Ontology Modeling for Handling Co-Morbidities in Decision Support Systems

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Abstract and Objective

This poster present a decision support framework for ontology based handling of clinical pathways (CP) of co-morbid Chronic Heart Failure (CHF) and Atrial Fibrillation (AF). Our knowledge management (KM) approach for synchronization of co-morbid clinical processes include; (i) knowledge synthesis-selection, interpretation, and augmentation of statements, logic and temporal relations within and across CHF and AF clinical practice guidelines (CPGs) to create CPs (ii) CP knowledge formalization-using semantically rich OWL constructs to unambiguously model implicit functional and temporal relations between concepts (iii) formalizing functional relations between care processes by defining co-morbid care plans to be executed in response to preconditions derived from both CHF and AF CPs (iv) execution of ontology in a clinical decision support system, named COMET, that after identifying a co-morbid incident can recommend appropriate care plans along with relevant information and protective measures to ensure patient safety.

Keywords:

Co-morbidity, Ontology, Decision support system

Materials and Methods

Phase 1: Knowledge Identification and Synthesis

This involved acquisition of clinically useful task-specific heuristics, CPG logic and task dependencies from the CPG. Next, the abstracted knowledge was systematically organized to develop CP for CHF and AF through the processes of selection, interpretation and augmentation of CPG heuristics and logic. CP were formatted as a series of temporally sequenced graphs, capturing temporal logic within and across the CPG to precisely express iterative execution of the care processes and to reorganize them in response to comorbid constraints.

Phase 2: Knowledge Formalization

This involved development of semantically-rich OWL based CP ontology that describes the CHF and AF diagnostic and treatment concepts and their inter-relationships. It consists of over 80 classes that are hierarchically arranged. The class Clinical_Pathway_Entry_Point refers to points in the CP course where a patient may be admitted. Each individual of Clinical_Pathway_Entry_Point corresponds to single disease and comorbid plans arranged in accordance to the comorbid constraints.

Phase 3: Alignment of Co-Morbid plans

This is achieved by establishing functional relationships between the care processes across comorbid ontologically-modeled CP. Co-morbidities were handled through the temporal and procedural alignments between the clinical processes defined by Clinical-Pathway_Entry_Point class, across the individual CHF and AF CPG in a unified ontological CP model. Our methodology demonstrates how to align two disease-specific CP so that they can be executed concurrently to handle co-morbidities.

Phase 4: Knowledge Execution via COMET

This involved operationalization of the ontologically-modeled CP in order to provide CPG-based decision support to health professionals so as to assist them in offering both single disease and co-morbid care-plans.

Evaluation Results

The ontology was found to be semantically consistent, complete and with adequate representational capacity to capture the both the co-morbid domain and procedural concepts.

Conclusion

Semantic web ontologies allowed the modeling of alignments between two semantically defined CPG, in keeping with clinical pragmatic relations between the co-morbid diseases.

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