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
 - 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:

Zeng, M. L., Y. Hong, J. Clunis, S. He, & L.P. Coladangelo. 2020. Implications of Knowledge Organization Systems for Health Information Exchange and Communication during the COVID-19 Pandemic. *Data and Information Management*, 4(3): 148-170.

Available at 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 (HINI)" WHO
- "Swine-Origin Influenza A HINI Virus" CDC, (MeSH)
- "Influenza A Virus, H I N I 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

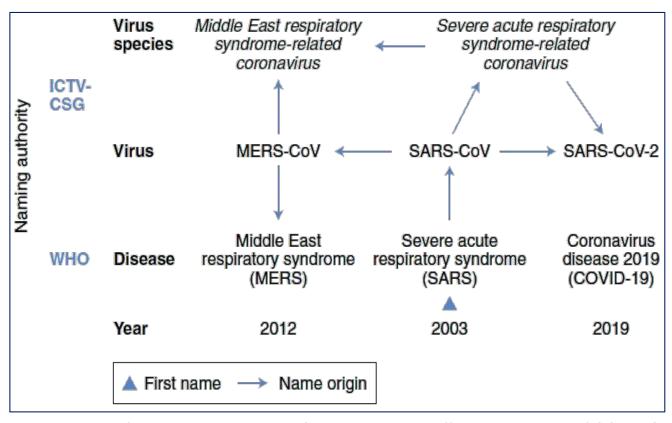


Image source: ICTV: Naming the 2019 Coronavirus. https://talk.ictvonline.org/ CC BY-SA 4.0 Gorbalenya, A.E., Baker, S.C., Baric, R.S. *et al.* The species *Severe acute respiratory syndrome-related coronavirus*: classifying 2019-nCoV and naming it SARS-CoV-2. *Nat Microbiol* **5**, 536–544 (2020). https://doi.org/10.1038/s41564-020-0695-z

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

WHO Best Practices for Naming of New Human Infectious Diseases

https://www.who.int/topics/infectious_diseases/naming-new-diseases/en/

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).

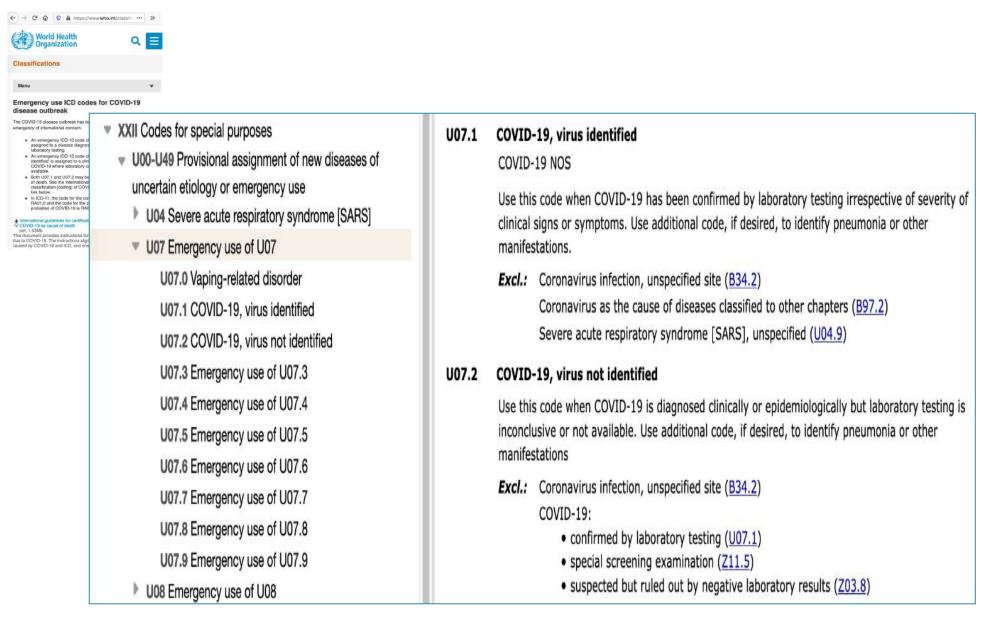
Establishing a name for a new disease provides a shared understanding for researchers and developers to discuss disease prevention, spread, transmissibility, severity, and treatment. Viruses are named based on their genetic structure to facilitate the development of diagnostic tests, vaccines, and medicines (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 <u>Classification</u> and <u>Statistics Advisory Committee</u> (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 <u>International Committee on Taxonomy of Viruses</u> (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



Source: https://icd.who.int/browse10/2019/en#/U07 (Image captured 2020-04-26).

