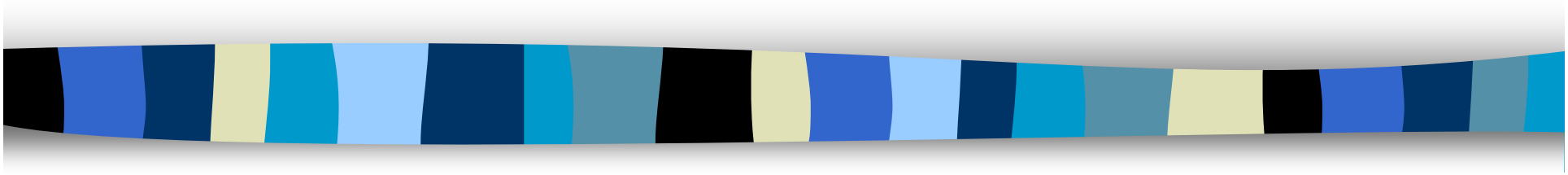
Interpretative framework of chronic disease management to guide textual guideline GEM-encoding



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Outline

- Background
  - Clinical Practice Guidelines
  - Decision support systems
- Material
  - Canadian Recommendations
  - Guideline Elements Model
- Method
  - Steps of GEM-encoding
  - Interpretative framework
- Conclusion

Background

- Clinical Practice Guidelines (CPGs)
  - Evidence-based therapeutic recommendations
  - Textual documents
  - Simple dissemination of texts (paper-based or numerized)

    → No impact on physician compliance with guidelines

- Decision support systems (DSSs)
  - Improvement of compliance

    → Translation of texts to build formalized knowledge bases

Canadian CPGs for the management of hypertension

VII Diabetes

Recommendations

1. Hypertension in people with diabetes (blood pressure greater than 140 / 90 mm Hg) should be treated to obtain target blood pressure lower than 130 / 80 mm Hg (grade C).
2. People with diabetes and hypertension with blood pressure of 130 / 80 to 139 / 89 mm Hg and target-organ damage should be treated to obtain a target blood pressure lower than 130 / 80 mm Hg (grade D).
3. For patients with diabetes who have hypertension without overt nephropathy and are under 60 years of age, preferred therapy is either an ACE inhibitor or a cardioselective β-adrenergic antagonist (grade A).
4. Second-line therapy includes low-dose thiazide diuretics (grade B), long-acting calcium-channel blockers (grade B) and α-adrenergic antagonists (grade C). α-adrenergic antagonists and centrally acting antihypertensive antihypertensive agents should be used with caution in the presence of autonomic neuropathy (grade C).
5. Preferred therapy for patients with diabetes, hypertension and overt nephropathy (albuminuria greater than 300 mg / day) is an ACE inhibitor (grade A).
6. When an ACE inhibitor causes adverse effects, an angiotensin II receptor antagonist may be substituted (grade D).

- Chapters correspond to specific clinical situations
- Sequence of therapeutic recommendations

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- Incompleteness of clinical situations
  - Pathologies associated to hypertension (HT) are considered one by one

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- Incompleteness of clinical situations
- Imprecision of terms
  - not defined

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- Incompleteness of clinical situations
- Imprecision of terms
  - not defined
  - imprecise or vague

Canadian CPGs for the management of hypertension

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- Incompleteness of clinical situations
- Imprecision of terms
- Ambiguity of therapeutic recommendations sequence
  - Preferred therapy

➡ starting treatment ?

Canadian CPGs for the management of hypertension

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- Incompleteness of clinical situations
- Imprecision of terms
- Ambiguity of therapeutic recommendations sequence
  - Initial therapy
  - Second-line therapy

