

# MAPPING WITH DESCRIPTION LOGIC

---

An Approach to Data Integration

Geraldine Wade MD  
Clinical Informatics Consulting  
October 28, 2016

# Outline

- Definition
- Challenges
- Use Case
- Purpose
- Method
- Comparison with single concept mapping
- Data quality
- Examples
- Summary

# Definition

Mapping with Description Logic is.....

*....the use of source code sets or legacy terms that map to post-coordinated expressions using SNOMED CT description logic components*

*....to enable the integration of source terms into a single corpus that can be more easily managed and maintained.*

# Challenges

- Existing data (legacy, interface, complex terms, special data sets)
- Evolving requirements
  - a. local (immediate inclusion of terms/outside of release cycle)
  - b. national (data sharing, quality reporting etc.)
- Implementation issues
  - a. speed of term inclusion
  - b. need for harmonization with other code sets
  - c. CDS, patient safety
- Terminology management (limited resources, data quality)

\*SNOMED is becoming more important (either on front end or back end)

# Use Case

- Increasing importance of SNOMED CT adoption
- Need to migrate existing terms (legacy, interface, local) to align with SNOMED CT
- Need to be able to expand your local extension (immediate need for term addition)
- Maintaining “fit for purpose”
- Simplify implementation/ terminology management
- Focus on data quality

GOAL: To transform the source data elements into the SNOMED CT corpus without data loss

# Purpose (why use DL method)

- More complete data representations of source terms through the use of SNOMED CT DL components
- Using SNOMED CT DL components allow for alignment with existing SNOMED CT content
- Source concepts can be directly integrated into the SNOMED CT corpus
- Data integration into a single corpus
- Can use classifier for terminology management/ equivalence testing
- Improve data quality

# Method

- Map source terms using description logic and post-coordinated expressions
- Apply rules for consistency for groups of similar concepts (consider source domains for context)
- Select proximal parent, defining and qualifying relationships (i.e. post-coordinated map)
- Add to SNOMED CT corpus in Protégé
- Evaluate using data quality metrics.....correctness, completeness, consistency, timeliness

# DL Method

## Advantages:

- Uses DL [formal knowledge representation]
- Conforms to OWL EL2 profile [for SNOMED CT/LOINC]
- New concepts are represented and modeled in a compatible data structure (alignment with SNOMED CT)
- Allows for the immediate inclusion of local terms
- Provides constraints, data quality checks/classifier (terminology management)
- Improves data quality from source legacy data

...more complete    ... more correct    ....more consistent  
more concepts are FULLY DEFINED



# Comparison with single concept mapping

- Single concept mapping ....map to best match to a single SNOMED CT concept
- Human subjectivity (BT, NT, =)(closest match), different mapping rules ...unless exact match, there is no semantic equivalency...the degree of “correctness” varies
- How do you apply CDS to BT or NT maps? What will be missed.
- Context of source term often not available
- Maps usually maintained separately from SNOMED CT
- Risk of data loss, overall diminished data quality

# Data quality

Correctness, Consistency, Completeness and Timeliness

*“An ontology that provides a framework of constraints and relationships between concepts”*

- applicable to structured EHR data
- reusable across domains and use cases

Correctness: measures whether data is likely correct between matching datasets

Consistency: accuracy of values and representation of output data

Completeness: are there missing components?

Timeliness: time of the observation, version

*Johnson S. A Data Quality Ontology for the Secondary Use of EHR Data. , AMIA 2015 Annual Symposium*

# Examples

## Map to single target

A	B	C	D	F
Local_Code	Local_Description	Target_Code	Target_Description	Usage_Count
234436	BLADDER NEOPLASM MALIGNANT MULLERIAN MIXED TUMOR	93689003	Primary malignant neoplasm of bladder (disorder)	
234453	BLADDER NEOPLASM MALIGNANT MESODERMAL MIXED TUMOR	399326009	Malignant tumor of urinary bladder (disorder)	
234690	BLADDER NEOPLASM MALIGNANT MESENCHYMOMA	93689003	Primary malignant neoplasm of bladder (disorder)	
234645	BLADDER NEOPLASM MALIGNANT PARAGANGLIOMA	93689003	Primary malignant neoplasm of bladder (disorder)	

