Authors: Lopez Osornio Alejandro [3 2], Campbell James [1], Campbell W. Scott [1], Gonzalez Bernaldo de Quiros Fernan [3], Luna Daniel [3], Reynoso Guillermo [2]

Affiliation: University of Nebraska Medical Center, Omaha, USA [1], termMed IT [2], Hospital Italiano de Buenos Aires [3]

INTEROPERATION OF SNOMED CT PROBLEM LIST WITHIN THE AMERICAS

Semantic interoperability

- *"The ability to automatically interpret exchanged information meaningfully and accurately in order to produce useful results as defined by the end users of both systems"*
- *Tag level interoperation employs only coded concepts published by a standard developer such as the IHTSDO*
- *Taxonomic interoperation employs a concept code supplemented by one or more subtype (IS_A) relationships to more general concepts*
- *Full ontologic interoperation employs a reference conceptual model to define meaning and shares complete description logic computable definitions for all new content*
- Full ontologic semantic interoperability is the ultimate business case for SNOMED CT; this includes requirements for health care information exchange as well as decision support in the sending and recipient system
- Let's try it…
  - Tested in 2007 (Presented in Medinfo)
  - New test in 2015

HOSPITAL ITALIANO de Buenos Aires

termMed

UNMC UNIVERSITY OF NEBRASKA MEDICAL CENTER

Objectives

- Characterize interoperation between two similar health centers
  - Hospital Italiano of Buenos Aires, Argentina
  - University of Nebraska Medical Center, Omaha, USA

- Both are academic hospitals with problem oriented electronic medical records
- Both have created local terminology enhancements modeled and maintained as SNOMED CT Extensions

HOSPITAL ITALIANO de Buenos Aires

termMed

UNMC UNIVERSITY OF NEBRASKA MEDICAL CENTER

Methodology

- Describe the general composition of the local interface terminologies in each center
- Select the top 1,000 concepts by frequency of use in the problem list of each center
- Evaluate the semantic interoperability of each extension using the SNOMED CT concept model and a Description Logic classifier
- Perform exhaustive analysis on ~250 extension concepts from each site to evaluate for compliance with SNOMED CT concept model and identification of modeling errors

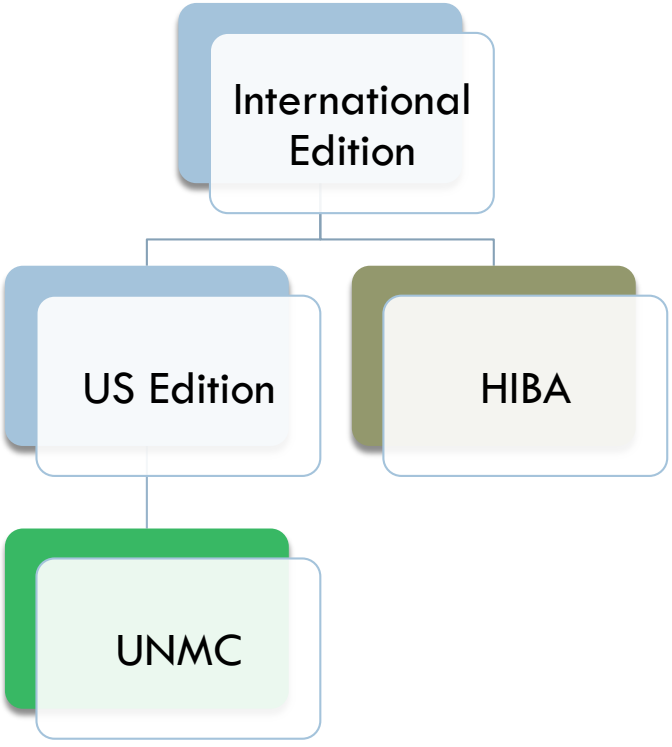
HOSPITAL ITALIANO de Buenos Aires

termMed

UNMC UNIVERSITY OF NEBRASKA MEDICAL CENTER

Interoperation pre-conditions

- Extension content definitions are asserted dependent upon the international module and sometimes national modules
- Extension meaning also depends on the publication date since modules change content over time



HOSPITAL ITALIANO de Buenos Aires

termMed

UNMC
UNIVERSITY OF NEBRASKA MEDICAL CENTER

Interoperation

- Pre-coordinated concepts may be:
  - Fully defined concepts – support full ontologic interoperation; hierarchy and equivalency can be inferred by the classifier
  - Primitive concepts – support only taxonomic interoperation
- Post-coordinated concepts likewise may be:
  - Primitive concepts – supporting taxonomic interoperation
  - Fully defined concepts - DL Classifier can check and adjust hierarchy but also identify semantically equivalent concepts

Interoperation Level

HIBA

UNMC

	Pre-coordinated	Pos-coordinated
Pre-Coordinated	Tag Level	Primitive → Taxonomic Suff. Def. → Full
Post-Coordinated	Primitive → Taxonomic Suff. Def. → Full	Primitive → Taxonomic Suff. Def. → Full

HOSPITAL ITALIANO de Buenos Aires

termMed

UNMC UNIVERSITY OF NEBRASKA MEDICAL CENTER

Definitions – Exhaustive analysis

- True positive: Concepts from different modules that are identified by DL as equivalent and are subsequently confirmed as semantically identical on detailed terminological analysis

Interoperation errors that can occur:

- False positive: Concepts that classify as equivalent but are semantically different on analysis
- False negative (masked synonymy): Two concepts that classify as not equivalent but are identical in meaning on terminological analysis

HOSPITAL ITALIANO de Buenos Aires

termMed

UNMC UNIVERSITY OF NEBRASKA MEDICAL CENTER

Descriptive stats from 2007

	Nebraska	H Italiano	Merged
Pre-coordinated	9734 (94.3%)	7666 (23.7%)	14069 (35.7%)
Post-coordinated	585 (5.7%)	24727 (76.3%)	25312 (64.3%)
Total concepts	10319	32393	39381

Problem list subsets at the two institutions were notably different in concept inventory, frequency of post-coordination and semantics. This table summarizes the number of concepts at each institution that were pre- and post-coordinated.

