INTRODUCTION TO PROBLEM LIST AND SNOMED CONCEPT MODEL

1. All subtypes of pneumonia
    - <233604007 |Pneumonia (disorder)| 225 concepts
2. All pneumonia caused by human coronavirus
    - << 233604007 |Pneumonia (disorder)| : 246075003 |Causative agent (attribute)| = << 84101006 |Human coronavirus (organism)| 3 concepts
3. All bacterial infectious diseases affecting the lung
    - << 87628006 |Bacterial infectious disease (disorder)| : 363698007 |Finding site (attribute)| = << 39607008 |Lung structure (body structure)| 117 concepts
4. All infectious diseases caused by Streptococcus
    - << 40733004 |Infectious disease (disorder)| : 246075003 |Causative agent (attribute)| = << 58800005 |Genus Streptococcus (organism)| 132 concepts
5. all acute diseases that have a clinical course relationship that has a value that is NOT a type of sudden onset and/or short duration.
    - << 2704003 |Acute disease (disorder)| : << 263502005 |Clinical course (attribute)| != << 424124008 |Sudden onset AND/OR short duration (qualifier value)| 11 concepts
6. All diseases caused by arterial occlusion, except those affecting the intestines or kidneys
    - << 2929001 |Occlusion of artery (disorder)| : 363698007 |Finding site (attribute)| != << 312577008 |Structure of blood vessel of intestine (body structure)|, << 363698007 |Finding site (attribute)| != << 2841007 |Structure of renal artery (body structure)| 208 concepts
7. Chronic diseases with exactly 2 finding sites
    - << 27624003 |Chronic disease (disorder)| : [2..2] << 363698007 |Finding site (attribute)| = * 745 concepts
8. All fractures with 2 or more body sites
    - << 125605004 |Fracture of bone (disorder)| : [2..*] << 363698007 |Finding site (attribute)| = * 550 concepts
9. Finding sites of any type of edema
    - << 267038008 |Edema (finding)| . 363698007 |Finding site (attribute)| OR 206 concepts
    - << 91723000 |Anatomical structure (body structure)| : R 363698007 |Finding site (attribute)| = < 267038008 |Edema (finding)| 203 concepts
    - Not equivalent, because not all finding site values are from Anatomic structure (body structure), to see difference: (<< 267038008 |Edema (finding)| . 363698007 |Finding site (attribute)|) MINUS (<< 91723000 |Anatomical structure (body structure)|) 3 concepts
    - The following will give equivalent results: << 123037004 |Body structure (body structure)| : R 363698007 |Finding site (attribute)| = < 267038008 |Edema (finding)|
10. Body sites affected by HIV

- (<< 404684003 |Clinical finding (finding)| : 246075003 |Causative agent (attribute)| = << 19030005 |Human immunodeficiency virus (organism)|).363698007 |Finding site (attribute)| 49 concepts

Look up ICD-10 and ICD-10-CM maps

1. Gestational diabetes
    a. ICD-10-CM has different codes depending on control and stage of pregnancy
2. Fracture of humerus
    a. ICD-10-CM is missing last digit (?) because needs episode of care and other information (open/closed fracture) for coding
3. Acute myocardial infarction – same code in ICD-10 and ICD-10-CM

INTEROPERATION FOR CLINICAL RESEARCH

COMPUTABLE PHENOTYPES
ALCOHOL USE DISORDER
<< 404684003 |Clinical finding (finding)| :
    << 246075003 |Causative agent (attribute)| = << 419442005 |Ethanol (substance)|

CORONARY VASCULAR DISEASE
/* *We don't want the findings from Clinical findings…* */
<< 64572001 |Disease (disorder)| :
    << 363698007 |Finding site (attribute)| = << 41801008 |Coronary artery structure (body structure)|,
//* *Looks pretty good, but – do we really want congenital disease as well?*
    << 116676008 |Associated morphology (attribute)| = << 28960008 |Arteriosclerosis (morphologic abnormality)|
*/

COLORECTAL CARCINOMA
<< 363346000 |Malignant neoplastic disease (disorder)| :
    << 363698007 |Finding site (attribute)| = << 71854001 |Colon structure (body structure)|
/* *62 relevant concepts found but, where are the rectal carcinomas?* */
ADD STRUCTURE OF RECTUM
<< 363346000 |Malignant neoplastic disease (disorder)| : << 363698007 |Finding site (attribute)| = (<< 71854001 |Colon structure (body structure)| OR <<34402009|Rectum structure (body structure)|)
/* *Better, now we have 94 codes* */

