

NHSNLink: A CDC Application for COVID Medication Data

Dr. Dan Pollock, Surveillance Branch Chief, CDC
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PARTNER



Who are We?

- Dr. Dan Pollock
- Surveillance Branch Chief,
Division of Healthcare Quality Promotion, CDC
- Rick Geimer
- Chief Innovation Officer,
Lantana Consulting Group
- HL7 FHIR Infrastructure, Co-chair



NHSN is an Extensible Surveillance Platform that Serves as a Resource for Healthcare Event Reporting, Quality Measurement, and Other Functions

Nation's most widely used healthcare-associated infection tracking system

- Central-line associated bloodstream infections
- Catheter-associated urinary tract infections
- Surgical site infections
- Ventilator-associated events
- Hospital-onset C. difficile
- Hospital-onset MRSA
- Antibiotic Use - 2,078 facilities
- Antibiotic Resistance - 872 facilities
- Late-onset sepsis and meningitis in very low birthweight babies

Settings

- Acute care facilities
- Long term care facilities
- Dialysis
- Outpatient procedural settings

Numbers

- Enrolled facilities: 37,400
- Distinct email addresses for active users: 113,281
- Patients: 36,297,408
- Data Imports: 73,996,149

Principles for an NHSN Reference Implementation

- Open standards, open source
- All can play, no single solution required
- Encourage a rise to the top – raise the bar
- Purpose
 - Lower the burden of public health reporting
 - Deploy rapidly
- Method
 - Open APIs (HL7 FHIR™)
 - Standard data (US Core Data for Interoperability/USCDI)
 - Human review where necessary
 - Create an NHSN Reference Implementation

Inpatient Medication Administration: What

Goal: Create a vendor-neutral, interoperable standard for fully electronic patient-level queries of medication data among U.S. inpatient populations and implement it using an open-source application

Inpatient Medication Administration: Why

COVID-19 pandemic highlighted the need for efficient, scalable reporting of medication exposure data during public health emergencies

- Data from single-source, proprietary vendors: time and cost-intensive, may not be sufficiently representative
- Data based on manual surveillance: time and labor-intensive, may not be sufficiently representative or accurate (e.g., ~50% medication data fields missing as part of COVID-NET data collection)

Inpatient Medication Administration: How

- **FHIR query of active inpatient** encounters for a reporting period
- Human review of results for **data cleaning, normalization**
- Storage of results in a **secure data repository**

Inpatient Medication Administration: Where

- Public health surveillance— Expands upon CDC’s experience with similar data for outpatient settings →
- Hospital quality and benchmarking efforts— Expands upon CDC’s experience with similar data for inpatient antibiotic use

New Online Views 2,131 | Citations 0 | Altmetric 188 | Comments

Research Letter ONLINE FIRST

July 6, 2020

US Hydroxychloroquine, Chloroquine, and Azithromycin Outpatient Prescription Trends, October 2019 Through March 2020

Nadine Shehab, PharmD, MPH^{1,2}; Maribeth Lovegrove, MPH¹; Daniel S. Budnitz, MD, MPH¹