Malignant mesodermal mixed tumor of the bladder →  
Malignant tumor of urinary bladder (disorder)

Single target constraint → data loss

## Map to post-coordinated expression (DL approach)

A	B	C	D	F
Local_Code	Local_Description	Target_Code	Target_Description	Usage_Count
234436	BLADDER NEOPLASM MALIGNANT MULLERIAN MIXED TUMOR	93689003	Primary malignant neoplasm of bladder (disord	
234453	BLADDER NEOPLASM MALIGNANT MESODERMAL MIXED TUMOR	399326009	Malignant tumor of urinary bladder (disorder)	
234690	BLADDER NEOPLASM MALIGNANT MESENCHYMOMA	93689003	Primary malignant neoplasm of bladder (disord	
234645	BLADDER NEOPLASM MALIGNANT PARAGANGLIOMA	93689003	Primary malignant neoplasm of bladder (disord	

Post coordinated expression  no data loss

399326009 | malignant tumor of urinary bladder | : 116676008 |  
associated morphology | = 112684005 | mesodermal mixed tumor

## UMLS Terminology Services

### Metathesaurus Browser

Basic View

Report View

Raw View

⊕ **Concept:** [C2212529] **malignant mesodermal mixed tumor of bladder**

⊖ **Semantic Types**

[Neoplastic Process](#) [T191]

⊖ **Atoms (2)** string [AUI / RSAB / TTY / Code]

⊖ malignant mesodermal mixed tumor of bladder [A13849442/MEDCIN/PT/234453]

⊕ **Attributes (1)** Name | Value | RSAB

⊖ **Relations (4)** REL | RELA | RSAB [SType1 - SType2] STypeld | String | CUI

CHD | isa | MEDCIN [SCUI - SCUI] 39016 | malignant neoplasm of bladder | [C0005684](#)

RN | isa | MEDCIN [SCUI - SCUI] 399326009 | Malignant tumor of urinary bladder | [C0005684](#)

RO | has\_finding\_site | MEDCIN [SCUI - SCUI] 89837001 | Urinary bladder structure | [C0005682](#)

RO | has\_associated\_morphology | MEDCIN [SCUI - SCUI] 112684005 | Mesodermal mixed tumor | [C1334603](#)

malignant mesodermal mixed tumor of bladder (diagnosis) [A13877088/MEDCIN/FN/234453]

