How the SNOMED CT to ICD-10 Map facilitated the map to a national extension of ICD-10

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Unified Medical Language System ®

Why do we need a map from SNOMED CT to ICD?

SNOMED CT vs. ICD

- SNOMED CT is a clinical terminology to facilitate coding, retrieval, sharing and re-use of clinical information

- ICD is a system of classification which focuses on gathering accurate, comparable statistics for a specific purpose e.g. population health, resource planning, reimbursement

Terminology of choice for the EHR

- As a clinical terminology, SNOMED CT is inherently more suitable than other terminologies/classifications for clinical documentation in the EHR (electronic health record)

- This is not to say that 'SNOMED CT is superior to ICD', since they are designed for different purposes and each should each be used for the purpose for which it was designed

Content coverage

- SNOMED CT has better clinical coverage than ICD
- Number of codes:
  - SNOMED CT (Clinical finding): 100,000
  - ICD-9-CM: 14,000
  - ICD-10-CM: 68,000
- ICD's focus is statistical – less common diseases get lumped together in "catch-all" categories e.g. *J15.8 Pneumonia due to other specified bacteria*, which could result in loss of information
- SNOMED CT is clinically-based – document whatever is needed for patient care

	ICD-9-CM	ICD-10-CM	SNOMED CT
Asperger's disorder	299.8 Other specified pervasive developmental disorders	F84.5 Asperger's disorder	23560001 Asperger's disorder
Apert syndrome	755.55 Acrocephalosyndactyly	Q87.0 Congenital malformation syndromes predominantly affecting facial appearance	205258009 Apert syndrome
Metabolic acidosis	276.2 Acidosis	E87.2 Acidosis	59455009 Metabolic acidosis
Respiratory acidosis	276.2 Acidosis	E87.2 Acidosis	12326000 Respiratory acidosis
Lactic acidosis	276.2 Acidosis	E87.2 Acidosis	91273001 Lactic acidosis

Clinical orientation

- Different users and usage
  - SNOMED CT - direct use by healthcare providers during the process of care
  - ICD – use by coding professionals after the episode of care
- It may be problematic for healthcare providers to use ICD directly
  - Some terms are not 'clinical user-friendly'
  - Some contents have little clinical relevance
  - Presumed knowledge of coding rules and conventions

"Unfriendly" terms

- Apparently "awkward" names (embedded coding guidelines)
  - *E878.2 Surgical operation with anastomosis, bypass, or graft, with natural or artificial tissues used as implant causing abnormal patient reaction, or later complication, without mention of misadventure at time of operation* (ICD-9-CM)
- Clinically "irrelevant" details
  - *V30.2xxD Person on outside of three-wheeled motor vehicle injured in collision with pedestrian or animal in nontraffic accident, subsequent encounter* (ICD-10-CM)

ICD coding rules and conventions

- Patient admitted with gastrointestional bleeding and found to be anemic. Which is the correct code?
  - *280 Iron deficiency anemias secondary to blood loss (chronic)*, OR
  - *285.1 Acute posthemorrhagic anemia*
  - There is no general code to cover both cases of acute and chronic blood loss
- In ICD convention, words in parenthesis e.g. (chronic) are known as "non-essential modifiers" – whether they are present or not doesn't affect coding, so 280 is the correct code if the clinical course is not certain. But clinical users may not be aware of this convention.
- SNOMED CT: *413532003 Anemia due to blood loss*

Flexible data entry and retrieval

- ICD dictates level of granularity of coding
  - NOS (Not otherwise specified) codes - cases with insufficient information for more specific codes
  - NEC (Not elsewhere classified) codes - cases with more specific information but not covered by existing codes
- SNOMED CT allows coding at any level of granularity as appropriate for the clinical situation - no need for NOS, NEC codes
- Flexible data retrieval
  - SNOMED CT has multiple hierarchy (single hierarchy for ICD)
  - SNOMED CT concepts are defined logically by their attributes (only textual rules and definitions in ICD)

Clinical guideline for hypertension

- ICD-9-CM
  - If one uses only codes in the range *HYPERTENSIVE DISEASE (401-405)*, will be missing
    - *410.9 Myocardial infarction with hypertension*
    - *642 Hypertension complicating pregnancy, childbirth, and the puerperium*
- SNOMED CT
  - All descendants of *38341003 Hypertensive disorder*

