Assessing the quality of mapping a data set to the OMOP Common Data Model

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Background

Within the IMI project European Medical Information Framework (EMIF), 10 databases were mapped to the OMOP Common Data Model. The Health Improvement Network (THIN) was one of the databases. THIN contains the data of 711 GP Practices in the UK, covering 15.6 million subjects.

As part of the workflow THIN is working together with the participating providers to input good quality data in line with the standards as identified in the General Medical Services (GMS) contract and Quality and Outcomes Framework (QoF).

Within EMIF, we were specifically interested on how to specify the quality of the mapping to an OMOP Common Data Model. Measuring the quality of the mapping process is a critical feature to enable reproducible and trustworthy evidence generation.

Methods

THIN v1701 was mapped to OMOP V5.2 using the open source version of Pentaho v7.1. A total of 21 Pentaho scripts were developed to map 6 input tables to 15 different OMOP tables. Given the sheer volume of data (in total over 6 billion rows) , the scripts had to be optimized to keep processing times to acceptable levels. This was achieved by reducing expensive lookups between tables and enabling –where appropriate- parallel processing in Pentaho.

Following the mapping process, different assessments were made to measure the quality of the mapping process. A distinction was made between the 'structural' mapping quality and the 'semantic' mapping quality. While the first one measures the extent to which data elements in the source are mapped at all to the target system and to the right entity, the second element – the semantic mapping quality- tries to qualify if the variables can be mapped to a standard OMOP concept and if there is a potential loss of granularity in this process.

The quality assessment included the following steps:

1) Reviewing the log of the mapping script execution (structural mapping quality)
2) Manual Review of Achilles and Achillesheel results (structural and semantic mapping quality)
3) Summary level queries per OMOP entity on completeness of mappings (semantic mapping)
4) Specific queries on drug_exposure and condition_occurrence comparing input data vs OMOP mapped data (structural mapping)

The quality assessment was also used to drive a gradual improvement in the mapping, so when results were deemed unacceptable, scripts (and/or the semantic mappings) were adapted / expanded to obtain a higher mapping quality and the whole cycle was repeated.

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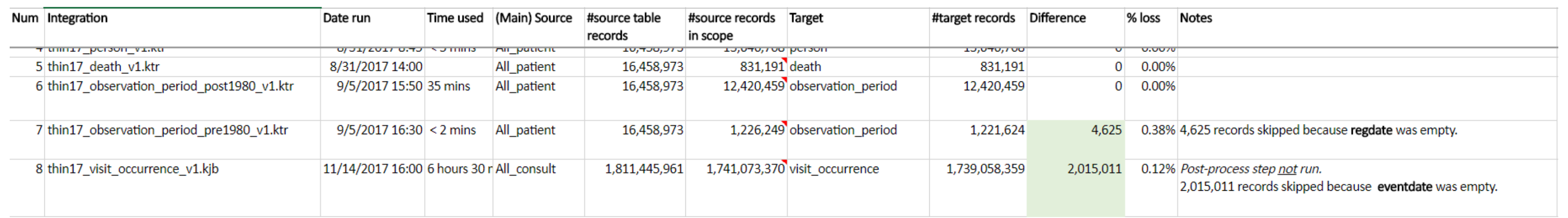
Results

During the execution of the mapping scripts, the generated logs were summarized to keep track of number of processes records, processing times and the mapped entities (see fig 1)



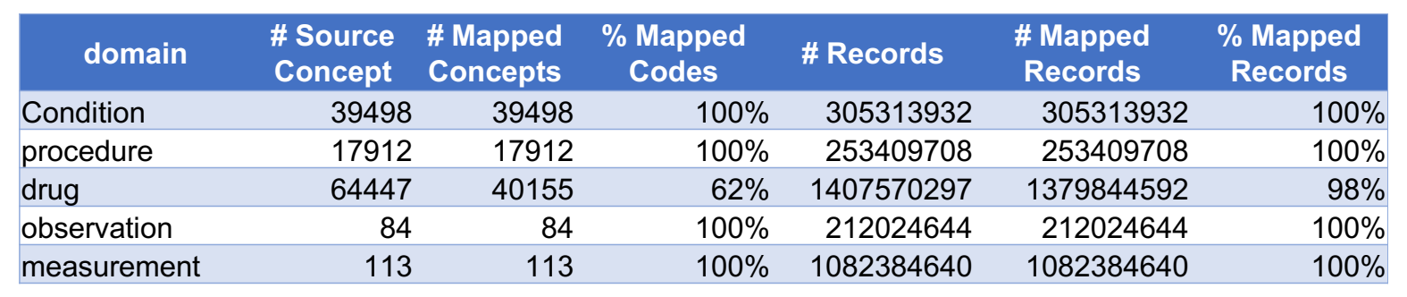
Num	Integration	Date run	Time used	(Main) Source	#source table records	#source records in scope	Target	#target records	Difference	% loss	Notes
4	thin17_person_v1.ktr	8/31/2017 8:45	< 5 mins	All_patient	16,458,973	15,040,708	person	15,040,708	0	0.00%	
5	thin17_death_v1.ktr	8/31/2017 14:00		All_patient	16,458,973	831,191	death	831,191	0	0.00%	
6	thin17_observation_period_post1980_v1.ktr	9/5/2017 15:50	35 mins	All_patient	16,458,973	12,420,459	observation_period	12,420,459	0	0.00%	
7	thin17_observation_period_pre1980_v1.ktr	9/5/2017 16:30	< 2 mins	All_patient	16,458,973	1,226,249	observation_period	1,221,624	4,625	0.38%	4,625 records skipped because **regdate** was empty.
8	thin17_visit_occurrence_v1.kjb	11/14/2017 16:00	6 hours 30 r	All_consult	1,811,445,961	1,741,073,370	visit_occurrence	1,739,058,359	2,015,011	0.12%	*Post-process step not run.* 2,015,011 records skipped because **eventdate** was empty.