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

Table 1 COVID-19 Coding Guidance			§ scienc
KOS	Code	Code Description	Coding guidance
ICD-10 International Classification of Diseases - Version 10. (Guidance released on 2020-03-25: https://www	807.1*	COVID-19, virus identified	Positive test result; COVID-19 documented cause of death "Use intervention/procedure codes to capture any mechanical ventilation or extracorporeal membrane oxygenation and identify any admission to intensive care un
who.int/classifications/ icd/COVID-19-coding-	U07.1	COVID-19, virus not identified	Positive test result only, patient showing no
RG/CVVII-19-coning- ied10.pdf)		o Clinically epidemiologically diagnosed	symptoms
		cOVID-19 o Probable COVID-19	-,
		o Suspected COVID-19	
	U07.1 + codes for symptoms	COVID-19, virus identified	Use additional code(s) for respiratory disease (e.g. viral pneumonia 112.8) or sign or symptoms of respiratory disease (e.g. shortness of breath R06.0, cough R05) as documented
	U07.2; Z20.8 + codes for symptoms	Contact or suspected exposure	Suspected/probable cases. No other etiology; history of travel
	U07.2; Z20.8 + codes for symptoms	Contact or suspected exposure	Suspected/probable cases. Contact with confirmed or probable case
	U07.2 + codes for symptoms		Suspected/probable cases. No other etiology: hospitalization required
	U07.2 + codes for any symptoms		Suspected/probable cases, COVID-19 documented without any further information regarding testing
CPT Current Procedural Terminology (Guidance released on 2020-03-13; https://www.ama- assn.org/practice- management/cpt/covid- 19-coding-and-guidance)	87635	SARS-COV-2 COVID-19 AMP PRB	Effective March 13, 2020, for novel coronavirus tests through infectious agent detection by nucleic acid
	86318	IMMUNOASSAY INFECTIOUS AGENT ANTIBODY	Effective April 10, 2020, for novel coronavirus tests through infectious agent detection by nucleic acid
	86328	IA NECT AB SARSCOV2 COVID19	Effective April 10, 2020, for antibody tests using a single step method immunoassay. This testing method typically includes a str with all of the critical components for the assaay and is appropriate for a point of care platform
	86769	SARS-COV-2 COVID-19 ANTIBODY	Effective April 10, 2020, for antibody tests using a multiple step method. For severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) (Coronavirus disease (COVID- 19)) antibody testing using single step method, use 86328
KOS	Code	Code Description	Coding guidance
SNOMED CT Systematized Nomenclature of Medicine	840539006	COVID-19	Fully specified name (FSN) = Disease cause by severe acute respiratory syndrome coronavirus 2 (disorder)
- Clinical Terms (Guidance released on 2020-03-09; https://	840544004	Suspected COVID-19	FSN = Suspected disease caused by sever acute respiratory coronavirus 2 (situation
confluence.ihtsdotools. org/display/snomed/	840534001	SARS-CoV-2 vaccination	FSN = Severe acute respiratory syndrome coronavirus 2 vaccination (procedure)
SNOMED+CT+COVID- 19+Related+Content)	840536004	Antigen of SARS-CoV-2	FSN = Antigen of severe acute respiratory syndrome coronavirus 2 (substance)
	840535000	Antibody to SARS-CoV-2	FSN = Antibody to severe acute respirator syndrome coronavirus 2 (substance)
	840546002	Exposure to SARS-CoV-2	FSN = Exposure to severe acute respirator syndrome coronavirus 2 (event)
	840533007	SARS-CoV-2	FSN = Severe acute respiratory syndrome coronavirus 2 (organism)
LOINC Logical Observation Identifiers Names and Codes	94721-8	COVID-19 Evaluation note	These pre-released terms are not yet part an official LOINC release and therefore no available as a direct download from LOINC website
(Special use codes and terms pre-released in mid-March; https://	94723-4	Emergency department COVID-19 Initial Evaluation form	For a complete list of COVID-19 related LO codes, check https://loinc.org/prerelease
clinicalarchitecture.com/ covid-19-updates/)	94722-6	COVID-19 Initial Evaluation form	

