SNOMED CT Basics

- Components and structure
- Post-coordination, Expressions & Description logic
- Terminology / Information model interaction
- Primary and Secondary uses (re-use) of data
- Extensions and Reference sets
- History tracking and Cross mapping
Building blocks

- **Concepts**
  - The anchors for meaning

- **Descriptions**
  - Terms (strings of readable characters) used to express the meanings of the concepts in human language

- **Relationships**
  - Concept-to-concept links used to express information in computer-processable language
    - First purpose: formal logical meanings
    - Other purposes: tracking retired concepts, representing “facts” that may vary, and supporting post-coordination by suggesting valid qualifiers
Codes, concepts, classes, instances

- **Code:**
  - In general, any sequence of characters used to represent something in a coding system
  - SNOMED Clinical Terms Identifier (SCTID):
    - A sequence of 6 to 18 digits that identifies a component

- **Concept:**
  - In general, an idea which has meaning. Through its meaning, a person can identify specific instances of the concept

- **Class:**
  - An abstract category of things sharing common features

- **Instance:**
  - A particular real member of a class
SCT Identifiers

Components and structure

Item identifier

SCTID 101291009

Partition identifier
00 = Core namespace, concept
01 = Core namespace, description
02 = Core namespace, relationship

Check-digit
Concepts vs classes

- From a formal ontological standpoint
  - Concepts are in people’s heads
  - Classes are abstract entities in the ontology

- Sometimes we speak of a SNOMED “concept” but really mean the code representing the class, instances of which can be identified by someone who understands the concept.
### Types of concepts – by FSN tag

Current FSN tags (41 in January 2008 release):

<table>
<thead>
<tr>
<th>TAG NAME</th>
<th>Active</th>
</tr>
</thead>
<tbody>
<tr>
<td>disorder</td>
<td>63564</td>
</tr>
<tr>
<td>procedure</td>
<td>45422</td>
</tr>
<tr>
<td>finding</td>
<td>32559</td>
</tr>
<tr>
<td>organism</td>
<td>27948</td>
</tr>
<tr>
<td>body structure</td>
<td>25627</td>
</tr>
<tr>
<td>substance</td>
<td>23456</td>
</tr>
<tr>
<td>product</td>
<td>19081</td>
</tr>
<tr>
<td>qualifier value</td>
<td>8795</td>
</tr>
<tr>
<td>observable entity</td>
<td>7740</td>
</tr>
<tr>
<td>physical object</td>
<td>4485</td>
</tr>
<tr>
<td>morphologic abnormality</td>
<td>4303</td>
</tr>
<tr>
<td>occupation</td>
<td>4161</td>
</tr>
<tr>
<td>event</td>
<td>3575</td>
</tr>
<tr>
<td>situation</td>
<td>3300</td>
</tr>
<tr>
<td>regime/therapy</td>
<td>2949</td>
</tr>
<tr>
<td>attribute</td>
<td>1126</td>
</tr>
<tr>
<td>environment</td>
<td>1109</td>
</tr>
<tr>
<td>specimen</td>
<td>1052</td>
</tr>
<tr>
<td>assessment scale</td>
<td>884</td>
</tr>
<tr>
<td>cell</td>
<td>609</td>
</tr>
<tr>
<td>geographic location</td>
<td>607</td>
</tr>
<tr>
<td>cell structure</td>
<td>510</td>
</tr>
<tr>
<td>person</td>
<td>370</td>
</tr>
<tr>
<td>navigational concept</td>
<td>346</td>
</tr>
<tr>
<td>ethnic group</td>
<td>262</td>
</tr>
<tr>
<td>tumor staging</td>
<td>214</td>
</tr>
<tr>
<td>record artifact</td>
<td>200</td>
</tr>
<tr>
<td>physical force</td>
<td>171</td>
</tr>
<tr>
<td>religion/philosophy</td>
<td>145</td>
</tr>
<tr>
<td>namespace concept</td>
<td>79</td>
</tr>
<tr>
<td>administrative concept</td>
<td>28</td>
</tr>
<tr>
<td>social concept</td>
<td>26</td>
</tr>
<tr>
<td>life style</td>
<td>21</td>
</tr>
<tr>
<td>racial group</td>
<td>19</td>
</tr>
<tr>
<td>staging scale</td>
<td>15</td>
</tr>
<tr>
<td>link assertion</td>
<td>8</td>
</tr>
<tr>
<td>inactive concept</td>
<td>7</td>
</tr>
<tr>
<td>environment / location</td>
<td>1</td>
</tr>
<tr>
<td>linkage concept</td>
<td>1</td>
</tr>
<tr>
<td>special concept</td>
<td>1</td>
</tr>
<tr>
<td>SNOMED RT+CTV3</td>
<td>1</td>
</tr>
</tbody>
</table>
Active concepts
Jan 2008 Release
By FSN Tag
Most important hierarchies based on number of defining relationships that use them as values.
“Special” hierarchies

