Making Standard Terminology Work In Clinical Guidelines

Robert McClure¹, James Campbell², Julie Glasgow³, Mark Nyman⁴

¹Apelon, Inc., Ridgefield, CT; ²University of Nebraska Medical Center, Omaha, NE; ³GE Healthcare Integrated IT Solutions, Seattle, WA; ⁴Mayo Clinic, Rochester, MN
Introductions

• Who are we?

• Who we think you are…
  – Training and experience:
    • Clinical understanding
    • Management of electronic information
  – Interest
    • Prepare to implement clinical guidelines
    • Understand how terminology standards are used in guidelines
Objectives

- Gain general understanding of CDSS and standard terminologies
- Understand use of standard terminologies in CDSS
- Learn to manage challenges that arise in mapping local concepts to a CDSS
Agenda

- Session Overview (McClure)
  - Intro
  - Guidelines overview
  - SAGE overview
  - Standard Terminologies
    - What and why important

- Guideline Abstraction (Glasgow)
  - SAGE process
  - Identifying concepts in the guideline

- Making terminology work locally (Nyman)
  - Mapping
  - Issues to grapple with

- Wrap-up – Questions (McClure)
What are Guidelines?

• Guideline(n): a cord or rope to aid passage over a difficult point (Merriam-Webster)

• Systematic statements of evidence-based policy rules or principles to assist clinicians and patients make decisions on healthcare alternatives

• Characteristics
  – May be developed by government agencies at any level, institutions, professional societies, governing boards, or by convening expert panels.
  – May be in narrative, outline, flowchart or tabular forms
  – Need to be formalized to provide computerized clinical decision support at point of care
Why Study Guidelines?

President’s Information Technology Advisory Committee (2001) “Transforming Health Care through Information Technology”

Findings…:
• The U.S. lacks a broadly disseminated and accepted national vision for information technology in health care
• The introduction of integrated decision-support systems that can proactively foster best practices and reduce errors requires enhanced information-technology methods and tools

Recommendations…:
• Expand the range and granularity of routinely captured data
• Standardize terminology
• Develop guidelines based on evidences and best practices
• Implement guidelines so that they are usable effectively at the point of care, including embedded decision support that is continually updated as new evidence accumulates
SAGE Project Overview

- Collaborative research and development project to develop a standards-based technology to enable encoding and dissemination of guidelines in executable format.
- Infrastructure will employ informatics standards including Protégé open source workbench, HL7 RIM, SNOMED CT and LOINC, and deployment technology to support encoding and dissemination of guidelines across vendor platforms and throughout the spectrum of care.
- Guideline deployment technology will present guideline content to clinicians through active, patient-specific recommendations surfaced through functions of the local clinical information system, and integrated into the care workflow.

SAGE is partially supported under a grant from the U.S. Department of Commerce, National Institute of Standards and Technology, Advanced Technology Program, Cooperative Agreement Number 70NANB1H3049.
Why Terminology Standards

• Interoperability
  – Common representation of meaning
    • Robust terminology model
  – Common coding
  – Interlingua
    • Translate once
  – Shared framework for collaborative improvement of the terminology

• Decision support needs all of this
Selected NCVHS Terminology Standards

- SNOMED CT
  - CAP, soon International SDO
- LOINC
  - Regenstrief Institute
- ICD-9-CM
  - WHO/NCHS
- CPT
  - AMA
- NDC, RxNorm, NDF-RT, …
SNOMED CT®

- Under development by the College of American Pathologists since the 1960’s
- Provides a disambiguated, polyhierarchical representation of over 450,000 medical concepts, with approximately 1 million descriptions
- Under licensing agreement with the NLM
- Crossmaps to other commonly-used terminologies are built in
- Presently the most complete formal medical ontology in existence
Why do we need SNOMED CT?

• Synonyms & homonyms
  – By assigning a unique numeric code to each medical concept, SNOMED CT formalizes clinical terminology.

• Subsumption
  – By representing the complete set of relationships among medical concepts, SNOMED CT automates classification logic.

• Expressiveness
  – By defining rules for combining concepts into “expressions”, many clinical ideas can be encoded.
SNOMED CT Structure

Concepts

Terms

Relationships
SNOMED CT Structure

Concepts

Terms

Relationships
SNOMED CT Structure

- Concepts
- Terms
- Relationships
SNOMED CT Structure

- Concepts
- Terms
- Relationships

4855003
SNOMED CT Structure

- Concepts
- Terms

Relationships

4855003
SNOMED CT Structure

Relationships

Concepts

4855003

Terms

Diabetic retinopathy
SNOMED CT Structure

- Concepts
  - 29555009
- Terms
  - Diabetic retinopathy
- Relationships
  - 4855003
SNOMED CT Structure

- **Concepts**
  - 29555009

- **Terms**
  - Diabetic retinopathy

**Relationships**

- 4855003
SNOMED CT Structure

- Concepts
  - 29555009 Retinal disorder

- Terms
  - 4855003 Diabetic retinopathy

Relationships
SNOMED CT Structure

- Concepts
  - 29555009 Retinal disorder

- Terms
  - Diabetic retinopathy

- Relationships
  - Is-A
  - 4855003

SNOMED CT Structure

- **Concepts**
  - 29555009: Retinal disorder
  - 4855003: Diabetic retinopathy

- **Is-A** relationship:
  - 29555009 is a subset of 4855003.

- **Relationships**
SNOMED CT Structure

- **Concepts**
  - 29555009: Retinal disorder
  - 4855003: Diabetic retinopathy

- **Terms**
  - Retinal disorder
  - Diabetic retinopathy

- **Relationships**
  - Is-A

---

AHIMA Denver 06

SNOMED CT Structure

- **Concepts**
  - 29555009: Retinal disorder
  - 4855003: Diabetic retinopathy

- **Terms**
  - Retinal disorder
  - Diabetic retinopathy

- **Relationships**
  - Is-A
SNOMED CT Structure

- **Concepts**
  - 29555009
    - Is-A Retinal disorder
  - 4855003
    - Due-to Diabetic retinopathy