» Author Affiliations

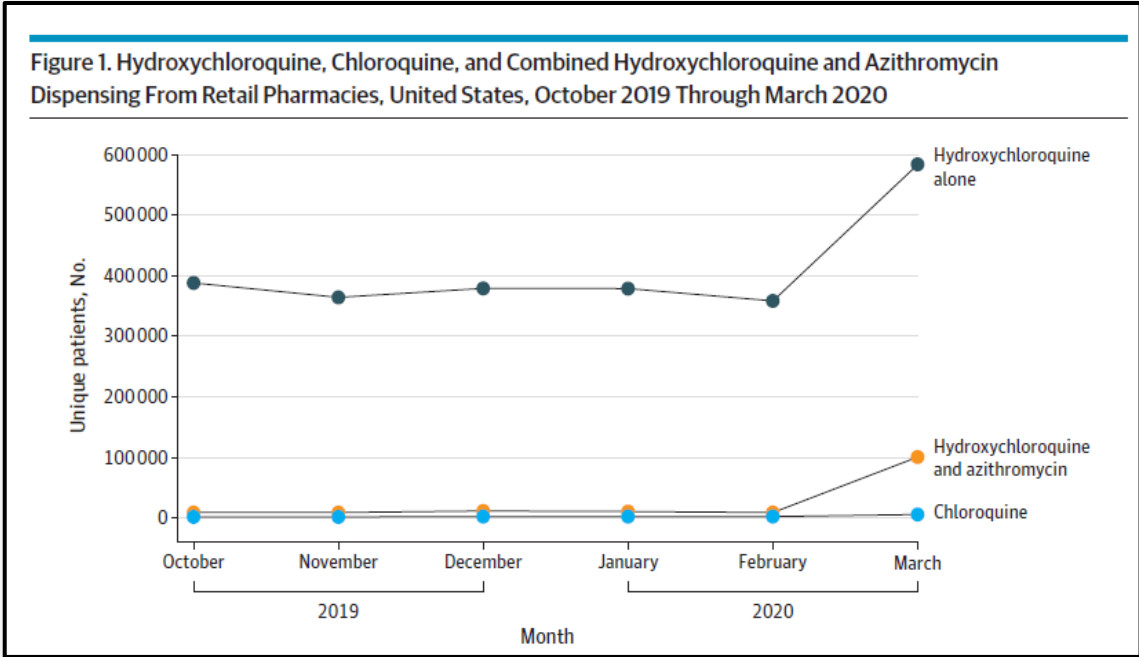
JAMA Intern Med. Published online July 6, 2020. doi:10.1001/jamainternmed.2020.2594

EDITOR'S CHOICE

The Standardized Antimicrobial Administration Ratio: A New Metric for Measuring and Comparing Antibiotic Use FREE

Katharina L van Santen ✉, Jonathan R Edwards, Amy K Webb, Lori A Pollack, Erin O’Leary, Melinda M Neuhauser, Arjun Srinivasan, Daniel A Pollock

Clinical Infectious Diseases, Volume 67, Issue 2, 15 July 2018, Pages 179–185, <https://doi.org/10.1093/cid/ciy075>



Inpatient Medication Administration: Where

- Public health emergencies
 - Dashboards
 - Trends
 - Targets for safety monitoring
 - Uptake of new (or controversial) treatments

FDA NEWS RELEASE

Coronavirus (COVID-19) Update: FDA Revokes Emergency Use Authorization for Chloroquine and Hydroxychloroquine

CNN NEWS CORONAVIRUS GOVERNMENT RESPONSE

Controversial coronavirus drug hydroxychloroquine administered at 2 nursing homes, senators say

Democratic senators want to know what's been done to stop unproven treatment.

FDA NEWS RELEASE

COVID-19 Update: FDA Broadens Emergency Use Authorization for Veklury (remdesivir) to Include All Hospitalized Patients for Treatment of COVID-19