Canadian CPGs for the management of hypertension

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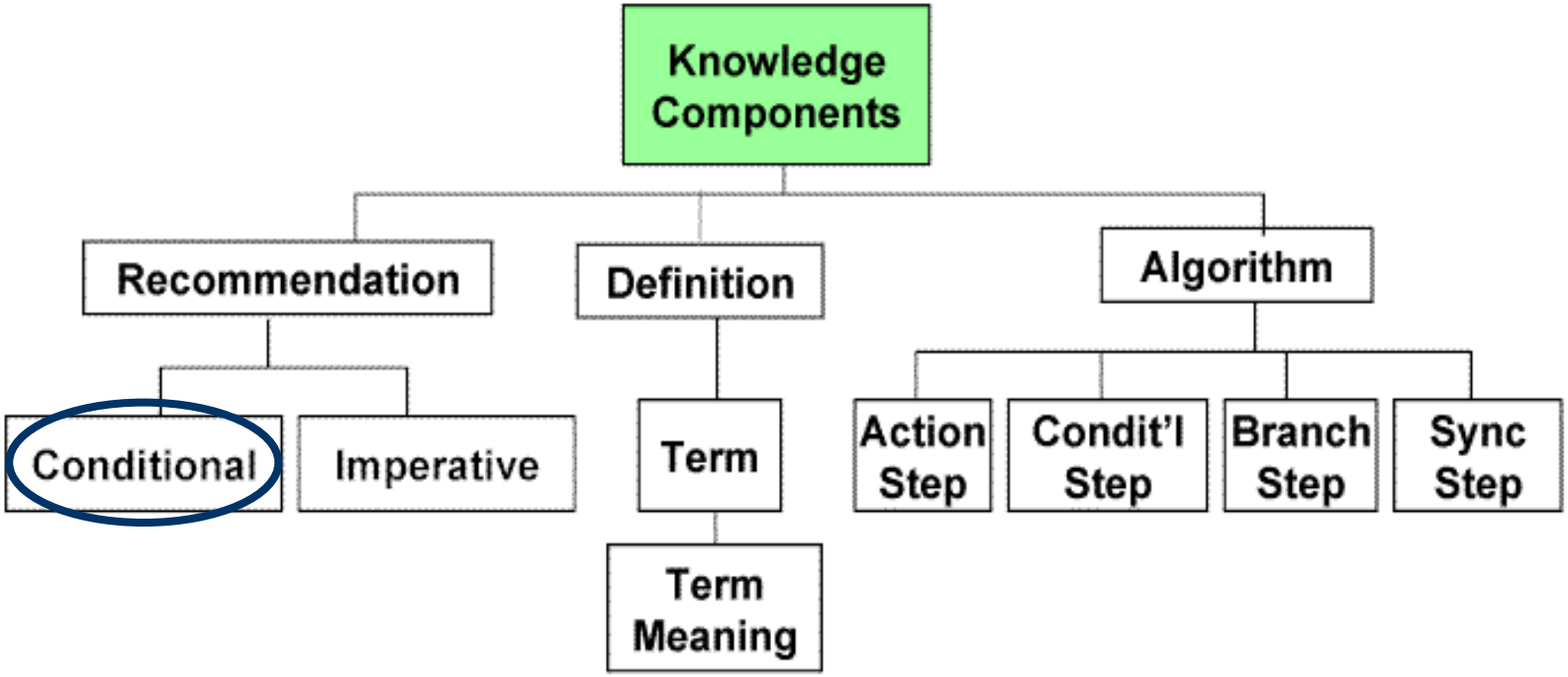
- Incompleteness of clinical situations
- Imprecision of terms
- Ambiguity of therapeutic recommendations sequence
  - Initial therapy
  - Second-line therapy

What is the place of these therapies in the sequence?