MEDICATION INTEROPERATION MODEL
AUSTRALIAN AMT MODEL FOR INTEROPERATION

-- Example SNOMED CT Product IDs --

1145421000 | Atorvastatin (as atorvastatin calcium) 40 mg oral tablet |
786021000 | Levofloxacin anhydrous (as levofloxacin) 15 mg/mL eye solution |
1149193009 | Voclosporin 7.9 mg oral capsule |
373994007 | Prednisone 5 mg oral tablet |
377263003 | Captopril 25 mg and hydrochlorothiazide 15 mg oral tablet |

-- Use case 1 - Finding AMT IDs --

-- Finding the most specific AMT concept that subsumes the SNOMED Clinical Drug concept

>>1145421000 {{ C moduleId= 90006201100003610 8}}
MINUS
>(>>1145421000 {{ C moduleId= 90006201100003610 8}})

-- Doing this for all the concepts at once

>>(1145421000 OR 786021000 OR 1149193009 OR 373994007 OR 377263003) {{ C moduleId= 90006201100003610 8}}
MINUS
>(>>(1145421000 OR 786021000 OR 1149193009 OR 373994007 OR 377263003) {{ C moduleId= 90006201100003610 8}})

-- Taking these AMT concepts for the rest of the examples
22785011000036108 | atorvastatin 40 mg tablet |
22541011000036103 | ofloxacin 0.3% eye drops |
23050011000036103 | cyclophosphamide 50 mg tablet |
22704011000036105 | prednisone 5 mg tablet |
23162011000036104 | captopril 25 mg tablet |
23387011000036109 | hydrochlorothiazide 25 mg tablet |

-- Flattenting this for use in ECL in the examples below
22785011000036108 OR 22541011000036103 OR 23050011000036103 OR 22704011000036105 OR 23162011000036104 OR 23387011000036109

-- Use Case 1 - Antibiotics --

-- 255631004 | Antibiotic | - primitive with no descendants. Perhaps a duplicate of 346325008|Antibacterial| which is defined and can be used
-- First for the SNOMED CT IDs
(1145421000 OR 786021000 OR 1149193009 OR 373994007 OR 377263003)
AND
<346325008 |Antibacterial|

-- Then for the AMT parents of the SNOMED CT concepts
(>>(1145421000 OR 786021000 OR 1149193009 OR 373994007 OR 377263003) {{ C moduleId= 9000620110000361 08}}
MINUS
>(>>(1145421000 OR 786021000 OR 1149193009 OR 373994007 OR 377263003) {{ C moduleId= 9000620110000361 08}}))
AND
<346325008 |Antibacterial|

-- Finally the actual AMT concepts
(22785011000036108 OR 22541011000036103 OR 23050011000036103 OR 22704011000036105 OR 23162011000036104 OR 23387011000036109)
AND
<346325008 |Antibacterial|

-- Use Case 2 - Cytotoxens --

-- 71837009 |Cytotoxic agent (product)| is again primitive with no descendants. However 27867009 |Antineoplastic agent| is present.
-- First for the SNOMED CT IDs

(1145421000 OR 786021000 OR 1149193009 OR 373994007 OR 377263003)
AND
<27867009 |Antineoplastic agent|

-- Then for the AMT products
(22785011000036108 OR 22541011000036103 OR 23050011000036103 OR 22704011000036105 OR 23162011000036104 OR 23387011000036109)
AND
<27867009 |Antineoplastic agent|

-- Use Case 3 - Migraine prophylaxis --

-- 773908008|Migraine prophylaxis therapeutic role| - unfortunately no content is marked as playing this role.

-- Use Case 3 - NSAIDs --

-- First for the SNOMED CT IDs
(<< 763158003 |Medicinal product| : << 127489000 |Has active ingredient| = << 372665008 |Non-steroidal anti-inflammatory agent|)
AND
(1145421000 OR 786021000 OR 1149193009 OR 373994007 OR 377263003)

-- Then for the AMT products
(<< 763158003 |Medicinal product| : << 127489000 |Has active ingredient| = << 372665008 |Non-steroidal anti-inflammatory agent|)
AND
(22785011000036108 OR 22541011000036103 OR 23050011000036103 OR 22704011000036105 OR 23162011000036104 OR 23387011000036109)

