The Structure of Guideline Recommendations: A Synthesis

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Outline

- Motivation
- Recommendation set formalism
- Validation
  - SAGE implementation
  - Comparisons with other models
- Conclusion
Motivation: HL7 CG SIG work item

- To develop standardized “flowchart” model for human understanding and computer encoding
  - Expressive process model
    - allows sequencing, repetition, and concurrency (branching and synchronization)
  - Integration of decision making and activity specification
  - Visual clarity
  - Well-understood semantics
- However: not all guideline recommendations are “flowcharts”
Reformulated work item

- To define structure and organization for sets of guideline recommendations

- Recommendation consists of:
  - Context: clinical setting, patient state, current therapy, provider role, triggering event
  - Decision: choice among alternatives based on evidence/preference
  - Action: computer or clinical actions

- Two classes of “recommendation set”
  - activity graph
  - decision map
Activity graph

- Used to specify processes
  - computational and care processes

- Directed graph of
  - context
  - decision step
  - action step
  - route: purely for branching and synchronization

- Adapted from Workflow Management Coalition process model
Decision map

- Not all guidelines are process-oriented
- Collection of decision points
  - Context, decision, action nodes
  - No interpretation as activities in a process
- Alternative computational models
  - If/then statements
  - Augmented transition network
    - Connected graph
    - One alternative allowed at decision point
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Validation: SAGE implementation

- SAGE project
  - Consortium of IDX, Apelon, IHC, Mayo, Nebraska, Stanford to develop infrastructure for guideline-based decision-support systems

- SAGE guideline modeling methodology
  - Select guideline
  - Develop usage scenarios
  - Specify guideline logic and terminology
  - Encode guideline in Protégé-2000
  - Simulate implementation in IDX clinical information system (CIS)

- Example guideline: immunization
Encoding of guideline in Protégé-2000: Top-level processes

- Top-level activity graphs model processes in which DSS interactions with providers through clinical information system
- Highly dependent on expected clinical workflow
Decisions involve choices of assertion to make about an immunization
- Possibly due
- Contraindicated

Assertion about immunizations tested at top-level activity graph

RE-usable medical logic called as subguidelines
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Comparison with Arden Syntax

- Arden Syntax and Medical Logic Modules
  - Evoke: Events that trigger MLMs => Context
    - e.g. storage of serum creatinine
  - Logic: Condition to be tested => Decision
    - e.g. if current_creatinine > baseline_creatinine+0.3 then conclude true;
  - Action: Action to be performed if logic slot “conclude true” => Action
    - e.g. write “The patient’s serum creatinine level may signify worsening renal function”
- A decision map analogous to a collection of MLMs
Comparison with PRODIGY scenario map

- **PRODIGY**
  - Guideline-based decision-support system for primary care developed at University of Newcastle
  - Release One available on UK GP systems

- Scenario map => Decision map with augmented transition semantics
Comparison with GLIF

- GLIF
  - Guideline modeling formalism developed by InterMed (collaboratory of Columbia, Harvard, Stanford)
- GLIF algorithm \(\rightarrow\) Activity graph
- GLIF patient-state step a specialization of Context node
- GLIF synchronization uses a complex expression (a series of Route nodes)
Comparison with HL7 RIM

- HL7 RIM Act decomposition => Activity graph
- Numerical ordering of acts (sequence_nbr) implies a particular structure
- A syntactic variant of activity graph where
  - Splits and joins are balanced
  - Sequences between branching and synchronization points is expressed as additional decomposition
HL7 split and join properties

- HL7 RIM split and join properties different from those of WfMC
  - Can be simulated using WfMC’s splits and joins

- Specifies split and join properties as attributes of Act relationship
  - Possible to specify split and join properties of individual subact (e.g. C1 may have a join property different from C2 and C3)
  - Need to work out relationship with WfMC process model used by activity graph
Conclusion

- Recommendation set formalism
  - Defines structure of guideline recommendations
  - Makes distinction between processes (activity graph) and collections of decisions (decision map)
  - Tested in SAGE implementation
  - Mapped to several guideline modeling formalisms

- Next steps
  - Specification of execution semantics
  - Further reconciliation with HL7 RIM?
  - Proposal as an HL7 informative document
Thank you
Lessons from SAGE experiment

- Activity graphs
  - Model reactions and interactions of guideline DSS with clinical information systems
  - Guideline DSS reacts to events in workflow

- Decision maps
  - Provide good cognitive correspondence with rule-like recommendations (e.g. whether hepatitis B vaccine due)
  - Reusable in different settings