Adding evidence type representation to DIDEO

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***Abstract*—In this poster we present novel development and extension of the Drug-drug Interaction and Drug-drug Interaction Evidence Ontology (DIDEO). We demonstrate how reasoning over this extension of DIDEO can a) automatically create a multi-level hierarchy of evidence types from descriptions of the underlying scientific observations and b) automatically subsume individual evidence items under the correct evidence type. Thus DIDEO will enable evidence items added manually by curators to be automatically categorized into a drug-drug interaction framework with precision and minimal effort from curators. As with all previous DIDEO development this extension is consistent with OBO Foundry principles.**

Keywords—drug-drug interaction; potential drug-drug interaction; evidence types; biomedical ontologies

I. Introduction

The Drug-drug Interaction and Drug-drug Interaction Evidence Ontology (DIDEO) is an ontology aimed at representing drug-drug interactions, potential drug-drug interactions and the underlying phenomena from physiology, anatomy, pharmacology and laboratory science. The goal in creating DIDEO is to provide a realism-based, semantically rich, and logically consistent OWL representation for the Drug Interaction Knowledge Base (DIKB) [1,2]. DIDEO is based on Basic Formal Ontology [3] and is compliant with the OBO Foundry [4] principles [5]. It is coded in Web Ontology Language (OWL2) [6] and is freely accessible from http://purl.obolibrary.org/obo/dideo.owl.

A key achievement of the initial version of DIDEO [7] was to establish a clear distinction between drug-drug interactions or DDIs (biological processes) and potential drug-drug interactions or PDDIs (information content entities) based on the paradigm of ontological realism [8]. This deliberate separation of *representations* of physiological processes and material entities, as opposed to the *representation of information about* physiological processes has been a core strategy in developing DIDEO.

In this poster we present the development of a new, semantically rich OWL representation of types of evidence for DDIs and PDDIs. An important use case for the new representation is to automatically categorize evidence items into multilevel taxonomy of evidence types. We plan for curators of DDI and PDDI information to use a web-based data entry form to enter information about a scientific observation that the particular evidence item is about (e.g. an experiment, a clinical study, a case report, etc.). Examples of the aspects of scientific observations relevant to our use case include among others: group randomization, targeting pharmacokinetics, number of drugs involved, enzymes involved, inclusion of antibodies, etc. Based on information about these aspects we want to enable automatic categorization of our evidence items into the DIKB evidence type taxonomy [9]. The top level of this evidence taxonomy is:

- Statements of various kinds
- Metabolic enzyme identification experiments
- Metabolic enzyme inhibition experiments
- Transport protein identification experiments
- Transport protein inhibition experiments
- Prospective clinical studies
- Non-randomized studies and case reports
- Observational studies

II. Methods

The key strategy for achieving automatic categorization of evidence is to use a) necessary and sufficient conditions of evidence types and b) property assertions for evidence items and the related scientific observations. Fig. 1 shows the classes and relations used to create the necessary and sufficient axiom of the class *randomized drug-drug interaction trial*.

To represent the scientific observations and their properties, we imported terms from the following ontologies: Chemical Entities of Biological Importance (ChEBI) [10], Drug Ontology (DRON) [11], Gene Ontology (GO) [12],

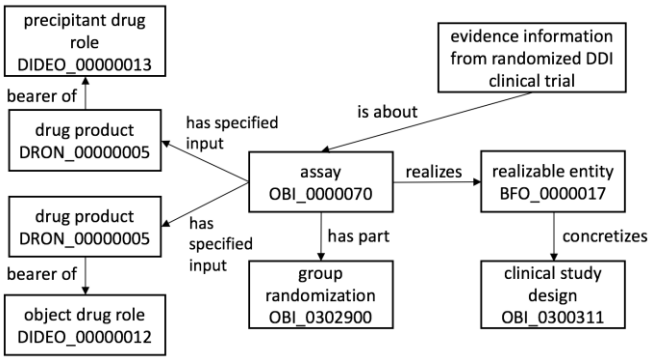

Fig. 1. The formal definition of *randomized drug-drug interaction trial* in DIDEO. The boxes represent classes; the arrows represent object properties. All depicted object properties are used in existential statements (SOME).

Ontology of Adverse Events (OAE) [13], Ontology of Biomedical Investigations (OBI) [14], and the Uberon multi-species anatomy ontology [15].

III. Results

The extension of DIDEO currently available includes 24 formally defined evidence types. It can be accessed from http://purl.obolibrary.org/obo/dideo/2016-05-12/dideo.owl. Representation of additional evidence types and additional axioms is underway for our project and will be implemented in a subsequent version of DIDEO.

Running the HermiT 1.3.8.3 reasoner, we generate the inferred hierarchy of the evidence types: it is an exact match to the previous DIKB taxonomy as built by domain experts (Fig. 2). In addition, the example individuals were correctly sorted into the evidence types based on the specified properties of the scientific observation that the evidence type was about. This result can be recreated by the reader by running the HermiT 1.3.8.3 reasoner over the test file including examples of evidence items. This test file can be found here: http://purl.obolibrary.org/obo/dideo/EvidenceTypes/dideo.owl.

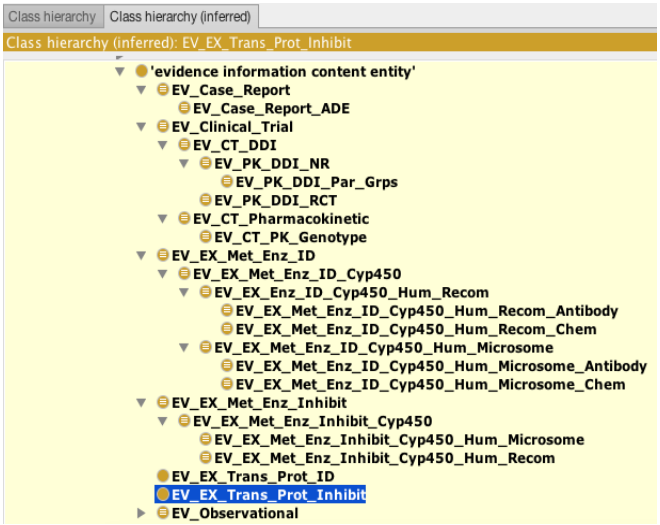

Fig. 2. View of the inferred evidence type taxonomy in Protégé

IV. Conclusion

Based on these results we conclude that the attributes of evidence as used by the DIKB are sufficient to infer a taxonomy of evidence types automatically. We also conclude that it is feasible to use these attributes to automatically categorize individual evidence items using OWL reasoning.

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