to RadLex and LOINC/RSNA terminologies and the barriers encountered.

## 2. Materials

As IT, we considered the labels describing imaging reports used at Rennes academic hospital over the last 18 years. For instance, the label “Scanner - Thorax sans IV” (Chest Computed tomography without intravenous injection of contrast agent) has been locally defined by the imaging department staff and is used in the radiology information system and in the electronic health records as a metadata of the imaging report for healthcare purposes. We queried these labels in our eHOP CDW which contains 1,467,000 imaging reports from more than 486,000 patients.

The Radiological Society of North America (RSNA) has created the RadLex Playbook [7], a standard system for naming radiological procedures that includes a list of 4,374 imaging procedure labels (terms) formed with elements of the RadLex ontology and identified by a RadLex Procedure ID (RPID). The RSNA and the Regenstrief Institute have been working together to create the LOINC/RSNA Radiology Playbook (L/R Playbook) [8] using a new information model to describe 6289 terms. This playbook uses LOINC ID as identifiers and provides correspondences between RadLex Playbook codes and LOINC codes. The RadLex Playbook has not been updated since 2018. The RSNA and Regenstrief Institute continue their collaboration to further develop the L/R playbook by adding new procedure codes identified only by a LOINC ID and not an RPID. In this work, we used version 2.71 of the L/R Playbook and version 2.5 of the RadLex Playbook.

## 3. Methods

First, we extracted the 200 most frequent imaging labels. This set represented our IT and covered 1,073,886 imaging exams (i.e 73.2% of all imaging exams in eHOP CDW). After removal of duplicates (e.g the same label but in upper case or with words separated by dashes instead of spaces), only 106 labels remained.

We then manually mapped our local labels to the RadLex and L/R Playbooks by considering all explicit information contained in the label. For example, although the expert (Y.G) knows that the “Ultrasound, intracranial vessels” exam is a Doppler exam, we did not map it to a RT term stating “Doppler” because this label did not specify the technique. Similarly, if the local term specified a reason for the exam, this reason must be mentioned in the RT term. Finally, the mapping was done with a single RT term, we did not combine several RT terms to describe a local term, unlike other approaches [5].

The mapping classification was rooted in previous classification proposals [9] and was as follows :

- **Exact match:** an RT code corresponded exactly to the procedure e.g. “Ultrasound - Abdomen-Kidney” perfectly matched “US ABD KIDNEY” (RPID1992);

- **Broader RT term issue:** the best RT candidate was broader in meaning than the local label. For instance, the L/R Playbook does not have a code containing all the elements from “CT - Chest Abdomen Pelvis Skull”;
- **Narrower RT term issue:** some RT terms specify additional information that is not available in the local label, e.g. the RadLex Playbook always specifies information on the contrast agent in breast MRI and this did not allow finding an exact match for the local label “MRI - Breasts”;
- **No exact match:** the local code used a concept that is not defined yet or never used in the RT. For instance, “Hemosiderosis” which is never used in the two playbooks (but is defined in the RadLex ontology (RID5203));

## 4. Results

### 4.1. Labels of the Interface Terminology

We observed much redundancy in our IT because the 200 most used labels represented 106 different imaging exams. This is explained by the fact that several teams of radiologists defined and modified this list of codes over the years. Among these labels, 80 specified only modalities and anatomic areas, 6 specified the contrast technique, 11 specified a procedure (e.g. “Densitometry”), 3 specified a reason (e.g. “Pulmonary embolism”) and 2 specified a technique (e.g “Doppler”).

By comparing these labels with the metadata that describe each acquisition made during the exam, we noted that the title was not always fully accurate. Indeed, sometimes, clinicians decide in the radiology room to make additional images than those scheduled, especially for X-rays exams in the context of trauma. For instance, procedures labeled as “X-ray - Wrist” contained a “wrist” acquisition but often also acquisitions targeting the “cervical spine”, “elbow” or “clavicle”.

### 4.2. Mapping of the Interface Terminology to Reference Terminologies

Table 1 shows the results of our manual mapping to the RadLex and L/R Playbooks.

