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Interoperability among Prenatal EHRs: A Formal Ontology Approach

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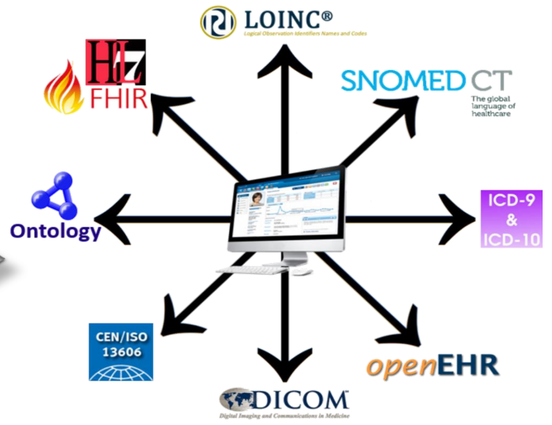
Introduction

During life course, a person attends several medical encounters involving different specialties

data of each encounter are documented on

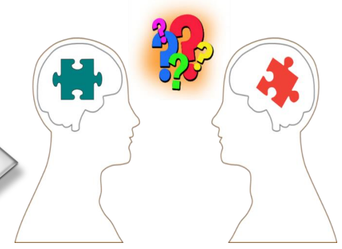
electronic health records (EHRs)

