An Introduction to GLIF

Mor Peleg, Ph.D.
Post-doctoral Fellow, SMI, Stanford Medical School, Stanford University, Stanford, CA

Aziz A. Boxwala, M.B.B.S, Ph.D.
Research Scientist and Instructor
DSG, Harvard Medical School
Brigham & Women's Hospital, Boston, MA

HL7 Winter Working Group Meeting
Orlando • January, 2001

Outline

- Computer-interpretable guidelines
- Sharing computer-interpretable guidelines
- Requirements for a shared guideline model
- GLIF

Computer-interpretable guidelines

- In this talk, we address computer-interpretable guidelines that
  - –deliver patient-specific recommendations
  - –are integrated with EMRs and Health Information Systems
    - »Automated reminders/alerts
    - »Decision support and task management
    - »Order entry appropriateness, referral criteria...
    - »Background monitoring, care plans, quality review

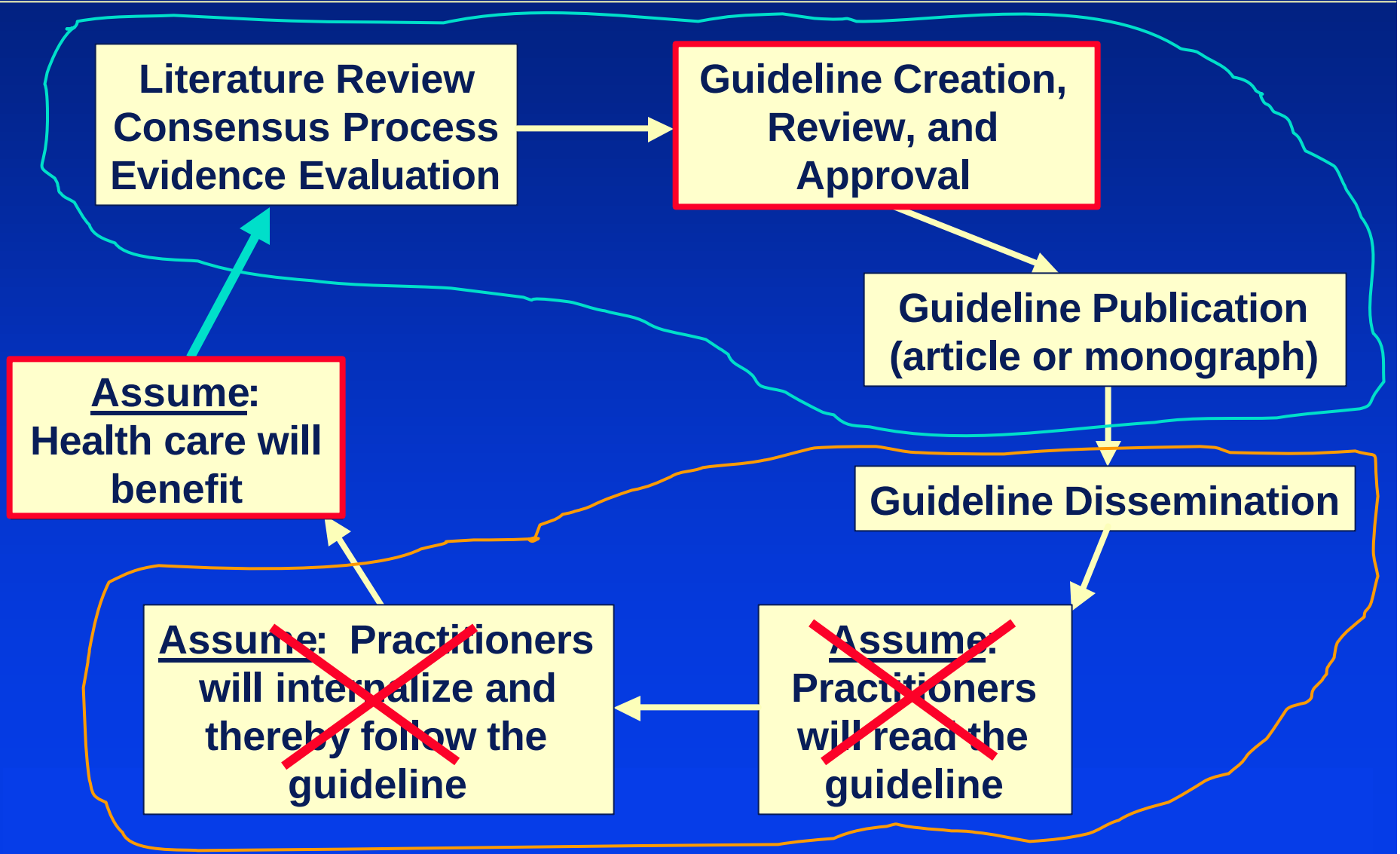
Benefits of computer-interpretable guidelines

- Provide automatic decision support
  - Applied to individual patients
  - Can be during the clinical encounter
- Guidelines can be better designed
  - Software tools and guideline models used to specifying logic precisely
  - Ambiguities reduced
- Can integrate guidelines into workflow
  - Patient-specific guideline knowledge available at point of care, to person or entity needing it

Benefits, cont'd

- Can be used for quality assurance
  - Guideline defines gold-standard of care
  - Perform retrospective analysis to test if patients were treated appropriately
- Simulations for educational purposes
- Can aid in human visualization
  - interactive, dynamic display of guideline pathways
  - allows one to focus on relevant sections of flowchart
  - useful for authoring as well as for use

Benefits: development & dissemination



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Why share computer-interpretable guidelines?

- Leverages cost of guideline development
- Provides consistency in guideline interpretation
- Can minimize misinterpretations and errors through the process of public review
- Facilitates execution rather than just read-only use
- Can provide common basis before local adaptation

Challenges in sharing guidelines by different institutions

- Local adaptation of guidelines
  - Availability of resources and expertise
  - Local workflow issues
  - Practice preferences
- Integration with information systems
  - Match patient data in EMR to GL terms
  - Match recommendations in guideline to actions in order entry system
- Every guideline model needs to address these issues

Obstacles to sharing

- Multiplicity of:
  - –conceptual guideline models
  - –intended applications
  - –authoring tools (separate conceptual from formal, and implementation-specific models?)
  - –dissemination formats (XML, RDF...)

Common shared model

- Ability to share guideline encodings across:
  - different platforms and systems (e.g., EMRs)
  - different guideline models
- Joint development of:
  - shared model that incorporates features of different models
  - tools to support entire guideline life cycle
    - » authoring, validation, local adaptation & mappings, execution, revision and update

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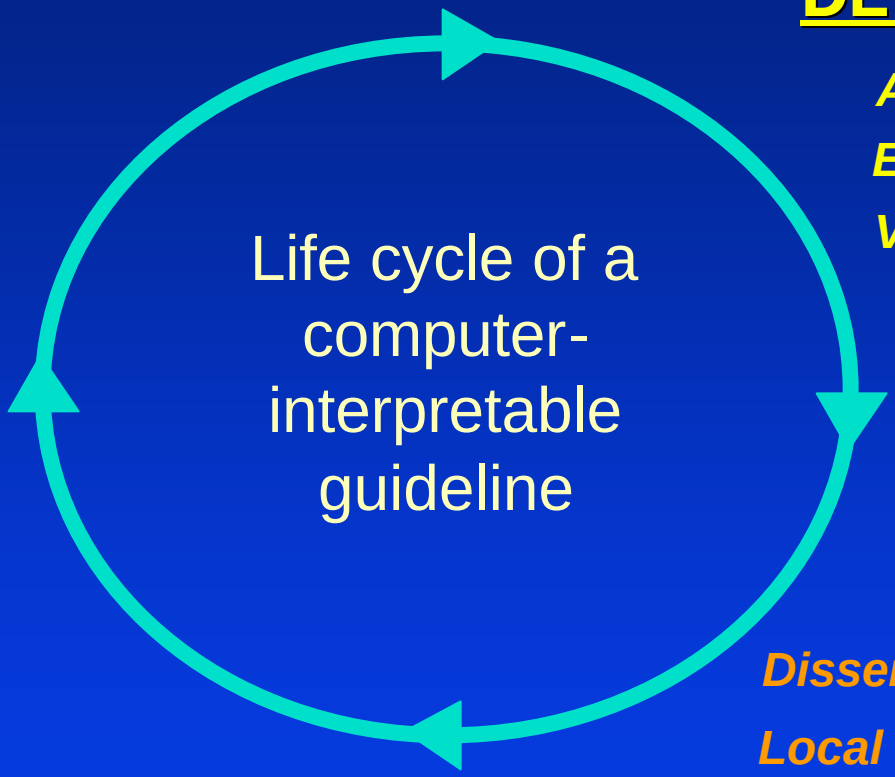
Functional requirements

- The shared model must be based on a set of functional requirements for sharable guidelines
- The functional requirements are organized according to the life-cycle of a computer-based guideline
- These requirements guide the design of GLIF, although we have not satisfied all of them yet

Life cycle of a computer-interpretable guideline



DEVELOPMENT

Authoring

Encoding

Validation

USE

Use and maintenance

Performance analysis

Dissemination

Local adaptation and implementation

Testing

IMPLEMENTATION

Development requirements

- Expressiveness
- Comprehensibility

Expressiveness

- Ability to express knowledge content of different types of guidelines
  - Structural parts
    - Definitions, recommendations, algorithms
  - Decision-support guideline tasks
    - Expressive decision model
    - Goal setting
    - Specifying work to be performed
    - Data interpretation
    - Generating alerts and reminders

Comprehensibility

- Guideline visualization and readability
- Complexity management
- Coherence facilitation (e.g., support material)

Implementation Requirements

- Ease of guideline integration into clinical environments
- Ease of sharing actual specifications

Guideline integration into clinical environments

- Local adaptation of guideline content
- Integration with EMR
  - Mapping references to patient data to entries in the medical record
  - Mapping recommendations to implementable actions
    - » e.g. linking to order entry system
      printing a prescription
- Workflow integration

Ease of sharing actual specifications

- Easy to transport specifications among collaborators
  - Text format
  - XML/RDF
- Standard representations should not contain proprietary, application-dependent details
  - e.g., devoid of visualization details

Use requirements

- Support different usage modes
  - Interactive use
  - Batch processing
- Version control