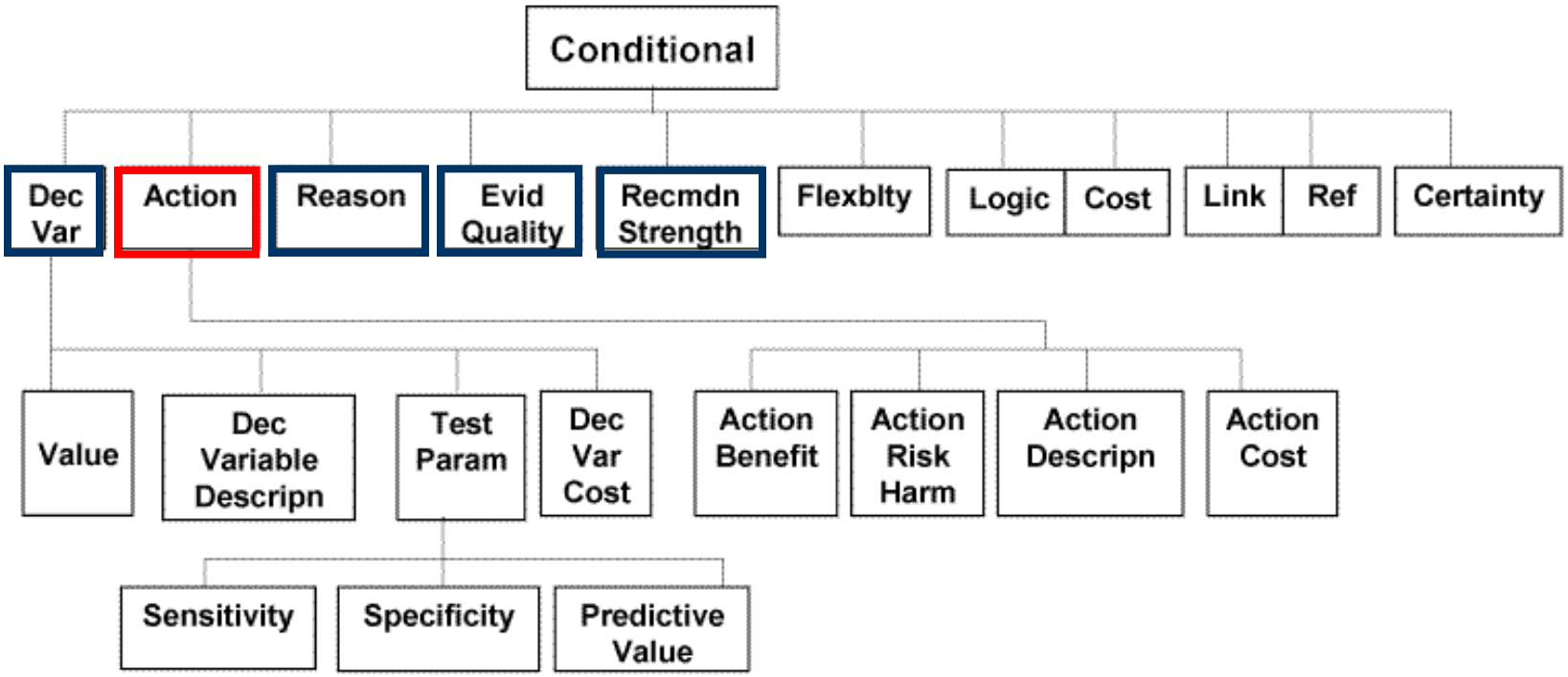
The document model GEM

- *Guideline Elements Model*
  - Guideline document model of CPGs
  - Define structure of basic units of information (XML model)
  - Multi-level hierarchy of more than 100 elements

