

Is this a Record? The language of health

Charles Gutteridge
CCIO Barts Health

Towards the end goal of static record becoming interactive machine



CREATING UTILITY AT
THE POINT OF CARE



TRANSLATING A
RECORD FOR GLOBAL
HEALTH



MESSAGING THE
CONTENT OF A
RECORD



HEALTH DATA USE BY
PATIENTS AND
CITIZENS



AGGREGATING
RECORDS FOR
POPULATION HEALTH



REAL WORLD DATA
FOR RESEARCH

A health IT challenge for all

- Aggregating and sharing clinical information
 - Disparate health IT systems and clinical vocabularies create barriers to using patient data efficiently and effectively
-




Mapping the reality



Classifications

HL7 Standards

What's now and next for interoperability






V2 CDA HL7 FHIR

Content

Content included in the Terminology Server

Code systems, value sets and concept maps for a growing number of national and internationally assured terminologies and classifications are included in the NHS England Terminology Server.

Currently loaded are:

- [SNOMED CT](#) - current version and current-1 at a minimum 
- [Human Phenotype Ontology \(HPO\)](#) (20201207)
- [ICD10](#) - including historical versions (4.0 and 5.0) 
- [NICIP codes](#) - including historical versions (2017-2020)
- [OPCS-4](#) - (4.8, 4.9 and 4.10) 
- [READ codes \(4 byte, V2 and CTV3\)](#) - including historical versions (2009-2018)
- [UCUM](#) (2.1)
- [FHIR®](#) - including all published CodeSystems, ValueSets and ConceptMaps
- [dm+d](#) - including historical versions, GTINs, ingredient strength and historical codes

How SNOMED
CT makes the
interactive
machine
possible

What is SNOMED CT?

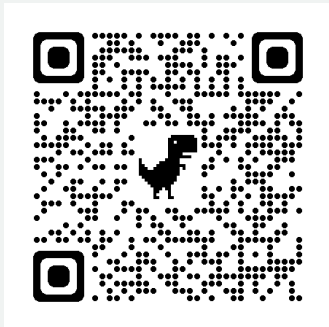
Clinical use of SNOMED CT

Data analytics

Use of SNOMED CT by coders

What is SNOMED CT?

- Digital dictionary of unique concepts
- Polyhierarchy
- Concept defined by descriptions, relationships and attribute values



SNOMED CT Browser

Taxonomy Search Favorites Refset

Taxonomy

Inferred view Language: FSN in US Descendants Count: Off

- ▼ SNOMED CT Concept (SNOMED RT+CTV3)
 - ▶ 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)
 - ▶ Staging and scales (staging scale)
 - ▶ Substance (substance)

Recording clinical thinking

History and examination

- Cough
- Sputum
- Blood stained
- Shortness of breath
- Fever
- Exhaustion

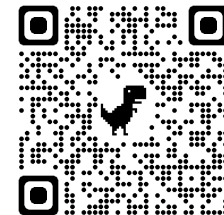
Clinical idea = Concept
Descriptions
Relationships
Relationship attributes

Machine readable concept model

A set of rules

Using the Machine Readable Concept Model

- Domain
- Attribute
- Attribute values



Domain

Filter Domains...

- Basic dose form (basic dose form)
- Body structure (body structure)
 - Anatomical structure (body structure)
 - Lateralizable body structure reference set (foundation metadata concept)
- Clinical finding (finding)** ←
- Event (event)
- Observable entity (observable entity)
- Pharmaceutical / biologic product (product)
 - Medicinal product package (product)
- Pharmaceutical dose form (dose form)
- Physical object (physical object)
- Procedure (procedure)
 - Surgical procedure (procedure)

Applicable Attributes

Filter Attributes...

- Associated morphology (attribute)
- Associated with (attribute)
- Causative agent (attribute)** ←
- Due to (attribute)
- Temporally related to (attribute)
 - After (attribute)
 - Before (attribute)
 - During (attribute)
- Clinical course (attribute)
- Episodicity (attribute)
- Finding informer (attribute)
- Finding method (attribute)
- Finding site (attribute)
- Has interpretation (attribute)

Attribute Range

All precoordinated SNOMED CT content - Mandatory concept model rule

All postcoordinated SNOMED CT content - Mandatory concept model rule

Range Constraint

<< 105590001 |Substance (substance)| OR << 260787004 |Physical object (physical object)| OR << 373873005 |Pharmaceutical / biologic product (product)| OR << 410607006 |Organism (organism)| OR << 78621006 |Physical force (physical force)|

Attribute Rule

(<< 272379006 |Event (event)| OR << 404684003 |Clinical finding (finding)|): [0..*] { [0..1] 246075003 |Causative agent| = (<< 105590001 |Substance (substance)| OR << 260787004 |Physical object (physical object)| OR << 373873005 |Pharmaceutical / biologic product (product)| OR << 410607006 |Organism (organism)| OR << 78621006 |Physical force (physical force)|) }

