SNOMED CT Implementation Showcase
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Criteria and metrics for assessing the quality of SNOMED CT value sets in clinical quality measures

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Objective

- To assess the quality of individual SNOMED CT value sets in clinical quality measures

- Context: "Meaningful Use" incentive program
  - Electronic clinical quality measures (eMeasures)
  - Leveraging data in EHR systems
  - Based on standard vocabularies
    - SNOMED CT for diagnoses, procedures and interventions
    - 586 of the 817 data elements (72%) have value sets are defined in reference to SNOMED CT

Example of eMeasure

- eMeasure (clinical quality measure)
  - Hemoglobin A1c Test for Pediatric Patients (CMS148v2)
- Description
  - Percentage of patients 5-17 years of age with diabetes with an HbA1c test during the measurement period
- Implementation

$$= \frac{\text{\# diabetic patients [age 5-17] } \textit{tested for HbA1c}}{\text{\# diabetic patients [age 5-17]}}$$

Example of value set

- Diabetes mellitus in SNOMED CT
  - 38 codes
  - Selected manually by experts

190330002	Diabetes mellitus, juvenile type, with hyperosmolar coma (disorder)
190331003	Diabetes mellitus, adult onset, with hyperosmolar coma (disorder)
190368000	Type I diabetes mellitus with ulcer (disorder)
190369008	Type I diabetes mellitus with gangrene (disorder)
190372001	Type I diabetes mellitus maturity onset (disorder)
190389009	Type II diabetes mellitus with ulcer (disorder)
190390000	Type II diabetes mellitus with gangrene (disorder)
[…]	

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190372001	Type I diabetes mellitus maturity onset (disorder)
190389009	Type II diabetes mellitus with ulcer (disorder)
190390000	Type II diabetes mellitus with gangrene (disorder)
199223000	Diabetes mellitus during pregnancy, childbirth and the puerperium (disorder)
199225007	Diabetes mellitus during pregnancy - baby delivered (disorder)
199226008	Diabetes mellitus in the puerperium - baby delivered during current episode of care (disorder)
199227004	Diabetes mellitus during pregnancy - baby not yet delivered (disorder)
199228009	Diabetes mellitus in the puerperium - baby delivered during previous episode of care (disorder)
199229001	Pre-existing diabetes mellitus, insulin-dependent (disorder)
199230006	Pre-existing diabetes mellitus, non-insulin-dependent (disorder)
23045005	Insulin dependent diabetes mellitus type IA (disorder)
237599002	Insulin-treated non-insulin-dependent diabetes mellitus (disorder)
237618001	Insulin-dependent diabetes mellitus secretory diarrhea syndrome (disorder)
81531005	Diabetes mellitus type 2 in obese (disorder)
9859006	Insulin-resistant diabetes mellitus AND acanthosis nigricans (disorder)

Value Set Authority Center
U.S. National Library of Medicine

https://vsac.nlm.nih.gov/

Welcome | Search Value Sets | Download | Help

Apply Filters | Clear Filters

Narrow search results by selecting from pull-down menus below:

CMS eMeasure (NQF Number)
CMS148v2 (0060)

Quality Data Model Category
Select

Value Set Developer
Select

Meaningful Use Measures
Select

Code System
SNOMEDCT

Search the NLM Value Set Repository

Query: Enter value set id, codes, words... Search

Search Results | Value Set Details

Value Set Information Definition ID 20130614

Export Value Set Results (Excel)

Metadata
Member Of

Name: Diabetes
Type: Extensional
Note:

OID: 2.16.840.1.113883.3.464.1003.103.11.1003
Developer: National Committee for Quality Assurance