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GLIF

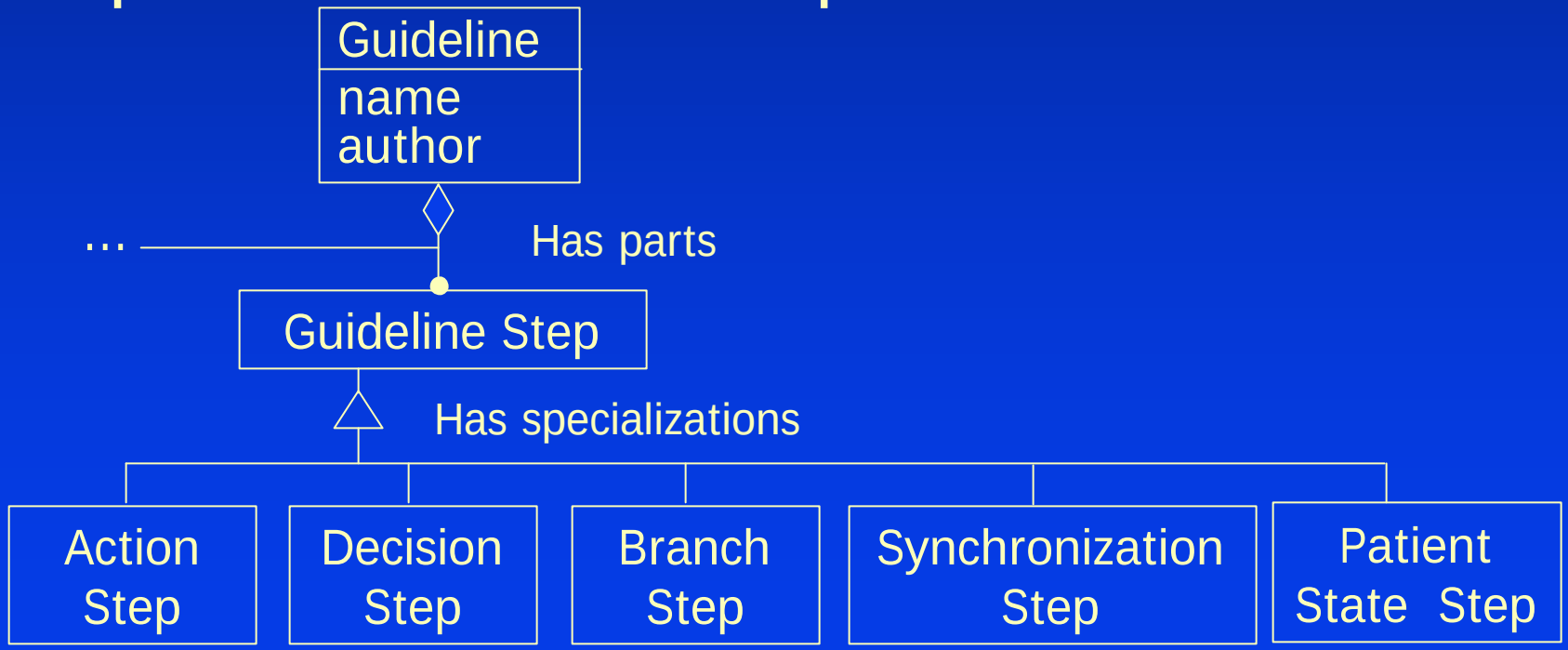
- GuideLine Interchange Format
- A format for sharing clinical guidelines independent of platforms and systems
- Based on an object-oriented logical model of concepts
- Has an XML-based syntax (RDF Schema)

An Approach to Enhance Sharing

- A multi-level representation
- Designed to support multiple vocabularies and medical knowledge bases
- InterMed: multi-institutional development process
- GLIF is evolving as an open standard
  - Cooperation with other guideline modeling groups (Arden, USAM, GEM)

GLIF model

- Object-oriented representation model for guidelines
- Flowchart representation of a temporal sequence of clinical steps



GLIF classes

- Action steps: recommendations for clinical actions to be performed
  - e.g., Prescribe aspirin
- Decision steps: decision criteria for conditional flowchart traversal
  - e.g., if patient has pain then ...
- Branch and synchronization steps allow concurrency
- Patient-state step: characterizes patient's clinical state

GLIF3 Modeling Process

3 Representation Levels

A. Author/viewer level

- Conceptual flowchart of clinical actions and decisions
- Aids in human understanding

B. Abstract machine representation

- Can be executed by an interpreter
- Correctness can be analyzed

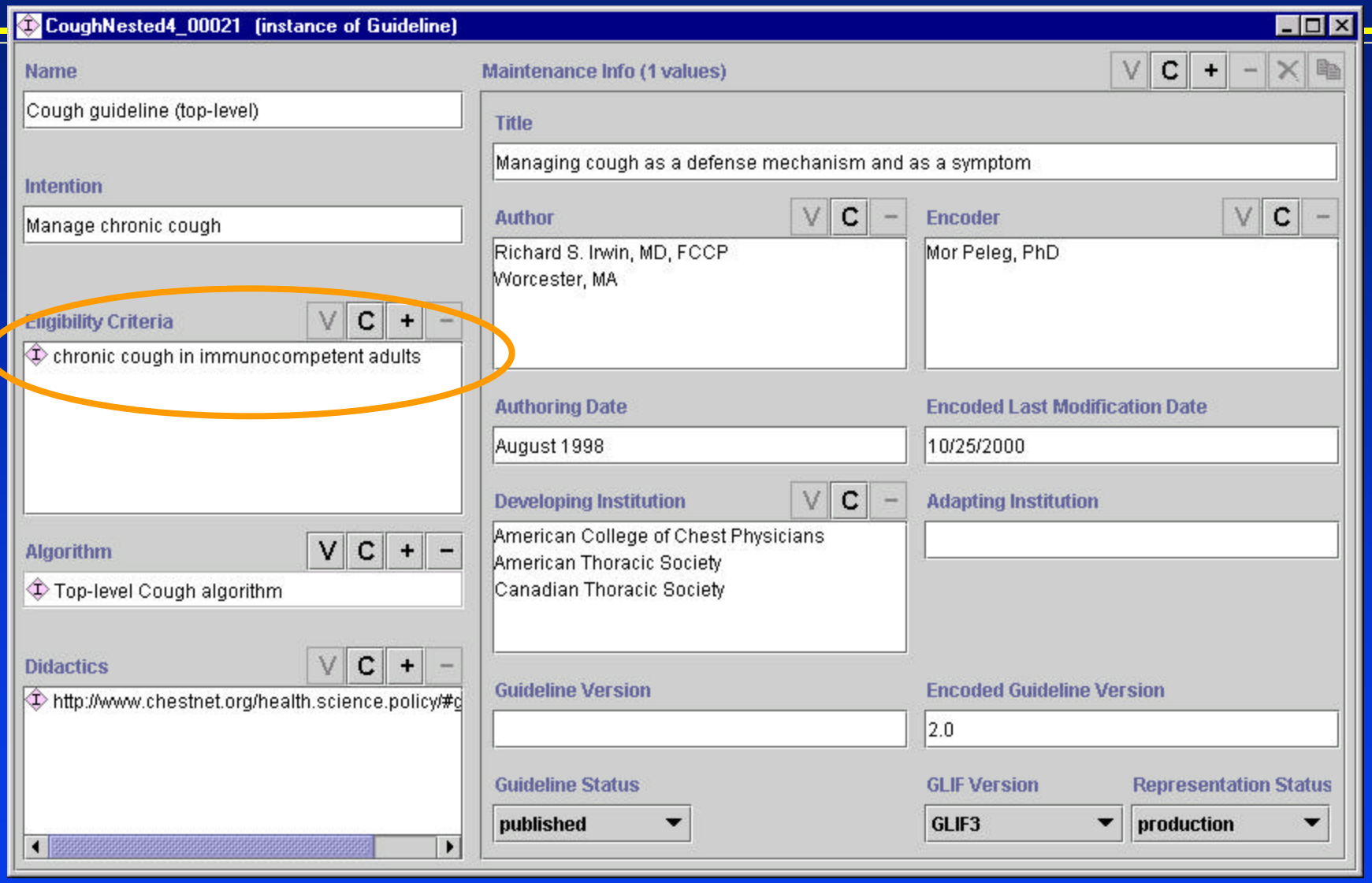
C. Integration into application environments

- Application-specific mappings and modifications
- Not yet supported

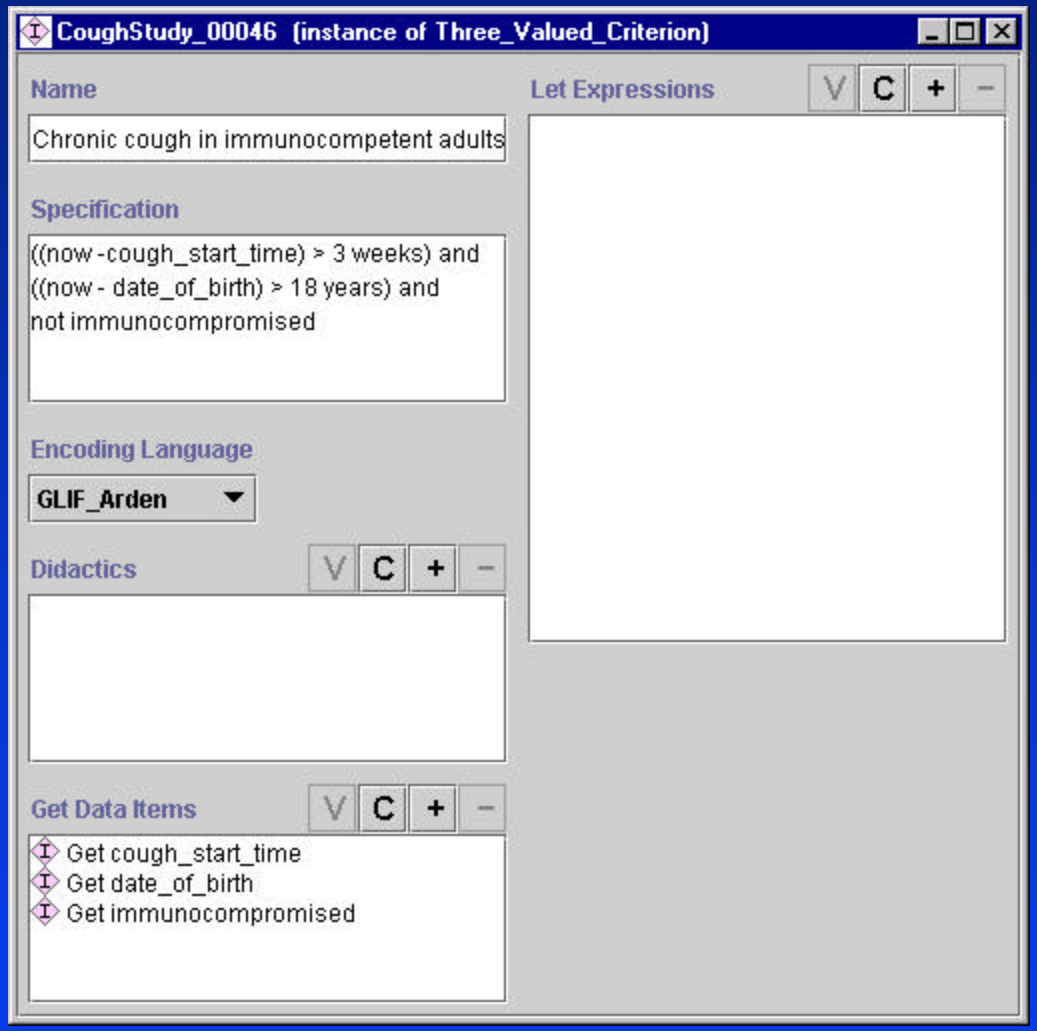
Abstract Machine Representation

- Unambiguous syntax for logical expressions
  - based on Arden Syntax
- All logical expressions & actions refer to defined concepts (medical ontology)
- Allowed values, ranges, & time constraints
- Can be interpreted and analyzed for correctness
  - syntax, type, and range checking