Rule Strength

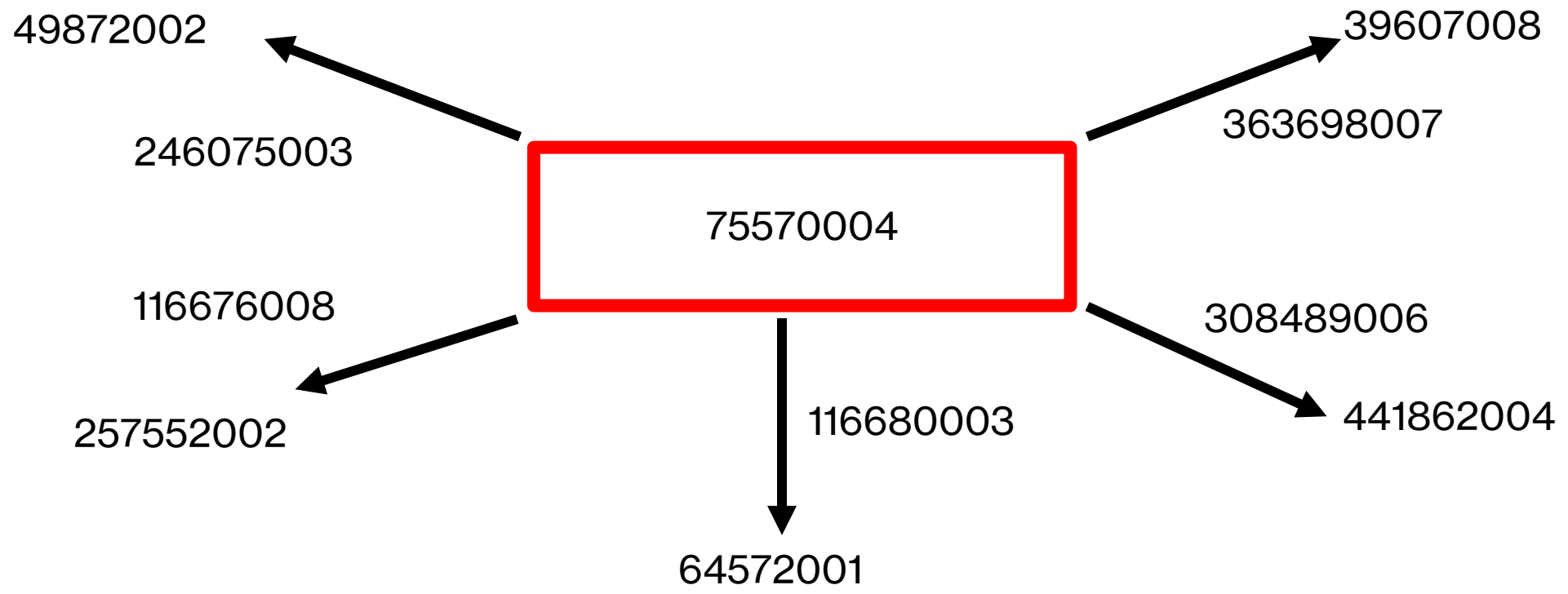
Mandatory concept model rule

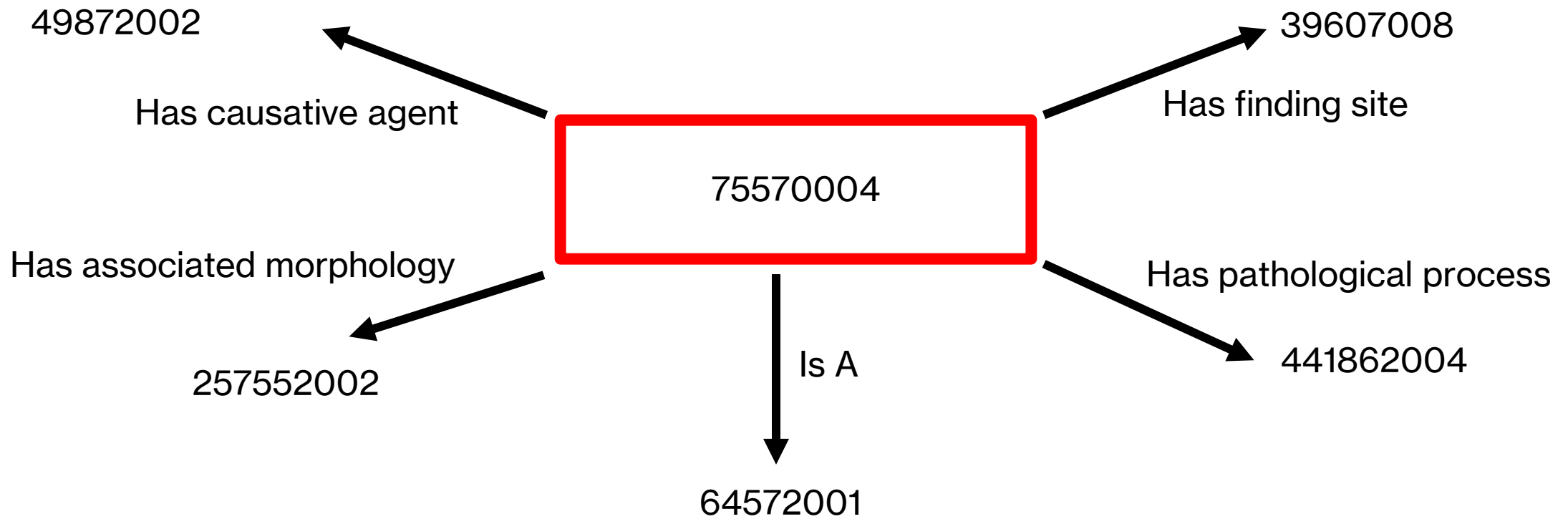
Content Type

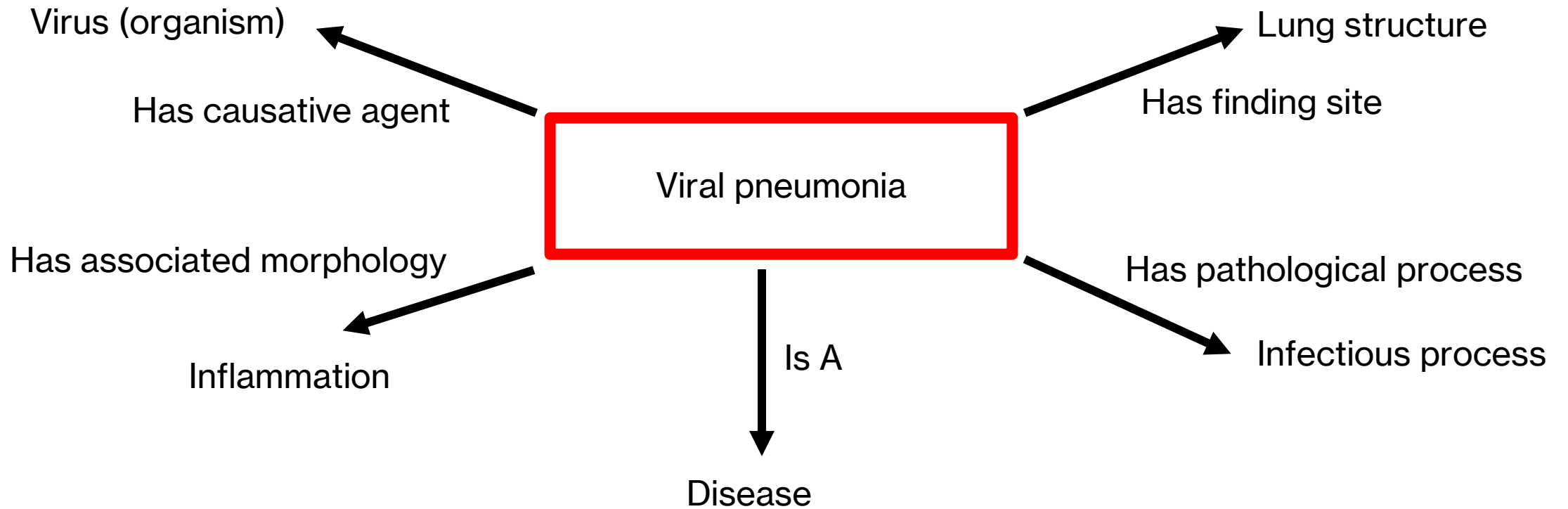
All precoordinated SNOMED CT content

98,577 Results ←

- Nocardia niwae (organism)
- Aspergillus japonicus (organism)
- Legionella hackeliae serogroup 2 (organism)
- Leptotrichia amnionii (organism)
- Candida tenuis (organism)







Parents

▶  Disease (disorder)

Pneumonia caused by severe acute respiratory syndrome coronavirus 2 (disorder)

SCTID: 882784691000119100

882784691000119100 | Pneumonia caused by severe acute respiratory syndrome coronavirus 2 (disorder) |

en Pneumonia caused by severe acute respiratory syndrome coronavirus 2 (disorder)