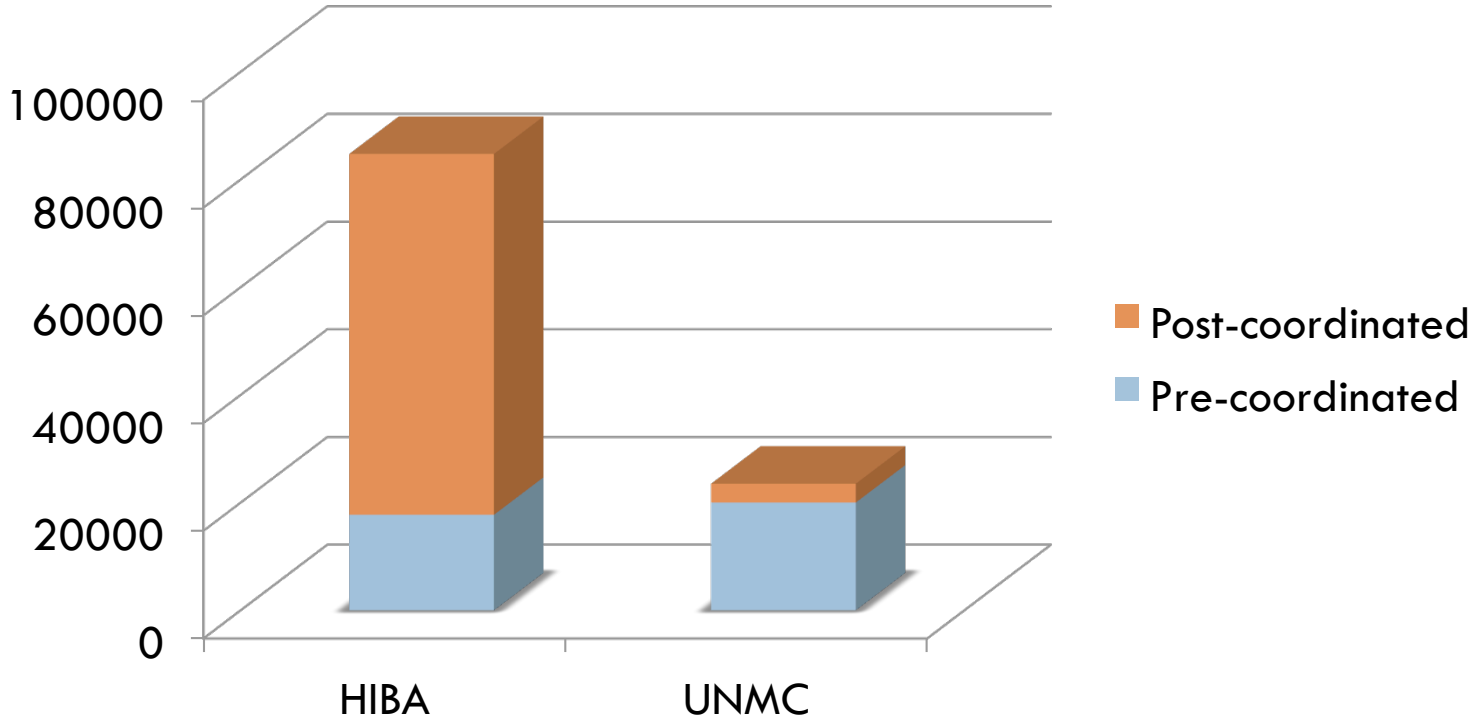
Results from 2007

Failure of post-coordination	
Vague source concept utterance	3 (1.2%)
Limited expressiveness of SNOMED model	3 (1.2%)
Conflict of SNOMED guidance	9 (3.6%)
Non-compliance with SNOMED editorial guidelines	72 (28.85)
Subtotal of classification errors	87 (34.8%)
Masked synonymy	3 (1.2%)

We sampled 250 concepts classified as unique from the merged subset and systematically evaluated the post-coordination and classification output for accuracy. Our review supported reasonable and accurate performance of semantic equivalency testing in 64.8% of cases. This table summarizes the problems we identified during detailed study of the classifier analysis of post-coordinated concepts.

Descriptive stats 2015

- Extension composition



HOSPITAL ITALIANO de Buenos Aires

termMed

UNMC
UNIVERSITY OF NEBRASKA MEDICAL CENTER

Results 2015

- HIBA Top 1,000 concepts in use:
  - 759 Pre-coordinated concepts
  - 241 Post-coordinated concepts
    - 35% Primitive 65% Fully defined

- UNMC Top 1,000:
  - 980 Pre-coordinated concepts
  - 5 Neb+15 US Post-coordinated concepts
    - 16% Primitive 84% Fully defined