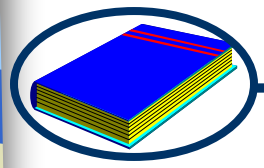


The document model GEM

- Representation of guidelines



Automated generation of a set of decision rules from a GEM-encoded CPG



Canadian CPGs

$S = \{L_1, L_2, \ldots\}$
$L_i = \{INT_{1_1}, INT_{1_2}, \ldots\}$

Interpretative framework

<?xml version="1.0"?>
<!DOCTYPE guideline.document SYSTEM "GEM_DTD.dtd">

GEM DTD

<?xml version="1.0"?>
<!DOCTYPE ext_guideline.document SYSTEM "EXT_GEM_DTD.dtd">

Extended GEM DTD

Normalized GEM-encoded instance

Automated derivation

R_i : IF … THEN … WITH
…
R_i : IF … THEN … WITH

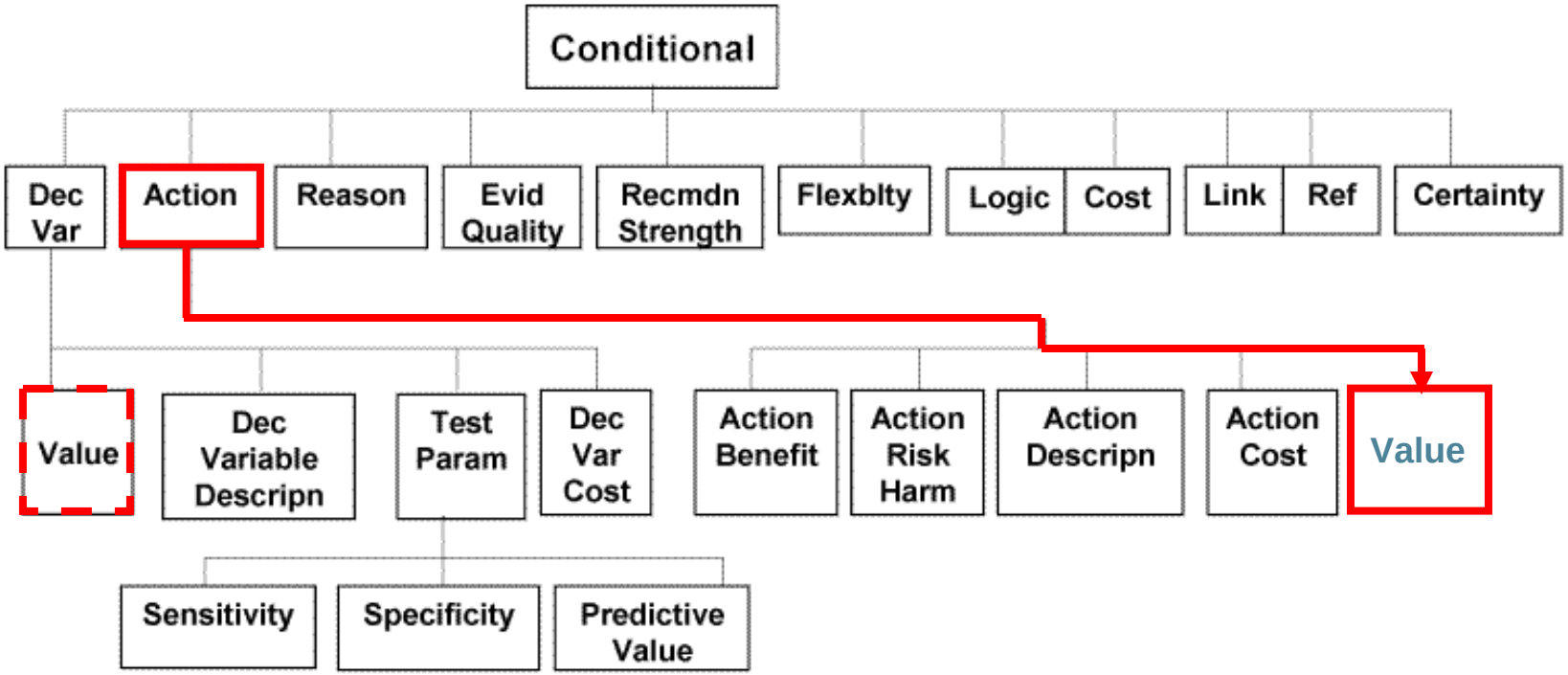
Rule base

Inference engine

Patient-specific therapeutic recommendations

Patient's state

Extension of GEM DTD



Creation of the GEM-encoded instance (1) : marking-up of the Canadian CPGs

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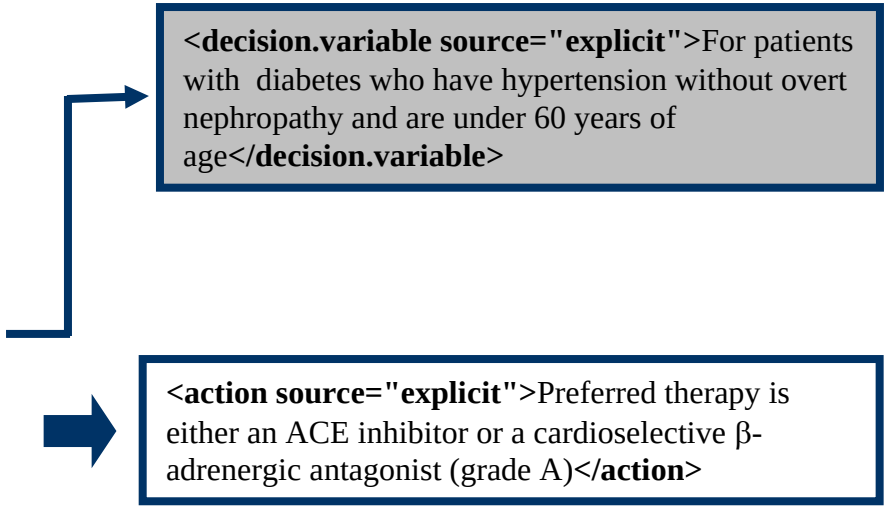