CNN health

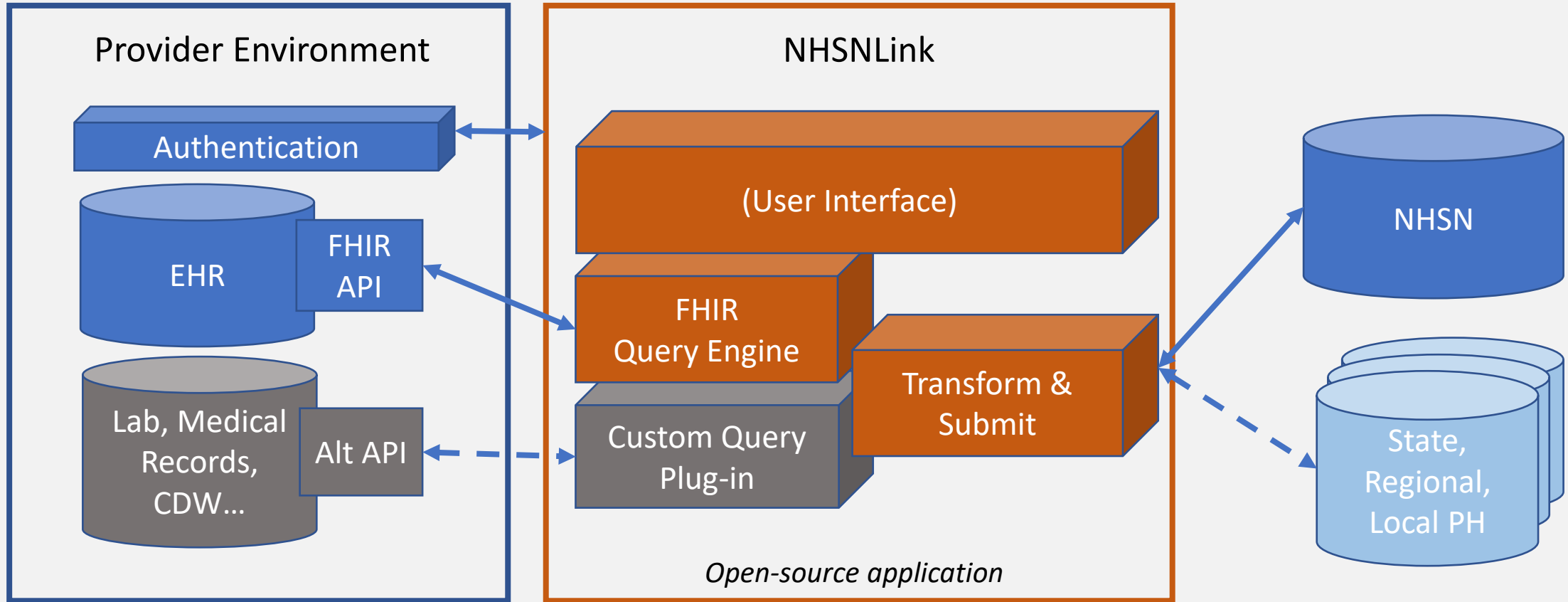
Hospitals in Covid-19 hotspots are running out of remdesivir

Inpatient Medication Administration: Data Elements and FHIR Resources

Data Element	FHIR Resource
Admission date	Encounter
Discharge date	Encounter
Laboratory-confirmed COVID	Observation or Condition
Suspected COVID	Condition
Patient sex	Patient
Patient age	Patient
Patient race	Patient
Patient ethnicity	Patient
Patient location	Location
Medication	MedicationRequest*
Medication dosage form	MedicationRequest
Medication route of administration	MedicationRequest
Medication dose	MedicationRequest
Medication start date	MedicationRequest
Medication stop date	MedicationRequest
Primary diagnosis	Encounter -> Condition
Chief complaint	Encounter -> Condition
Other diagnosis	Encounter -> Condition
Discharge disposition	Encounter
SARS-CoV-2 Lab Tests	Observation

*Includes "MedicationAdministration" resource in anticipation of inclusion in US Core requirements in near future (currently at USCDI Level 2)