**Relationships**

**Terms**

Diabetic retinopathy

Retinal disorder
SNOMED CT Structure

Concepts

29555009
Retinal disorder

4855003
Diabetic retinopathy

Terms

Relationships

Is-A

Due-to
SNOMED CT Structure

**Concepts**

- 29555009 Retinal disorder
- 4855003 Diabetic retinopathy

**Terms**

- 73211009

**Relationships**

- Is-A
- Due-to
SNOMED CT Structure

- Concepts:
  - 29555009: Diabetic retinopathy
  - 4855003: Retinal disorder

- Terms:
  - 73211009: Diabetic retinopathy

Relationships:
- Is-A:
  - 29555009: Diabetic retinopathy
  - 73211009: Diabetic retinopathy
- Due-to:
  - 4855003: Retinal disorder
SNOMED CT Structure

Concepts

29555009
Retinal disorder

4855003
Diabetic retinopathy

73211009
Diabetes mellitus

Relationships

Is-A

Due-to
SNOMED CT Structure

Concepts

29555009
Retinal disorder

4855003
Diabetic retinopathy

73211009
Diabetes mellitus

Terms

Is-A

Due-to

Relationships
The Inheritance Hierarchy

Concepts are arranged in a tree hierarchy

- Medication
  - Antibiotic
    - Penicillin
      - Ampicillin
    - Quinolone
      - Methicillin
  - Anti-HTN
    - Beta-blocker
      - Atenolol
    - Diuretic
      - Betaxolol
      - Metoprolol
The Inheritance Hierarchy

Concepts are arranged in a tree hierarchy

- **Medication**
  - **Antibiotic**
    - Penicillin
    - Quinolone
  - **Anti-HTN**
    - Beta-blocker
    - Diuretic
      - Atenolol
      - Betaxolol
      - Metoprolol
  - . . .

- **Ampicillin**
- **Methicillin**
The Inheritance Hierarchy

Concepts are arranged in a tree hierarchy
The Inheritance Hierarchy
Concepts are arranged in a tree hierarchy

Chemical Compounds:
- **Antibiotic**
  - Penicillin
  - Ampicillin
  - Methicillin
- **Quinolone**
- **Anti-HTN**
  - Beta-blocker
    - Atenolol
  - Diuretic
    - Betaxolol
    - Metoprolol
The Inheritance Hierarchy
Concepts are arranged in a tree hierarchy

Antibiotic subsumes Penicillin and Methicillin
Polyhierarchical structure

A concept may have more than one parent in the hierarchy

- **procedure**
  - **procedure by device**
    - **laparoscopic procedure**
    - **laparoscopic cholecystectomy**
    - is a
  - **procedure by site**
    - **procedure on abdomen**
    - **operation on gall bladder**
    - **cholecystectomy**
    - is a
    - is a
Polyhierarchical structure

A concept may have more than one parent in the hierarchy

- procedure
  - procedure by site
    - procedure on abdomen
      - operation on gall bladder
        - cholecystectomy
          - laparoscopic cholecystectomy
            - laparoscopic procedure
              - procedure by device

Polyhierarchic structure

A concept may have more than one parent in the hierarchy.

- **procedure**
  - **procedure by device**
    - **laparoscopic procedure**
  - **procedure by site**
    - **procedure on abdomen**
    - **operation on gall bladder**
    - **cholecystectomy**
      - **laparoscopic cholecystectomy**
Pre- and Post-Coordination

Suprarenal Artery Embolus
297143008

or

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2929001</td>
<td>Occlusion of Artery</td>
</tr>
<tr>
<td>116676008</td>
<td>Associated Morphology</td>
</tr>
<tr>
<td>55584005</td>
<td>Embolus</td>
</tr>
<tr>
<td>363698007</td>
<td>Finding Site</td>
</tr>
<tr>
<td>895000000</td>
<td>Suprarenal Artery</td>
</tr>
</tbody>
</table>
Pre- and Post-Coordination

Suprarenal Artery Embolus
297143008

or

Occlusion of Artery 2929001
Associated Morphology 116676008
Embolus 55584005
Finding Site 363698007
Suprarenal Artery 89500000

Pre-Coordinated
Pre- and Post-Coordination

Suprarenal Artery Embolus
297143008

Pre-Coordinated

or

<table>
<thead>
<tr>
<th>Condition</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Occlusion of Artery</td>
<td>2929001</td>
</tr>
<tr>
<td>Associated Morphology</td>
<td>116676008</td>
</tr>
<tr>
<td>Embolus</td>
<td>55584005</td>
</tr>
<tr>
<td>Finding Site</td>
<td>363698007</td>
</tr>
<tr>
<td>Suprarenal Artery</td>
<td>895000000</td>
</tr>
</tbody>
</table>
Pre- and Post-Coordination

Suprarenal Artery Embolus
297143008

or

<table>
<thead>
<tr>
<th>-associated_morphology_116676008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Associated Morphology</td>
</tr>
<tr>
<td>Embolus</td>
</tr>
<tr>
<td>Finding Site</td>
</tr>
<tr>
<td>Suprarenal Artery</td>
</tr>
</tbody>
</table>

Pre-Coordinated

Post-Coordinated
Effective use of SNOMED vocabulary by the CDSS requires that these functions (at a minimum) be supported by the query/vocabulary management software:

1) Retrieve information about a single concept
2) Determine if concept A is a “child” of concept B
3) Query for a set of concepts, such as those defined for use in clinical systems
   a) “All the concepts that represent an immunocompromised host”
Guideline Abstraction

Julie Glasgow, MD
SAGE Guideline Encoding Process

1. Assemble Source Guidelines
2. Envision Clinical Scenarios
3. Formalize Guideline Logic
4. Define Guideline Concepts
5. Formalize Vocabulary Inventory
6. Specify Information Queries
7. Encode Guideline Knowledgebase

Guideline Installation and Execution
SAGE Guideline Encoding Process

1. Assemble Source Guidelines
2. Envision Clinical Scenarios
3. Formalize Guideline Logic
4. Define Guideline Concepts
5. Formalize Vocabulary Inventory
6. Specify Information Queries
7. Encode Guideline Knowledgebase

Guideline Installation and Execution
SAGE Guideline Encoding Process

1. Assemble Source Guidelines
2. Envision Clinical Scenarios
3. Formalize Guideline Logic
4. Define Guideline Concepts
5. Formalize Vocabulary Inventory
6. Specify Information Queries
7. Encode Guideline Knowledgebase

