Using a Guideline-Centered Approach for the Design of a Clinical Decision Support System to Promote Smoking Cessation

Richard N. Shiffman, MD, MCIS
George Michel, MS
Abdelwaheb Essaihi, MD
Theodore W. Marcy, MD, MPH
Yale Center for Medical informatics
University of Vermont College of Medicine
Knowledge Acquisition from Guidelines: What’s the Problem?

- Ambiguity; guideline terms often lack explicit definitions
- Incomplete specification
- Additional knowledge is always necessary to create a decision support tool
- Creation of DSS KB risks error
- Local adaptation (necessary) risks preservation of habit, self interest
- Knowledge maintenance is a largely unaddressed but critical issue
Representation of Guideline Knowledge for Decision Support

- Members of the InterMed Collaboratory encoded representations of guidelines for vaccination and workup of breast masses
- Tested with patient scenarios
- Different recommendations were given for the same patient

Patel VL. JAMIA 1998
Guideline Implementation Gap

Published Guideline

Computer-Based Guideline Implementation
Goal (Intention) of This Work
Overview of Presentation

• Articulate a systematic, explicit, and transparent process for translating GL knowledge into DS tools

• GEM Overview

• Handheld, wireless DSS (under construction) for smoking cessation
Advantages of Document-Centered DSS Design

- Preservation of authenticity of knowledge
- Audit of local adaptation (knowledge modifications)
- Diminished variability of DSS designs
GEM

• XML
• Hierarchy of > 100 elements
• Models heterogeneous information
• Has been used successfully for:
  Guideline quality appraisal (GEM-Q)
  Feedback to developers (Extractor)
  Partial generation of MLMs (GEM-Arden)
  Creating database of NGC guidelines
• DTD adopted as standard by ASTM (E2210-02)
GEM: Top Levels

Guideline

Document Header
- Identity
- Developer

Document Body
- Purpose
- Method of Development
- Testing
- Revision Plan
- Intended Audience
- Target Population
- Knowledge Components
Knowledge Components

- Recommendation
  - Conditional
  - Imperative
- Definition
  - Term
  - Term Meaning
- Algorithm
  - Action Step
  - Condit’l Step
  - Branch Step
  - Sync Step
GEM Cutter

DEFINITION OF THE PROBLEM
This practice parameter provides recommendations for the neurodiagnostic evaluation of neurologically healthy infants and children between 6 months and 5 years of age who have had their first simple febrile seizures and present within 12 hours of the event. This practice parameter is not intended for patients who have had complex febrile seizures (prolonged, focal, and/or recurrent), nor does it pertain to those children with previous neurologic insults, known central nervous system abnormalities, or histories of febrile seizures.

TARGET AUDIENCE AND PRACTICE SETTING:
This practice parameter is intended for use by pediatricians, family physicians, child neurologists, neonatologists, emergency physicians, and other providers who treat children for febrile seizures.

INTERVENTIONS OF DIRECT INTEREST:
1. Lumbar puncture;
2. Electroencephalogram (EEG);
3. Magnetic resonance imaging (MRI);
4. Computed tomography (CT);
Maintaining Links to Guideline Text

- Each GEM element has
  - a unique `identifier` attribute
  - a `source` attribute:
    - default value is “explicit”
    - changes to “inferred” if content is modified
GEM Polishing

- Select (GL & Rec)
- **Semantic Refinement**
  - (Markup)
  - Atomize
  - De-abstract
  - Disambiguate
  - Verify completeness
  - Build executables

**Workflow Integration**
- Origins and insertions
- Define action types
- Assoc’d beneficial services
- Develop requirement spec
- **Encode, design interface**
- **Test**
Smoking Cessation

- Cigarette smoking is most common cause of preventable death in the US
- Cessation can dramatically reduce risk of cancer and other diseases
- Smokers are more likely to quit if physicians counsel them
- Physicians infrequently counsel them
- -->USPHS Guideline
Bupropion SR should be used during pregnancy only if the increased likelihood of smoking abstinence, with its potential benefits, outweighs the risk of bupropion SR treatment and potential concomitant smoking.
Semantic Refinement

• **Atomize**: “Bupoprion should be used”
  -> Prescribe bupoprion

• **Deababstract**: “potential benefits outweigh the risks”

  • Benefits: avoid smoking-induced stillbirths, spontaneous abortions, decreased fetal growth, premature births, low birth weight, placental abruption, sudden infant death syndrome (SIDS), cleft palates and cleft lips, and childhood cancers. and infant respiratory disease

  • Risks: unknown + seizures in 1:1000; may be ineffective
## Extractor -> Decision Variables,

<table>
<thead>
<tr>
<th>Tobacco use</th>
<th>Current, quit recently, abstinent for an extended period, never used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Adolescent, adult</td>
</tr>
<tr>
<td>Pregnant</td>
<td>Y/N/0</td>
</tr>
<tr>
<td>Breastfeeding</td>
<td>Y/N/0</td>
</tr>
<tr>
<td>Hx of depression</td>
<td>Y/N/0</td>
</tr>
<tr>
<td>Cardiovascular disease</td>
<td>Y/N/0</td>
</tr>
<tr>
<td>Concern about weight gain</td>
<td>Y/N/0</td>
</tr>
<tr>
<td>Hx of seizures</td>
<td>Y/N/0</td>
</tr>
</tbody>
</table>
Workflow Integration

- Identify **origins** of DVs, **insertions** of actions
- Define **action type**
- Describe **associated beneficial services**
Guideline Action Classifier (N=405)

Action

- Gather
  - Test
  - Monitor
- Interpret
  - Conclude
- Perform
  - Prescribe
    - Educate
    - Document
    - Prepare
  - Procedure
  - Consult
  - Advocate
- Dispose
System for Delivering Advice
Conclusion

• Bridging the gap between guideline text and valid, useful decision support tools is complex.

• Extraction of DVs and actions from contextual narrative facilitates clarification.

• Document-centered approach helps maintain authenticity of knowledge.

richard.shiffman@yale.edu
http://ycmi.med.yale.edu/GEM