Implications of the Major Health KOSs during the COVID-19 Pandemic

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NKOS Workshop 2020, Sept. 9 &10.
Outline

1. Prompt actions of the major health KOSs
   a) The recent efforts to eliminate ambiguities and semantic conflicts through naming of the disease
   b) New codes and coding guidance from major standardized health KOSs

2. Usages of Health KOSs

3. Conclusion

Based on Chapter 1 & 2 of the full paper:
Outline

1. Prompt actions of the major health KOSs
   a) The recent efforts to eliminate ambiguities and semantic conflicts through naming of the disease
   b) New codes and coding guidance from major standardized health KOSs

2. Usages of Health KOSs

3. Conclusion
"Information overload" refers to the difficulty a person can have understanding an issue and making decisions that can be caused by the presence of too much information. Toffler, 1970

Challenges during a global pandemic

• News reports are from around the world;
• Terms carry different meanings in different contexts;
• Uncertain methods or criteria for collecting data;
• Communicating across languages, regions, and cultures,
• ...

Standardized health KOSs

- increasingly play a larger and more important role in healthcare information systems to facilitate data normalization,
  -- which is a fundamental requirement for any subsequent data analysis, information management, and decision-making.
The Problem of Semantic conflicts

Naming of a disease; Classifying and defining a disease.

- 2009 H1N1 Flu (Swine Flu)
  - "swine flu"
  - "pig flu"
  - "[new] Spanish flu"
  - "Mexican flu"
  - "North American influenza"
  - "Influenza A virus subtype H1N1" – Wikipedia
  - "Influenza A (H1N1)" – WHO
  - "Swine-Origin Influenza A H1N1 Virus" – CDC, (MeSH)
  - "Influenza A Virus, H1N1 Subtype" – MeSH

- Even after standardized authority control efforts, semantic conflicts can still occur through the way concepts are classified and defined.
- Incorrect diagnoses and cause of death is a well-known problem with international morbidity and mortality statistics (O’Malley et al., 2005).
LePan, Nicholas, 2020-03. “Visualizing the History of Pandemics”
https://www.visualcapitalist.com/history-of-pandemics-deadliest
Three most important names to be decided

- the species
- the virus
- the disease

Image source: ICTV: Naming the 2019 Coronavirus. https://talk.ictvonline.org/ CC BY-SA 4.0


**ICTV** = International Committee on Taxonomy of Viruses, the official body of the Virology Division of the International Union of Microbiological Societies.  
**ICTV-CSG** = The *Coronaviridae* Study Group (CSG) of the International Committee on Taxonomy of Viruses
Ensuring that the name does not refer to:
- a geographical location,
- an animal,
- an individual or group of people,

while still being pronounceable and related to the disease (WHO, 2015).

Establishing a name for a new disease provides a shared understanding for researchers and developers to discuss disease prevention, spread, transmissibility, severity, and treatment. Viruses are named based on their genetic structure to facilitate the development of diagnostic tests, vaccines, and medicines (WHO, 2020a).
Naming and Classifying by WHO and ICD-10*

- 2020-01-30.
  - WHO declared the 2019 Novel Coronavirus (2019-nCoV) disease outbreak a public health emergency of international concern.

- 2020-01-31.
  - WHO Family of International Classifications (WHO-FIC) network’s Classification and Statistics Advisory Committee (CSAC) convened an emergency meeting to discuss the creation of a specific code for this new type of coronavirus.
  - ICD-10 established a new emergency code (“U07.1, 2019-nCoV, acute respiratory disease”).

- 2020-02-11.
  - The WHO officially announced the name of the disease, COVID-19, an acronym for “coronavirus disease 2019.”
  - A study group of the International Committee on Taxonomy of Viruses (ICTV) christened the novel virus as “severe acute respiratory syndrome coronavirus 2,” or SARS-CoV-2 (ICTV, 2020).
  - The ICD-10 was updated with two emergency codes:
    - “U07.1 COVID-19, virus identified” and
    - “U07.2 COVID-19, virus not identified”

*ICD-10 = International Classification of Diseases 10th
WHO ICD-10 codes of COVID-19

U07.1 COVID-19, virus identified
COVID-19 NOS

Use this code when COVID-19 has been confirmed by laboratory testing irrespective of severity of clinical signs or symptoms. Use additional code, if desired, to identify pneumonia or other manifestations.

