ihtsdo

Leading healthcare
terminology, worldwide

SNOMED CT
Content and Authoring Basics

Delivering

SNOMED CT

The global
language of
healthcare

Cathy Richardson
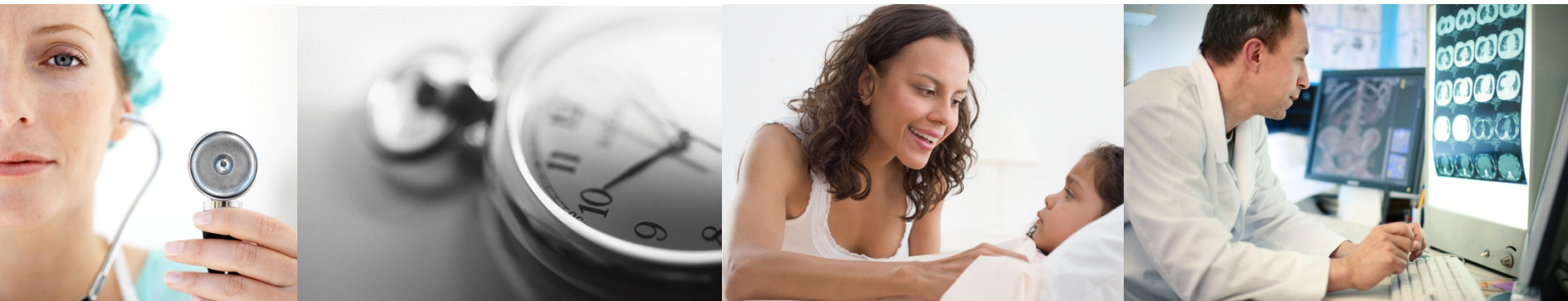Senior Terminologist

Outline of tutorial

- Welcome
- SNOMED CT content
- Content development overview
- Looking at a request
- Modeling content
  - New
  - Changes
  - Classification
- Options to learn more
- Questions

SNOMED CT CONTENT

Concept

A clinical idea with a unique identifier

22298006

Descriptions

FSN	**myocardial infarction (disorder)**	751689013
SYN	**myocardial infarction**	37436014
SYN	**cardiac infarction**	37442013
SYN	**heart attack**	37333015
SYN	**MI – Myocardial infarction**	17848
SYN	**myocardial infarct**	17848

22298006
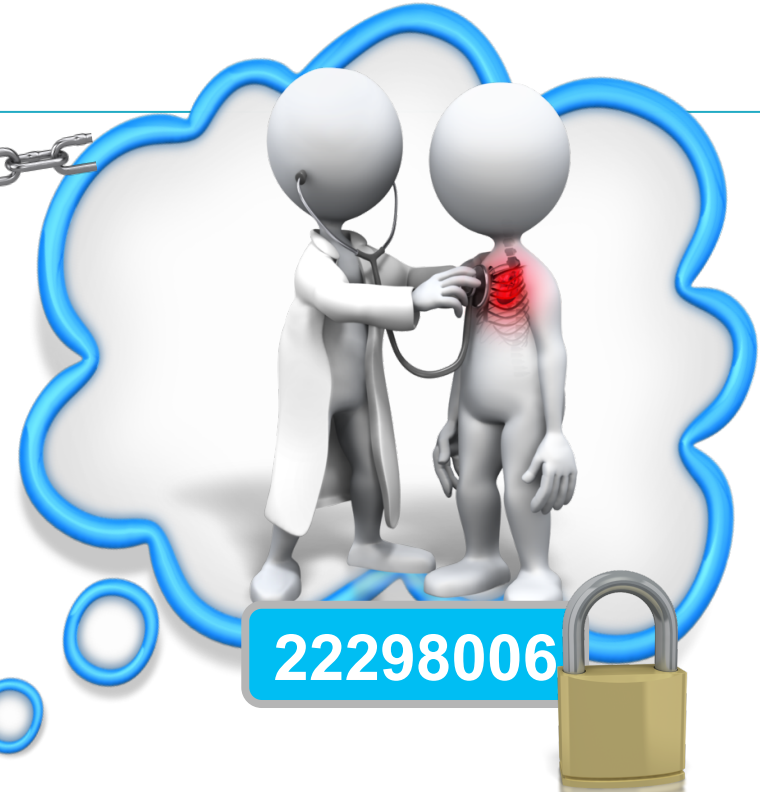
Human-readable term linked to a concept

SNOMED CT Top Level Hierarchies

- SNOMED CT Concept
  - Body structure (body structure)
  - Clinical finding (finding)
  - Environment or geographical location (environment / location)
  - Event (event)
  - Observable entity (observable entity)
  - Organism (organism)
  - Pharmaceutical / biologic product (product)
  - Physical force (physical force)
  - Physical object (physical object)
  - Procedure (procedure)
  - Qualifier value (qualifier value)
  - Record artifact (record artifact)
  - Situation with explicit context (situation)
  - SNOMED CT Model Component (metadata)
  - Social context (social concept)
  - Special concept (special concept)
  - Specimen (specimen)
  - Stages and scales (staging scale)
  - Substance (substance)

Body Structure

SNOMED CT Concept
- Body structure (body structure)
- Clinical finding (finding)
- Environment or geographical location (environm…
- Event (event)
- Observable entity (observable entity)
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- Substance (substance)

Body structure

Normal and abnormal anatomical structures

Semantic tags include (body structure) and (morphologic abnormality)

Examples:
- | femur |
- | mitral valve structure |
- | adenosarcoma |

Used for:
- Symptom location
- Disorder location
- Procedure site
- Site of administration

Clinical Finding

SNOMED CT Concept
- Body structure (body structure)
- **Clinical finding (finding)**
- Environment or geographical locat...
- Event (event)
- Observable entity (observable entity)
- Organism (organism)
- Pharmaceutical / biologic product (product)
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Clinical finding

The result of a clinical observation, assessment or judgement and includes normal and abnormal clinical states.

Semantic tags: (finding) and (disorder)

Examples:
- | asthma |
- | headache |
- | normal breath sounds |

Used for:
- Reason for admission
- Diagnosis
- Signs and symptoms
- Laboratory test results
- Assessment result

Procedure

- SNOMED CT Concept
  - Body structure (body structure)
  - Clinical finding (finding)
  - Environment or geographical location (environment / location)
  - Event (event)
  - Observable entity (observable entity)
  - Organism (organism)
  - Pharmaceutical / biologic product (product)
  - Physical force (physical force)
  - Physical object (physical object)
  - Procedure (procedure)
  - Qualifier value (qualifier value)
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  - Situation with explicit context (situation)
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  - Special concept (special concept)
  - Specimen (specimen)
  - Staging and scales (staging scale)
  - Substance (substance)

Procedure

Activities performed in the provision of health care.

Semantic tags include (procedure) and (evaluation procedure)
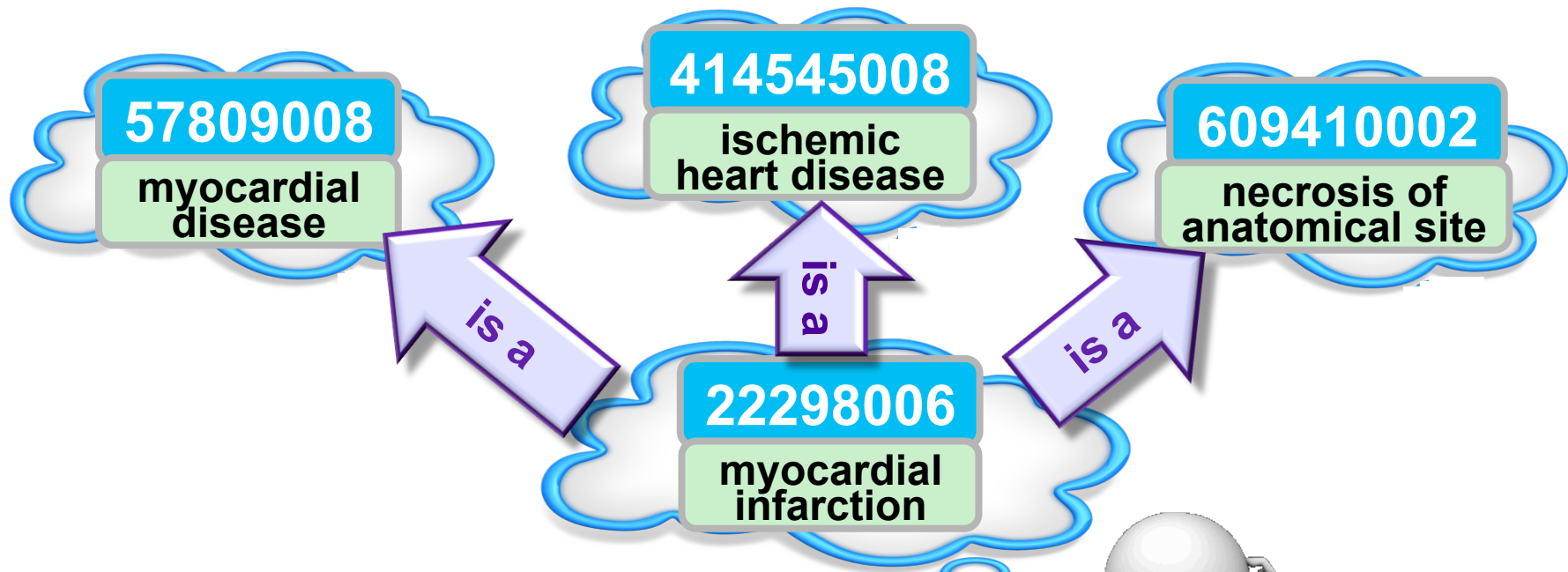
Examples:

- | appendectomy |
- | ultrasound |
- | physiotherapy |
- | discharge |

Used for:

- *Procedures performed*
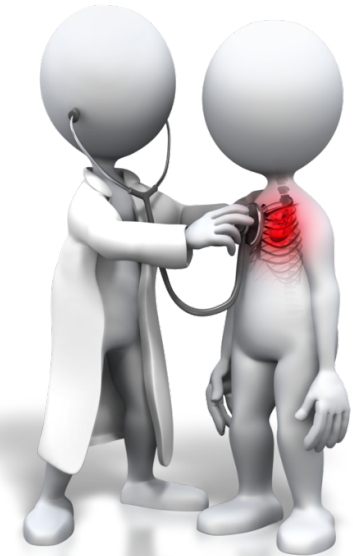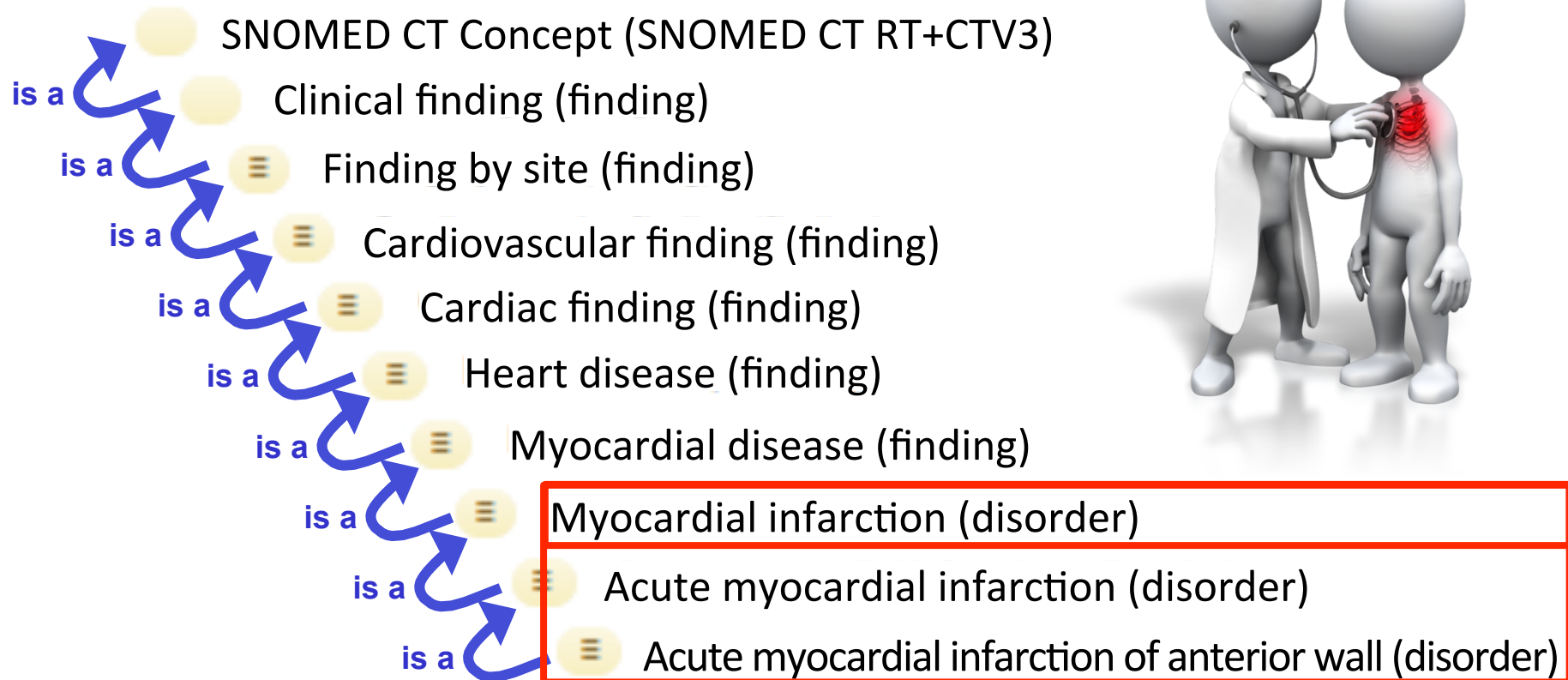- *Planned procedures*
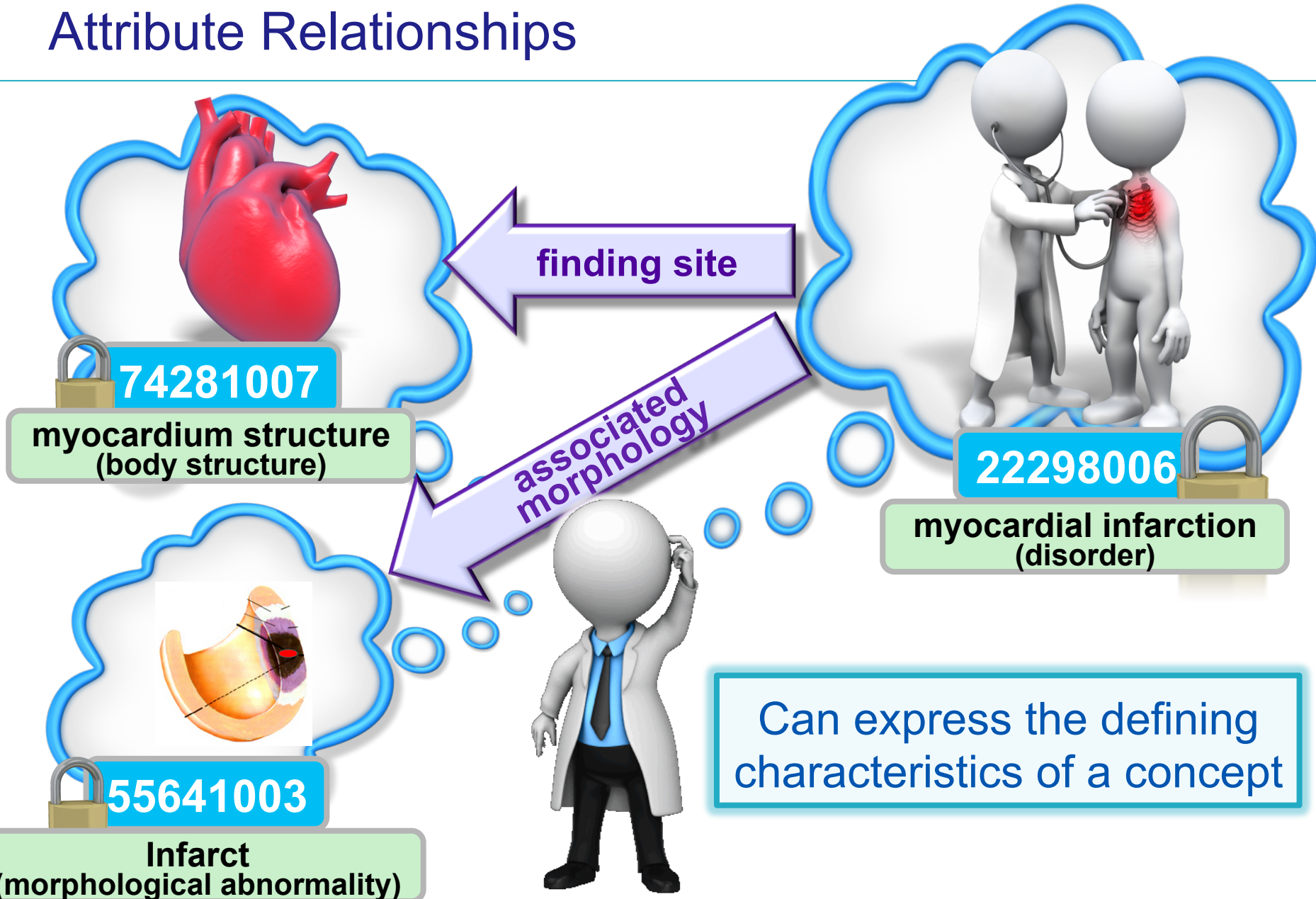- *Requested procedures*

