

Clinical Decision Support Standards Worldwide (in Health Level Seven)

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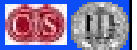
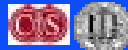
Overview: Clinical Decision Support Standards

- HL7: Role of the SDO in KR
- Rationale for Guidelines: Knowledge dissemination
- Shareable components of computable guidelines
- Guideline models
- Convergence & the future



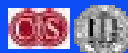
I. Work on KR: HL7

- Growing international organization
 - 20+ international affiliates
 - participation by wide range of stakeholders: academia, vendors, government, consultants
- Moving beyond the core messaging standard
 - CDA, CCOW, Arden Syntax
- Key characteristics
 - All-volunteer organization
 - Refereed consensus process



Improving KR of Guidelines: Focus on HL7

- Main focus: Clinical Decision Support TC
 - Arden Syntax SIG
 - Clinical Guidelines SIG
 - Electronic Health Records SIG
- Related tasks elsewhere in organization
 - Modeling and Methodology TC: HDF
 - RIM



HL7 Clinical Decision Support Activities

- Decision Support Workbook: Identifying potential decision support standards
- Arden Syntax: Procedural medical knowledge
- Infobutton: Querying knowledge sources
- Clinical guideline formalism



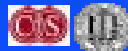
II. Rationale for Guidelines: Evidence of Poor Performance

- **USA: Only 54.9% of adults receive recommended care for typical conditions**
 - community-acquired pneumonia: 39%
 - asthma: 53.5%
 - hypertension: 64.9%

McGlynn EA, Asch SM, Adams J et al. The quality of health care delivered to adults in the United States. *N Engl J Med* 2003;348:2635-2648.

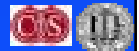
- **Delay in adoption: 10+ years for adoption of thrombolytic therapy**

Antman EM, Lau J, Kupelnick B et al. A comparison of results of meta-analyses of randomized control trials and recommendations of clinical experts. Treatments for myocardial infarction. *JAMA* 1992;268(2):240-8.



Rationale for Guidelines: What are they?

- “Systematically developed statements to assist practitioners and patient decisions about appropriate health care for specific clinical circumstances.” (Field MJ, Lohr KN eds. *Clinical Practice Guidelines: Directions for a New Program*. IOM, Washington, DC: NAP, 1990)
- **Guideline: Multi-step plan that unfolds over time**
 - Incorporate the latest (scientific) evidence
 - Identify a standard of care
 - Distribute to caregivers



Rationale for Guidelines: Guideline Types

- Screening and prevention
- Diagnosis and prediagnosis management of patients
- Indications for use of surgical procedures
- Appropriate use of specific technologies and tests as part of clinical care
- Care of specific clinical conditions

Field MJ, Lohr KN eds. *Guidelines for Clinical Practice: From Development to Use*. Washington, DC: NAP, 1992.



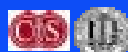
Improving Guidelines: Incorporate in CDSS

- Use in context of systems for providing patient care
 - CPOE
 - EMR
- Use at the time decisions are being made
- Ample success for limited alerts/reminders
 - Medication prescribing practices
 - Preventive care: screening tests, immunizations
- Less demonstrated success for complex guidelines



Challenges in Implementing Guidelines in CDSS

- Availability of data
- Identification of data: structured, controlled vocabularies
- Clinical data repositories: Data model
- Shareable knowledge representation



Benefits of Shareable Guidelines

- Avoid duplication of effort when using common guidelines in many institutions
- Rapid dissemination of modifications
- Encourage development of tools for retrieving and using guideline information
- Encourage future guideline authors to be more rigorous (decreased ambiguity)

Ohno-Machado L, Gennari JH, Murphy SN et al. The Guideline Interchange Format: a model for representing guidelines. *JAMIA* 1998;5:357-372.



