

Medical encounters in the obstetric and neonatal domain: an approach based on ontological realism

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Abstract — Electronic health records (EHRs) serve as repositories of data collected in health care encounters. They record, for example, information about who receives and who provides the health care, and about the place where the encounter occurs. We describe a consensus representation of data from different EHR repositories focusing on the obstetric and neonatal domain. Our approach is based on ontological realism and on the principles of the OBO Foundry, including reuse of reference ontologies such as the Ontology for General Medical Science (OGMS) and the Ontology of Medically Related Social Entities (OMRSE).

Keywords — *Biomedical Ontology, Obstetric and Neonatal Ontology, electronic health records, Basic Formal Ontology, OBO Foundry, social entities.*

I. INTRODUCTION

Our starting point is the Stork Network, an initiative of the Brazilian Health Care Program that aims to provide comprehensive care for both mother and child during the course of pregnancy and in the postpartum period. The organization of health care in Brazil involves health care facilities at different government levels, each of which has a certain autonomy. Most importantly, health care facilities are free to adopt their own electronic health record (EHR) information systems, and this creates challenges to data interoperability. To address some of these challenges we are developing the Obstetric and Neonatal Ontology (OntONeo) [3], which aims to represent the diversity of data registered in the EHRs involved in pregnancy care. OntONeo is an initiative to overcome failures of semantic interoperability among EHR information systems built using different standards and terminologies.

The scope of OntONeo covers not only Brazilian but also international EHR standards such as the *Woman's Health Record* and *Antepartum Record and Postpartum Form* provided by the American College of Obstetricians and Gynecologists (ACOG) and the *Children's Electronic Health Record Format* provided by the Agency for Health care Research and Quality (AHRQ). We also conducted interviews with Brazilian and American obstetricians to identify the information needs associated with workflows in women's health clinics.

The course of pregnancy, childbirth and child development involves a series of stages referred to as the prenatal, intrapartum and postnatal periods of care [2; 7]. Clinical care in each of these

stages involves different medical specialties. Specific EHRs record all information generated in a given care encounter according to the specialty of the care provider.

EHRs across different medical specialties need to record information about the elements observed in medical encounters. Every such encounter necessarily involves three common elements: first, the location where clinical activity is performed; second, the provider of health care (for example the doctor); and third, the recipient of health care (the consumer or patient).

In addition, in every health care encounter a provider collects demographic data from the consumer. The demographic data section of an EHR is present not just to allow identification and categorization of the consumer [4]. It also provides the information needed to locate the consumer in the future and data about people related to the consumer: the consumer's *emergency contact*, information about the *spouse* or *partner* of the consumer, and, if the consumer is a minor, information about the *legally responsible person*. All of these persons are elements that are documented in medical encounters and the corresponding information is included in the demographic subsection of the EHR. They are connected to a consumer through social relations defined by the Ontology of Medically Related Social Entities (OMRSE) [4].

Our representations of the demographic data section of the EHR and of the elements of the medical encounter are quite generic. We follow the practice of the Ontology for General Medical Science (OGMS) which deals with general terms of medicine used across multiple medical disciplines [5]. Thus, these representations will support not only the interoperability needs of the Stork Network Program and of specialists working in the obstetric and gynecological domains, but also corresponding needs of EHRs pertaining to other medical specialties.

The main contribution of the work described here, however, is to extend OGMS and OMRSE to the specific case of pregnant care.

II. METHODOLOGY

To build OntONeo we adopt the principles of ontological realism to foster semantic coherence and usability for both humans and computers [3]. The set of principles established to achieve these goals is summarized in [1; 8].

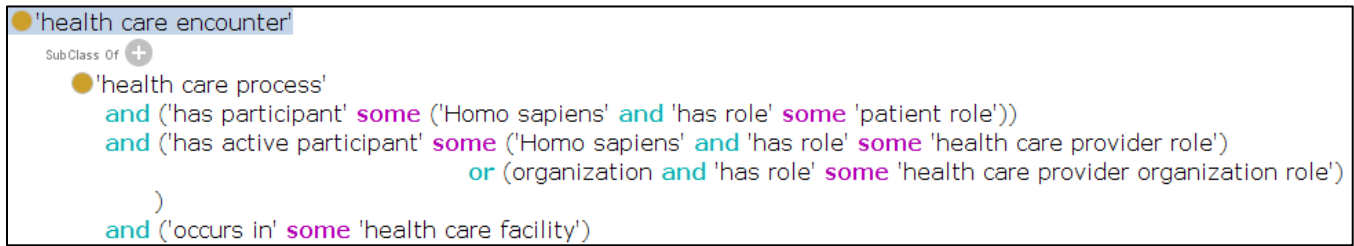


Fig. 1 : Basic elements in a health care encounter (By authors)