Relationships

'is a' relationships form a subtype 'polyhierarchy'

Subtype Relationships

SNOMED CT Concept (SNOMED CT RT+CTV3)

is a

Clinical finding (finding)

is a

Finding by site (finding)

is a

Cardiovascular finding (finding)

is a

Cardiac finding (finding)

is a

Heart disease (finding)

is a

Myocardial disease (finding)

is a

Myocardial infarction (disorder)

is a

Acute myocardial infarction (disorder)
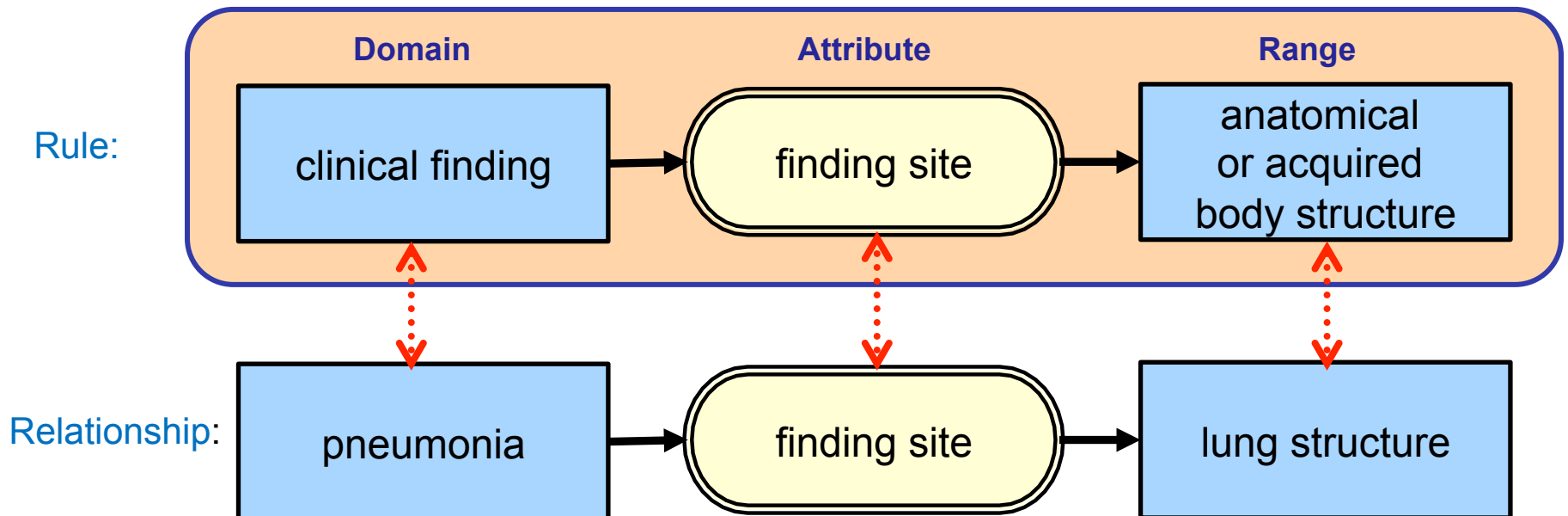
is a

Acute myocardial infarction of anterior wall (disorder)

Domain and Range

- Domain
  - The hierarchy to which a specific attribute can be applied
  - The set of permissible 'source concepts' of relationships of that type
- Range
  - The set of concepts that are allowed as the value of the attribute
  - The set of permissible 'target concepts' of relationships of that type

Relationship Groups

- A set of relationships that are grouped together in a concept definition to enable its correct interpretation
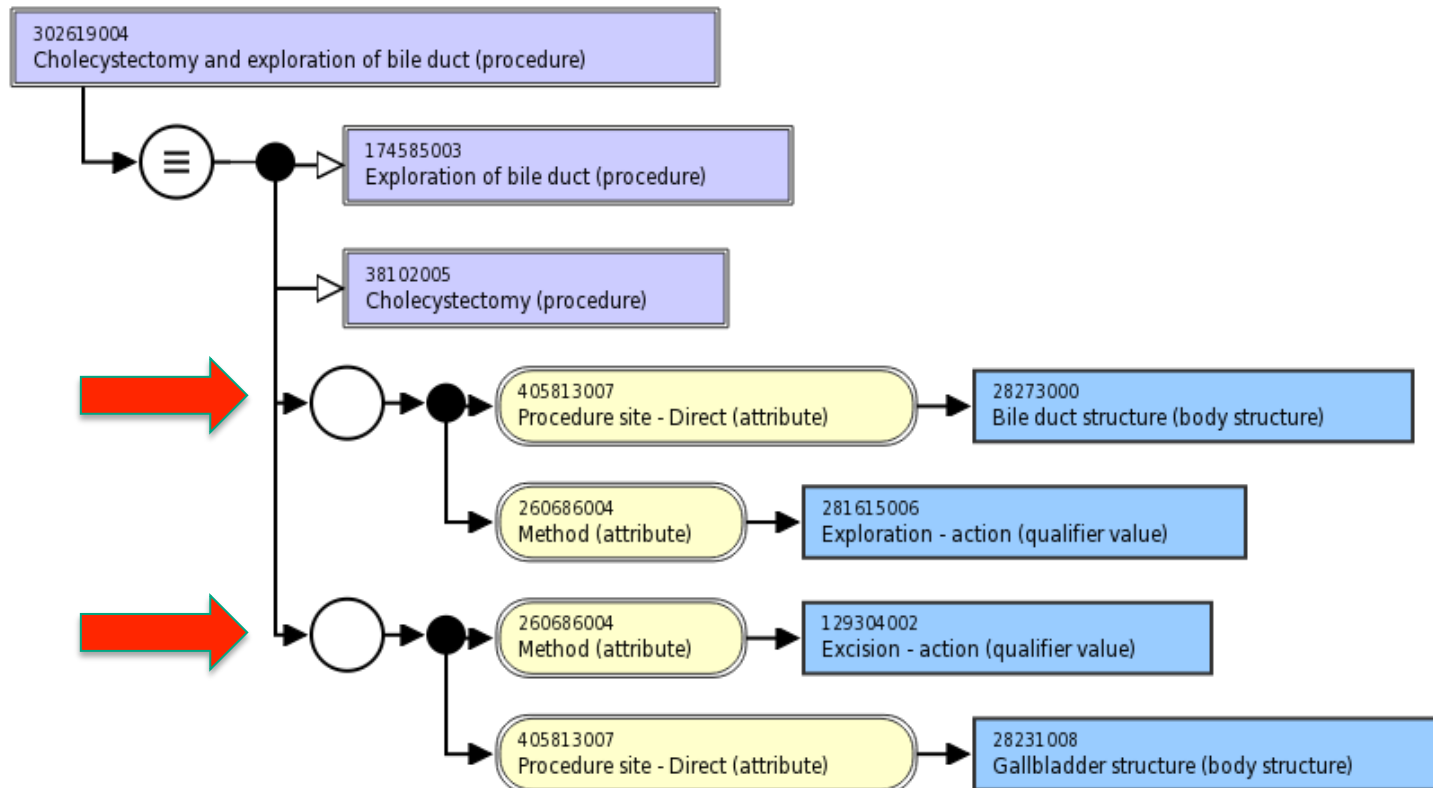
The SNOMED CT Concept Model

The concept model

- Specifies how SNOMED CT concepts are defined
- Constrains the permitted attributes and values that may be applied to each kind of concept
- Based on formal Description Logic (OWL 2 EL)

Value of the model

- Defines terminology editorial & validation rules
- Foundation for processing meaning in clinical records
- Facilitates effective retrieval
- Enables appropriate use of clinical information