NLM VSAC COVID-19 SNOMED CT Codeset

NIH Value Set Auth	ary of Medicine		
Value Set Name	2019 Novel Coronavirus COVID 19 Codeset		
Code System	SNOMEDCT		
OID	2.16.840.1.113762.1.4.1114.7		
Туре	Extensional		
Definition Version	20200324		
Steward	Office of the National Coordinator for Health Information Technology		
Program	null,20200324 using this value set		
Expansion Version	20200324		
Expanded Code List			
Code	Description		
461911000124106	Swab specimen from oropharynx (specimen)		
840533007	Severe acute respiratory syndrome coronavirus 2 (organism)		
840534001	Severe acute respiratory syndrome coronavirus 2 vaccination (procedure)		
840535000	Antibody to severe acute respiratory syndrome coronavirus 2 (substance)		
840536004	Antigen of severe acute respiratory syndrome coronavirus 2 (substance)		
840539006	Disease caused by severe acute respiratory syndrome coronavirus 2 (disorder)		
840544004	Suspected disease caused by severe acute respiratory coronavirus 2 (situation)		
840546002	Exposure to severe acute respiratory syndrome coronavirus 2 (event)		

[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

Details Concepts

MeSH Supplementary COVID-19

Unique ID C000657245

RDF Unique Identifier http://id.nlm.nih.gov/mesh/C000657245

Entry Term(s) 2019 novel coronavirus disease

2019 novel coronavirus infection

2019-nCoV disease 2019-nCoV infection COVID-19 pandemic COVID-19 virus disease COVID-19 virus infection

COVID19

SARS-CoV-2 infection coronavirus disease 2019 coronavirus disease-19

Registry Number 0

Heading Mapped to *Pneumonia, Viral

*Coronavirus Infections

*Pandemics

Note 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.

Indexing Information severe acute respiratory syndrome coronavirus 2

Date of Entry 2020/02/13 **Revision Date** 2020/04/07

Wikipedia and Wikidata entries of COVID-19

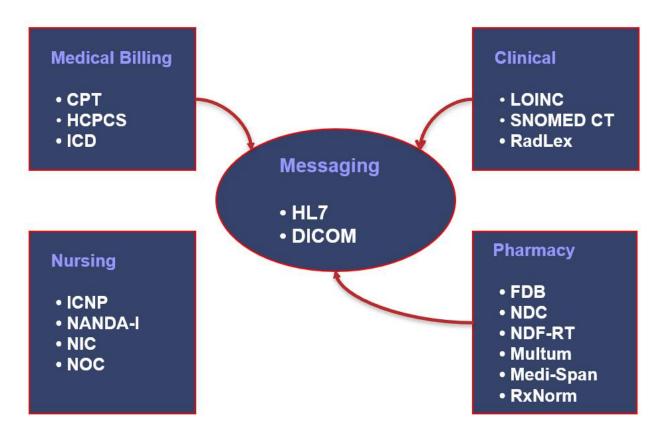
(Data collected on May 20, 2020)

Wikipedia		Wikidata				
Wikipedia entry	# of entries (languages)	Matching KOS IDs	Wikidata English Label and ID	scope notes	# of "Also Known as" in English	# of mapped "Identifier"
Coronavirus disease 2019	128	*MeSH: C000657245 *ICD-10: U07.1 *ICD-10: U07.2 *SNOMED CT: 840539006	(Q84263196) zoonotic respiratory syndrome and infectious disease in humans, caused by SARS coronavirus 2		19	21
Coronavirus	69	•ICD-10:B97.2 •MeSH:D017934	Coronavirus group of related viruses that cause diseases in mammals and birds		1	6
COVID-19 pandemic	125		COVID-19 ongoing pandemic COVID-19 (Q81068910)		15	23
Severe acute respiratory syndrome coronavirus 2	102	•ICD-10: U07.1 •MeSH: C000656484 •SNOMED CT: 840533007	SARS-CoV-2 (Q82069695)	strain of virus causing the ongoing pandemic of coronavirus disease 2019 (COVID-19)	16	14