en Pneumonia caused by SARS-CoV-2

en COVID-19 pneumonia

en Pneumonia caused by 2019 novel coronavirus

en Pneumonia caused by 2019-nCoV

en Pneumonia caused by severe acute respiratory syndrome coronavirus 2

Axiom

Pathological process → Infectious process

Associated morphology → Inflammation and consolidation

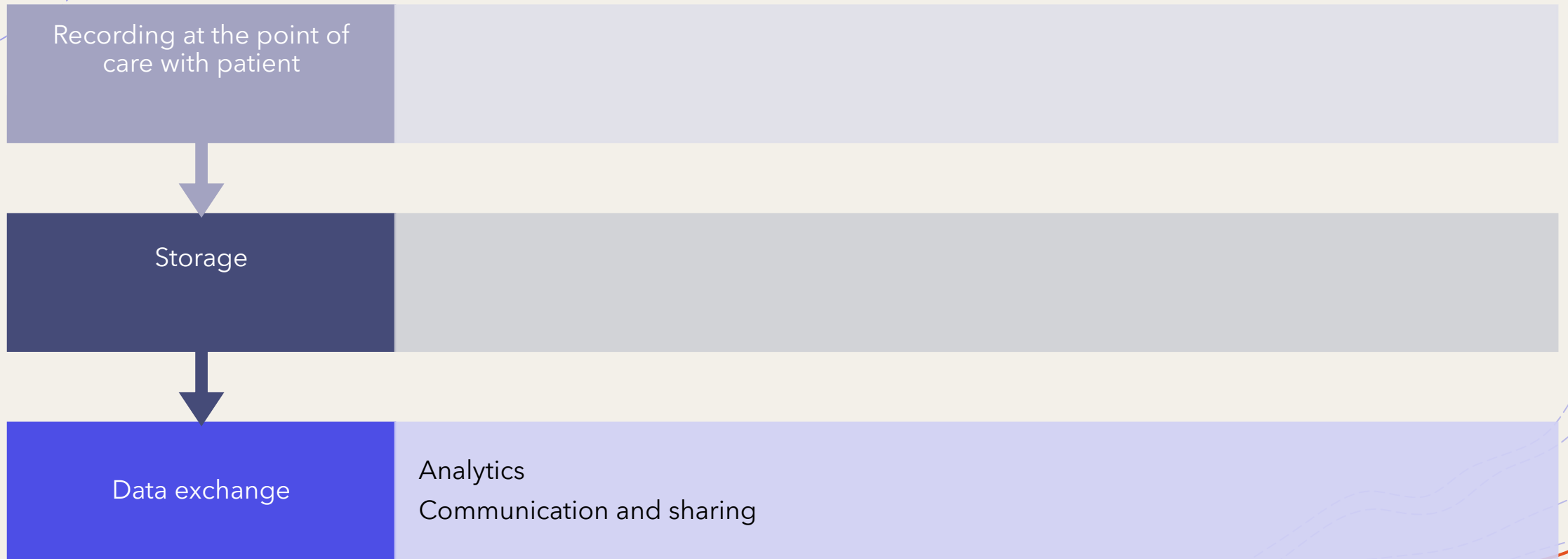
Finding site → Lung structure

Causative agent → Severe acute respiratory syndrome coronavirus 2

Children (0)

No children

Data flow



Information models

+Problem list

- + This visit

- + Chronic problems

- + Past history

+Procedures

- + Surgical

- + Care interventions

+Allergies and reactions

+Care requirements

+Medications

+Environmental determinants

+Social determinants

+Family history

CP 13: Not Performed MRN: 5088028 DOD: 07/Jan/1960 Gender: Male

Clinician Workflow

Clinical Overview Admission **Progress** Handover Dis

Documents (2) Display: Cli

Time of Service	Subject	Note Type	Auth
▼ In Progress (0)			
▼ Completed (2)			
26 JUL 2022 15:42	Operation Note	Operation Note	Gutt
26 JUL 2022 15:33	Op Note	Operation Note	Gutt

Problem list

Classification Medical and Patien **Add as** This Visit

Priority	Problem Name	Code	Onse
--	Biliary cirrhosis	--	--
--	COPD (chronic obstructive pulmonary disease) disturbs sl...	--	--
--	Malignant bone pain	--	--
--	Pneumonia (Right)	--	--
--	Pneumonia caused by Influenza A virus	--	--
--	Systemic lupus erythematosus	--	--
	Adenocarcinoma of lung	--	--
	Chronic pancreatitis	--	01 JI
	Chronic pelvic pain of female	--	--
	Community specialist palliative care not required	--	--
	Current smoker	--	199C

Presenting complaints

Clinical summary

Documents (2)

Problem list

Review of Systems

Allergies and adverse reactions (2)

Examination findings

Clinical Images <-- Click Here (0)

Clinical results

Vital signs

Fluid balance

Lines/Tubes/Drains

Labs ...

Diagnostics ...

Order Profile ...



New order entry ...

Plan and requested actions ...

Child Safeguarding ...