Clinical finding attributes

- Finding site

- Associated morphology

- Associated with
  - Causative agent
  - Due to
  - After

- Severity

- Clinical course

- Episodicity

- Interprets

- Has interpretation

- Pathological process

- Has definitional manifestation

- Occurrence

- Finding method

- Finding informer

Example: Fracture of femur
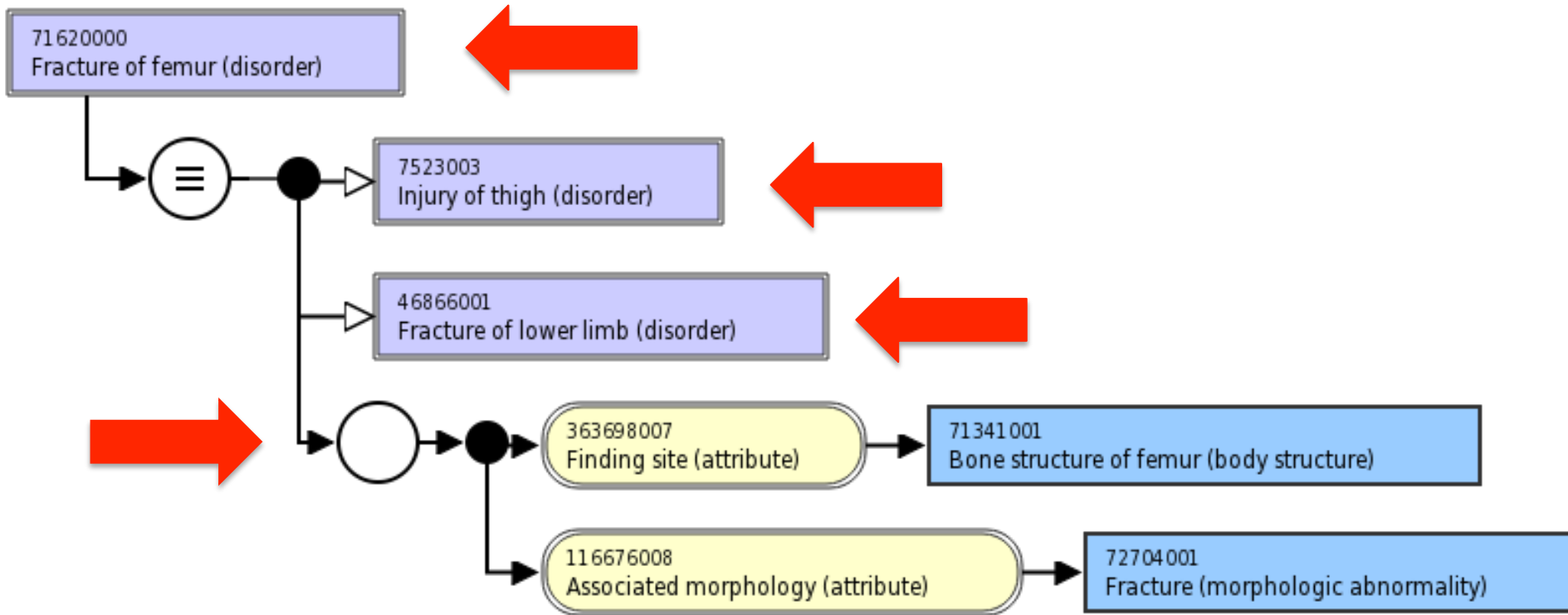
Primitive and Fully Defined Concepts

- A concept is "primitive" if
  - Its definition *is **not sufficient*** to fully define the concept
    - Basically the relationships it has aren't enough to determine if it is different from its supertypes
  - Two primitive concepts may have the same definition

- A concept is "fully defined" if
  - Its definition *is **sufficient*** to fully define the concept
    - Basically it has additional relationships or more specific values assigned to its attribute relationships than its supertypes. This enables the classifier to determine it is a subtype.
  - **No** two fully defined concepts can have the same definition

Primitive and Fully Defined Concepts - Examples

- Head injury **FULLY DEFINED**
  - **is a** = Disease
  - **associated morphology** = Traumatic abnormality
  - **finding site** = Head structure

- Aching pain **PRIMITIVE**
  - **is a** = Pain

- Headache **FULLY DEFINED**
  - **is a** = Aching pain
  - **finding site** = Head structure

CONTENT DEVELOPMENT OVERVIEW

What is Content Development?

- Any change to content however minor is considered to be content development.
- Development is ongoing to ensure the product is fit for purpose.

What triggers content development

- Member country implementation activities
  - User requests
  - Member country priorities
- Collaboration agreements
  - SNOMED CT - ICD11 alignment work with WHO
- IHTSDO Special Interest and Project Group work
  - Event Condition and Episode Group
- Advances in knowledge and technology
- Identification of issues and areas of work

Types of content development

- ## Creation of new content
  - Concepts
  - Descriptions

- ## Changes to current content
  - Reviewing and changing relationships
  - Changes to the text string of a description
  - Changing the concept definition status
  - Description preferences and acceptability
  - Inactivation of a component
  - Transfer of concepts between extensions and the international edition
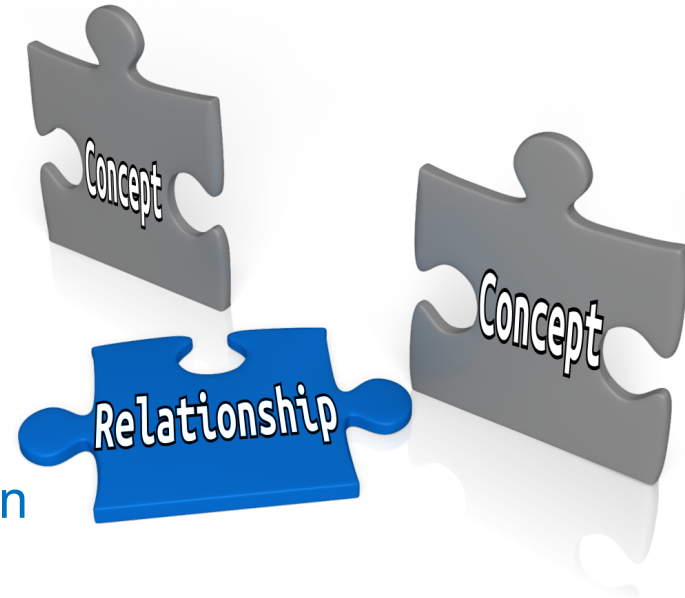
Types of content development

- Some more complex content issues:
    - Review and redesign of hierarchies
        - E.g. Anatomy
    - Concept model reviews
        - Part of a hierarchy redesign
        - Attributes
    - How should 'like' concepts be modeled?
    - Terming patterns

Who works on SNOMED CT content?

- IHTSDO
- National Release Centers (NRC's)
- Other organizations that hold an active namespace identifier
  - Healthcare software vendors and healthcare organizations
- Volunteers
  - IHTSDO Special Interest and Project Groups
  - Consultant Terminologists

LOOKING AT A REQUEST

Examining a request: The background

- What is the request?

- Supporting use case?

- Are there usage statistics?

- Has current supporting evidence been provided?

- Intellectual property rights or copyright to consider?

- Has a definition been provided?

- What analysis has been done by the requester?

- Priority for inclusion?

- Is it in scope?

Example of a good request

Definition: A patient speculated to have Ebola virus disease (EVD) based on symptomatology and history of exposure to the Ebola virus (this definition is based on the United States Centers for Disease Control and Prevention (CDC) criteria listed here: http://www.cdc.gov/vhf/ebola/hcp/patient-management-us-hospitals.html)

Proposed Use: To document Ebola virus related data elements in the electronic health record. All requests in this batch submission are elements derived from the CDC Algorithm for Evaluation of the Returned Traveler (http://www.cdc.gov/vhf/ebola/pdf/ebola-algorithm.pdf)

Justification: Necessary for documentation of CDC guidelines related to the Ebola virus epidemic. Denial will result in inadequate representation of important data elements in the patient record.

Parent Concept Ids

Parent Concept Id	Terminology	Preferred Term
473130003	SNOMED CT International	Suspected infectious disease (situation)

Descriptions

Description Type	Term
Preferred Term	Suspected Ebola virus disease
Synonym	Suspected Ebola hemorrhagic fever
Synonym	Suspected Ebola haemorrhagic fever
Fully Specified Name	Suspected Ebola virus disease (situation)

Notes

Note	Submitted By	Timestamp	Actions
The requested change has been made for the January 31, 2015 release.	Penni Hernandez phe@ihtsdo.org	Dec 12, 2014	❌
A new concept has been added as requested. This response is subject to change until the time of release.	Kathleen Brown kbr@ihtsdo.org	Oct 24, 2014	❌
Proposed value for the Associated Finding attribute: 37109004 | Ebola virus disease (disorder)	James T. Case james.case@mail.nih.gov	Oct 23, 2014	❌

Examining a request: Meaning/Clarity

- A request for the concept 'cold' comes in.

  - Do they want to say patient feels cold?
    - | Feeling cold (finding) |

  - Do they want to say patient has a cold?
    - | Common cold (disorder) |

  - Is it relating to the weather or environment?
    - | Cold environment (environment) |
    - | Cold weather (physical force) |

  - Does the patient have Chronic Obstructive Lung Disease?
    - | Chronic obstructive lung disease (disorder) |

Examining a request: Checking content

- **Is the concept there but different terms are used?**
  - Heart or cardiac
  - Neck or cervical

- **Is the concept there but has been inactivated?**
  - Reason for inactivation?

- **Is there work happening in that area?**
  - SNOMED CT-LOINC agreement
  - Working Groups
    - X with Y, X due to Y
  - Content tracker items

Examining a request: Belong in SNOMED CT?