Outline

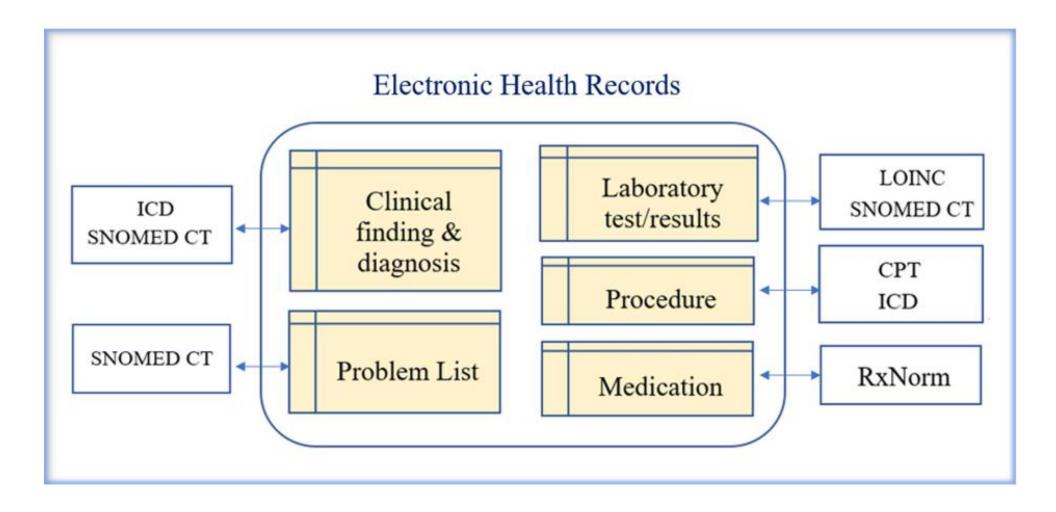
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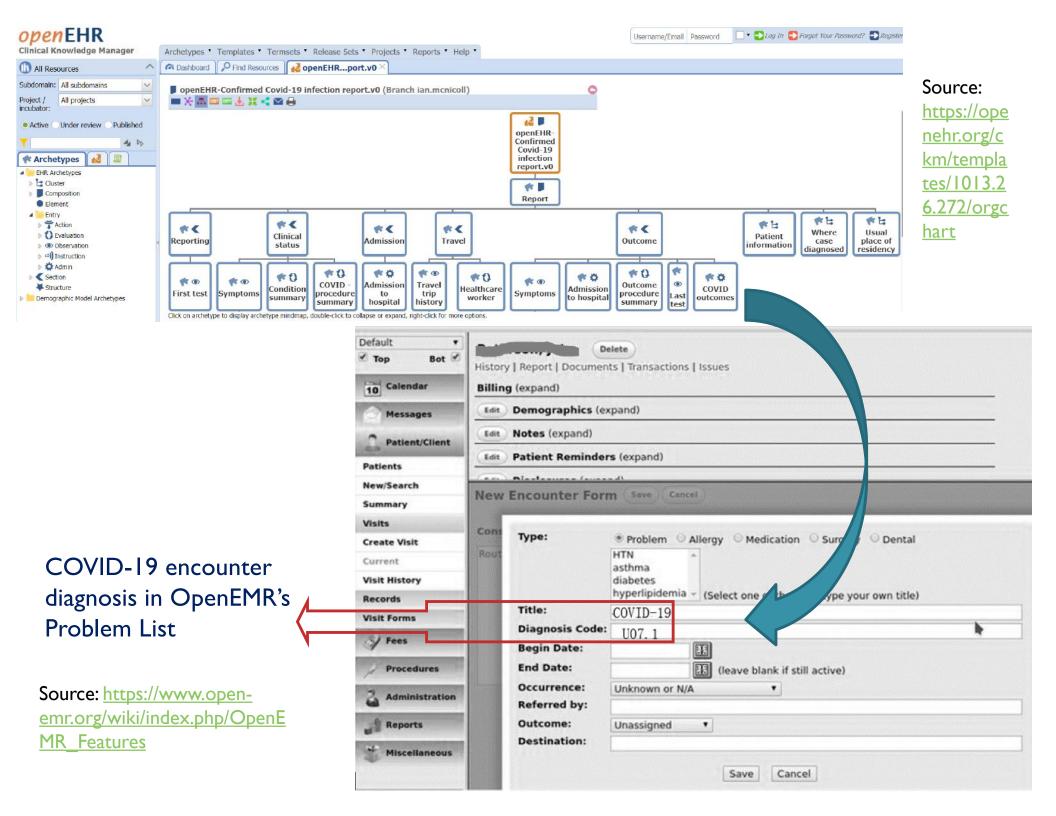
Common Health KOS Standards