- These may not be the source or the value of a defining relationship:
  - Linkage concept
    - Attribute
    - Link assertion
  - Special concept
    - Inactive concept
    - Namespace concept
    - Navigational concept
How are the codes organized?

1. Directed acyclic graph
   - Logical subsumption relationships, with a single root

2. Attributes with values
   - Necessarily true “existential restrictions”

3. Description logic definitions of each concept code
   - Structured combinations of isa’s and attribute-value relationships
Relationships: isa examples

- Lung disease
- Pneumonia
- Infectious disease
- Infectious pneumonia
- Viral pneumonia
- Virus
- Infectious agent
Attribute-value relationships

- **attribute – value**
  - Logical “existential restriction”
  - A rel B means that for every instance of A, there is at least one relationship “rel” with a value that is an instance of B
Attribute example: causative agent

- Lung disease
- Pneumonia
- Infectious disease
- Infectious pneumonia
- Viral pneumonia
- Virus

Causative agent

Components and structure
Combining isa and attribute relationships

Lung disease

Pneumonia

Infectious disease

Infectious pneumonia

Viral pneumonia

Virus

Infectious agent

Causative agent

Causative agent
What is description logic?

- **Mathematical viewpoint:**
  - A family of logics characterized by
    - Formal set-theoretic semantics
    - Proofs of correctness and completeness of computation
    - Proofs of algorithmic complexity (PSpace, NP-complete, NExpTime, etc)

- **Knowledge representation viewpoint:**
  - A set of constructs for representing terminological knowledge (that which is always true of a meaning)
  - Algorithms and their implementations for performing:
    - Subsumption (testing pairs of expressions to see whether one is a subtype of the other & vice versa)
    - Classification (structuring a set of expressions according to their subsumption relationships)
A SNOMED example

- Headache is-a ache: finding-site = head structure
  - (and headache is marked as “defined” in concepts table).

- The class “headache” is sufficiently defined as the set of instances of the class “ache” which also have at least one finding-site relationship to an instance of the class “head structure”.

- And all instances of class “ache” with some finding-site relationship to an instance of “head structure” are instances of “headache”.

- Now, is that what you mean when you say “headache”? 
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SNOMED CT Expressions

- SNOMED CT coded information consists of structured (composed) collections of concept codes
  - These are called expressions
  - The meaning of an expression depends on the situation in which it is used

**Example**

- The SNOMED CT code for “fracture of femur” represents the meaning of “a break in a femur”
  - Depending on where it is used in a patient record, the code may mean
    - The patient has a fractured femur
    - The patient’s main diagnosis is a fracture of the femur
    - The patient has a past history of fractured femur
    - The patient is suspected of having a fractured femur … etc
  - In a query it may be one of several criteria for retrieving the records of patients with particular types of injury
  - In an index to the clinical literature it might indicate a paper that is relevant to this condition
Expressions

- Single code (coordinated pre-release -> “pre-coordination”)
- Combination of codes (coordinated by user post-release -> “post-“)
  - Compositional grammar specifies a way to create combinations
- Expression diagrams:
  - Illustrate the compositional grammar.
  - Focus concepts and values: yellow. Attributes: blue

- focus: attribute = value
Refinement and qualification:
Two common ways to derive post-coordinated expressions

- **Refinement**
  - Replacing value C with a more specific value C1 within an existing (defining) “some R C” relationship in the definition, giving “some R C1”