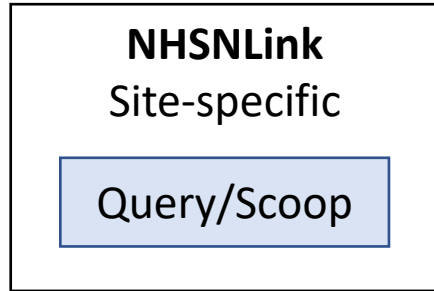
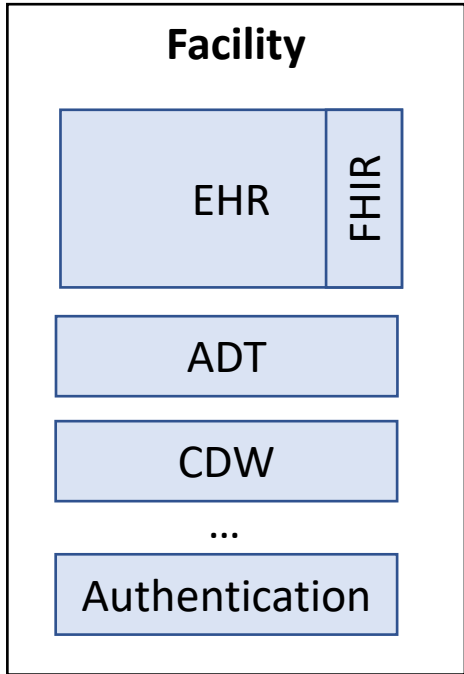
[Draft] Functional Diagram



Facility

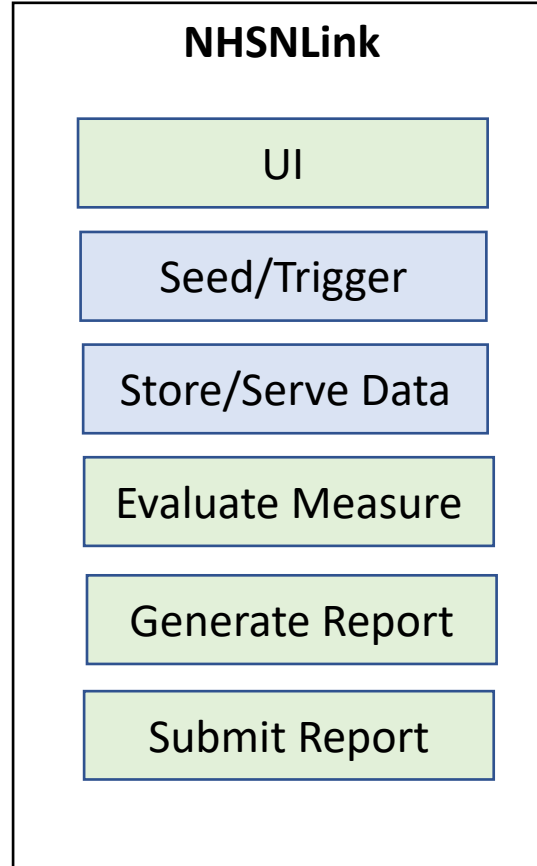
On-Prem

Cloud or On-Prem



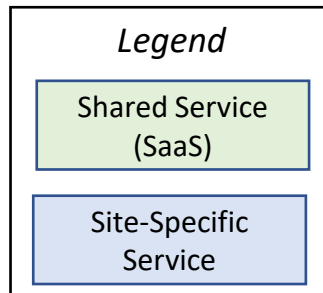
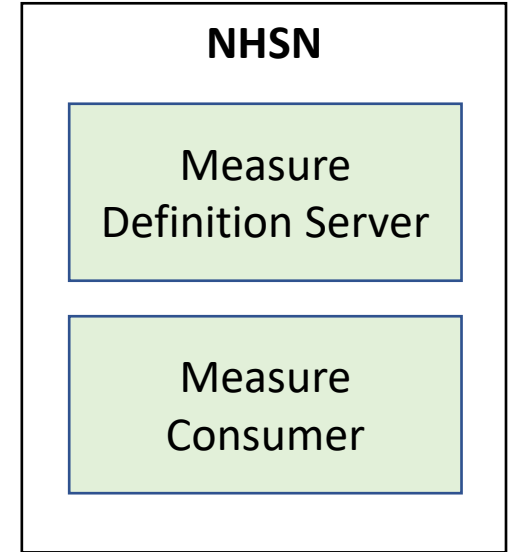
Cloud