Guideline Installation and Execution
SAGE Guideline Encoding Process

1. Assemble Source Guidelines
2. Envision Clinical Scenarios
3. Formalize Guideline Logic
4. Define Guideline Concepts
5. Formalize Vocabulary Inventory
6. Specify Information Queries
7. Encode Guideline Knowledgebase

Guideline Installation and Execution
SAGE Guideline Encoding Process

1. Assemble Source Guidelines
2. Envision Clinical Scenarios
3. Formalize Guideline Logic
4. Define Guideline Concepts
5. Formalize Vocabulary Inventory
6. Specify Information Queries
7. Encode Guideline Knowledgebase

Guideline Installation and Execution
SAGE Guideline Encoding Process

1. Assemble Source Guidelines
2. Envision Clinical Scenarios
3. Formalize Guideline Logic
4. Define Guideline Concepts
5. Formalize Vocabulary Inventory
6. Specify Information Queries
7. Encode Guideline Knowledgebase

Guideline Installation and Execution
SAGE Guideline Encoding Process

1. Assemble Source Guidelines
2. Envision Clinical Scenarios
3. Formalize Guideline Logic
4. Define Guideline Concepts
5. Formalize Vocabulary Inventory
6. Specify Information Queries
7. Encode Guideline Knowledgebase

Guideline Installation and Execution
SAGE Guideline Encoding Process

1. Assemble Source Guidelines
2. Envision Clinical Scenarios
3. Formalize Guideline Logic
4. Define Guideline Concepts
5. Formalize Vocabulary Inventory
6. Specify Information Queries
7. Encode Guideline Knowledgebase

Guideline Installation and Execution
SAGE Guideline Encoding Process

1. Assemble Source Guidelines
2. Envision Clinical Scenarios
3. Formalize Guideline Logic
4. Define Guideline Concepts
5. Formalize Vocabulary Inventory
6. Specify Information Queries
7. Encode Guideline Knowledgebase

Guideline Installation and Execution
## Recommended Adult Immunization Schedule, by Vaccine and Age Group

**UNITED STATES, OCTOBER 2005–SEPTEMBER 2006**

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>19–49 years</th>
<th>50–64 years</th>
<th>≥ 65 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tetanus, diphtheria (Td)¹*</td>
<td>1-dose booster every 10 yrs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measles, mumps, rubella (MMR)²*</td>
<td>1 or 2 doses</td>
<td>1 dose</td>
<td></td>
</tr>
<tr>
<td>Varicella³*</td>
<td>2 doses (0, 4–8 wks)</td>
<td>2 doses (0, 4–8 wks)</td>
<td></td>
</tr>
<tr>
<td>Influenza⁴*</td>
<td>1 dose annually</td>
<td>1 dose annually</td>
<td></td>
</tr>
<tr>
<td>Pneumococcal (polysaccharide)⁵,⁶</td>
<td>1–2 doses</td>
<td></td>
<td>1 dose</td>
</tr>
<tr>
<td>Hepatitis A⁷*</td>
<td></td>
<td>2 doses (0, 6–12 mos, or 0, 6–18 mos)</td>
<td></td>
</tr>
<tr>
<td>Hepatitis B⁸*</td>
<td></td>
<td>3 doses (0, 1–2, 4–6 mos)</td>
<td></td>
</tr>
<tr>
<td>Meningococcal⁹</td>
<td></td>
<td>1 or more doses</td>
<td></td>
</tr>
</tbody>
</table>

*Vaccines below broken line are for select populations.

**Note:** These recommendations must be used along with individual patient history and/or travel history.
**CDC Adult Immunization Sub-guideline Schedule**

**Recommended Adult Immunization Schedule, by Vaccine and Age Group**

**UNITED STATES, OCTOBER 2005—SEPTEMBER 2006**

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>Age group 19–49 years</th>
<th>50–64 years</th>
<th>≥ 65 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tetanus, diphtheria (Td)&lt;sup&gt;1*&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measles, mumps, rubella (MMR)&lt;sup&gt;2*&lt;/sup&gt;</td>
<td>1 or 2 doses</td>
<td>1 dose</td>
<td></td>
</tr>
<tr>
<td>Varicella&lt;sup&gt;3*&lt;/sup&gt;</td>
<td>2 doses (0, 4–8 wks)</td>
<td>2 doses (0, 4–8 wks)</td>
<td></td>
</tr>
<tr>
<td>Influenza&lt;sup&gt;4*&lt;/sup&gt;</td>
<td>1 dose annually</td>
<td>1 dose annually</td>
<td></td>
</tr>
<tr>
<td>Pneumococcal (polysaccharide)&lt;sup&gt;5,6&lt;/sup&gt;</td>
<td></td>
<td>1–2 doses</td>
<td>1 dose</td>
</tr>
<tr>
<td>Hepatitis A&lt;sup&gt;7*&lt;/sup&gt;</td>
<td></td>
<td>2 doses (0, 6–12 mos, or 0, 6–18 mos)</td>
<td></td>
</tr>
<tr>
<td>Hepatitis B&lt;sup&gt;8*&lt;/sup&gt;</td>
<td></td>
<td>3 doses (0, 1–2, 4–6 mos)</td>
<td></td>
</tr>
<tr>
<td>Meningococcal&lt;sup&gt;9&lt;/sup&gt;</td>
<td></td>
<td>1 or more doses</td>
<td></td>
</tr>
</tbody>
</table>

*NOS: These recommendations must be used along with the footnote*
### TABLE 2. Recommendations for the use of pneumococcal vaccine