-- Looking at products that are NSAIDs in AMT using the AMT reference set for the equivalent of Clinical Drug
-- 929360071000036103 | Medicinal product unit of use reference set |
(<< 763158003 |Medicinal product| : << 127489000 |Has active ingredient|

= << 372665008 |Non-steroidal anti-inflammatory agent|)
AND
^929360071000036103 | Medicinal product unit of use reference set |

-- Use Case 3 - Immunosuppressants --

-- Taking the sample AMT products
(<< 763158003 |Medicinal product| : << 127489000 |Has active ingredient|
= <<372823004|Immunosuppressant (substance)|)
AND
(22785011000036108 OR 22541011000036103 OR 23050011000036103
OR 22704011000036105 OR 23162011000036104 OR
23387011000036109)

-- Use Case 3 - Glucocorticoids --

-- Using 116596006 | Product containing glucocorticoid (product) |
-- For the AMT products this is
(22785011000036108 OR 22541011000036103 OR 23050011000036103
OR 22704011000036105 OR 23162011000036104 OR
23387011000036109)
AND
<116596006 | Product containing glucocorticoid (product) |

-- Use Case 3 - Thiazide diuretic --

-- Using 372747003|Thiazide diuretic|
(< 763158003|Medicinal product| : <<127489000|Has active ingredient| =
<<372747003|Thiazide diuretic|)
AND
(22785011000036108 OR 22541011000036103 OR 23050011000036103
OR 22704011000036105 OR 23162011000036104 OR
23387011000036109)

-- Use Case 3 - Medication classes that treat or manage diabetes --
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-- There are no useful precoordinated concepts for this, taking Biguanide, Insulin, and Sulfonylurea
<<(109082004 | Biguanide-containing product | OR
39487003 | Insulin-containing product | OR
34012005 | Sulfonylurea-containing product |)
AND
^929360071000036103 | Medicinal product unit of use reference set |

-- This provides examples of products that MIGHT be diabetes treatment medications

OBSERVABLES CONCEPT MODEL AND LAB RESULTS

Any quantity concentration of any glucose in any blood material, with no precondition:

<< 363787002 |Observable entity (observable entity)| : 370130000 |Property (attribute)| = << 118594004 |Quantity concentration (property) (qualifier value)|, 246093002 |Component (attribute)| = << 67079006 |Glucose (substance)|, 704319004 |Inheres in (attribute)| = << 256906008 |Blood material (substance)|, [0..0] 704326004 |Precondition (attribute)| = *

Any identitity of any bacterium, using any culture technique, identified in any microbial isolate:

<< 363787002 |Observable entity (observable entity)| : 246501002 |Technique (attribute)| = <<703725008 |Culture technique (qualifier value)|, 704319004 |In-heres in (attribute)| = << 409822003 |Domain Bacteria (organism)|, 370130000 |Property (attribute)| = << 118584009 |Presence OR identity (property) (qualifier value)|, 704327008 |Direct site (attribute)| = << 119303007 |Microbial isolate specimen (specimen)|

Any identitity of any bacterium in any blood, using any culture techni-que,

<< 363787002 |Observable entity (observable entity)| : 246501002 |Technique (attribute)| = << 703725008 |Culture technique (qualifier value)|, 704319004 |Inheres in (attribute)| = << 409822003 |Domain Bacteria (organism)|, 370130000 |Property (attribute)| = << 118584009 |Presence OR identity (pro-perty) (qualifier value)|, 718497002 |Inherent location (attribute)| = << 256906008 |Blood material (substance)|

Any property of any benzodiazepine in any body fluid

<< 363787002 |Observable entity (observable entity)| : 370130000 |Property (attribute)| = *, 246093002 |Component (attribute)| = << 372664007 |Benzo-diazepine (substance)|, 704319004 |Inheres in (attribute)| = << 32457005 |Body fluid (substance)

PATHOLOGY AND CANCER RESEARCH

/*CASE #1 */
/*The research is interested in knowing the number of cases of primary malignancy in the digestive system */
/*These are observations made by the pathologist about a histology that is a primary tumor located in some part of the digestive system*/

< 363787002 |Observable entity (observable entity)|:

/*Look for assessments about histologic type property)*/
370130000 |Property|=6030001000004102 |Histologic type (property)|,

/*The histology is a primary malignant neoplasm*/
704319004 |Inheres in|=86049000 |Malignant neoplasm, primary|,

/*The neoplasm is located in any subtype of the digestive system*/
718497002 |Inherent location|=<<86762007 |Structure of digestive system (body structure)|

