SNOMED CT: Ontologies in support of global interoperation of the EHR SNOMED CT Showcase

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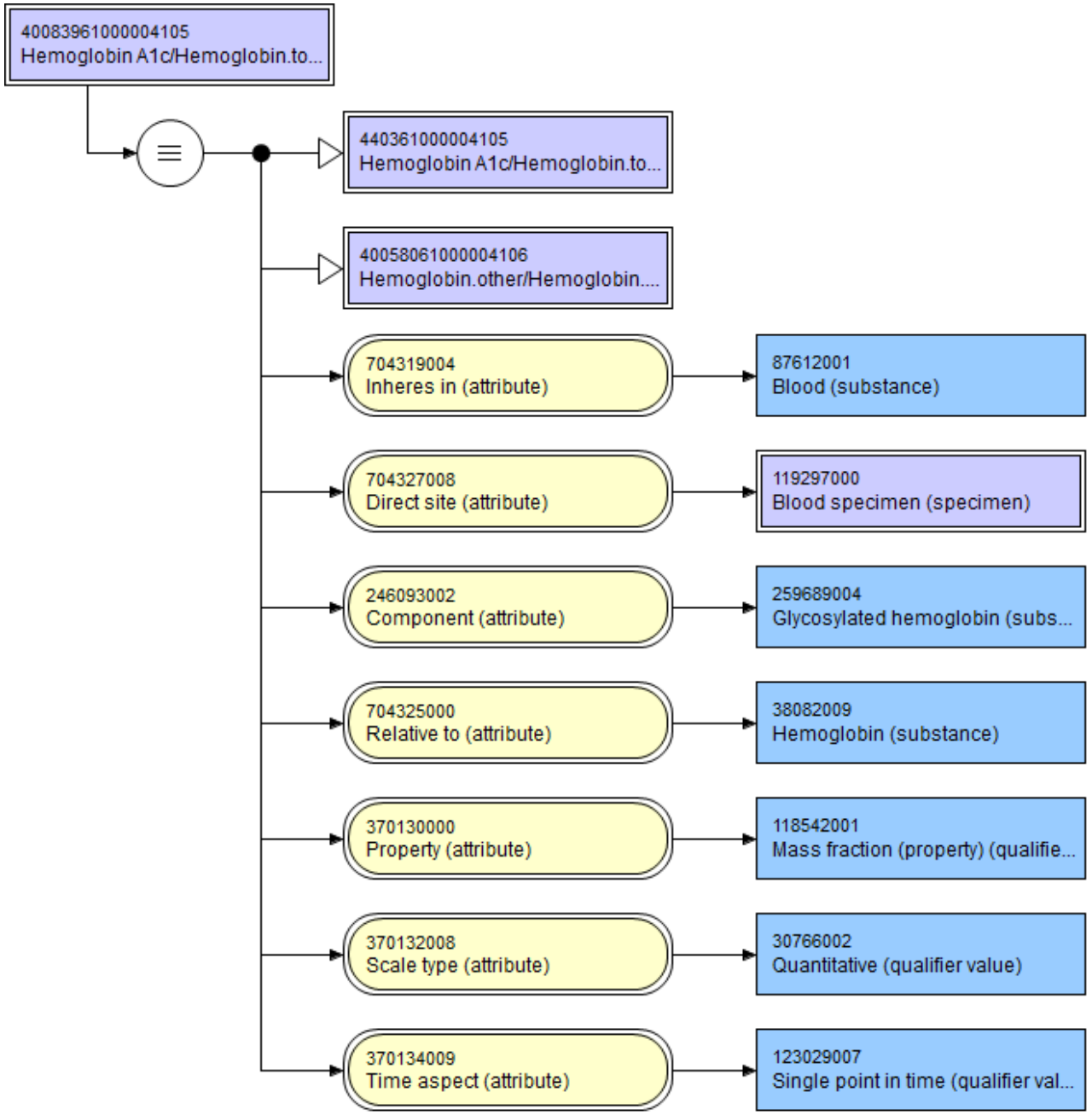
Interoperation Use Case

- US tourist in Australia stricken with acute febrile illness presents to local physician, providing a CDA record summary to the physician for medical history.
- November 1 Session 2:
  - What are the patient's problems?
  - Does the patient have history of infections?
  - Has the patient had a low white count?
  - Is the patient on an immunosuppressant medication?
  - Is the diabetes under good control?
  - Has the patient been screened for diabetic kidney disease?

