

Evaluation of a semi-automated code mapping and management system

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Abstract

In CDM (Common Data Model), vocabulary mapping plays a vital role in global-network studies. In order to map Korean vocabularies effectively and efficiently, EvidNet developed an application named 'MASO' (Mapping Assistance System on OMOP), and evaluated the suitability of the vocabulary mapping protocol, efficiency of entire system functions, and usability of candidate target concept providing algorithm. MASO showed good performance in quantity and quality, it provided time efficiency by offering semi-automatic system and increased agreement rate among experts.

Introduction

In CDM, it is indisputable that vocabulary mapping is vital to researches via international networking. EvidNet have chosen a mapping protocol to increase agreement on relationship between Korean and international codes: this mapping process has included initial mapping, cross-check, and the third review¹. Even though it could draw better agreement, this process leads to some human-error without a management tool. We developed an application named 'MASO' (Mapping Assistance System on OMOP) and evaluated the (1) suitability of the vocabulary mapping protocol, (2) efficiency of the entire system functions, and (3) usability of the algorithm which will be applied on MASO.

Methods

MASO is an application based on Server-Client model to manage mapping process. It was designed with WPF (Windows presentation foundation) and implemented by Node.js. The goals of MASO are to reduce laborious jobs besides vocabulary mapping, and to decrease time spending through automatic recommendation of proper vocabulary candidates. The basic function of MASO is to keep 3 mapping phases of initial mapping, cross-check and review to get better mapping results (Figure 1). We also have implemented essential functions for automation of manual jobs such as source code preprocessing, job assignment, importing, recording, searching, note, discussion, feedback and history management. Also, an algorithm, called RPM (Recommender from Past mappings) was applied on MASO to provide proper candidate concepts from past mapping results. It extracts keywords from the name of source code and searches those from previous mapped source code names. MASO automatically recommends candidates sorted by similarity score with Levenshtein algorithm² when a mapping expert tries to map a new source code (Figure 2). Also if the recommendation of candidate seems not proper, the expert can try to put the the other keywords the expert wants on MASO (Figure 3).

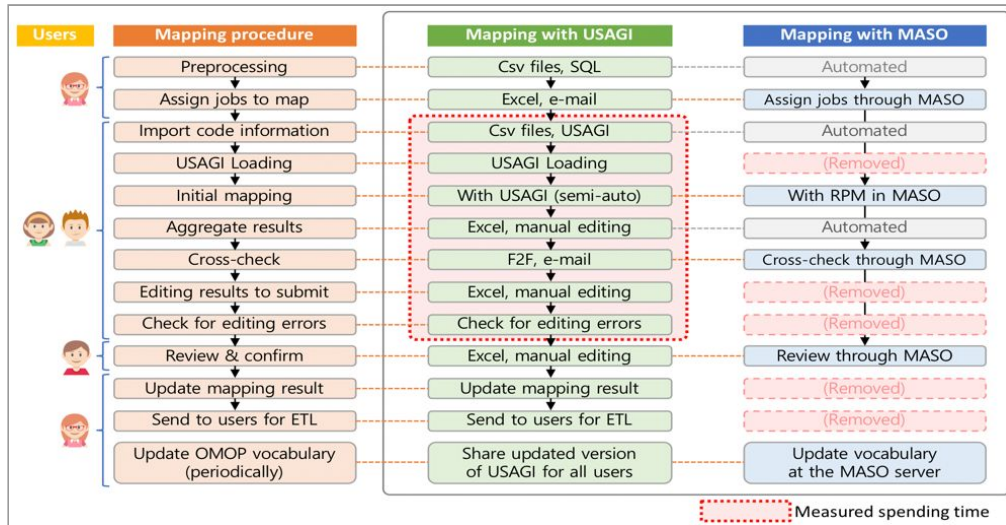


Figure 1. Simplified mapping procedure and activities with MASO.

ExtractedSourceSeq	LocalCd1	LocalCd1Name	ConceptID	ConceptName	SourceDomainId	DomainId	Frequency	VocabularyId
2210463	PD	[P] Conjunctival swab	4119507	Conjunctival swab	Specimen	Specimen	115	SNOMED
2210463	PE	[P] Lacrimal gland discharge	4161922	Specimen from eye region	Specimen	Specimen	2	SNOMED
2210464	PF	[P] Liver abscess	40488846	Specimen from abscess of liver	Specimen	Specimen	1465	SNOMED
2210465	PG	[P] Lung abscess	4133172	Specimen from lung	Specimen	Specimen	190	SNOMED

ConceptId	ConceptName	DomainId	VocabularyId	ConceptClassId	StandardConcept	ConceptCode	ValidStartDate	ValidEndDate	InvalidReason	Comment
4133172	Specimen from lung	Specimen	SNOMED	Specimen	S		1970-01-01	2099-12-31		