Creation of the normalized GEM-encoded instance (2) : normalization of decision variables

- Characterization of patient's state

<decision.variable source="explicit">For patients with diabetes who have hypertension without overt nephropathy and are under 60 years of age **</decision.variable>**

<decision.variable source="explicit"
decision.variable.id="state_patient.age"> under 60 years of age
<value source="implicit" id="INF_60"/> **</decision.variable>**

<decision.variable source="explicit"
decision.variable.id="state_patient.pathology"> hypertension
<value source="implicit" id="HT"/> **</decision.variable>**

<decision.variable source="explicit"
decision.variable.id="state_patient.pathology"> diabetes
<value source="implicit" id="DIA"/> **</decision.variable>**

<decision.variable source="explicit"
decision.variable.id="state_patient.normality"> without overt nephropathy
<value source="implicit" id="N_NEPH"/>
</decision.variable>

<action source="explicit"> Preferred therapy is either an ACE inhibitor or a cardioselective β-adrenergic antagonist (grade A) **</action>**

<action source="explicit"> Preferred therapy is either an ACE inhibitor or a cardioselective β-adrenergic antagonist (grade A)**</action>**

Interpretative framework of therapeutic lines and modeling of actions (1)

<action source="explicit"> Preferred therapy is either an ACE inhibitor or a cardioselective β-adrenergic antagonist (grade A)</action>

- Ambiguous terms
- Imprecise sequence

Interpretative framework

Lines of therapy

Levels of therapeutic intention

$$S = (L_1, L_2, \ldots, L_n)$$

$$\forall i,\ L_i = (INT_{i_1}, INT_{i_2}, \ldots, INT_{i_j})$$

<action source="explicit"> Preferred therapy is either an ACE inhibitor or a cardioselective β-adrenergic antagonist (grade A)</action>

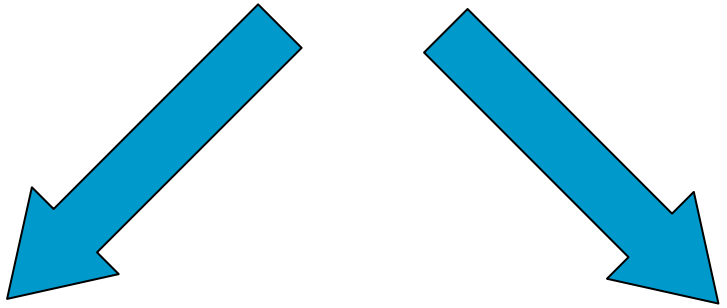
L = L1

INT = INT_1

= { ACE inhibitor OR cardioselective β-adrenergic antagonist }

Interpretative framework of therapeutic lines and modeling of actions (2)