**Table 1.** Outcomes of the manual mapping of the 106 local labels.

Mapping category	RadLex Playbook	LOINC/RSNA (L/R) Radiology Playbook
Exact match	61(57.5%)	73 (68.8 %)
Broader RT term issue	18 (17.0 %)	13 (12.3 %)
Narrower RT term issue	17 (16.0 %)	10 (9.4 %)
No exact match	10 (9.4 %)	10 (9.4 %)

The “Broader RT term issues” outcome occurred when the closest terms in the RT did not include all words to match the local label. We observed that the level of specification of RT terms can vary according to the modality, among other things. For example, the code “MR Lower Extremity Joint” exists in L/R Playbook, but there is no exact equivalent for “Ultrasound - Lower Extremity Joint”.

In most cases, the “Narrower RT terms issues” outcome was due to the mention of the contrast agent in the RT labels, while this information was not specified in the local label. However, this information is not provided homogeneously in the RTs e.g. in the L/R Playbook, the terms “CT Chest”, “CT Abdomen” and “CT Chest and Abdomen and Pelvis” (resp. 24627-2, 41806-1, 87869-4) do not mention contrast agent, whereas terms

describing CTs of “Chest and Abdomen” always specify the use of a contrast agent (“with”, “without” or “without and with” resp. 42275-8, 42276-6, 42277-4). The expert review showed that in some cases, the imaging exam was done with and/or without a contrast agent in practice. However, as the local label did not explicitly specify this information, we could not perfectly match the label with an RT term, although the RT specifies the code that would allow the perfect match.

In the case of no exact match, the most common reason was the specification by the local code of the reason for the exam, or a procedure that was not mentioned in the two playbooks. For instance, “tuberculosis” or “cystography” are never used in the L/R Playbook (but exist in the RadLex ontology, RID34878 and RID29116). Another reason for the lack of match was the use of a new imaging technique that has not been added in the RT yet (e.g. the recently described EOS™ imaging system) [10]. Finally, in several cases, the French local label referred to an anatomic structure that was not referenced in the anatomical concepts of the RadLex ontology. For instance, the “Troncs supra aortiques” (supra-aortic trunk), which designates the brachio-cephalic artery, left common carotid artery and left subclavian artery has no exact equivalent in the RadLex ontology. Four of the ten “no exact match” cases identified (both playbooks) were explained by local labels referring to the “Troncs supra aortiques”

## 5. Discussion and Conclusions

The aim of this work was to identify the issues encountered in mapping an IT to a RT in the medical imaging field, and focused on the coverage of the local terminology by the two RTs by taking into account the whole content of local terms. This work tried to identify areas for improvement in IT and RT for data reuse and is, to our knowledge, the first work of this type using local French terminology.

As a limitation, our study was based on data from a single hospital and some of the identified issues may be specific to our institution. Moreover, we used a limited set of local terms and thus we might have missed problems linked to less common exams.

Other works about mapping of ITs to RTs in different domains mention the same problems of different granularity between ITs and RTs [4-6], or of terms that only have meaning within the local institution [6]. These observations show that ITs are primarily designed to be human-readable and highlight the importance of following good practice in creating ITs based on RTs [1,11]. This approach to creating ITs also permits the identification of terms that would be missing from the RT to efficiently evolve it [6].

Beitia *et al.* analyzed the CT procedure coverage by LOINC (before the unification of LOINC radiology procedures with RadLex) and RadLex terminologies [4] and obtained coverage rates of 70% and 75% respectively. The difference with our results can be explained by the stricter mapping method we used, the language barrier (e.g. “Supra aortic trunks”), the fact that we considered all modalities (by focusing only on CT, we obtained 75% and 66% of exact mapping to the L/R and RadLex playbooks respectively) and possibly by the construction method of our IT (e.g. the mention of “reasons for exam”, such as “endometriosis” or “hemosiderosis”, in local labels led to a “no exact match” with our mapping method).

