

Workbench and Wizard: Making Protégé Usable as a Workbench for Encoding Clinical Practice Guidelines



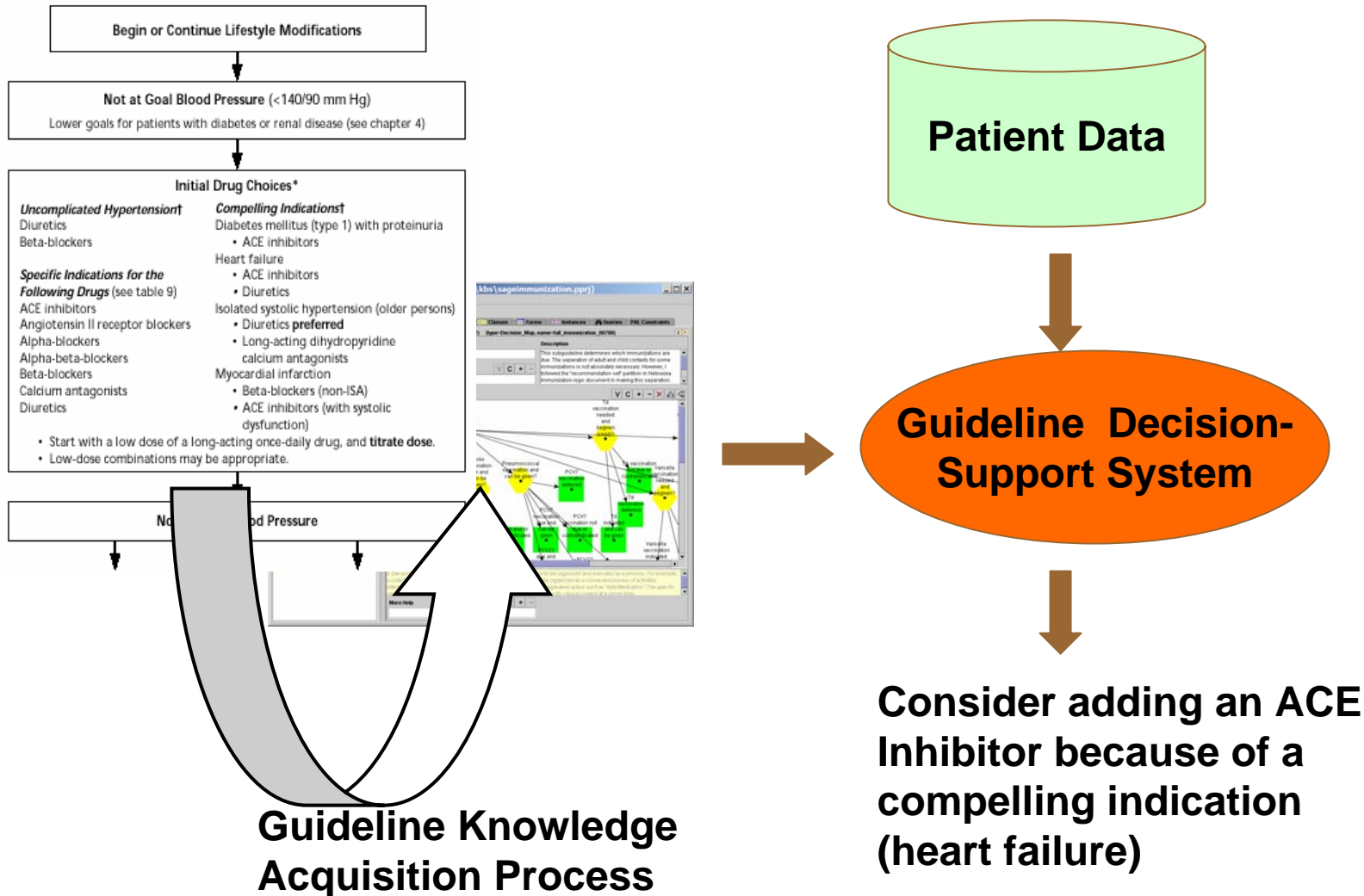
Samson Tu, Ravi Shankar, Mark Musen
Stanford Medical Informatics
(And SAGE Project partners: IDX, Nebraska, Mayo,
Apelon, IHC)

Overview



- Clinical practice guidelines (CPG) and their use in clinical decision support
- Enhancement to Protégé-2000 for encoding CPGs
 - ◆ A knowledge-acquisition wizard
 - ◆ A terminology plug-in
 - ◆ Validation plug-ins
- Outstanding issues
- Protégé wish list