Re?	Similarity	ExtractedSourceSeq	LocalCd1Name	ConceptID	ConceptName	DomainId	VocabularyId	CodeOwnerName	SourceDomainId	Frequency	Comment
<input type="checkbox"/>	0.55	620822	Abscess	4001183	Specimen from abscess	Specimen	SNOMED	Kyungpook National	Specimen	879	
<input type="checkbox"/>	0.29	3028	Lung LLL	4133172	Specimen from lung	Specimen	SNOMED	KyungHee Universit	Specimen	59	
<input type="checkbox"/>	0.29	3082	Lung LUL	4133172	Specimen from lung	Specimen	SNOMED	KyungHee Universit	Specimen	139	
<input type="checkbox"/>	0.29	2996	Lung RLL	4133172	Specimen from lung	Specimen	SNOMED	KyungHee Universit	Specimen	63	
<input type="checkbox"/>	0.29	3076	Lung RUL	4133172	Specimen from lung	Specimen	SNOMED	KyungHee Universit	Specimen	150	
<input type="checkbox"/>	0.24	3140	Lung(LLL)	4133172	Specimen from lung	Specimen	SNOMED	KyungHee Universit	Specimen	46	

Figure 2. MASO UI for recommending candidate concepts with similarity.

The screenshot shows the MASO UI interface. At the top, there are search filters for 'DomainId' (Specimen) and 'CodeOwnerName' (신익진입). Below the filters, there is a table of past mapping results with columns: Re?, Similarity, ExtractedSourceSeq, LocalCd1Name, ConceptName, SourceDomainId, CodeOwnerName, Frequency, CommonCd, CommonCdName, and LocalCd.

Re?	Similarity	ExtractedSourceSeq	LocalCd1Name	ConceptName	SourceDomainId	CodeOwnerName	Frequency	CommonCd	CommonCdName	LocalCd
<input type="checkbox"/>	0.45	3452	Liver aspiration	Specimen from liver obtained by aspiration	Specimen	ALUSM_Aju university Hospital	3383			371
<input type="checkbox"/>	0.45	3453	Kidney aspiration	Specimen from kidney obtained by fine needle aspiration procedure	Specimen	ALUSM_Aju university Hospital	3382			388
<input type="checkbox"/>	0.45	3358	Kidney aspiration	Specimen from kidney	Specimen	ALUSM_Aju university Hospital	3314			396
<input type="checkbox"/>	0.39	3451	Bone marrow aspiration	Specimen from bone marrow obtained by aspiration	Specimen	ALUSM_Aju university Hospital	1879			318
<input type="checkbox"/>	0.34	3028842	Thyroid fine needle aspirate sample	Thyroid fine needle aspirate sample	Specimen	Pusan National University Hospital	1384			04
<input type="checkbox"/>	0.32	3029	Knee joint aspiration fluid	Specimen from knee joint obtained by aspiration	Specimen	ALUSM_Aju university Hospital	331			378
<input type="checkbox"/>	0.30	3450	Liver aspiration %	Specimen from liver obtained by aspiration	Specimen	ALUSM_Aju university Hospital	3387			386
<input type="checkbox"/>	0.48	1382322	Upper respiratory tract aspiration	Upper respiratory sample	Specimen	National Health Insurance Service Seon Hospital	3			916
<input type="checkbox"/>	0.14	11481	Upper respiratory tract aspiration	Upper respiratory sample	Specimen	Hanyang University Seoul Hospital	537			PG021
<input type="checkbox"/>	0.10	40289	Aspirate, fine needle	Specimen obtained by fine needle aspiration procedure	Specimen	Kyungpook National University Daegu Hospital	18			073

Figure 3. MASO UI for searching keywords and showing past mapping results.

We evaluated our mapping processes with Usagi and MASO in the aspects of 3 factors in the following Table 1.

Table 1. Three factors (Suitability, efficiency, usability) with evaluation criteria and their evaluation methods

Evaluation factor	Evaluation method	source data for evaluation
1. suitability - agreement rate difference	- calculate disagreement rate between expert A vs. B, A vs. C, B vs. C, and cross-checked result (agreed result of A and B) vs. C and compared each rate (initial mapping was done by A and B; C was 3rd reviewer)	- mapped results of Procedure domain (n=3,452)
2. Efficiency - saved time - prevention of errors by hand	- measure average spent time for each action without MASO during mapping procedure from assignment of new job to submission of cross-checked results (e.g. downloading, comparing with other expert's results or organizing the result report) - aggregate survey results from experts for what kinds of errors had they experienced during mapping procedures without MASO	- hand recorded time for source codes of Specimen domain (n=468) by 2 expert each - survey from experts participated in mapping (n=9)
3. Usability - changes of performance	- measure average hitting rate of proper concept, the number of average candidate concepts and expectation rate for proper concept as completed mapping data increases	- test: mapped results of Specimen domain (n=468) - search source: mapped results of Specimen domain (n=3,635) and OMOP DB (n=1921) of Specimen domain

Results

1 [Suitability] In terms of agreement rate, while comparison of mapping result in expert A vs. C and expert B vs. C was 62.3 - 69.3%, comparison in cross-checked result vs. expert C was 73.6%.

2 [Efficiency] Mapping 468 source code of Specimen took around 12 hours per each expert. It saved 52 mins and 90 mins for expert A and B respectively, with mapping on MASO. According to the survey, all mapping experts have experienced recording errors quite frequently on editing phase of file (n=9). Missing information or file during communication via email or summary files was ranked the second reason of error(n=5).