Data retrieval using attributes

- Find all diseases caused by occlusion of artery affecting any artery except mesenteric or renal arteries
- SNOMED CT
  - Find all descendants of *2929001 Occlusion of artery*
  - Exclude those with "Finding site" = 'Structure of mesenteric artery' or 'Structure of renal artery'
- ICD-9-CM
  - *440 Atherosclerosis and descendants (except 440.1 Of renal artery)*
  - *433 Occlusion and stenosis of precerebral arteries and descendants*
  - *437.0 Cerebral atherosclerosis*
  - *414.0 Coronary atherosclerosis*
  - *416.0 Idiopathic pulmonary arteriosclerosis*
  - *443.9 Peripheral vascular disease, unspecified…*
  - List needs to be reviewed with each update

Extensibility

- No single terminology will be complete for every use case - there is always a need for extension

- ICD – no available method for extension provided by the classification

- SNOMED CT – well-defined rules to extend coverage by combining existing concepts (post-coordination) e.g.
  - "Left kidney stone" can be represented by adding the laterality attribute *7771000 Left* to *95570007 Kidney stone*

- Advantages:
  - Can compute equivalence of new concepts to existing concepts
  - The new concept will be recognized as a sub-class of existing concepts

The need for a map

- Requirements to generate ICD-10 (reporting to WHO) and ICD-9/10-CM codes (reimbursement in the US, ICD-9-CM to be replaced by ICD-10-CM in 2014) have a strong influence on EHR development

- A map from SNOMED CT to ICD will promote the use of SNOMED CT for clinical documentation in the EHR, while allowing the generation of administrative codes from SNOMED CT-encoded data

- Other potential benefits: improve speed and quality of ICD coding

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The maps from SNOMED CT to ICD-10 and ICD-10-CM

Two mapping projects

- Mapping SNOMED CT to ICD-10
  - Started in 2008
  - Joint effort between IHTSDO and WHO
  - International participation (including USA, UK, Canada, Sweden, Australia, and New Zealand)
  - Funded by IHTSDO with a lot of volunteer contribution
- Mapping SNOMED CT to ICD-10-CM
  - Started in 2010
  - Led by NLM with direct involvement from National Center for Health Statistics (NCHS)
  - Methodology and tools – based on ICD-10 Map project

Re-use of mapping resources

- A stated purpose of the SNOMED CT to ICD-10 map
  - To serve as a SNOMED CT to ICD-10 map validated and sanctioned by WHO and the IHTSDO which may serve as **a source for development of maps to ICD-10 extension classifications developed and maintained by a member country**
- Heavy re-use of
  - Mapping principles and methodology
  - Tools
  - Actual map data

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Re-use of mapping methodology

ICD-10 and ICD-10-CM

- Similarities (1)
  - Structurally – most codes in ICD-10-CM are refinements of ICD-10 codes

I26.0   **Pulmonary embolism with mention of acute cor pulmonale**
        Acute cor pulmonale NOS

▶ I26.0   Pulmonary embolism with acute cor pulmonale
    ▶ I26.01   Septic pulmonary embolism with acute cor pulmonale
    ▶ I26.02   Saddle embolus of pulmonary artery with acute cor pulmonale
    ▶ I26.09   Other pulmonary embolism with acute cor pulmonale

ICD-10 and ICD-10-CM

- Similarities (2)
  - Coding resources
    - an alphabetical index and a tabular list, with the same notations and conventions (e.g. essential and non-essential modifiers, exclusions and inclusions)
  - Coding procedure
    - first look up the term in the alphabetical index and then confirm the code in the tabular listing by checking the inclusion, exclusion and other notes

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ICD-10 and ICD-10-CM

- Differences:
  - Number of codes: 11,000 (ICD10) vs. 68,000 (ICD-10-CM)
  - Much more granular codes e.g.
    - Episode of care (injury codes)
    - Laterality
    - Trimester
  - Some high-level code (category or 3-character level) differences
    - ICD-10 code deleted e.g. E14 Unspecified diabetes mellitus (included in E11 Type 2 diabetes mellitus)
    - New ICD-10-CM category e.g. K68 Disorders of retroperitoneum

