Engineering a Clinical Decision Support Framework for Point of Care Use

Szymon Wilk¹, Wojtek Michalowski¹, Dympna O’Sullivan¹, Ken Farion², Stan Matwin³

MET Research Group, University of Ottawa
¹ Telfer School of Management
² Departments of Pediatrics and Emergency Medicine
³ School of Information Technology and Engineering
Outline

- Integrative clinical decision support at the point of care (ICDS@POC)
- MET-A³Support framework and O-MaSE methodology
- MET-A³Support and its O-MaSE process
- Management of pediatric asthma and MET-A³Support-Asthma
- Conclusions and future plans
Integrative Clinical Decision Support at the Point of Care (ICDS@POC)

- Intensive, but disjoint research on:
  - Hospital information systems (HIS), including electronic health record (EHR)
  - Clinical decision support systems (CDSS)
  - Computerized clinical practice guidelines (CPG)
  - Repositories of clinical evidence

- Our goal is to develop ICDS@POC framework integrating clinical data, decision support and evidence
Scenario: Managing a Patient in the ED

1. Patient is registered. The ADT notifies the EHR and the CDSS.
2. The physician uses the CDSS to record and retrieve patient data.
3. The physician asks for diagnostic support. The CDSS provides a diagnostic suggestion.
4. The physician orders a test and the CDSS passes this request to the LIS.
5. ...
6. Upon prescription of a treatment, the CDSS consults an embedded CPG.
7. The physician requests the evidence. The CDSS retrieves it from the evidence repository.
8. ...
Requirements for ICDS@POC

- Need to manage and support multiple clinical decision problems
- Need to retrieve dispersed data and provide evidence
- Need to integrate with "services" (e.g., labs) provided by the hospital
- Need to support continuity of care (within POC)
MET-A³Support: Framework for ICDS@POC

- System design along multi-agent system architecture (MAS) principles

- Structured translation of needs into functional requirements using O-MaSE methodology
  - Abstraction of object-oriented paradigm (agents are specialized objects)
  - Support separation of ontologies from their processing and introduced creation of an domain ontology as important part of analysis
O-MaSE Process for MET-A³Support

ICDS@POC needs

- Domain modeling
- Goal modeling
- Organization modeling
- Role modeling

- Domain ontology
- Goal model
- Organization model
- Role model

Agent class modeling
Protocol modeling
Plan modeling

Analysis
Design
Domain Ontology
Role Model
Protocol Models

Diagram:

- «Agent»: EncounterSupport
  - request_treatment()
  - treatment():

- «Agent»: TreatmentSuggestor
  - request_treatment()

- «Agent»: EvidenceProvider
  - request_evidence(t)
  - evidence(c)
  - no_evidence()
Plan Models
MET-A$^3$Support: Implementing MAS
MET-A³ Support - Asthma

- ED management of pediatric asthma patients
  - Supports early management (around 1 hour after triage)
  - Designed for physicians and nurses @ POC
  - Integrates with HIS (ADT, EHR) to share patient data and with the Cochrane Library to retrieve evidence
  - Uses decision model for predicting severity and integrates with the CPG for treatment options
  - Uses indexing and retrieval model for identifying and providing patient-specific evidence

- Provides user-driven support
Evaluation Suggester: Predicting Severity of Exacerbation

- Tree-based model was developed from prospective data using data mining techniques enhanced with
  - Secondary clinical knowledge
  - Contextual normalization
- Model is customized for local settings, readable and interpretable
Treatment Suggester
Suggesting Treatment Options

- Rule-based model developed from the CAEP Pediatric Asthma CPG
- Links severity prediction or assessment with treatment options
- Easy to maintain and update

CAEP = Canadian Association of Emergency Physicians
Evidence Provider: Providing Relevant Evidence

- Complex model of UMLS concepts was developed for customized indexing of Systematic Reviews and referenced articles in the Cochrane Library
- Retrieval methodology enables patient-specific queries
MET-A³Support: Conclusions

- Requires structured engineering methodology to translate complex needs into successful design
- Meets the requirements for ICDS@POC
- Brings together data, decision support, and evidence
- Combines MAS and ontology-driven design for decision/information retrieval models

- MET-A³Support-Asthma brings together data from HIS and collected at POC, severity prediction model, CAEP CPG, and evidence from Cochrane
Future Directions & Challenges

- Pilot clinical trial in the ED at the Children’s Hospital of Eastern Ontario

- Using guidelines as models of clinical workflow to drive the process of intelligent integration of information and services
MET Research Group @ uOttawa

www.mobiledss.uottawa.ca