Decision Support For Guideline Based Care

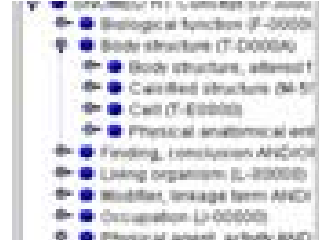


Guideline Knowledge-Acquisition Process

Guideline Model



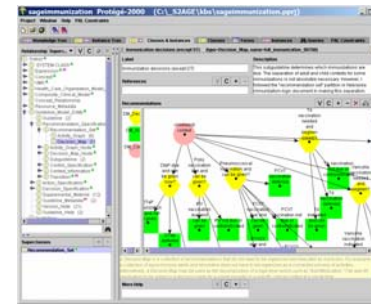
External Resources (Terminology)



Source Documents



Access Model and Resources



Conceptualization



Validation



Protégé-2000 As a Guideline KA Workbench



- Automatic generation of model-specific user-interface forms allows rapid prototyping
- No guidance for conceptualization and encoding of CPG in KBs
 - ◆ Create 'wizards' to support KA tasks
- Protégé-2000 is component-based and has an extensible architecture
 - ◆ Access to external terminology through slot plug-in
 - ◆ Validation through special tab plug-ins

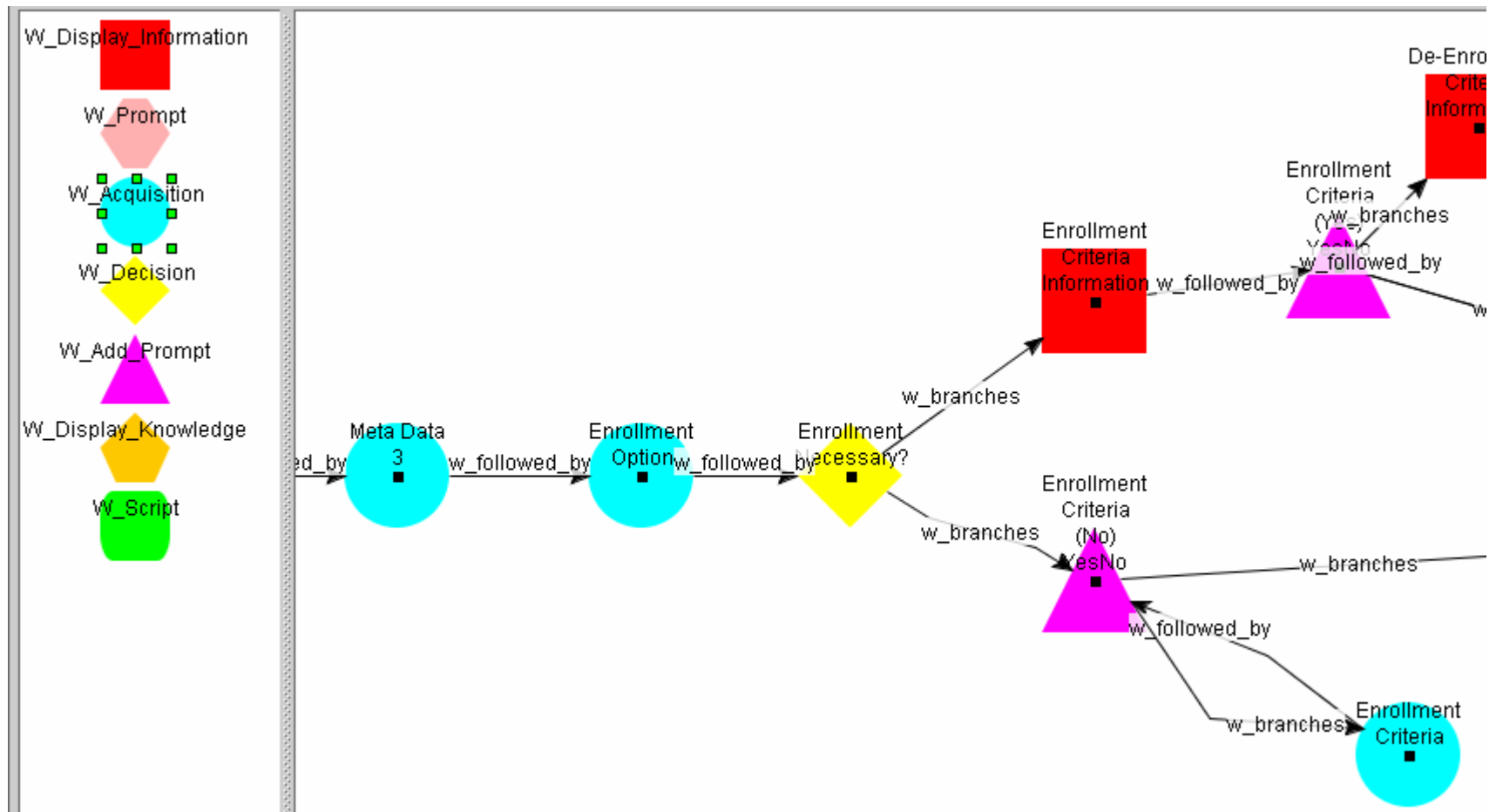
Overview



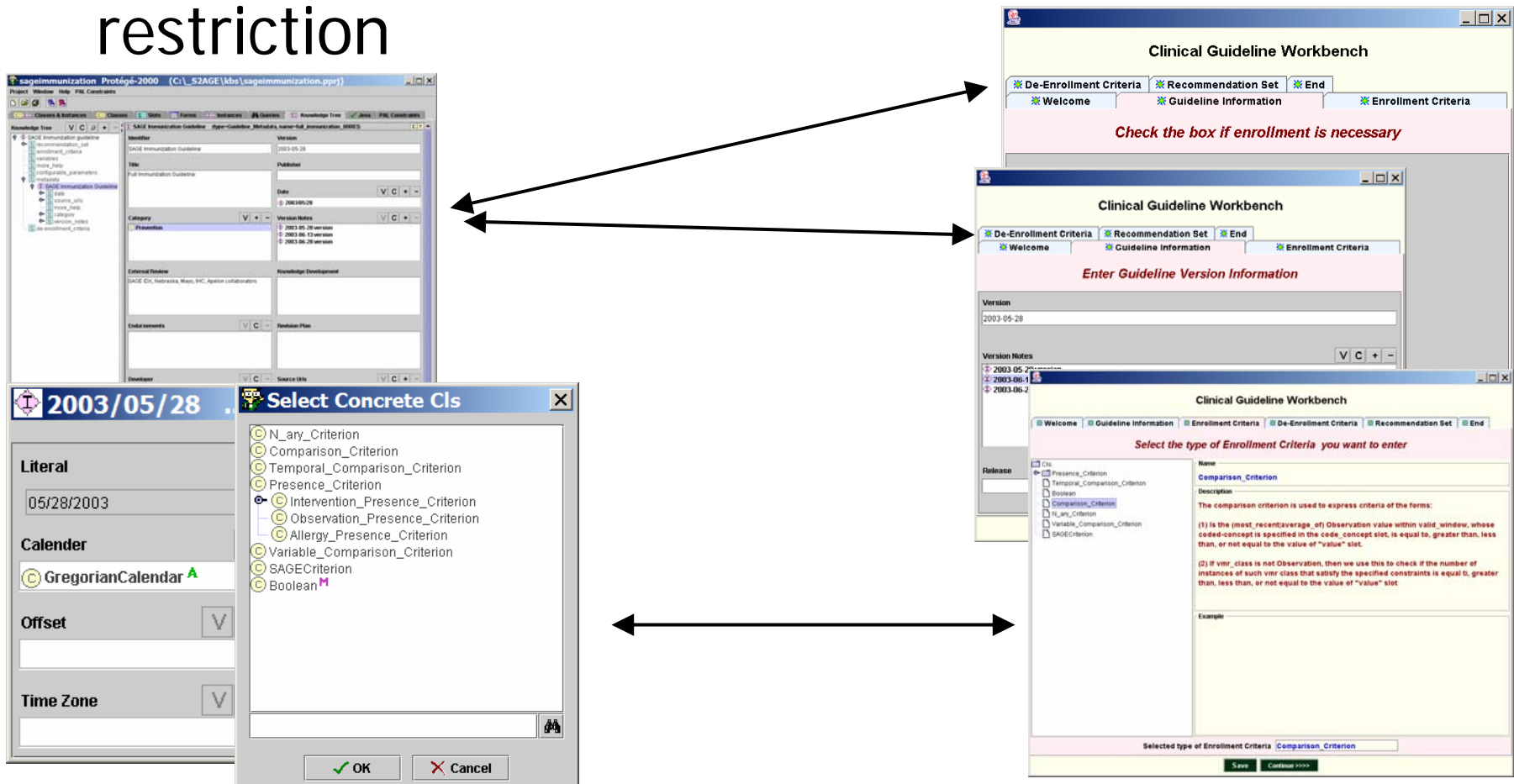
- Clinical practice guidelines (CPG) and their use in clinical decision support
- ➔ Enhancement to Protégé-2000 for encoding CPGs
 - ◆ A knowledge-acquisition wizard
 - ◆ A terminology plug-in
 - ◆ Validation plug-ins
- Outstanding issues
- Protégé wish list

