

Introduction to AIR·MS

Health Data Literacy

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Hasso Plattner Institute for Digital Health at Mount Sinai

The Patient Journey & Epic



Epic

Admission

Orders

Document

Discharge

Pop. Health

EMERGENCY MEDICINE EVALUATION NOTE

History of Present Illness

Chief Complaint: @EDCC@

HPI: @NAME@ is a @AGE@ @SEX@

ROS: A complete 11 system ROS was performed (constitutional, eyes, ENMT, cardiovascular, respiratory, gastrointestinal, genitourinary, musculoskeletal, skin, neurological, psychiatric) and was negative aside from the pertinent positives and negatives noted in the HPI.

Previous History

@PMH@
 @PHS@
 @SOCH@
 @FAMH@
 @GALLERY@
 @MEDCONDENSED@

Physical Exam

@VSHOSP@

Results

@EDLABS@
 @SERADIOLOGY@
 The laboratory results, imaging results and other diagnostic exam results were reviewed.

ED Course & Medical Decision Making

@EDMEDS@
 @EDCOURSE@

Procedures

@PROCDOC@

Diagnosis

@DxKca@

Disposition

@EDDISCHARGEX@

Orders

Manage Orders Order Sets

Place new orders or order sets

Verbal with readback

New Orders

- CBC
- STAT, First occurrence today at 1326
- Blood, Blood, Venous
- Basic metabolic panel
- STAT, First occurrence today at 1326
- Blood, Blood, Venous
- Troponin I
- STAT, First occurrence today at 1326
- Blood, Blood, Venous
- D-dimer, quantitative
- STAT, First occurrence today at 1326
- Blood, Blood, Venous
- ECG 12 lead
- Once, First occurrence today at 1326
- Reason for Exam: chest pain
- XR chest 2 views
- STAT, Once, First occurrence today at 1326
- Reason for Exam: Chest Pain

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Discharge

Review Home Medication 1. Review Orders for Discharge

View by: Discharge Outpatient and inpatient

Home Medications

- multivitamin tablet
- Take 1 tablet by mouth 2 (twice) a day.
- Not Taking At Home
- HYDROMORPHONE 20mg in NS 100mL @DIAUIDIO 0.2 mg/mL infusion
- 100 mcg/hr (0.5 mcg/hr), intravenous, at 0.5 mL/hr, Continuous, Starting Tue 2/8/19 at 1315
- Not Taking At Home
- Ibuprofen (ADVIL, MOTRIN) 200 mg tablet
- Take 1 tablet (200 mg total) by mouth every 6 (six) hours if needed for mild pain for up to 10 days.
- Fax, Disp 30 tablet, R-0
- Not Taking At Home
- lorazepam injection 1 mg
- 1 mg, intravenous, Every 4 Hours PRN, anxiety, Starting Fri 2/8/19 at 1135
- Not Taking At Home
- vancomycin 1 g in NaCl 0.9 % 100 mL IVB
- 1 g, intravenous, Administer over 60 Minutes, Every 12 hours scheduled, First dose on Tue 2/8/19 at 0900, Dialysis
- Not Taking At Home

Inpatient Medications

No Active Inpatient Medication

Discharge Instructions

Reconcile Meds for Discharge is complete

This patient has active treatment/therapy plans.

New Inpatient Orders

Discharge 1/7/19/2020

Order Discharge

After Visit Summary Preview

START Taking:

- Ibuprofen (ADVIL, MOTRIN) 200 mg tablet
- Take 1 tablet (200 mg total) by mouth every 6 (six) hours if needed for mild pain for up to 10 days.
- Fax, Disp 30 tablet, R-0

CONTINUE taking your other medications

- multivitamin tablet
- Take 1 tablet by mouth 2 (twice) times a day.
- Historical Med

Other Unsigned Actions

Do Not Order:

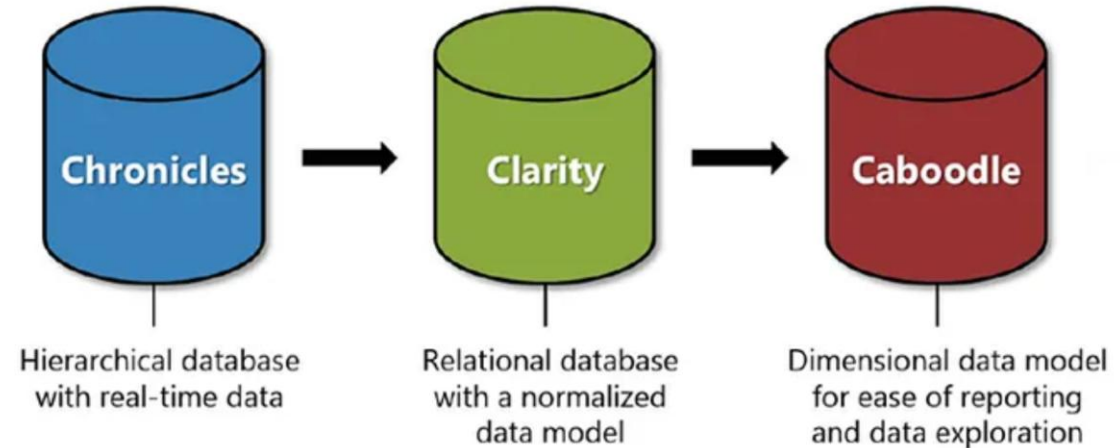
- HYDROMORPHONE 20mg in NS 100mL (DIAUIDIO) 0.2 mg/mL infusion
- 100 mcg/hr (0.5 mcg/hr), intravenous, at 0.5 mL/hr, Continuous, Starting Tue 2/8/19 at 1315.



- Margaret Smith is a 75 year old female who has arrived at the emergency room today with dyspnea (shortness of breath) and angina (chest pain)
- Patient has a previous history of pneumonia, anxiety

The Health Data Ecosystem

- Once we have all this data, it then goes into a series of databases in Epic
- Epic has multiple databases that store information
- SQL = structured query language – Clarity, Caboodle
- NOSQL = other types of databases (ex. hierarchical, graph)- Chronicles



<https://it.uclahealth.org/about/ohia/services/reports-dashboards/webi-dashboards>

AIR·MS & OMOP

Using the Data: Introduction to OMOP

- Data is stored in “OMOP” format
- OMOP = Observational Medical Outcomes Partnership
- After the initial work completed in 2013, the OMOP group then became the Observational Health Data Sciences and Informatics (OHDSI) group (pronounced “Odessey”)
- The common data model (CDM) for OHDSI is OMOP
- A significant project is the OMOP vocabulary
- In the US – OMOP leadership is located at Columbia U.
- Visit <https://ohdsi.org>
- Mount Sinai's OMOP data is maintained by Dr. Timothy Quinn (Chief Data Architect)