several EHR system built using different standards and terminologies



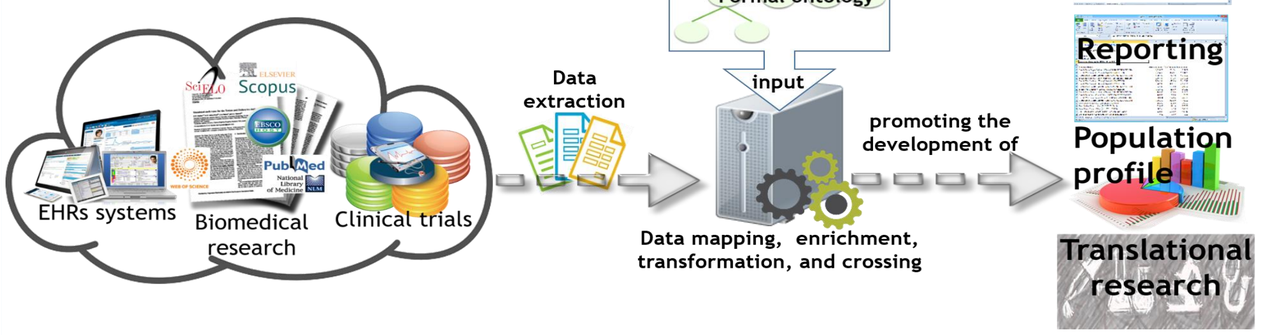
Heterogeneity of medical terminologies

leads to



lack of semantic interoperability

Proposal



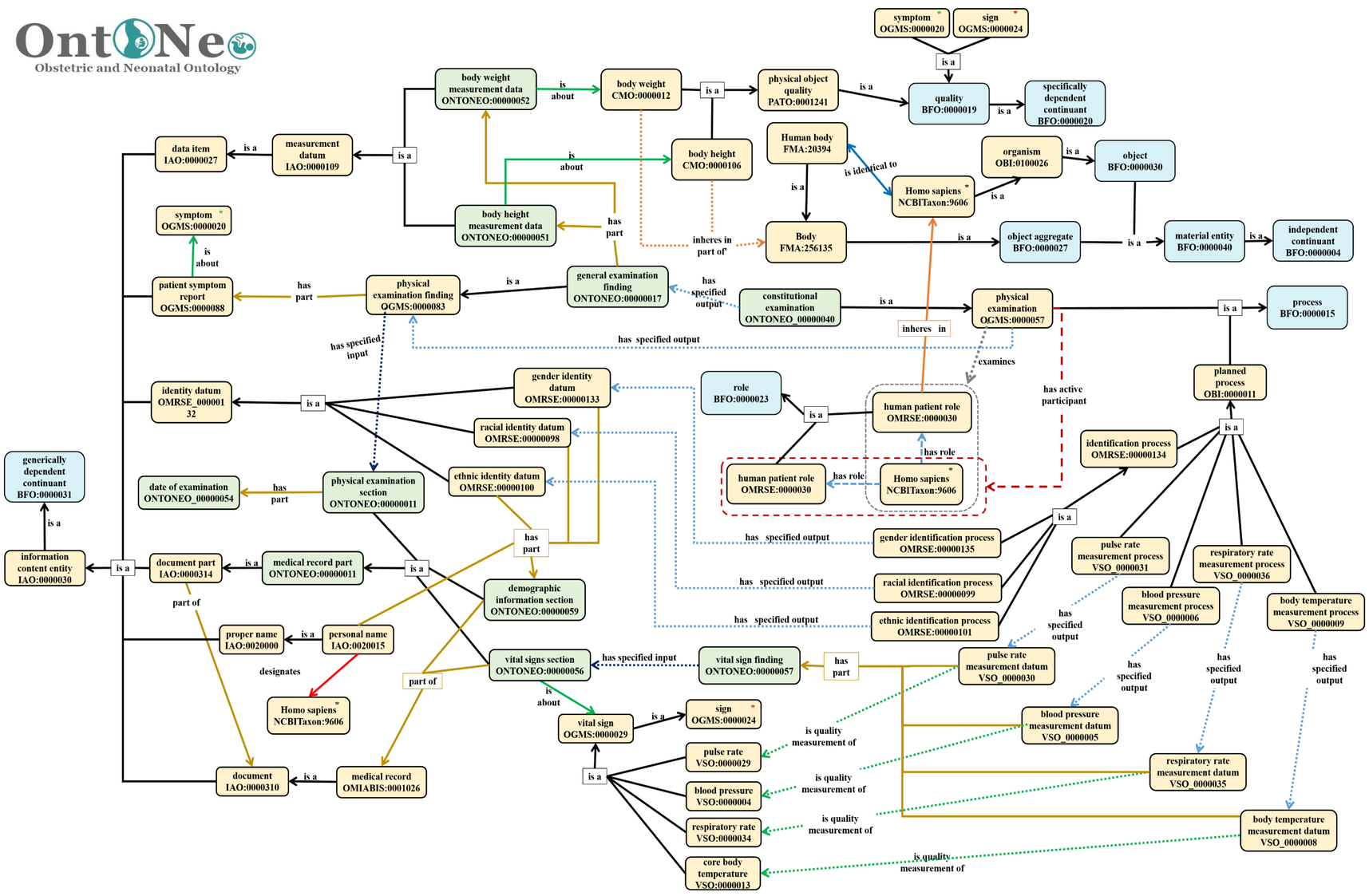
Methodology

- Ontological realism
- OBO Foundry principles
- Basic Formal Ontology 2.0
- Ontology reuse
  - OGMS, OBI, IAO
  - GO, FMA, PATO, DOID, ORMSE
  - EFO, UBERON, HP, SYMP, OMIABIS

Solution

1st) Knowledge representation through formal ontology

OntONeo
Obstetric and Neonatal Ontology



Full version available at: *http://bioportal.bioontology.org/ontologies/ONTONEO*

2nd) Data extraction using SPARQL Language

Question 1 query

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX obo: <http://purl.obolibrary.org/obo#>

PREFIX MedicalEncounter_Class: <http://purl.obolibrary.org/obo/OGMS_0000097>
PREFIX Date_Class: <http://purl.bioontology.org/OntONeo/ONTONEO_00000055>
PREFIX OccursIn: <http://purl.obolibrary.org/obo/BFO_0000066>
PREFIX HumanPatientRole_Class: <http://purl.obolibrary.org/obo/OMRSE_00000030>
PREFIX Realize: <http://purl.obolibrary.org/obo/BFO_0000055>
PREFIX HomoSapiens: <http://purl.obolibrary.org/obo/NCBITaxon_9606>
PREFIX RoleOf: <http://purl.obolibrary.org/obo/RO_0000081>
PREFIX PersonalName_Class: <http://purl.obolibrary.org/obo/IAO_0020015>
PREFIX Designate: <http://purl.obolibrary.org/obo/IAO_0020012>

