Dealing with elements of medical encounters: an approach based on ontological realism

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Abstract — **Electronic health records (EHRs) serve as repositories of documented data collected in a health care encounter. An EHR records information about who receives, who provides the health care and about the place where the encounter happens. We also observe additional elements relating to social relations in which the healthcare consumer is involved. To provide a consensus representation of common data and to enhance interoperability between different EHR repositories we have created a solution grounded in formal ontology. Here, we present how an ontology for the obstetric and neonatal domain deals with these general elements documented in health care encounters. Our goal is to promote the interoperability of information among EHRs created in different specialties. To develop our ontology, we used two main approaches: one based on ontological realism, the other based on the principles of the OBO Foundry, including reuse of reference ontologies.**

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

I. INTRODUCTION

The motivation here grows out of the workings of the Stork Network Program, a Brazilian Healthcare Program that aims to provide comprehensive care of both woman and child during the course of pregnancy and in the postpartum stage. The organization of healthcare in Brazil involves health facilities at different government levels each of which has certain autonomy. These government levels are even free to adopt their own electronic health record (EHR) information systems, which 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 EHRs involved in pregnancy care. OntONeo is an initiative to overcome failures of semantic interoperability among EHR information systems that were built using different standards and terminologies.

The scope of OntONeo was defined from a set of Brazilian and international EHR standards, for instance: the *Woman's Health Record* and *Antepartum Record and Postpartum Form* provided by the American College of Obstetricians and Gynecologists (ACOG); the *Children's Electronic Health Record Format* provided by the Agency for Healthcare Research and Quality (AHRQ). We also conducted interviews with Brazilian and American obstetricians to identify the workflow of the women's health clinic and the information needs of this

medical practice. In the future, we will conduct interviews also with pediatricians to identify their needs.

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 calls upon different medical specialties. Information pertaining to all stages of care is recorded in specific EHRs according to their specialty of origin.

EHRs across different medical specialties need information about elements observed in medical encounters. Each such encounter necessarily involves three elements: first, the location where clinical activity is performed, named *health care facility*; second, who performs or serves as the provider of health care, named the *human health care provider*; and third, who participates in an event as recipient of health care (consumers), named the *human health care consumer*.

In addition, during the health care encounter a provider collects demographic data from a consumer. The demographic data section of an EHR is more than just data to allow the identification and categorization of the consumer [4]. It includes also information needed to locate the consumer and data about people related to the consumer: the consumer's *emergency contact*, information about the *spouse* or *partner* of the consumer, and finally, 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 included in a corresponding demographic sub-section of the EHR. They are connected to a consumer by social relations, as a *marital status* defined by Ontology of Medically Related Social Entities (OMRSE) [4].

Our representation of the demographic data section of the EHR and the elements of the medical encounter are quite generic. We follow the practice of the Ontology for General Medical Science (OGMS) which deal with general terms of medicine used across medical disciplines [5]. Thus they will meet not only the needs of interoperability of the Stork Network Program, but also corresponding needs of EHRs pertaining to any medical specialty.

This paper describes the OntONeo approach to deal with the elements present in medical appointments: the consumer and the provider in a medical encounter, the place of the health care facility, and the social relations of the consumer that are

important to document. We are extending OGMS and OMRSE to the specific case of pregnancy.

II. METHODOLOGY

To build OntONeo we adopt the principals of ontological realism to foster semantic coherence, both for humans and computers [3]. On the view of ontological realism a useful domain ontology should be built not to represent existing data or models of a domain, but rather to represent the relevant established science. The set of principles established to foster achievement of this goal are summarized in [1; 8].

The top-level ontology used as starting point for OntONeo is the Basic Formal Ontology 2.0 [1]. To maximize the interoperability among biomedical ontologies, and following the OBO Foundry principles [6], we reuse previous ontologies developed as: Ontology of Document Acts (d-acts), Phenotype Ontology (PATO), and Ontology for Biomedical Investigations (OBI), in addition to Ontology for General Medical Science

(OGMS) and Ontology of Medically Related Social Entities (OMRSE).

OntONeo is divided into modules designed to meet specific needs. In this work, we present the part of the *OntONeo-Social* that covers the domain of social entities involved in obstetric and neonatal care, such as family relations and demographic information.

III. ELEMENTS OF A MEDICAL APPOINTMENT

Fig. 1 and 2 show a sketch of the elements documented in a health care encounter. Terms in black represent entities reused from BFO, terms in gray are taken over from other ontologies; and terms in white are new entities of OntONeo. The term *health care encounter* is defined by OGMS ontology as a *process* in which at least one human being participates. Then we have in OMRSE ontology the term *Homo sapiens* that was reused from NCBI organismal.
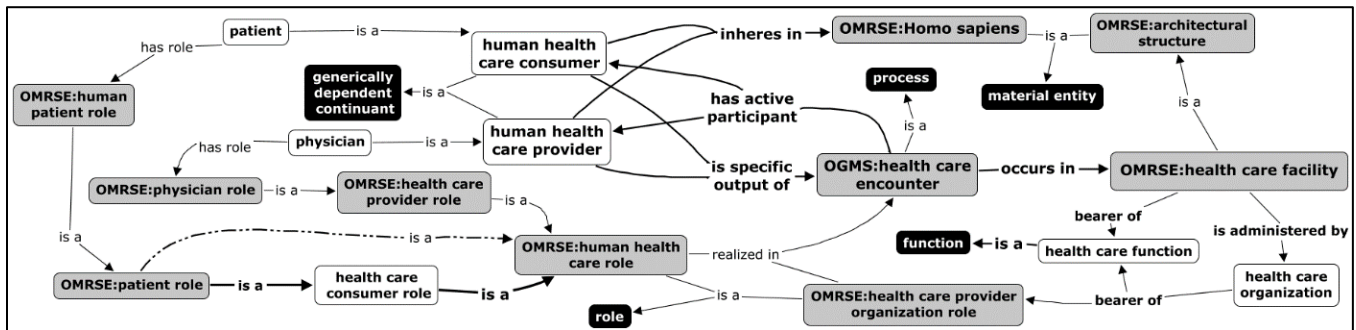

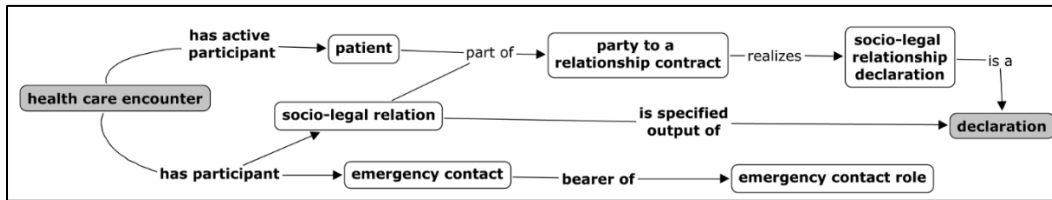Fig. 1 : Basic elements in a healthcare encounter (By authors)

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

IV. CONCLUSION AND REMARKS

This paper described how OntONeo deals with the elements involved in a health care encounter. These elements defined by OntONeo has the potential to contribute to interoperability of information among EHR from different specialties. In addition, these definitions facilitate the understanding of how such information can be organized in EHRs for purposes of healthcare.

OntONeo is an on-going project in the early stages of development, and the current version is available on the web at http*://ontoneo.wordpress.com*. Its worth to mention that this work is justified above all by the lack of formal representations in the obstetric and neonatal domains.

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