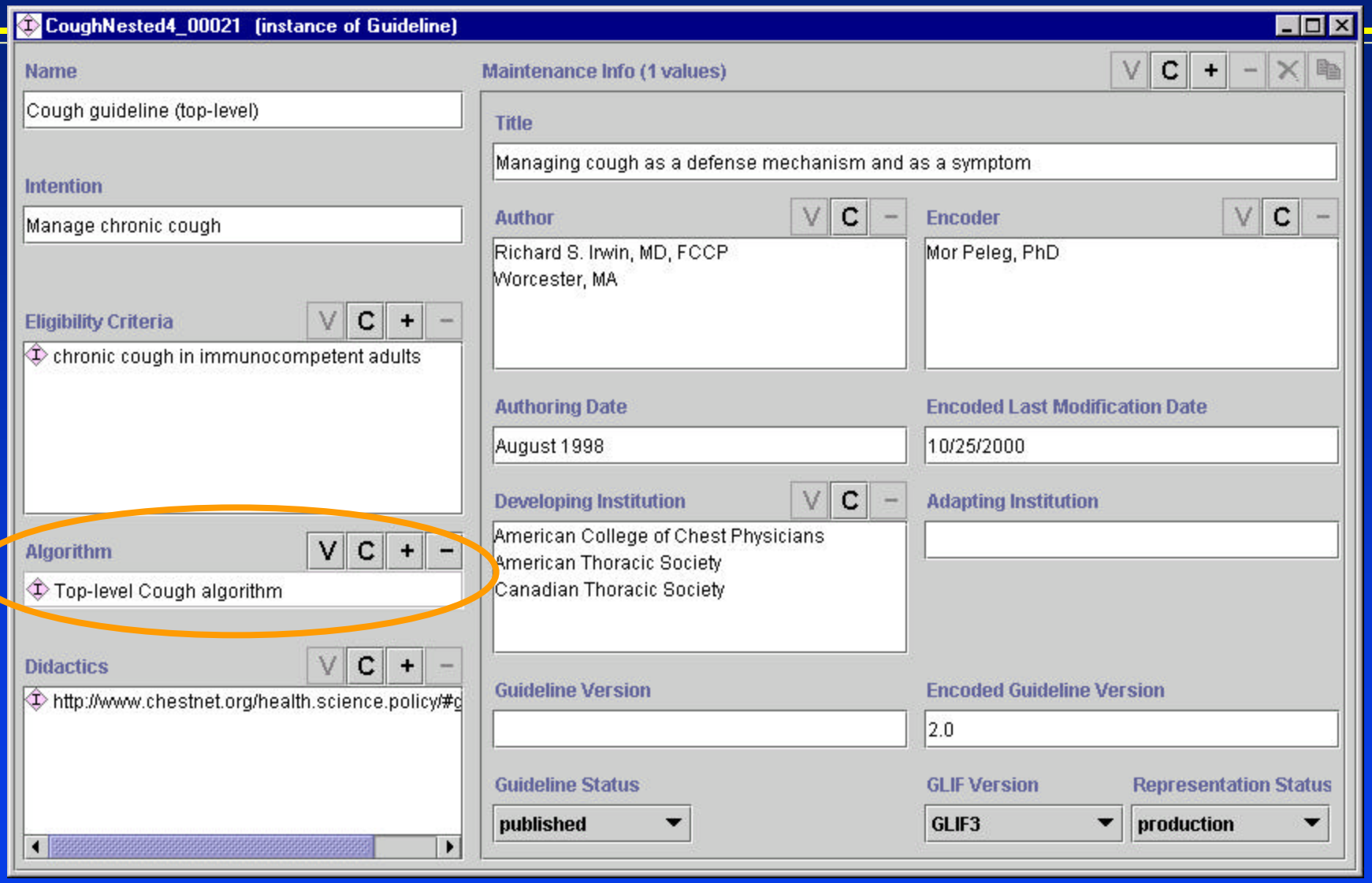
GLIF example: Guideline



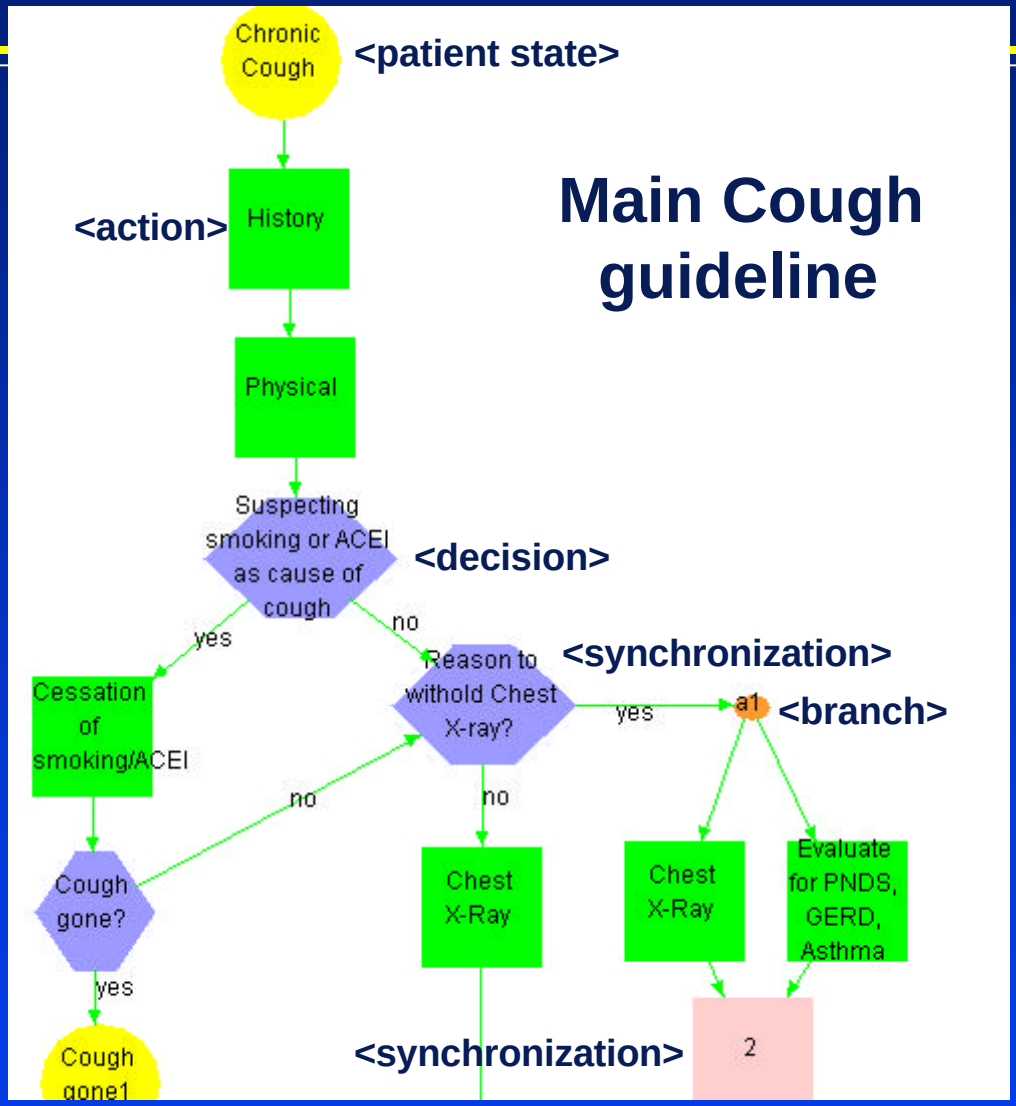
Eligibility Criteria



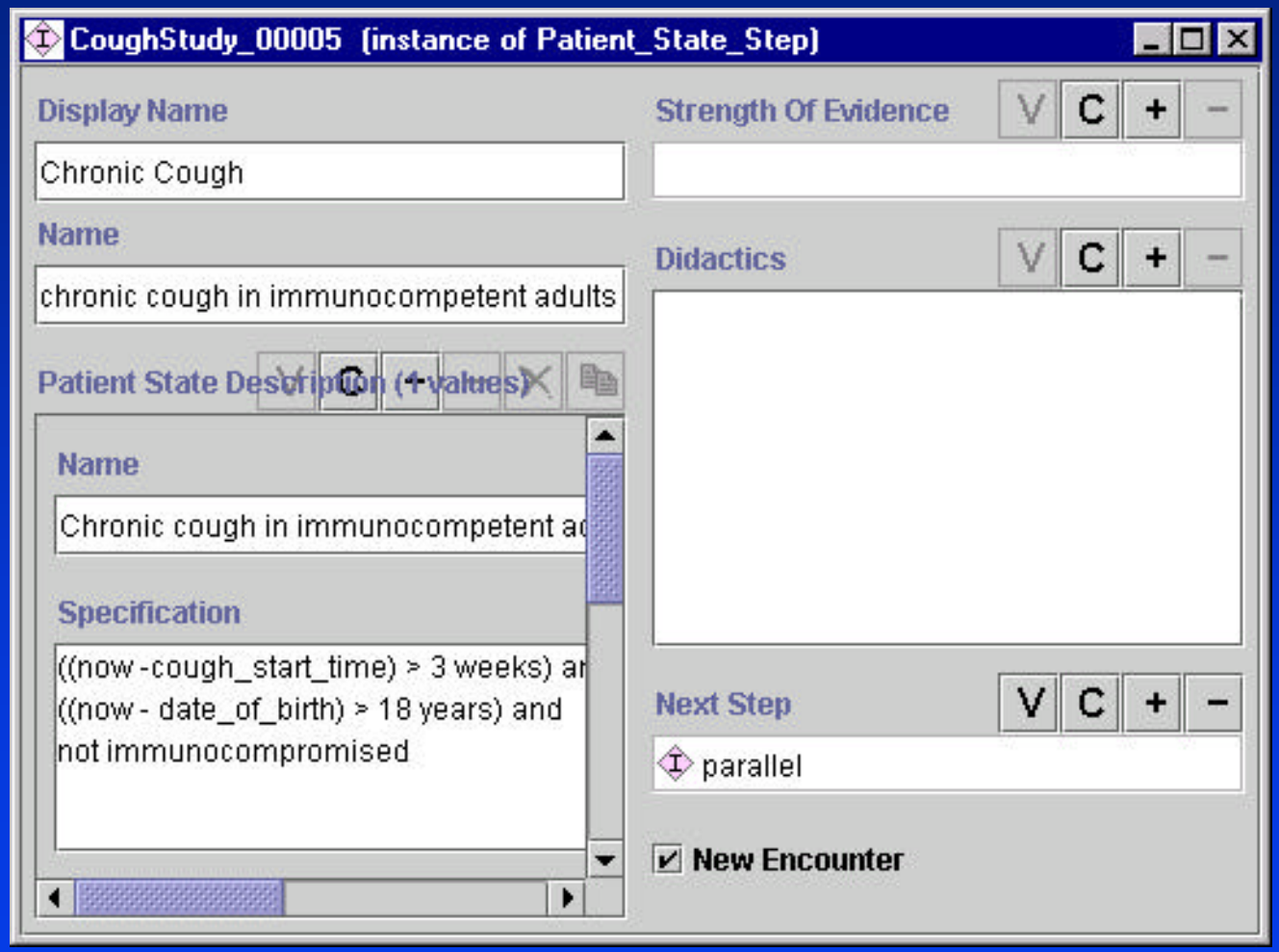
GLIF example: Guideline



Algorithm

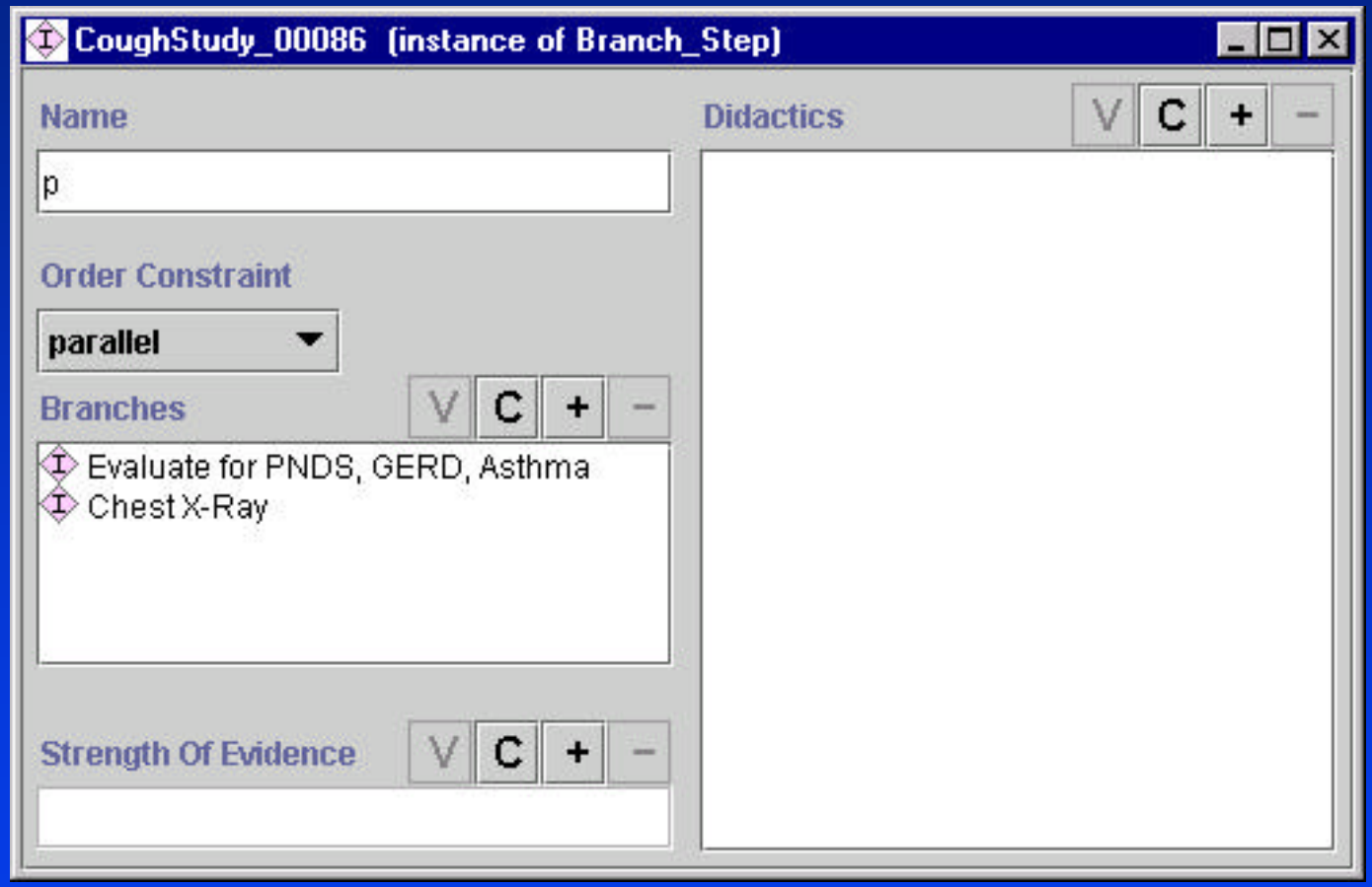

Chronic Cough
<patient state>
<action>
History
Physical
Main Cough guideline
Suspecting smoking or ACEI as cause of cough
<decision>
yes
no
Cessation of smoking/ACEI
Reason to withold Chest X-ray?
<synchronization>
yes
a1
<branch>
no
no
Cough gone?
Chest X-Ray
Chest X-Ray
Evaluate for PNDS, GERD, Asthma
yes
Cough gone1
<synchronization>
2