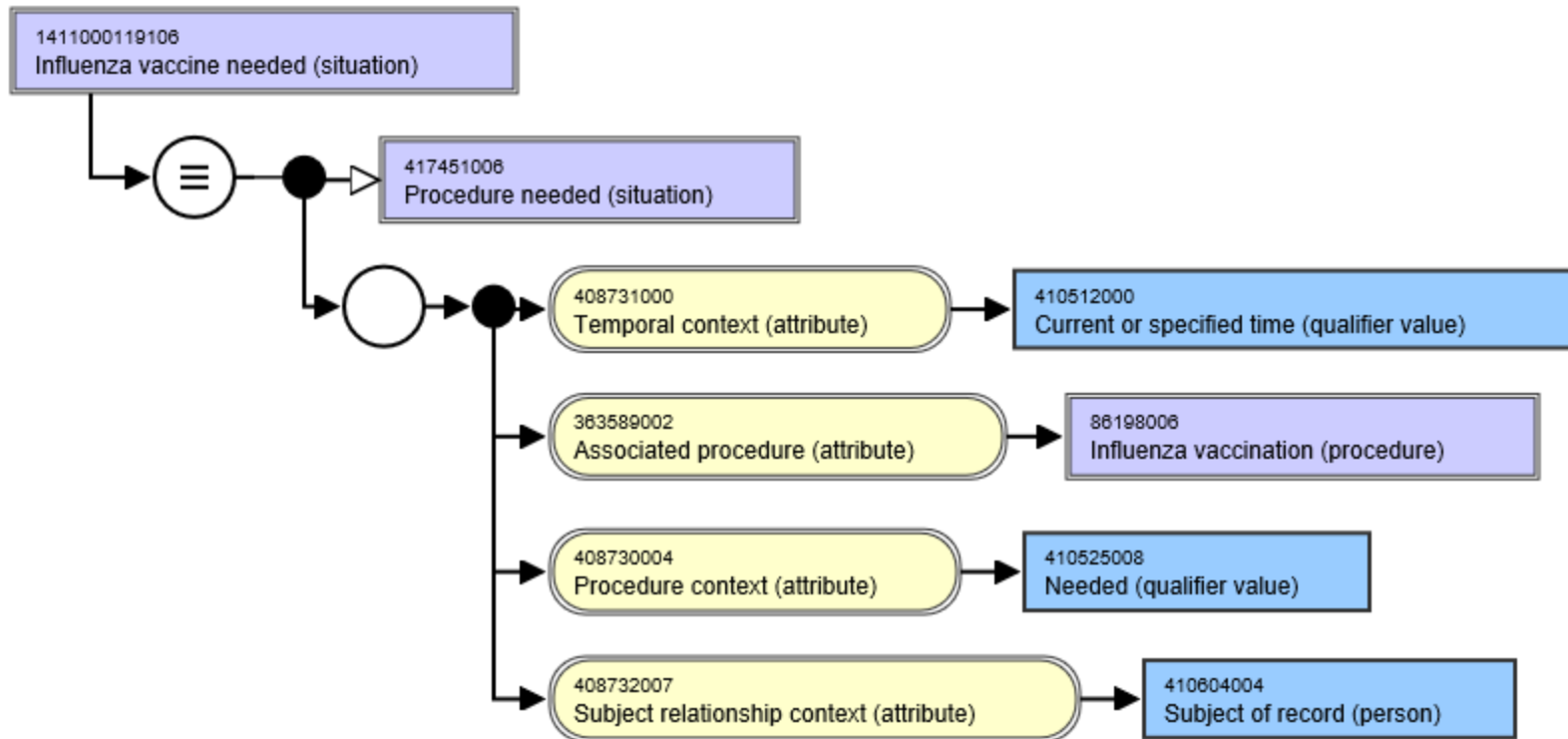
## Single vs post-coordinated map

Source: 132976| Need for rabies vaccination (MEDCIN term)

→ requires rabies vaccination course (finding)

Closest single map → inconsistency/domain change

# Look for similar concept



# UMLS Terminology Services

## Metathesaurus Browser

Basic View

Report View

Raw View

Concept type

[Finding](#) [T033]

[-] **Atoms (13)** string [AUI / RSAB / TTY / Code]

[-] need for rabies vaccination [A13748031/MEDCIN/PT/132976]

⊕ Attributes (1) Name | Value | RSAB

[-] Relations (3) REL | RELA | RSAB [SType1 - SType2] STypeld | String | CUI

CHD | isa | MEDCIN [SCUI - SCUI] 197086 | need for vaccination | [C2193787](#)

RN | isa | MEDCIN [SCUI - SCUI] 417451006 | Procedure needed | [C1562512](#)


RO | has\_associated\_procedure | MEDCIN [SCUI - SCUI] 34631000 | Rabies vaccination | [C0042205](#)

need for rabies vaccination (treatment) [A18093007/MEDCIN/FN/132976]

⊕ need for vaccination rabies [A13996816/MEDCIN/SY/132976]

Requires rabies vaccination course (finding) [A15087253/MTH/PN/NOCODE]


⊕  Requires rabies vacc course [A1266818/RCD/OA/65W6.]

⊕  Requires rabies vaccination course [A1266819/RCD/OP/65W6.]