- **Example**
  - Fracture of femur
    - Defined as: finding-site = bone structure of femur
    - May be refined to: finding-site = structure of neck of femur
  - Yielding the new meaning: Fracture of neck of femur
Refinement and qualification: Two common ways to derive post-coordinated expressions

- **Qualification (also called “subtype qualification”)**
  - Replacing value C with a more specific value C1 within a qualifier “some R C” relationship (found in the qualifying relationships in the relationships table), giving “some R C1”

- **Example**
  - Bronchitis
    - Qualifier exists as: clinical-course = courses (any course value)
    - May be qualified to: clinical-course = acute (sudden onset AND/OR short duration)
  - Yields the meaning: Acute bronchitis

- **End results of refinement or qualification are post-coordinated expressions with an identical logical structure**
Primitive & sufficiently-defined concepts

- A concept is “sufficiently defined”
  - If its definition is sufficient to distinguish it from all its supertype concepts

- A concept is “primitive”
  - If it is not “sufficiently defined”
Primitive & sufficiently defined concepts

- **Head injury**
  - Is a = Disease
  - Associated morphology = Traumatic abnormality
  - Finding site = Head structure
  - Sufficiently Defined

- **Aching pain**
  - Is a = Pain
  - Primitive

- **Headache**
  - Is a = Aching pain
  - Finding site = Head structure
  - Sufficiently Defined
Different views of relationships

- **Stated view**
  - The view that SNOMED CT modelers edit
  - Includes only the defining relationships that an author has explicitly stated to be true
  - To be distributed in KRSS and/or OWL syntax

- **Inferred view**
  - The view distributed in the distribution file
  - Generated by auto-classification
  - Includes relationships inferred from the stated view
  - Excludes redundant relationships

- **Normalized view**
  - The view best suited to comparing expressions
  - Reduces all values to their proximal primitive subtypes
Auto-classification

- Many relationships are inferred by auto-classification rather than authored directly
- Auto-classification
  - Takes definitions “stated” by SNOMED authors and uses them to “infer” other relationships
  - Removes redundant (less specific) defining relationships
  - Creates a logically consistent parsimonious set of relationships
- Review the results of classification
  - Although logically consistent … it may not be “correct” due to errors in “stated” definitions
  - Human errors that might otherwise be overlooked are often highlighted by auto-classification
  - Auto-classification is repeated frequently during authoring and the results are then rechecked
An example of a stated view

- pain
  - is a pain in lower limb
  - finding site lower limb structure
- pain in calf
  - is a finding site calf structure
  - is a
Classifier adds new is-a relationships

Inferred from other relationships
Redundant “direct flights” are removed for the distributed form of SNOMED CT
Advantages of post-coordination

- **Scope coverage**
  - Coverage of scope to an adequate level of specificity does not require every possible concept to exist

- **Terminology size**
  - Reduces the need for “combinatorial explosion” in concept numbers to cover every eventuality

- **Data entry**
  - Allows concepts to be constructed rather than searching through hundreds of similar terms for precisely the correct one

- **Retrieval**
  - Provides greater consistency between sets of similar variants for different concepts
    - For example, ability to specify “severity” for any disorder or “laterality” for any bilateral body structure
Disadvantages of post-coordination

- **Human readability**
  - Extreme post-coordination can lead to loss of natural terms
    - “Appendectomy” might be expressed as “Procedure, with method excision and procedure site appendix”

- **Data entry**
  - Users may need to construct concepts by selecting multiple options rather than simply typing or choosing the term they want

- **Storage**
  - Expressions that have an unspecified number of refinements are less easy to store and manipulate than simple codes

- **Retrieval**
  - Several post-coordinated expressions may mean the same
  - Queries need to consider expressions rather than simple lists of codes
Pros and cons of post-coordination

- Both pre and post-coordination have benefits
- Any successful terminology should
  - Enable post-coordination to add flexibility
  - Include pre-coordinated concepts that express concepts with commonly used terms
  - Avoid attempting to identify an absolute boundary of what may or may not be pre-coordinated
  - Deal with the issues raised by alternative representations
    - The key issue is detection of equivalence and subsumption of alternative expressions
Which one does SNOMED allow?