These questions require interoperation of laboratory and testing results!

LOINC: 4548-4 Hemoglobin A1c/ Hemoglobin .total in Blood



SNOMED CT Observable entities

- Representation of the results that can be observed or measured in health care
- Based on work from the areas of ontology and metrology
- From 2008, introduced in SNOMED CT in Jan 2017

Observables areas developed and in use

- Large areas of laboratory medicine, pathology, molecular and genomic testing
- “Functioning” together with SNOMED CT Functioning project and Nursing CRG/SIG
- Vital signs
- ...and smaller scale experiments in many areas

Observables model as of today

- All-in-all 20 attributes used to define Observable entities
- Model is stable, but application to new domains requires re-evaluation and changes are made to accommodate for new use cases
- Four classes of Observables:
  - Quality observable (includes quantitative!)
  - Process observable
  - Function observable
  - Disposition observable

Quality Observables model principles
LOINC: 17856-6 Hemoglobin A1c/ Hemoglobin.total [Mass fraction] in Blood by HPLC(Observable entity)

WHAT MEASURED?

Blood sample

FEATURE

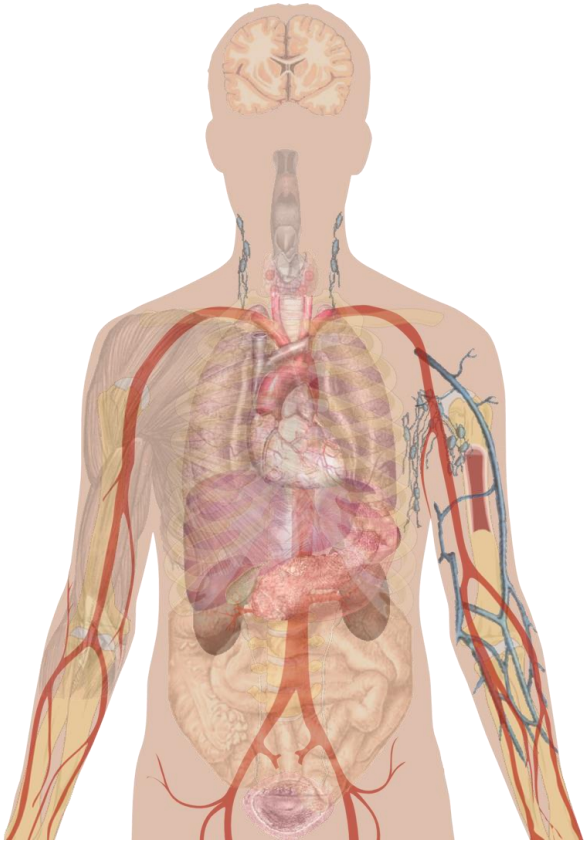
Glycosylated hemoglobin

RELATIVE TO

Total hemoglobin

PROPERTY

Mass fraction



HOW

HPLC

WHEN?

Single point in time

SCALE

Quantitative

Quality Observables model principles

NPU: 27300 B-Hæmoglobin beta kæde(B)—N-(1-deoxyfructos-1-yl)hæmoglobin beta kæde; stoffr. = ? mmol/mole

WHAT MEASURED?

Blood sample

FEATURE

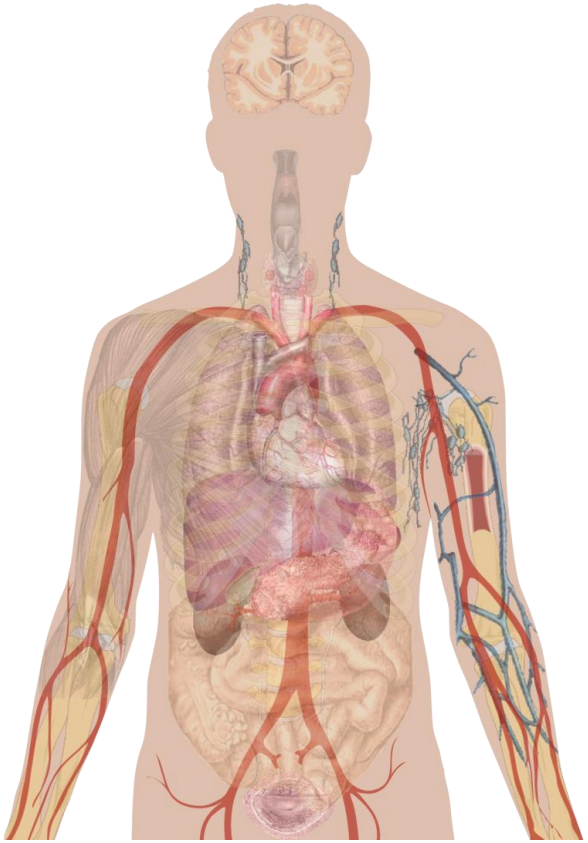
Glycated hemoglobin

RELATIVE TO

Total hemoglobin

PROPERTY

Substance fraction



HOW

HPLC

WHEN?