SELECT ?patientName ?date
WHERE {
        ?MedicalEncounter_instance rdf:type MedicalEncounter_Class: .
        ?date_instance rdf:type Date_Class: .
        ?MedicalEncounter_instance OccursIn: ?date_instance .
        ?date_instance rdfs:label ?date .
        ?HumanPatientRole_instance rdf:type HumanPatientRole_Class: .
        ?MedicalEncounter_instance Realize: ?HumanPatientRole_instance .
        ?Patient rdf:type HomoSapiens: .
        ?HumanPatientRole_instance RoleOf: ?Patient .
        ?PatientName_instance rdf:type PersonalName_Class: .
        ?PatientName_instance Designate: ?Patient .
        ?PatientName_instance rdfs:label ?patientName .
FILTER ( lang(?date) != "pt" )
}
ORDER BY ?patientName
```

Question 1:

When patients had a medical encounter?

Result:

patientName	date
C.K.	January 12, 2012
C.K.	March 16, 2013
J.S.	November 18, 2010
V.B.	May 24, 2011
V.B.	September 24, 2014

Question 2 query

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX obo: <http://purl.obolibrary.org/obo#>

SELECT DISTINCT ?name ?BPLabel ?PRLabel ?RRLabel ?BTLabel
WHERE {
        ?womanID rdf:type <http://purl.obolibrary.org/obo/IAO_0020015> .
        ?womanHS rdf:type <http://purl.obolibrary.org/obo/NCBITaxon_9606> .
        ?womanID <http://purl.obolibrary.org/obo/IAO_0020012> ?womanHS .
        ?womanID rdfs:label ?name .
        ?encounter  rdf:type <http://purl.obolibrary.org/obo/OGMS_0000097> .
        ?roleHS rdf:type <http://purl.obolibrary.org/obo/OMRSE_00000030> .
        ?encounter <http://purl.obolibrary.org/obo/BFO_0000055> ?roleHS .
        ?roleHS <http://purl.obolibrary.org/obo/RO_0000081> ?womanHS .
        ?EHR rdf:type <http://purl.obolibrary.org/obo/OMIABIS_0001026> .
        ?encounter <http://purl.obolibrary.org/obo/OBI_0000299> ?EHR .
        ?vitals rdf:type <http://purl.bioontology.org/OntONeo/ONTONEO_00000056> .
        ?EHR <http://purl.obolibrary.org/obo/BFO_0000051> ?vitals .
        ?BPDatum rdf:type <http://purl.obolibrary.org/obo/VSO_0000005> .
        ?vitals <http://purl.obolibrary.org/obo/IAO_0000583> ?BPDatum .
        ?BPIRI rdf:type <http://purl.obolibrary.org/obo/VSO_0000004> .
        ?BPDatum <http://purl.obolibrary.org/obo/IAO_0000221> ?BPIRI .
        ?BPIRI rdfs:label ?BPLabel .
        ?PRDatum rdf:type <http://purl.obolibrary.org/obo/VSO_0000030> .
        ?vitals <http://purl.obolibrary.org/obo/IAO_0000583> ?PRDatum .
        ?PRIRI rdf:type <http://purl.obolibrary.org/obo/VSO_0000029> .
        ?PRDatum <http://purl.obolibrary.org/obo/IAO_0000221> ?PRIRI .
        ?PRIRI rdfs:label ?PRLabel .
        ?RRDatum rdf:type <http://purl.obolibrary.org/obo/VSO_0000035> .
        ?vitals <http://purl.obolibrary.org/obo/IAO_0000583> ?RRDatum .
        ?RRIRI rdf:type <http://purl.obolibrary.org/obo/VSO_0000034> .
        ?RRDatum <http://purl.obolibrary.org/obo/IAO_0000221> ?RRIRI .
        ?RRIRI rdfs:label ?RRLabel .
        ?BTDatum rdf:type <http://purl.obolibrary.org/obo/VSO_0000008> .
        ?vitals <http://purl.obolibrary.org/obo/IAO_0000583> ?BTDatum .
        ?BTIRI rdf:type <http://purl.obolibrary.org/obo/VSO_0000013> .
        ?BTDatum <http://purl.obolibrary.org/obo/IAO_0000221> ?BTIRI .
        ?BTIRI rdfs:label ?BTLabel .
}
```

Question 2:

What are the vital signs of the patient measured at the last medical encounter?

Result:

name	BPLabel	PRLabel	RRLabel	BTLabel
J.S.	105:80	85	13	97.1
C.K.	106:82	95	18	96.9
V.B.	100:75	88	15	97

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