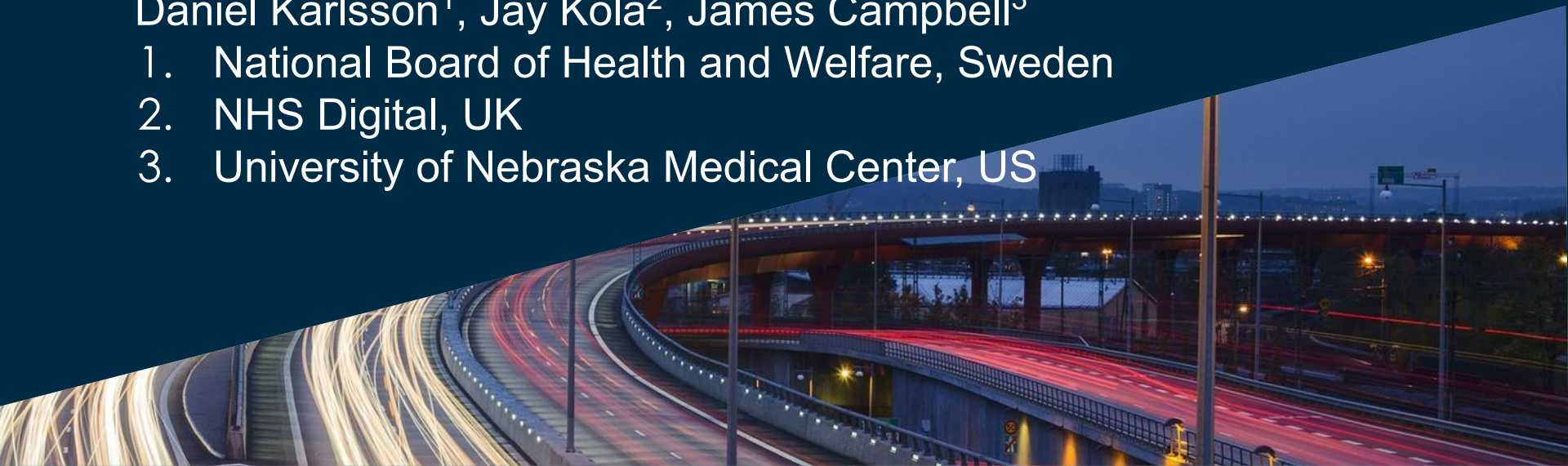




# SNOMED CT, NPU and LOINC integration for semantic interoperability of laboratory test results

Daniel Karlsson<sup>1</sup>, Jay Kola<sup>2</sup>, James Campbell<sup>3</sup>

1. National Board of Health and Welfare, Sweden
2. NHS Digital, UK
3. University of Nebraska Medical Center, US



# Interoperability through SNOMED CT

- There are today a few laboratory medicine terminologies, e.g.
  - LOINC is used in US, AU, MY, and many more countries
  - NPU Terminology is used in Scandinavia, CZ
  - SNOMED CT is the lab terminology in UK
- Neither LOINC nor NPU are based on any ontologies

# Interoperability through SNOMED CT

- Proposal to apply SNOMED CT to bridge between the three efforts

# LOINC-SNOMED CT linking

- SNOMED International has since 2014 provided SNOMED CT concepts associated with LOINC parts and SNOMED CT expressions associated with LOINC terms
- Approx. 20 000 LOINC terms associated
- Project currently on hold

# NPU-SNOMED CT pilot

- IUPAC project to determine feasibility of associating NPU Terminology to SNOMED CT
- Set of ~800 commonly used NPU terms
- Missing about 1/3 of elements/parts → 3/4 of terms had 1 or more missing elements

# SNOMED CT in OWL

- SNOMED International provides tools to render a SNOMED CT release in OWL format
  - <https://github.com/IHTSDO/snomed-owl-toolkit>
- LOINC expression association reference set can also be rendered as an OWL file

# Lab terminologies on SNOMED CT

- Association between lab terminologies and SNOMED CT can facilitate
  - Querying
  - Use and re-use of lab data
  - Interoperability between users of different lab terminologies

Query (class expression)

**Query (class expression)**

'Observable entity (observable entity)' **and**  
 ('Role group (attribute)' **some** ('Property (attribute)' **some** 'Quantity concentration (property) (qualifier value)')) **and**  
 ('Role group (attribute)' **some** ('Inheres in (attribute)' **some** 'Urine (substance)')) **and**  
 ('Role group (attribute)' **some** ('Component (attribute)' **some** 'Morphinan opioid (substance)'))

