Towards an Imaging Biomarker Ontology based on the Open Biological and Biomedical Ontologies Foundry

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Abstract. The importance of imaging biomarkers in biomedical research and drug design is well-acknowledged in the literature, calling for appropriate standards and guidelines for imaging biomarker development, validation and qualification. The objective of this work is to define explicitly, by means of an ontology, the vocabulary pertaining to imaging biomarkers.

1 Introduction

The wide-scale use and reuse of imaging biomarkers in medical research and clinical practice makes it very important to be able to share information about biomarkers. In Ball et al. (2010), the Institute of Medicine stressed the need to define in a consistent and precise way the vocabulary related to biomarkers. Besides, recent works from different communities (imaging research, clinical radiology, genetics, knowledge management, etc.) showed interest in a consistent representation of imaging biomarkers, but, these efforts have not converged to a consensual model, yet. This have motivated us to develop an ontology entitled Imaging Biomarker Ontology (IBO) to formally define basic aspects related to the imaging biomarker concept. IBO is founded on the Open Biological and Biomedical Ontologies (OBO) foundry (2007) as well as it takes into consideration some state-of-the-art propositions: e.g. QIBO (2013), BiomRKRS (2014) and QIBA profiles (2007).

2 Materials and Methods

IBO involves many diverse entities related to imaging biomarkers that concern many domains (medical imaging, metrology, clinical research, informatics, etc.). Therefore, most of classes are aligned with Basic Formal Ontology (BFO) and were developed according to the OBO foundry principles, thus facilitating the integration of terms. Extraction was made following the MIREOT principles, thanks to the OntoFox tool. We have, mainly, reused Ontology for Biomedical Investigations (OBI), Phenotypic Quality Ontology (PATO), Chemical Entities of Biological Interest (ChEBI) Ontology and Foundational Model of Anatomy (FMA) ontology.

3 Results

Our proposed ontology, IBO, articulates three basic aspects related to imaging biomarkers namely, facet 1: measured biological characteristics, facet 2: measurement protocols and facet 3: role in decision making applications. The first facet defines physical qualities related to imaged objects or processes. We have distinguished between two kinds of qualities: qualities that are related to a continuant (e.g. tumor size, longest diameter, tumor volume, tissue radioactivity concentration, etc.) and qualities that describe an occurrent (e.g. volume change measurement between two time points or more complex processes as volume change speed measurement, etc.). The second facet, specifies imaging requirements and describes performed measurement processes leading to imaging biomarker values. Measurement processes are composed of many sub-processes (subject preparation, image acquisition, image processing, etc.) that involve many material entities (image acquisition device, imaging agent, imaging subject, etc.) as well as roles realized in the context of the processes in which they participate. The third facet represents imaging biomarker applications, namely: diagnosis, prediction, prognosis, treatment assessment and therapy monitoring. All imaging biomarker applications involve some imaging biomarker value which bears a particular role, e.g predictive, diagnostic, etc. and their degrees of validation for specific intended uses.

4 Conclusion

The aim of IBO is to define explicitly the domain of imaging biomarker in health care context, we have based our work on preliminary work from QIBO and BiomRKRS as well as relevant OBO foundry's ontologies. Future work will aim at applying IBO for representing imaging biomarkers in brain gliomas.

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