- SNOMED CT allows both enumeration and composition

- The degree of enumeration depends on IHTSDO (for the international release) and National Release Centres (for National release extensions) and other extension developers

- Rules for composition are becoming more formal – see the machine readable concept model group for details
Equivalence

- “Laparoscopic repair of inguinal hernia”
  =
- “Repair of inguinal hernia” + Endoscopic approach

Recognizing equivalence requires more structure than simple concatenation
Equivalence

- Laparoscopic repair of inguinal hernia:
  - Method = Repair
  - Site = Inguinal canal
  - Object = Hernia
  - Approach = Endoscopic

- Repair of inguinal hernia: [Approach = Endoscopic]
  - Method = Repair
  - Site = Inguinal canal
  - Object = Hernia
Compositional grammar (1)

- Simplest expression is a single conceptid
  - For example
    - 71620000

- Optionally conceptId may be followed by a term enclosed in pipe delimiters
  - For example
    - 71620000|fracture of femur|

- Concepts can be combined with a plus sign that means logical “and” (conjunction)
  - For example
    - 31978002|fracture of tibia| +75591007|fracture of fibula|
Compositional grammar (2)

- Refinements can be added after a colon
  For example
  125605004: 363698007=29627003

- Refinements can be nested in parentheses
  For example
  53057004|hand pain|:
    363698007|finding site| = (76505004|thumb structure|:
      272741003|laterality| = 7771000|left|)

- Refinements can be grouped in braces
  For example
  71388002|procedure|:
    {260686004|method| = 129304002|excision - action|,
      363704007|procedure site| = 66754008|appendix structure|}

Note: the comma also means logical “and” in this expression
Expression example: “Severe pain the left thumb”

Compositional grammar mapped to diagrammatic representation

53057004:363698007=(76505004:272741003=7771000),272141005=24484000
Alternative ways to represent expressions

- SNOMED Compositional Grammar is a recommended common form for review of expressions, and possibly for messages.

- Internally within an application any form that captures the SNOMED CT abstract logical model for an expression is acceptable:
  - SNOMED CT or a proprietary compositional grammar
  - XML in accord with (old) HL7 CD data type or proprietary schema
  - Relational database schema with table joins
    - Similar to SNOMED CT Relationships table
  - Use of internal unique identifiers pointing to an expression reference table.
Single hierarchy: Retrieval by site
Single Hierarchy: Retrieval by morphology
Multiple Parents: More complete retrieval

- Disorder
  - Infectious disease
    - Infectious pneumonia
      - Bacterial pneumonia
    - Pulmonary disease
      - Inflammatory lung disease
Multiple attributes

- **Attribute** = Site
  - **Values** = Kidney, Bladder, Ureter

- **Attribute** = Morphology
  - **Values** = Cyst, Tumor, Abscess

- **Attribute** = Etiologic agent
  - **Values** = Infectious agents (hierarchy), Substances (hierarchy)
Which ones are abscesses?
Expression transformations

- Expressions can be transformed by applying rules that
  - Impose formal structures from associated SNOMED CT definitions (e.g. nesting and/or grouping of attributes)
  - Remove redundancy where a refinement contains an attribute which duplicates a part of the definition of the focus concept
  - Add redundancy to assist processing at the expense of storage
  - Add explicit representation of assumed contextual information
  - Fully “normalize” the expression to support subtype and equivalence testing during selective retrieval

- Details of the transformation rules
  - See “Transforming expressions to normal forms” document
Expression transformation & forms used for storage and communication

- Recognition of the possibility of transformation affects decisions about representation of expression
  - Should information be transformed to a common “normal form” before storage or communication?
  - or
  - Should information be stored in a “close-to-user” form that closely represents the information as actually entered?
- To preserve clinical integrity the close-to-user form is preferred as the primary representation for storage and communication
  - The reasons for this are explained on subsequent slides …
Advantages of close-to-user form

- For clinical integrity and reliability the form stored should be as close to that entered as possible
  - The “normal form” of a given input may change as the definitions of referenced concepts are enhanced in new SNOMED CT releases
  - Close-to-user form preserves integrity across releases
  - Normal form is usually more verbose which is not ideal for storage or communication

- Formal rules specified by SNOMED allow a “close-to-user” expression to be transformed to the “normal form”
  - Normal form is vital for retrieval but for effective retrieval the normal form for all expressions must be based on the same set of SNOMED CT released definitions
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Where do the codes and expressions go in a record?