Patient state step

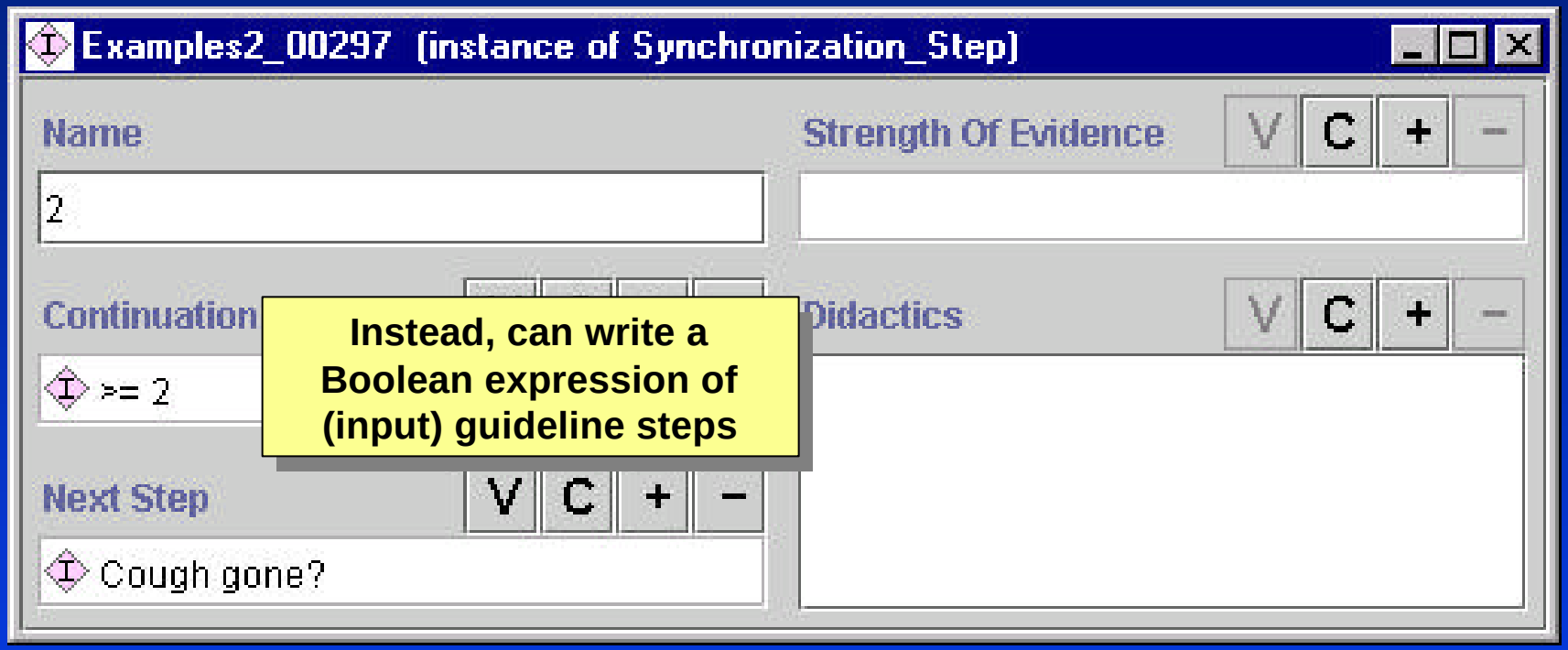


Branch Step

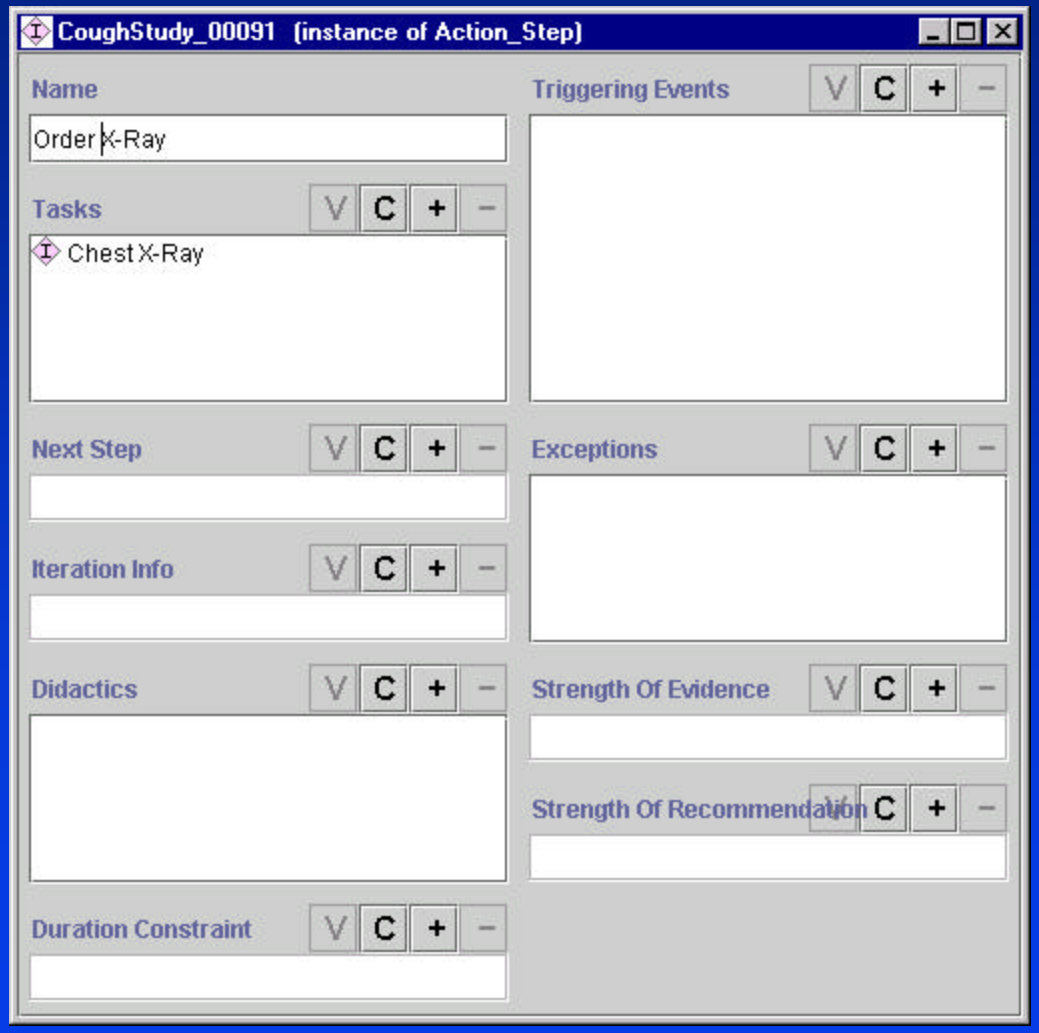
Or “any order”



Synchronization step



Action step


CoughStudy_00091 (instance of Action_Step)
Name
Order X-Ray
Tasks
Chest X-Ray
Next Step
Iteration Info
Didactics
Duration Constraint
Triggering Events
Exceptions
Strength Of Evidence
Strength Of Recommendation
V
C
+
–

Action tasks

Action tasks specify work to be performed

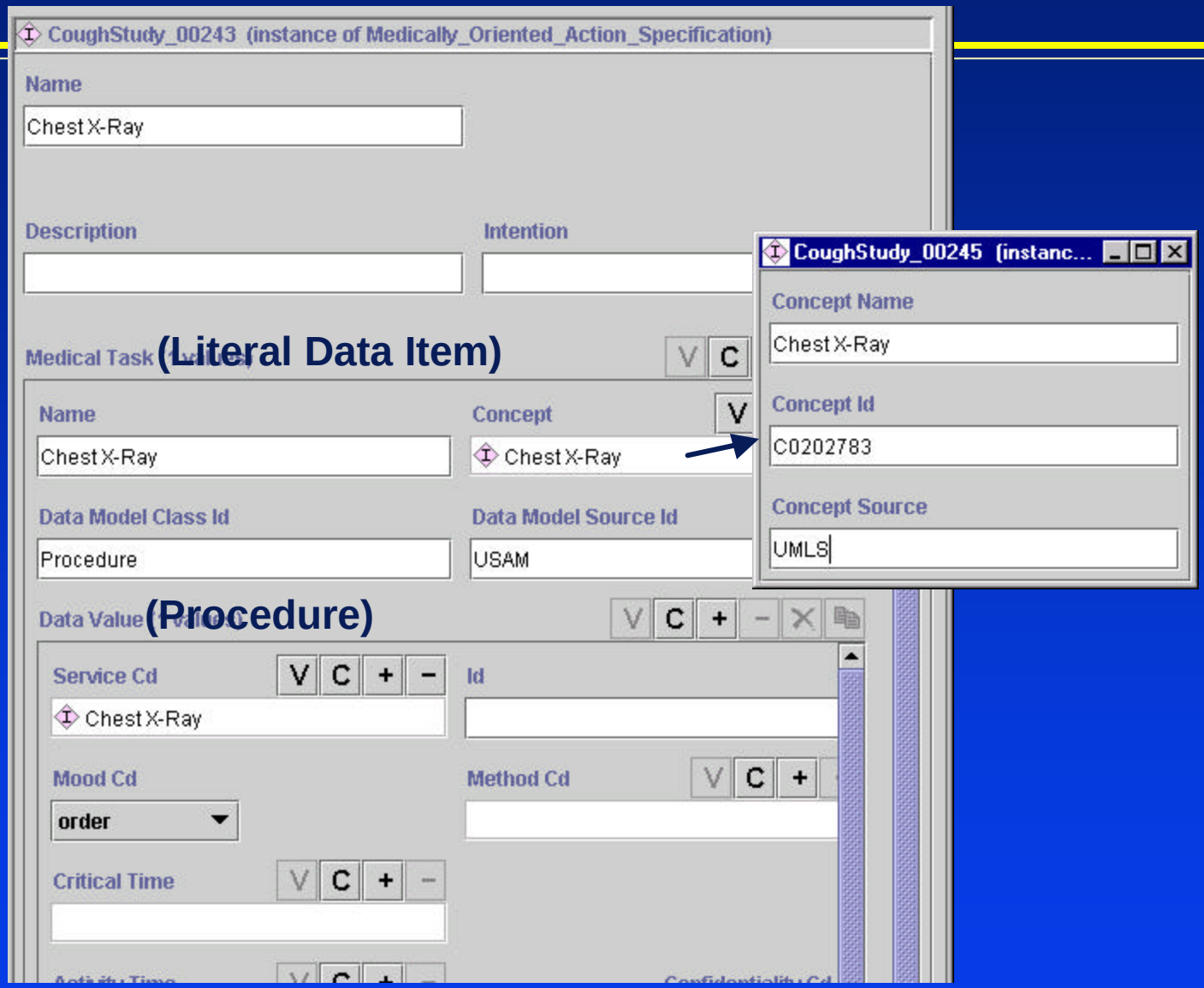
- Medically-Oriented
  - –Prescription
  - –Lab test order
- Programming-Oriented
  - –Call sub-guideline
  - –Send message
  - –Get patient data (from EMR or User)

Medically-oriented tasks

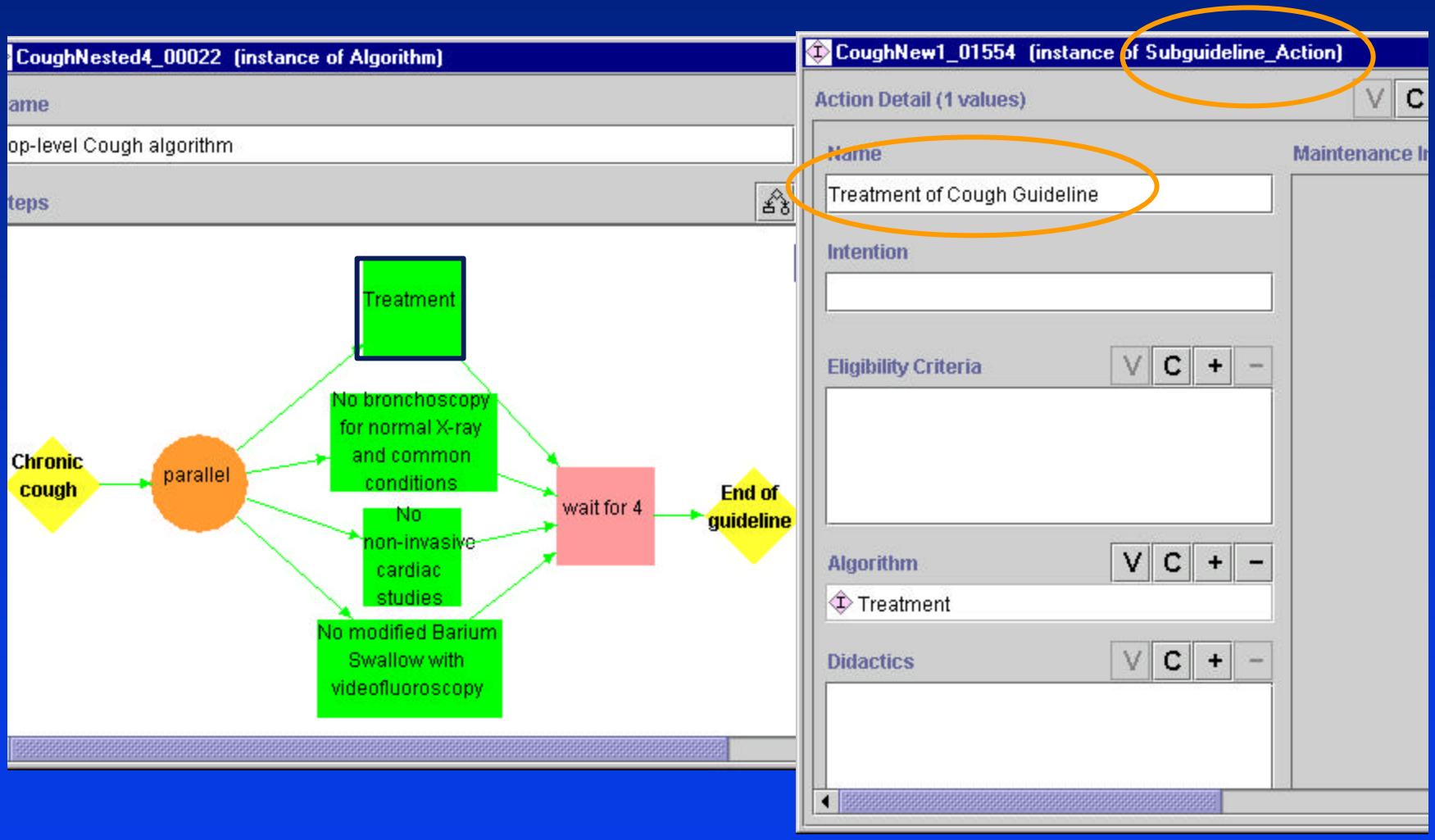
- Refer to a medical domain ontology that supports:
  - Standard vocabularies
  - Standard data models for representing patient data

    e.g., HL-7's Unified Service Action Model (USAM)