Single point in time

SCALE

Quantitative

Process Observables model principles
LOINC: 9279-1 Respiratory rate (Observable entity)

PROCESS OUTPUT?

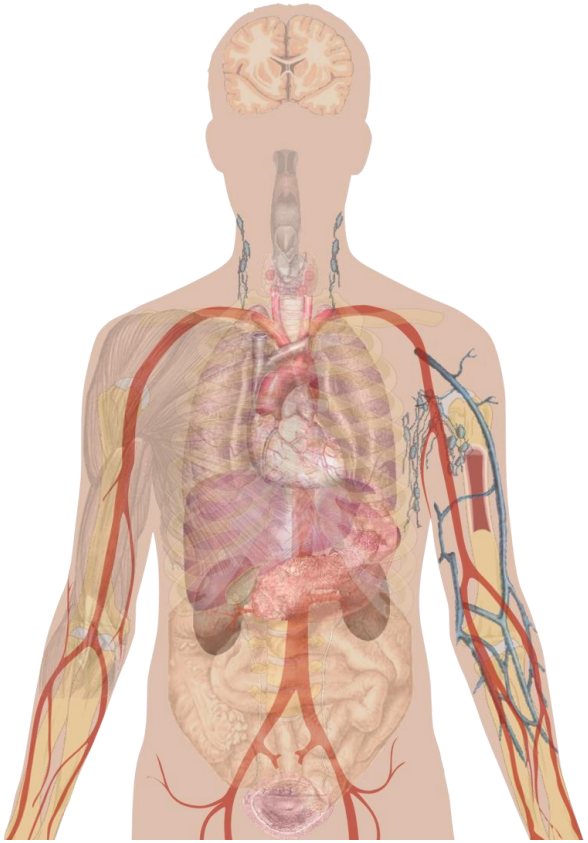
Ventilatory cycle

PROCESS

Inspiratory process

PROPERTY

Number rate



WHEN?

Single point in time

SCALE

Quantitative

Disposition Observables model principles
LOINC: 12-5 Amikacin [Susceptibility] of bacterium by Minimum inhibitory concentration (Observable entity)

WHAT MEASURED?

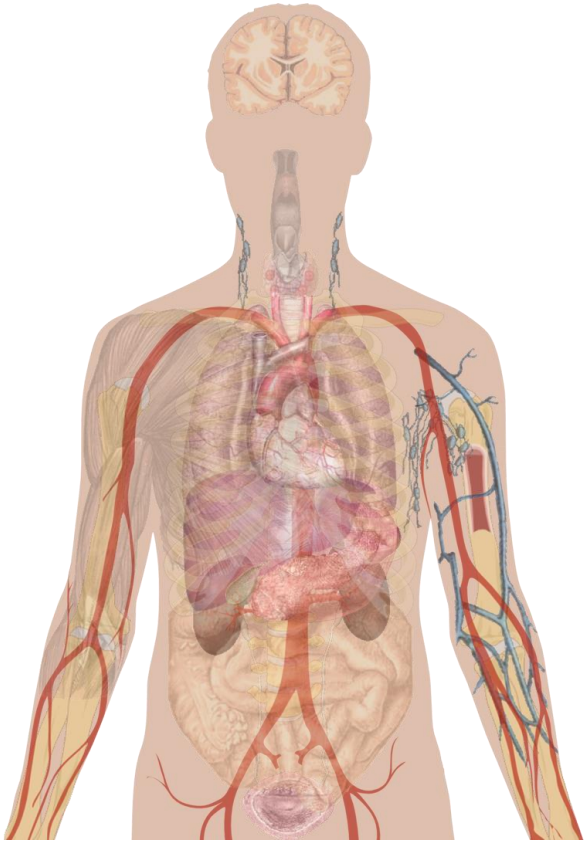
Bacterium

PROPERTY

Susceptibility

TOWARDS

Product containing Amikacin



HOW

MIC

WHEN?

