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

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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:
Available at [https://doi.org/10.2478/dim-2020-0009](https://doi.org/10.2478/dim-2020-0009)
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The Problem of Information Overload

"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

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

Hong & Zeng, NKOS Workshop 2020
### NLM VSAC COVID-19 SNOMED CT Codeset

<table>
<thead>
<tr>
<th>Value Set Name</th>
<th>2019 Novel Coronavirus COVID 19 Codeset</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code System</td>
<td>SNOMEDCT</td>
</tr>
<tr>
<td>OID</td>
<td>2.16.840.1.113762.1.4.1114.7</td>
</tr>
<tr>
<td>Type</td>
<td>Extension</td>
</tr>
<tr>
<td>Definition Version</td>
<td>20200324</td>
</tr>
<tr>
<td>Steward</td>
<td>Office of the National Coordinator for Health Information Technology</td>
</tr>
<tr>
<td>Program</td>
<td>null, 20200324 using this value set</td>
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</table>

**Expansion Version:** 20200324

**Expanded Code List**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>461911000124106</td>
<td>Swab specimen from oropharynx (specimen)</td>
</tr>
<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>
</tr>
<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>
</tbody>
</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](https://confluence.ihtsdotools.org/display/snomed/SNOMED%2BCT%2BCoronavirus%2BContent)
**COVID-19** MeSH Supplementary Concept Data 2020

<table>
<thead>
<tr>
<th>Details</th>
<th>Concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td>MeSH Supplementary Unique ID</td>
<td>COVID-19</td>
</tr>
<tr>
<td>RDF Unique Identifier</td>
<td>C000657245</td>
</tr>
<tr>
<td>Entry Term(s)</td>
<td><a href="http://id.nlm.nih.gov/mesh/C000657245">http://id.nlm.nih.gov/mesh/C000657245</a></td>
</tr>
<tr>
<td></td>
<td>2019 novel coronavirus disease</td>
</tr>
<tr>
<td></td>
<td>2019 novel coronavirus infection</td>
</tr>
<tr>
<td></td>
<td>2019-nCoV disease</td>
</tr>
<tr>
<td></td>
<td>2019-nCoV infection</td>
</tr>
<tr>
<td></td>
<td>COVID-19 pandemic</td>
</tr>
<tr>
<td></td>
<td>COVID-19 virus disease</td>
</tr>
<tr>
<td></td>
<td>COVID-19 virus infection</td>
</tr>
<tr>
<td></td>
<td>COVID19</td>
</tr>
<tr>
<td></td>
<td>SARS-CoV-2 infection</td>
</tr>
<tr>
<td></td>
<td>coronavirus disease 2019</td>
</tr>
<tr>
<td></td>
<td>coronavirus disease-19</td>
</tr>
<tr>
<td>Registry Number</td>
<td>0</td>
</tr>
<tr>
<td>Heading Mapped to</td>
<td>*Pneumonia, Viral</td>
</tr>
<tr>
<td></td>
<td>*Coronavirus Infections</td>
</tr>
<tr>
<td></td>
<td>*Pandemics</td>
</tr>
<tr>
<td>Note</td>
<td>A viral disorder characterized by high FEVER; COUGH; DYSPNEA; renal dysfunction</td>
</tr>
<tr>
<td></td>
<td>and other symptoms of a VIRAL PNEUMONIA. A coronavirus SARS-CoV-2 in the</td>
</tr>
<tr>
<td></td>
<td>genus BETACORONAVIRUS is the suspected agent.</td>
</tr>
<tr>
<td>Indexing Information</td>
<td>severe acute respiratory syndrome coronavirus 2</td>
</tr>
<tr>
<td>Date of Entry</td>
<td>2020/02/13</td>
</tr>
<tr>
<td>Revision Date</td>
<td>2020/04/07</td>
</tr>
</tbody>
</table>

Source: https://meshb.nlm.nih.gov/record/ui?ui=C000657245
## Wikipedia and Wikidata entries of COVID-19
(Data collected on May 20, 2020)

<table>
<thead>
<tr>
<th>Wikipedia entry</th>
<th># of entries (languages)</th>
<th>Matching KOS IDs</th>
<th>Wikipedia entry</th>
<th>Matching KOS IDs</th>
<th>Wiki (languages)</th>
<th>scope notes</th>
<th># of &quot;Also Known as&quot; in English</th>
<th># of mapped &quot;Identifier&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coronavirus</td>
<td>69</td>
<td>*ICD-10:B97.2 *MeSH:D017934</td>
<td>Coronavirus</td>
<td>*SNOMED CT: 840539006</td>
<td>69</td>
<td>Coronavirus (Q89469904) group of related viruses that cause diseases in mammals and birds</td>
<td>1</td>
<td>6</td>
</tr>
</tbody>
</table>
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Most popular KOS standards in EHR and HIE:

- *International Classification of Diseases (ICD)*
- *SNOMED Clinical Terms (SNOMED-CT)*
- *Logical Observation Identifiers Names and Codes (LOINC)*
- RxNorm
- Health Lever Seven (HL7) messages
Standard health KOSs in electronic health records (EHR)
COVID-19 encounter diagnosis in OpenEMR’s Problem List

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

Parents

- Human coronavirus (organism)