Lantana's Azure (Pilot)
CDC Cloud (Prod)



NHSN

Leidos (Pilot)
CDC Cloud (Prod)



Inpatient Medication Administration: Sample Query Output

Patient Demographics

	A	D	E	F	G	H	I	J
1	DateCollected	Patient_ID	Admit_Date	Discharge_Date	Patient_age	Patient_sex	Patient_race	Patient_ethnicity
2	6/26/2020	http://hospital.goodhealth.org 07091990	5/3/2020	5/12/2020	120	male	null	null
3	6/26/2020	http://hospital.smarthealthit.org 1032702	3/2/2020	3/14/2020	69	female	urn:oid:2.16.840.1.113883.6.238 2106-3	urn:oid:2.16.840.1.113883.6.238 2135-2

Clinical Data

	A	D	K	L	M	N
1	DateCollected	Patient_ID	Chief_complaint	Primary_dx	Patient_location	Disposition
2	6/26/2020	http://hospital.goodhealth.org 07091990	null null	http://snomed.info/sct 840539006	null	null null
3	6/26/2020	http://hospital.smarthealthit.org 1032702	null null	http://snomed.info/sct 840539006	null	http://terminology.hl7.org/CodeSystem/discharge-disposition home

Diagnoses – SNOMED

	A	B
1	Patient_ID	Other_dx
2	http://hospital.goodhealth.org 07091990	http://snomed.info/sct 840539006
3	http://hospital.smarthealthit.org 1032702	http://snomed.info/sct 38341003
4	http://hospital.smarthealthit.org 1032702	http://snomed.info/sct 73211009
5	http://hospital.smarthealthit.org 1032702	http://snomed.info/sct 195951007
6	http://hospital.smarthealthit.org 1032702	http://snomed.info/sct 840539006
7	http://hospital.smarthealthit.org 1032702	http://snomed.info/sct 62315008

Labs – LOINC

	A	B	C	D
	Patient_ID	SARSCOV_Lab_Order	SARSCOV_Lab_DateTime	SARSCOV_Lab_Result
	http://hospital.smarthealthit.org 1032702	http://loinc.org 20862-9	3/12/2020	null
	http://hospital.smarthealthit.org 1032702	http://loinc.org 94763-0	3/12/2020	null
	http://hospital.smarthealthit.org 1032702	http://loinc.org 94763-0	3/2/2020	http://snomed.info/sct 707785005

Medications – RxNorm and “Free Text”

	A	B	C	D	E	F	G
1	Patient_ID	Medication_Name	Medication_Code	Medication_Dose	Medication_Route	Medication_Start	Medication_Stop
2	http://hospital.smarthealthit.org 1032702	20 ML tocilizumab 20 MG/ML Injection [Actemra]	http://www.nlm.nih.gov/research/umls/rxnorm 1657982	400 MG	null	null	null
3	http://hospital.smarthealthit.org 1032702	potassium 80 MG	http://www.nlm.nih.gov/research/umls/rxnorm 259128	80 MG	http://snomed.info/sct 47625008	null	null
5	http://hospital.smarthealthit.org 1032702	hydroxychloroquine sulfate 400 MG Oral Tablet	http://www.nlm.nih.gov/research/umls/rxnorm 979092	400 MG	null	null	null
6	http://hospital.smarthealthit.org 1032702	ceftriaxone 2 G Injectable Solution	http://www.nlm.nih.gov/research/umls/rxnorm 309090	2000 MG	http://snomed.info/sct 47625008	null	null
7	http://hospital.smarthealthit.org 1032702	12 HR albuterol 4 MG Extended Release Oral Tablet	http://www.nlm.nih.gov/research/umls/rxnorm 359144	4 MG	http://snomed.info/sct 26643006	null	null
8	http://hospital.smarthealthit.org 1032702	amlodipine 10 MG / atorvastatin 10 MG Oral Tablet	http://www.nlm.nih.gov/research/umls/rxnorm 597987	10 MG	http://snomed.info/sct 26643006	null	null
9	http://hospital.smarthealthit.org 1032702	Insulin	http://www.nlm.nih.gov/research/umls/rxnorm 977842	30 MG	http://snomed.info/sct 26643006	null	null
10	http://hospital.smarthealthit.org 1032702	Metformin	http://www.nlm.nih.gov/research/umls/rxnorm 1810997	150 MG	http://snomed.info/sct 26643006	2020-06-05T15:14:00.000-05:00	2020-06-05T16:15:45.000-05:00