Create Note

Select Other Note

Data linking at the point of care and in the database

Chronic (5)

- Acute myeloid leukaemia
- Adhesive capsulitis of shoulder
- BMI 30+ - obesity
- Ex-smoker
- Hypothyroidism

Historical(3)

- Acute kidney injury
- Allogeneic graft
- Red flag sepsis

Procedure History (4)

Name	Implant	Date	Time Since Procedure
Theatre Record (0)			
Procedures (4)			
Holistic needs assessment		07/07/20	16 months
Ultrasonography guided insertion of PICC (peripherally inserted central catheter)		27/09/19	2 years
Ultrasonography guided insertion of PICC (peripherally inserted central catheter)		30/07/19	2 years
Holistic needs assessment			

Condition: Acute myeloid leukaemia
This Visit - SNOMED CT Term: Acute myeloid leukaemia (201612010)
Chronic - SNOMED CT Term: Acute myeloid leukaemia (201612010)
Problem Status: Active | Classification: . | Confirmation: Confirmed
Onset Date: 01/07/19 00:00
Recent Visits:
08/01/20 00:00 Classification: . | Confirmation: Confirmed

- Menu - All
- Diagnoses and Problems
- Diagnoses and Procedures
- Histories
- Allergies + Add
- Drug Chart
- Drug Chart Summary
- Patient Information
- Appointments
- Requests/Care Plans + Add
- Documentation + Add
- Notes
- Form Browser
- Tasks
- Clinical Images + Add
- Pregnancy Summary
- Newborn Summary
- Growth Chart
- Critical Care Summaries
- Overview
- Chart Review
- eCoach
- Clinical Research
- Historical Data Viewer
- East London Patient Record

Miscellaneous Reports (1) Summary

Report Name	Updated by	Date Completed	Source
Holistic Needs Assessment		02/11/2021 13:19:13	BHNT

Allergies & Adverse Reactions (5) Summary

Allergy	Severity	Date Onset	Source
[X] Adverse reaction to flucloxacillin		10/07/2019	SLMC
Clarithromycin	Moderate		Royal London
Flucloxacillin			Royal London
Metronidazole	Moderate		Royal London
Penicillin adverse reaction		10/12/2020	SLMC



Matching the exchange

Primary care medicines data in the hospital record

Please note the patient data being viewed may not be the complete patient record. For a detailed list of the clinical codes included please [click here](#).

Current Medication Past Medication Medication Issues



Last Issue Drug / Dosage / Quantity

Acute Medication

06-Oct-2021	Biatain Silicone dressing 15cm x 15cm (Coloplast Ltd), As directed, 20 dressing
12-May-2021	COVID-19 Vaccine AstraZeneca (ChAdOx1 S [recombinant]) 5x10,000,000,000 viral particles/0.5ml dose suspension for injection multidose vials (AstraZeneca UK Ltd), 1 dose by Intramuscular Injection, 1 dose
02-Mar-2021	COVID-19 Vaccine AstraZeneca (ChAdOx1 S [recombinant]) 5x10,000,000,000 viral particles/0.5ml dose suspension for injection multidose vials (AstraZeneca UK Ltd), 1 dose by Intramuscular Injection, 1 dose
20-Oct-2021	FreeStyle Libre Sensor (Abbott Laboratories Ltd), As Directed, 2 kit

Repeat Medication

29-Sep-2021	Biatain Silicone dressing 10cm x 10cm (Coloplast Ltd), use as directed, 10 dressing
Not yet issued	Tresiba FlexTouch 100units/ml solution for injection 3ml pre-filled pens (Novo Nordisk Ltd), For Subcutaneous Injection, According To Requirements, 5 pre-filled disposable injection
29-Sep-2021	Duloxetine 60mg gastro-resistant capsules, One To Be Taken Each Day, 28 capsule
02-Jun-2021	Clinitas Carbomer 0.2% eye gel (Altacor Ltd), One drop into both eyes twice day, 10 gram
25-May-2021	Thealoz Duo eye drops preservative free (Thea Pharmaceuticals Ltd), qds as per opd clinic for bothe eyes March 2020, 10 ml
14-Jan-2021	Atorvastatin 20mg tablets, One To Be Taken Each Day, 28 tablet
21-Jul-2021	GlucRx FinePoint Ultra hypodermic insulin needles for pre-filled / reusable pen injectors screw on 4mm/32gauge (GlucRx Ltd), As Directed, 100 needle
14-Jan-2021	Metformin 500mg tablets, One To Be Taken Twice A Day, 56 tablet
02-Sep-2021	Insulin lispro 100units/ml solution for injection 3ml pre-filled disposable devices, For Subcutaneous Injection, Shortly Before Meals Or When Necessary Shortly After Meals, According To Requirements(6 to 14 units Twice a day with lunch and dinner according to carbs/pt aware now), 1 pre-filled disposable injection

	Name of Problem ▾
	Type 2 diabetes mellitus
	Transplant recipient
	Skin lesion
	Retinopathy with type 2 diabetes mellitus
	Renal dialysis

Medline Clinical Search

Search String:

- Include Only Selected Categories
 All Categories

Categories

- Aetiology Diagnosis Patient Care Preventive Health Services
 Therapy Prognosis Nursing Care Health Education

- Include Only Selected Publication Types
 All Publication Types

Publication Types

- Review Clinical Trials Meta Analysis Randomised Controlled Trial
 Multicentre Study Practice Guidelines Controlled Clinical Trial

[Advanced](#) [Create alert](#) [Create RSS](#)

[User Guide](#)

Sorted by: Best match

MY NCBI FILTERS

559 results

Page 1 of 56

RESULTS BY YEAR



1

Cite

Share



From Pre-Diabetes to Diabetes: Diagnosis, Treatments and Translational Research.