HOSPITAL ITALIANO de Buenos Aires

termMed

UNMC UNIVERSITY OF NEBRASKA MEDICAL CENTER

Exhaustive Analysis

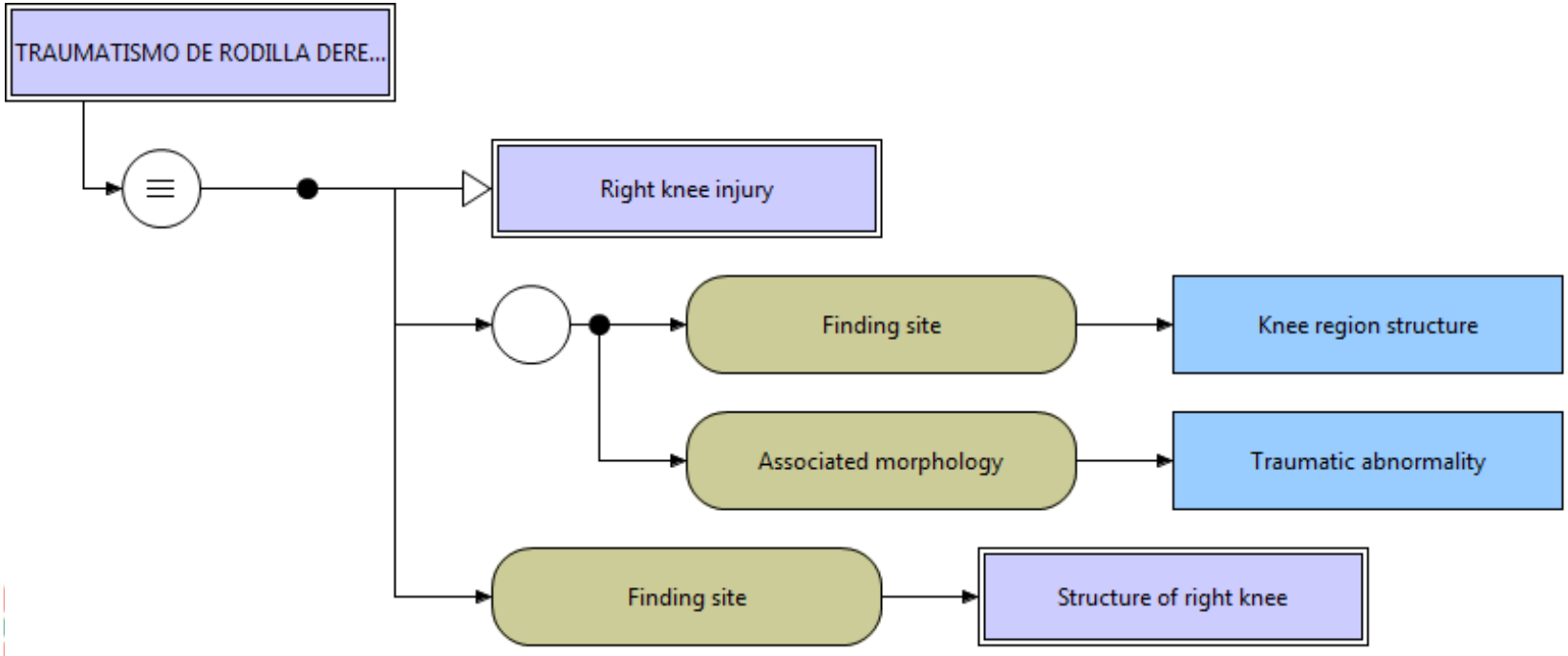
DL Equivalence (True positive HIBA - Neb)
187351000999104|Traumatismo de rodilla derecha|

13260001000004107|Right knee injury|:

363698007|Finding site| = 6757004|Structure of right knee|

{ 363698007|Finding site| = 72696002|Knee region structure|,

116676008|Associated morphology| = 19130008|Traumatic abnormality|}



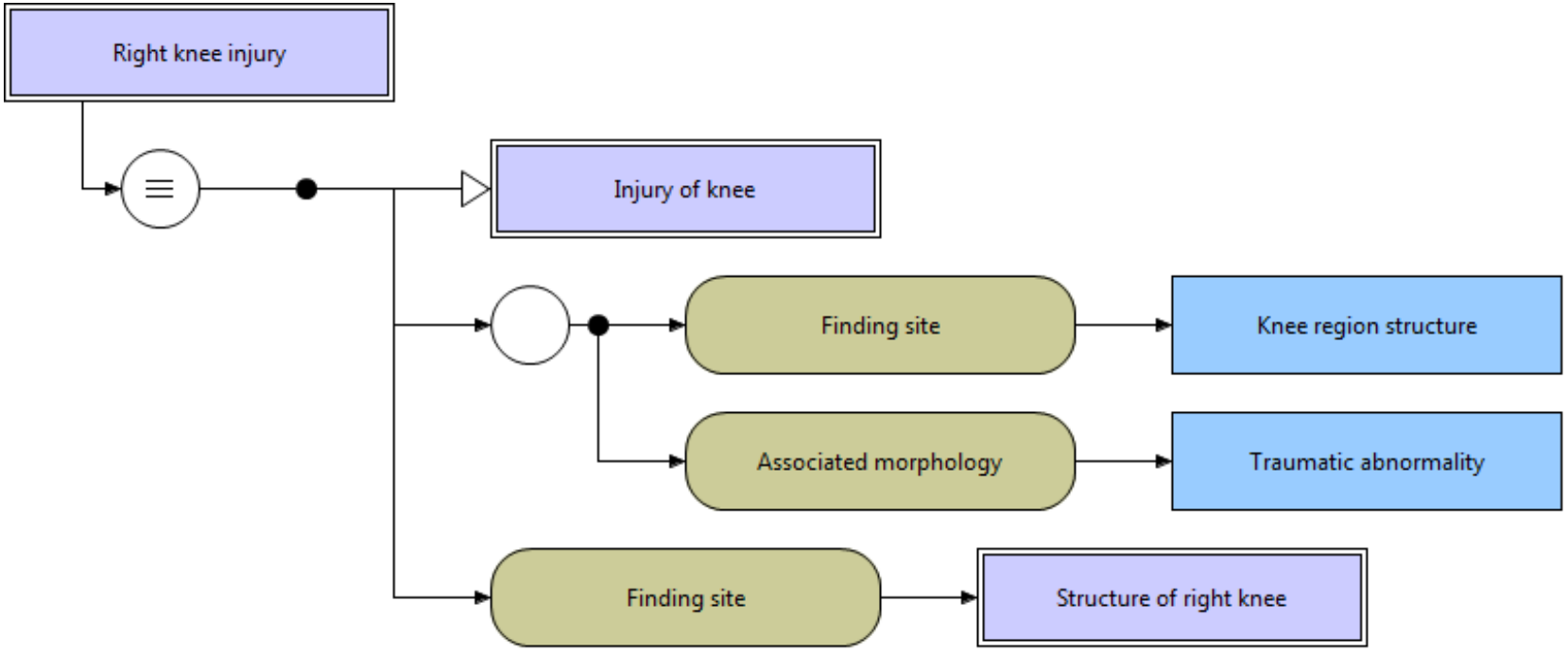
DL Equivalence
132600010000004100|Right knee injury|

