



Mapping existing medical terminologies to SNOMED CT: An investigation of the novice user's experience

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Objective

- Investigate the novice user's experience mapping an existing terminology to SNOMED CT using a dedicated mapping tool
- Gain an understanding of the difficulties
- Inform future software tool development efforts

SNOMED CT

- Systematized Nomenclature of Medicine – Clinical Terms
- Is an international standard maintained by IHTSDO (International Health Terminology Standards Development Organisation)
 - Australia is a member country
- A terminology designed for clinical purposes
- ~300,000 active concepts
- Despite its size, its coverage can be patchy – particularly in specialist domains
- Some benefits of SNOMED CT include
 - No more data translation issues
 - Sophisticated querying such as subsumption queries

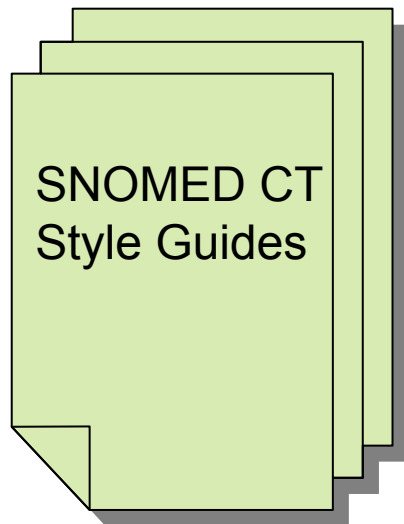
Mapping to SNOMED CT

- To switch over to SNOMED CT a mapping of the existing terms to SNOMED CT will need to be done
- Sometimes this will be “simple” – a direct mapping to a single SNOMED CT concept
 - E.g. “craniotomy” → “**25353009** | Craniotomy (procedure) |”
- Sometimes there will be no single SNOMED CT concept that encapsulates the existing term and a post-coordinated expression will need to be created
 - E.g. “Cut right calf” → “**283437002** | Cut of calf (disorder) | : **272741003** | Laterality (attribute) | = **24028007** | Right (qualifier value) |”

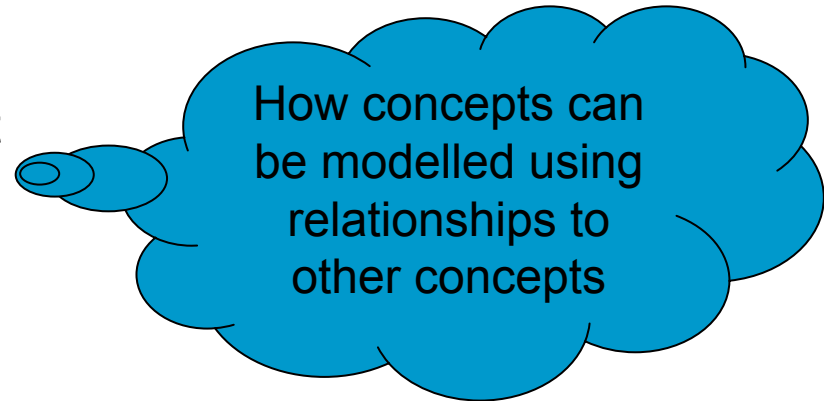
Post-coordinated expressions

- Composing post-coordinated expressions is no easy task ..
 - SYNTAX Rules
 - SNOMED CT Compositional Grammar
 - SEMANTICS (Meaning) Rules
 - SNOMED CT Style Guides
 - Expressions violating semantic rules ..
 - **238516007** | Suntan (disorder) | : **32911000** | Homeless (finding) | = **387207008** | Ibuprofen (substance) |
 - **16331000** | Heartburn | : **246454002** | Occurrence (attribute) | = **70232002** | Frequent |

SNOMED CT Style Guides



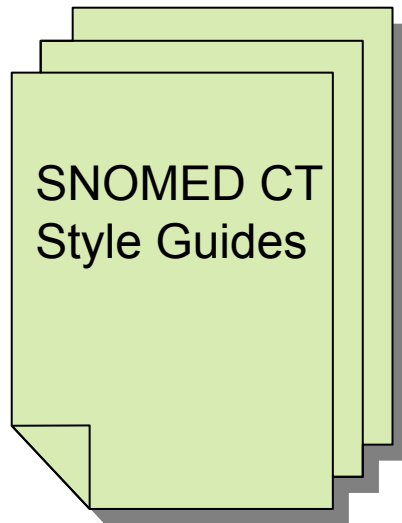
Concept
Model



- Example

- Procedures may specify an intent and valid values for intent are palliative, guidance, diagnostic, therapeutic, preventative or screening

SNOMED CT Style Guides



Concept
Model



Editorial
Guidelines

- 6 documents – 148 pages in total

- Introduction and Overview
- Body Structures - Anatomy
- Clinical Findings
- Morphologic Abnormalities
- Procedures
- Situations with Explicit Context

- <http://www.ihtsdo.org/publications/inside-ihtsdo/>

Machine Readable Concept Model (MRCM)

- Software can't assess your expression against a set of documents
 - A machine readable version is needed
 - There is already an awareness of this need
 - IHTSDO Machine Readable Concept Model Working Group
 - Prototype MRCMs have been produced

Snapper

The screenshot displays the Snapper application within the Eclipse SDK. The interface includes a menu bar (File, Edit, Navigate, Project, Tools, Model Editor, Window, Help), a toolbar with a red box highlighting the 'Find' icon, and a Project Explorer on the left showing the 'Demo' project and 'Mapping.mapping' file.

