An Introduction to Modeling and Representation of Clinical Guidelines

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 format that enables machine inference. Because creating guidelines in this format is difficult, sharing the guideline specification across different institutions is vital. Many research groups have been working individually on developing modeling methods and computer-interpretable representations for clinical guidelines. Naturally, most of these efforts have been guided by local, application-specific considerations.

An invitational workshop addressing these issues was held in Boston on March 3-4, 2000. The workshop was hosted by InterMed, a collaboration of researchers at Stanford, Harvard, Columbia, and McGill, as well as by the American College of Physicians-American Society of Internal Medicine. The meeting was attended by stakeholders from academia in 8 different countries, government agencies, professional organizations, users, providers, and industry. All stakeholders recognized the need for a standard sharable computer-interpretable guideline representation. One focus of the workshop was to address and further define functional requirements for such a standard representation of clinical guidelines. A task force initiated at the workshop continued to address these requirements after the meeting. The proposed requirements encompass the entire life cycle of a computer-interpretable guideline: (1) authoring; (2) encoding; (3) reliability studies; (4) dissemination; (5) local adaptation and implementation; (6) testing; (7) use and maintenance; and (8) performance analysis. The instructors of this tutorial, who are members of the InterMed Collaboratory that developed the GuideLine Interchange Format (GLIF), will present the requirements for a sharable computer-interpretable guideline representation, discussed at the meeting in Boston, and demonstrate them using GLIF.

General description of the tutorial's content

The tutorial will include presentations on modeling and representing clinical guidelines and presentations on the requirements for a sharable computer-interpretable representation of clinical guidelines. The instructors will also use guidelines encoded in the third version of GLIF (GLIF3) to explain the meaning of the requirements and will also demonstrate GLIF-based approaches to satisfying these requirements.

An outline of topics to be covered

The material will be organized around the following topics:
- What are guidelines?
  - Types of guidelines
  - Types of guideline applications
- What are computer-interpretable guidelines?
  - Encoding decision logic
  - Structuring guideline recommendations
- Benefits of computer-interpretable guidelines
  - Decision support
  - Verification and reliability studies
  - Quality assurance of the patient care process
  - Simulation for educational purposes
- Differences in decision support provided by computer-interpretable and text-based guidelines
- What is a sharable representation?
  - Sharing a guideline in different clinical settings

- ♦ Integrating the guideline into different information system environments
- What are guideline-models and guideline representation formats?
  - ♦ Models and knowledge representation paradigms
  - ♦ Guideline models
  - ♦ Guideline representations
- What are the potential benefits of a **standard** for a sharable computer-interpretable guideline representation?
  - ♦ Benefits from sharing guidelines
  - ♦ Issues in sharing computer-interpretable guideline representations
    - ❖ Local adaptation
    - ❖ Mapping to information system environments
- Functional requirements for a sharable computer-interpretable guideline representation
  - ♦ Expressiveness (authoring)
    - ❖ Ability to express different guidelines and clinical trial protocols
    - ❖ Ability to express different guideline knowledge components: recommendations, definitions, and algorithms
    - ❖ Ability to express different guideline tasks, including decision making, alert sending, goal setting, specifying work to be performed, and data interpretation
  - ♦ Human comprehension (authoring, use)
    - ❖ Support guideline visualization
    - ❖ Support readability
    - ❖ Manage complexity
    - ❖ Support different views of the guideline (different users such as patient or MD; different settings, such as in-patient or out-patient)
  - ♦ Accessing patient data
    - ❖ Representing patient data (authoring)
    - ❖ Mapping guideline variables into the local electronic patient record (localization)
    - ❖ Support for using vocabularies and reference information models (authoring, encoding)
    - ❖ Support for expressing data abstractions (*e.g.*, pharmacological agent) (authoring, encoding)
    - ❖ Handling semantic matches and range checks (encoding, use)
  - ♦ Structuring guideline output
    - ❖ Enabling multiple views of guideline output (localization, use)
    - ❖ Enabling better workflow integration (localization, use)
  - ♦ Handling negative recommendations and contraindications
    - ❖ Expressing negative recommendations (authoring, encoding)
    - ❖ Expressing course of action if negative recommendations are not followed (authoring, encoding)
    - ❖ Supporting an interactive mode that gives the negative recommendations only if it is necessary (the non-recommended option was considered by the user) (authoring, encoding)
  - ♦ Representing patient preferences (authoring, encoding)
  - ♦ Representing costs and qualities of services (authoring, encoding, localization)
  - ♦ Expressive decision model
    - ❖ Automatic and non-automatic decisions (authoring, encoding)
    - ❖ Utility theory, patient preferences, cost-effectiveness, Bayesian model, sensitivity analysis (authoring, encoding, localization)
  - ♦ Representing adverse conditions (authoring, encoding)
  - ♦ Handling uncertainties in data (missing and incomplete data)
    - ❖ Three-valued criterion semantics (True, False, Unknown) (authoring, encoding)
    - ❖ Providing recommendations despite uncertainty in data (authoring, encoding, use)
  - ♦ Linking the guideline to support material (authoring)
  - ♦ Present clear statements of evidence and recommendations
    - ❖ Strength of evidence (authoring, use)
    - ❖ Strength of recommendations (authoring, use)
    - ❖ Magnitude of anticipated benefits to following a recommendation (authoring, use)

