Modeling Clinical Guidelines in a Sharable and Computer-interpretable Way: Development, Implementation, and Use Requirements

Instructors

Mor Peleg, Ph.D., Stanford Medical Informatics, Stanford University School of Medicine, Stanford, CA;

Aziz Boxwala, M.B.B.S., Ph.D., Decision Systems Group, Harvard Medical School, Brigham & Women's Hospital, Boston, MA.

Abstract

Clinical guidelines are potential tools for standardizing care in order to improve its quality and cost effectiveness. For guidelines to be delivered to the point of care through decision-support systems, they must be represented in a computer-interpretable (CI) format that enables responsiveness to known data and machine inference. Since much effort goes into creating guidelines in a CI format, it is desirable that different institutions and software systems share them. In a guideline representation workshop hosted by the InterMed Collaboratory in March 2000, the need for a standard representation format for sharable computer-interpretable guidelines (CIGs) was recognized. As a first step towards achieving this goal, we proposed a set of functional requirements for sharable CIGs. The requirements encompass the entire life cycle of a CIG: from development to implementation, use and maintenance. In this tutorial we discuss requirements that are important during the entire life cycle of a CIG. We have abstracted the requirements into six groups: (1) expressiveness (i.e., the ability to express the knowledge content of different types of guidelines), (2) comprehensibility (i.e., the ability to manage complexity, facilitate coherence, and visualize a guideline model to aid in human comprehension), (3) local adaptation, (4) integration with institutional health information systems (HISs) and medical knowledge sources, (5) support for different modes of use (e.g., simulation for educational purposes, patient-specific decision-support at point of care), and (6) revision management.

The Guideline Interchange Format version 3 (GLIF3) is a language for structured representation of CIGs. It is under development by InterMed and through the HL-7 Clinical Guidelines Special Interest Group to facilitate sharing of CIGs among different institutions and systems. We illustrate how GLIF3 and other guideline models, such as EON, Asbru, PRODIGY and PRO*forma*, meet the specified requirements.

General description of the tutorial's content

The tutorial will include presentations on modeling and representing clinical guidelines and discussion of the requirements for a sharable computer-interpretable representation of clinical guidelines. The instructors will also use guidelines encoded in GLIF3 and in other guideline modeling methodologies, such as EON, Asbru, PRODIGY and PRO*forma*, to explain the meaning of the requirements and approaches to satisfying these requirements.

An outline of topics to be covered

The material will be organized around the following topics:

- Current approaches to using clinical guidelines
  - Why do we need clinical guidelines?
    - Improve quality of care
    - Reduce unjustified treatment variation
    - Reduce treatment cost
    - Desire to base clinical actions on evidence studies
  - What are the different types of guidelines? Guidelines vary according to the following categories [1]:
    - Clinical domain
    - Stage of the medical problem and its management (e.g., screening, diagnosis, disease management)
    - Multiple or single encounters
    - Clinical setting (e.g., inpatient or outpatient clinic)
    - Time frame (emergency, acute, or chronic)

        - Guideline computability (i.e., algorithmic, guiding, or intermediate)
    - How are guidelines developed and disseminated?
    - What are the factors that affect guideline use?
        - Knowledge of guidelines
        - Provider attitudes towards guidelines
        - Factors affecting practitioner behavior
- Computer-interpretable guidelines
    - What are computer-interpretable guidelines?
    - Why would we want to computerize guidelines?
        - Provide automatic decision-support
        - Reduce ambiguities in guidelines
        - Integrate guidelines into workflow
        - Use guidelines for quality assurance
        - Use guidelines for simulations for educational purposes
    - How can guidelines be made computer-interpretable?
    - What are some of the existing models for computer-interpretable guidelines?
        - Arden Syntax [2]
        - EON [3]
        - Asbru [4]
        - PRO*forma* [5]
        - PRODIGY [6]
        - GLIF3 [7]
- Sharing computer-interpretable guidelines
    - Why is sharing of encoded guidelines important?
        - Provide consistency in guideline interpretation
        - Reduce cost of guideline development
        - Minimize misinterpretations and errors through the process of public review
        - Focus the effort of achieving (1) a good representation format, and (2) useful and usable authoring tools and execution applications
    - What are the challenges in sharing encoded guidelines?
        - Local adaptation of guidelines
        - Integration with hospital information system environments
- Functional requirements for a format for sharable computer-interpretable guidelines
    - Deriving functional requirements from guideline life-cycle stages:
        - Development
        - Implementation
        - Use and maintenance
    - Expressiveness Requirements
        - Expressing different types of guidelines
        - Expressing a guideline's structural parts (i.e., recommendations, concept definitions, and algorithms)
        - Expressing decision-support guideline tasks, including decision making, alert sending, goal setting, specifying work to be performed, and data interpretation
    - Comprehensibility
        - Visualization and readability
        - Complexity management
        - Coherence facilitation
    - Local adaptation of guidelines
        - Formal adaptation of knowledge contained in guidelines
        - Tracking and documenting modifications to the guideline
        - Maintaining the integrity of the setting-independent intentional objectives
    - Integration with institutional Health Information Systems (HIS) and medical knowledge sources
        - Workflow integration
        - Mapping to electronic medical record (EMR) systems, communication/paging systems, and order-entry systems

