



Ontology Development: Palliative Care and Access Control Ontologies

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Outline

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Ontologies at the CLI

- Ontologies provide a conceptual and representational foundation on which to build systems. This foundation enables data and information exchange.
- Two ontologies are being developed at the CLI:
 - **Palliative Care Ontology (PCO)**
 - **Access Control Ontology (ACO)**
- The **PCO** is aiming to comprehensively represent palliative and senior care terminology, by adding our own local concepts to existing trusted medical ontologies.
- The **ACO** is concerned with expressing the level of access to sensitive information each role possesses.



Why ontologies?

- In health care, a standard terminology is key to facilitating effective communication among medical personnel and increasing efficiency of dialogue. Without it, it is difficult to make further progress in any other health care issue or to easily complete tasks. Clarity and speed of information access are also essential in a safety critical industry.
- Problems:
 - The total amount of terms and roles involved in the health care industry is vast.
 - Any terminology must be rigorously and precisely defined in such a way that computers as well as people can utilize and understand it.
- An *effective tool* for the compilation and organization of information is needed: Ontologies can thoroughly define and restrict concepts, and concisely express relationships between concepts. This allows ontologies to be an excellent tool to manage and classify the information available in the domain of interest.



Why ontologies?

- The design of an ontology centers around incorporating and managing domain-specific needs. This approach is highly beneficial in a safety critical industry.
- Consider: The health care domain encompasses a community with often diverse interpretations or usages of terminology. The same term may be used in different contexts by different actors, or similarly different terms may be used for the same concept.
- An ontology can be a good tool to remedy such differences through standardization and also by allowing equivalent terms. Ontology building can also easily include the addition of local terminology, which again allows for a higher level of specificity and familiarity for its users.



PCO Components

(a) Imported existing ontologies:

- *SNOMED CT* – thorough collection of medical terms covering most areas of clinical information; contains over 300 000 unique concepts
- *ICNP* – contains terminology mainly for nursing practices
- *BFO* - Basic Formal Ontology

- Also, *SNOMED and ICNP relations* (i.e. there are about 1.3 million relationships expressed between SNOMED concepts), along with the *BFO-based Relation Ontology*, which provides other (non-medical) relations

(b) Individual additions:

- GASHA-specific terms are also being added by hand on a case-by-case basis, in order to fully capture the specifics of the local environment.
- Terms are being mined from
 - Palliative care and senior care forms
 - Case studies
 - CHPCA Model to Guide Hospice Palliative Care
 - etc.

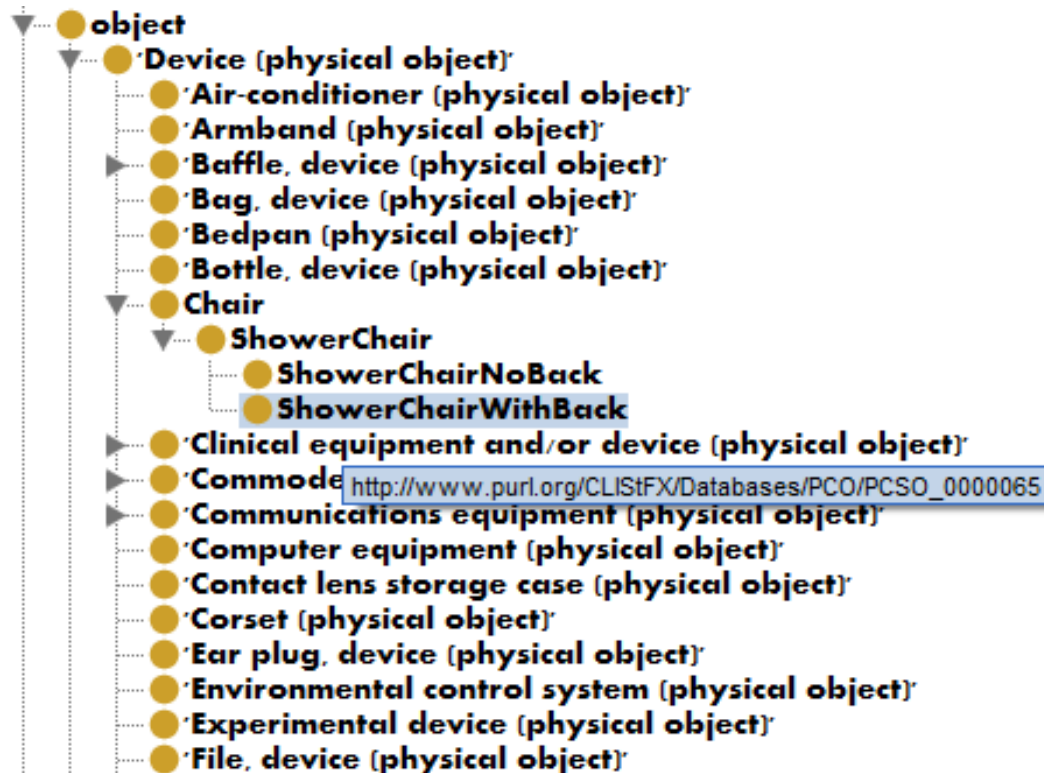
- As with classes, relations are being added from term pools (i.e. *assesses*, *referredTo*. etc.)



Task: Developing PCO

- The Palliative Care Ontology was being developed by hand through careful additions of local terms.
- Process:
 - Find important terms from regional palliative and senior care forms.
 - Determine if each term or some appropriate equivalent is already present.
 - If not, find the most reasonable placement in the ontology hierarchy.
- This thorough process aimed to ensure that all area-specific terms were expressed, in order to comprehensively represent the community terminology. This slowly tailored the ontology design and made the existing structure richer and more functional for its prospective purpose.