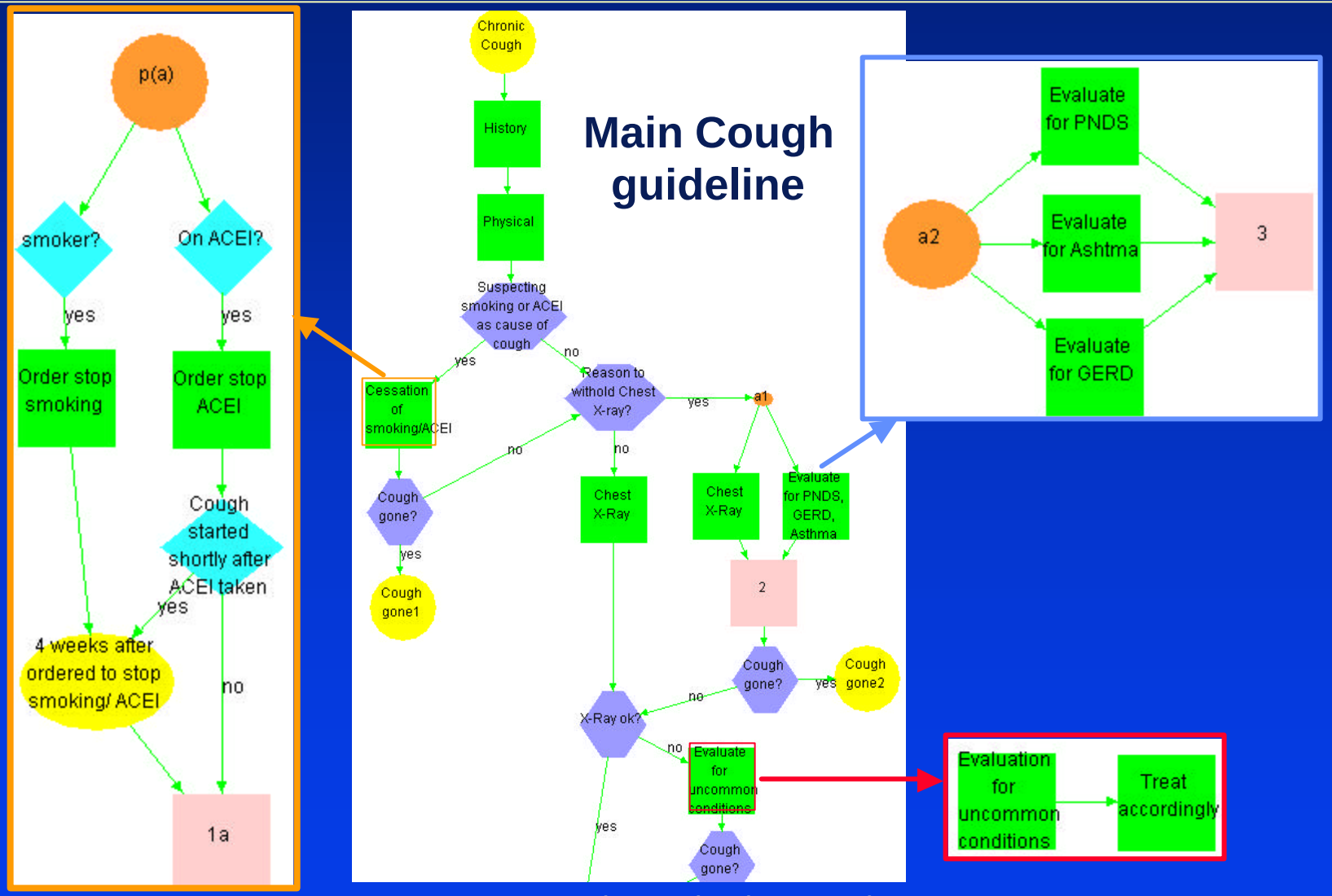
A medically-oriented task



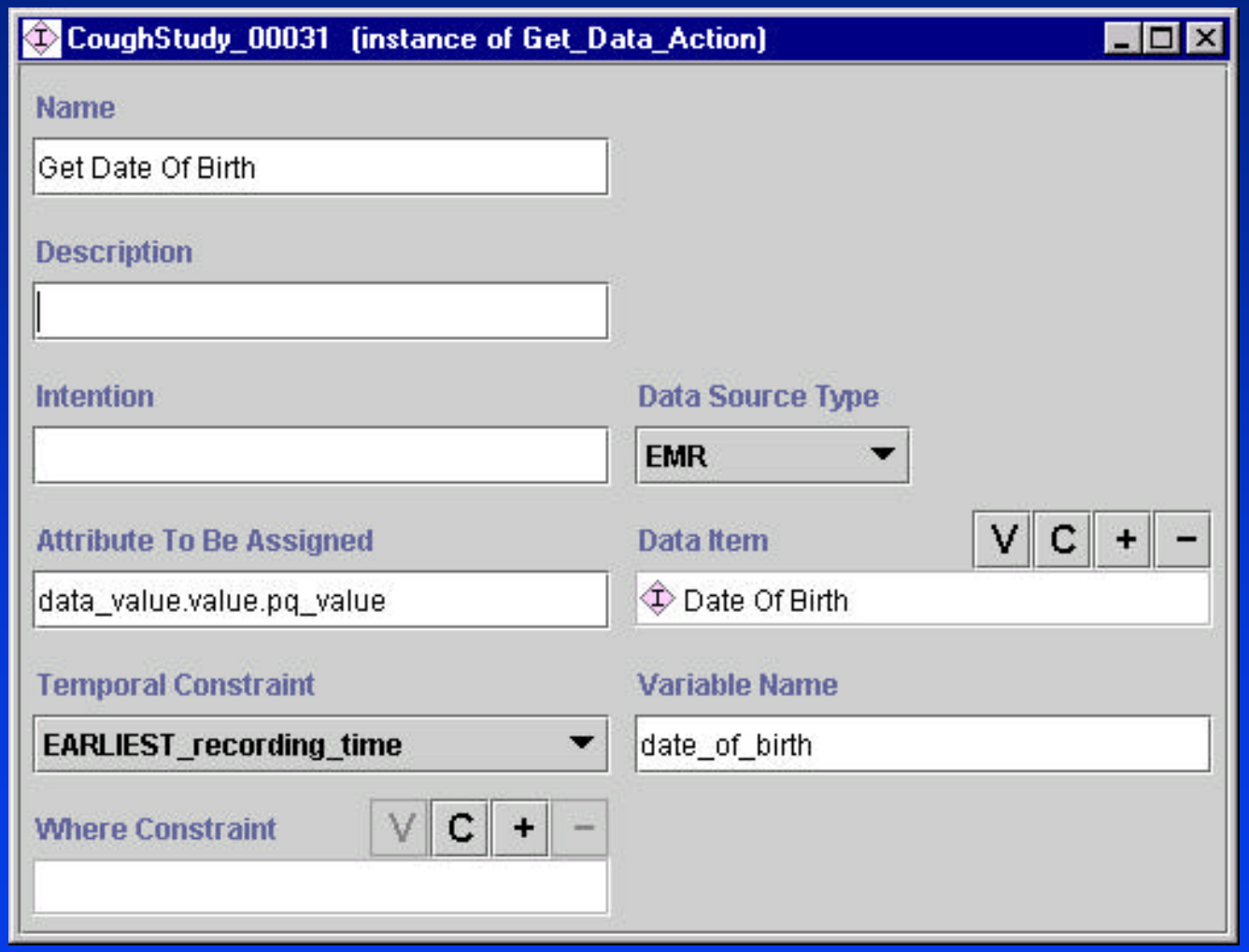
Calling Sub-guidelines: Nesting



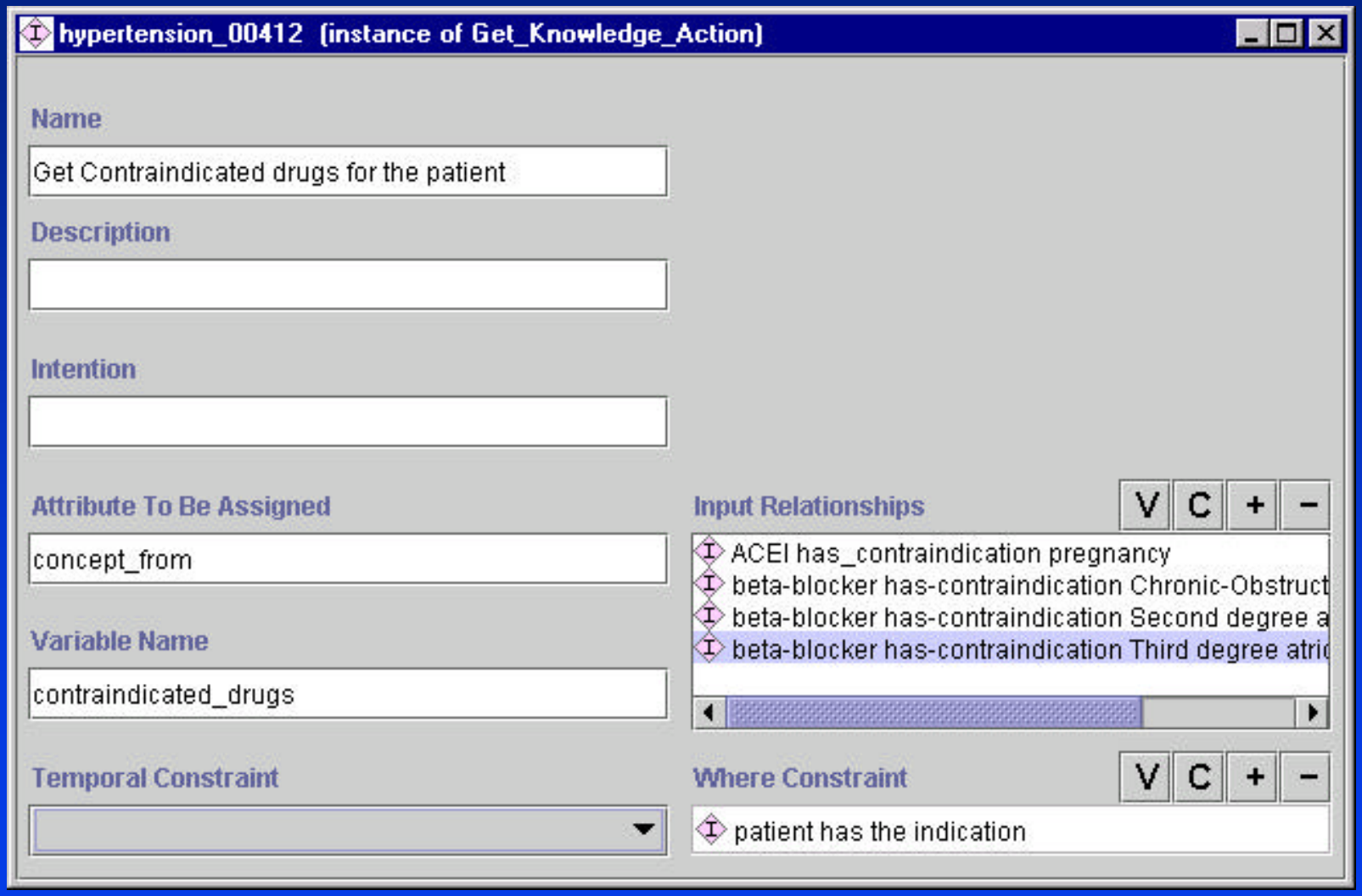
Nesting (comprehensibility)



Get data task



Get knowledge task

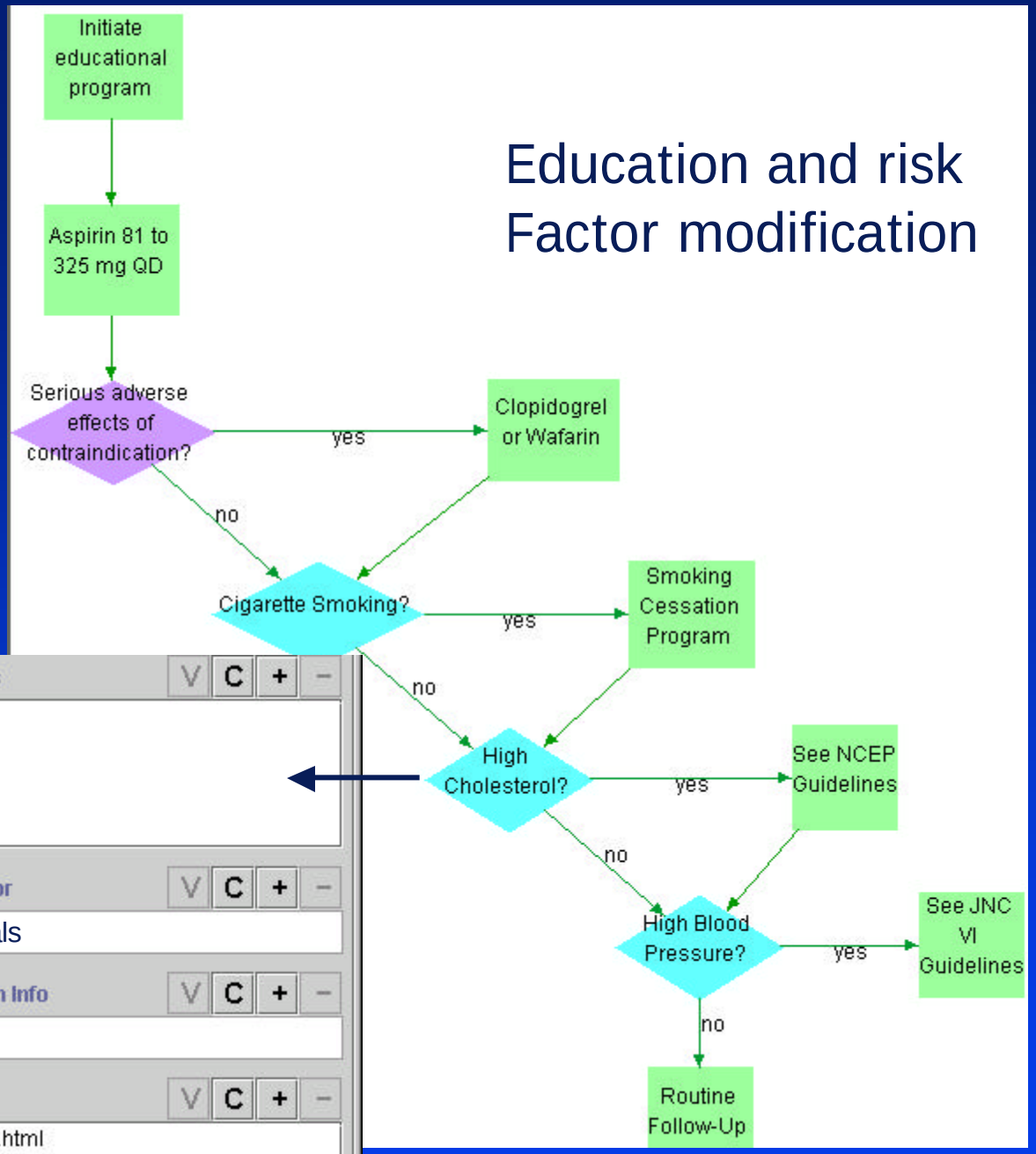


Decision model

- Case Step
  - represent decisions that can be automated by directly evaluating logical criteria based on data items from the EMR