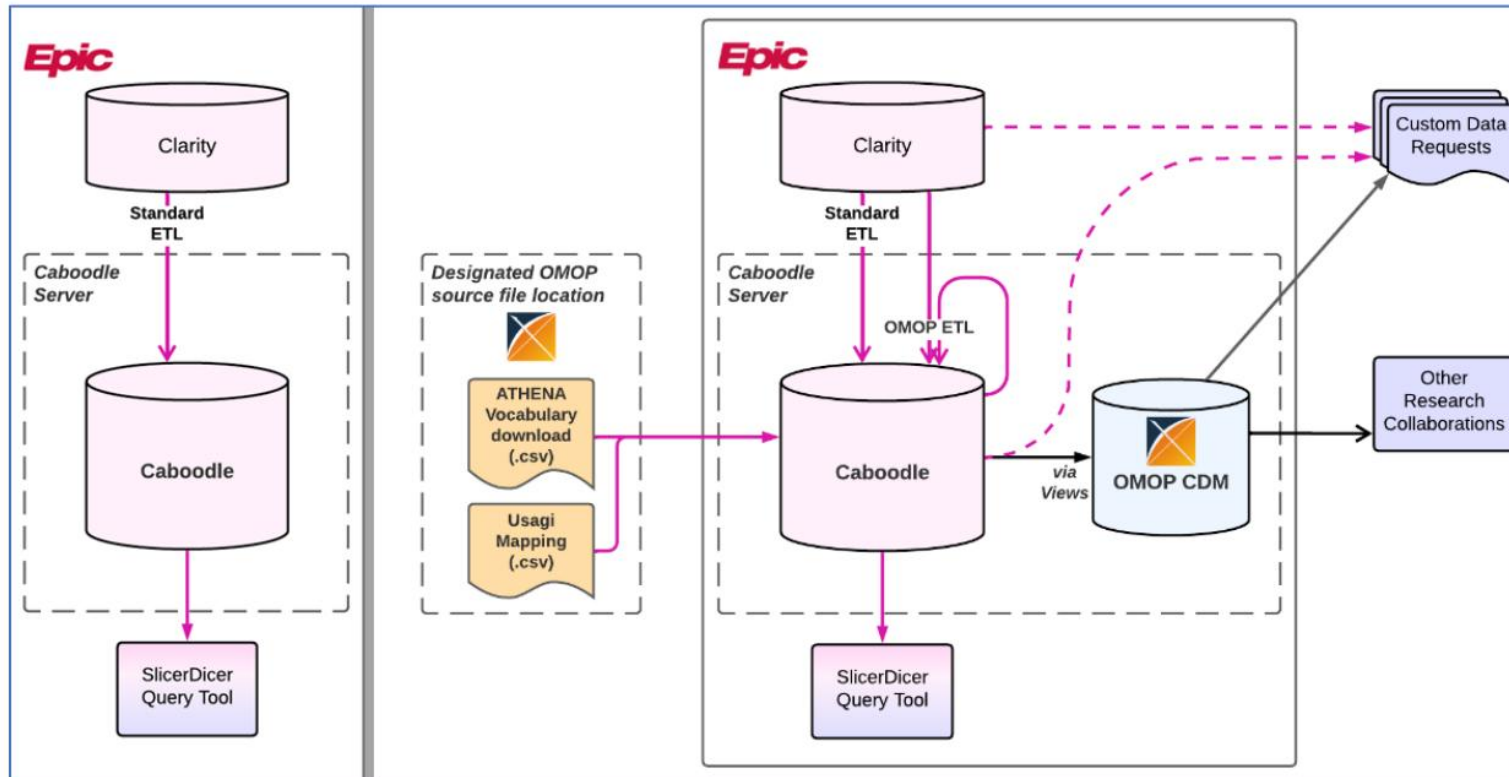
Using the Data: Who Uses OMOP?

- Several large collaborations use OMOP:



- Federal observational data research usually involves OMOP formatted data

Using the Data: How Does OMOP Work?