Fig 1: Screenshot of the script execution tracker

As the table structure in the THIN source doesn't map one-on-one to the target OMOP table schema, one particular use of the tracker was to understand the relative contribution that each source entity made to particular target tables. In a second step, the counts and possible discrepancies in counts between source and target was used to assess potential deficiencies in the mappings

Achilles and Achillesheel output were also reviewed as part of the quality assessment and the identified errors were used to gradually improve the mapping scripts

Summary level queries executed per OMOP entity were executed and results are represented in fig 2.



domain	# Source Concept	# Mapped Concepts	% Mapped Codes	# Records	# Mapped Records	% Mapped Records
Condition	39498	39498	100%	305313932	305313932	100%
procedure	17912	17912	100%	253409708	253409708	100%
drug	64447	40155	62%	1407570297	1379844592	98%
observation	84	84	100%	212024644	212024644	100%
measurement	113	113	100%	1082384640	1082384640	100%

Fig 2: Mapping overview per OMOP entity (all results are against CDM tables)

By applying the repetitive cycle of improving scripts and mappings, almost all records that were uploaded to OMOP could be mapped using standard concepts. For drugs, despite the fact that only 62% of the codes were mapped, this still resulted in 98% of the records that could be mapped. It has to be noted in addition, that since the mapping was done, a more comprehensive coverage of local drug codes is available in OMOP, which would result in a significantly higher percentage of mapped codes.

The last step assessed specifically the full count comparison or a given code in the source system vs a count on the standard concept in OMOP. Results are given below for drug_occurrence.

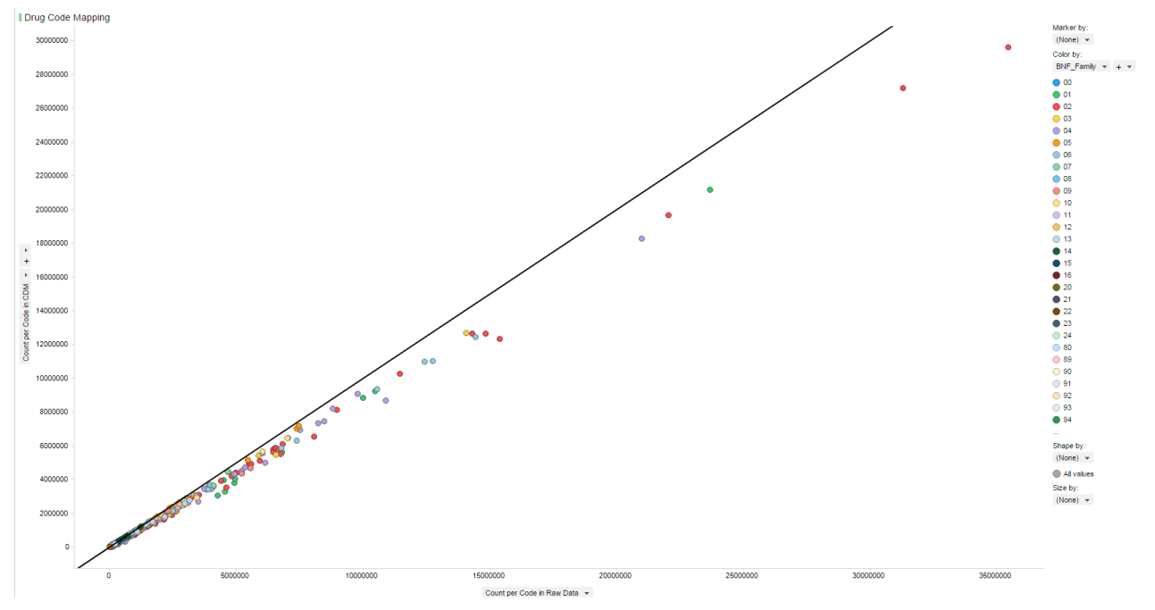


Figure 3 shows that there is indeed a difference in count between source and OMOP CDM . As indicated in figure 2, this discrepancy is only marginally caused by the absence of a standard concepts (counting for about 2% of the losses). The main contributing factor was the explicit business rule to only include records which had at source a flag indicating an 'acceptable record'.

Conclusions

The assessment indicates that based on absolute counts, a difference can be found between the source system and OMOP. This difference is based on explicit design decisions. For the semantic mappings, a near complete mapping to standard concepts could be obtained. However, this is following a repetitive cycle of assessment , adjustment and re-execution of the mapping logic. In addition, it's imperative that consistent design decisions are made when mapping data sources i.e. mapping all records or only mapping records that adhere to certain established criteria.