Excl.: Coronavirus infection, unspecified site (B34.2)

Coronavirus as the cause of diseases classified to other chapters (B97.2)
Severe acute respiratory syndrome [SARS], unspecified (U04.9)

U07.2 COVID-19, virus not identified

Use this code when COVID-19 is diagnosed clinically or epidemiologically but laboratory testing is inconclusive or not available. Use additional code, if desired, to identify pneumonia or other manifestations.

Excl.: Coronavirus infection, unspecified site (B34.2)

COVID-19:
• confirmed by laboratory testing (U07.1)
• special screening examination (Z11.5)
• suspected but ruled out by negative laboratory results (Z03.8)

Releases of Guidelines by KOSs in March 2020

- ICD-10
- CPT (Current Procedural Terminology)
- LOINC (Logical Observation Identifiers Names and Codes)
- SNOMED CT (Systematized Nomenclature of Medicine – Clinical Terms)

Refer to our full paper’s Table 1 ——> https://doi.org/10.2478/dim-2020-0009
NLM VSAC COVID-19 SNOMED CT Codeset

<table>
<thead>
<tr>
<th>Value Set Name</th>
<th>2019 Novel Coronavirus COVID 19 Codeset</th>
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<td>Code</td>
<td>Description</td>
</tr>
<tr>
<td>461911000124106</td>
<td>Swab specimen from oropharynx (specimen)</td>
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<tr>
<td>840533007</td>
<td>Severe acute respiratory syndrome coronavirus 2 (organism)</td>
</tr>
<tr>
<td>840534001</td>
<td>Severe acute respiratory syndrome coronavirus 2 vaccination (procedure)</td>
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<tr>
<td>840535000</td>
<td>Antibody to severe acute respiratory syndrome coronavirus 2 (substance)</td>
</tr>
<tr>
<td>840536004</td>
<td>Antigen of severe acute respiratory syndrome coronavirus 2 (substance)</td>
</tr>
<tr>
<td>840539006</td>
<td>Disease caused by severe acute respiratory syndrome coronavirus 2 (disorder)</td>
</tr>
<tr>
<td>840544004</td>
<td>Suspected disease caused by severe acute respiratory coronavirus 2 (situation)</td>
</tr>
<tr>
<td>840546002</td>
<td>Exposure to severe acute respiratory syndrome coronavirus 2 (event)</td>
</tr>
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</table>

[Note: This value set contains codes from the March 2020 Interim International Edition release. New approved terms for these codes will appear in the next release in September 2020. Source: https://confluence.ihtsdotools.org/display/snomed/SNOMED%2BCT%2BCoronavirus%2BContent]
# MeSH Supplementary Concept for COVID-19

## COVID-19 MeSH Supplementary Concept Data 2020

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<thead>
<tr>
<th>Details</th>
<th>Concepts</th>
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<tr>
<td>Registry Number</td>
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</tr>
<tr>
<td>Heading Mapped to</td>
<td>*Pneumonia, Viral, *Coronavirus Infections, *Pandemics</td>
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<tr>
<td>Note</td>
<td>A viral disorder characterized by high FEVER; COUGH; DYSPNEA; renal dysfunction and other symptoms of a VIRAL PNEUMONIA. A coronavirus SARS-CoV-2 in the genus BETACORONAVIRUS is the suspected agent.</td>
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<tr>
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<td>severe acute respiratory syndrome coronavirus 2</td>
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<td>Date of Entry</td>
<td>2020/02/13</td>
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<td>Revision Date</td>
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Source: https://meshb.nlm.nih.gov/record/ui?ui=C000657245

Hong & Zeng, NKOS Workshop 2020
# Wikipedia and Wikidata entries of COVID-19

(Data collected on May 20, 2020)