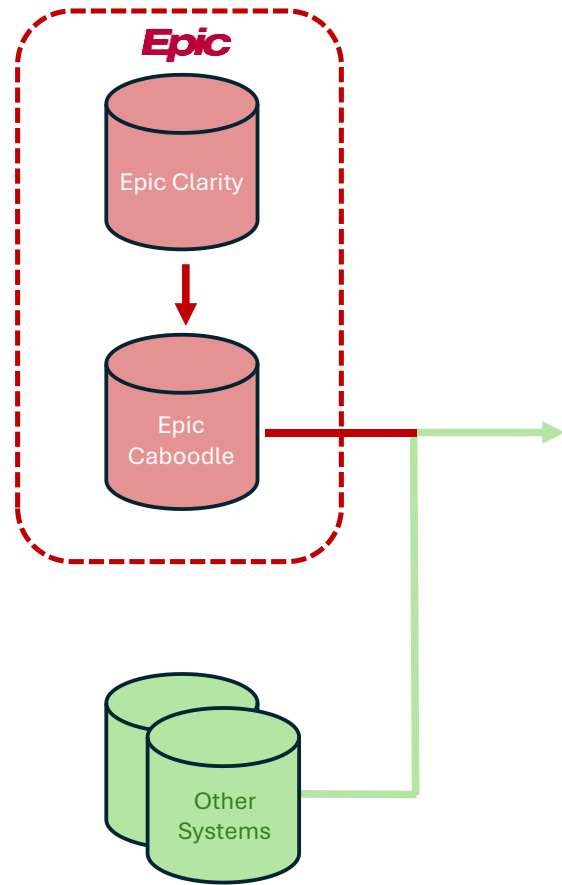


<https://www.ohdsi.org/wp-content/uploads/2023/10/10-Willett-BriefReport.pdf>

