## An Introduction to GLIF

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## 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

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## 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

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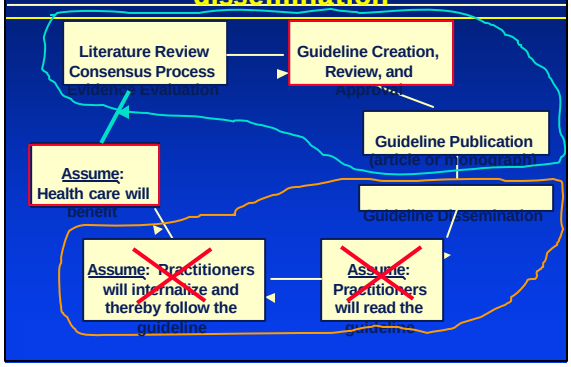
## Benefits: development & dissemination



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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

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## 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

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## Obstacles to sharing

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

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## 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

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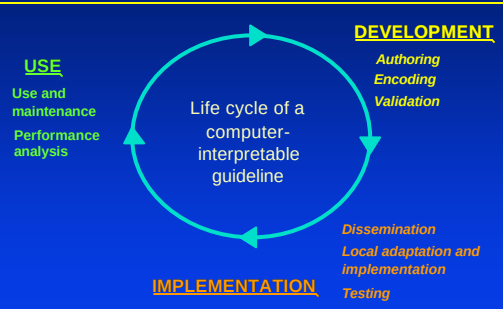
## Life cycle of a computer-interpretable guideline

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## Development requirements

- Expressiveness
- Comprehensibility

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## 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

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## Compressibility

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

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## Implementation Requirements

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

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## 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

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## 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

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## 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)

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## 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)

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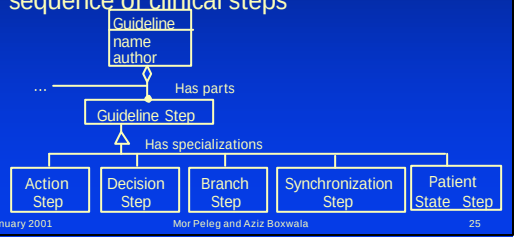
## GLIF model

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

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## 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

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## 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

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## 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

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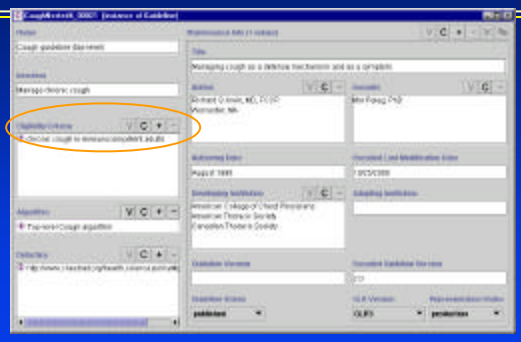
## GLIF example: Guideline



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## Eligibility Criteria

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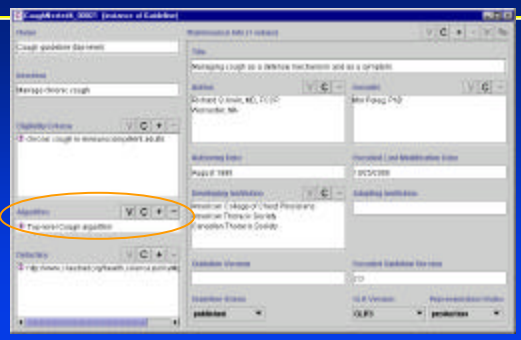
## GLIF example: Guideline



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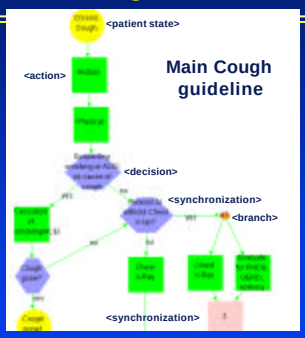
## Algorithm