125601008|Injury of knee|:

363698007|Finding site| = 6757004|Structure of right knee|

{ 363698007|Finding site| = 72696002|Knee region structure|,

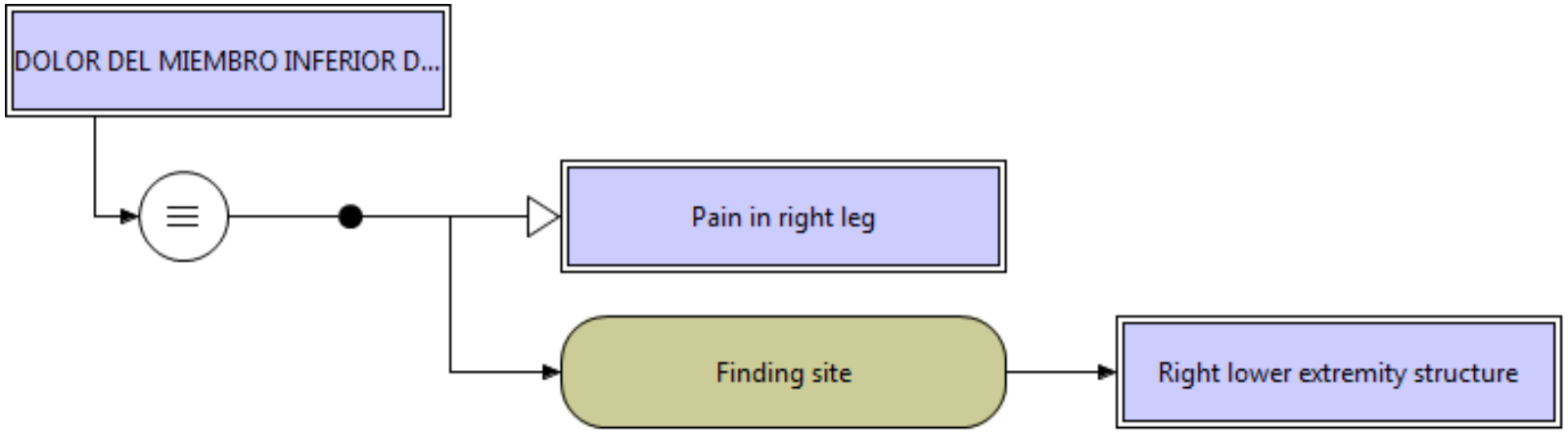
116676008|Associated morphology| = 19130008|Traumatic abnormality|}



DL Equivalence (True positive HIBA – Intnl)

51207100099102|Dolor del miembro inferior derecha|

287048003|Pain in right leg|:363698007|Finding site| = 62175007|Right lower extremity structure|



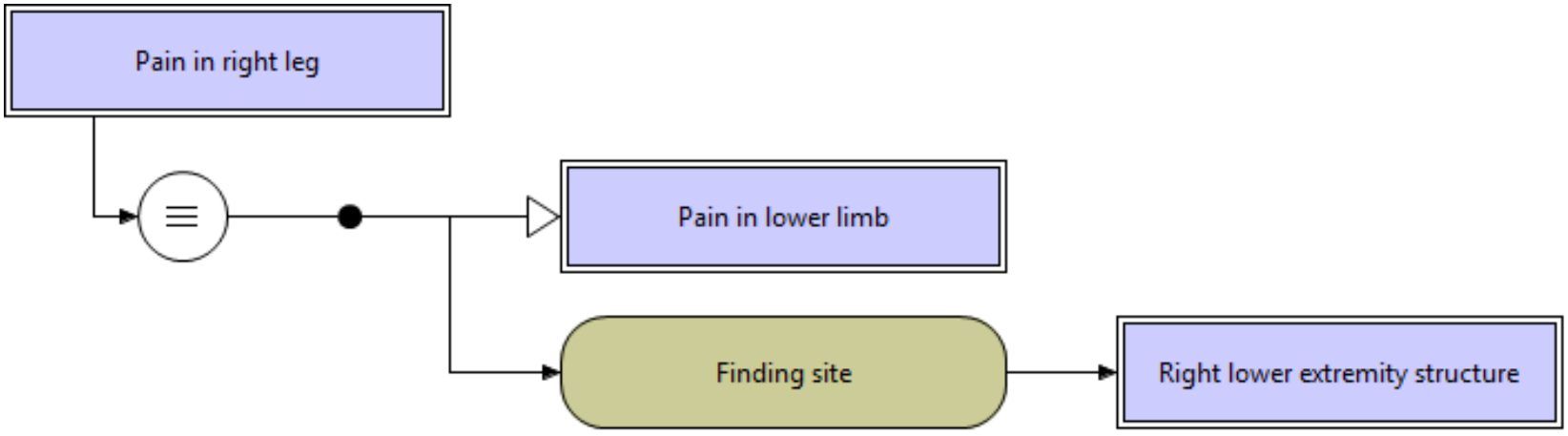
HOSPITAL ITALIANO de Buenos Aires

termMed

UNMC UNIVERSITY OF NEBRASKA MEDICAL CENTER

DL Equivalence
287048003|Pain in right leg|

10601006|Pain in lower limb|:363698007|Finding site| = 62175007|Right lower extremity structure|