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<th>Wikipedia entry</th>
<th># of entries (languages)</th>
<th>Matching KOS IDs</th>
<th>Wikidata English Label and ID</th>
<th>scope notes</th>
<th># of &quot;Also Known as&quot; in English</th>
<th># of mapped &quot;Identifier&quot;</th>
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<td>*ICD-10: U07.2</td>
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<td></td>
<td></td>
<td>*SNOMED CT: 840539006</td>
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<tr>
<td>Coronavirus</td>
<td>69</td>
<td>*ICD-10:B97.2</td>
<td>Coronavirus</td>
<td>group of related viruses that cause diseases in mammals and birds</td>
<td>1</td>
<td>6</td>
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<td></td>
<td></td>
<td>Q81068910</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Severe acute respiratory syndrome coronavirus 2</td>
<td>102</td>
<td>*ICD-10: U07.1</td>
<td>SARS-CoV-2</td>
<td>strain of virus causing the ongoing pandemic of coronavirus disease 2019 (COVID-19)</td>
<td>16</td>
<td>14</td>
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<td></td>
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<td></td>
<td>*SNOMED CT: 840533007</td>
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<td></td>
</tr>
</tbody>
</table>
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Common Health KOS Standards

- **Most popular KOS standards in EHR and HIE:**
  - International Classification of Diseases (ICD)
  - Systematized Nomenclature of Medicine--Clinical Terms (SNOMED-CT)
  - Logical Observation Identifiers Names and Codes (LOINC)
  - RxNorm
  - Health Level Seven (HL7) messages

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Standard health KOSs in electronic health records (EHR)
COVID-19 encounter diagnosis in OpenEMR’s Problem List

Source: https://www.openemr.org/wiki/index.php/OpenEMR_Features
SNOMED CT code of COVID-19

Parents
- Human coronavirus (organism)
- Disease caused by Coronaviridae (disorder)
- Coronavirus infection (disorder)

Source:
COVID-19 Data Exchange on the AIMS Platform

### COVID-19 HL7 data messaging - Sample HL7 messages for lab data exchange

MSH|^~\&|STARLIMS.AR.STAG^2.16.840.1.114222.4.3.3.2.5.2^ISO|AR.LittleRock.SPHL^2.16.840.1.114222.4.1.20 083^ISO|US WHO Collab LabSys^2.16.840.1.114222.4.3.3.7^ISO|CDC-EPI Surv Branch^2.16.840.1.114222.4.1.10416^ISO|20191203100718- 0600|ORU^R01^ORU_R01|170703|T|2.3.1||PHIP.ORU_v1.0.2^PHIN_Profile_ID^2.16.840.1.114222.4.10.3^ISO PID|1|PID13295037|STARLIMS.AR.STAG&2.16.840.1.114222.4.3.3.2.5.2&ISO|PI|~^~~~S|20000101|F|~^~~~A R^72016^USA ORC|RE|1905700000256-12^PHIP-Test-EHR^2.16.840.1.113883.3.72.5.24^ISO|1905700000256- 176^STARLIMS.AR.STAG^2.16.840.1.114222.4.3.3.2.5.2^ISO|CM||Little Rock General Hospital Lab|2217 Trancas^Little Rock^AR^72205 OBR|1|1905700000256-12^PHIP-Test-EHR^2.16.840.1.113883.3.72.5.24^ISO|1905700000256- 176^STARLIMS.AR.STAG^2.16.840.1.114222.4.3.3.2.5.2^ISO|68991-9^Epidemiologically important info-pnl^LN||20191125201900- 0600||20191126|ORH&Other&HL70070|1412941681^Smith^John^C^DR^NPI&2.16.840.1.113883.4.6^ISO|L|^ PH^952|4863332|F OBX|1|CX|LAB202^Unique Specimen ID^PHINQUESTION|1905700000256|STARLIMS.AR.STAG&2.16.840.1.114222.4.3.3.2.5.2&ISO|||F|20191203 100718-0600 ORC|RE|1905700000256-13^PHIP-Test-EHR^2.16.840.1.113883.3.72.5.24^ISO|1905700000256- 177^STARLIMS.AR.STAG^2.16.840.1.114222.4.3.3.2.5.2^ISO|CM||Little Rock General Hospital Lab|2217 Trancas^Little Rock^AR^72205 OBR|2|1905700000256-13^PHILP-Test-EHR^2.16.840.1.113883.3.72.5.24^ISO|1905700000256- 177^STARLIMS.AR.STAG^2.16.840.1.114222.4.3.3.2.5.2^ISO|94306-8^SARS-CoV-2 RNA Pnl XXX NAA+probe^LN||1901125201900- 0600||20191126|ORH&Other&HL70070&&&Nasopharyngeal|1412941681^Smith^John^C^DR^NPI&2.16.840.1.1 13883.4.6^ISO|L|^PH^952|4863332|20191203081920-0600|F OBX|1|CE|94307-6^SARS-CoV-2 N gene XXX Qi NAA N1^LN|260373001^Detected^SCT||F|20191203081920-0600 OBX|2|CE|94308-4^SARS-CoV-2 N gene XXX Qi NAA N2^LN|260373001^Detected^SCT||F|20191203081920-0600 OBX|3|CE|68993-5^Human RNase P RNA XXX Qi NAA+probe^LN|260373001^Detected^SCT||F|20191203081920-0600