Single point in time

SCALE

Ordinal or Quantitative

Observables model principles

WHAT HOW

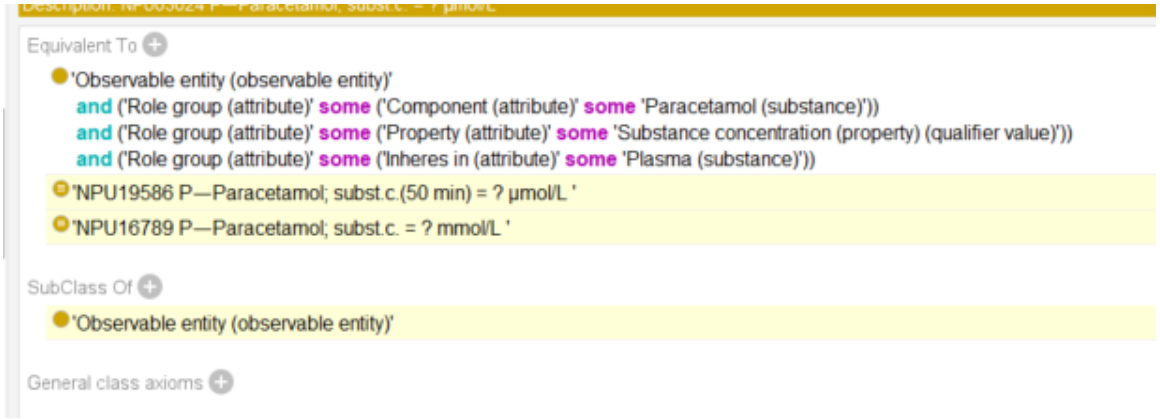
- Procedure information is needed for interpretation of value
- Multiple ways (observation procedures) of observing the same (or sufficiently similar) “thing” lead to different types of results
- New methods of observation will evolve over time

Defining LOINC and NPU using SNOMED CT concept model

- Mapping of LOINC parts done by SNOMED International in collaboration with LOINC; published as refset
- IFCC-IUPAC NPU Terminology
  - NPU = Nomenclature Properties and Units
- A selection of common NPU terms were defined with the SNOMED CT concept model in a **PoC** IUPAC project 2015-2016
- Modelling made by subgroup of the NPU Scientific Committee

Defining LOINC and NPU through SNOMED CT

- NPU03024 P—Paracetamol; subst.c. = ? µmol/L
- NPU01710 U—Codeine; arb.c.(proc.) = ?
- NPU54368 Syst—Amikacin; threshold mass c. = ? mg/L



Interoperatic
…have a White

DL query:

Query (class expression)

'Observable entity (observable entity)'
and ('Role group (attribute)' some ('Component (attribute)' some 'Leukocyte (cell)'))
and ('Role group (attribute)' some ('Inheres in (attribute)' some 'Blood (substance)'))

Execute | Add to ontology

Query results

Subclasses (39 of 40)