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Rule-based Mapping

- Map is one-to-many and rule-based because
  - One SNOMED CT concept may need more than one ICD-10-CM codes to fully represent its meaning e.g. etiology and manifestation, injury codes
  - One SNOMED CT concept may have multiple alternative ICD target codes depending on patient context e.g. age, gender

Map structure – an example

At run-time resolve to   Final output

- **Map group 1**
  - Rule 1 → target code 1
  - Rule 2 → target code 2   code2
  - Else → target code 3

- **Map group 2**   Codes 2+ 4 +6
  - Rule 1 → target code 4   code4
  - Else → target code 5

- **Map group 3**
  - Always → target code 6   code6

Multiple ICD codes – etiology and manifestation

- Source concepts which map to ICD codes with asterisk (*) conventions (manifestations of an underlying disease) will be mapped to two target codes.

- The dagger code (the underlying disease, or etiology) will always be the primary code (first map group)

Source concept: 111900000 Pneumonia in aspergillosis (disorder)

Map group 1

Rule 1 → B44.1† Other pulmonary aspergillosis

Map group 2

Rule 1 → J17.2* Pneumonia in mycoses

Multiple ICD codes – External causes

- The source concepts denoting a condition (usually an injury) with an identifiable cause will be mapped to two target codes.
- The external cause code will be assigned to the second target record.

Source concept: 242012005 Thermal burns from lightning (disorder) :

Map group 1

Rule 1 → T30.0 Burn of unspecified region

Map group 2

Rule 1 → X33 Victim of lightning

Map rule – gender

- Source concept: 8619003 Infertile (finding)
- Map group 1
  - Rule 1 IFA 1086007| FEMALE (FINDING) | → N97.9 Female infertility, unspecified
  - Rule 2 IFA 248153007 | MALE (FINDING) | → N46 Male infertility
  - Rule 3 OTHERWISE TRUE -> NULL

Map rule – age at onset

- Source concept: 32398004 Bronchitis (disorder)

- Map group 1

  ◦ Rule 1 IF 44518008 |AGE AT ONSET OF CLINICAL FINDING (OBSERVABLE)| < 15 YEARS → J20.9 Acute bronchitis, unspecified

  ◦ Rule 2 OTHERWISE TRUE → J40 Bronchitis not specified as acute or chronic

Adaptation of mapping methods (1)

- Episode of care
  - Mostly not specified in SNOMED CT concept
  - No default code available in ICD-10-CM e.g.
    - S00.01XA Abrasion of scalp, initial encounter
    - S00.01XD Abrasion of scalp, subsequent encounter
    - S00.01XS Abrasion of scalp, sequela
  - Solution: placeholder code added
    - S00.01X? Abrasion of scalp, episode of care unspecified
    - Map advice: EPISODE OF CARE INFORMATION NEEDED

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Adaptation of mapping methods (2)

- For other situations that involve additional information not usually expressed in SNOMED CT e.g. Laterality
  - Usually there is a default ICD-10-CM code for unspecified laterality
- New map advice to alert user about possible refinement
  - CONSIDER LATERALITY SPECIFICATION
  - CONSIDER TRIMESTER SPECIFICATION
  - CONSIDER WHICH FETUS IS AFFECTED BY THE MATERNAL CONDITION
- 'Use additional code' notes
  - Identify target code if possible - new map group
  - Otherwise use map advice: CONSIDER ADDITIONAL CODE TO IDENTIFY SPECIFIC CONDITION OR DISEASE

Dual independent mapping

- Built-in quality assurance process – each map has to be agreed by 2 independent sources
  - Concepts with no legacy maps – mapped independently by 2 map specialists
  - Concepts with legacy maps – mapped by 1 map specialist first, and by another if there is discordance between legacy map and 1st map specialist
- Sources of legacy maps
  - Existing reliable sources of maps e.g. UK SNOMED CT to ICD-10 map, ICD-10-CM maps in Kaiser Permanente donated content
  - Maps derived from UMLS
  - ICD-10-CM maps derived from finalized ICD-10 maps
- Minor conflicts resolved by map leads
- Otherwise referred for broader discussion or consensus management panel

