Incorporation of CVX Vaccines into OMOP Drug Hierarchy

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Abstract

To generate real-world evidence about the effectiveness of vaccination, we need to handle electronic health records and their inevitable processing in terms of ETL. Thus, there is an urgent need to have a universal tool for immunization status definition on the population level regardless of the source or granularity of patient data. Therefore we would like to draw researchers' attention to a possible and effective way of vaccination-related data representation in the OMOP CDM.

Research Category: Observational data management

Introduction

According to the preliminary list of COVID-19 candidate vaccines that have been prepared by the World Health Organization (WHO) for information purposes[1], there are numerous biological preparations with the potential to provide active acquired immunity against the SARS-CoV-2, and all of them still require further study[2]. However, some clinical trials have already been started[3] consequently generating new medical data flow, which is not going to stop anytime soon. This means that to bring the end of the pandemic closer, researchers need to generate evidence on new vaccines safety and efficacy as quickly as possible, using a unified solution easily extrapolated to any health system and data. OMOP CDM tends to be a treasure trove of such "ready-to-go" solutions. Currently, it has a comprehensive Drug Hierarchy based on The Anatomical Therapeutic Chemical (ATC) Classification System and vocabulary, RxNorm and RxNorm Extension[4].

Challenge

The flexibility of OMOP CDM drives us to develop approaches serving to enrich the set of instruments available to OHDSI collaborators. The particular case is CVX vocabulary, the purpose of which is to code vaccinations performed by different healthcare providers and to be a target for the mapping of immunization drugs[4]. Although CVX codes arise quite often in the real-world data and are very useful for the conversion of immunization-related source records with a lack of details (e.g. "unspecified influenza vaccination"), none of them can be obtained as a descendant of ATC classification concepts in Atlas.

Solution

In order to simplify the determination of patient immunization status during cohort definition and concept set creation, we propose the methodology of vaccine administration data representation in OMOP Standardized Vocabularies. It is based on the embedding of CVX vocabulary into the existing ATC - RxNorm/RxNorm Extension Drug Hierarchy. The level of incorporation of a particular CVX code depends on the presence of one-to-one equivalent mapping and a semantic topography relative to the Standard Ingredient taken as a benchmark[5]. Using this, we have defined the following categories:

1. CVX vaccines having single Standard semantic equivalents in the RxNorm.
2. Multicomponent CVX vaccines with several Standard compositional parts represented by separate RxNorm Ingredients. They are considered to be "close to" the RxNorm Ingredient level and above RxNorm Clinical Drug Form.
3. CVX vaccines which cannot be covered by OMOP Drug Domain rules and figuratively are "above" the RxNorm Ingredient level:

   3.1 CVX vaccines with several relevant RxNorm Ingredients, Dose Forms, and/or Dosages.

   3.2 Category-like CVX vaccines of "unspecified formulation".
4. CVX vaccines requiring mapping to SNOMED Procedures.
5. "Unmappable" CVX concepts excluded from the hierarchy (e.g. vaccines which are represented in other vocabularies).

There are some examples for each category in Table 1 below.

Table 1. Examples of CVX mapping and hierarchical matching.

category	CVX code	CVX name	relationship	target concept code	target concept name	target concept class	target vocabulary
1	30	hepatitis B immune globulin	Maps to	26744	hepatitis B immune globulin	Ingredient	RxNorm
2	118	human papilloma virus vaccine, bivalent	Is a	798264	L1 protein, Human papillomavirus type 16 Vaccine	Ingredient	RxNorm
			Is a	798266	L1 protein, Human papillomavirus type 18 Vaccine	Ingredient	RxNorm
3.1	19	Bacillus Calmette-Guerin vaccine	Is a	L03AX03	BCG vaccine	ATC 5th	ATC
			Subsumes	314513	BCG, Live, Montreal Strain	Ingredient	RxNorm
			Subsumes	76469	BCG, Live, Connaught Strain	Ingredient	RxNorm
			Subsumes	221050	BCG, Live, Tice Strain	Ingredient	RxNorm
3.2	88	influenza virus vaccine, unspecified formulation	Is a	J07BB	Influenza vaccines	ATC 4th	ATC
			Subsumes	111	influenza virus vaccine, live, attenuated, for intranasal use	CVX	CVX
			Subsumes	149	influenza, live, intranasal, quadrivalent	CVX	CVX
			Subsumes	155	Seasonal, trivalent, recombinant, injectable influenza vaccine, preservative free	CVX	CVX
			Subsumes	185	Seasonal, quadrivalent, recombinant, injectable influenza vaccine, preservative free	CVX	CVX
4	96	tuberculin skin test; purified protein derivative solution, intradermal	Is a	8948	Purified Protein Derivative of Tuberculin	Ingredient	RxNorm
			Has related procedure	28163009	Skin test for tuberculosis, Tine test	Procedure	SNOMED

In general, CVX concepts from 1st category will get "Maps to" relationships and become non-standard while concepts from categories 2-4, at the appropriate hierarchical level, will be embedded via "Is a" relationships indicating "one hierarchical step" from a descendant (a child) to an ancestor (a parent), while "Subsumes" relationships have an opposite meaning(Figure 1).
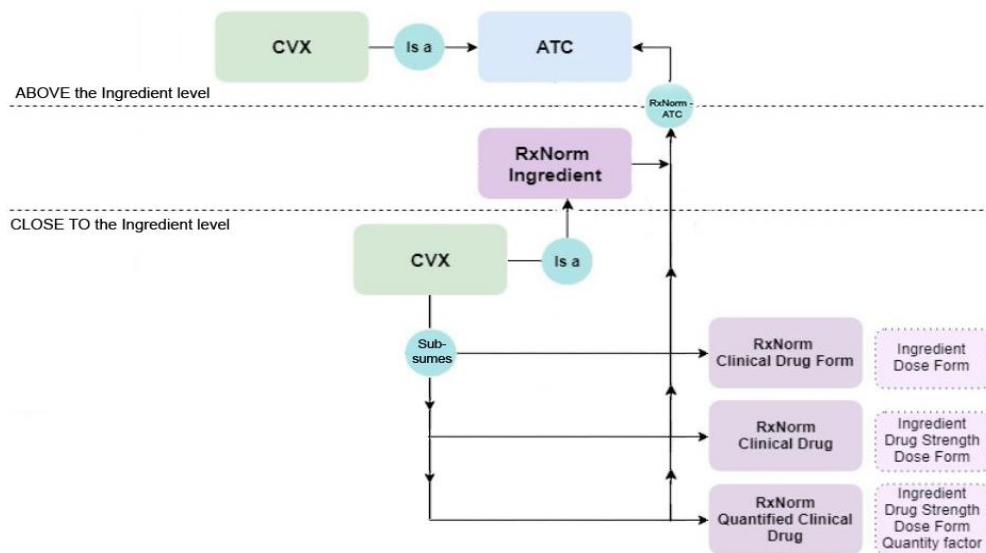

Figure 1. Hierarchical crosswalk from CVX concepts to ATC as well as RxNorm.

Conclusion

The approach provides us with the opportunity to incorporate the majority of CVX concepts into OMOP Drug Hierarchy. Such integration will increase the sample size in any cohort somehow related to patient immunity status by expanding the ancestry of Standardized Vaccines in OMOP CDM.

References

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