**Source:** [https://www.aphl.org/programs/preparedness/Crisis-Management/Documents/2019nCoV_PHLIPsample_2.3.1_Detected_UPDATED3.3.20.pdf](https://www.aphl.org/programs/preparedness/Crisis-Management/Documents/2019nCoV_PHLIPsample_2.3.1_Detected_UPDATED3.3.20.pdf)

Hong & Zeng, NKOS Workshop 2020
### Sample HL7 Message with “Not Detected” Test Results

<table>
<thead>
<tr>
<th>Sort</th>
<th>vsID</th>
<th>vsName</th>
<th>rowStatus Code</th>
<th>ConceptName</th>
</tr>
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<tbody>
<tr>
<td>10037</td>
<td>av-319</td>
<td>Conclusion PCR result</td>
<td>A</td>
<td>260373001 Detected</td>
</tr>
<tr>
<td>10039</td>
<td>av-319</td>
<td>Conclusion PCR result</td>
<td>A</td>
<td>419984006 inconclusive</td>
</tr>
<tr>
<td>10041</td>
<td>av-319</td>
<td>Conclusion PCR result</td>
<td>A</td>
<td>260415000 Not Detected</td>
</tr>
<tr>
<td>10045</td>
<td>av-319</td>
<td>Conclusion PCR result</td>
<td>A</td>
<td>125154007 Specimen unsatisfactory for evaluation</td>
</tr>
<tr>
<td>10970</td>
<td>av-318</td>
<td>Target PCR result</td>
<td>A</td>
<td>260373001 Detected</td>
</tr>
<tr>
<td>10973</td>
<td>av-318</td>
<td>Target PCR result</td>
<td>A</td>
<td>260415000 Not Detected</td>
</tr>
</tbody>
</table>