- Is the term URU
  - Useful – demonstrable use or applicable to health/health care
  - Reproducible- can used and understood in the same way by multiple people
  - Understandable- meaning understood by the average health care provider

- Does it represent a class/category or an instance?
  - SNOMED CT codes name classes of things
    - | Ileostomy set (physical object) | not Dr. Wang's ileostomy set
    - Heart structure not Sam's heart

Examining a request: Belong in SNOMED CT?

- **Classification derived phrases not accepted**
  - NOS (not otherwise specified)
    - Hyperthyroidism NOS
  - NEC (not elsewhere classified)
    - Other specified coagulation defect
  - Unspecified
    - Unspecified asthma
  - Not mentioned/ not associated with
    - Anal sphincter tear complicating delivery, not associated with third-degree perineal laceration, postpartum
  - With or without
    - Peptic ulcer with or without hemorrhage

Examining a request: Belong in SNOMED CT?

- International content:
    - Necessary for health information conformance and interoperability
    - Useful in more than one national healthcare system
    - Meets the editorial guidelines

- Level of precoordination
    - Policy/guidelines acceptance
    - Too much leads to combinatorial explosion
        - | Patient involved in major incident associated with incendiary device (causing fire) (event) |

Examining a request: Belong in SNOMED CT?

- International, national or local content:
  - | Framingham coronary heart disease 10 year risk score adjusted to Joint British Societies 2 guidelines (assessment scale) | **NATIONAL**
  - | Local hospital anesthetic cream (product) | **LOCAL**
  - | Avian influenza (disorder) | **INTERNATIONAL**
  - | Diabetic educator (occupation) | **PROBABLY INTERNATIONAL**

Resources: The Editorial Guide

Editorial Guide

July 2014

Content | Search | Documents

1 SNOMED CT Editorial Guide
2 SNOMED CT Purpose
3 Scope and boundaries
4 Requirements
5 Attributes Used in SNOMED CT
6 Individual Hierarchies
7 Terming and Naming Conventions

Document directory

Resources: General

- The request
- Clinical resources
    - Clinicians
    - Professional bodies
    - Journal articles
    - Position statements
- Selected internet sites
    - Clinical sites
    - Avoid patient information sites
- Other IHTSDO information
    - Content development documentation
    - Content tracker
- Other terminologists or authors

MODELING
CONTENT

Modeling a concept: Which hierarchy?

- **The semantic tag contributes to the meaning**
  - The 'Clinical Finding' or 'Body Structure' hierarchy?
    - | Hematoma (morphologic abnormality) |
      - what the pathologist sees examining the tissues
    - | Hematoma (disorder) |
      - what the doctor diagnoses- clinical judgment
  - The 'Clinical Finding' or 'Qualifier Value' hierarchy?
    - | Red color (qualifier value) |
      - a descriptor, adjectival modifier
    - | Red color (clinical finding) |
      - a morphological color finding

Modeling: Findings and Disorders

Findings

- Normal or abnormal state
- May exist at a single point in time
- Can not be temporally separate from the observation
- Can not be defined by an underlying pathological process that is present when the observation is not

Disorders

- Have an underlying pathological process
- Always represent an abnormal state
- Exist over time, though manifestations may not be evident

Similar finding and disorder concepts?

SNOMED CT has finding and disorder concepts that may appear similar. Be aware they have different meanings!

- Example:
    - Hearing worse (finding)
    - Hearing loss (disorder)

A hearing disorder is different from the symptom of reduced hearing which may have a range of causes such as excessive ear wax.

Modeling: Finding or Disorder?

Are these concepts findings or disorders?

- Decreased progesterone level (finding)
- Asthma (disorder)
- Acquired pulmonary artery aneurysm (disorder)
- Itching (finding)
- Type 1 diabetes mellitus well controlled (finding)

Modeling: Context

Does your concept have context?

- Did it occur in the past?

  - | History of asthma |

- Is it planned?

  - | Appendectomy planned |

- Refer to someone other than the patient

  - | Family history of diabetes mellitus |

- State presence or absence

  - | Bowel sounds absent |

Modeling: The Fully Specified Name

- The FSN uniquely describes the concept

- Most FSN's are in US English.

- Worded to capture meaning- not the 'common' way to say it
  - | Operation on aneurysm of carotid artery (procedure) |

- Unambiguous
  - Immunosuppression:

    means immunosuppressed or immunosuppressive therapy?

Modeling: The Fully Specified Name

- No acronyms
  - Computerized tomography not CT

- Ends with a semantic tag
  - | Appendectomy (procedure) |

- Editorial guidance on structure of text string
  - The FSN for a 'Clinical Finding' should name the morphologic abnormality before naming the site.
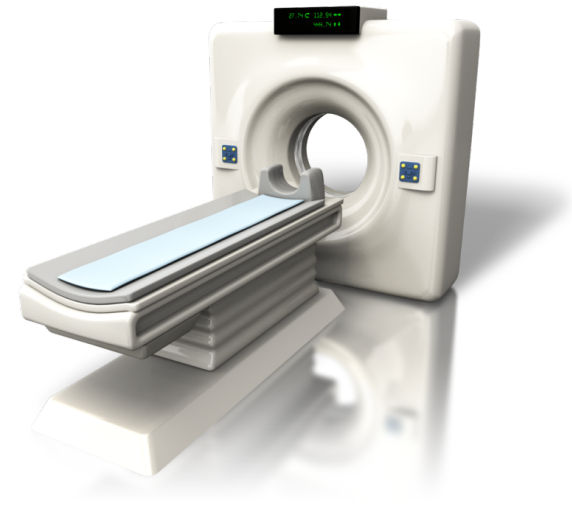
Modeling: Synonyms
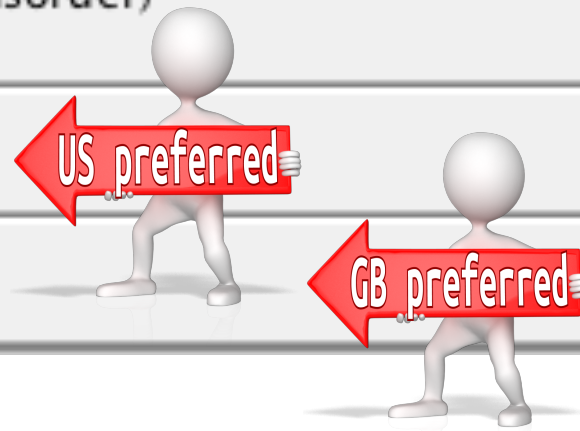
- A term other than FSN that can express the meaning
- Have the same meaning as the FSN
    - Should not be narrower

        FSN: | Removal of device (procedure) |

        SYN: | Removal and replacement of prosthetic device |

    - Should not be broader

        FSN: | Sprain (morphologic abnormality) |

        SYN: | Joint injury |

    - Near synonyms
        - More general is valid when context of use provides the meaning
        - Should to be marked as near synonymous (language reference set)

        FSN: | Entire fundus uteri (body structure) |

        SYN: | Fundus | in the context of obstetrics.

Descriptions and Language Reference Sets

- FSN
  - International Edition- US English
  - National extension- may be in language of the country

- Synonym
  - One can be marked as preferred for use in a particular language or dialect.
  - Known as the Preferred Term.
  - A synonym may be the Preferred Term in one dialect, a synonym in another dialect and unacceptable for third dialect
    - E.g. the US English synonyms in Australia are not used

- Identified within the Language Reference Set for that language or dialect

Descriptions and Language Reference Sets

Modeling: Editorial Guidelines

Some examples from
the guide

No 'an' or 'the'

Patient not subject

Singular not plural

No abbreviations

Punctuation

Modeling: The 'is a' relationships

Selecting supertype (parent) concepts:

- Need to keep within the same top level hierarchy

- At least one parent, can have several

- Must always be true

- Parent selection dependent on:

  - Preferred modeling approach

    - International- closest proximal primitive parent

    - Other options include closest parent

  - Availability of a classifier

Modeling: The Attribute Relationships

- Check the editorial guide on which attributes are allowed for the hierarchy you are placing the concept in.
  - Not all hierarchies have attributes
- Each attribute has a range of allowable values.
  - Some values are for qualifying relationships only
- Can not only sometimes be true
  - | Pneumonia (disorder) | can not be defined by the CAUSATIVE AGENT | Virus (organism) | as bacteria can also cause pneumonia.