- **Statements in EHRs**
  - Electronic health record is made up of a series of statements
- **Codes and expressions are the values for fields/slots in the information model**
  - Codes and expressions from the terminology fill in some or all of the statement body
  - Information model determines the fields/slots available
- **Coordination required to avoid gaps & overlaps between**
  - terminology model
  - Information model
Record Structure vs Patient Data

Record Structure:
- Patient
  - Has-diagnosis: Disease
  - Has-treatment: Surgical Procedure
    - Has-complication: Disease

Patient Data:
- Mrs. Jones
  - Has-diagnosis: melanoma
  - Has-treatment: surgical excision
    - Has-complication: infection
Terminology Model vs. Record Structure

**Terminology Model**

- Concept
  - Disease
    - Melanoma
  - Surgical Procedure
    - Excision

**Record Structure**

- Patient
- Disease
  - Has-diagnosis
- Surgical Procedure
  - Has-treatment
  - Has-complication
- Disease
Need for information model

- Clinical statements require an information model
- The simplest information model is just
  - “put your information here: ____________________”
- This is absurd, especially for data that ordinarily goes into fields such as:
  - Name, ID, Date of visit
Structuring individual observations

<table>
<thead>
<tr>
<th>Date</th>
<th>Observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-Nov-2008</td>
<td>Free text</td>
</tr>
</tbody>
</table>

You can’t make effective use of free text for decision support and other secondary purposes

<table>
<thead>
<tr>
<th>Date</th>
<th>Observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-Nov-2008</td>
<td>Coded value</td>
</tr>
</tbody>
</table>

This extreme is absurd – requires everything to be in the coded terminology

<table>
<thead>
<tr>
<th>Date</th>
<th>Observation type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-Nov-2008</td>
<td>Code for “question”</td>
<td>Code for “answer”</td>
</tr>
</tbody>
</table>

How do we decide what goes in the “question” and what goes in the “answer”???
Balance, overlaps, gaps

- **Record the fact that “malignant mesothelial cells were found in a pleural fluid aspirate”:**

<table>
<thead>
<tr>
<th>Field or question</th>
<th>Terminology value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pleural fluid finding</td>
<td>Malignant mesothelial cells</td>
</tr>
<tr>
<td>Site of malignant mesothelial cells</td>
<td>Pleural fluid</td>
</tr>
<tr>
<td>Lab test result</td>
<td>Malignant mesothelial cells in pleural fluid</td>
</tr>
<tr>
<td>Type of mesothelial cells in pleural fluid</td>
<td>Malignant</td>
</tr>
<tr>
<td>Type of malignant cells in pleural fluid</td>
<td>Mesothelial</td>
</tr>
</tbody>
</table>
Clinical statements

- Are the basis for a common view of patient record structure.
- The electronic medical record can be viewed as a collection of statements
- A faithful record of what clinicians have heard, seen, thought, and done
  - Not a collection of facts
- Other requirements for a medical record, follow naturally from this view
  - e.g. that it be attributable and permanent

Statement based view of a patient record
Overall high-level view

- Patient record
  - Statement
  - Statement
  - Statement
    - Statement
    - Statement
    - Statement

- Common repeating elements represent statements
- Subsidiary statements may be nested
- Statements may be related to one another
- All statements have a common basic structure with a minimum set of specializations
Identifying concepts, context, values

Mr Harvey Q. Patient

Community Health Centre

Dr Smith

Heparin syringes

PathLab

- Mr Harvey Q. Patient
  - 5-Feb-2008
  - 01) visit to Community Health Centre, seen by Dr Smith
    - 02) Complained of pain the right calf
    - 03) Swelling and tenderness over right gastrocnemius
    - 04) Doppler ultrasonography done
    - 05) Diagnosis of right proximal deep venous thrombosis
    - 06) Prescription
      - 07) Supply request – low molecular weight heparin syringes x 4
      - 08) Recommend administer – low molecular weight heparin 70 mg subcutaneously twice a day for 2 days
    - 07) Return to clinic in 2 days to begin warfarin therapy
    - 08) Test request for International Normalized Ratio (INR), Antithrombin 3 and Protein C sent to PathLab
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First rule of coding

- Yesterday’s data should be usable tomorrow
- Corollary: If no-one is going to re-use the data, then no-one needs to code it.
Why do clinicians record patient data?