/*Notice how this query returns ALL parts of the digestive system from Mouth to anus*/

/CASE#2*/
/*The researcher REALLY wants to know about the number of cases of GI cancer*/

< 363787002 |Observable entity (observable entity)|:

/*Look for assessments about histologic type property)*/
370130000 |Property|=6030001000004102 |Histologic type (property)|,

/*The histology is a primary malignant neoplasm*/
704319004 |Inheres in|=86049000 |Malignant neoplasm, primary|,

/*The neoplasm is located in any subtype of the GI tract*/
718497002 |Inherent location|=<<122865005 |Gastrointestinal tract structure (body structure)|

/*CASE #3*/

/*Well, really, the investigator is interested in CRC cancer cases*/

< 363787002 |Observable entity (observable entity)|:

/*Look for assessments about histologic type property)*/
370130000 |Property|=6030001000004102 |Histologic type (property)|,

/*The histology is a primary malignant neoplasm*/
704319004 |Inheres in|=86049000 |Malignant neoplasm, primary|,

/*The neoplasm is located in the colon, rectum or anus*/
718497002 |Inherent location|=(<<14742008 |Structure of large intestine (body structure)| OR <<281088000 |Structure of anus and/or rectum (body structure)|)

/*This returns appendix, too. Can refine with 71854001 |Colon structure (body structure)|. Note that rectum is missing…needs modeling*/

/*CASE#4*/
/*Researcher wants to know all pancreatic neoplasms*/

< 363787002 |Observable entity (observable entity)|:

/*Look for assessments about histologic type property)*/
370130000 |Property|=6030001000004102 |Histologic type (property)|,

/*The histology is a primary malignant neoplasm*/
704319004 |Inheres in|=<<416939005 |Proliferative mass (morphologic abnormality)|,

/*The neoplasm is located in pancreas*/
718497002 |Inherent location|=15776009 |Pancreatic structure (body structure)|

/*Remember, need to include the Pancreas and all parts of pancreas*/

/*CASE#5*/
/*Researcher wants to know all pancreatic neoplasms*/

< 363787002 |Observable entity (observable entity)|:

/*Look for assessments about histologic type property)*/
370130000 |Property|=60300010000004102 |Histologic type (property)|,

/*The histology is a primary malignant neoplasm*/
704319004 |Inheres in|=<<416939005 |Proliferative mass (morphologic abnormality)|,

/*The neoplasm is located in pancreas*/
718497002 |Inherent location|=<<15776009 |Pancreatic structure (body structure)|

/*Remember, need to include the Pancreas and all parts of pancreas including the ampulla of Vater*/

/*CASE #6*/

/*Researcher wants to know all cases of locally invasive prostate cancer*/
/*Direct invasion to X from male genital organ to abdominal pelvic region*/
< 363787002 |Observable entity (observable entity)|:
    /*Primary malignancy*/
        704319004 |Inheres in|=86049000 |Malignant neoplasm, primary|,

    /*Prostate*/
        718497002 |Inherent location|= <<41216001 |Prostatic structure (body structure)|,

/*Characterizes Direct local extension*/
704321009 |Characterizes (attribute)|=1505281000004101 |Direct local invasion (qualifier value)|,

/*Any part of abdominal region*/
1003703000 |Process extends to| = *
/*This query returns perineural and lymph-vascular invasion…that is not "invasive" in common terms. Need to exclude those areas*/

/*CASE #7*/

/*Researcher wants to know all cases of locally invasive prostate cancer*/
/*Direct invasion to X from male genital organ to abdominal pelvic region*/
< 363787002 |Observable entity (observable entity)|:
/*Primary malignancy*/
704319004 |Inheres in|=86049000 |Malignant neoplasm, primary|,

/*Prostate*/
718497002 |Inherent location|= <<41216001 |Prostatic structure (body structure)|,

/*Characterizes Direct local extension*/
704321009 |Characterizes (attribute)|=1505281000004101 |Direct local invasion (qualifier value)|,

/*Exclude nerve, lymph-vascular */
1003703000 |Process extends to| = (* MINUS (<<3057000 |Nerve structure (body structure)| OR << 870401000004107 |Structure of lymphatic vessel and/or small blood vessel (body structure)|))

/*This returns periprostatic space, neck of male bladder, and seminal vesicle*/

/*CASE #8*/
/*Researcher wants to know Gleason scores for all prostate cancers*/
/*The long way and usable for other cancers*/