Value Set Members Expansion ID 20121025

Expanded Code List

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Code	Descriptor	Code System	Version	Code System OID
190330002	Diabetes mellitus, juvenile type, with hyperosmolar coma (disorder)	SNOMEDCT	2013-01	2.16.840.1.113883.6.96
190331003	Diabetes mellitus, adult onset, with hyperosmolar coma (disorder)	SNOMEDCT	2013-01	2.16.840.1.113883.6.96
190368000	Type I diabetes mellitus with ulcer (disorder)	SNOMEDCT	2013-01	2.16.840.1.113883.6.96
190369008	Type I diabetes mellitus with gangrene (disorder)	SNOMEDCT	2013-01	2.16.840.1.113883.6.96
190372001	Type I diabetes mellitus maturity onset (disorder)	SNOMEDCT	2013-01	2.16.840.1.113883.6.96
190389009	Type II diabetes mellitus with ulcer (disorder)	SNOMEDCT	2013-01	2.16.840.1.113883.6.96
[illegible]	Type II diabetes mellitus with gangrene (disorder)	[illegible]	2013-01	2.16.840.1.113883.6.96
44054006	Diabetes mellitus type 2 (disorder)	SNOMEDCT	2013-01	2.16.840.1.113883.6.96
46635009	Diabetes mellitus type 1 (disorder)	SNOMEDCT	2013-01	2.16.840.1.113883.6.96
4783006	Maternal diabetes mellitus with hypoglycemia affecting fetus OR newborn (disorder)	SNOMEDCT	2013-01	2.16.840.1.113883.6.96
75682002	Diabetes mellitus due to insulin receptor antibodies (disorder)	SNOMEDCT	2013-01	2.16.840.1.113883.6.96
76751001	Diabetes mellitus in mother complicating pregnancy, childbirth AND/OR puerperium (disorder)	SNOMEDCT	2013-01	2.16.840.1.113883.6.96
81531005	Diabetes mellitus type 2 in obese (disorder)	SNOMEDCT	2013-01	2.16.840.1.113883.6.96
9859006	Insulin-resistant diabetes mellitus AND acanthosis nigricans (disorder)	SNOMEDCT	2013-01	2.16.840.1.113883.6.96

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Quality criteria for value sets

- Completeness
  - A value set should contain all the relevant codes for a particular data element
- Correctness
  - A value set should contain only the relevant codes for a particular data element

- What are the relevant codes for a given data element?

Relevant codes for a data element

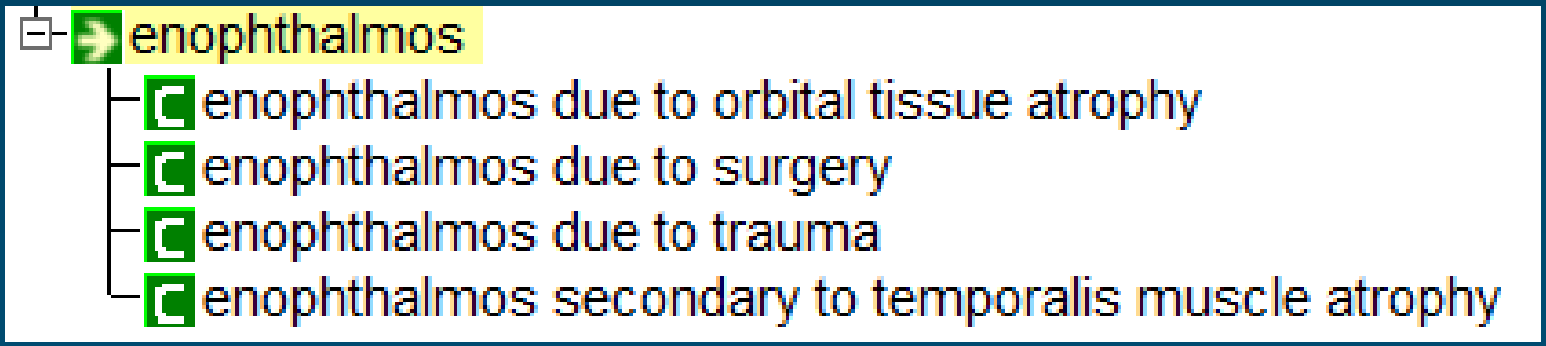
- The code corresponding to the data element in the code system should be present in the value set, along with all its descendants
- The value set is expected to be rooted by one concept and to contain all the descendants of this root concept