The central 'Mapping.mapping' editor shows a table with the following data:

Source Term	Relationship	Snomed Expression	Status	Comments
Rectum	Equivalent	181261002 Entire rectum (body structure)	Automap	
Colon	Equivalent	302608007 Entire colon (body structure)	Automap	

A red box highlights the 'Snomed Expression' and 'Status' columns. Overlaid on the table is a text box with the words 'Interactive', 'Automap', and 'Hierarchy' stacked vertically.

The 'Search Ontology' panel on the right shows a search for 'rectum' within the 'tag:aehrc.com,2009-01-31:SnomedCT' ontology. The search results list various rectum-related terms, with 'Entire rectum (body structure)' selected. Below the list, the details for 'ID: 181261002' are shown, including its primitive status, terms, concept ID, and descriptions.

The 'Expression Editor' at the bottom left shows the selected expression: '181261002 | Entire rectum (body structure) |'. The 'Ontology view' at the bottom right displays a hierarchical diagram of the rectum structure, starting from 'Lower gastrointestinal tract structure' and 'Pelvic alimentary structure', leading to 'Intestinal structure', 'Large intestinal structure', 'Region of large intestine', 'Large intestine part', 'Lower bowel structures', 'Anorectal structure', 'Rectum structure', and finally 'Entire rectum'.

The status bar at the bottom indicates 'Selected Object: Rectum'.

Snapper

The screenshot displays the Snapper application interface, which is used for mapping existing medical terminologies to SNOMED CT. The interface includes a menu bar (File, Edit, Navigate, Project, Tools, Model Editor, Window, Help), a toolbar, and several panes.

Main Mapping Table:

Source Term	Relationship	Snomed Expression	Status	Comments
Rectum	Equivalent	181261002 Entire rectum (body structure)	Automap	
Colon	Equivalent	302508007 Entire colon (body structure)	Automap	
Craniotomy for neoplasm	Specialise	25353009 Craniotomy (procedure) : 40873004	Incomplete	

Search Ontology: The search results for "neoplastic dis" are displayed, showing a list of terms including "Neoplastic disease (disorder)", "Malignant meningitis (disorder)", "Non-neoplastic nevus (disorder)", "Benign neoplastic disease (disorder)", "Neoplastic cyst of pancreas (disorder)", "Familial neoplastic disease (disorder)", "Neoplastic pleural effusion (disorder)", "Malignant neoplastic disease (disorder)", and "Anemia in neoplastic disease (disorder)".

Expression Editor: The expression editor shows the selected term "25353009 | Craniotomy (procedure) |" and its associated terms: "408730004 | Procedure context (attribute)" and "55342001 | Neoplastic disease (disorder)".

Constraint Checker: A red box highlights the Constraint Checker panel, which displays the following information:

- FOCUS CONCEPT = 25353009 | Craniotomy |**
- refinement = 408730004 | Procedure context | = 55342001 | Neoplastic disease |**
- DOMAIN = procedure**
- CONSTRAINT (Mandatory CM Constraint) (All forms)**
- ATTRIBUTE = has focus - <<363702006**
- RANGE = Finding or Procedure - <<404684003, <<71388002**
- CONSTRAINT (Mandatory CM Constraint) (All forms)**
- ATTRIBUTE = direct substance - <<363701004**
- RANGE = substance - <<105590001**
- CONSTRAINT (Mandatory CM Constraint) (All forms)**
- ATTRIBUTE = procedure site - Direct - <<406813007**
- RANGE = Body structures as finding and procedure sites - <<91723000, <<280115004**

Console: The console shows the selected object: "Craniotomy for neoplasm".

An existing medical terminology

- ANZICS (Australian and New Zeland Intensive Care Society) diagnosis codes
 - Real-world candidate codes that could be replaced by SNOMED CT
 - We had access to an ICU clinician

ANZICS Diagnosis Codes

- Consist of 2 levels
 - Diagnosis codes (99)
 - Optional more detailed “sub-codes” grouped under a diagnosis code (396)

Diagnostic Code	Diagnostic Code Description	Diagnostic Sub-code	Diagnostic Sub-code Description
312	GI Cancer	312.01	Cancer of the colon/rectal
		312.02	Cancer of the oesophagous
		312.03	Cancer of the pancreas
		312.04	Cancer of the stomach
		312.05	Cancer of other GI



Data Analyst
experienced with
health data but no
SNOMED CT
experience

- ICU Clinician (1 session)
- SNOMED CT Style Guide documents
- SNOMED CT compositional grammar resources
- Informal training session
- ANZICS diagnosis codes loaded into a version of Snapper that did not have the constraint checker

Interview with Data Analyst



- Issues the Data Analyst raised
 - Amount of information in the style guides was initially so overwhelming that they were only skimmed at first.
 - The quality of the mappings improved with experience and as their knowledge of the style guides improved.
 - They noted how different their mappings would be without the assistance of the ICU clinician to explain intended meanings and emphasis of codes
 - The Data Analyst's tendency was to do nothing rather than try something and get it wrong – potentially for a lot of mappings

Interview with Data Analyst (cont.)