III. Shareable Guideline Components: Challenges to Agreeing a Standard Guideline Model

- Many models: GEODE-CM, GLIF, Arden Syntax, EON, DILEMMA, PROforma, Asbru, GEM, GUIDE, PRODIGY, ...
- Many stakeholders: government, vendors, academics, professional organizations, etc
- Many types of guidelines
- Many types of (paper) guideline formats: narrative text, tables, flowcharts, graphs, maps, lists, critical pathways, if-then statements, etc



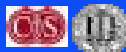
Shareable Guideline Components: Decomposing the Problem

- Agreement on an overall standard formalism is challenging.
- Instead, first focus on shareable components:
 - Data model
 - Expression language
- Future: One or more widely implemented models with shared components
 - Shared components = ease the process of database mapping, etc



Shareable Guideline Components: Standard Data Models

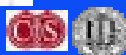
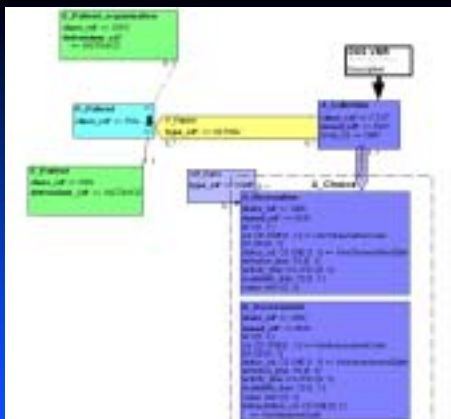
- Candidates
 - RIM = HL7 Reference Information Model
 - vMR = Virtual Medical Record
- Purpose: Standardize references to patient data
 - *Promote knowledge transfer*: One-time mapping between standard and local model, followed by automated translation at the time of transfer/execution
 - *Goal*: Avoid manual rewriting of data references



Standard Data Model: vMR

- Problem with RIM: Too abstract
- Potential solution: Tailored version of RIM specifically for decision support
- Current work: Virtual Medical Record (SCHIN)
 - Establish distinct objects that in RIM might be high-level classes (with mood and other attributes)
- Key classes: patient, plan, procedure, medication, appointment, referral, goal and assessment

Johnson PD, Tu SW, Musen MA, Purves I. A virtual medical record for guideline-based decision support. Proc AMIA Symp 2001;:294-298.



Standard Data Model: Not Enough

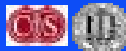
- Need standard vocabularies
- Agreement is difficult
 - Solution: Format for referring to a standard vocabulary in data references
 - Examples: SNOMED-CT, ICD-9, LOINC, CPT, etc
 - Implementation: One-time mapping between local and standard vocabularies
- Facilitation: Free licensing of SNOMED in USA as part of UMLS



Shareable Guideline Components: Expression Language

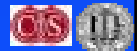
- Purposes
 - Query data (READ)
 - Logically manipulate data (IF-THEN, etc)
- Current work: GELLO (BWH) = Guideline Expression Language

Ogunyemi O, Zeng Q, Boxwala A. Object-oriented guideline expression language (GELLO) specification: Brigham and Women's Hospital, Harvard Medical School, 2002. Decision Systems Group Technical Report DSG-TR-2002-001.



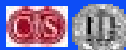
Expression Language: GELLO

- Original goal (InterMed): Procedural component for high-level guideline format (GLIF)
- Subsequent goal: Provide similar functionality for current HL7 KR standard (Arden Syntax)
- Emphasis: Shareability of queries and expressions
- Mechanism: Reference data in OO fashion



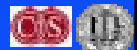
GELLO (continued)

- Provides basic data types
- Allows reference to underlying standard data model (vMR)
- Based on the Object Constraint Language (UML)
- Current goal: Ballot as a separate HL7 standard during the coming 12 months



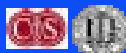
GELLO: Examples

- Queries
 - Observation.select(coded_concept='03245')
 - Observation.selectSorted(coded_concept='C0428279')
- Expressions
 - The variables calcium and phosphate are not null
calcium.notEmpty() and phosphate.notEmpty()
 - The patient has renal failure and the product of calcium and phosphate exceeds a threshold signifying osteodystrophy
renal_failure and calcium_phosphate_product > threshold_for_osteodystrophy



IV. Guideline Models

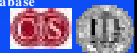
- Work proceeds in parallel with shareable components
- Process: HL7 HDF
 - story board modeling process
 - work from use cases
- Candidate models
 - Arden Syntax
 - GLIF
 - GEM
 - CPGA



Guideline Models: Arden Syntax

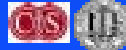
- ASTM v1 1992, HL7 v2 1999, v2.1 (ANSI) 2002
- Formalism for procedural medical knowledge
- Unit of representation = Medical Logic Module (MLM)
 - Enough logic + data to make a single decision
 - Generate alerts/reminders
- Adopted by several major vendors

Jenders RA, Dasgupta B. Challenges in implementing a knowledge editor for the Arden Syntax: knowledge base maintenance and standardization of database linkages. Proc AMIA Symp 2002;:355-359.