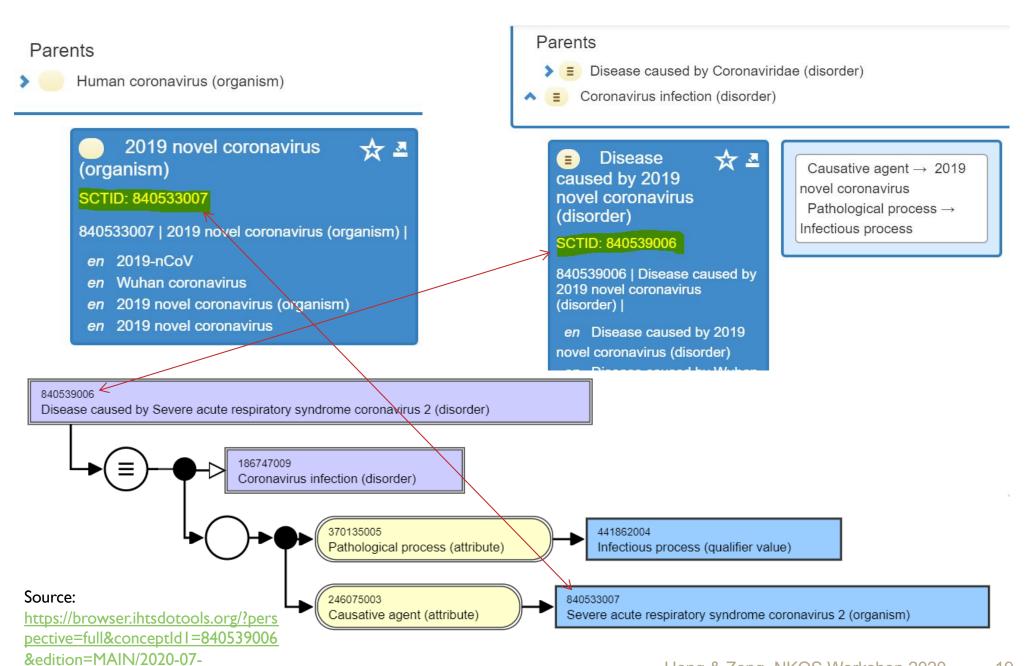
- Most popular KOS standards in EHR and HIE:
 - International Classification of Diseases (ICD)
 - Current Procedural Terminology (CPT)
 - SNOMED Clinical Terms (SMOMED-CT)
 - Logical Observation Identifiers Names and Codes (LOINC)
 - RxNorm
 - Health Lever Seven (HL7) messages

Standard health KOSs in electronic health records (EHR)