<table>
<thead>
<tr>
<th>Groups for which vaccination is recommended</th>
<th>Strength of recommendation</th>
<th>Revaccination</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Immunocompetent persons</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Persons aged ≥65 years</td>
<td>A</td>
<td>Second dose of vaccine if patient received vaccine ≥5 years previously and were aged &lt;65 years at the time of vaccination.</td>
</tr>
<tr>
<td>Persons aged 2–64 years with chronic cardiovascular disease,† chronic pulmonary disease,‡‡ or diabetes mellitus</td>
<td>A</td>
<td>Not recommended.</td>
</tr>
<tr>
<td>Persons aged 2–64 years with alcoholism, chronic liver disease,†† or cerebrospinal fluid leaks</td>
<td>B</td>
<td>Not recommended.</td>
</tr>
<tr>
<td>Persons aged 2–64 years with functional or anatomic asplenia‡§</td>
<td>A</td>
<td>If patient is aged ≥10 years: single revaccination ≥5 years after previous dose. If patient is aged ≤10 years: consider revaccination 3 years after previous dose.</td>
</tr>
<tr>
<td>Persons aged 2–64 years living in special environments or social settings‖</td>
<td>C</td>
<td>Not recommended.</td>
</tr>
<tr>
<td><strong>Immunocompromised persons</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Immunocompromised persons aged ≥2 years, including those with HIV infection, leukemia, lymphoma, Hodgkin's disease, multiple myeloma, generalized malignancy, chronic renal failure, or nephrotic syndrome; those receiving immunosuppressive chemotherapy (including corticosteroids); and those who have received an organ or bone marrow transplant.</td>
<td>C</td>
<td>Single revaccination if ≥5 years have elapsed since receipt of first dose. If patient is aged ≤10 years: consider revaccination 3 years after previous dose.</td>
</tr>
</tbody>
</table>
**TABLE 2. Recommendations for the use of pneumococcal vaccine**

<table>
<thead>
<tr>
<th>Groups for which vaccination is recommended</th>
<th>Strength of recommendation</th>
<th>Revaccination†</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Immunocompetent persons‡</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Persons aged ≥65 years</td>
<td>A</td>
<td>Second dose of vaccine if patient received vaccine ≥5 years previously and were aged &lt;65 years at the time of vaccination.</td>
</tr>
<tr>
<td>Persons aged 2–64 years with chronic cardiovascular disease,† chronic pulmonary disease,** or diabetes mellitus</td>
<td>A</td>
<td>Not recommended.</td>
</tr>
<tr>
<td>Persons aged 2–64 years with alcoholism, chronic liver disease,†† or cerebrospinal fluid leaks</td>
<td>B</td>
<td>Not recommended.</td>
</tr>
<tr>
<td>Persons aged 2–64 years with functional or anatomic asplenia‡‡</td>
<td>A</td>
<td>If patient is aged &gt;10 years: single revaccination ≥5 years after previous dose. If patient is aged ≤10 years: consider revaccination 3 years after previous dose.</td>
</tr>
<tr>
<td>Persons aged 2–64 years living in special environments or social settings¶¶</td>
<td>C</td>
<td>Not recommended.</td>
</tr>
<tr>
<td><strong>Immunocompromised persons§</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Immunocompromised persons aged ≥2 years, including those with HIV infection, leukemia, lymphoma, Hodgkins disease, multiple myeloma, generalized malignancy, chronic renal failure, or nephrotic syndrome; those receiving immunosuppressive chemotherapy (including corticosteroids); and those who have received an organ or bone marrow transplant.</td>
<td>C</td>
<td>Single revaccination if ≥5 years have elapsed since receipt of first dose. If patient is aged ≤10 years: consider revaccination 3 years after previous dose.</td>
</tr>
</tbody>
</table>
Concepts in the Source Guideline

• What is a chronic cardiovascular disease?
• What defines diabetes mellitus?
• What is functional or anatomic asplenia?
• Who is an immunocompromised person?
### Concepts in the Source Guideline

- What is a chronic cardiovascular disease?
- What defines diabetes mellitus?
- What is functional or anatomic asplenia?
- Who is an immunocompromised person?

<table>
<thead>
<tr>
<th>Condition</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Persons aged 2–64 years with chronic cardiovascular disease,(^\d)  (,^{\dagger}) diabetes mellitus</td>
<td>A Not recommended.</td>
</tr>
<tr>
<td>Persons aged 2–64 years with alcoholism, chronic liver disease,(^{\dagger\dagger}) or cerebrospinal fluid leaks</td>
<td>B Not recommended.</td>
</tr>
<tr>
<td>Persons aged 2–64 years with functional or anatomic asplenia(^{\ddagger})</td>
<td>A If patient is aged &gt;10 years: single revaccination (\geq 5) years after previous dose. If patient is aged (\leq 10) years: consider revaccination 3 years after previous dose.</td>
</tr>
<tr>
<td>Persons aged 2–64 years living in special environments or social settings(^{\dagger\dagger})</td>
<td>C Not recommended.</td>
</tr>
<tr>
<td>Immunocompromised persons(^{\dagger})  (,^{\dagger}) Immunocompromised persons aged (\geq 2) years, including those with HIV infection, leukemia, lymphoma, Hodgkins disease, multiple myeloma, generalized malignancy, chronic renal failure, or nephrotic</td>
<td>C Single revaccination if (\geq 5) years have elapsed since receipt of first dose. If patient is aged (\leq 10) years: consider revaccination 3 years after previous dose.</td>
</tr>
</tbody>
</table>
Concepts in the Source Guideline

- What is a chronic cardiovascular disease?
- What defines diabetes mellitus?
- What is functional or anatomic asplenia?
- Who is an immunocompromised person?
Concepts in the Source Guideline

• What is a chronic cardiovascular disease?
• What defines diabetes mellitus?
• What is functional or anatomic asplenia?
• Who is an immunocompromised person?
Concepts in the Source Guideline

- What is a chronic cardiovascular disease?
- What defines diabetes mellitus?
- What is functional or anatomic asplenia?
- Who is an immunocompromised person?
“Functional or anatomic asplenia”

**Clinical Definition**
- Congenital asplenia
- Functional asplenia
- Splenectomy
- Asplenia syndrome
- Hyposplenism
- Sickle cell disease

**SNOMED CT Concept**
- 93030006
- 38096003
- 234319005 (Procedure)
- 17604001
- 23761004
- 127040003 (Hemoglobin S disease)
“Functional or anatomic asplenia”

- **Clinical Definition**
  - Congenital asplenia
  - Functional asplenia
  - Splenectomy
  - Asplenia syndrome
  - Hyposplenism
  - Sickle cell disease

- **SNOMED CT Concept**
  - 93030006
  - 38096003
  - 234319005 (Procedure)
  - 17604001
  - 23761004
  - 127040003 (Hemoglobin S disease)
Concepts in the Encoded Guideline: Protégé

Label: Adult Immunization Subguideline
Description: Computes eligibility and contraindications for all vaccines applicable to patient 19 years older.