Example Enophthalmos value set

- Part of an eMeasure about cataract complications
- 5 SNOMED CT codes

14858001	Enophthalmos due to surgery (disorder)
194029009	Enophthalmos due to orbital tissue atrophy (disorder)
52102006	Enophthalmos due to trauma (disorder)
80093006	Enophthalmos (disorder)
95773007	Enophthalmos secondary to temporalis muscle atrophy (disorder)

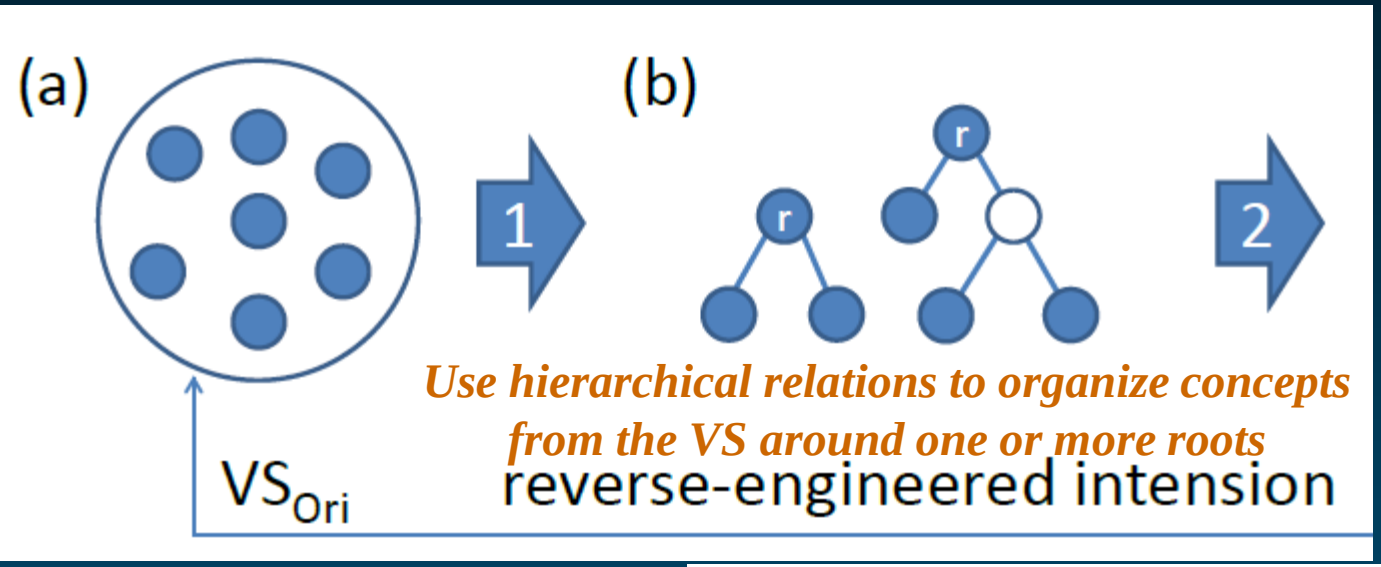
- Enophthalmos subtree in SNOMED CT

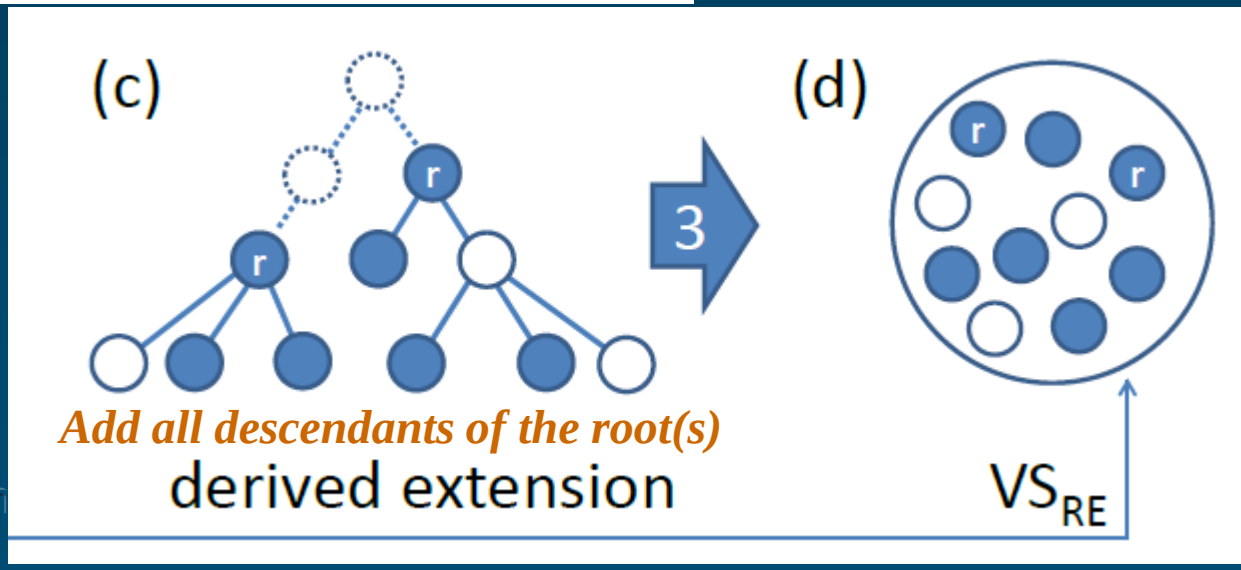


Example Enophthalmos value set

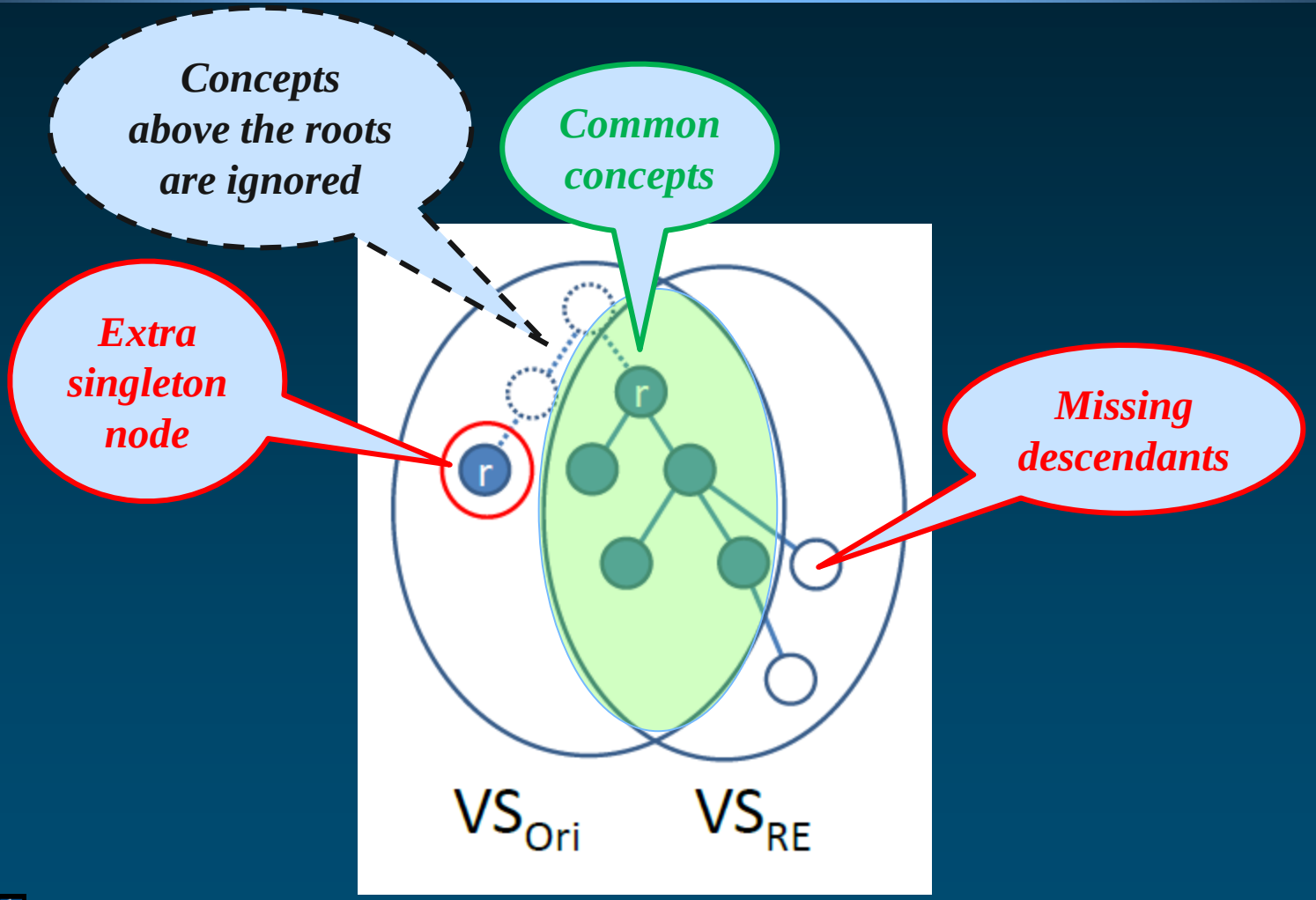
- Ideal case
- Original VS
  - Has only 1 root (Enophthalmos)
  - Includes all the descendants of the root
    - Completeness = 100%
  - Does not include any other concepts
    - Correctness = 100%

