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Mapping Korean National Health Insurance Claim Codes for Laboratory Test to SNOMED CT

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Abstract. The aim of this study was to map Korean national health insurance claims codes for laboratory tests to SNOMED CT. The mapping source codes were 4,111 claims codes for laboratory test and mapping target codes were the International Edition of SNOMED CT released on July 31, 2020. We used rule-based automated and manual mapping methods. The mapping results were validated by two experts. Out of 4,111 codes, 90.5% were mapped to the concepts of procedure hierarchy in SNOMED CT. Of them, 51.4% of the codes were exactly mapped to SNOMED CT concepts, and 34.8% of the codes were mapped to SNOMED CT concepts as one-to-one mapping.

Keywords. Systematized Nomenclature of Medicine Clinical Terms, National Health Insurance Reimbursement, Semantic interoperability

1. Introduction

As most medical institutions in South Korea adopted hospital information system (HIS), a large amount of clinical data is being collected at the point of care [1]. In addition, a large amount of personal health data is being collected through wearable devices and mobile applications [2]. However, the collected data is not fully utilized due to the lack of data sharing strategies [3]. To use the collected data for patient care or clinical research,

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it is essential to ensure semantic interoperability through the use of health data standards including standard terminologies.

In 2020, to achieve semantic interoperability in healthcare, South Korea joined the SNOMED International as the 39th member country. As a way to promote the use of SNOMED CT in Korea, there have been various national initiatives such as mapping Korean Classification of Disease-7 (KCD-7), national health insurance claims codes which is also called electronic data interchange (EDI) codes for procedures, pharmaceutical products, narrative medical records of gastrectomy patients, and Korean national health checkup questionnaire to SNOMED CT [4-8]. However, the national health insurance claims codes for laboratory tests were not mapped to SNOMED CT, limiting the use of laboratory tests information for patient care or clinical research.

With this background, the aim of this study was to map national health insurance claims codes for laboratory tests to SNOMED CT to improve semantic interoperability.

2. Methods

The mapping source codes used in this study comprise 4,111 codes for laboratory tests covered by the national health insurance service in 2020. The codes for laboratory tests include codes for evaluation procedures such as complete blood counts, electrolytes, liver function tests, poisoning screening tests and genetic tests.

The mapping target terminology is the International Edition of SNOMED CT released on July 31, 2020. Before we selected SNOMED CT as a target terminology, we also reviewed LOINC as a possible target terminology. When we reviewed insurance claims codes for laboratory tests, most of EDI codes did not have 6 parts of LOINC, namely component, property, time, system, scale, and method. An example is presented in Table 1. We selected SNOMED CT as target terminology over LOINC. The target concepts were restricted to the concepts in the 'Procedure' top-level hierarchy.

Table 1. Comparison of the mapping results between SNOMED CT and LOINC

Mapping sources	Map target	
EDI	**SNOMED CT**	**LOINC**
D1850 ALT(SGPT)	34608000 |Alanine aminotransferase measurement (procedure)|	16324-6 Alanine aminotransferase:CCnc:Pt:RBC:Qn 76625-3 Alanine aminotransferase:CCnc:Pt:Bld:Qn 54492-4 Alanine aminotransferase:CCnc:Pt:Plr fld:Qn 96586-3 Alanine aminotransferase:CCnc:Pt:Bld.dot:Qn 50168-4 Alanine aminotransferase:CCnc:Pt:Dial fld:Qn 1742-6 Alanine aminotransferase:CCnc:Pt:Ser/Plas:Qn 25302-1 Alanine aminotransferase:CCnc:Pt:Body fld:Qn 1741-8 Alanine aminotransferase:CCnc:Pt:Amnio fld:Qn 54491-6 Alanine aminotransferase:CCnc:Pt:Periton fld:Qn 77144-4 Alanine aminotransferase:CCnc:Pt:Ser/Plas/Bld:Qn

Mapping process is consisted of 5 steps: 1) understanding meaning of the source terms, 2) identifying the mapping rules, 3) automatic or manual mapping, 4) classification and 5) validation as presented in Figure 1.

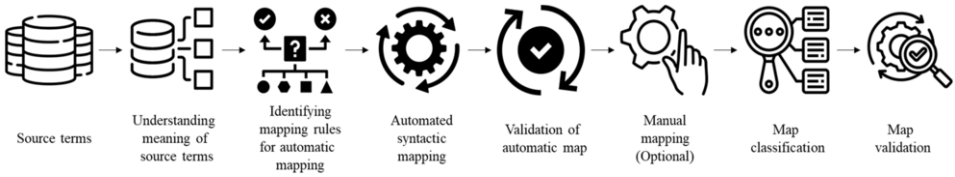

Figure 1. The overall mapping processes.

To understand the meaning of the source terms, we analyzed the laboratory test labels and extracted the component, property, time, system, scale, and method of the laboratory tests and presented them in a structured format.

We identified the pre-processing rules by manually mapping randomly selected 800 source terms to SNOMED CT (as presented in Table 2). Automated syntactic mapping was conducted using self-developed solution. If the automated mapping failed to find the SNOMED CT concept matched, the pre-processing rules were applied according to the numerical order. The automated syntactic mapping results were validated for the semantic match. If the maps did not semantically match or automatic mapping failed, we manually mapped the laboratory test codes to SNOMED CT. The manual mapping prioritized mapping the laboratory test codes to the pre-coordinated concept. If there is no pre-coordinated SNOMED CT concept matching to the source codes, we mapped to post-coordinated expression.