- **B lymphocytes [#/volume] in Blood (LOINC:11130-2)**
- **Band form neutrophils [Presence] in Blood by Automated count (LOINC:34524-9)**
- **Eosinophils [Presence] in Blood by Wright stain (LOINC:32173-7)**
- **Granulocytes [#/volume] in Blood (LOINC:30394-1)**
- **Granulocytes [#/volume] in Blood by Automated count (LOINC:20482-6)**
- **Granulocytes [#/volume] in Blood by Manual count (LOINC:51588-2)**
- **Granulocytes/100 leukocytes in Blood (LOINC:30395-8)**
- **Granulocytes/100 leukocytes in Blood by Automated count (LOINC:19023-1)**
- **Heterophils/100 leukocytes in Blood (LOINC:30157-2)**
- **Histiocytes [Presence] in Blood by Light microscopy (LOINC:44721-9)**
- **Large granular lymphocytes [#/volume] in Blood (LOINC:35082-7)**
- **Large granular lymphocytes [Presence] in Blood (LOINC:59808-6)**
- **Large granular lymphocytes/100 leukocytes in Blood (LOINC:30420-4)**
- **Large granular lymphocytes/100 leukocytes in Blood by Flow cytometry (FC) (LOINC:60439-7)**
- **Large granular lymphocytes/100 leukocytes in Blood by Manual count (LOINC:11275-5)**
- **Metamyelocytes [Presence] in Blood (LOINC:40651-2)**
- **Metamyelocytes.neutrophilic/100 leukocytes in Blood by Manual count (LOINC:74428-4)**
- **Mononuclear cells atypical [#/volume] in Blood by Manual count (LOINC:40548-0)**
- **Mononuclear cells atypical/100 leukocytes in Blood by Manual count (LOINC:69003-2)**
- **Myelocytes.eosinophilic/100 leukocytes in Blood by Manual count (LOINC:74427-6)**
- **Myelocytes.neutrophilic/100 leukocytes in Blood by Manual count (LOINC:74425-0)**
- NPU02593 B—Leukocytes; num.c. = ? × 10⁹/L
- NPU02636 B—Lymphocytes; num.c. = ? × 10⁹/L
- NPU02840 B—Monocytes; num.c. = ? × 10⁹/L
- NPU03974 B—Promyelocytes; num.c. = ? × 10⁹/L
- NPU03976 B—Myelocytes; num.c. = ? × 10⁹/L
- NPU03978 B—Metamyelocytes; num.c. = ? × 10⁹/L
- NPU04708 B—Plasmocytes; num.c. = ? × 10⁹/L
- **Neutrophils.hypogranulated [Presence] in Blood by Light microscopy (LOINC:40654-6)**
- **Plasma cells immature [#/volume] in Blood (LOINC:58355-9)**
- **Prolymphocytes [#/volume] in Blood (LOINC:30464-2)**

Interope
…taking

DL query:

Query (class expression)

'Observable entity (observable entity)'
and ('Role group (attribute)' some ('Component (attribute)' some 'Immunosuppressant (substance)'))