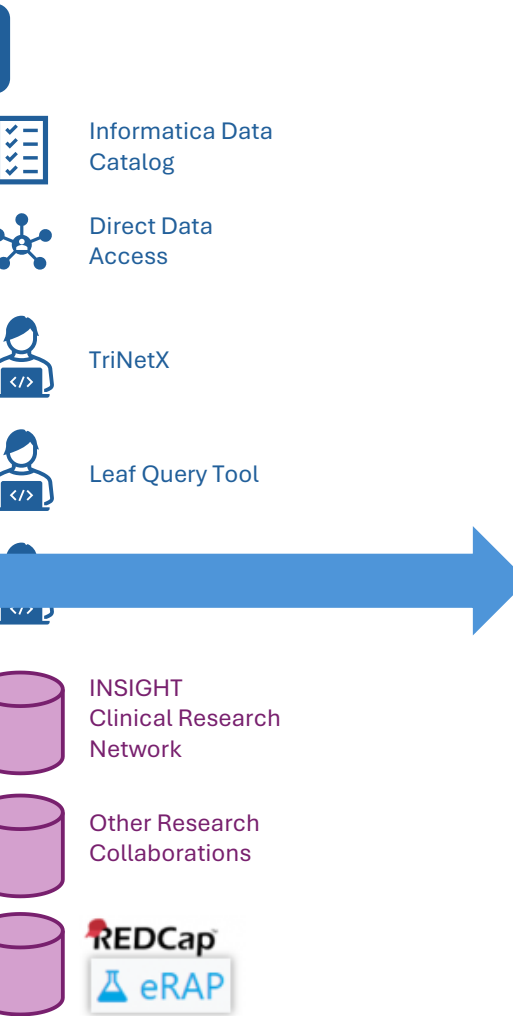
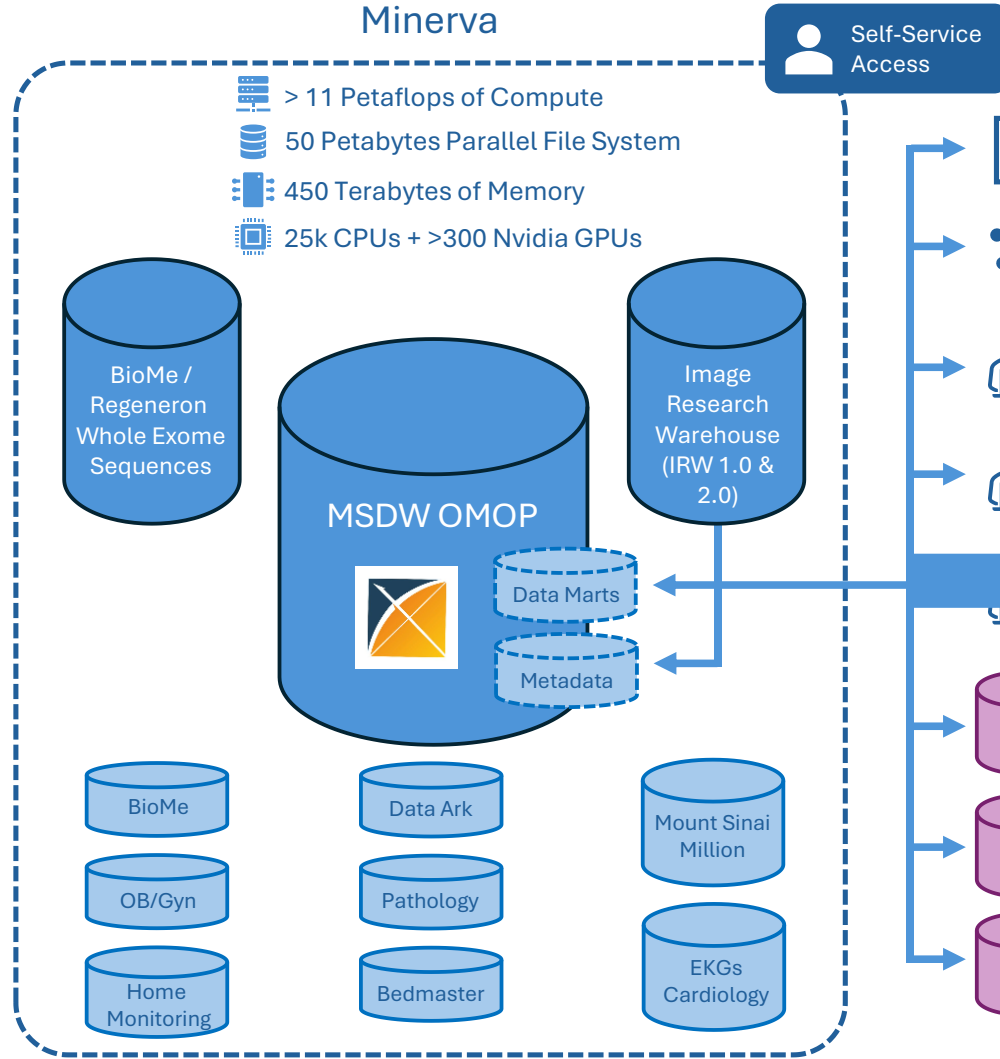
- Data is extracted from Caboodle into the OMOP Common Data Model (CDM)