Modeling: The Attribute Relationships

Check the editorial guide for allowable attributes and values

Defining Attribute	Subsumed Attribute	Allowable Values
I FINDING METHOD I		I Procedure I 71388002 (<=)
I FINDING INFORMER I		I Performer of method I 420158005 (<<) I Subject of record or other provider of history I 419358007 (<<)

👉 **Note:**

Meaning of Allowable Values (*Range*) notations:

- **(<<)** this code and *descendants*,
- **(<)** *descendants* only,
- **(<=)** *descendants* only (stated) except for supercategory groupers,
- **(==)** this code only,
- **(< Q)** *descendants* only when in a qualifying *Relationship*,
- **(< Q only)** *descendants* only, and only allowed in a qualifying *Relationship*.
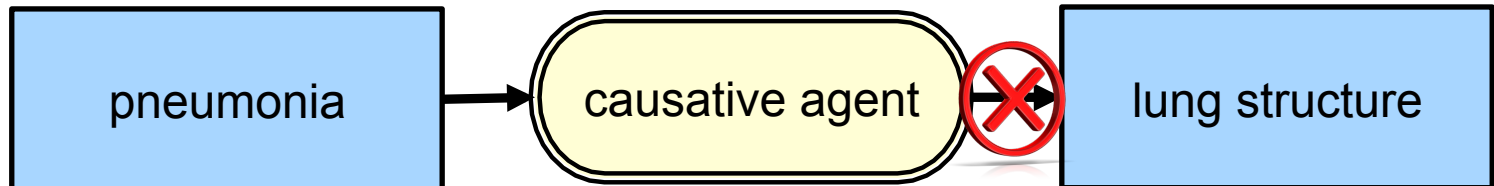
Modeling: The Attribute Relationships

- Don't use:
  - Unapproved attributes
  - Attributes from the concept models for other hierarchies
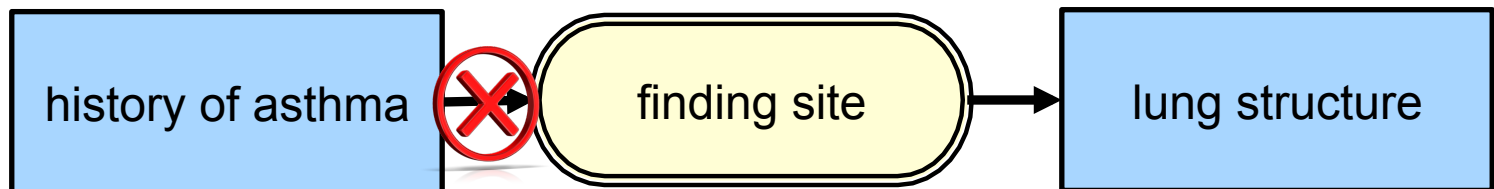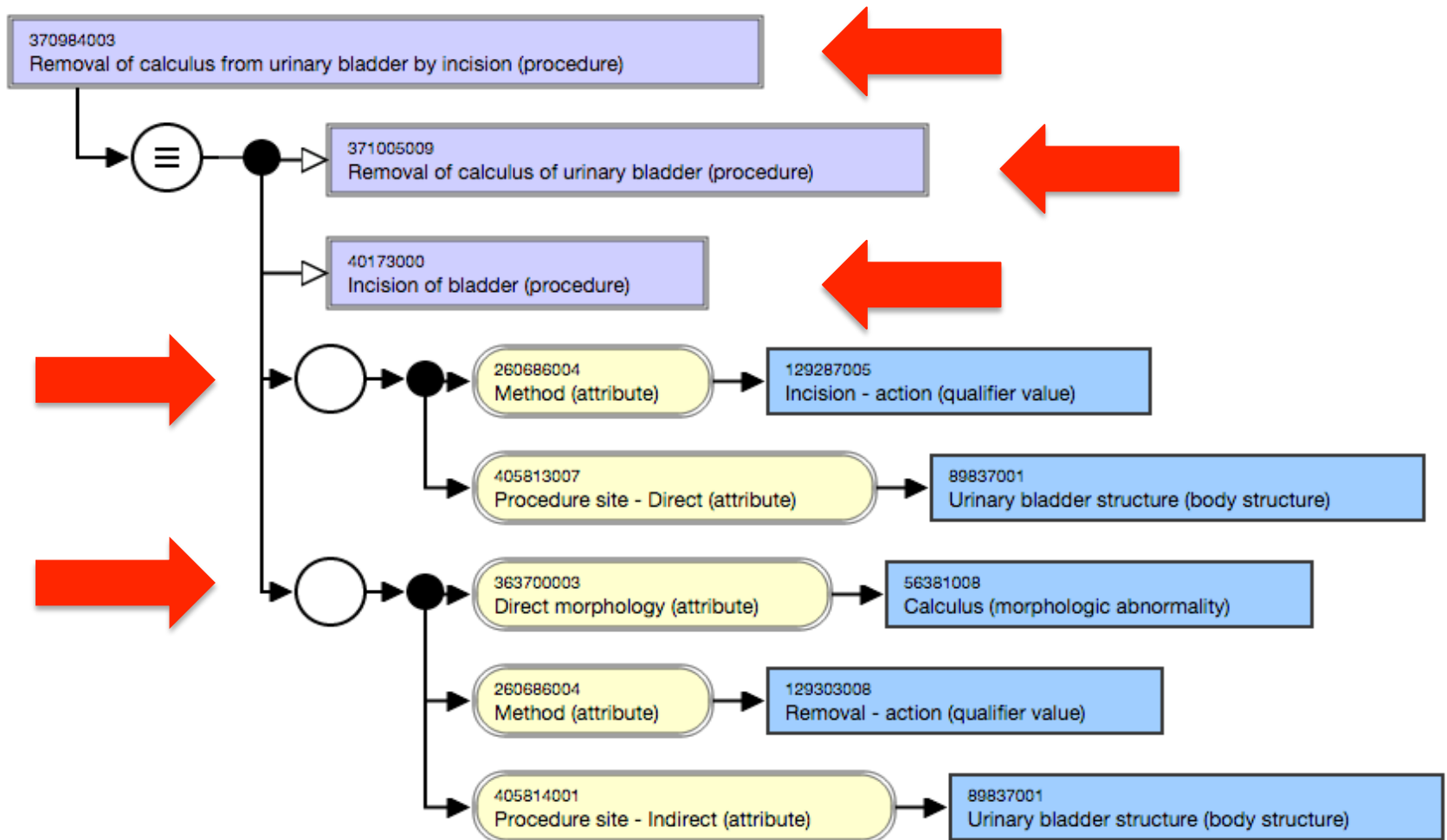- Only use allowed values
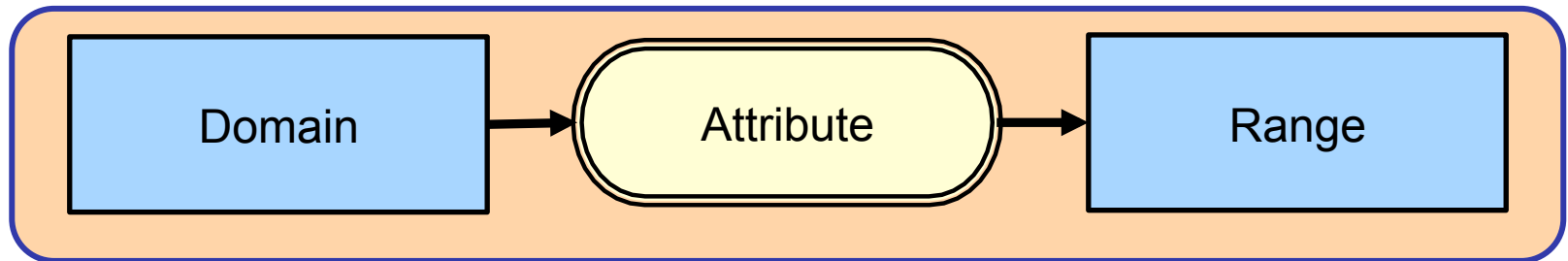
Procedure – Example

Modeling: Definitions

- A textual description can be added to the concept.
- The FSN remains the source of truth for meaning.

Allergic process (qualifier value)

SCTID: 472964009

Allergic process (qualifier value)

Allergic process

A type of immune mediated hypersensitivity process that represents the underlying mechanism of allergic conditions.