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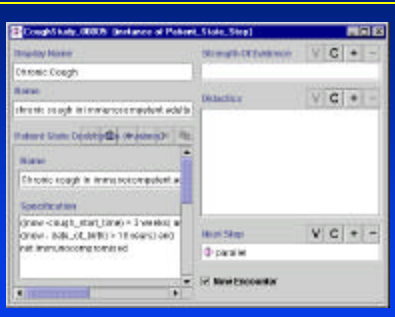
## Patient state step



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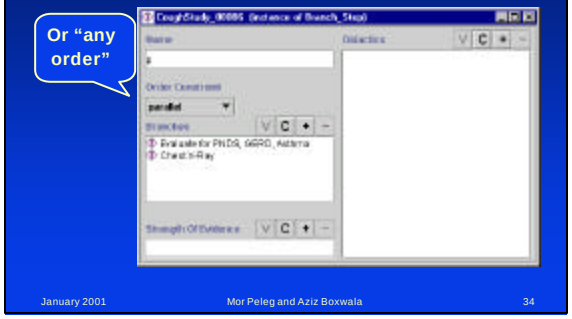
## Branch Step

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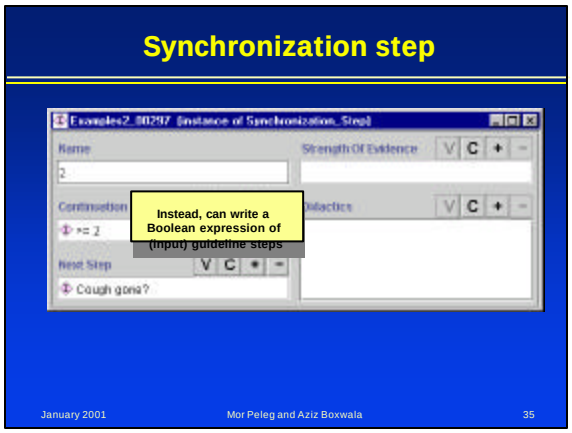
## Synchronization step

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## Action step

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## 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)

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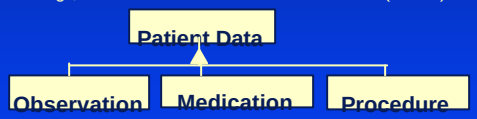
## Medically-oriented tasks

- 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)

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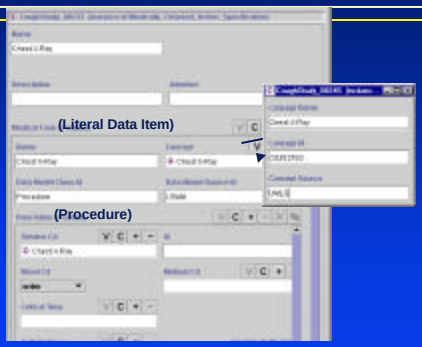
## A medically-oriented task

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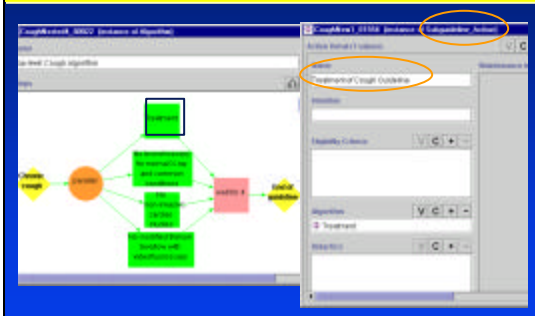
## Calling Sub-guidelines: Nesting