- Separation of system-dependent data references from the medical knowledge
- The "virtual EMR" approach
- Medical concept abstractions (e.g., drug classes)
- Formal definitions of medical terms
- Representation of drug-drug interactions and drug-medical_condition interactions (e.g., contraindications)
- Integration with heterogeneous knowledge bases

♦ Supporting multiple usage modes
- Interactive vs. batch mode
- Enabling different possible user-interfaces
- Views of the same guideline for different user groups (e.g., general practitioner, specialist, nurse)
- Simulation for educational purposes
- Quality assurance applications
- Risk assessment
- Eligibility determination
- Resource management
- Decision-support for chronic disease management

♦ Maintenance/ Revision management
- Version control: dates, names of updating person, guideline-author, encoder, version number, etc.
- Change management: documenting changes in a structural way
- Methods for documenting changes only, without specifying the full new version
- Synchronizing revisions with the changes made previously to the guideline for local adaptation and integration
- Documenting problems in a structured way

Educational goals

- To demonstrate the nature of a computer-interpretable guideline
- To demonstrate the type of decision support that can be provided by a computer-interpretable guideline
- To demonstrate the need for a standard for a sharable computer-interpretable guideline representation
- To demonstrate what makes a good guideline representation
- To demonstrate how GLIF3 and other guideline modeling methodologies approach some of the requirements posed for a sharable computer-interpretable guideline representation

Who should attend?

- People interested in knowledge representation, knowledge-based systems and modeling of clinical guidelines
- Clinicians interested in learning about computer-interpretable guidelines, their authoring process and uses. The aim of the tutorial is to educate the participants on the benefits of computer-interpretable guidelines, the different issues that have to be handled while encoding clinical guidelines, and how GLIF3 and other guideline modeling methodologies address these issues. At the end of the tutorial, participants will not be able to author and implement a computer-interpretable guideline in their hospital/clinic environments.
- Developers of clinical decision-support systems who want to understand what will be required from hospital information system environments to support the execution of computer-interpretable clinical guidelines
- Stakeholders who want to understand how a standard for guideline representation could facilitate guideline sharing and how far we are from such a standard

Level of content: 40% basic; 40% intermediate; 20% complex

References from organizations that have previously sponsored tutorials of similar duration:
Aziz Boxwala and Mor Peleg have presented a similar tutorial in the AMIA 2000 Annual Fall Symposium. The AMIA 2000 tutorial was entitled "An Introduction to Modeling and Representation of Clinical Guidelines". This tutorial has a similar introduction that explains computer-interpretable clinical guidelines and the importance of sharing them. The tutorial is different in the way that the requirements for a format for sharable computer-interpretable guidelines are classified and presented. Additional requirements were added, relative to the 2000

tutorial. The examples that we use to demonstrate the way in which GLIF3 and various other guideline modeling methodologies addressed the requirements will be changed to reflect the current state of the modeling methodologies. We also revised the "who should attend?" section to reflect comments that were received from participators of the AMIA 2000 tutorial.

Prerequisites: none

Audio-visual equipment: Projector capable of projecting PowerPoint slides from a laptop.

References

1. Bernstam E, Ash N, Peleg M, Tu S, Boxwala AA, Mork P, et al. Guideline classification to assist modeling, authoring, implementation and retrieval. In: Proceedings of the American Medical Informatics Association (AMIA) Annual Symposium November 2000; Los Angeles, CA,: American Medical Informatics Association; p. 66-70.
2. Hripcsak G, Ludemann P, Pryor TA, Wigertz OB, Clayton PD. Rationale for the Arden Syntax. Comput Biomed Res 1994;27(4):291-324.
3. Musen MA, Tu SW, Das AK, Shahar Y. EON: A component-based approach to automation of protocol-directed therapy. JAMIA 1996;3:367-388.
4. Shahar Y, Miksch S, Johnson P. The Asgaard Project: A Task-Specific Framework for the Application and Critiquing of Time-Oriented Clinical Guidelines. Artificial Intelligence in Medicine 1998;14:29-51.
5. Fox J, Rahmanzadeh A. Disseminating medical knowledge: the PROforma approach. Artificial Intelligence in Medicine 1998;14:157-181.
6. Johnson PD, Tu SW, Booth N, Sugden B, Purves IN. Using Scenarios in Chronic Disease Management Guidelines for Primary Care. In: Proc. AMIA Annual Symposium; 2000; Los Angeles, CA; 2000.
7. Peleg M, Boxwala A, Ogunyemi O, Zeng Q, Tu S, Lacson R, et al. GLIF3: The Evolution of a Guideline Representation Format. In: Proc. AMIA Annual Symposium; 2000; p. 645-649.