Recommendations:
- PPV23 possibly due (Adult)
  - Is Hep A needed (adult)?
    - Hep A possibly due (adult)
    - Hep B possibly due (Adult)
  - Is Varicella vaccine needed (adult)?
    - Varicella possibly
  - Is Td or Tdap vax needed (adult)?
    - Tdap possibly due (adult)
    - Td possibly due (adult)
  - Is Meningococcal vax needed (adult)?
    - MPSV4 possibly due (adult)
    - MCV4 possibly due (adult)
  - Is MMR needed (adult)?
    - MMR possibly due (Adult)
  - Is Influenza needed (adult)?
    - Influenza (splitvirus) possibly due (adult)
Context Nodes organize and specify the relationship to workflow:
- What triggers the session
- Who is involved
- Where the session occurs
**Context Nodes** organize and specify the relationship to workflow.
- What triggers the session
- Who is involved
- Where the session occurs
Concepts in the Encoded Guideline: Protégé

**Context Nodes** organize and specify the relationship to workflow:
- What triggers the session
- Who is involved
- Where the session occurs

**Decision Nodes** provide support for making choices:
- Specification of alternatives
- Logic used to evaluate choices
Concepts in the Encoded Guideline: Protégé

**Context Nodes** organize and specify the relationship to workflow.
- What triggers the session
- Who is involved
- Where the session occurs

**Decision Nodes** provide support for making choices:
- Specification of alternatives
- Logic used to evaluate choices

---

**Diagram:**
- Adult Immunization Subguideline
- References
- Recommendations

**Nodes:**
- Is Hep A needed (adult)?
- PPV23 possibly due (adult)
- Is Meningococcal vaccine needed (adult)?
- Is Varicella vaccine needed (adult)?
- Is MMR possibly due (adult)?
- Is Influenza (splitvirus) possibly due (adult)?
- Is Td or Tdap needed (adult)?
- MCV4 possibly due (adult)
- MPSV4 possibly due (adult)
- Varicella possibly due (adult)
- Tdap possibly due (adult)
- Td possibly due (adult)
Concepts in the Encoded Guideline: Protégé

**Context Nodes** organize and specify the relationship to workflow.
- What triggers the session
- Who is involved
- Where the session occurs

**Decision Nodes** provide support for making choices:
- Specification of alternatives
- Logic used to evaluate choices

### Table

<table>
<thead>
<tr>
<th>Label</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult Immunization Subguideline</td>
<td>Computes eligibility and compliance based on demographic data.</td>
</tr>
<tr>
<td>References</td>
<td></td>
</tr>
<tr>
<td>Recommendations</td>
<td></td>
</tr>
</tbody>
</table>

### Diagram

- **PPV23** possibly due (Adult)
- **Hep A** possibly due (Adult)
- **Varicella** possibly
- **Hep B** possibly due (Adult)
- **Varicella vaccine needed (adult)**
- **Is Hep A needed (adult)?**
- **Is Hep B needed (adult)?**
- **Is Varicella vaccine needed (adult)?**
- **Is Meningococcal vax needed (adult)?**
- **Is MMR needed (adult)?**
- **Is Influenza needed (adult)?**
- **Is Influenza (splitvirus) possibly due (adult)?**
- **Is Influenza wholevirus possibly due (adult)?**
- **Is Td or Tdap needed (adult)?**
- **Is MPSV4 possibly due (adult)?**
- **Is MCV4 possibly due (adult)?**
### Concepts in the Encoded Guideline: Protégé

**Context Nodes** organize and specify the relationship to workflow.
- What triggers the session
- Who is involved
- Where the session occurs

**Decision Nodes** provide support for making choices:
- Specification of alternatives
- Logic used to evaluate choices

**Action Nodes** define activity to be accomplished by the CIS:
- User interaction, query, messaging
- Order sets
- Appointments and referrals
- Goal setting
- Documentation and recording

<table>
<thead>
<tr>
<th>Label</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult Immunization Subguideline</td>
<td>Computes eligibility and considerations for immunizations.</td>
</tr>
</tbody>
</table>

References

Recommendations

[Diagram showing decision and action nodes related to immunization guidelines.]

- **Is a Pneumococcal (PPV23) Vaccine needed? (adult)?**
- **PPV23 possibly needed?**
- **Is Hep A needed (adult)?**
- **Adult immunization subguideline**
- **Is Meningococcal vax needed (adult)?**
- **Is Td or TdaP needed (adult)?**
- **Is M Needed (adult)?**
- **MMR possibly due (adult)**
- **Influenza (split) possibly due (adult)**
- **Influenza (whole) possibly due (adult)**
- **MPSV4 possibly due (adult)**
- **MCV4 possibly due (adult)**
- **Varicella possibly due (adult)**
- **TdaP possibly due (adult)**
- **Td possibly due (adult)**
Concepts in the Encoded Guideline: Protégé

Context Nodes organize and specify the relationship to workflow:
- What triggers the session
- Who is involved
- Where the session occurs

Decision Nodes provide support for making choices:
- Specification of alternatives
- Logic used to evaluate choices

Action Nodes define activity to be accomplished by the CIS:
- User interaction, query, messaging
- Order sets
- Appointments and referrals
- Goal setting
- Documentation and recording
Adult Pneumococcal Vaccine Logic

For Instance: Pneumococcal (PPV23) vaccine general indications (adult)

Label: Pneumococcal (PPV23) vaccine general indications (adult)

Criteria:
- Chronic heart disease
- Diabetes
- Hematologic malignancy
- Chronic renal failure
- Institutionalized
- Nephrotic syndrome
- CSF leak
- Terminal complement deficiencies
- Cochlear implant problem history
- Chronic liver disease
- Alcoholism
- Nursing home resident
- Chronic Pulmonary disease (excludes asthma)
- Hemodialysis (problem)
- Patient occupation: Healthcare professional
- Patient is American Indian or Alaskan native
- Functional or anatomic asplenia
- Immunosuppressive conditions
Adult Pneumococcal Vaccine Logic

For Instance: 

Pneumococcal (PPV23) vaccine general indications (adult) (instance of N_ary_Criterion, internal name is IMMS2004_00161)

Label:
Pneumococcal (PPV23) vaccine general indications (adult)

Boolean Connective:
OR

Criteria:
- Chronic heart disease
- Diabetes
- Hematologic malignancy
- Chronic renal failure
- Institutionalized
- Nephrotic syndrome
- CSF leak
- Terminal complement deficiencies
- Cochlear implant problem history
- Chronic liver disease
- Alcoholism
- Nursing home resident
- Chronic Pulmonary disease (excludes asthma)
- Hemodialysis (problem)
- Patient occupation: Healthcare professional
- Patient is American Indian or Alaskan native