Our results show that the mapping coverage was higher with the L/R Playbook than with the RadLex Playbook. However, we could note that the unification process is not completely achieved (e.g. the RadLex playbook term “XRAY BONE DENSITO” (RPID3335) does not yet have an equivalent in the L/R Playbook).

In this study, we could identify the elements to be taken into account concerning IT, RT, and data workflow in the healthcare system to develop a classification system of imaging exams that will allow optimal data integration and sharing among centers.

## Acknowledgment

We would like to thank the French National Research Agency (ANR), for funding this work in the framework of the LabCom LITIS project (grant no. ANR-17-LCV1-0004).

## References

- [1] Rosenbloom ST, Miller RA, Johnson KB, Elkin PL, Brown SH. Interface terminologies: facilitating direct entry of clinical data into electronic health record systems. *J Am Med Inform Assoc.* 2006 May-Jun;13(3):277-88. doi: 10.1197/jamia.M1957. PMID: 16501181; PMCID: PMC1513664.
- [2] Rosenbloom ST, Brown SH, Froehling D, Bauer BA, Wahner-Roedler DL, Gregg WM, Elkin PL. Using SNOMED CT to Represent Two Interface Terminologies. *Journal of the American Medical Informatics Association.* 2009 Jan;16(1):81-8.
- [3] Madec J, Bouzillé G, Riou C, Van Hille P, Merour C, Artigny ML, Delamarre D, Raimbert V, Lemordant P, Cuggia M. eHOP Clinical Data Warehouse: From a Prototype to the Creation of an Inter-Regional Clinical Data Centers Network. *Stud Health Technol Inform.* 2019 Aug 21;264:1536-1537. doi: 10.3233/SHTI190522. PMID: 31438219.
- [4] Beitia AO, Kuperman G, Delman BN, Shapiro JS. Assessing the performance of LOINC<sup>®</sup> and RadLex for coverage of CT scans across three sites in a health information exchange. *AMIA Annu Symp Proc.* 2013 Nov 16;2013:94-102. PMID: 24551324; PMCID: PMC3900124.
- [5] Sandhu RS, Shin J, Wang KC, Shih G. Single-Center Experience Implementing the LOINC-RSNA Radiology Playbook for Adult Abdomen/Pelvis CT and MR Procedures Using a Semi-Automated Method. *J Digit Imaging.* 2018 Feb;31(1):124-132. doi: 10.1007/s10278-017-0016-0. PMID: 28842816; PMCID: PMC5788822.
- [6] Peng P, Beitia AO, Vreeman DJ, Loo GT, Delman BN, Thum F, Lowry T, Shapiro JS. Mapping of HIE CT terms to LOINC<sup>®</sup>: analysis of content-dependent coverage and coverage improvement through new term creation. *J Am Med Inform Assoc.* 2019 Jan 1;26(1):19-27. doi: 10.1093/jamia/ocy135. PMID: 30445562; PMCID: PMC7587153.
- [7] Radiological Society of North America, *Radlex playbook*, <http://playbook.radlex.org>
- [8] The LOINC<sup>®</sup>/RSNA Radiology playbook. <https://loinc.org/collaboration/rsna>. Accessed January 2022.
- [9] Humphreys BL, McCray AT, Cheh ML. Evaluating the coverage of controlled health data terminologies: report on the results of the NLM/AHCPR large scale vocabulary test. *J Am Med Inform Assoc.* 1997 Nov-Dec;4(6):484-500. doi: 10.1136/jamia.1997.0040484. PMID: 9391936; PMCID: PMC61267.
- [10] Illés T, Somoskeőy S. The EOS<sup>™</sup> imaging system and its uses in daily orthopaedic practice. *Int Orthop.* 2012 Jul;36(7):1325-31. doi: 10.1007/s00264-012-1512-y. PMID: 22371113; PMCID: PMC3385897.
- [11] Griffon N, Savoye-Collet C, Massari P, Daniel C, Darmoni SJ. An interface terminology for medical imaging ordering purposes. *AMIA Annu Symp Proc.* 2012;2012:1237-43. PMID: 23304401; PMCID: PMC3540496.