- Choice Step
  - represent choices that should be made by the user since they are either safety-critical or require knowledge that is not specified by the guideline

Case step

Education and risk Factor modification



Level B

Name: High Cholesterol?

Options: yes, no

Condition: LDL_Cholesterol > 160 mg/dL

Decision Detail:

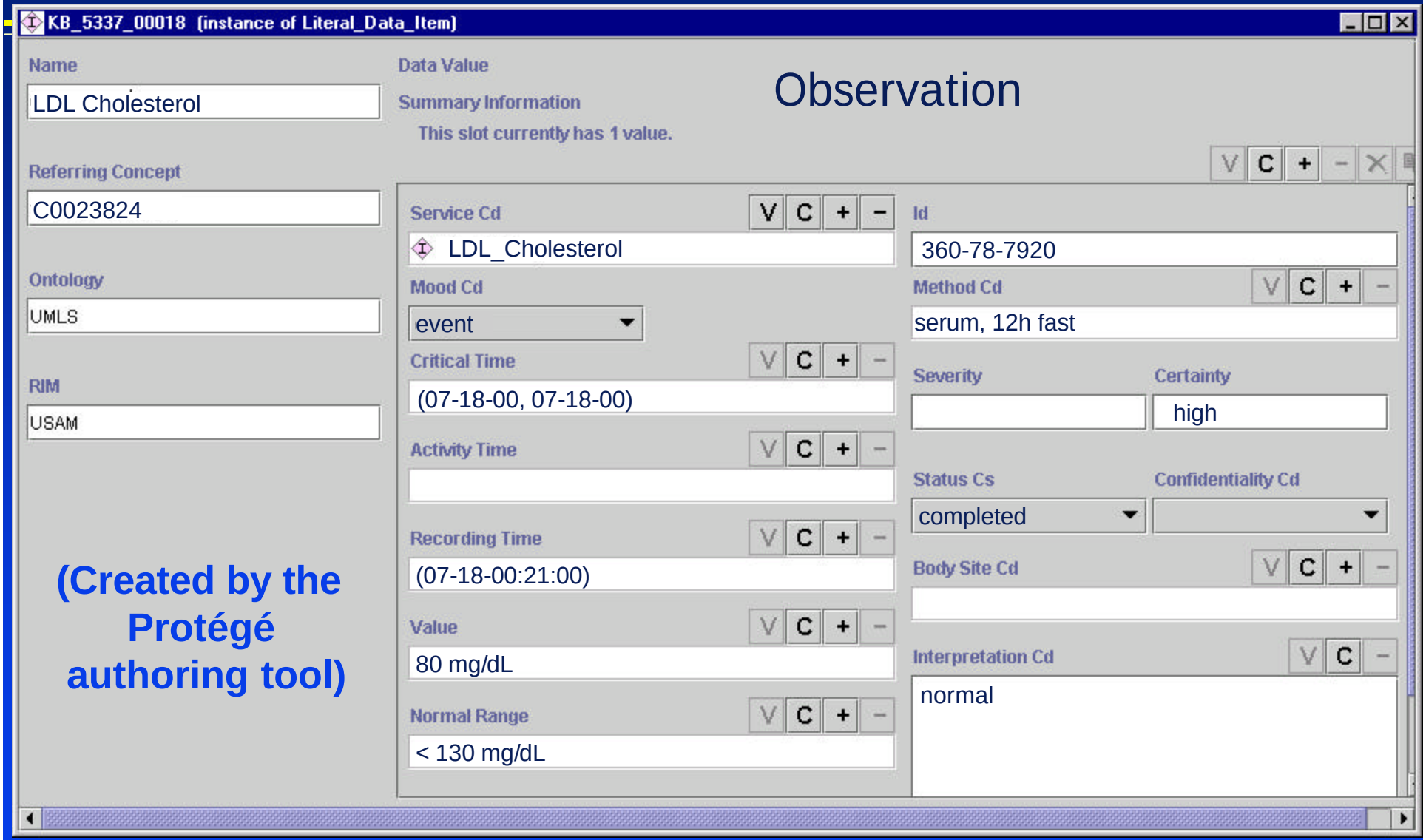
Operator: equals

Default Next Step:

Iteration Info:

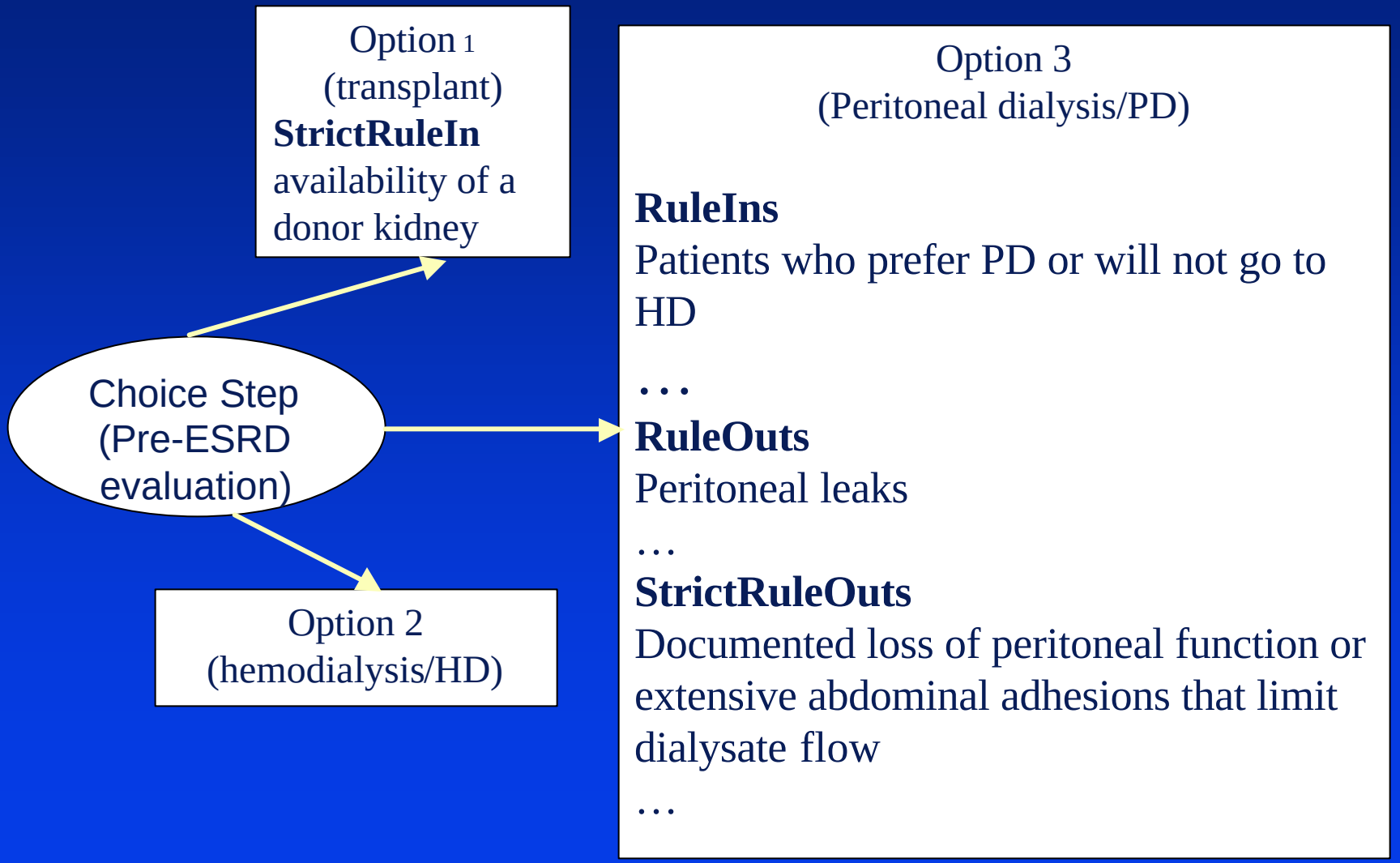
Didactics: http://www.acc.org/clinical/guidelines/june99/index.html

Specifying patient data



(Created by the Protégé authoring tool)

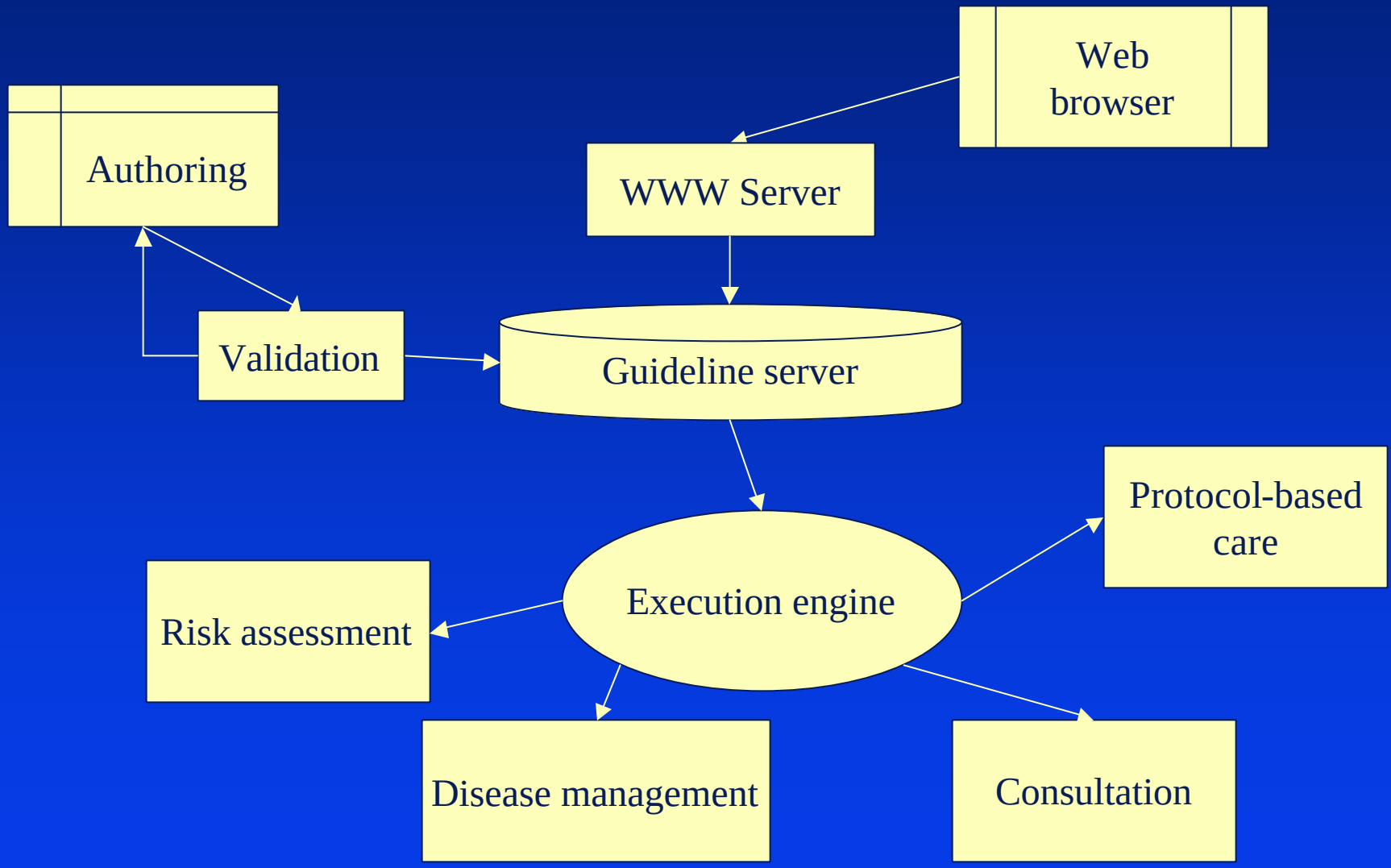
Choice Step


Option 1
(transplant)
StrictRuleIn
availability of a donor kidney
Choice Step
(Pre-ESRD evaluation)
Option 2
(hemodialysis/HD)
Option 3
(Peritoneal dialysis/PD)
RuleIns
Patients who prefer PD or will not go to HD
…
RuleOuts
Peritoneal leaks
…
StrictRuleOuts
Documented loss of peritoneal function or extensive abdominal adhesions that limit dialysate flow
…

GLIF3: Summary

- GLIF3 is a language designed to allow sharing of clinical guidelines across different platforms and systems
- GLIF3 enables encoding of the logic of guidelines in a way that is computable
  - Highly structured specification
  - Formal expression syntax (based on Arden Syntax)
  - Medical domain ontology (vocabularies, USAM)
- For more information see www.GLIF.org

Architecture for software tools

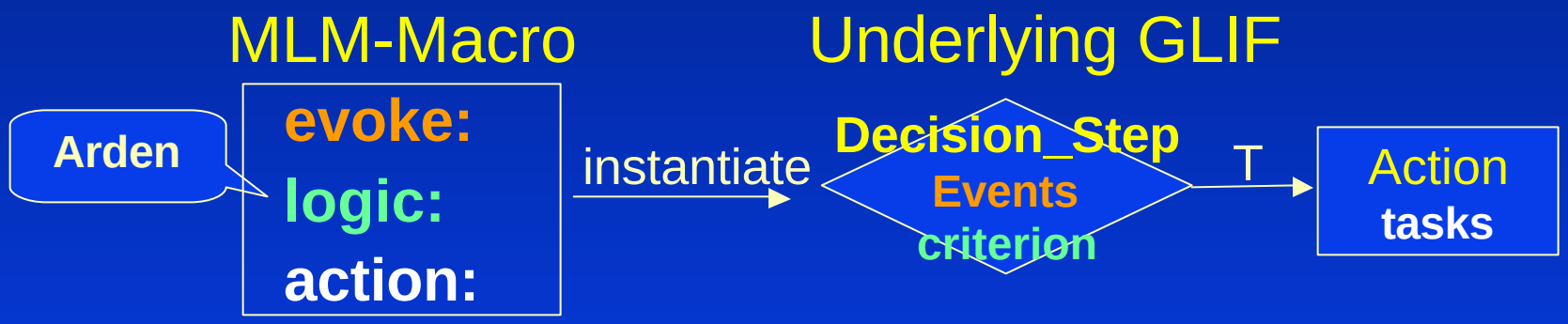


GLIF: a proposed basis for a shared representation

- GLIF addresses authoring & dissemination
- InterMed's major focus now is on:
  - mapping to clinical information systems
  - tools to facilitate validation and execution
- Under the HL7 GLIF SIG:
  - collaborative refinement and extension to support the needs of the guideline life cycle
  - reconciliation of functional requirements of different models and identification of those most important for supporting implementation

Macro Step

- Subclasses of action and decision steps
- Declaratively specify a procedural pattern



- Benefits for authoring, visual understanding, and execution of guidelines