- Functional or anatomic asplenia
- Immunosuppressive conditions
Functional or Anatomic Asplenia

- Functional asplenia
- Congenital asplenia
- Sickle cell disease
- Asplenia syndrome
- Hyposplenism
- Splenectomy problem history
Functional or Anatomic Asplenia

- Functional asplenia
- Congenital asplenia
- Sickle cell disease
- Asplenia syndrome
- Hyposplenism
- Splenectomy problem history
**Functional Asplenia**

![Functional Asplenia Diagram](image)

<table>
<thead>
<tr>
<th>Name</th>
<th>Documentation</th>
<th>Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional asplenia (disorder) [SNOMED CT]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Role</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Abstract</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code</th>
<th>DisplayName</th>
</tr>
</thead>
<tbody>
<tr>
<td>38096003</td>
<td>Functional asplenia (disorder)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CodeSystemName</th>
<th>CodeSystem</th>
</tr>
</thead>
<tbody>
<tr>
<td>SNOMED CT</td>
<td>SNOMED CT</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CodedSystemVersion</th>
<th></th>
</tr>
</thead>
</table>
Functional Asplenia
SAGE Protégé Tool for Vocab. Inventory
SAGE Protégé Tool for Vocab. Inventory
Guideline Concepts ↔ Patient Record

- Concepts must be defined in order to find them in the electronic patient record
- There is variation in data representation across EMRs
  - Concepts used
  - Structures to hold concepts
  - Usage customs
- A standard representation allows translation of concepts for inclusion in database queries
Example: Possible Representations of a Patient’s Diabetes Mellitus

• Entry on Problem List
  – Diabetes Mellitus type II

• Observation
  – Lab Value of Fasting Glucose > 125 mg/dL or
  – Lab value for two-hour 75-g oral glucose tolerance test > 200 mg/dL

• Entry in Diagnoses & Procedures list
  – Diabetes Mellitus type II
Example: Possible Representations of a Patient’s Diabetes Mellitus

• Entry on Problem List
  – Diabetes Mellitus type II

• Observation
  – Lab Value of Fasting Glucose > 125 mg/dL or
  – Lab value for two-hour 75-g oral glucose tolerance test > 200 mg/dL

• Entry in Diagnoses & Procedures list
  – Diabetes Mellitus type II

Data engineers must map standard guideline concept representations to local concepts and structures
Making terminology work locally

Mark Nyman, MD
1. Assemble Source Guidelines

2. Envision Clinical Scenarios

3. Formalize Guideline Logic

4. Define Guideline Concepts

5. Formalize Vocabulary Inventory

6. Specify Information Queries

7. Encode Guideline Knowledgebase

Guideline Installation and Execution
1. Assemble Source Guidelines
2. Envision Clinical Scenarios
3. Formalize Guideline Logic
4. Define Guideline Concepts
5. Formalize Vocabulary Inventory
6. Specify Information Queries
7. Encode Guideline Knowledgebase

Guideline Installation and Execution
SAGE Guideline Deployment System
Execution Architecture

- **Encoded Guideline**
- **SAGE Execution Engine**
  - **Event Listener**
  - **Data Query Service Calls**
  - **Action Service Calls**
  - **Terminology Functions**
  - **Terminology Server**
- **VMR Interface**
  - **Event Notifications**
  - **Local Modifications**
- **Clinical Information System**
  - **Binding**
  - **data**
Mapping

Decision Support System

Problems
Lab
Orders

Local Computer Information System

Problems
Lab
Orders
Example: Mapping of Problems

Diabetes
SNOMED: diabetes

- 73211009 diabetes mellitus
- 237820003 abnormal metabolic state in diabetes mellitus
- 11530004 brittle diabetes
- 70694009 diabetes mellitus AND insipidus with optic atrophy AND deafness
- 5969009 diabetes mellitus associated with genetic syndrome
- 91352004 diabetes mellitus due to structurally abnormal insulin
- 198223000 diabetes mellitus during pregnancy, childbirth and the puerperium
- 190324002 diabetes mellitus NOS with no mention of complication
- 46635009 diabetes mellitus type 1
- 44054006 diabetes mellitus type 2
- 372089003 diabetes mellitus with complication
- 190321005 diabetes mellitus with no mention of complication
- 190417004 diabetes mellitus with other specified manifestation
- 111552007 diabetes mellitus without complication
- 123763000 Houssay's syndrome
- 408539000 insulin autoimmune syndrome
- 359939009 maternal diabetes mellitus
- 49817004 neonatal diabetes mellitus
- 190336008 other specified diabetes mellitus with coma
- 190420000 other specified diabetes mellitus with multiple complications
- 190420007 other specified diabetes mellitus with other specified complications
- 33559001 pineal hyperplasia AND diabetes mellitus syndrome
- 82260000 Pregestational diabetes mellitus AND/OR impaired glucose tolerance, modified White classification
- 8801005 secondary diabetes mellitus
- 190383005 unspecified diabetes mellitus with multiple complications
- 275918005 unstable diabetes
- 191046007 Other specified diabetes mellitus
- 200505002 Pre-existing diabetes mellitus, unspecified
- 191048009 unspecified diabetes mellitus with renal complications
<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2202566</td>
<td>DM</td>
<td>2202588</td>
<td>DM Type1 Nephrotic Syndrome</td>
</tr>
<tr>
<td>2202567</td>
<td>DM Type2</td>
<td>2202589</td>
<td>DM Type1 Nephropathy</td>
</tr>
<tr>
<td>2202568</td>
<td>DM w/o Complications</td>
<td>2202590</td>
<td>DM Type2 Nephropathy Uncontrolled</td>
</tr>
<tr>
<td>2202569</td>
<td>DM Type1</td>
<td>2202591</td>
<td>DM Type1 Nephropathy Uncontrolled</td>
</tr>
<tr>
<td>2202570</td>
<td>DM Type2 Uncontrolled</td>
<td>2202592</td>
<td>DM Retinopathy</td>
</tr>
<tr>
<td>2202571</td>
<td>DM Type1 Uncontrolled</td>
<td>2202593</td>
<td>DM Retinopathy Proliferative</td>
</tr>
<tr>
<td>2202572</td>
<td>DM Ketoacidosis</td>
<td>2202594</td>
<td>DM Type2 Cataract</td>
</tr>
<tr>
<td>2202573</td>
<td>DM Type2 Ketoacidosis</td>
<td>2202596</td>
<td>DM Retinopathy Background</td>
</tr>
<tr>
<td>2202574</td>
<td>DM Type1 Ketoacidosis</td>
<td>2202598</td>
<td>DM Retinopathy Macular Edema</td>
</tr>
<tr>
<td>2202577</td>
<td>DM Type2 Hyperosmolarity</td>
<td>2202599</td>
<td>DM Type2 Retinopathy</td>
</tr>
<tr>
<td>2202578</td>
<td>DM Type1 Hyperosmolarity</td>
<td>2202600</td>
<td>DM Type2 Retinopathy Background</td>
</tr>
<tr>
<td>2202581</td>
<td>DM Coma</td>
<td>2202601</td>
<td>DM Type2 Retinopathy Prolif</td>
</tr>
<tr>
<td>SNOMED #</td>
<td>Term</td>
<td>CIS #</td>
<td>Description</td>
</tr>
<tr>
<td>---------------</td>
<td>-------------------------------</td>
<td>----------</td>
<td>---------------</td>
</tr>
<tr>
<td>46635009</td>
<td>Diabetes mellitus type 1</td>
<td>2202569</td>
<td>DM type 1</td>
</tr>
<tr>
<td>44054006</td>
<td>Diabetes mellitus type 2</td>
<td>2202567</td>
<td>DM type 2</td>
</tr>
</tbody>
</table>
Example:
Mapping of Lab Observations