⊕ requiere una dosis de vacuna antirrábica [A6152861/SCTSPA/PT/170543008]

⊕ requiere una dosis de vacuna antirrábica (hallazgo) [A6152860/SCTSPA/FN/170543008]

⊕ Requires rabies vaccination course [A3269801/SNOMEDCT\_US/PT/170543008]

⊕  Requires rabies vaccination course [A4874126/SNOMEDCT\_US/OF/147797002]



## Single vs post-coordinated map

```
417451006 | procedure needed | : { 363589002 | associated procedure |  
= 34631000 | rabies vaccination | }
```

Can put as rows in table or post-coord expression

Post coordinated expression  consistency/no domain  
change/aligns with current SNOMED CT content

# Data Integration

How to we align these expressions within SNOMED CT?

399326009 | malignant tumor of urinary bladder | : 116676008 |  
associated morphology | = 112684005 | mesodermal mixed tumor

417451006 | procedure needed | : { 363589002 | associated  
procedure | = 34631000 | rabies vaccination | }

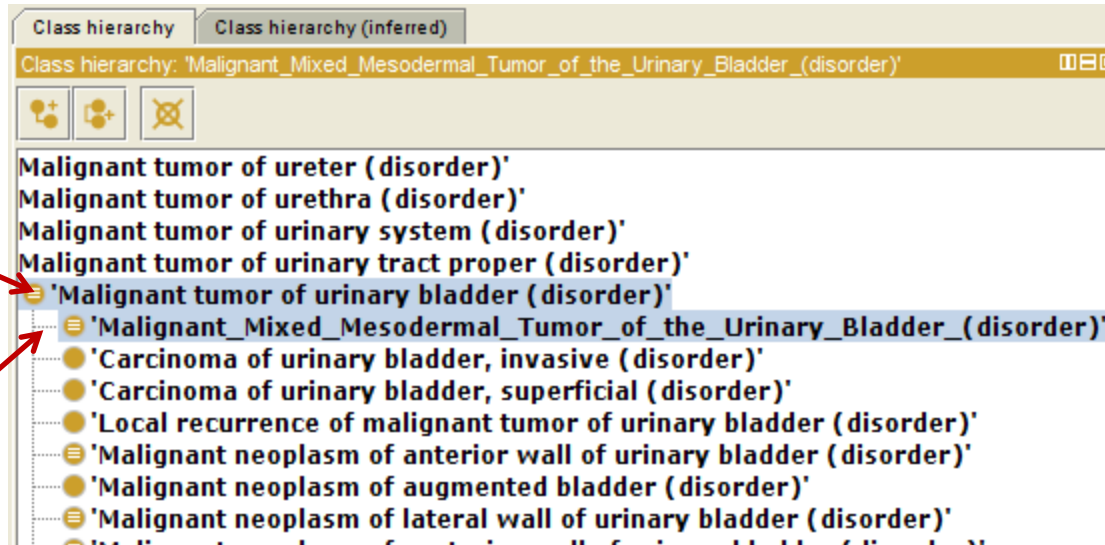
\*Interface terminology can be integrated with the SNOMED CT corpus

# Add concept to SNOMED CT

399326009 | malignant tumor of urinary bladder | : 116676008 |  
associated morphology | = 112684005 | mesodermal mixed tumor

SNOMED CT  
concept

MEDCIN term



# Add relationships/classify

The image shows a software interface for managing relationships and classifications. On the left is a class hierarchy with two tabs: 'Class hierarchy' and 'Class hierarchy (inferred)'. The selected class is 'Malignant\_Mixed\_Mesodermal\_Tumor\_of\_the\_Urinary\_Bladder\_(disorder)'. The hierarchy lists several classes, with 'Malignant tumor of urinary bladder (disorder)' and its subclass 'Malignant\_Mixed\_Mesodermal\_Tumor\_of\_the\_Urinary\_Bladder\_(disorder)' highlighted.