HOSPITAL ITALIANO de Buenos Aires

termMed

UNMC
UNIVERSITY OF NEBRASKA MEDICAL CENTER

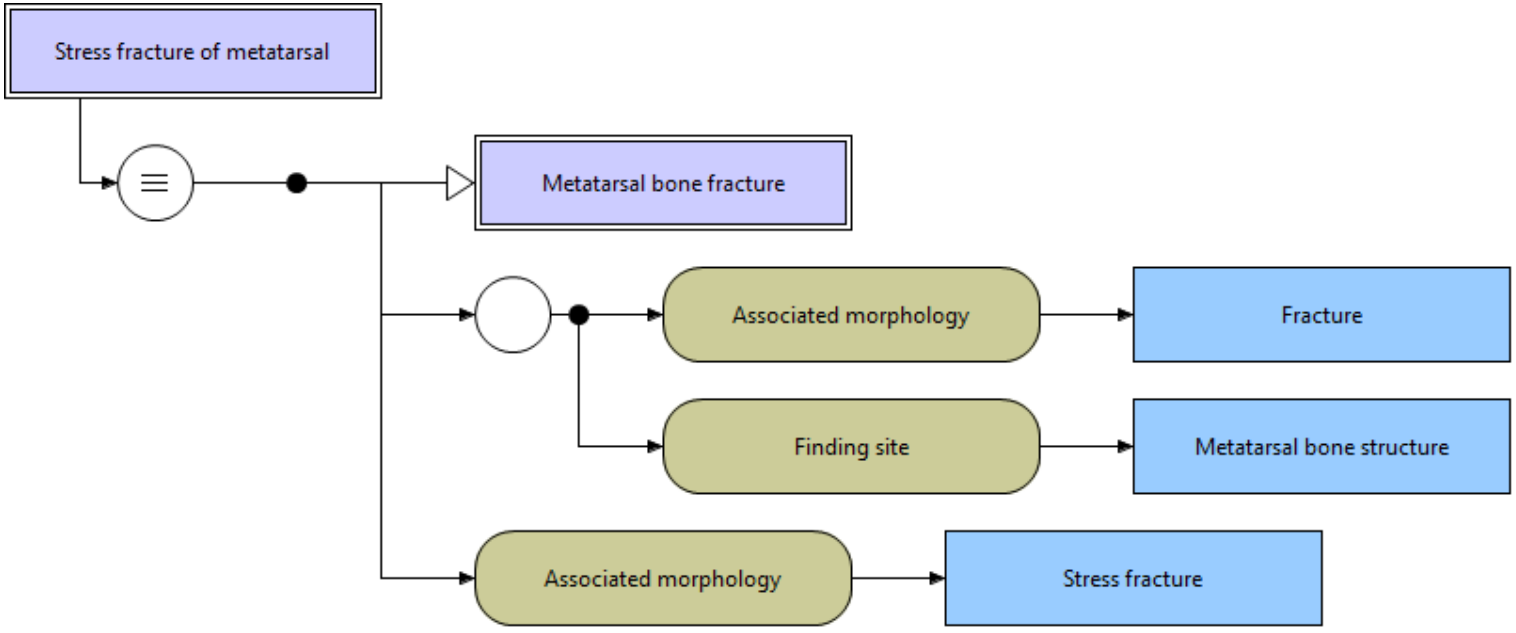
Masked synonymy - False negative
Fractura de stress de metatarso

263251009|Metatarsal bone fracture|:

116676008|Associated morphology| = 23382007|Stress fracture

{ 116676008|Associated morphology| = 72704001|Fracture|,

363698007|Finding site| = 53884002|Metatarsal bone structure|}



HOSPITAL ITALIANO de Buenos Aires

termMed

UNMC UNIVERSITY OF NEBRASKA MEDICAL CENTER

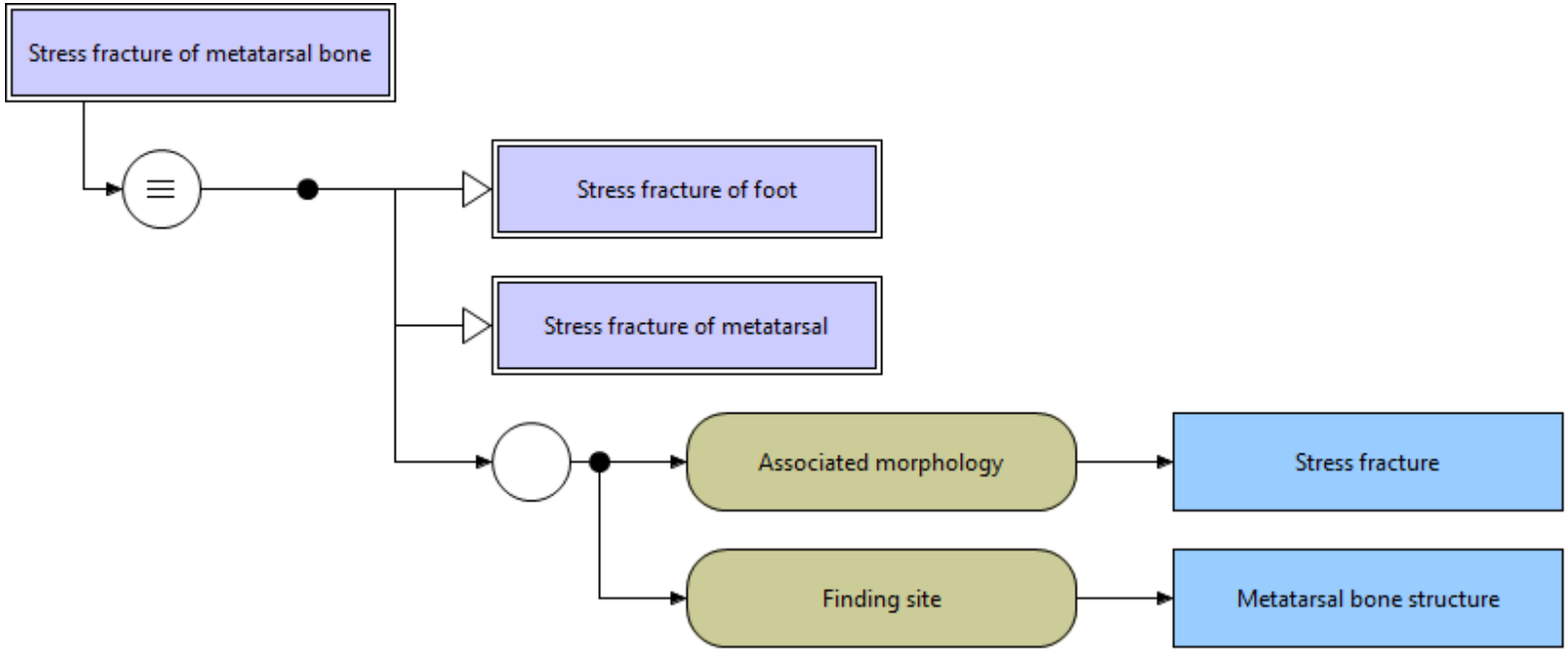
Stress fracture of metatarsal bone

704065008|Stress fracture of foot| +

17340001000004100|Stress fracture of metatarsal|:

{ 116676008|Associated morphology| = 23382007|Stress fracture|,

363698007|Finding site| = 53884002|Metatarsal bone structure|}



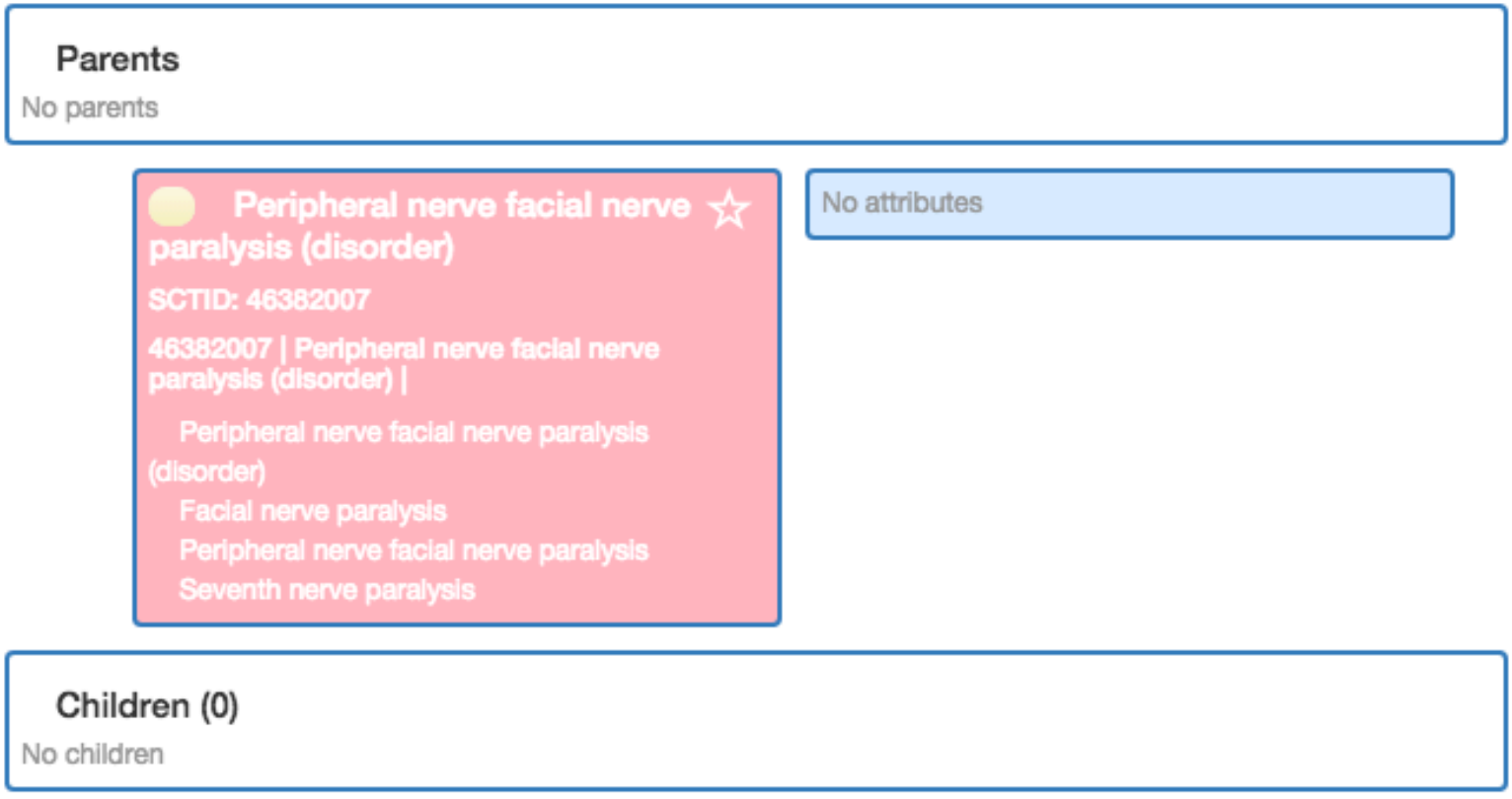
HOSPITAL ITALIANO de Buenos Aires

termMed

UNMC UNIVERSITY OF NEBRASKA MEDICAL CENTER

Concept definition employs inactive concept:

"Right facial palsy"



HOSPITAL ITALIANO de Buenos Aires

termMed

UNMC
UNIVERSITY OF NEBRASKA MEDICAL CENTER

Outdated concept definition: "Right facial palsy"

Attribute Value Refset name

Concept inactivation indicator attribute value reference set (foundation metadata concept)

Ambiguous component (foundation metadata concept)

Association Refset name

POSSIBLY EQUIVALENT TO association reference set (foundation metadata concept)

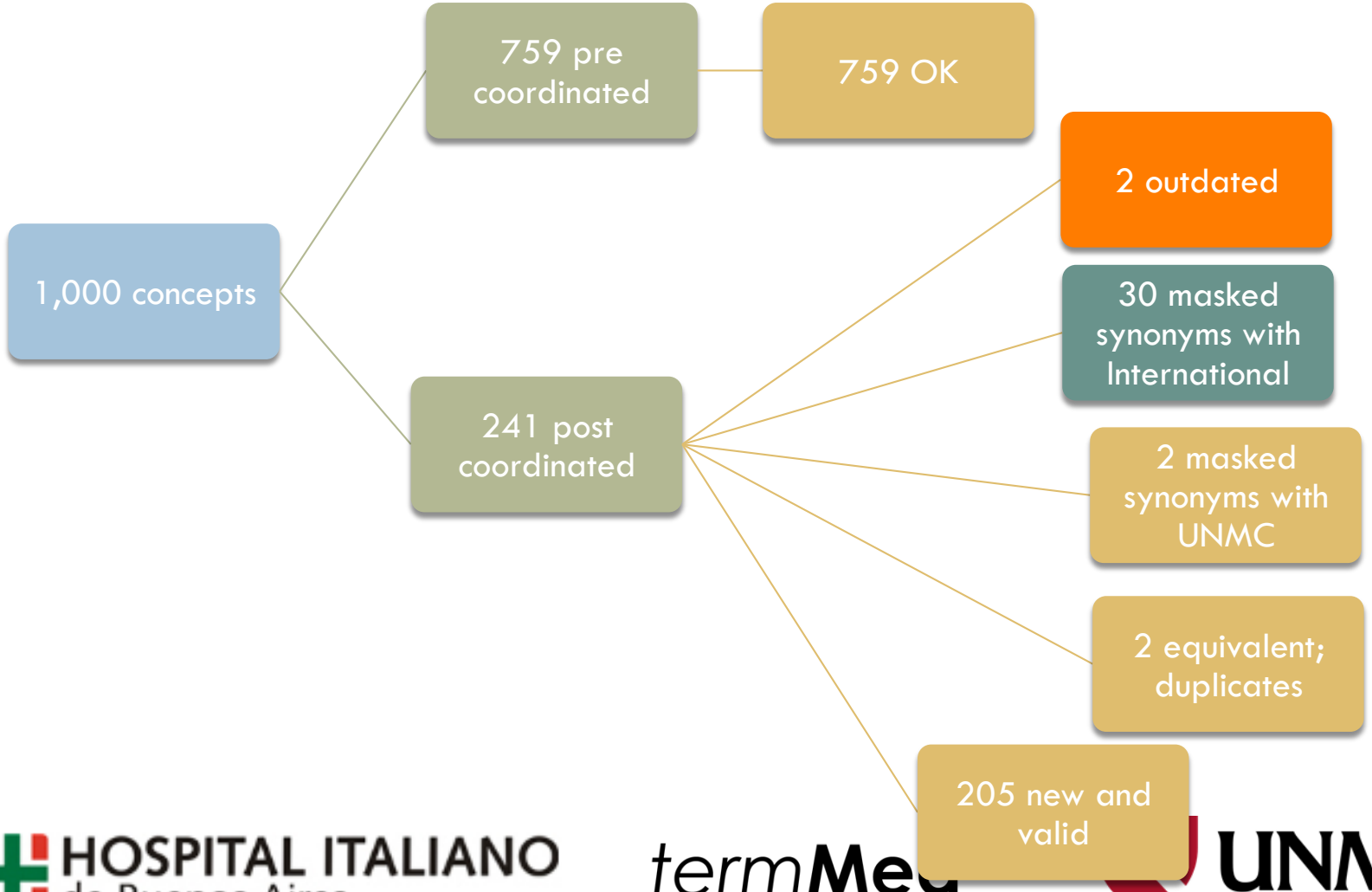
Facial palsy (disorder)