Hgb A1c
Retrieve Sub-guideline

Start state for retrieving diabetes lab data

Previous HbA1C value exists?
- No previous HbA1C; order now
- Check when HbA1C due and whether out of goal

Previous creatinine value exists?
- No previous creatinine; order now
- Check when creatinine due and whether WNL

Previous microalbumin value exists?
- No previous microalbumin; order now
- Check when microalbumin due and whether out of goal
Retrieve Sub-guideline

Start state for retrieving diabetes lab data

Previous HbA1C value exists?
  - No previous HbA1C; order now
  - Check when HbA1C due and whether out of goal

Previous creatinine value exists?
  - No previous creatinine; order now
  - Check when creatinine due and whether WNL

Previous microalbumin value exists?
  - No previous microalbumin; order now
  - Check when microalbumin due and whether out of goal
# Mayo Lab Code for Hgb A1c

<table>
<thead>
<tr>
<th>LOINC</th>
<th>Unit code name</th>
<th>Unit code</th>
<th>Performed/reported</th>
</tr>
</thead>
<tbody>
<tr>
<td>4548-4</td>
<td>Hemoglobin A1C, B</td>
<td>82080</td>
<td>Central Clinical Lab/in MICS</td>
</tr>
<tr>
<td>4548-4</td>
<td>Hemoglobin A1C, B</td>
<td>80947</td>
<td>Clinical Trials/not in MICS</td>
</tr>
<tr>
<td>4548-4</td>
<td>Hemoglobin A1C, B</td>
<td>124055</td>
<td>New England/not in MICS</td>
</tr>
<tr>
<td>4548-4</td>
<td>Hemoglobin A1C, B</td>
<td>82990</td>
<td>Kasson/in MICS</td>
</tr>
<tr>
<td>LOINC</td>
<td>Unit code name</td>
<td>Unit code</td>
<td>Performed reported</td>
</tr>
<tr>
<td>--------</td>
<td>-------------------------</td>
<td>-----------</td>
<td>----------------------------</td>
</tr>
<tr>
<td>4548-4</td>
<td>Hemoglobin A1C, B</td>
<td>82080</td>
<td>Central Clinical Lab/in MICS</td>
</tr>
<tr>
<td>4548-4</td>
<td>Hemoglobin A1C, B</td>
<td>80947</td>
<td>Clinical Trials/not in MICS</td>
</tr>
<tr>
<td>4548-4</td>
<td>Hemoglobin A1C, B</td>
<td>124055</td>
<td>New England/not in MICS</td>
</tr>
<tr>
<td>4548-4</td>
<td>Hemoglobin A1C, B</td>
<td>82990</td>
<td>Kasson/in MICS</td>
</tr>
</tbody>
</table>
Mayo Lab Code for Hgb A1c

<table>
<thead>
<tr>
<th>LOINC</th>
<th>Unit code name</th>
<th>Unit code</th>
<th>Performed/reported</th>
</tr>
</thead>
<tbody>
<tr>
<td>4548-4</td>
<td>Hemoglobin A1C, B</td>
<td>82080</td>
<td>Central Clinical Lab/in MICS</td>
</tr>
<tr>
<td>4548-4</td>
<td>Hemoglobin A1C, B</td>
<td>80947</td>
<td>Clinical Trials/not in MICS</td>
</tr>
<tr>
<td>4548-4</td>
<td>Hemoglobin A1C, B</td>
<td>124055</td>
<td>New England/not in MICS</td>
</tr>
<tr>
<td>4548-4</td>
<td>Hemoglobin A1C, B</td>
<td>82990</td>
<td>Kasson/in MICS</td>
</tr>
</tbody>
</table>
## Mayo Lab Code for Hgb A1c

<table>
<thead>
<tr>
<th>LOINC</th>
<th>Unit code name</th>
<th>Unit code</th>
<th>Performed/reported</th>
</tr>
</thead>
<tbody>
<tr>
<td>4548-4</td>
<td>Hemoglobin A1C, B</td>
<td>82080</td>
<td>Central Clinical Lab/in MICS</td>
</tr>
<tr>
<td>4548-4</td>
<td>Hemoglobin A1C, B</td>
<td>80947</td>
<td>Clinical Trials/not in MICS</td>
</tr>
<tr>
<td>4548-4</td>
<td>Hemoglobin A1C, B</td>
<td>124055</td>
<td>New England/not in MICS</td>
</tr>
<tr>
<td>4548-4</td>
<td>Hemoglobin A1C, B</td>
<td>82990</td>
<td>Kasson/in MICS</td>
</tr>
</tbody>
</table>
Mayo Lab Code for Hgb A1c