- To aid their memory
- To legally document what they saw & did (and sometimes why)
- To communicate to other members of a team
- To support and justify reimbursement
- To satisfy requirements of protocols & systems
  - Research protocols
  - Minimum data sets
  - Professional guidelines
  - (? And some incidental constraints imposed by software)
Secondary uses

- Secondary uses of clinical data are any uses other than the primary purpose(s) for which the data is recorded.

  - ICD-10 coding for reimbursement can be derived from the dictated discharge summary, where the primary purpose may be documentation +/- communication, (not reimbursement).

  - Communicable disease reports to the health department can be derived from routine lab culture reports, where the primary purpose is communication to the ordering physician, (not epidemic detection).
Examples where the ideal is beginning to work

- **Microbiology laboratories**
  - **positive Salmonella culture**
    - Reports go to the physician(s) caring for the patient
    - Reports also go to local/state reportable disease registries
Data re-use

- Requires the ability to:
  - Query databases containing coded clinical data
  - Systematically retrieve patients based on general criteria
  - Aggregate data in ways *not directly encoded*
  - Consider the following type of rule:
    - If the patient has had an MI but has no CHF, AV block, asthma, peripheral vascular disease, or Type 1 diabetes mellitus, and is not taking a beta blocker, you need to consider adding beta blocker therapy ...
Dilemmas requiring attention

- The value of secondary data accrues (mainly) to parties other than those who collect it

- The value of secondary data depends on its quality, while the quality of data is directly proportional to the care with which it is collected
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Extensions and namespaces

- Local extension is a fact of life
  - If so-called “local” identifiers (codes) are added to patient records, it is unlikely they will remain solely within an organisation, since patients and their records are inherently mobile
- The extension namespace mechanism is intended to allow organisations other than IHTSDO to create and distribute valid identifiers
  - Main benefits:
    - prevention of collisions
    - Software systems can be built to ignore certain namespaces, or to allow special handling of others
  - Proper use of namespaces is the responsibility of the namespace holder
Extension namespaces

- Contained within part of the code (SCTID)
  - A namespace is controlled by an organization other than IHTSDO

- Extensions allow addition of content to National Releases that is not required in the international release
  - leave granted under the Mental Health Act 1983 (England and Wales)

- Extensions also allow addition of local/regional content:
  - Multnomah County (Oregon) jail cell number
Identifiers for extensions

- **SCTID**: 9999999990989121102

- **Extension item identifier**

- **Partition identifier**
  - 10 = Extension, concept
  - 11 = Extension, description
  - 12 = Extension, relationship

- **Namespace identifier**

- **Check-digit**
Reference Sets (RefSets)

- Formerly called “subsets”
- Define groups of SNOMED components to be used for a particular purpose
- Types of RefSets
  - Simple
  - Group
  - Tagged
  - Language
  - Navigation
  - Aggregation
  - Prioritized
Navigational RefSet example

How a GP might like to navigate to Influenza A virus from “virus”:

- Virus
- Influenza A virus

Six levels deep if you try to navigate the is-a hierarchy:

- Virus
  - RNA virus
    - Enveloped ssRNA virus without a DNA step in life-cycle
    - Enveloped ssRNA virus without a DNA step with multiple-stranded negative-sense genome
  - Family Orthomyxoviridae
  - Genus Influenzavirus A
  - Influenza A virus
Making SNOMED usable

- Requires **design and selection** of usable components
  - Examples:
    - Problem list reference set
    - Primary care reference set
    - Non-human reference set (to be removed from browser for practitioners of human medicine)

- Requires **hiding some of the complexity** from the users
  - Search, adding qualifiers, doing queries, etc.