KA Wizard (1): Explicit Modeling of Guideline KA Process

- Scripts define sequence of KA tasks



■ Work around Protégé's 1-class/1-form restriction



KA Wizard (3): Guiding a User through KA Tasks

- Based on specification of KA tasks and mapping of forms, the wizard presents a sequence of KA forms

The screenshot shows a window titled "Clinical Guideline Workbench" with a series of tabs: Welcome, Guideline Information, Enrollment Criteria, De-Enrollment Criteria, Recommendation Set, and End. The "Enrollment Criteria" tab is active. Below the tabs, a pink banner reads "Select the type of Enrollment Criteria you want to enter". On the left, a tree view shows a hierarchy: CIs, Presence_Criterion, Temporal_Comparison_Criterion, Boolean, Comparison_Criterion (highlighted), N_ary_Criterion, Variable_Comparison_Criterion, and SAGECriterion. On the right, the "Name" field contains "Comparison_Criterion" and the "Description" field contains two paragraphs of text. At the bottom, a pink bar shows "Selected type of Enrollment Criteria" with "Comparison_Criterion" in a text box. Below this are "Save" and "Continue >>>" buttons.

Clinical Guideline Workbench

Welcome Guideline Information Enrollment Criteria De-Enrollment Criteria Recommendation Set End

Select the type of Enrollment Criteria you want to enter

CIs

- Presence_Criterion
 - Temporal_Comparison_Criterion
 - Boolean
 - Comparison_Criterion
 - N_ary_Criterion
 - Variable_Comparison_Criterion
 - SAGECriterion

Name

Comparison_Criterion

Description

The comparison criterion is used to express criteria of the forms:

(1) Is the (most_recent|average_of) Observation value within valid_window, whose coded-concept is specified in the code_concept slot, is equal to, greater than, less than, or not equal to the value of "value" slot.

(2) If vmr_class is not Observation, then we use this to check if the number of instances of such vmr class that satisfy the specified constraints is equal to, greater than, less than, or not equal to the value of "value" slot

Selected type of Enrollment Criteria Comparison_Criterion

Save Continue >>>

- Top-down interview (TurboTax metaphor)
- Task-oriented "recipe" of how-to ("Office paper-clip" metaphor)

Accessing External Resources: Terminology Plug-In

- A concept is represented as a terminological class
- A plug-in allows search and selection of terms from an external terminology server (developed by Apelon colleagues)
 - ◆ Invoked everywhere that a controlled term is needed
 - ◆ "Cache" references to controlled terms in Protégé to support browsing in absence of terminology server

The screenshot shows the 'Apelon DTS Concept View' window. On the left, a 'Vmr Class' is set to 'Procedure' and a 'Code' is 'Splernectomy'. A red arrow points from the 'Code' field to the 'Concept Roles' table. The 'Concept Roles' table has two columns: 'Name' and 'Value'. Below it, the 'Concept Properties' table lists various attributes for the concept 'PROCEDURES'.

Name	Value
CUI	C0184661
ICDcode	NOCODE
Version	Sample DB 1
preferredName	PROCEDUR

Below the 'Concept Properties' table is a 'Select' button. To the right of the 'Concept Roles' table is a list of procedures under the heading 'PROCEDURES'. The list includes:

- MISCELLANEOUS DIAGNOSTIC AND THERAPEUTIC PROCEDURES
- OBSTETRICAL PROCEDURES
- OPERATIONS ON THE CARDIOVASCULAR SYSTEM
- OPERATIONS ON THE DIGESTIVE SYSTEM
- OPERATIONS ON THE EAR
- OPERATIONS ON THE ENDOCRINE SYSTEM
- OPERATIONS ON THE EYE
- OPERATIONS ON THE FEMALE GENITAL ORGANS
- OPERATIONS ON THE HEMIC AND LYMPHATIC SYSTEM
- OPERATIONS ON THE INTEGUMENTARY SYSTEM

Validation of Guideline KB



■ Integrity constraints

◆ Local constraints

- constraints on slot values (e.g. type, cardinality)
- shown with red border in Protégé GUI