Using the Data: How Does OMOP Work? (Cont'd)

Electronic Health Record (EHR)

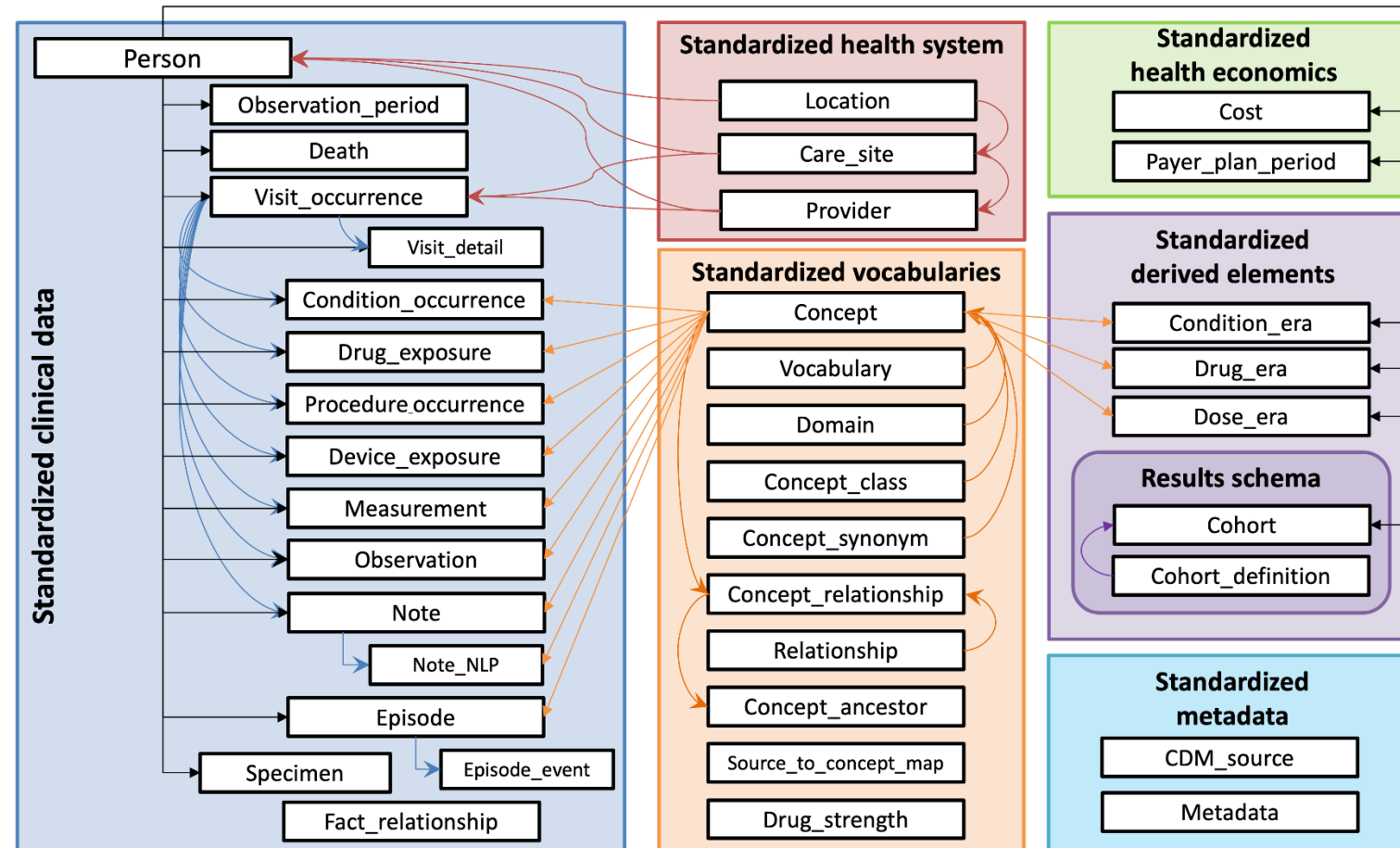


Minerva



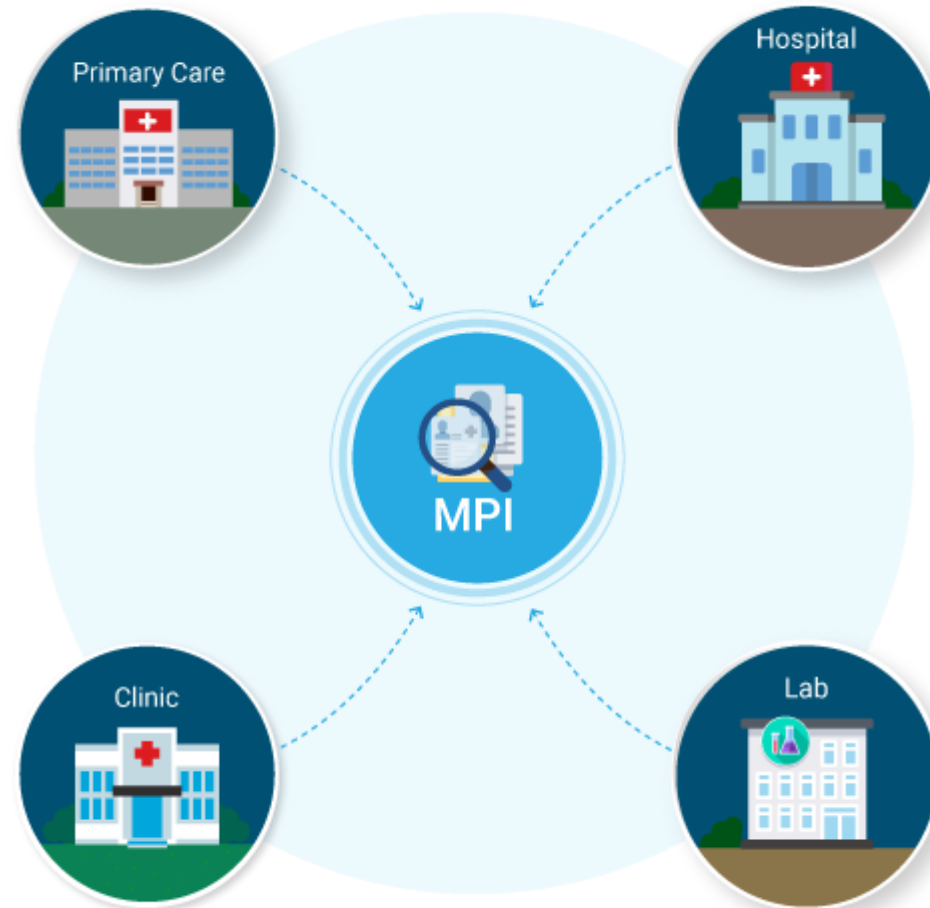
Using the Data: How Does OMOP Work? (Cont'd)

- The OMOP CDM consists of about 35 tables
- Very simplified compared to the ~20,000 tables in Clarity