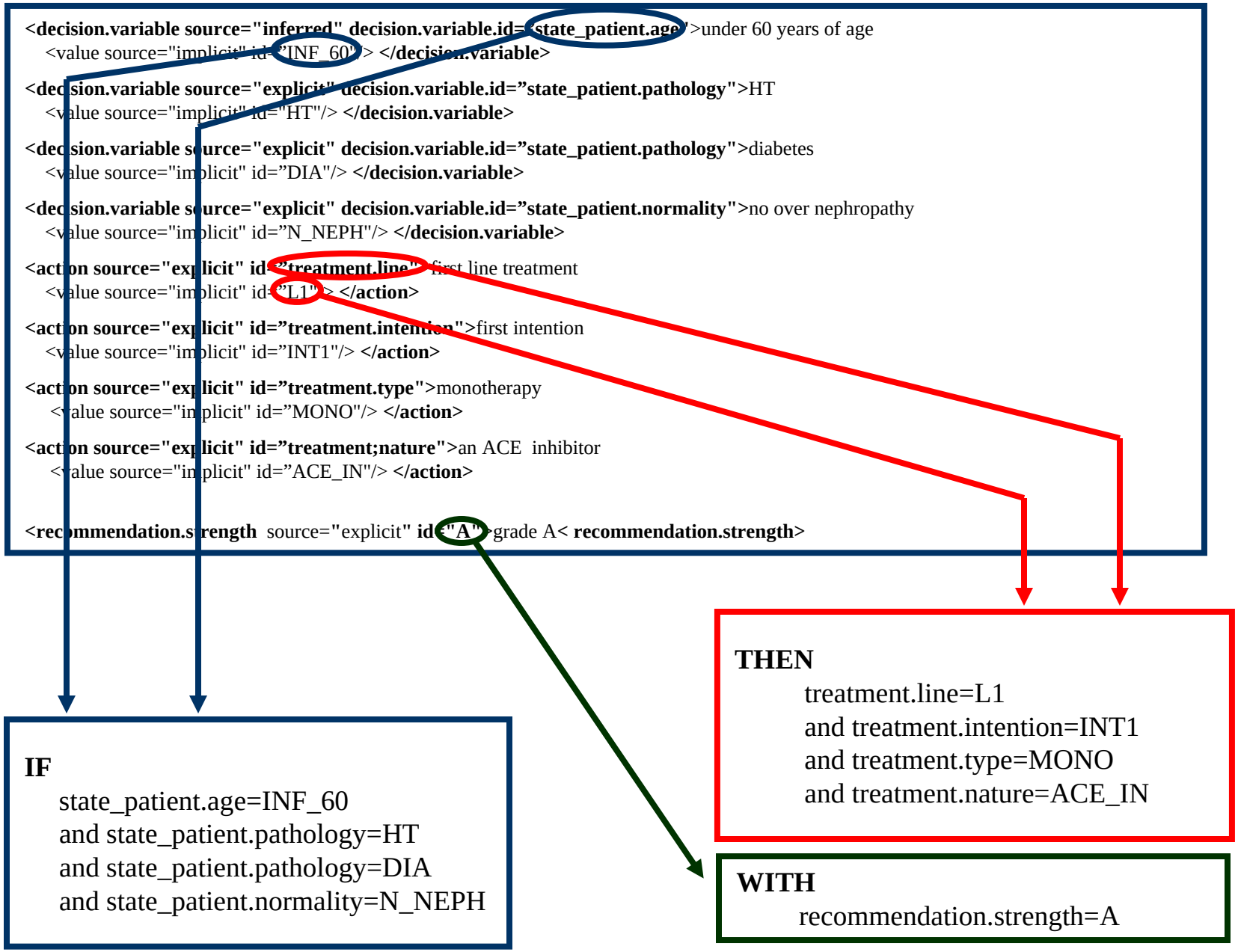
<action source="explicit"> Preferred therapy is either an ACE inhibitor or a cardioselective β-adrenergic antagonist (grade A)**</action>**



<action source="explicit"
action.id="treatment.line">first line treatment
<value source="implicit" value.id="L1"/>**</action>**
<action source="explicit"
action.id="treatment.intention">
first intention
<value source="implicit" value.id="INT1"/>**</action>**
<action source="explicit"
action.id="treatment.type"> monotherapy
<value source="implicit"
value.id="MONO"/>**</action>**
<action source="explicit"
action.id="treatment.nature">an ACE inhibitor
<value source="implicit"
value.id="ACE_IN"/>**</action>**

<action source="explicit"
action.id="treatment.line"> first line treatment
<value source="implicit" value.id="L1"/>**</action>**
<action source="explicit"
action.id="treatment.intention"> first intention
<value source="implicit"
value.id="INT1"/>**</action>**
<action source="explicit"
action.id="treatment.type"> monotherapy
<value source="implicit"
value.id="MONO"/>**</action>**
<action source="explicit"
action.id="treatment.nature">
cardioselective β-adrenergic antagonist
<value source="implicit"
value.id="CBA"/>**</action>**

Automated extraction of IF-THEN-WITH rules



Conclusion

- Automated process of a normalized GEM-encoded instance enables to generate decision rules

- Ambiguities of CPGs
  - GEM model to structure textual document
  - Interpretative framework

- Comparison of rule bases
  - Rule base manually built (ASTI project)

➡ Rules generated with GEM are more specific and richer