- Requires **software** that enables the users to accomplish their goals
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- Terminology / Information model interaction
- Primary and Secondary uses (re-use) of data
- Extensions and Reference sets
- History tracking and Cross mapping
Use case for history tracking

- IHTSDO issues a new release containing
  - New concepts
  - Changed relationships
  - Changed concept status (concepts are inactivated)
  - Different subsets, cross maps, and other components
- Temporary local identifiers (for content submitted for inclusion in the international release) have been replaced by official international release identifiers.
- ICD-10-AM & other classifications are released, with new content that requires updating the mappings
- Application content needs to be updated
History representation

- **Component History Table**
  - Identifies each change in the status of a Component and the Version in which the change was made, along with the Change type and Status after the change and (sometimes) a reason for the change.

- **Relationships Table**
  - Relates inactive concepts to active concepts in the terminology. The relationship types that support history are SAME AS, MAYBE A, REPLACED BY, WAS A, MOVED TO and MOVED FROM.
Principles of change

- Graceful evolution of content and structure
  - Avoid radical change
  - Clearly identify changes and why they occurred
- Concept persistence
  - Meaning of a concept must not be changed or deleted
  - Concept may be inactivated if its meaning is found to be redundant, ambiguous, or otherwise incorrect
- Address redundancy
  - Recognize redundancy
  - Provide a mechanism for resolution
Managing changes in systems

- Systematic planning for change management is essential to efficient updating
- Some systems that require “rip and replace” are never updated, with implications for safety
- The best software is designed to ensure modularity of:
  - Terminology and terminology services
  - Patient data repository and query services
  - User Interface and UI services
General change policies

- Always retain data in the form it was recorded
  - Data over-writing has serious quality issues and (in some realms) also medico-legal implications
- Update terminology regularly as necessary to keep pace with improved terminology quality and advanced knowledge
  - Terminology can be updated either incrementally or as a whole
    - *Incremental changes* generally require more effort to design & set up and less effort to do it each time.
    - *Complete replacement* is less difficult to design, requires more effort to actually do it.
Assumptions about cross maps

- Clinical care is documented using a terminology
- Reimbursement and statistical coding use:
  - Classifications (e.g. ICD10)
  - Groupers (e.g. HRGs, DRGs)
  - Administrative or financial codes
- Mapping is the way to link and coordinate
  - Reduce but not eliminate need for separate coding
- All maps are directional (from a source to a target)
- Producing a crossmap is not trivial
  - Different uses implies different levels of detail & grouping
  - Mapping is rarely one-to-one and may be many-to-many
- Using a crossmap can be straightforward,
  - if it is well designed, and supported with software
Direction of a crossmap

- Every mapping has a **direction**
  - The direction depends on the use case
  - Use case 1: code clinical statements in SNOMED, derive ICD codes afterwards:
    - Direction is *from* a SNOMED CT concept *to* one or more target codes, taking account of inclusion and exclusion criteria, etc
  - Use case 2: legacy data already coded in ICD, now want to do queries on new and legacy data using SNOMED CT
    - Direction is *from* ICD *to* SNOMED CT
    - General and “disjunctive” ICD codes may not have a corresponding code in SNOMED
      - E.g. “Other superficial injuries of abdomen, lower back and pelvis”
        - Best you can do is “superficial injury of trunk”
Scope of mapping to ICD

- What SNOMED Concepts should be mapped?
- Hierarchies:
  - Clinical findings
  - Situations with explicit context
- Concept status
  - Current concepts (status 0)
  - Not legacy (‘status 6’)
- Excludes codes in the non-human subset
- Any concept meeting these conditions, but has no corresponding ICD code, is explicitly noted to be unmappable
Example crossmap

46635009 Diabetes mellitus type 1 maps via the ICD-9-CM crossmap to

250.01 Diabetes mellitus without mention of complication, type I, not stated as uncontrolled

➢ Note that “without mention of” and “not stated as” are meaningless in a terminology context.

➢ They become meaningful in a classification / coding context, and depend on the contents of a pre-existing clinical record.