Establishing the expected value set

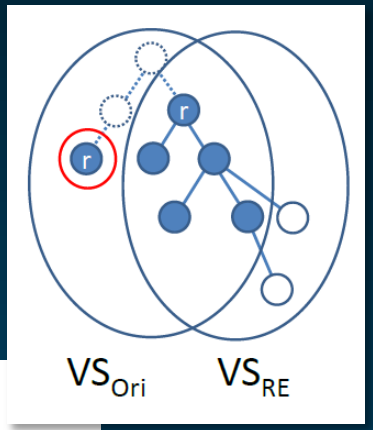




Comparing original and expected VSs



Completeness and Correctness metrics



Completeness

$$Compl\ (VS_{Ori}) = |VS_{Ori} \cap VS_{RE}| \ / \ |VS_{RE}|$$

5/7

Evaluates the proportion of VS_{RE} covered by VS_{Ori}

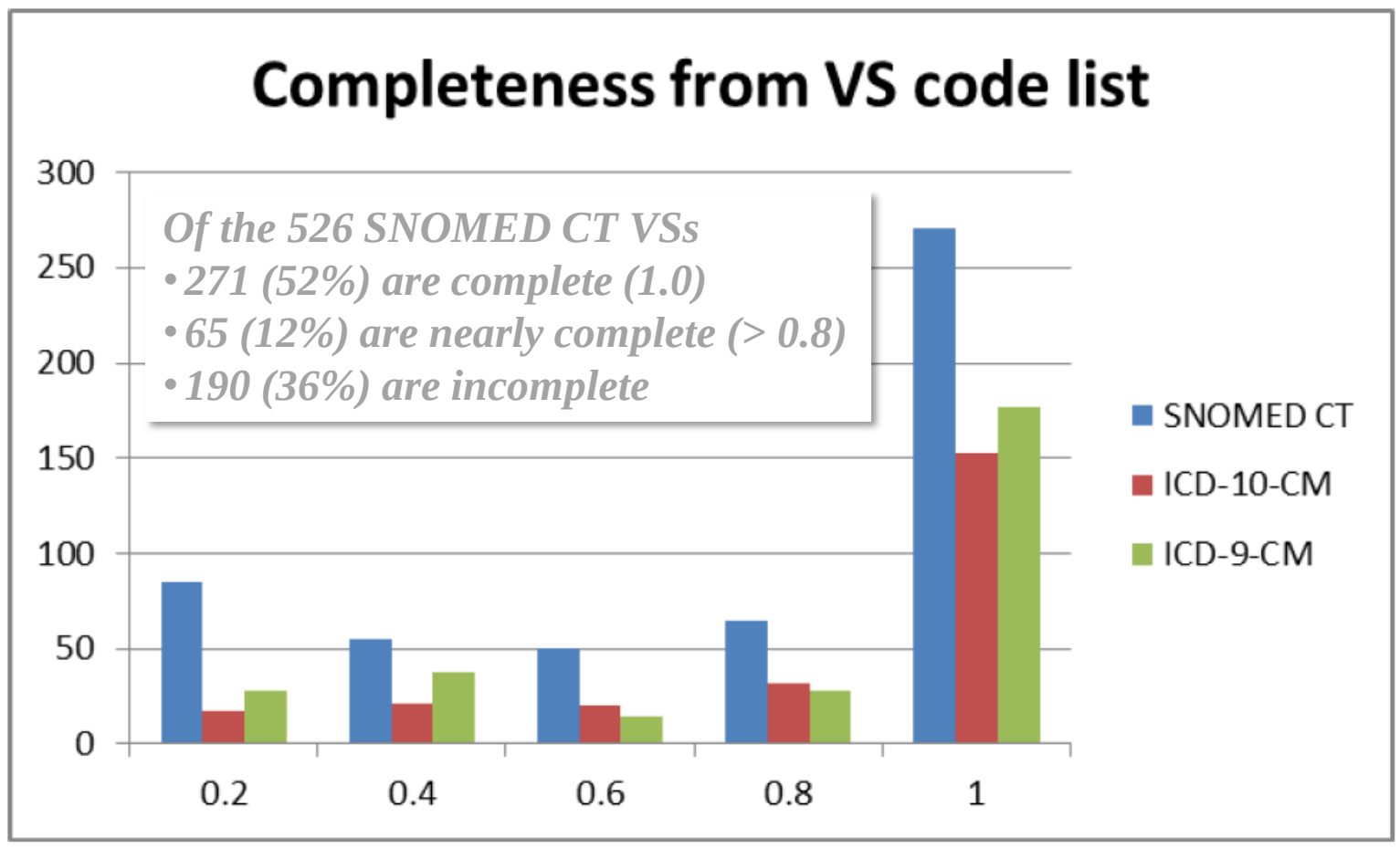
Correctness

$$Correct\ (VS_{Ori}) = |VS_{Ori} \cap VS_{RE}| \ / \ |VS_{Ori}|$$

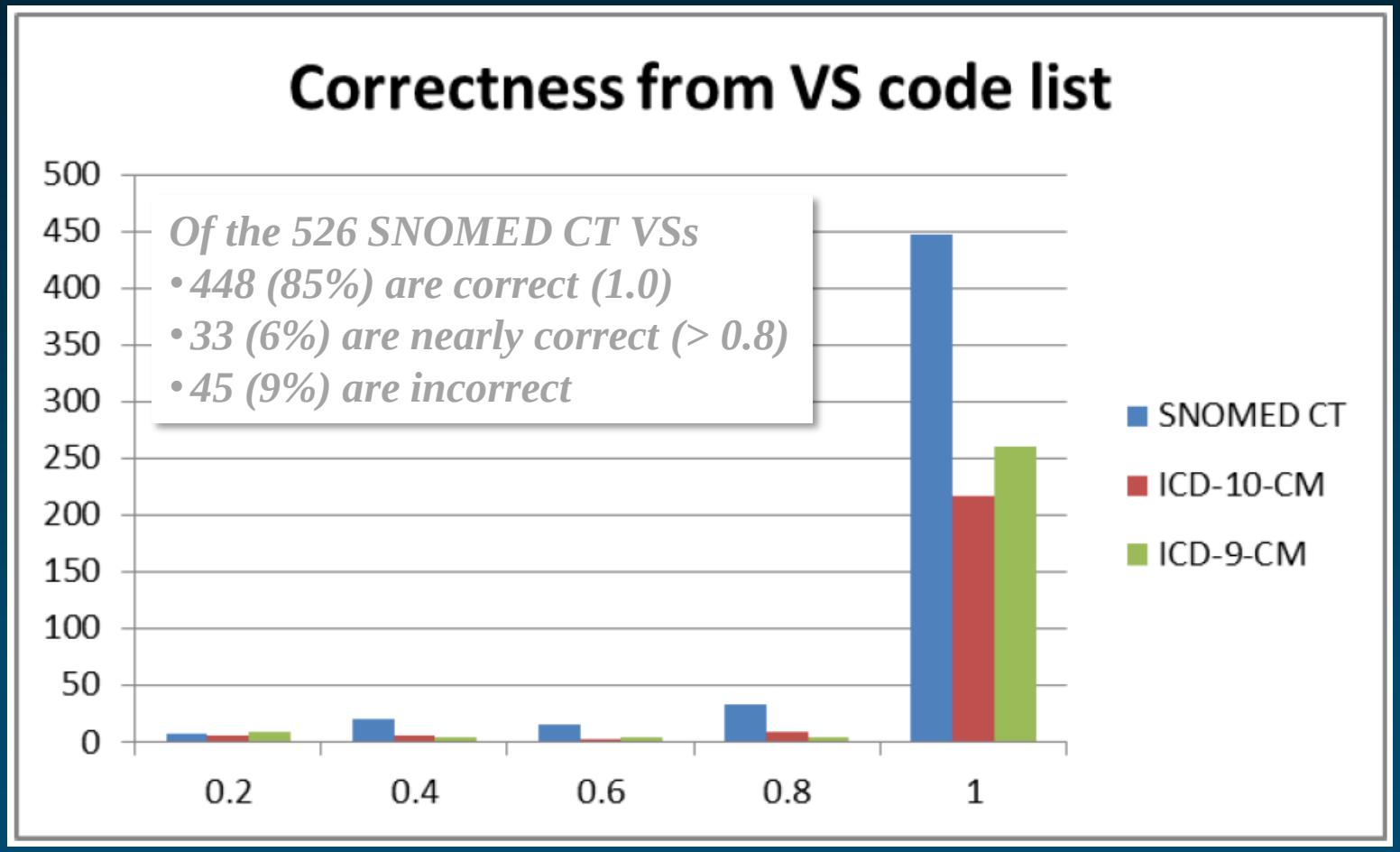
5/6

Evaluates the proportion of VS_{Ori} NOT covered by VS_{RE}

Results Completeness



Results Correctness



Discussion (1/2)

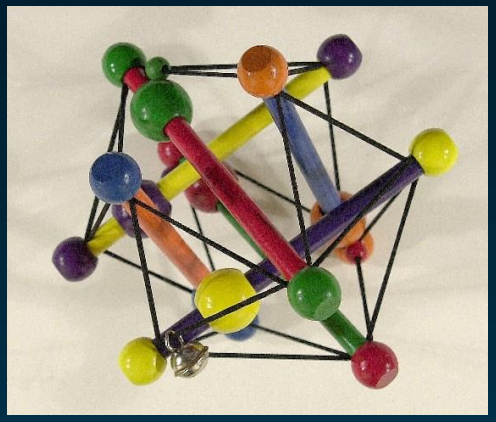
- The intension (purpose) of the value set is not provided explicitly
  - Needs to be reverse-engineered (“expected VS”)
- Not always only one root
  - Range: 1 to 107
  - Median: 1
  - Average: 6.0

Discussion (2/2)

- Extra concepts in the original VS (compared to the expected VS) may reflect differences in knowledge organization
  - *Acute tonsillitis*
    - Correctly includes *Acute lingual tonsillitis* in the original VS (assuming the intension is to capture all cases of tonsillitis)
    - *Acute lingual tonsillitis* is not a descendant of *Acute tonsillitis* in SNOMED CT
      - *Acute lingual tonsillitis* finding site *Lingual tonsil structure*
      - *Acute tonsillitis* finding site *Tonsilar structure (palatine)*

Conclusions

- These metrics facilitate the curation of value sets by providing compact indicators of their completeness and correctness
- Our approach has proved effective on a variety of value sets of different sizes and can be adapted to other code systems (e.g., ICD10-CM)
- We recommend that such metrics be integrated into value set authoring systems, such as the NLM Value Set Authority Center



Medical Ontology Research

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