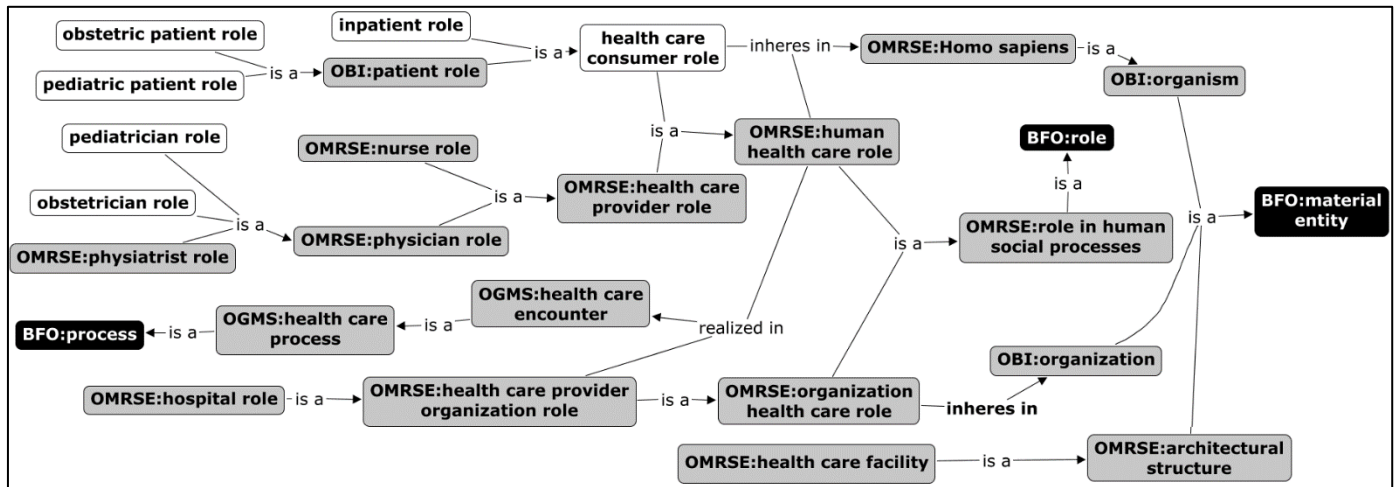


Fig. 2: Complimentary elements in a health care encounter (By authors)

The top-level ontology used as starting point for OntONEo is Basic Formal Ontology (BFO) 2.0 [1]. To maximize interoperability among biomedical ontologies, and following the OBO Foundry principles [6], we reuse previous ontologies developed on the same basis, including not only OGMS and OMRSE but also the Ontology of Document Acts (d-acts), the Phenotype Ontology (PATO), and the Ontology for Biomedical Investigations (OBI).

OntONEo is divided into modules designed to meet specific needs. We focus here on *OntONEo-Social*, which is the module that covers social entities involved in obstetric and neonatal care such as family relations and demographic information.

III. ELEMENTS OF A MEDICAL ENCOUNTER

Figures 1 and 2 provide a sketch of our approach to those elements that are documented in a health care encounter. Terms in black represent entities reused from BFO, terms in gray are from other OBO Foundry-conformant ontologies; and terms in white are new entities proposed by OntONEo. The central term *health care encounter* is taken from the OGMS ontology where it is defined as a *health care process*, in which at least one human being participates as consumer (human being *has_role* patient role).

IV. CONCLUSION AND REMARKS

OntONEo is an on-going project in the early stages of development. the current version is available on the web at <http://ontoneo.wordpress.com>. The work seeks above all to address the lack of formal representations in the obstetric and neonatal domains.

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REFERENCES

- [1] R. Arp, B. Smith, and A.D. Spear, *Building Ontologies with Basic Formal Ontology*, The Mit Press, Cambridge, Massachusetts, 2015.
- [2] C.R.B. Beckmann, F.W. Ling, W.N.P. Herbert, D.W. Laube, and R.P. Smith, *Obstetrics and Gynecology*, Wolters Kluwer Health/Lippincott Williams & Wilkins, Philadelphia, 2014.
- [3] F. Farinelli, M.B. Almeida, P. L. Elkin, and B. Smith, OntONEo: The Obstetric and Neonatal Ontology, in: *7th International Conference on Biological Ontology (ICBO 2016)*, Oregon State University, Corvallis, OR, USA, 2016.
- [4] W.R. Hogan, S. Garimalla, and S.A. Tariq, Representing the Reality Underlying Demographic Data, in: *2nd International Conference on Biological Ontology (ICBO 2011)*, O. Bodenreider, M.E. Martone, and A. Ruttenberg, eds., CEUR Workshop Proceedings, Buffalo, NY, USA, 2011, pp. 147-152.
- [5] R.H. Scheuermann, W. Ceusters, and B. Smith, Toward an ontological treatment of disease and diagnosis, *Proceedings of the 2009 AMIA summit on translational bioinformatics* **2009** (2009), 116-120.
- [6] B. Smith, M. Ashburner, C. Rosse, J. Bard, W. Bug, *et al.*, The OBO Foundry: coordinated evolution of ontologies to support biomedical data integration, *Nature Biotechnology* **25** (2007), 1251-1255.
- [7] B. Smith and B. Brogaard, Sixteen days, *The Journal of Medicine and Philosophy* **28** (2003), 45-78.
- [8] B. Smith and W. Ceusters, Ontological realism: A methodology for coordinated evolution of scientific ontologies, *Applied ontology* **5** (2010), 139-188.