Re-use of mapping tools

Adaptation of tools

- Prototype mapping tool
  - The existing standalone mapping tool can be used with minor modifications – expanding the list of map advice
  - ICD-10-CM tabular list loaded into tool after transformation to ClaML (Classification Markup Language)
- Index browser
  - No electronic searchable version of ICD-10-CM index
  - Custom-built index browser – search at specific levels of the index to allow speedy retrieval

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Re-use of map data

Re-use of ICD-10 map data

- Despite differences between ICD-10-CM and ICD-10, it is sometimes possible to generate ICD-10-CM candidate (legacy) maps from ICD-10 maps

- Algorithm created to derive ICD-10-CM candidate maps based on length and terminal digit of ICD-10 code

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Algorithmic code translation

| ICD-10 code	rule	ICD-10 example	ICD-10-CM example
Not found anywhere in ICD-10-CM	Give up	*E14 unspecified diabetes mellitus*	No corresponding code
Also valid for coding in ICD-10-CM	Use same target code	*K70.0 Alcoholic fatty liver*	*K70.0 Alcoholic fatty liver*
3-digit code	Give up	*R92 Abnormal and inconclusive findings on diagnostic imaging of breast*	No "unspecified" code at 4th digit level
4-digit code ending in .8	Use .89	*H10.8 Other conjunctivitis*	*H10.89 Other conjunctivitis*
4-digit code ending in .y (y ≠ .8)	Use .y0	*M75.5 Bursitis of shoulder*	*M75.50 Bursitis of unspecified shoulder*
	OR Use .y09	*S31.1 Open wound of abdominal wall without penetration into peritoneal cavity*	*S31.109? Unspecified open wound of abdominal wall, unspecified quadrant without penetration into peritoneal cavity, episode of care unspecified*
5-digit code .yz	Use .yz9	*S92.30 Fracture of unspecified metatarsal bone(s)*	*S92.309? Fracture of unspecified metatarsal bone(s), unspecified foot*

Evaluation of algorithm (retrospective)

- Among 7,230 mapped concepts in the ICD-10-CM map, 5,264 concepts were covered in the ICD-10 map

- Using the algorithm, 4,317 concepts could have ICD-10-CM targets generated from the ICD-10 map

- Compare the default map target of the first map group of the generated maps and the final ICD-10-CM map

- Result: 77% of generated targets agreed with final map

- Potential saving in mapping time: 4317 x 0.7 x 10 minutes = 63 days of mapping by a map specialist

Work progress

- ICD-10 map
  - Full release of phase 1 maps (covering 19,000 concepts) in August 2012
  - IHTSDO has set up a mapping service team with funded personnel to support future mapping activity
- ICD-10-CM map
  - Full release of phase 1 maps (covering 15,000 concepts) in July 2012
  - Phase 2 of mapping already started
    - Update of published maps to synchronize with changes in SNOMED CT and ICD-10-CM
    - Expand scope of map – newly-received CMT subspecialty subsets, new concepts from the CORE Problem List Subset, additional concepts identified by the ICD-9-CM to SNOMED CT map