Khan RMM, Chua ZJY, Tan JC, Yang Y, Liao Z, Zhao Y.

Medicina (Kaunas). 2019 Aug 29;55(9):546. doi: 10.3390/medicina55090546.

PMID: 31470636

Features of SNOMED CT for analytics

- Cohort creation at different levels of hierarchy *
 - Using axioms and OWL2 semantics
 - Testing for membership of predefined subsets *
 - Translation and use of dialects
 - Cohort creation and aggregation
 - Intersection of data
 - Semantic queries
 - Mapping
 - Clinical queries over heterogeneous datasets *
 - Free text analysis *
 - Clinical decision support
 - Mapping to classifications *
-

SNOMED CT based analytics in east London

- Point of care analytics
 - Decision support – VTE assessments, allergy alerts, BMI encoding
 - Automation – referral document for smoking, patient finding with infection
 - Info Button in EHR system
 - Population based analytics
 - Use of Emergency Care Data Set to track emergency attendances
 - Haemophilia registry
 - Clinical research
 - COVID-19 master dataset
 - Diabetes related foot disease study
-



[Home](#) | [Projects](#)

Project

Can we enable harmonised, near real-time, data on pharmacovigilance of COVID-19 vaccines using routinely collected linked national datasets across the UK?

Show me all the **COVID Vaccine** patients **5-30 days** after vaccination who attended the **ED** presenting with any type of **Thrombosis** and showed features of: low platelet count, Raised FDPs and Platelet Factor 4 antibodies

Data required

- Vaccination date
 - Vaccine type
 - Attendance date in Emergency Department
 - SNOMED concept recorded in ED using Emergency Care Data Set
 - Inpatient SNOMED concepts recorded in diagnosis/problem lists
 - Laboratory test results: platelet count, D-dimer, Platelet Factor 4 antibodies
-



Numbers of patient records analysed?

Pop coverage	No pts attending ED 01/12/20-01/07/21	No of pts attending ED in defined timescale registered with GP	No of pts attending ED in defined timescale with vaccination record
2.2M	128,000	104,649	72,426

Data acquisition

```
import requests
import json
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import pyodbc
import datetime

pd.set_option('display.max_colwidth', None)
```

1. Read in files:

- Emergency Department admissions dataset
- Vaccination datasets (from Discovery)
- Inpatient stays dataset
- Laboratory data: platelets

- Laboratory data: D-Dimer

- Laboratory data: anti platelet factor 4
- SNOMED code lists (ED + inpatient problem lists)

VITT algorithm

Using value sets to match SNOMED concepts with patient's problems list or ED diagnosis