< 363787002 |Observable entity (observable entity)|:

	/*Property of histologic grade*/
	370130000 |Property|=1590001000004108 |Histologic grade (property) (qualifier value)|,
	/*Primary malignancy*/
		704319004 |Inheres in|=86049000 |Malignant neoplasm, primary|,

	/*Any prostate structure*/
		718497002 |Inherent location|= <<41216001 |Prostatic structure (body structure)|

/*Note that is query returns all components of grading process AND ISUP vs. Gleason*/
/*Need to refine by grading technique*/

/*CASE #9*/
/*Researcher wants to know Gleason scores for all prostate cancers*/
/*The long way and usable for other cancers*/

< 363787002 |Observable entity (observable entity)|:

	/*Property of histologic grade*/
	370130000 |Property|=1590001000004108 |Histologic grade (property) (qualifier value)|,
	/*Primary malignancy*/
		704319004 |Inheres in|=86049000 |Malignant neoplasm, primary|,

	/*Any prostate structure*/
		718497002 |Inherent location|= <<41216001 |Prostatic structure (body structure)|,

/*Gleason grading method*/
246501002 |Technique (attribute)|=<<897202005 |Gleason scoring system for malignant neoplasm of prostate (staging scale)|

/*CASE #10*/
/*Researcher wants to know if lymph nodes involved*/

< 363787002 |Observable entity (observable entity)|:

/*Use of component - the thing we are looking for…*/
246093002 |Component (attribute)|=14799000 |Neoplasm, metastatic (morphologic abnormality)|,

/*Lymph node*/
704319004 |Inheres in|=<<59441001 |Structure of lymph node (body structure)|

/*Returns counts, locations and micro/macro*/

CLINICAL DECISION SUPPORT
ANTIMICROBIAL STEWARDSHIP

/* What is the BUG that we identified in that culture? */
<< 363787002 |Observable entity (observable entity)| :
704319004 |Inheres in (attribute)| = << 41146007 |Bacterium (organism)|,
370130000 |Property (attribute)| = << 118584009 |Presence OR identity (property) (qualifier value)|
/* We want the coded final result, not the text report */
<< 363787002 |Observable entity (observable entity)| :
704319004 |Inheres in (attribute)| = << 41146007 |Bacterium (organism)|,
370130000 |Property (attribute)| = << 118584009 |Presence OR identity (property) (qualifier value)|,
370132008 |Scale type (attribute)| = << 117362005 |Nominal value (qualifier value)|

/* What DRUGS did we test for susceptibility by that BUG?
First we query for instances of observables in the value set of susceptibility
Tests we run: */

<< 363787002 |Observable entity (observable entity)| :
370130000 |Property (attribute)| = << 118588007 |Susceptibility (property) (qualifier value)|, << 704320005 |Towards (attribute)| = << 895275007 |Medicinal product acting as antiinfective agent (product)|

/* Then we check for any of these susceptibility tests that were reported
On the bug we found in the first query – by accession # or specimen
Datetime for the patient – and assemble the list of generic drugs
Tested by susceptibility results */
ANTIBIOTIC MEDICINAL PRODUCTS
/* Then we query the formulary for “sensitive” drugs in the family of
Antibacterial drugs which have agents that can be delivered
by the clinically relevant route */
<< 763158003 |Medicinal product (product)| :
762949000 |Has precise active ingredient (attribute)| = << 419241000 |Substance with antibacterial mechanism of action (substance)|,

411116001 |Has manufactured dose form (attribute)| = << 385287007 |Parenteral dose form (dose form)|, 762949000 |Has precise active ingredient (attribute)| = 1269009 |Amikacin sulfate (substance)|

PRESCRIBING AND ALLERGY CHECKING
THE DRUG:
<< 363787002 |Observable entity (observable entity)| :
704319004 |Inheres in (attribute)| = 41146007 |Bacterium (organism)|,
370130000 |Property (attribute)| = << 118588007 |Susceptibility (property) (qualifier value)|,
246501002 |Technique (attribute)| = << 624641000004109 |Antibiotic susceptibility technique (qualifier value)|

THE DOSE
<< 763158003 |Medicinal product (product)| :
127489000 |Has active ingredient (attribute)| = << 387266001 |Amikacin (substance)|, /* THE DRUG */
411116001 |Has manufactured dose form (attribute)| = << 385287007 |Parenteral dose form (dose form)| /* THE DOSING */