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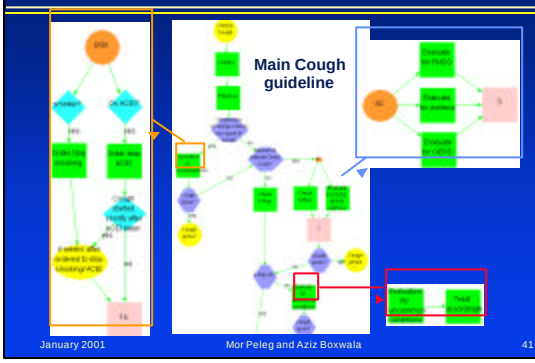
## Nesting (comprehensibility)

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## Get data task

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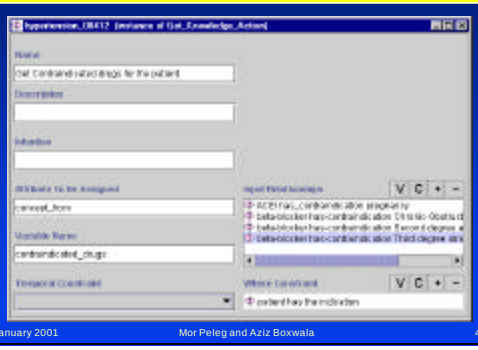
## Get knowledge task



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## 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

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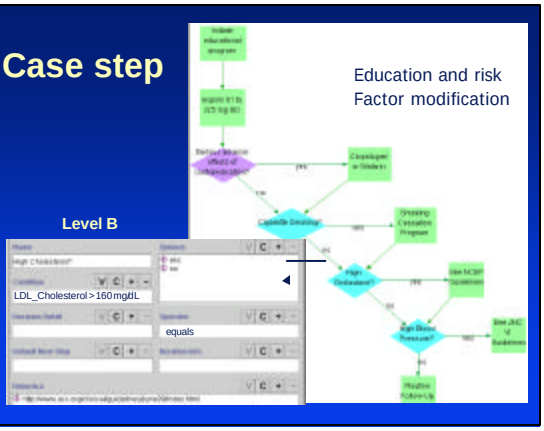
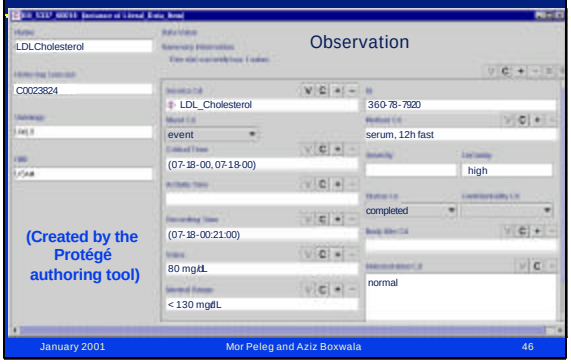
## Case step



## Specifying patient data

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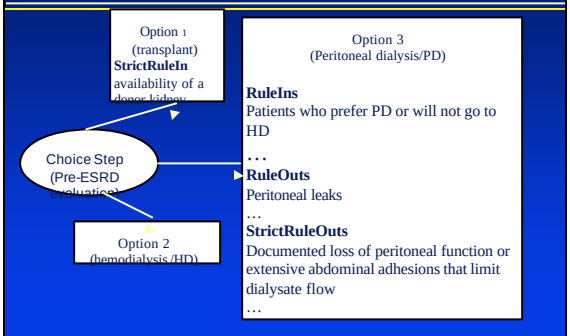
## Choice Step

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## 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

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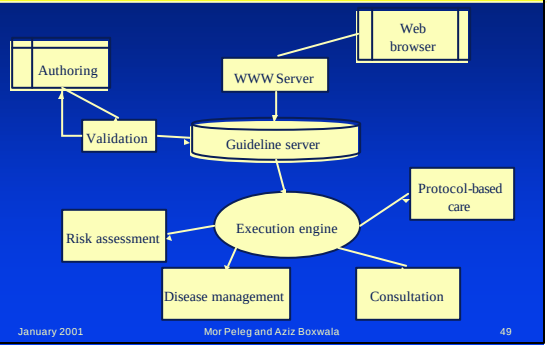
## Architecture for software tools






## 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