Two panels on the right show 'Equivalent To' relationships with logical expressions:

**Top Panel:** Description: 'Malignant tumor of urinary bladder (disorder)'. Equivalent To: 

- 'Malignant tumor of urinary tract proper (disorder)' and ('Role group (attribute)' some (('Associated morphology (attribute)' some 'Malignant neoplasm of primary, secondary, or uncertain origin (morphologic abnormality)') and ('Finding site (attribute)' some 'Urinary bladder structure (body structure)'))))

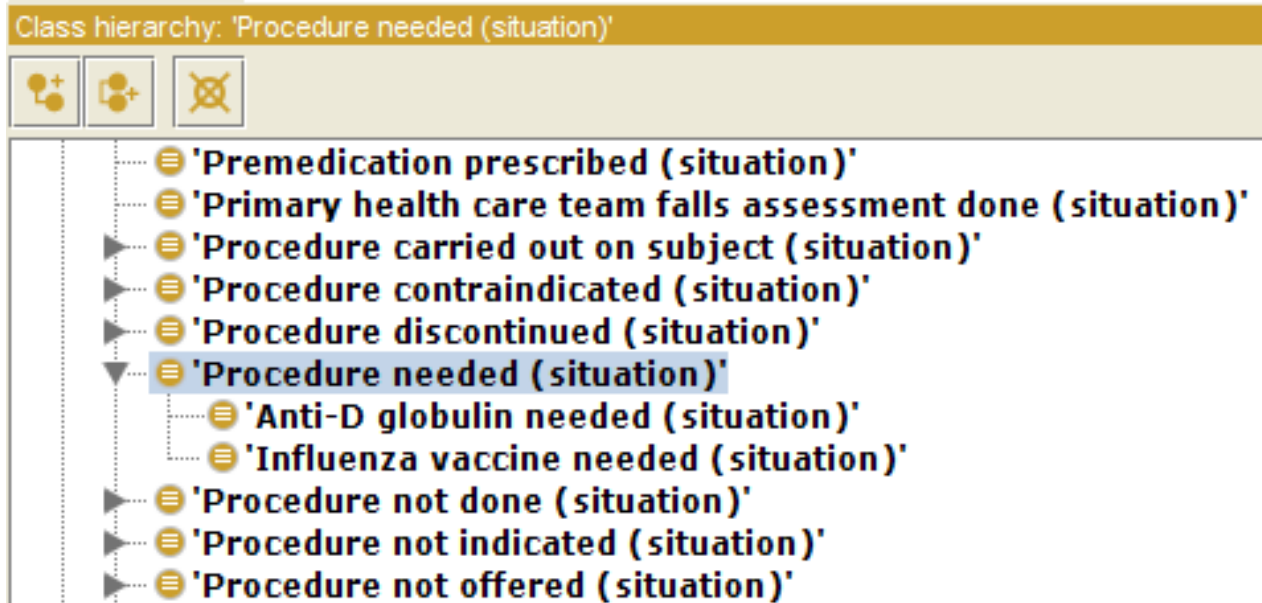
**Bottom Panel:** Description: 'Malignant\_Mixed\_Mesodermal\_Tumor\_of\_the\_Urinary\_Bladder\_(disorder)'. Equivalent To: 

- 'Malignant tumor of urinary bladder (disorder)' and ('Role group (attribute)' some (('Associated morphology (attribute)' some 'Mesodermal mixed tumor (morphologic abnormality)') and ('Finding site (attribute)' some 'Urinary bladder structure (body structure)'))))

A red arrow points from the 'Malignant\_Mixed\_Mesodermal\_Tumor\_of\_the\_Urinary\_Bladder\_(disorder)' class in the hierarchy to the top panel. A blue arrow points from the bottom panel back to the same class in the hierarchy. A blue arrow labeled 'Refinement' points from the top panel to the bottom panel.