Inpatient Medication Administration: Sample Query Output

```
1 <Bundle xmlns="http://hl7.org/fhir">
2   <type value="collection" />
3   <entry>
4     <resource>
5       <MeasureReport xmlns="http://hl7.org/fhir">
6         <contained [19 lines]
26       <measure value="Measure/NHSNMedicationAdministration" />
27     </MeasureReport>
28   </resource>
29 </entry>
30 <entry>
31   <resource>
32     <Observation xmlns="http://hl7.org/fhir">
33       <id value="observation-lab-sars-cov-med-admin" />
34       <status value="final" />
35       <category>
36         <coding>
37           <system value="http://terminology.hl7.org/CodeSystem/observation-category" />
38           <code value="laboratory" />
39           <display value="Laboratory" />
40         </coding>
41       </category>
42       <code>
43         <coding>
44           <system value="http://loinc.org" />
45           <code value="94564-2" />
46           <display value="SARS-CoV-2 (COVID-19) IgM Ab [Presence] in Serum or Plasma by Immunoassay" />
47         </coding>
48       </code>
49       <subject [3 lines]
53       <effectiveDateTime value="2021-01-02" />
54     </Observation>
55   </resource>
56 </entry>
201 <entry>
202   <resource>
203     <Patient xmlns="http://hl7.org/fhir">
204       <id value="patient-med-admin-1" />
205       <text [19 lines]
225     <extension url="http://hl7.org/fhir/us/core/StructureDefinition/us-core-race" [11 lines]
237     <extension url="http://hl7.org/fhir/us/core/StructureDefinition/us-core-ethnicity" [11 lines]
249     <extension url="http://hl7.org/fhir/us/core/StructureDefinition/us-core-birthsex" [2 lines]
252     <identifier [7 lines]
260     <active value="true" />
261     <name>
262     <extension url="http://hl7.org/fhir/StructureDefinition/data-absent-reason"
263       <valueCode value="masked" />
264     </extension>
265     </name>
266     <gender value="female" />
267     <birthDate value="1974-11-24" />
268   </Patient>
269 </resource>
270 </entry>
271 </Bundle>
Patient Demographics

57 <entry>
58   <resource>
59     <MedicationRequest xmlns="http://hl7.org/fhir">
60       <id value="medicationrequest-med-admin-1" />
61       <status value="completed" />
62       <intent value="order" />
63       <medicationCodeableConcept>
64         <coding>
65           <system value="http://www.nlm.nih.gov/research/umls/rxnorm" />
66           <code value="617311" />
67           <display value="atorvastatin calcium 40 MG Oral Tablet" />
68         </coding>
69       </medicationCodeableConcept>
70       <subject [3 lines]
74     <encounter [3 lines]
78     <authoredOn value="2021-01-03" />
79     <requester [3 lines]
83     <dosageInstruction>
84       <route>
85         <coding>
86           <system value="http://snomed.info/sct" />
87           <code value="26643006" />
88           <display value="Oral route (qualifier value)" />
89         </coding>
90       </route>
91       <doseAndRate>
92         <doseQuantity>
93           <value value="40" />
94           <unit value="MG" />
95         </doseQuantity>
96       </doseAndRate>
97     </dosageInstruction>
98   </MedicationRequest>
99 </resource>
100 </entry>
Medications - RxNorm

158 <entry>
159   <resource>
160     <Condition xmlns="http://hl7.org/fhir">
161       <id value="condition-lab-confirmed-covid-med-admin-1" />
162       <clinicalStatus>
163         <coding>
164           <system value="http://terminology.hl7.org/CodeSystem/condition-clinical" />
165           <code value="active" />
166         </coding>
167       </clinicalStatus>
168       <verificationStatus>
169         <coding>
170           <system value="http://terminology.hl7.org/CodeSystem/condition-ver-status" />
171           <code value="confirmed" />
172         </coding>
173       </verificationStatus>
174       <category>
175         <coding>
176           <system value="http://terminology.hl7.org/CodeSystem/condition-category" />
177           <code value="encounter-diagnosis" />
178           <display value="Encounter Diagnosis" />
179         </coding>
180       </category>
181       <code>
182         <coding>
183           <system value="http://snomed.info/sct" />
184           <code value="840539006" />
185           <display value="Disease caused by Severe acute respiratory syndrome coronavirus 2 (disorder)" />
186         </coding>
187       </code>
188     </Condition>
189     <subject [3 lines]
193     <encounter>
194       <reference value="Encounter/encounter-completed-inpatient-med-admin-1" />
195     </encounter>
196     <onsetDateTime value="2021-08-02T10:30:35-06:00" />
197     <recordedDate value="2021-08-02T10:30:35-06:00" />
198   </Condition>
199 </resource>
200 </entry>
Diagnosis - SNOMED
```