HOSPITAL ITALIANO de Buenos Aires

termMed

UNMC UNIVERSITY OF NEBRASKA MEDICAL CENTER

HIBA → UNMC

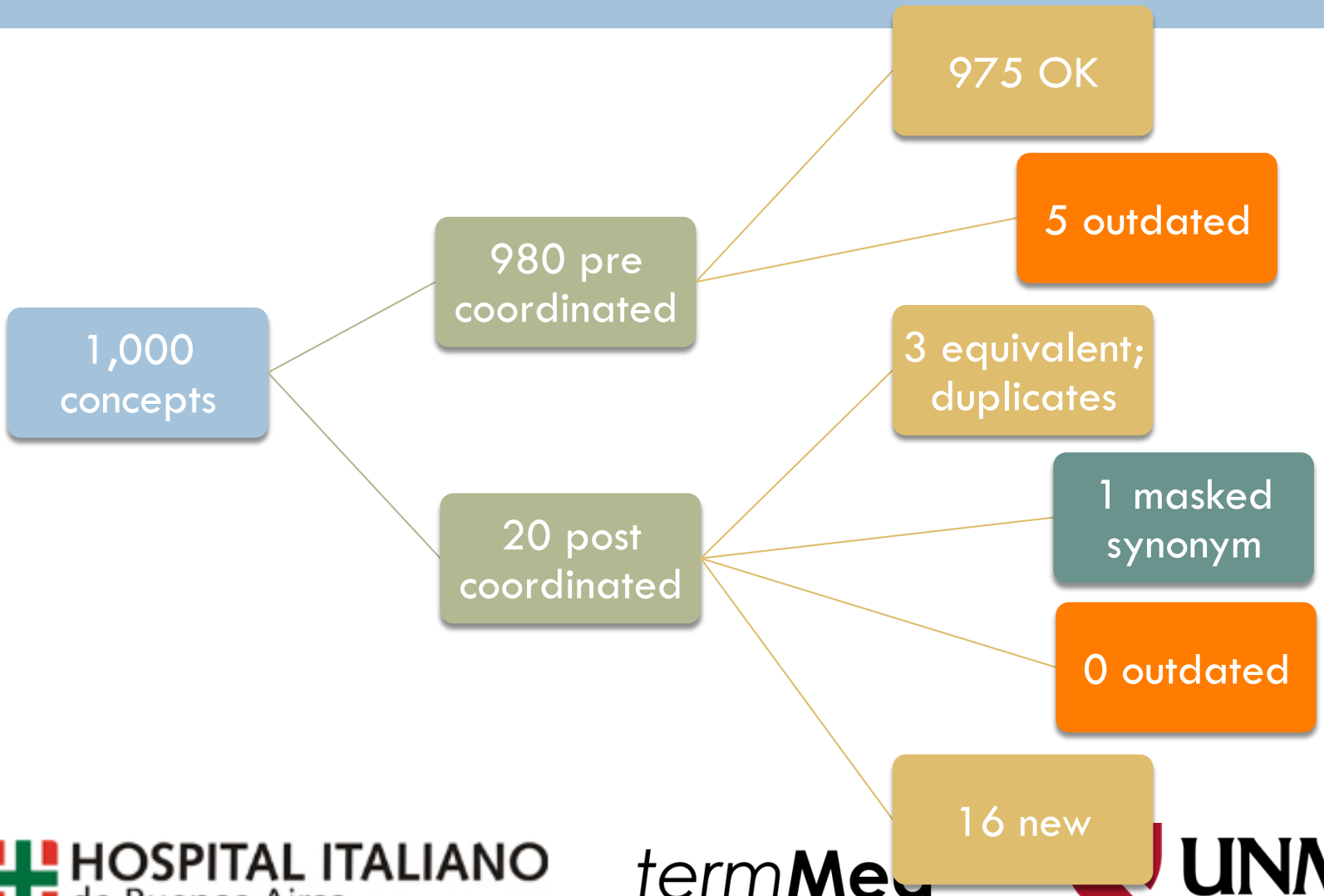


HOSPITAL ITALIANO de Buenos Aires

termMed

UNMC
UNIVERSITY OF NEBRASKA MEDICAL CENTER

UNMC → HIBA



HOSPITAL ITALIANO de Buenos Aires

termMed

UNMC
UNIVERSITY OF NEBRASKA MEDICAL CENTER

Interoperation scorecard

Taxonomic level score = % of valid definitions

Ontological level score = Taxonomic level - % of primitives

	Tag level	Taxonomic level	Ontological level
HIBA Extension - Neb	100%	99.8%	64.8%
Neb Extension - HIBA	100%	99.5%	83.5%
Intnl Clinical Findings	100%	100%	37.5%
Intnl Situations	100%	100%	60.2%

HOSPITAL ITALIANO de Buenos Aires

termMed

UNMC UNIVERSITY OF NEBRASKA MEDICAL CENTER

Root causes of DL classification failure

- Primitive concepts in the international release; these change DL classification of extension concept
- International concepts inactivated or moved to other hierarchies; release date discrepancies
- Extension concepts modeled as primitive
- Inconsistent use of role groups in concept definitions
- Ambiguity in proper application of concept model including degree of complexity of concept definition

HOSPITAL ITALIANO de Buenos Aires

termMed

UNMC UNIVERSITY OF NEBRASKA MEDICAL CENTER

Discussion

- Editorial management of international release and all extensions are critical to interoperability
- What should be the protocol for arbitrating between different editorial release dates when sharing content?
  - Using historical associations for inactive content
- Do we have reference for the best way to communicate post-coordinated concept definitions? RF2 has limitations!
  - SNOMED CT Expressions, nested definitions
- The importance of local Quality Assurance

HOSPITAL ITALIANO de Buenos Aires

termMed

UNMC UNIVERSITY OF NEBRASKA MEDICAL CENTER

THANKS!
GRACIAS!