Trancas^^Little Rock^AR^72205
OBR|1|19057000000276-12^PHLIP-Test-EHR^2.16.840.1.113883.3.72.5.24^ISO|19057000000276-177^STARLIMS.AR.STAG^2.16.840.1.114222.4.3.3.2.5.2^ISO^68991-9^Epidemiologically important info pnn^LN||20191125201900-0600||20191126|ORH&Other&HL70070|1412941681^Smith^John^C^^DR^^NPI&2.16.840.1.113883.4.6&ISO^L^\^PH^^952^4863332^|F\F|100718-0600
ORC|RE|19057000000276-13^PHLIP-Test-EHR^2.16.840.1.113883.3.72.5.24^ISO|19057000000276-177^STARLIMS.AR.STAG^2.16.840.1.114222.4.3.3.2.5.2^ISO^CM^|Little Rock General Hospital Lab|2217 Trancas^^Little Rock^AR^72205
OBR|2|19057000000276-13^PHLIP-Test-EHR^2.16.840.1.113883.3.72.5.24^ISO|19057000000276-177^STARLIMS.AR.STAG^2.16.840.1.114222.4.3.3.2.5.2^ISO^94306-8^SARS-CoV-2 RNA Pnl XXX NAA+probe^LN||20191125201900-0600||20191126|ORH&Other&HL70070&&Nasopharyngeal|1412941681^Smith^John^C^^DR^^NPI&2.16.840.1.113883.4.6&ISO^L^\^PH^^952^4863332^|F\F|20191203081920-0600
OBR|1|CE|94307-6^SARS-CoV-2 N gene XXX Qi NAA N1^LN|2260415000^Not detected^SCT^|F|20191203081920-0600

Sample HL7 Message with “Inconclusive” Test Results

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<tr>
<td>10037</td>
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<td>Conclusion PCR result</td>
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<td>Detected</td>
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<tr>
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<td>av-319</td>
<td>Conclusion PCR result</td>
<td>A</td>
<td>419984006</td>
<td>inconclusive</td>
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<td>10041</td>
<td>av-319</td>
<td>Conclusion PCR result</td>
<td>A</td>
<td>260415000</td>
<td>Not Detected</td>
</tr>
<tr>
<td>10045</td>
<td>av-319</td>
<td>Conclusion PCR result</td>
<td>A</td>
<td>125154007</td>
<td>Specimen unsatisfactory for evaluation</td>
</tr>
</tbody>
</table>

ORC|RE|1905700000266-13^PHLIP-Test-EHR^2.16.840.1.113883.3.72.5.24^ISO|||1905700000266-177^STARLIMS.AR.STAG^2.16.840.1.114222.4.3.3.2.5.2^ISO|||1412941681^Smith^John^C^DR^NPI&2.16.840.1.113883.4.6^ISO^L^NPI^MD|^WPN^PH^1^707^2643378||Little Rock General Hospital Lab^D^NPI&2.16.840.1.113883.4.6^ISO^NPI^1255402921|2217 Trancas^Suite 22^Little Rock^AR^72205^USA^M^WPN^PH^1^707^5549876
OBR|^2^1905700000266-13^PHLIP-Test-EHR^2.16.840.1.113883.3.72.5.24^ISO||1905700000266-177^STARLIMS.AR.STAG^2.16.840.1.114222.4.3.3.2.5.2^ISO|^94309-2^2019-nCoV RNA XXX NAA+probe-Imp^LN^1902281257-0500||1412941681^Smith^John^C^DR^NPI&2.16.840.1.113883.4.6^ISO^L^NPI^MD|^WPN^PH^1^707^2643378||190402082143-0500||
OBX|^1^CWE|^94309-2^2019-nCoV RNA XXX NAA+probe-Imp^LN^419984006^inconclusive^SCT|||201902281257-0500||201904020721-0500||Public Health Laboratory^D^CLIA|^2.16.840.1.113883.19.4.6^ISO^XX^05D0897628|3434 Industrial Loop^Little Rock^AR^72205^USA^B
NTE|^1|L|94309-2 is a report code. It should be conditional in the panel = either this OR all the target codes MUST be used; both may be used also.
SPM|^1^1905700000266-12&STARLIMS.AR.STAG&2.16.840.1.114222.4.3.3.2.5.2^ISO|^258500001^Nasopharyngeal swab(specimen)^SCT;;;;201902281257-0500|201903011118-0500

Conclusion

Health KOSs have become even more critical to aid the frontline endeavors to overcome the obstacles of information overload and semantic conflicts that can occur during special historic and worldwide events like the COVID-19 pandemic. They have played important roles in:

- supporting health data exchange and information management,
- ensuring consistency and interoperability of data collection and reuse among various providers and healthcare settings
- facilitate data normalization, which is a fundamental requirement for any subsequent data analysis and information management
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