- Levorphanol [Presence] in Urine (LOINC:3711-9) ?
- Levorphanol [Presence] in Urine by Confirmatory method (LOINC:16213-1) ?
- Levorphanol [Presence] in Urine by Screen method (LOINC:19516-4) ?
- Morphine [Mass/volume] in Urine (LOINC:3831-5) ?
- Morphine [Mass/volume] in Urine by Confirmatory method (LOINC:16251-1) ?
- Morphine [Moles/volume] in Urine by Confirmatory method (LOINC:70210-0) ?
- Morphine [Presence] in Urine (LOINC:3830-7) ?
- Morphine [Presence] in Urine by Confirmatory method (LOINC:16196-8) ?
- Morphine [Presence] in Urine by Screen method (LOINC:19597-4) ?
- NPU04536 U—Nalbuphine; arb.c.(proc.) = ?** ?
- NPU04591 U—Oxycodone; arb.c.(proc.) = ?** ?
- NPU08990 U—Morphine+analogue; arb.c.(proc.) = ?** ?
- NPU23881 U—Ethylmorphine; mass c. = ? µg/L** ?
- NPU24866 U—Morphine; mass c. = ? µg/L** ?
- NPU26819 U—Morphine; arb.c.(confirm; proc.) = ?** ?
- NPU27984 U—Morphine+analogue; arb.c.(confirm; proc.) = ?** ?
- NPU28000 U—Oxycodone; mass c. = ? µg/L** ?
- Nalbuphine [Mass/volume] in Urine (LOINC:3840-6) ?
- Nalbuphine [Mass/volume] in Urine by Confirmatory method (LOINC:20551-8) ?
- Nalbuphine [Presence] in Urine (LOINC:3839-8) ?
- Nalbuphine [Presence] in Urine by Confirmatory method (LOINC:16218-0) ?
- Nalbuphine [Presence] in Urine by Screen method (LOINC:19605-5) ?
- Oxycodone [Mass/volume] in Urine (LOINC:11246-6) ?
- Oxycodone [Mass/volume] in Urine by Confirmatory method (LOINC:16249-5) ?
- Oxycodone [Moles/volume] in Urine by Confirmatory method (LOINC:70215-9) ?
- Oxycodone [Presence] in Urine (LOINC:10998-3) ?



# Sodium in (Serum or) Plasma

Description: 'Sodium [Moles/volume] in Serum or Plasma (LOINC:2951-2)'

Equivalent To 

- 'Clinical chemistry observable (LOINC grouper)'
  - and ('Role group (attribute)' some ('Component (attribute)' some 'Sodium electrolyte (substance)'))
  - and ('Role group (attribute)' some ('Property (attribute)' some 'Substance concentration (property) (qualifier value)'))
  - and ('Role group (attribute)' some ('Scale type (attribute)' some 'Quantitative (qualifier value)'))
  - and ('Role group (attribute)' some ('Time aspect (attribute)' some 'Single point in time (qualifier value)'))
  - and ('Role group (attribute)' some ('Inheres in (attribute)' some 'Plasma (substance)'))
  - and ('Role group (attribute)' some ('Direct site (attribute)' some 'Acellular blood (serum or plasma) specimen (specimen)'))

SubClass Of 

- 'Serum or plasma clinical chemistry (observable entity)'
- 'Sodium [Moles/volume] in Body fluid (LOINC:2950-4)'
- 'NPU03429 P—Sodium ion, subst.c. = ? mmol/L'

Description: NPU03429 P—Sodium ion, subst.c. = ? mmol/L

Equivalent To 

- 'Observable entity (observable entity)'
  - and ('Role group (attribute)' some ('Component (attribute)' some 'Sodium electrolyte (substance)'))
  - and ('Role group (attribute)' some ('Property (attribute)' some 'Substance concentration (property) (qualifier value)'))
  - and ('Role group (attribute)' some ('Inheres in (attribute)' some 'Plasma (substance)'))

Description: 'Trimethoprim and sulfamethoxazole [Susceptibility] of bacterium by Minimum inhibitory concentration (LOINC:51

Equivalent To +

- 'Microbiology laboratory observable (LOINC grouper)'
  - and ('Role group (attribute)' some ('Technique (attribute)' some 'Minimum inhibitory concentration susceptibility test technique (qualifier value)'))
  - and ('Role group (attribute)' some ('Property (attribute)' some 'Susceptibility (property) (qualifier value)'))
  - and ('Role group (attribute)' some ('Scale type (attribute)' some 'Oral value (qualifier value)'))
  - and ('Role group (attribute)' some ('Time aspect (attribute)' some 'Single point in time (qualifier value)'))
  - and ('Role group (attribute)' some ('Inheres in (attribute)' some 'Bacterium (organism)'))
  - and ('Role group (attribute)' some ('Relative to (attribute)' some 'Product containing sulfamethoxazole and trimethoprim (medicinal product)'))
  - and ('Role group (attribute)' some ('Direct site (attribute)' some 'Specimen (specimen)'))

SubClass Of +

- 'Antibiotic [Susceptibility] of bacterium by Minimum inhibitory concentration (LOINC:21070-8)'

- 'NPU57715 Syst\_Sulfamethoxazole+Trimethoprim; threshold mass c. = ? mg/L'

Description: 'NPU57715 Syst—Sulfamethoxazole+Trimethoprim; threshold mass c. = ? mg/L'

Equivalent To +

- 'Observable entity (observable entity)'
  - and ('Role group (attribute)' some ('Property (attribute)' some 'Threshold mass concentration (property) (qualifier value)'))

◀ 'Threshold mass concentration (property) (qualifier value)'

'Observable entity (observable entity)' and  
( 'Role group (attribute)' some ('Technique (attribute)' some 'Minimum inhibitory concentration susceptibility test technique (qualifier value)')  
( 'Role group (attribute)' some ('Property (attribute)' some 'Susceptibility (property) (qualifier value)')) and  
( 'Role group (attribute)' some ('Inheres in (attribute)' some 'Bacterium (organism)'))

SubClassOf

( 'Role group (attribute)' some ('Property (attribute)' some 'Threshold mass concentration (property) (qualifier value)'))

# Conclusions

- SNOMED CT and the Observables model can be used as an interlingua for lab terminology interoperability

# Thanks!