Table 2. Pre-processing mapping rules identified for automated syntactic mapping

Orders	Mapping rules
1	Extract the term within "( )" or the term after "-" in the source term, and then match to SNOMED CT
2	Change pleural to singular words in the source term, and then match to SNOMED CT
3	Remove the following brackets and terms in the source term, and then match to SNOMED CT 1) "( )" and the term within "( )" 2) "[ ]" and the term within "[ ]"
4	Add one of the following terms to the source term, and then match to SNOMED CT 1) Level 2) Measurement 3) Measurement of 4) Test 5) Assay
5	Add one of the following terms to the term after "-" or "_" of source term, and then match to SNOMED CT 1) Level 2) Measurement 3) Measurement of
6	Combine the extracted 6 parts, and then match to SNOMED CT

The maps were classified by expression, map cardinality, and map correlation. Maps were classified as 'pre-coordinated concept' or 'post-coordinated expression' based on expression of target terminology. Maps were classified as 'one to one' or 'one to many' according to the map cardinality. Maps were classified as 'exactly mapped,' 'broadly mapped,' 'partially mapped,' or 'not mapped' according to the map correlation. The examples were presented in Table 3.

Table 3. The examples of the maps

Mapping methods	Source codes	Target SNOMED CT	Classification		
Automatic mapping	D2280 Creatinine	70901006 |Creatinine measurement (procedure)|	Pre-coordinated concept	One to one	Exactly mapped
Automatic mapping	D3061 Hemoglobin A1c	43396009|Hemoglobin A1c measurement (procedure)|	Pre-coordinated concept	One to one	Exactly mapped
Automatic + manual mapping (revised)	D0001020 Complete blood cell count- RBC Count [Microscope]	14089001|Red blood cell count (procedure)|:424226004|Using device (attribute) | = 65473004|Microscope, device (physical object)|	Post-coordinated expression	One to one	Exactly mapped
Automatic + manual mapping (revised)	D1071 D-dimer, Qualitative [Immunoassay]	70648006|D-dimer assay (procedure)| + 414464004|Immunoassay method (procedure)| :370132008|Scale type (attribute) | = 26716007|Qualitative (qualifier value)|	Post-coordinated expression	One to many	Exactly mapped
Manual mapping	Hemolytic Anemia- Auto Hemolysis Test	401297005|Hemolysis screening test (procedure)|	Pre-coordinated concept	One to one	Broadly mapped

The maps were finally validated by two experts who have experiences in SNOMED CT mapping. When the two experts did not agree on the map, the maps were discussed in group meetings attended by the project manager and research team members who were not involved in the mapping process.

3. Results

In automatic mapping, 3,406 (82.9%) of the total codes were mapped correctly, 1,764 (42.9%) were applied to pre-processing rules 1 to 5, and 1,642 (39.9%) were applied to rule 6, which matches SNOMED CT by combining structured 6 parts. 191 (4.6%) were mapped incorrectly and 514 (12.5%) were not mapped. Incorrectly mapped or unmapped were revised manually by the authors.

Of the 4,111 source codes, 1,574 (38.2%) were mapped to pre-coordinated concept, 2,148 (52.2%) were mapped to post-coordinated expression. 1,434 (34.8%) were mapped to one concept, and 2,288 (55.6%) were mapped to more than two concepts of procedure hierarchy. 2,114 (51.4%) were exactly mapped, 1,505 (36.5%) were broadly mapped, and 103 (2.5%) were partially mapped. 385 (9.5%) codes were not mapped to SNOMED CT concept. The final map is publically available on the website of Healthcare Information Standard by the Korea Health Information Service [9].

4. Discussion

To the best of our knowledge, this study is the first attempt to map the Korean health insurance claims codes for laboratory tests to SNOMED CT rather than LOINC. This study attempted to identify mapping rules and map the claims codes using the automatic

mapping method. If automatic mapping failed, the source codes were manually mapped by combining structured 6 parts after analyzing the source codes. As a result, a total of 90.1% of EDI codes were mapped to SNOMED CT, and among them, 39.9% were mapped by combining 6 parts of the source codes which implied that structuring laboratory test codes will improve the mapping rate to internationally standardized laboratory terms. In addition, using SNOMED CT instead of LOINC as the map target, it is possible to qualify details of laboratory tests other than 6 parts of LOINC in more detail with SNOMED CT attribute-value pairs. Examples of SNOMED CT attributes include '363702006 |Has focus (attribute)|', '363703001 |Has intent (attribute)|', '424226004 |Using device (attribute)|', and '260507000 |Access (attribute)|'.

The map developed in this study can be used for mapping codes or terms for laboratory tests used in Korean medical institutions to SNOMED CT in the future. Since codes used in the hospitals in Korea are linked to the EDI code for national health insurance reimbursement, refining the map developed in this study with more attribute-value pairs will be useful for introducing SNOMED CT in hospitals.

5. Conclusion

In this study, we developed the map between Korean national health insurance reimbursement claims codes for laboratory test and SNOMED CT throughout automatic and manual mapping methods. The map we developed can be used to map local codes for laboratory tests to SNOMED CT in the local hospital. Finally, the map will facilitate semantic interoperability at the point of care and use for clinical research.

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