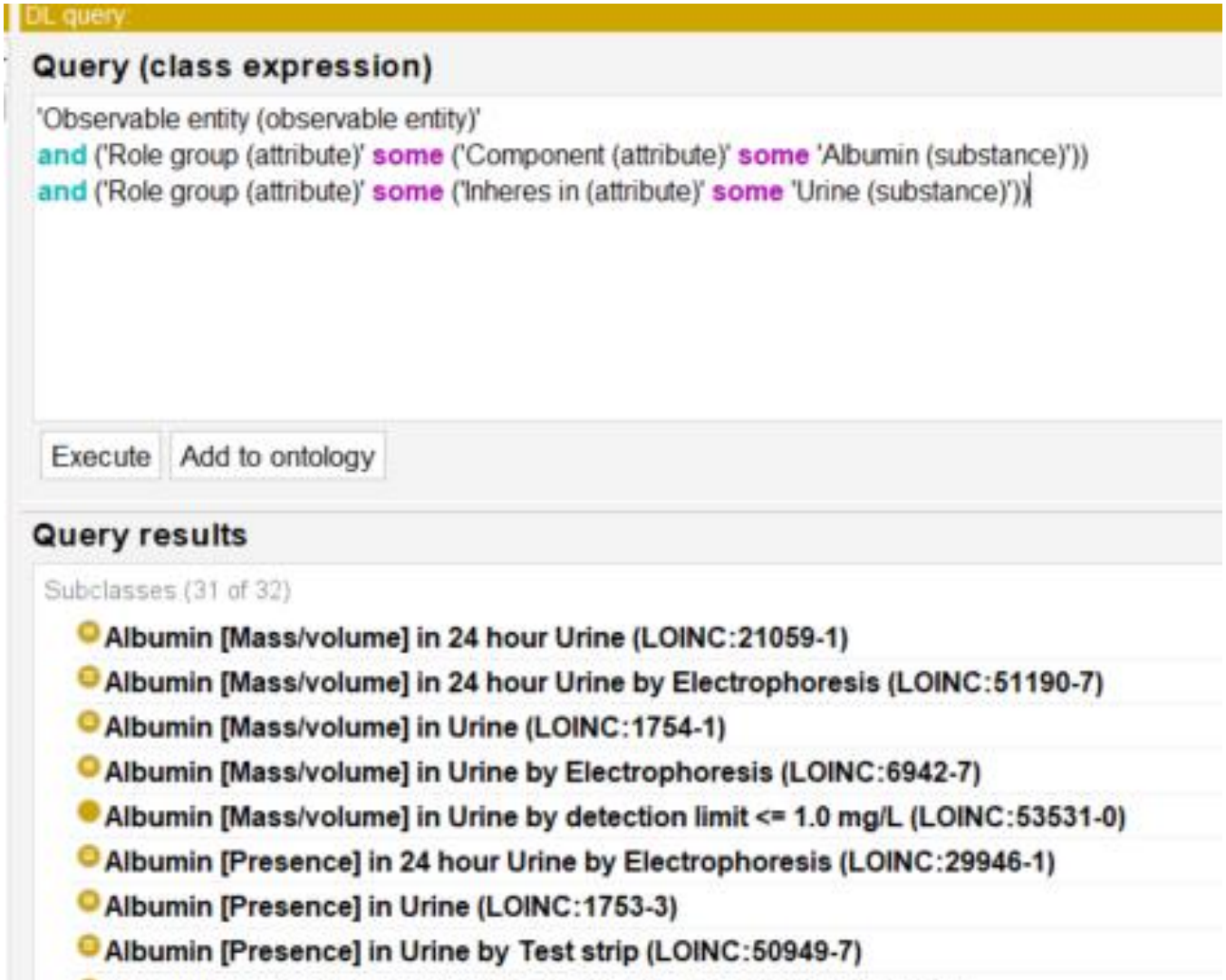
Execute | Add to ontology

Query results

Subclasses (30 of 31)

- **Azathioprine [Mass/volume] in Serum or Plasma (LOINC:16419-4)**
- **Azathioprine [Presence] in Serum or Plasma (LOINC:43924-0)**
- **Cyclosporine [Mass/volume] in Blood (LOINC:3520-4)**
- **Cyclosporine [Mass/volume] in Blood --trough (LOINC:53828-0)**
- **Cyclosporine [Mass/volume] in Body fluid (LOINC:17807-9)**
- **Cyclosporine [Mass/volume] in Dried blood spot (LOINC:80561-4)**
- **Cyclosporine [Mass/volume] in Plasma (LOINC:16703-1)**
- **Cyclosporine [Mass/volume] in Serum (LOINC:3521-2)**
- **Cyclosporine [Moles/volume] in Serum (LOINC:15103-5)**
- **Everolimus [Mass/volume] in Blood (LOINC:50544-6)**
- **Everolimus [Mass/volume] in Dried blood spot (LOINC:80529-1)**
- **Everolimus [Mass/volume] in Plasma --trough (LOINC:72671-1)**
- **Infliximab [Mass/volume] in Serum or Plasma (LOINC:39803-2)**
- **Mycophenolate [Mass/volume] in Serum or Plasma (LOINC:23905-3)**
- **Mycophenolate [Mass/volume] in Serum or Plasma --trough (LOINC:72667-9)**
- **Mycophenolate [Moles/volume] in Serum or Plasma (LOINC:70211-8)**
- NPU19725 B—Ciclosporin; mass c. = ? µg/L
- NPU19862 P—Mycophenolate; mass c. = ? mg/L
- NPU19909 B—Sirolimus; mass c. = ? µg/L
- NPU19912 B—Tacrolimus; mass c. = ? µg/L
- NPU21707 B—Everolimus; mass c. = ? µg/L
- **OKT3 [Mass/volume] in Serum or Plasma (LOINC:14187-9)**

Interoperation Use Case
…have a urine albumin screen?



Interoperation Use Case
…have a glycohemoglobin check?

DL query:

Query (class expression)

'Observable entity (observable entity)'
and ('Role group (attribute)' some ('Component (attribute)' some 'Glycosylated hemoglobin (substance)'))
and ('Role group (attribute)' some ('Relative to (attribute)' some 'Hemoglobin (substance)'))
and ('Role group (attribute)' some ('Inheres in (attribute)' some 'Blood (substance)'))

Execute | Add to ontology

Query results

Subclasses (6 of 7)

- Hemoglobin A1c / Hemoglobin total [Substance fraction] in blood by IFCC technique (NPU27300)
- Hemoglobin A1c/Hemoglobin total [Ratio] in Blood by unspecified method (LOINC grouper)
- Hemoglobin A1c/Hemoglobin.total [Mass fraction] in Blood by Electrophoresis (LOINC:4549-2)
- Hemoglobin A1c/Hemoglobin.total [Mass fraction] in Blood by HPLC (LOINC:17856-6)
- Hemoglobin A1c/Hemoglobin.total [Mass fraction] in Blood by calculation (LOINC:17855-8)
- Hemoglobin A1c/Hemoglobin.total [Mass fraction] in Blood by unspecified technique (LOINC:4548-4)

QUESTIONS?

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