CHANGING CONTENT

Changing the FSN

- Minor changes only or concept **must** be retired
    - Capitalization
    - Punctuation
    - Spelling
    - Word order variation
    - Acronym expansion
    - Semantic type within a top level hierarchy
        - (Finding) to (Disorder)
        - Not permitted across top level hierarchies
- New description ID required
- Must **NOT** change meaning

Other changes- examples

Synonym:

- Addition Inactivation
- Moved to another concept
- Can change acceptability for a language or dialect

Relationships

- Change to or addition of supertype concepts
- Change to or addition of defining attributes
- Change of permissible values for the attributes

The concept does not need to be retired for these changes

Inactivation of a concept

- Concepts are inactivated not deleted.
- Concepts can be inactivated for several reasons:
    - Ambiguous
    - Duplicate
    - Erroneous
    - Outdated
    - Moved elsewhere
- With inactivation a historical relationship is created to a active concept
- With Release Format 2 historical content is placed in the Historical association reference sets

CLASSIFICATION
OF CONTENT

Description Logic

- A type of mathematical logic

- Used in a computer program

- Supports defining the meaning of terms

  - Knowledge representation

- Allows us to

  - Determine if 'this' is a kind of 'that'

    - Is 'asthma' a type of 'respiratory disease'"

  - Find all the kinds of 'X'

    - Find all the types of 'joint' disorders

Classification

Description Logic Classifier (Reasoner)
- A computer program with description logic rules
- Used within some terminology authoring tools
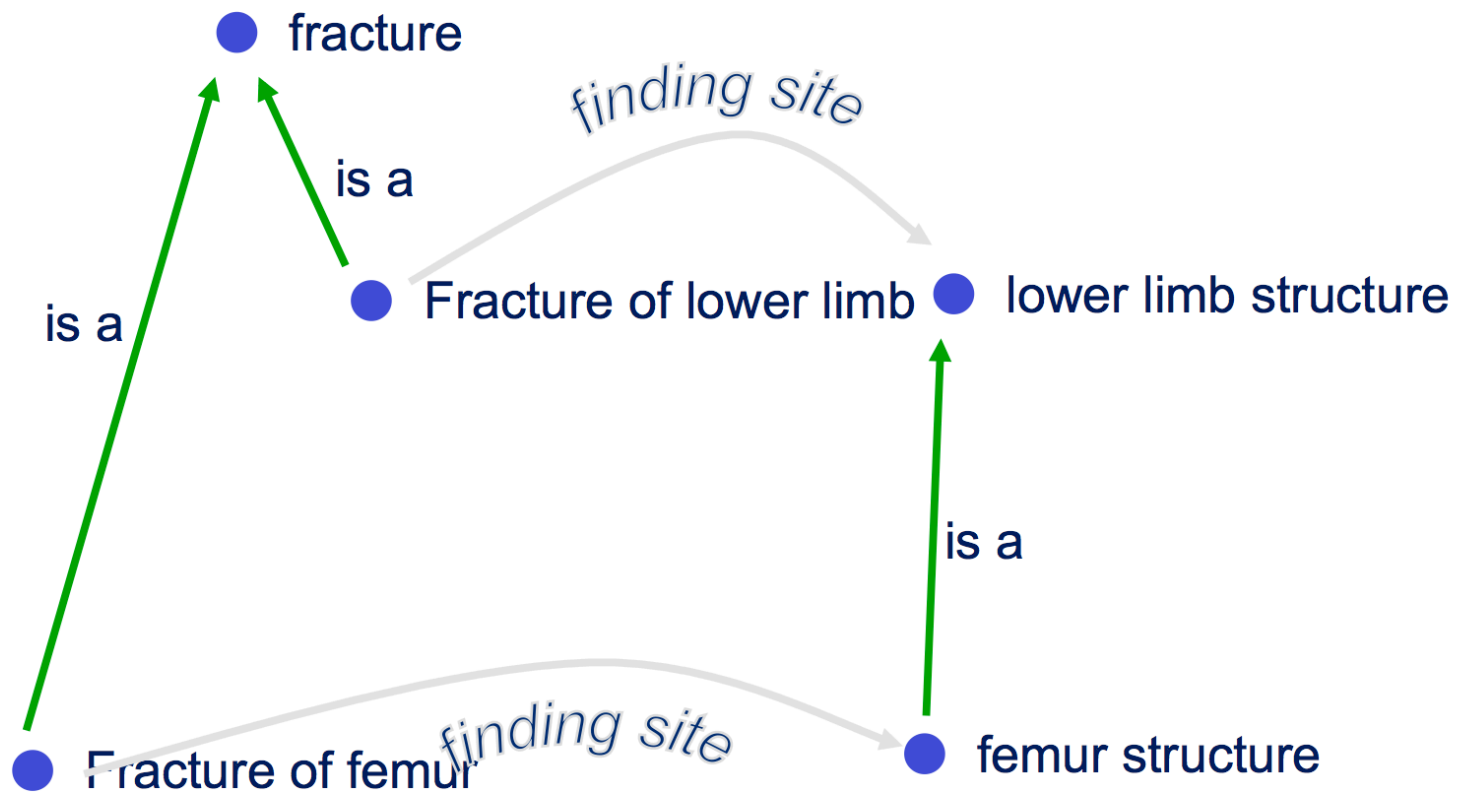
Classification:
- A process that generates a logically consistent subtype classification by applying description logic rules to the stated definitions of a set of concepts.

Basically
- Using from the relationships between concepts that have been stated by an author, other relationships can be inferred.
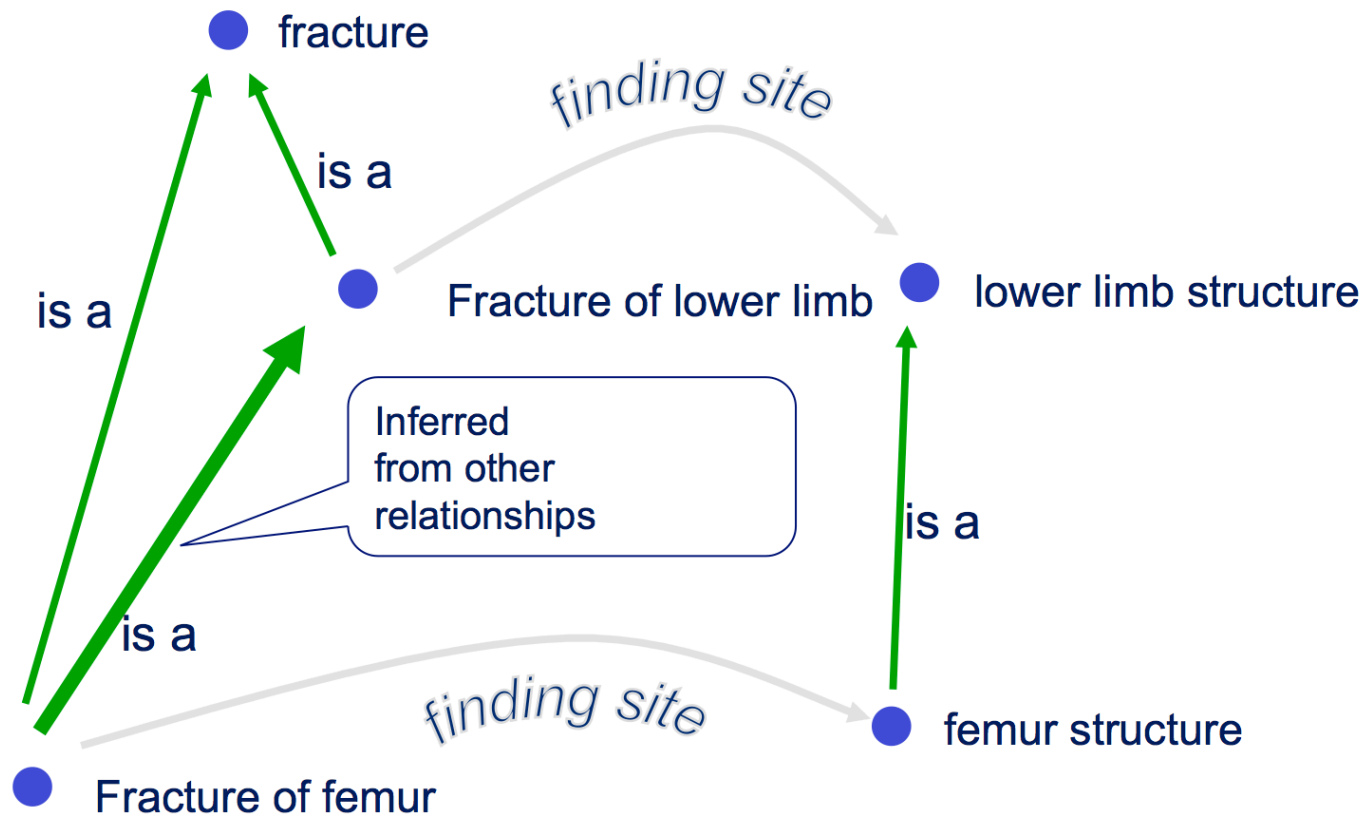- Enables correct placement of concepts in the hierarchical structure