Source:
https://browser.ihtsdotools.org/?perspective=full&conceptId1=840539006&edition=MAIN/2020-07-31&release=&languages=en
COVID-19 Data Exchange on the AIMS Platform

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

MSH|~\|STRLIMS.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|PHILIP.ORU_v1.0.2^PHIN_Profile_ID^2.16.840.1.114222.4.10.3^ISO PID|^2013295037^^STRLIMS.AR.STAG&2.16.840.1.114222.4.3.3.2.5.2^ISO|PI|~^S|20000101[F]|^AAPR^72016^USA|ORC^RE|1905700000256-12^PHILIP-Test-EHR^2.16.840.1.113883.3.72.5.24^ISO|1905700000256-176^STRLIMS.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^PHILIP-Test-EHR^2.16.840.1.113883.3.72.5.24^ISO|1905700000256-176^STRLIMS.AR.STAG^2.16.840.1.114222.4.3.3.2.5.2^ISO|68991-9^Epidemiologically important info|pnl^LN|20191125201900-0600^2|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^STRLIMS.AR.STAG&2.16.840.1.114222.4.3.3.2.5.2^ISO|100718-0600|ORC^RE|1905700000256-13^PHILIP-Test-EHR^2.16.840.1.113883.3.72.5.24^ISO|1905700000256-177^STRLIMS.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^PHILIP-Test-EHR^2.16.840.1.113883.3.72.5.24^ISO|1905700000256-177^STRLIMS.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|20191203081920-0600|OBX^1^CEF|94307-6^SARS-CoV-2 N gene XXX Qi NAA N1^LN|260373001^Detected^SCT|20191203081920-0600|OBX^2^CEF|94308-4^SARS-CoV-2 N gene XXX Qi NAA N2^LN|260373001^Detected^SCT|20191203081920-0600|OBX^3^CEF|68993-5^Human RNase P RNA XXX Qi NAA+probe^LN|260373001^Detected^SCT|20191203081920-0600

Source: https://www.aphl.org/programs/preparedness/Crisis-Management/Documents/2019nCoV_PHILPsamp_2.3.1_Detected_UPDATED3.3.20.pdf

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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>
</thead>
<tbody>
<tr>
<td>10037</td>
<td>av-319</td>
<td>Conclusion PCR result</td>
<td>A</td>
<td>260373001</td>
</tr>
<tr>
<td>10039</td>
<td>av-319</td>
<td>Conclusion PCR result</td>
<td>A</td>
<td>419984006</td>
</tr>
<tr>
<td>10041</td>
<td>av-319</td>
<td>Conclusion PCR result</td>
<td>A</td>
<td>260415000</td>
</tr>
<tr>
<td>10045</td>
<td>av-319</td>
<td>Conclusion PCR result</td>
<td>A</td>
<td>125154007</td>
</tr>
<tr>
<td>10970</td>
<td>av-318</td>
<td>Target PCR result</td>
<td>A</td>
<td>260373001</td>
</tr>
<tr>
<td>10973</td>
<td>av-318</td>
<td>Target PCR result</td>
<td>A</td>
<td>260415000</td>
</tr>
</tbody>
</table>

Tranas^~Little Rock^AR^72205
OBR|1|19057000000276-12^PHLIP-Test-EHR^2.16.840.1.113883.3.72.5.24^ISO^1905700000276-177^STARLIMS.AR.STAG^2.16.840.1.114222.4.3.3.2.5.2^ISO^|68991-9^Epidemiologically important info
pnl^|LN|||20191125201900-0600|||201911126|ORH&Other&HL70070|1412941681^Smith^John^C^DR^NPI&2.16.840.1.113883.4.6&ISO^L|^ ^PH^952^4863332||
OBX|1|CX|LAB202^Unique Specimen
ID^PHINQUESTION^19057000000276^STARLIMS.AR.STAG&2.16.840.1.114222.4.3.3.2.5.2&ISO^|||F|20191203100718-0600
ORC|RE|19057000000276-13^PHLIP-Test-EHR^2.16.840.1.113883.3.72.5.24^ISO^1905700000276-177^STARLIMS.AR.STAG^2.16.840.1.114222.4.3.3.2.5.2^ISO^CM|||Little Rock General Hospital Lab|2217
Tranas^|Little Rock^AR^72205
OBR|2|19057000000276-13^PHLIP-Test-EHR^2.16.840.1.113883.3.72.5.24^ISO^1905700000276-177^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|||201911126|ORH&Other&HL70070|&^Nasopharyngeal|1412941681^Smith^John^C^DR^NPI&2.16.840.1.113883.4.6&ISO^L||^^PH^952^4863332|||20191203081920-0600|F
OBX|1|CE|94307-6^SARS-CoV-2 N gene XXX Qi NAA N1^LN|2260415000^Not detected^SCT|||F|20191203081920-0600


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### Sample HL7 Message with “Inconclusive” Test Results

**5/23/2020**

<table>
<thead>
<tr>
<th>sort</th>
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<th>Code</th>
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<tbody>
<tr>
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<td>av-319</td>
<td>Conclusion PCR result</td>
<td>A</td>
<td>260373001</td>
<td>Detected</td>
</tr>
<tr>
<td>10039</td>
<td>av-319</td>
<td>Conclusion PCR result</td>
<td>A</td>
<td>419984006</td>
<td>inconclusive</td>
</tr>
<tr>
<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>

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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Marcia Zeng
Kent State University
References