3 [Usability] As completed mapping results with new institutions increase in numbers, the number of hits and probabilities of source code to hit the proper target concept were increased. The percentage of a concept that fits to perfectly proper target concept per single candidate from the algorithm (hit expectation rate per candidate) was 8.6 to 12.5%: It was 5-7 times higher than that of recommended concepts in OMOP concepts (1.8%) (Figure4).

Table 2. target concept searching performances with Atlas and the newly proposed algorithm

searching source		number of record (n)	number of hits (n)	hit rate(%)	avg. number of candidates (n)	max. number of candidates (n)	hit expectation rate per candidate (%)
DB	number of site (n)						
OMOP	-	1,921	201	42.9	24.2	113	1.8
RPM utilizing past mapping result	1	503	196	41.9	3.35	19	2.5
	2	973	217	46.4	4.88	20	9.5
	3	1,380	217	46.4	4.93	20	9.4
	4	1,626	217	46.4	5.19	23	8.9
	5	1,989	217	46.4	5.21	23	8.9
	6	2,515	237	50.6	5.44	23	9.3
	7	3,148	241	51.5	5.99	26	8.6
	8	3,635	252	53.8	5.88	26	9.2

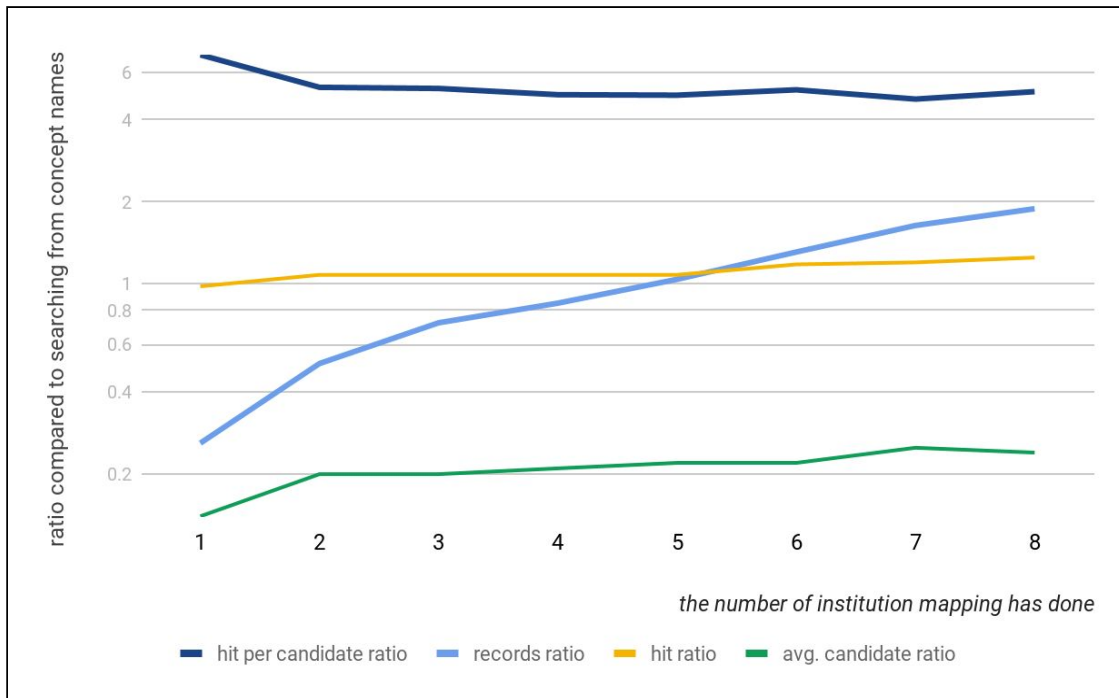


Figure 4. Target concept searching performance ratio of the new algorithm compared to the search from concept names for local source codes.

Discussion

MASO is based on 3 mapping phase with multiple experts to draw the agreement through discussion. With MASO, the agreement rate of vocabulary mapping increased because several experts were involved in mapping process through online discussion without interval. And, it also helped to reduce human-errors as shown by the user survey. Through mapping process on MASO, we expect to save time and raise the quality of vocabulary mapping.

Although Usagi had developed to help mapping process, not only it looks more helpful for codes in English rather than codes in other languages, but it is offline program and saves mapping data in file-form instead of databases exposed to various human errors. For these reasons, we need an algorithm for codes having Korean vocabularies that utilized experience and knowledge from the previous mapping results. We could see the effects of the former mapping knowledge to new mappings as shown in the result section, and when the development of an algorithm is completed to apply to MASO, we expect to obtain higher quality of vocabulary mapping outcome with better efficiency.

Acknowledgement

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References

1. G Song, HK Woo, DH Shin, SY Cho, HJ Kam. Implementing the OMOP CDM and OMOP Ecosystem in Korea. 2019 OHDSI Symposium poster abstract: 29 MAR 2019
2. <https://www.npmjs.com/package/levenshtein>