Inpatient Medication Administration: Sample Query Output

Patient Demographics

	A	D	E	F	G	H	I	J
1	DateCollected	Patient_ID	Admit_Date	Discharge_Date	Patient_age	Patient_sex	Patient_race	Patient_ethnicity
2	6/26/2020	http://hospital.goodhealth.org 07091990	5/3/2020	5/12/2020	120	male	null	null
3	6/26/2020	http://hospital.smarthealthit.org 1032702	3/2/2020	3/14/2020	69	female	urn:oid:2.16.840.1.113883.6.238 2106-3	urn:oid:2.16.840.1.113883.6.238 2135-2

Clinical Data

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Diagnoses – SNOMED

	A	B
1	Patient_ID	Other_dx
2	http://hospital.goodhealth.org 07091990	http://snomed.info/sct 840539006
3	http://hospital.smarthealthit.org 1032702	http://snomed.info/sct 38341003
4	http://hospital.smarthealthit.org 1032702	http://snomed.info/sct 73211009
5	http://hospital.smarthealthit.org 1032702	http://snomed.info/sct 195951007
6	http://hospital.smarthealthit.org 1032702	http://snomed.info/sct 840539006
7	http://hospital.smarthealthit.org 1032702	http://snomed.info/sct 62315008

Labs – LOINC

	A	B	C	D
	Patient_ID	SARSCOV_Lab_Order	SARSCOV_Lab_DateTime	SARSCOV_Lab_Result
	http://hospital.smarthealthit.org 1032702	http://loinc.org 20862-9	3/12/2020	null
	http://hospital.smarthealthit.org 1032702	http://loinc.org 94763-0	3/12/2020	null
	http://hospital.smarthealthit.org 1032702	http://loinc.org 94763-0	3/2/2020	http://snomed.info/sct 707785005

Medications – RxNorm and “Free Text”