Arden Syntax (continued)

- Has been used to encode guidelines (as hierarchy of MLMs)
- Consensus: Not ideally suited for guidelines
 - Entry points and eligibility criteria (not triggers)
 - Flow of steps (not procedures)
- Ongoing work
 - Arden as a separate standard for simple alerts
 - Examine other models for guidelines
 - Standardize data mappings: Eliminate the “curly brackets”



Guideline Model: GLIF

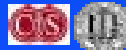
- Guideline Interchange Format
- Origin: Study collaboration in medical informatics
- Now: GLIF3
 - Very limited implementation
- Guideline = Flowchart of temporally ordered steps
 - Decision & action steps
 - Concurrency: Branch & synchronization steps

Pekg M, Ogunyemi O, Tu S et al. Using features of Arden Syntax with object-oriented medical data models for guideline modeling. Proc AMIA Symp 2001;:523-527.



GLIF (continued): Levels of Abstraction

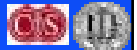
- Conceptual: Flowchart
- Computable: Patient data, algorithm flow, clinical actions specified
- Implementable: Executable instructions with mappings to local data



Guideline Model: GEM

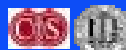
- Guideline Elements Model = Current ASTM standard
- Markup of a narrative guideline into structured format using XML
 - Not procedural programming
 - Tool = GEM Cutter
- Resulting structure might be used to translate to executable version

Shiffman RN, Agrawal A, Deshpande AM, Gershkovich P. An approach to guideline implementation with GEM. Proc Medinfo 2001;271-275.



GEM (continued)

- Model = 100+ discrete elements in 9 major branches
 - identity and developer, purpose, intended audience, development method, target population, testing, revision plan and knowledge components
- Iterative refinement: Adds elements not present verbatim but needed for execution
- Customization: Adding meta-knowledge
 - controlled vocabulary terms, input controls, prompts for data capture



Guideline Model: CPGA

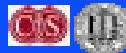
- Clinical Practice Guideline Architecture (SCHIN -> UK NHS)
- Model = Based on HL7 CDA (XML)
 - Not a programming language
 - Represents the structure of a guideline

Sowerby Centre for Health Informatics at Newcastle. Clinical practice guideline architecture, version 0.797. <http://www.schin.ncl.ac.uk/cpga> Web site accessed 24 April, 2003.



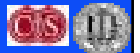
CPGA (continued)

- **Guideline = Hierarchy of elements**
 - Header
 - Title, developer, etc
 - Body
 - Basis of evidence, recommendation, etc
- **Elements can be refined into more atomic elements**
 - Action recommendation -> recommendation ID, author, evidence, prose recommendation and structured recommendation



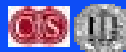
V. Convergence and The Future

- **Ongoing work:** Use HDF to broker consensus on a computable guideline formalism
 - Proceed from real-world use cases
 - Use story board techniques
 - Resulting formalism may include elements of Arden, GLIF, GEM and CPGA
 - Ultimate result probably will include both a high-level document model and a low-level execution model



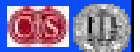
Convergence (continued)

- **Opposing view:** A single formalism may not be possible or desirable
 - Complexity of guidelines and their purposes
 - Result: A small number of “niche” formalisms
 - Arden for simple alerts/reminders
 - Others for complex guidelines
 - A small group of formalisms would share common components (data model, vocabulary, expression language)



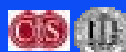
The Future: Parallel Tracks

- HDF process for a guideline model
- Shareable components of a guideline model
 - Work on these components may promote consensus on an overall guideline model



Summary

- Clinical performance is not ideal + knowledge is exploding
 - Guidelines can help
- Paper guidelines not used ideally
 - Need computable guidelines
- Knowledge sharing is fostered by standards
 - Components: Expression language, data model
 - Guideline formalism: Arden, GLIF, GEM, CPGA, etc



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