◆ Global constraints

- constraints that span across multiple slots, instances, or classes
- encoded in Protégé's PAL constraint language

■ Other types of validation (not done yet)

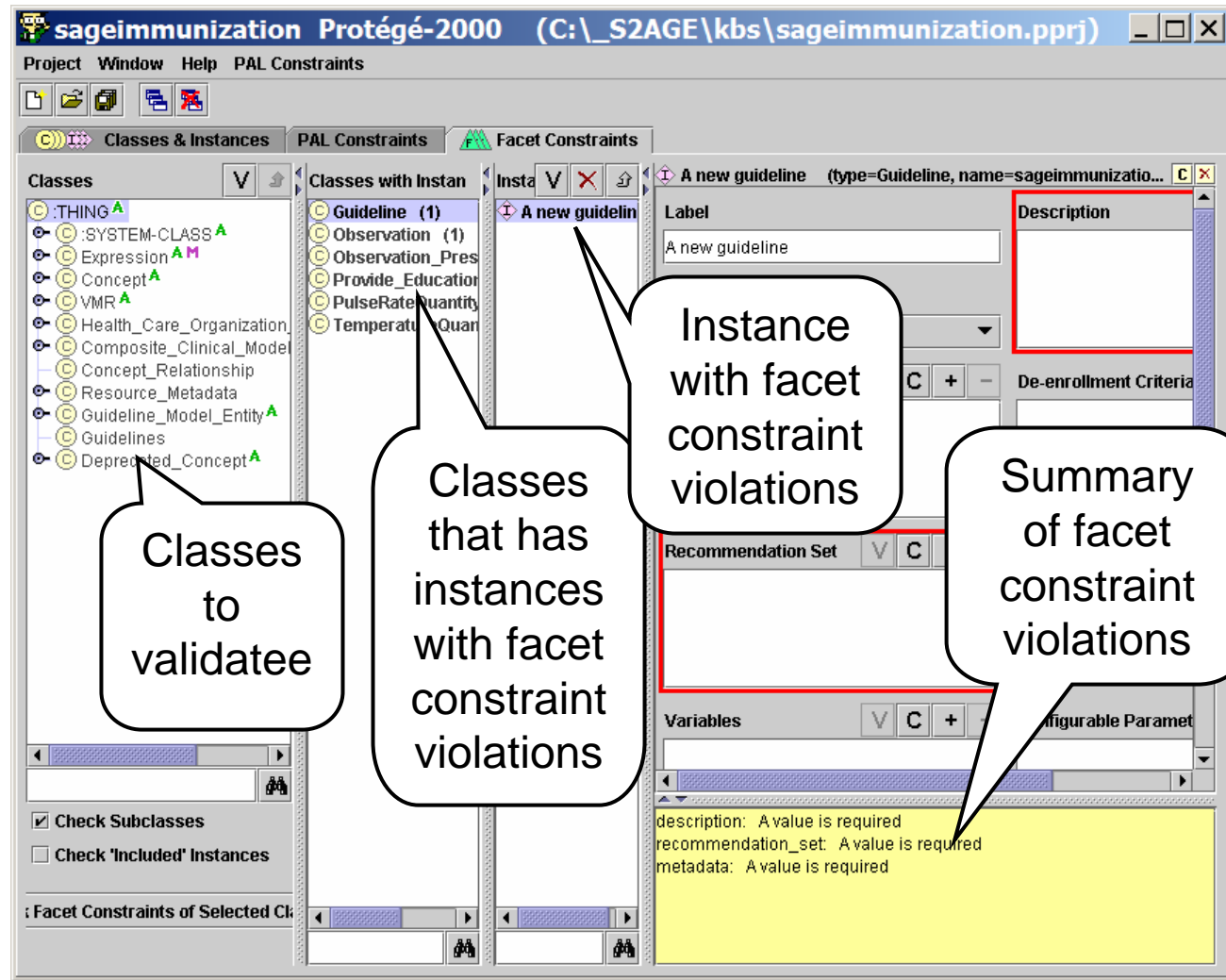
◆ Safety rules

◆ Conformance to guideline intentions

◆ Correctness of subsumption relationships

Local Constraints: Validation Through Facet-Constraint Tab

- Tab that allows checking of select classes for instances with facet constraint violations



Global Constraints: Validation Using PAL Constraints

sageimmunization Protégé-2000 (C:_S2AGE\kbs\sageimmunization)