# Add concept to SNOMED CT

417451006 | procedure needed | : { 363589002 | associated procedure | = 34631000 | rabies vaccination | }



# Add procedure as Situation/classify

Class hierarchy: 'Procedure needed (situation)'

- 'Premedication prescribed (situation)'
- 'Primary health care team falls assessment done (situation)'
- 'Procedure carried out on subject (situation)'
- 'Procedure contraindicated (situation)'
- 'Procedure discontinued (situation)'
- 'Procedure needed (situation)'
- 'Anti-D globulin needed (situation)'
- 'Influenza vaccine needed (situation)'
- 'Procedure not done (situation)'
- 'Procedure not indicated (situation)'
- 'Procedure not offered (situation)'

Parent concept

Class hierarchy: 'Rabies\_vaccination\_needed\_(situation)'

- 'Premedication prescribed (situation)'
- 'Primary health care team falls assessment done (situation)'
- 'Procedure carried out on subject (situation)'
- 'Procedure contraindicated (situation)'
- 'Procedure discontinued (situation)'
- 'Procedure needed (situation)'
- 'Rabies\_vaccination\_needed\_(situation)'
- 'Anti-D globulin needed (situation)'
- 'Influenza vaccine needed (situation)'
- 'Procedure not done (situation)'
- 'Procedure not indicated (situation)'
- 'Procedure not offered (situation)'
- 'Procedure not wanted (situation)'

Description: 'Rabies\_vaccination\_needed\_(situation)'

Equivalent To +

- 'Procedure needed (situation)'  
and ('Role group (attribute)' some  
 (('Associated procedure (attribute)' some 'Rabies vaccination (procedure)')  
 and ('Procedure context (attribute)' some 'Needed (qualifier value)')  
 and ('Temporal context (attribute)' some 'Current or specified time  
(qualifier value)')  
 and ('Subject relationship context (attribute)' some 'Subject of record  
(person)'))))

# More examples

[MEDCIN term] 141060 | routine gynecological exam visit  
308335008 | patient encounter procedure | :  
363702006 | has focus | = 83607001 | gynecologic examination|  
, 260870009 | priority | = 50811001 | routine |

*\*need mapping rules to apply for consistency across all terms..like all visits...etc.*

[MEDCIN term] 275089 | MALIGNANT PROSTATE NEOPLASM  
STAGE III

399068003 | malignant tumor of prostate | :  
47429007 | associated with | = 369837008 | t3: Prostate tumor extends through the  
prostatic capsule |

No data loss from the original source term.

# Integrating complex terms

right elbow suddenly 'locked up' but can be 'unlocked'  
[MEDCIN ID 112452]



difficult to model interface terms



# Interface terms may be complex

MEDCIN term: “right elbow suddenly ‘locked up’ but can be unlocked”

Class hierarchy: right\_elbow\_suddenly\_locked\_up\_but\_can\_be\_unlocked

- 'Elbow locking (finding)'
  - ≡ right\_elbow\_suddenly\_locked\_up\_but\_can\_be\_unlocked
  - 'Elbow joint red (finding)'
- ▶ 'Finding of elbow joint stability (finding)'
  - 'Flail elbow (finding)'
- ≡ 'Increased active range of elbow extension (finding)'
- ≡ 'Increased active range of elbow flexion (finding)'
- ≡ 'Increased active range of elbow pronation (finding)'

Description: right\_elbow\_suddenly\_locked\_up\_but\_can\_be\_unlocked

Equivalent To +

- 'Elbow locking (finding)'
  - and ('Role group (attribute)' some  
(('Finding site (attribute)' some 'Elbow joint structure (body structure)')  
and ('Laterality (attribute)' some 'Right (qualifier value)'))

Can add as a primitive concept

# Summary

- Mapping with DL enables direct data integration into the SNOMED CT using existing DL components
- Improves data quality in terms of completeness, correctness and consistency....more FULLY DEFINED terms
- Maintenance of interface concepts in one location
- Allows for the immediate entry of local terms
- Has “built in” quality checks through use of classifier
- Terminology management
- Patient safety is the most important outcome – focus on implementation....CDS components...limited number of concepts and nodes