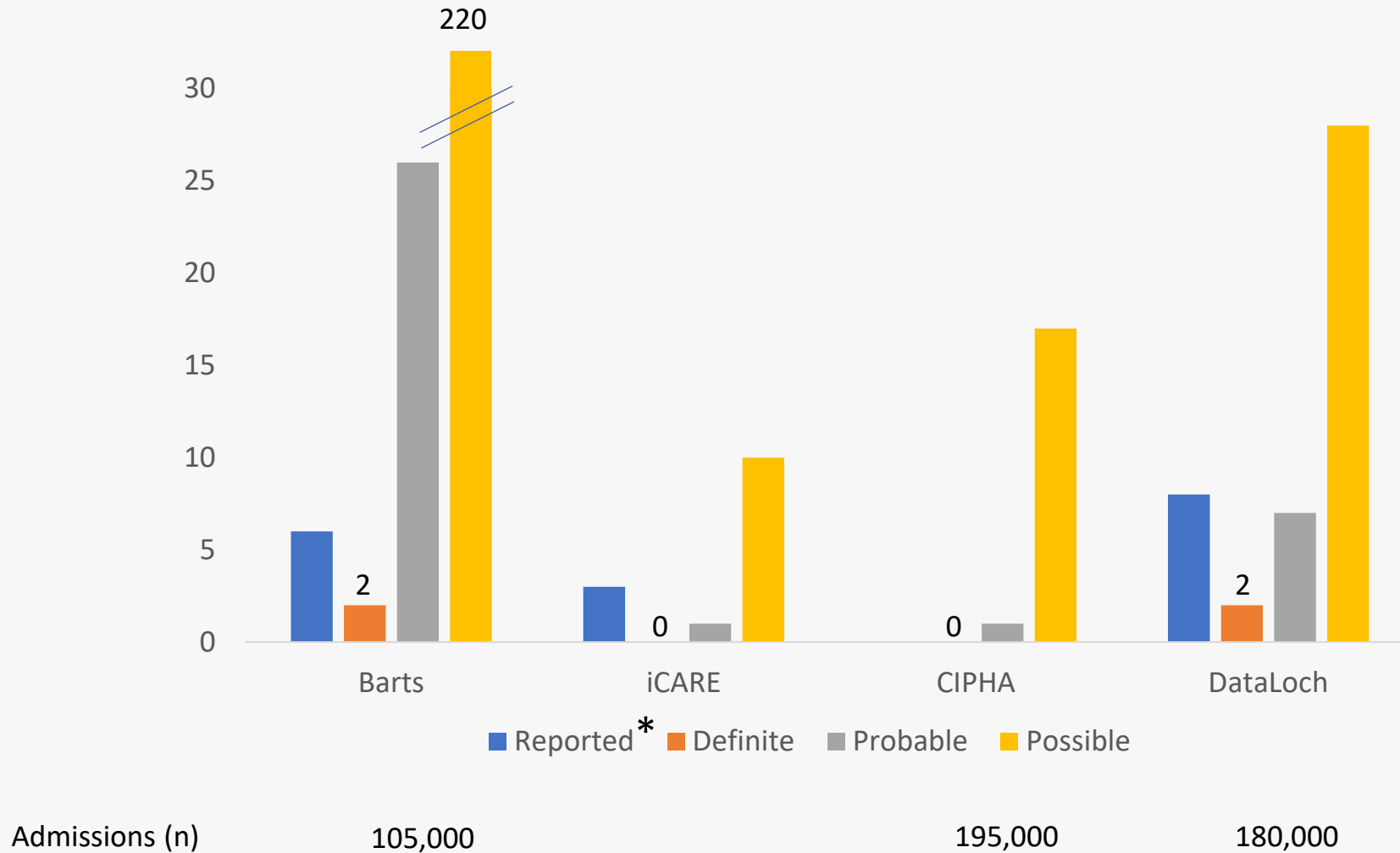
diagnosis	Onset_date	confirmation	ConceptID	list	Update_Dt_Tm
Intracranial tumour	2021-03-12	Suspected	254935002	d	2021-03-12
Thrombosis of superior sagittal sinus	2021-03-12	Confirmed	70607008	p	2021-03-16
bony cyst on scalp	2021-02-12	Suspected	281900007	d	2021-02-12
neuro exp for wound revision	2021-05-14	Confirmed	407626008	d	2021-05-14
Intracranial tumour	2021-03-12	Confirmed	254935002	p	2021-03-16
Tension-type headache	2021-04-01	Suspected	398057008	d	2021-04-01
Intracranial tumour	2021-03-12	Confirmed	254935002	p	2021-03-16
bony cyst on scalp	2021-02-12	Suspected	281900007	d	2021-02-12
Headache	2021-02-12	Suspected	25064002	d	2021-02-12
Current smoker	1900-01-01	Confirmed	77176002	p	2021-03-22
Tension-type headache	2021-04-01	Su			

Filter to include those admitted after vaccination, who have a low platelet count, high d-dimer and positive a-PF4 antibodies



diagnosis	Onset_date	confirmation	Arrival_Dt_Tm	Chief_Complaint_Cd	Chief_Complaint_Desc	Diag_ECD_Cd	Diagnosis_Snomed_Desc
Intracranial tumour	2021-03-12	Su	2021-03-11	95320005	Disorder of skin (disorder)	254935002	intracranial tumor (disorder)
neuro exp for wound revision	2021-05-14	Cc	2021-03-31	25064002	Headache (finding)	398057008	tension-type headache (disorder)
Headache	2021-02-12	Su	2021-02-12	95320005	Disorder of skin (disorder)	281900007	No abnormality detected (finding)
			2021-05-14	25064002	Headache (finding)	407626008	Neurological disorder confirmed (situation)

Of people admitted to ED from 5 to 30 days of vaccination, how many VITT cases were identified with discharge data + laboratory data?



*reported to British Society of Haematology VITT group from regional hospitals

VITT modelled in SNOMED

Parents

- Disorder following clinical procedure (disorder)
- Drug-induced immune thrombocytopenia (disorder)

Vaccine-induced prothrombotic immune thrombocytopenia (disorder)

SCTID: 1156746003

1156746003 | Vaccine-induced prothrombotic immune thrombocytopenia (disorder) |

- en* Vaccine-induced prothrombotic immune thrombocytopenia (disorder)
- en* Vaccine-induced prothrombotic immune thrombocytopenia
- en* VIPIT - vaccine-induced prothrombotic immune thrombocytopenia
- en* VITT - vaccine-induced immune thrombotic thrombocytopenia