	A	B	C	D	E	F	G
1	Patient_ID	Medication_Name	Medication_Code	Medication_Dose	Medication_Route	Medication_Start	Medication_Stop
2	http://hospital.smarthealthit.org 1032702	20 ML tocilizumab 20 MG/ML Injection [Actemra]	http://www.nlm.nih.gov/research/umls/rxnorm 1657982	400 MG	null	null	null
3	http://hospital.smarthealthit.org 1032702	potassium 80 MG	http://www.nlm.nih.gov/research/umls/rxnorm 259128	80 MG	http://snomed.info/sct 47625008	null	null
5	http://hospital.smarthealthit.org 1032702	hydroxychloroquine sulfate 400 MG Oral Tablet	http://www.nlm.nih.gov/research/umls/rxnorm 979092	400 MG	null	null	null
6	http://hospital.smarthealthit.org 1032702	ceftriaxone 2 G Injectable Solution	http://www.nlm.nih.gov/research/umls/rxnorm 309090	2000 MG	http://snomed.info/sct 47625008	null	null
7	http://hospital.smarthealthit.org 1032702	12 HR albuterol 4 MG Extended Release Oral Tablet	http://www.nlm.nih.gov/research/umls/rxnorm 359144	4 MG	http://snomed.info/sct 26643006	null	null
8	http://hospital.smarthealthit.org 1032702	amlodipine 10 MG / atorvastatin 10 MG Oral Tablet	http://www.nlm.nih.gov/research/umls/rxnorm 597987	10 MG	http://snomed.info/sct 26643006	null	null
9	http://hospital.smarthealthit.org 1032702	Insulin	http://www.nlm.nih.gov/research/umls/rxnorm 977842	30 MG	http://snomed.info/sct 26643006	null	null
10	http://hospital.smarthealthit.org 1032702	Metformin	http://www.nlm.nih.gov/research/umls/rxnorm 1810997	150 MG	http://snomed.info/sct 26643006	2020-06-05T15:14:00.000-05:00	2020-06-05T16:15:45.000-05:00

Inpatient Medication Administration: Sample Query Output

Data Elements Intended for Collection:

- Admission date
- Discharge date
- Patient sex
- Patient age
- Patient race
- Patient ethnicity
- Patient location*
- Primary diagnosis
- Chief complaint*
- Other diagnoses
- Medication name
- Medication code
- Medication dosage form
- Medication dose
- Medication start date*
- Medication stop date*
- Discharge disposition
- Adverse event
- SARS-CoV-2 Laboratory Tests (for COVID-19 pilot phase, future phases may expand to other laboratory tests)

Sample Query Output:**

Date_Collected	6/16/2020	Medication_Code	979092
Facility_ID	xxxxxxxx	Medication_Name	hydroxychloroquine sulfate 400 MG Oral Tablet
Patient_ID	1032702	Medication_Code	1657982
Admit_date	3/2/2020	Medication_Name	20 ML tocilizumab 20 MG/ML Injection [Actemra]
Discharge_date	3/14/2020	Medication_Code	977842
Patient_age	69	Medication_Name	Insulin
Patient_sex	female	Medication_Code	309090
Patient_race	2106-3 (white)	Medication_Name	ceftriaxone 2 G Injectable Solution
Patient_ethnicity	2135-2 (hispanic)	Medication_Code	359144
Primary_dx	840539006 (disease caused by 2019 novel coronavirus disorder)	Medication_Name	12 HR albuterol 4 MG Extended Release Oral Tablet
Other_dx	38341003 (hypertension) 7321109 (diabetes mellitus) 195951007 (COPD exacerbation)	SARSCOV_Lab_Order	94763-0 (SARS-CoV-2 (COVID-19) [Presence] in Unspecified specimen by Organism specific culture)
Disposition	discharged home	SARSCOV_Lab_DateTime	3/2/2020
		SARSCOV_Lab_Result	707785005

*Some results have been returned within the EHR sandbox environment for these data elements, but further confirmation in real-world EHR environment is planned.

**Data are based on FHIR query within EHR sandbox environment as of June 16, 2020. For simplicity, only selected values (e.g., selected other diagnoses, medications, laboratory tests) that were returned are shown here.

Contact

- During DevDays, you can find / reach me here:
 - Via Whova App – Speaker’s Gallery
 - Email: dpollock@cdc.gov; Rick.Geimer@lantanagroup.com

Q&A

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