Intended uses of the map

- Embedded in the EHR for real-time, interactive ICD codes generation: I-MAGIC (Interactive Map-Assisted Generation of ICD Codes)
- To assist coding professionals by suggesting ICD codes based on SNOMED CT-encoded problem list entries
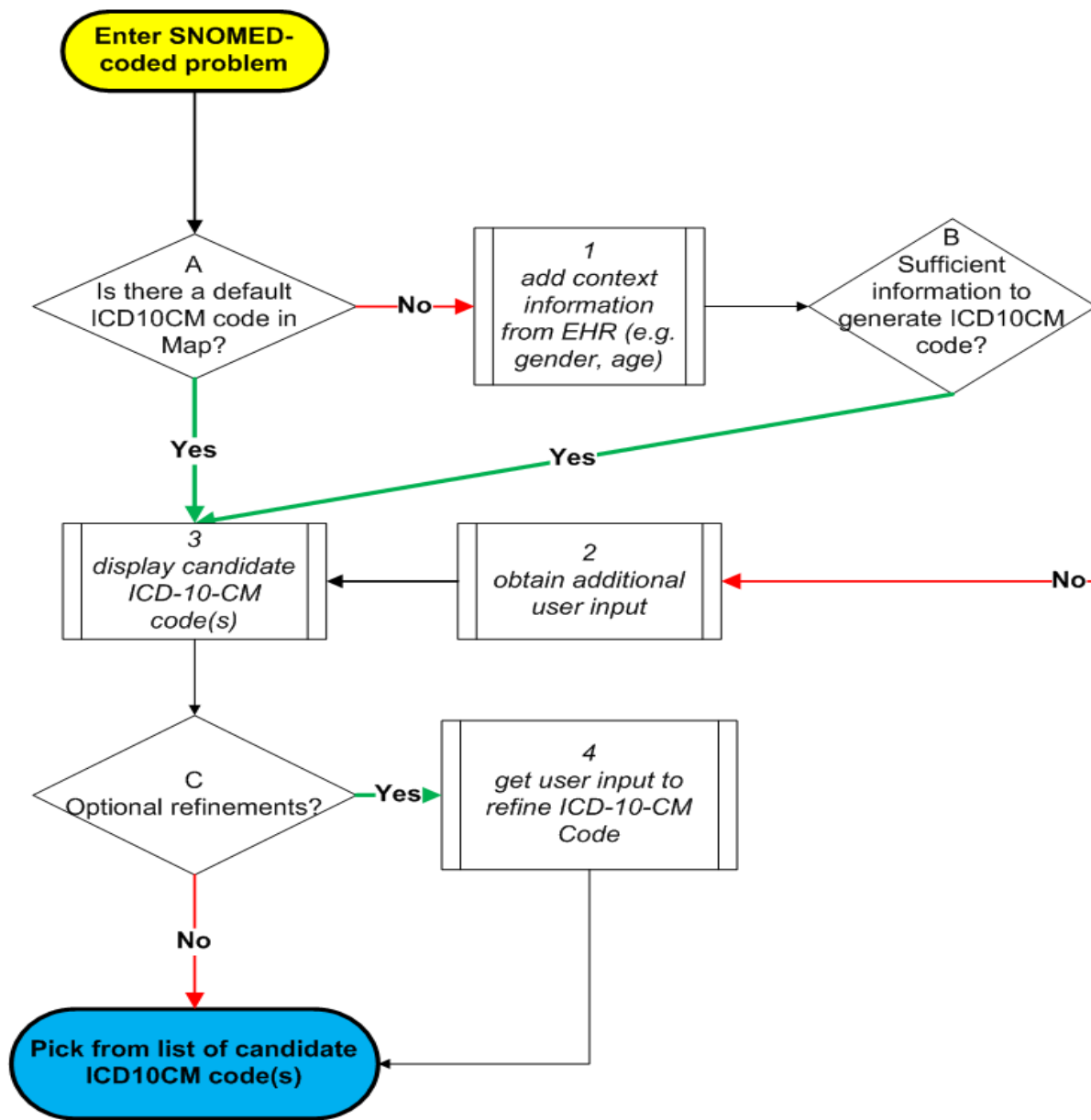
Interactive Map-Assisted Generation of ICD Codes (I-MAGIC) Algorithm

I-MAGIC demo tool for the ICD-10-CM map

- http://imagic.nlm.nih.gov/imagic/code/map

Return of favor…

The ICD-10-CM map will also benefit the ICD-10-CM map

- Mapping Workflow Tools and Reports
  - A suite of web-based tools for management of batches and generation of statistics in the ICD-10-CM project – can be used in future ICD-10 work

- Index browser
  - No browsable index for 2010 version of ICD-10
  - ICD-10-CM index browser can be tweaked to browse ICD-10 index

- Generation of legacy maps
  - ICD-10-CM maps can be used to generate candidate ICD-10 maps algorithmically

- I-MAGIC demo tool
  - Adapted to work with ICD-10 map data

Conclusion

- The ICD-10-CM map benefited significantly from work done for the ICD-10 map by re-using:
  - Map methodology and documentation
  - Tooling
  - Map data
- This enabled the ICD-10-CM map to be created in a short period of time
- Work done for the ICD-10-CM map will benefit future ICD-10 work
- The same synergism can potentially occur in the maps to other national extensions e.g. ICD-10-CA and ICD-10-AM

Questions?

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