Project Window Help PAL Constraints

Classes & Instances Forms PAL Constraints Facet Constraints

Choose Constraints

Evaluate ?	Status	Constraint
<input checked="" type="checkbox"/>		all slots are bound to some class
<input checked="" type="checkbox"/>		if an action is repeating, then its subguideline, if there is any, has synchron...
<input checked="" type="checkbox"/>		compound action condition constraint
<input checked="" type="checkbox"/>		all variables must either have a derivation expression, a prompt, or an a...
<input checked="" type="checkbox"/>		an n-ary criterion must have boolean connective and criteria
<input checked="" type="checkbox"/>		can negate only one criterion
<input checked="" type="checkbox"/>		code constraint on pulse rate
<input checked="" type="checkbox"/>		either subguideline or action_spec has a start
<input checked="" type="checkbox"/>		value constraint on pulse rate
<input checked="" type="checkbox"/>		An activity graph that's a subguideline should have a start
<input checked="" type="checkbox"/>		A context that does not have an incoming edge
<input checked="" type="checkbox"/>		all instances should be the same
<input checked="" type="checkbox"/>		code is either "Immunization constraint" or "Finding of Rubella status value is either"
<input checked="" type="checkbox"/>		finding of Rubella status value is either

Warn about Indicated constraints Evaluate

Attachments for selected constraint

Activity_Graph

An activity graph that's a subguideline sho...

Name: graph that's a subguideline should have a start

Range: (defrange ?subguideline :FRAME Subguideline)

Statement:

```
(forall ?activityGraph (= > (exists ?subguideline
(subrecommendations ?subguideline ?activityGraph))
(own-slot-not-null start ?activityGraph))
)
```

Overview



- Clinical practice guidelines (CPG) and their use in clinical decision support
- Enhancement to Protégé-2000 for developing CPG knowledge bases
 - ◆ A knowledge-acquisition wizard
 - ◆ A terminology plug-in
 - ◆ Validation plug-ins
- ➡ Outstanding issues
- Protégé wish list

Problems in Use of Wizards



- Mapping and synchronization of guideline instances and wizard instances
 - ◆ Wizard creates and display wizard-specific forms and instances for mapped instances in guideline KB
 - ◆ Easy to partition a guideline instance into multiple wizard instances, difficult to aggregate multiple guideline instances
- Management and automation of domain-specific and book-keeping actions
- Specification of meaningful knowledge-acquisition subtasks

Problems in Use of Terminology



- Constraints on allowed terms
- Concepts used in guidelines are not always available as terms in existing terminology
 - ◆ Primitive terms
 - e.g. haemophilus influenza type b conjugate vaccine
 - ◆ Compositional terms
 - e.g. {Progressive neurological finding isa 'Neurological finding' Associated course 'Progressive'}
 - e.g. {Respiratory problems excluding asthma}

Problems in Use of Constraints



- Insufficient facet constraints
 - ◆ e.g. allowed values for Instance type
- Difficulty in extending PAL
 - ◆ Not easy to add new predicates to PAL
- Weak constraint checking during editing process
 - ◆ Facet constraints insufficient to specify allowed slot values
 - ◆ PAL constraints not used for selecting slot values

Wish List



- Standardized terminology and information models
 - ◆ Express constraints on legal codes
 - ◆ Facilitate definition of new codes
- A plug-in architecture for developing and using 'wizards' to perform specific tasks
- A plug-in architecture for defining and using alternative constraints in selecting and setting slot values
 - ◆ A variety of constraint types
 - ◆ A standardized way to invoke alternative constraint engines for checking legal slot values

SAGE: “A word from our sponsor . . .”



- The National Institute of Standards and Technology (NIST), an arm of the U.S. Department of Commerce, funds “high risk” research through its Advanced Technology Program (ATP).
- The mission of the NIST/ATP program is *“To accelerate the development of innovative technologies for broad national benefit through partnerships with the private sector”*.
- NIST/ATP projects must entail research that ‘leads to significant national benefits.’

CPG and Their Use in Clinical Decision Support



■ Clinical practice guidelines

- ◆ Statements to assist practitioner and patient in making decisions about appropriate health care in specific circumstances
- ◆ Traditionally published as monographs or journal papers

■ Methods to change physician behavior

- ◆ Traditional diffusion model
 - Expects clinicians will change behavior on receipt of information
- ◆ Specific strategies rather than passive dissemination
 - opinion leaders
 - performance feedback
 - computer-based decision-support at point of care

Decision Support For Guideline Based Care