Added term with identifier:



Description
Equivalent
Superclass
<input checked="" type="radio"/> Show
Inherited a
<input checked="" type="radio"/> conti or or
<input checked="" type="radio"/> depe or in or sp
<input checked="" type="radio"/> fiat_c or ol or ol
<input checked="" type="radio"/> mate or ol



Task: Reconstructing PCO

Palliative Care Ontology design:

- The PCO is being built with BFO, an upper-level ontology, as a framework.
- Within this framework, the medical ontology SNOMED CT is providing the largest amount of terminology. To incorporate SNOMED into the PCO, branches and individual classes are being regrouped under appropriate branches of the upper-level BFO.
- The same tactic is being used for ICNP, albeit with much less terminology (overlap).



Task: Reconstructing PCO

Creating the “new ontology”:

- After some time, a new ontology framework was created, comprised of SNOMED, ICNP, and BFO. Working from previous changes made to the “old ontology”, the PCO was reconstructed within the new framework. A thorough process of comparison was employed to reconstruct the class hierarchy and their relations.
- This process took place to allow for documentation of changes we made to pre-existing ontologies as well as our own manual additions, and to increase our awareness of the overall ontology structure.
- During the reconstruction process (and throughout any later changes), an important step was to run the reasoner; this tested for logical consistency within the entire ontology. This should be run after every major change, especially when you are using multiple imported ontologies which may be



PCO documentation:

85	Moved Classes	Class Identifier	New Superclass	Previous Placement
86	Binding capacity	SCTID_258732003	quality	Observable entity > Feature of entity
87	>All subclasses moved			
88	Body fluid property	SCTID_106090003	quality	Observable entity > Feature of entity > Fluid observable
89	>All subclasses moved			
90	Body product observable	SCTID_364684009	quality	Observable entity
91	>All subclasses moved			
92	Cell feature	SCTID_417595002	quality	Observable entity > Feature of entity
93	>All subclasses moved			
94	Feature of anatomical entity	SCTID_414236006	quality	Observable entity > Feature of entity
95	>All subclasses moved			
96	Feature of circulating blood	SCTID_416251000	quality	Observable entity > Feature of entity > Fluid observable
97	>All subclasses moved			
98	Blood pressure	SCTID_75367002	Feature of circulating blood	Observable entity > Vital sign
99	>All subclasses moved			



Task: Developing ACO

- The Access Control Ontology features specific roles that are given clearance levels, which dictates how much sensitive information each role can ultimately access.
- A database section has been developed and is comprised of palliative care forms. Each form contains subclasses detailing any information in that form that could be deemed confidential on some level.
- Each piece of information is then associated with one of seven categories (patient demographic data, medication, treatment steps etc.) to aid the process of assigning the necessary clearance level for that detail.

ACOntology.owl (http://www.purl.org/CLISTFX/Databases/PCO/ACOntology.owl)

Active Ontology Entities Classes Object Properties Data Properties Individuals OWLViz DL Query OntoGraf

Class hierarchy Class hierarchy (inferred)

Class hierarchy: DatabaseField

- Thing
 - CareTeamComposition
 - DiagnosticData
 - PatientDemographicData
 - PatientHealthStatusIndicators
 - PatientMedication
 - TreatmentAndOtherDates
 - TreatmentSteps
 - entity
 - continuant
 - dependent_continuant
 - generically_dependent_continuant
 - 'information content entity'
 - Proposition
 - DeclarativeProposition
 - DatabaseField**
 - AdultPainAssessmentField
 - AdvanceDirectiveField
 - AmbulatoryCareRecordField
 - Comm.RoundsField
 - ActionPlanField
 - FaxedToField
 - PatientChangeInSituationField
 - PatientDNRStatusField
 - PatientHealthCardNumberField
 - PatientNameField
 - PatientPPSField
 - PatientUseOfExistingServicesField
 - ContactRecordField
 - DiagnosisAndAllergyField
 - DistressScreeningField
 - EdmontonAssessmentField
 - F1.10Field
 - F1.1Field
 - F1.3Field
 - F1.7Field
 - F1.8Field
 - FallRiskInterventionsField
 - HospicePCMedicationCalendarField
 - MultiDisciplinaryNotesField
 - NursingDocumentationField
 - PPSv2Field
 - PainAssessmentCognitivelyIntactField
 - PatientAndFamilyIssuesLogField
 - PatientDNRField
 - PhysicianDNRField
 - PreVisitRiskAssessmentField

Annotations Usage

Annotations: DatabaseField

Annotations +

label

"DatabaseField"@

Description: DatabaseField

Equivalent classes +

Superclasses +

DeclarativeProposition

Inherited anonymous classes

continuant
or **occurrent**

dependent_continuant
or **independent_continuant**
or **spatial_region**

generically_dependent_continuant
or **specifically_dependent_continuant**

Members +

Keys +

Disjoint classes +



Task: Developing ACO

- This ontology is a good example of creating a functional bank of information, in this case relating to how particular data can be accessed. The class hierarchy is used to include information that derives from specific forms, and relations are used to indicate which roles do and do not have sufficient clearance.
- It is also easy to see how such an ontology could be intrinsic to a workflow. Consider a task being executed which reaches a decision point: information is required to determine who can continue the task, if data should be sent to someone else who would have clearance, etc. The ACO would be able to supply these details easily.



Further Steps

Work to be maintained:

- Continuing to move and document branches and individual classes until all SNOMED and ICNP concepts are fully expressed or are redundant under the PCO's upper-level framework.
- Putting any unnecessary terms, i.e. those from ICNP that are equivalent to a term from SNOMED, in `ObsoleteClass`.
- Finding terms from GASHA and other locally relevant resources to be placed manually in the PCO.
- Detailing clearance roles for the confidential form information in the ACO.