Medication dosage and exposure duration in OMOP CDM: mapping challenges

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Background

There is a growing demand in transformation of medical data to Observational Medical Outcome Partnership (OMOP) Common Data Model (CDM). One of the main ETL challenges is to transform native data to the Drug domain retaining the exact drug dosages administered or prescribed. Starting from CDM v.2.3.0 the drug exposure table contains only quantity field designed for storing the amount of drug. In the latest CDM documentation², it is stated that “the quantity should be converted to the correct unit given in the drug_strength table”. Despite the CDM documentation³ provides examples on this topic, there is still considerable ambiguity between quantity and drug dose calculations. Moreover, since OMOP CDM v.5.2.0 drug_exposure_end_date field is required. It’s known that the end date of a drug intake is not always available in the source data, so OMOP CDM documentation provides the day to change calculation based on the days supply, total dosage/daily dosage proportion, and default values (1 day for administration records, 29 days for written prescriptions and 90 days for mail-order prescriptions). Default value rule does not tend to be precise enough and there’s a need for development of alternative solutions on the data sources lacking days supply and daily dosage information.

In our work we would like to share the best practices on:

1. Calculation of quantity comprehensively considering the source information, target standard concept of the drug_exposure record and associated dosage from the drug_strength table.
2. Imputation of drug_exposure_end_date using daily dose and derived daily dose (DDD) from Anatomical Therapeutic Chemical Classification System (ATC) vocabulary

Methods: Calculation of quantity value

We developed an automated approach for the drug_exposure quantity calculation by taking into account the source information, respective dosage from the drug_strength table, a target concept and the way the source units match the units in the drug_strength table fields.

Use the formula as shown in the Table 1. Which formula to choose depends on the source drug representation, drug_strength composition of the target concept and the match between the two.

Table 1. Calculation of quantity value

<table>
<thead>
<tr>
<th>Source table</th>
<th>Concept mapping</th>
<th>DRUG_STRENGTH</th>
<th>UK_UNIT</th>
<th>Calculation of quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>source_drug</td>
<td>source_quantity</td>
<td>drug_concept_id</td>
<td>amount</td>
<td>amount</td>
</tr>
<tr>
<td>acetaminophen 250 MG TABLETS</td>
<td>0.5</td>
<td>G</td>
<td>1125325</td>
<td>acetaminophen 250 MG Oral Tablet</td>
</tr>
<tr>
<td>furosemide 10 MG/ML INJECTION</td>
<td>0.4</td>
<td>G</td>
<td>5660225</td>
<td>furosemide 10 MG/ML Injection</td>
</tr>
<tr>
<td>rofecoxib, vioxx - suspension</td>
<td>0.375</td>
<td>G</td>
<td>2110607</td>
<td>rofecoxib 2.5 MG/ML Oral Suspension [Vioxx]</td>
</tr>
</tbody>
</table>

Methods: Imputation of drug_exposure_end_date

If the daily dose is not available in the source data, the most frequent dose can be used for each source drug concept or source-target drug concept combination, the most frequent dose is defined and then it is applied to those records where the dosage is missing.

If daily dose is not available at all, ATC DDD (defined daily dose) can be used as the assumed average maintenance dose per day for a drug used for its main indication in adults. This method was discussed on the ODHS forum⁴ and tested on oral solid drugs. Method plausibility was assessed using another plausible gusteinated calculation of end date based on the following prescription and assumption that most common durations of taking the drug should be 7/30/30 days. In addition, we reviewed results for 200 most common drugs in the source and made a conclusion that for most of cases ATC DDD method is suitable.

However, there are some limitations for ATC DDD method:

- Some drugs are indicated in different dosages for different therapeutic purposes, e.g. aspirin is used in dosage of 3g/day as analgesic/antipyretic and in dosage of 1 tablet per day (independent of strength) as antiplatelet agent.
- ATC DDD is less than the dosage of one entity (tablet, capsule, etc.) it is unlikely that partial entities were administered (see the last three rows in Table 2).
- The method was tested for oral solid drug forms only, while liquid, inhalation forms requires much more extensive logic and calculations.
- Suitable only for adult dosages (patients at least 16 years old or older).

Table 2. ATC DDD approach implementation

In this work we addressed the principal use cases of calculating the drug_exposure_quantity values using the drug_strength table and imputation of drug_exposure_end_date based on a daily dose. Population of the quantity values in the drug_exposure table in accordance with drug_strength data and source units and imputing the drug_exposure_end_date are important steps to assure correct calculations in the drug, end and dose, end tables and make OMOP drug dosage studies possible. The unified automated scripts that calculate quantity based on the drug_strength fields values and source unit information can be a performing solution, but more research is required to solve the limitations of this approach (conflicting source and target units, based medications, combined medications). One of the possible steps to improve the drug dosage conversion and representation in OMOP is drug signature standardization.

The approach of imputing drug_exposure_end_date using ATC DDD can be considered to be added to the CDM documentation. ATC DDD data need to be integrated into the Standardized OMOP vocabularies.

References:

1. Release CDM v. 5.2.0 ODHSUS Common Data Model. https://github.com/ODHSUS/CommonDataModel/releases/tag/v5.2.0
4. ATC DDD: https://www.who.int/topics/atc-ddd-toolkit/about-ddd

Conclusions

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