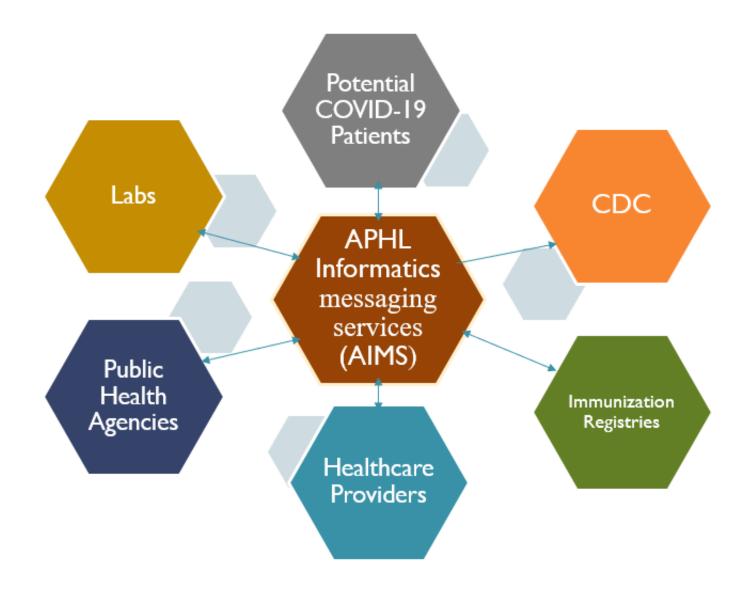


SNOMED CT code of COVID-19



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|\^\&|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|||||||PHLIP 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^PHLIP-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 LOINC code OBR|1|1905700000256-12^PHLIP-Test-EHR^2.16.840.1.113883.3.72.5.24^ISO|1905700000256and name 176^{STARLIMS.AR.STAG^2.16.840.1.114222.4.3.3.2.5.2^{ISO} 68991-9^{Epidemiologically important inf}} 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^PHLIP-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 **SNOMED CT** OBR|2|1905700000256-13^PHLIP-Test-EHR^2.16.840.1.113883.3.72.5.24^ISO|1905700000256code and name 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^^D 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 Q1NAA N1^LN||260373001^Detected^SCT||||||F|||20191203081920-0600 OBX|2|CE|94308-4^SARS-CoV-2 N gene XXX Ql NAA N2^LN||260373001^Detected^SCT||||||F||20191203081920-0600 OBX|3|CE|68993-5[^]Human RNase P RNA XXX QI LOINC code NAA+probe^LN||260373001^Detected^SCT||||||F|||20191203081920-0600

Source: https://www.aphl.org/programs/preparedness/Crisis-

and name

Sample HL7 Message with "Not Detected" Test Results

sort	vsID	vsName	row	/Status Code	ConceptName
MSH ^~\& ST/					
083^ISO US W 10037	av-319	Conclusion PCR result	А	260373001	Detected
Branch^2.16.84 10039	av-319	Conclusion PCR result	А	419984006	inconclusive
0600 ORU^R0 10041	av-319	Conclusion PCR result	А	260415000	Not Detected
PID 1 PID1325 10045	av-319	Conclusion PCR result	А	125154007	Specimen unsatisfactory for evaluation
R^72016^USA					
ORC RE 19057 10970	av-318	Target PCR result	А	26037300 <u>1</u>	Detected
176 [^] STARLIN 10973		Target PCR result	Α	260415000	Not Detected
		2.2			

Trancas^^Little Rock^AR^72205

OBR|1|1905700000276-12^PHLIP-Test-EHR^2.16.840.1.113883.3.72.5.24^ISO|1905700000276-

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||1905700000276^^^STARLIMS.AR.STAG&2.16.840.1.114222.4.3.3.2.5.2&ISO||||||F|||20191203 100718-0600

ORC|RE|1905700000276-13^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

Trancas^^Little Rock^AR^72205

OBR|2|1905700000276-13^PHLIP-Test-EHR^2.16.840.1.113883.3.72.5.24\[^\text{ISO}\]1905700000276-

177^STARLIMS.AR.STAG^2.16.840.1.114222.4.3.3.2.5.2^ISO|94306-8^\$ARS-CoV-2 RNA Pnl XXX

NAA+probe^LN|||20191125201900-

0600|||||||20191126|ORH&Other&HL70070&&Nasopharyngeal|1412941681^Smith^John^C^^DR^^^NPI&2.16.840.1.1

13883.4.6&ISO^L|^^PH^^^952^4863332|||||20191203081920-0600|||F

OBX|1|CE|94307-6^SARS-CoV-2 N gene XXX Ql NAA N1^LN||2260415000^Not

detected^SCT||||||F|||20191203081920-0600

Source: https://www.aphl.org/programs/preparedness/Crisis-
Management/Deguments/2019p.Co.V. PHJ IPsemple 2.5.1. Not Details

Sample HL7 Message with "Inconclusive" Test Results

5/23/202	0		:	2019-nCoV_Encoding Guidelines_FINAL_r1.xlsx			
sort	vsID	vsName		tus Code	ConceptName		
10037	av-319	Conclusion PCR result	А	260373001	Detected		
10039	av-319	Conclusion PCR result	Α	419984006	inconclusive		
10041	av-319	Conclusion PCR result	Α /	260415000	Not Detected		
10045	av-319	Conclusion PCR result	A	125154007	Specimen unsatisfactory for evaluation		

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&2.16.84

0.1.113883.4.6&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|||201902281257-

OBX|1|CWE|94309-2^2019-nCoV RNA XXX NAA+probe-

Imp^LN||419984006^Inconclusive^SCT|||||F|||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

Source: https://www.aphl.org/programs/preparedness/Crisis-

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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 https://www.who.int/publications-detail/global-covid-19-clinical-platform-novel-coronavius-(-covid-19)-rapid-version
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