Pathological process → Autoimmune process
Causative agent → Drug or medicament

Interprets → Hemostatic function
Has interpretation → Abnormal

Interprets → Platelet count
Has interpretation → Below reference range

After → Administration of vaccine to produce active immunity

Pathological process → Hypersensitivity process

Due to → Disease

Children (0)

No children

VITT SNOMED code mapped to ICD10

Summary Details Diagram Expression Refsets Members History References

Stated Inferred

1156746003 |Vaccine-induced prothrombotic immune thrombocytopenia (disorder)|

Open maps for this concept

Simple Refsets Memberships

No memberships

Simple Map Refset name

SNOMED CT to ICD-10 extended map	D69.5
CTV3 to SNOMED CT simple map	XVG9e
SNOMED CT to ICD-10 extended map	Y59.9

The road ahead....codes, computation, machine learning

SCCI0034: SNOMED CT

SNOMED CT is the information standard for clinical terminology; it is an international standard published by SNOMED International providing a global common language for health terms.



Opportunities for development and improvement

- Clinical quality

Data quality - automation

Safety initiatives

Effective care

Precision health

- Population health

Data aggregation

Descriptive statistics

Computational health

The screenshot shows the SNOMED ECL query interface. At the top, there are navigation buttons for 'Release: International Edition', 'Version: 2022-06-30', 'Perspective: Full', 'Feedback', 'About', and a language selector. The main input area contains the query: '<< 71388002 [Procedure (procedure)] : << 363700003 [Direct morphology (attribute)] = << 56381008 [Calculus (morphologic abnormality)], << 405814001 [Procedure site - Indirect (attribute)] = << 89837001 [Urinary bladder structure (body structure)]'. Below the query is a red text overlay: '21 concepts on calculus in urinary bladder'. The interface includes buttons for 'ECL Builder', 'Execute', and 'Enter additional search filter (optional)'. Below the query, there are dropdown menus for 'Description type', 'Language: R/Sets', and 'Modules'. The results section shows 'Results: Found 21 concepts' and a table with 10 rows of concept data.

Concept	Preferred Term	Id
Cystoscopy and electrohydraulic lithotripsy of calculus of bladder (procedure)	Cystoscopy and electrohydraulic lithotripsy of calculus of bladder	446685001
Cystoscopy and lithotripsy of calculus of bladder using laser (procedure)	Cystoscopy and lithotripsy of calculus of bladder using laser	446546004
Cystoscopy and removal of calculus of bladder (procedure)	Cystoscopy and removal of calculus of bladder	445950006
Percutaneous litholapaxy using fluoroscopy guidance (procedure)	Percutaneous litholapaxy using fluoroscopy guidance	432036009
Lithotripsy of bladder calculus (procedure)	Lithotripsy of bladder calculus	386195006
Cystolitholapaxy (procedure)	Cystolitholapaxy	386194005
Crushing of calculus of urinary bladder (procedure)	Crushing of calculus of urinary bladder	386189005
Removal of calculus of urinary bladder by suprapubic approach (procedure)	Removal of calculus of urinary bladder by suprapubic approach	371010008
Removal of calculus of urinary bladder (procedure)	Removal of calculus of urinary bladder	371005009
Removal of calculus from urinary bladder by incision (procedure)	Removal of calculus from urinary bladder by incision	370984003

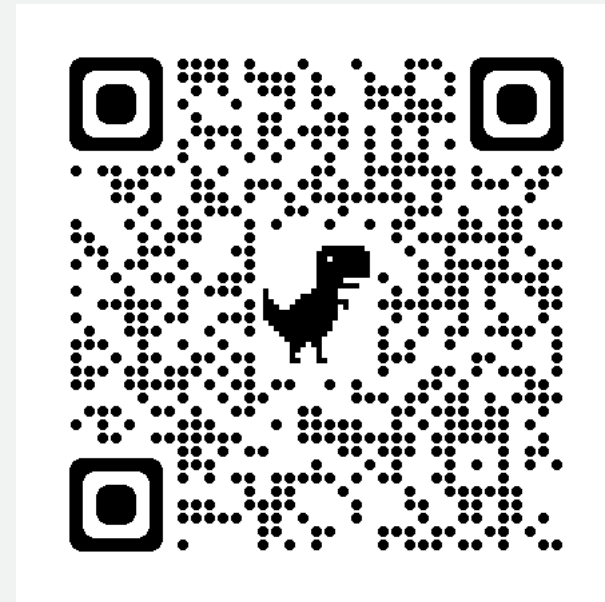
Clinical engagement for health and informatics professionals

- SNOMED CT Confluence pages
- Clinical reference groups
- E-learning pages

Introduction to SNOMED CT

Authoring codes

Data analytics



Developing next steps – join the ecosystem



Intelligent decision support



Data exchange and returning data into the EHR



Technology developments



Active patient use of the record



Real world data research platforms



Curriculum development for health students