- ♦ Expressing what cannot be changed in the guideline representation during local adaptation (authoring, localization)
- ♦ Representing goals (authoring, use, analysis)
- ♦ Documenting use-cases of guidelines: who uses them and in what settings/situations (authoring, encoding, use, analysis)
- ♦ Ensuring reliability and safety
  - ❖ Ensuring reliability and safety within a guideline, among several guidelines that apply to a patient (simulation, testing)
  - ❖ Verification and/or validation capabilities (simulation, testing)
  - ❖ Documenting test cases that were run (authoring, simulation, testing)
- ♦ Ease of transporting representation format among collaborators (text format, preferably, XML) (dissemination)
- ♦ Possibility of sharing standard representations that are devoid of visualization and site-specific details (dissemination)
- ♦ Coupling guidelines to workflow: resource allocation (authoring, encoding, use, analysis)
- ♦ Ability to link to vendor applications: interface to information systems data and functions (localization and implementation)
- ♦ Support different usage modes
  - ❖ Interactive vs. batch (usage)
  - ❖ Enable different possible user-interfaces (usage)
- ♦ Maintenance
  - ❖ Version control: dates, names of updating person, guideline-author, encoder, version number, etc.
  - ❖ Change management: documentation changes in a structural way (authoring)
  - ❖ Methods for documenting changes only, without specifying the full new version (authoring)
  - ❖ Document problems in a structured way (use, analysis)
- ♦ Support analysis of user compliance with the guideline (available patient data, actions taken, decision options chosen, goals reached, adverse conditions and contraindications) (usage, analysis)
- ♦ Handle legal issues: disclaimers (authoring)

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 is needed
- To demonstrate differences between a guideline model and a guideline representation format
- To demonstrate what makes a good guideline representation
- To demonstrate how GLIF3 meets some of the requirements posed for a sharable computer-interpretable guideline representation

Who should attend?
- Clinicians interested in using or learning more about computer-interpretable guidelines, their authoring and uses
- Developers of clinical decision-support systems
- People interested in knowledge representation, knowledge-based systems and modeling them
- 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 has presented this and related topics at several international scientific meetings and in educational settings. Recent presentations have been:

1. An invited seminar at the Yale Center for Medical Informatics, 1999 (Dr. Perry L. Miller perry.miller@yale.edu).

2. Panel participant in AMIA Fall Symp. 1999 (Panel chair: Dr. Mark Musen, musen@smi.stanford.edu)
3. Demonstration at Integrating the Healthcare Enterprise, Chicago, IL (Program Chair: Dr. Robert A. Greenes, greenes@harvard.edu)

References:

Dr. Robert A. Greenes   Dr. Perry Miller
Decision Systems Group   Director Center for Medical Informatics
Department of Radiology   Yale University School of Medicine
Brigham and Women's Hospital   333 Cedar Street
75 Francis St, Boston, MA 02115   P.O. Box 208009 New Haven, CT 06520-8009
Tel: (617) 732-6281 Fax: (617) 732-6317   Tel: (203) 764-6715 Fax: (203) 764-6717
Email: greenes@harvard.edu   Email: Perry.Miller@yale.edu

Dr. Mark Musen
251 Campus Drive
MSOB X-215
Stanford, CA 94305-5479
Tel: (650) 723-6979 Fax: (650) 725-7944
Email: musen@smi.stanford.edu

Mor Peleg has given presentations in international and local conferences and workshops (Prof. Dori, dori@ie.technion.ac.il; Prof. Shortliffe, shortliffe@columbia.edu) She was an instructor in a commercial genetic engineering workshop entitled "Touching the Genes" that was held in the Technion – Israel Institute of Technology (Prof. Lev zlev@tx.technion.ac.il). She was twice awarded the "excellent instructor" prize by the Technion – Israel Institute of Technology (dori@ie.technion.ac.il, zlev@tx.technion.ac.il) and has lectured and instructed in tutorial sessions and laboratory sessions between 1991-1999 in the Technion – Israel Institute of Technology (dori@ie.technion.ac.il).

References:

Edward H. Shortliffe, MD, PhD   Prof. Dov Dori, Ph.D.
Professor and Chair   Associate Editor, IEEE Trans. Pattern Analysis and
Department of Medical Informatics   Machine Intelligence
Columbia University, College of Physicians   Sloan School of Management
and Surgeons   Massachusetts Institute of Technology
New York, NY 10032   Cambridge, MA 02139, USA
Tel: (212) 305-6896 Fax (212) 305-3302   Tel: (617) 964-7930 Fax: (617) 253-8632
Email: shortliffe@columbia.edu   On sabbatical from Technion, Israel Institute of Technology
                                              Email: dori@ie.technion.ac.il

Zeev Lev, Ph.D.
Department of Biology
Technion - Israel Institute of Technology
Haifa, Israel 32000
Tel: (office): (972) 4-829-4215   (lab): (972) 4-829-3440 Fax: (972) 4-822-5153
Email: zlev@tx.technion.ac.il

Prerequisites: none

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