- Issues we noted from the discussion
 - Some knowledge of SNOMED CT is needed
 - Inferred refinements from parent concepts
 - Terms cannot always be mapped to SNOMED CT
 - E.g. negation and disjunction
 - The distinction between primitive concepts and fully specified concepts and how full modelling is not always required
 - Existing concepts can be used as a pattern for constructing new concepts
 - The broader the terminology, the greater the Style Guide knowledge the mapper must have
 - ANZICS diagnosis codes are broad and are a difficult starting point for a novice

Snapper Constraint Checker

The screenshot displays the Snapper Constraint Checker application. The main window features a tabbed interface with 'Ontology View', 'Console', 'Progress', 'Problems', and 'Expression Trace'. The 'Ontology View' tab is active, showing a hierarchical tree structure for a concept named 'Craniotomy (procedure)'. The tree includes a 'DOMAIN' and several 'CONSTRAINT (Mandatory CM Constraint) (All forms)' entries, each with an 'ATTRIBUTE' and a 'RANGE'.

On the right, a 'Check Constraints' window is open, displaying the results of a constraint check. It lists three constraints with their corresponding SNOMED CT codes and descriptions:

- 25353009 | Craniotomy (procedure) | :
- 408730004 | Procedure context (attribute) | =
- 55342001 | Neoplastic disease (disorder) |

The main window's ontology view shows the following structure:

- FOCUS CONCEPT = 25353009 | Craniotomy |
 - refinement = 408730004 | Procedure context | = 55342001 | Neoplastic disease |
 - DOMAIN = procedure
 - CONSTRAINT (Mandatory CM Constraint) (All forms)
 - ATTRIBUTE = procedure site - Indirect - <<405814001
 - RANGE = Body structures as finding and procedure sites - <<91723000, <<280115004
 - CONSTRAINT (Mandatory CM Constraint) (All forms)
 - ATTRIBUTE = component - <<246093002
 - RANGE = Observable entities, substances, organisms and cell structures - <<363787002, <<105590001, <<410607006, <<4421005
 - CONSTRAINT (Mandatory CM Constraint) (All forms)
 - ATTRIBUTE = has focus - <<363702006
 - RANGE = Finding or Procedure - <<404684003, <<71388002
 - CONSTRAINT (Mandatory CM Constraint) (All forms)
 - ATTRIBUTE = direct substance - <<363701004
 - RANGE = substance - <<105590001
 - CONSTRAINT (Mandatory CM Constraint) (All forms)
 - ATTRIBUTE = procedure site - Direct - <<405813007
 - RANGE = Body structures as finding and procedure sites - <<91723000, <<280115004
 - CONSTRAINT (Mandatory CM Constraint) (All forms)
 - ATTRIBUTE = revision status - <<246513007
 - RANGE = Procedure stages - <<255231005, <<257958009, <<261424001
 - CONSTRAINT (Mandatory CM Constraint) (All forms)
 - ATTRIBUTE = procedure device - <<405815000
 - RANGE = Device - <<49062001
 - CONSTRAINT (Mandatory CM Constraint) (All forms)

Interview with Data Analyst (cont.)



- Mappings checked using Snapper's constraint checker
 - ALL expressions that were checked were wrong!
 - Helped the Data Analyst understand why the expressions were wrong
 - Made the Data Analyst fully appreciate the need to understand and follow the style guides.
 - Gave the Data Analyst the confidence to attempt the mappings again
 - Immediate feedback when trying something a little more complex

What the SNOMED CT Concept Model can't do

- Examine mappings to single concepts (no refinements) for semantic correctness
 - Peer review of mappings can help
- Check expressions against editorial guidelines
 - No machine readable version

Conclusions

- In general ..
 - Mappings should be performed by trained, experienced people
 - Documents recently added to the IHTSDO website support this
 - A domain expert needs to be involved
- For tools ..
 - Should maintain the hierarchy that can exist in terminologies
 - Maintaining the context of child and sibling terms makes mapping easier
 - Provide feedback when expressions violate the expression grammar
 - Highlight part of the expression that is causing the violation
 - Provide feedback when expressions violate the concept model
 - Support peer-review of mappings

Wish List for the Future

- All of the Style Guides to be machine readable
- An even better constraint checker
 - Easy to understand
 - Easy to locate source of problem and see alternatives
- Intelligent editor that prevents you from making syntax and semantic mistakes in the first place!

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Thank you