An Example of a Stated View
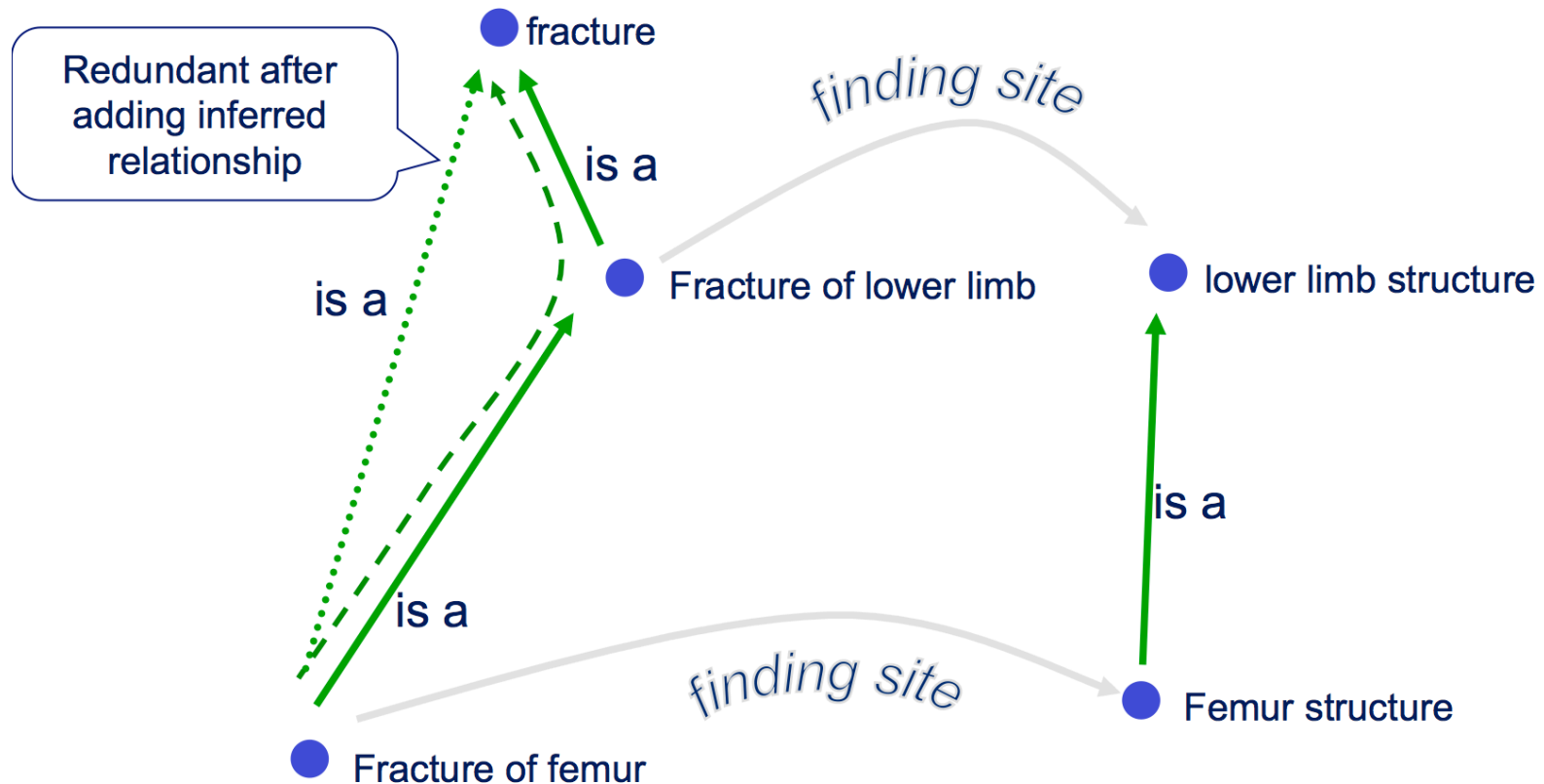
- The relationships created by the author

An Example of an Inferred View

- The relationships created by the author plus those inferred by the classifier

An Example of an Inferred View

- ▪ What the author would see after classification
    - ▪ The |fracture of femur| is a |fracture| relationship is redundant and would not be shown

Primitive and Fully Defined Concepts

- A concept is "primitive" if
  - Its definition *is **not sufficient*** to fully define the concept
    - Basically the relationships it has aren't enough to determine if it is different to its supertypes
  - Two primitive concepts may have the same definition

- A concept is "fully defined" if
  - Its definition *is **sufficient*** to fully define the concept
    - Basically it has additional relationships or more specific values assigned to its attributes (than its immediate supertypes) that enable the classifier to determine it is a subtype
  - **No** two fully defined concepts can have the same definition

Classification and definition status

A fully defined concept
- Classifier does the work
  - Inherited by its supertype/s
  - Inherits its subtype/s
  - Duplicate fully defined concepts detected

A primitive concept
- Can't be fully acted upon by the classifier
  - Inherited by its supertype/s
  - Will **NOT** be assigned any subtypes
    - Assignment of subtypes – manual process
  - Classifier will not pick up duplicates

- Note- not all concepts can be 'fully defined'

Back to Modeling: After change is made

- It's **really** important to check the outcome
    - Any duplicates?
    - Supertype concepts
    - Subtype concepts
    - The defining attributes

SUMMARY

Summary- SNOMED CT Content

- Concept- a clinical idea with a unique identifier

- Description- human readable term linked to a concept

- 19 top level content hierarchies e.g. 'Clinical Finding'

- Relationship/s

    - An associations between two concepts

    - Provide the logical definition of the concept

- Concept model specifies how concepts are defined

- Concepts can be primitive or fully defined

Summary - Content Development

- Content development – any change to content
- Triggers include
    - implementation activities
    - changes in knowledge
- Types of development include
    - Additions
    - Changes e.g. relationships
    - Inactivation
- Worldwide- a number of organizations involved in development work around the world

Summary – Requests

- Importance of getting enough detail in the request

- Be clear on what's required

- Does it belong in SNOMED CT?

- The International Edition or an extension?

- Check existing content.

- Make use of current professional resources

Summary - Modeling

- Which hierarchy does it belong in?
- How should the descriptions be worded?
- Which synonym should be the preferred term?
- Case sensitivity?
- Text definition required?
- Supertype concepts?
- Defining attributes and values?
- Definition status?

Don't forget to check the concept after classification!

Summary – Changes and Classification

- Changes to content can be made
  - Minor for FSN e.g. capitalization
  - Synonyms e.g. which is the preferred term
  - Relationships e.g. change the value

  but editorial guidance needs to be followed.

- Description logic supports defining the meaning of terms

- Classification
  - A process that generates a logically consistent subtype classification by applying description logic rules to the stated definitions of a set of concepts.
 - Works best with fully defined concepts as primitive concepts can not be fully acted upon by classifier

LEARNING MORE

SNOMED CT Foundation Course

- Provides authoritative coverage of a broad range of topics related to SNOMED CT at a relatively basic level
- Those who complete the course may join more advanced SNOMED CT courses
- Self paced requiring a total of 30 – 35 hours
- May be completed in between 1 week and 4 months
- E-Learning presentations
  - 3 modules with 6 presentations per module
- Online assessments
  - 4 assessments (1 per module and 1 final practical assessment)
- Completion certificate
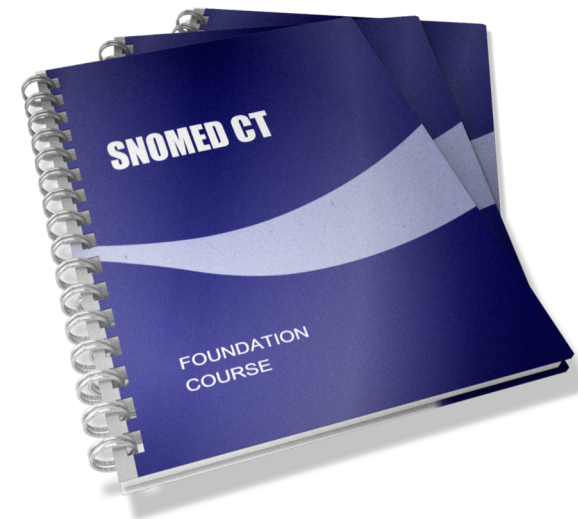
SNOMED CT Foundation Course – Topics

Module A

- Learning about SNOMED CT
- Introduction to SNOMED CT
- SNOMED CT Benefits for Organizations
- Why Clinical Terminology Matters
- Introduction to IHTSDO
- Exploring SNOMED CT Content

Module B

- SNOMED CT Components
- SNOMED CT Licensing
- Release Files and Formats
- SNOMED CT Concept Model
- Content Development
- Introduction to Extensions

Module C

- Reference Sets
- SNOMED CT Configurable Features
- Translation and Language Preferences
- Introduction to Mapping
- SNOMED CT Expressions
- SNOMED CT Implementation

SNOMED CT Content Development Theory Course

- Explores
  - SNOMED CT content and concept models
  - Principles of development and changes to content
- Audience
  - Those interested in learning more about SNOMED CT content and how changes to content are made
- Duration
  - 3 months
- Prerequisite
  - Successful completion of the SNOMED CT Foundation Course

Other SNOMED CT Resources

- IHTSDO Website (http://www.ihtsdo.org)
- SNOMED CT Document Library (http://snomed.org/doc)
  - SNOMED CT Starter Guide
  - SNOMED CT Editorial Guide
  - SNOMED CT Diagramming Guideline
- SNOMED CT E-Learning http://elearning.ihtsdotools.org/
- SNOMED CT Browser (http://browser.ihtsdotools.org/)

QUESTIONS AND DISCUSSION