<table>
<thead>
<tr>
<th>LOINC</th>
<th>Unit code name</th>
<th>Unit code</th>
<th>Performed/reported</th>
</tr>
</thead>
<tbody>
<tr>
<td>4548-4</td>
<td>Hemoglobin A1C, B</td>
<td>82080</td>
<td>Central Clinical Lab/in MICS</td>
</tr>
<tr>
<td>4548-4</td>
<td>Hemoglobin A1C, B</td>
<td>80947</td>
<td>Clinical Trials/not in MICS</td>
</tr>
<tr>
<td>4548-4</td>
<td>Hemoglobin A1C, B</td>
<td>124055</td>
<td>New England/not in MICS</td>
</tr>
<tr>
<td>4548-4</td>
<td>Hemoglobin A1C, B</td>
<td>82990</td>
<td>Kasson/in MICS</td>
</tr>
</tbody>
</table>
## Mayo Lab Code for Hgb A1c

<table>
<thead>
<tr>
<th>LOINC</th>
<th>Unit code name</th>
<th>Unit code</th>
<th>Performed/reportred</th>
</tr>
</thead>
<tbody>
<tr>
<td>4548-4</td>
<td>Hemoglobin A1C, B</td>
<td>82080</td>
<td>Central Clinical Lab/in MICS</td>
</tr>
<tr>
<td>4548-4</td>
<td>Hemoglobin A1C, B</td>
<td>80947</td>
<td>Clinical Trials/not in MICS</td>
</tr>
<tr>
<td>4548-4</td>
<td>Hemoglobin A1C, B</td>
<td>124055</td>
<td>New England/not in MICS</td>
</tr>
<tr>
<td>4548-4</td>
<td>Hemoglobin A1C, B</td>
<td>82990</td>
<td>Kasson/in MICS</td>
</tr>
</tbody>
</table>
Mayo Lab Code for Hgb A1c

<table>
<thead>
<tr>
<th>LOINC</th>
<th>Unit code name</th>
<th>Unit code</th>
<th>Performed/reported</th>
</tr>
</thead>
<tbody>
<tr>
<td>4548-4</td>
<td>Hemoglobin A1C, B</td>
<td>82080</td>
<td>Central Clinical Lab/in MICS</td>
</tr>
<tr>
<td>4548-4</td>
<td>Hemoglobin A1C, B</td>
<td>80947</td>
<td>Clinical Trials/not in MICS</td>
</tr>
<tr>
<td>4548-4</td>
<td>Hemoglobin A1C, B</td>
<td>124055</td>
<td>New England/not in MICS</td>
</tr>
<tr>
<td>4548-4</td>
<td>Hemoglobin A1C, B</td>
<td>82990</td>
<td>Kasson/in MICS</td>
</tr>
</tbody>
</table>
## Translation Table

<table>
<thead>
<tr>
<th>/mapping/@context</th>
<th>/mapping/from/concept</th>
<th>/mapping/from/concept/@label</th>
<th>/mapping/to/@label</th>
<th>Mayo Lab Code</th>
<th>/mapping/to</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>observation</td>
<td>LOINC:4548-4</td>
<td>Hemoglobin A1C</td>
<td>Hemoglobin A1C, B (Rochester)</td>
<td>82080-ROCLIS</td>
<td>6105267</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hemoglobin A1C, B (Kasson)</td>
<td>82990-ROCLIS</td>
<td>6105673</td>
<td></td>
</tr>
</tbody>
</table>
## Translation Table

<table>
<thead>
<tr>
<th>/mapping/@context</th>
<th>/mapping/from/concept</th>
<th>/mapping/from/concept/@label</th>
<th>/mapping/to/@label</th>
<th>Mayo Lab Code</th>
<th>/mapping/to/@context</th>
</tr>
</thead>
<tbody>
<tr>
<td>observation</td>
<td>LOINC:4548-4</td>
<td>Hemoglobin A1C</td>
<td>Hemoglobin A1C, B</td>
<td>82080-ROCLIS</td>
<td>6105267</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(Rochester)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hemoglobin A1C, B</td>
<td>82990-ROCLIS</td>
<td>6105673</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(Kasson)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>observation</td>
<td>LOINC:17855-8</td>
<td>Hemoglobin A1C, calculated</td>
<td>Hemoglobin A1C, B</td>
<td>15958-ROCLIS</td>
<td>6112899</td>
</tr>
</tbody>
</table>


## Translation Table

<table>
<thead>
<tr>
<th>/mapping/@context</th>
<th>/mapping/from/concept</th>
<th>/mapping/from/concept/@label</th>
<th>/mapping/to/@label</th>
<th>Mayo Lab Code</th>
<th>/mapping/to</th>
</tr>
</thead>
<tbody>
<tr>
<td>observation</td>
<td>LOINC:4548-4</td>
<td>Hemoglobin A1C</td>
<td>Hemoglobin A1C, B</td>
<td>82080-ROCLIS</td>
<td>6105267</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(Rochester)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hemoglobin A1C, B</td>
<td>82990-ROCLIS</td>
<td>6105673</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(Kasson)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hemoglobin A1C, B</td>
<td>15958-ROCLIS</td>
<td>6112899</td>
</tr>
</tbody>
</table>
Example:
Mapping of Lab Orders

Hgb A1c
Instance of Order

[Image of a computer screen displaying an instance of an order for HbA1C, with fields for label, condition, code, VMR class, effective time, priority code, repeat number, order frequency, nurse or lab draw, and department responsible for order.]
Translation Table

<table>
<thead>
<tr>
<th>/mapping/@context</th>
<th>/mapping/from/concept/@label</th>
<th>/mapping/to/@label</th>
<th>Mayo Lab Code</th>
<th>/mapping/to/@label</th>
</tr>
</thead>
<tbody>
<tr>
<td>order</td>
<td>LOINC:4548-4</td>
<td>Hemoglobin A1C</td>
<td>82080-ROCLISO</td>
<td>XSERVI #</td>
</tr>
</tbody>
</table>
Mapping Challenges

• Mismatch in vocabularies
• Mismatch of data representation
• Absence of data elements in the CIS
Potential Solutions

• Mismatch in vocabularies
  – Petition change in standard
  – Change local vocabulary

• Mismatch of data representation
  – Search the problem list

• Absence of data elements in the CIS
  – Query the user
  – Accept absence
Thanks for your attention..
Questions?