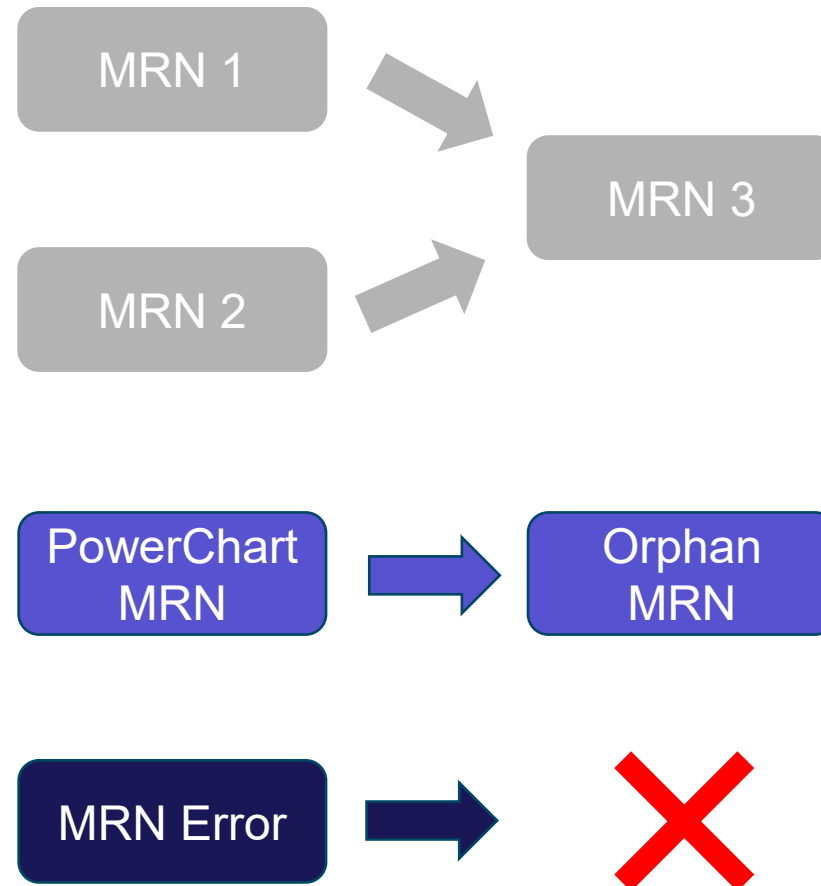
Medical Record Numbers (MRNs)

- Medical record numbers (MRNs) are the primary identifiers of patients
- They link information from across a health system
- Help with standardizing patient identifiers
- Identifiers can (1) merge, (2) be deleted, (3) be substituted/change
- These are tracked in the Master Patient Index (MPI)



Master Patient Index (MPI)

- In MSHS, several hospitals joined the system at different types, using different medical record systems (ex. PowerChart)
- Even though we have standardized over several years, there still may be old PowerChart MRNs in the system
- Additionally, some patient records have been merged across hospitals, so old identifiers may disappear



*Two MRNs
for same
patient from
separate
hospitals*

*Old EHR
System*

*Patient
Accidentally
Admitted*

Coding Systems & Concept Mapping



Mapping Overview

- We need to map information between Epic and AIRMS (OMOP)
- Epic stores medications, diagnoses, procedures, etc. In Epic ID codes, a proprietary commercial system they maintain
- These codes are then mapped to other coding systems like ICD-10, SNOMED, RxNorm, etc.
- Mount Sinai's OMOP has their own mapping tables (because we can't use the ones in Epic due to commercial license issues)
- Why can't we just map Epic codes to a standard set of OMOP codes in a big table? Due to codes being commercial properties, licensing, etc.



Exploring the OMOP Mapping



- OMOP uses several standard vocabularies for mapping
- This table describes the relationships between the EHR coding system (ex. Epic, PowerChart, etc) and the OMOP Standard Vocabulary

EHR Source	Source Coding System	OMOP Standard Vocabulary
Diagnoses	ICD-10-CM, Epic Codes	SNOMED CT
Procedures	CPT, HCPCS	SNOMED CT / CPT4
Drugs	ATC, NDC	RxNorm
Labs	LOINC	LOINC
Vitals	LOINC	LOINC / Extensions
Devices	HCPCS	SNOMED CT
...		

<https://athena.ohdsi.org/search-terms/start>

MSDW has an “Extended” OMOP CDM



Column Type	OMOP CDM	MSDW Extension Tables
Standard OMOP columns	242	<i>n/a</i>
De-identification columns that mask standard OMOP PHI columns	104	0
Extension columns from Caboodle	297	54
Data lineage & ETL audit columns	479	45
TOTAL:	1,122	99

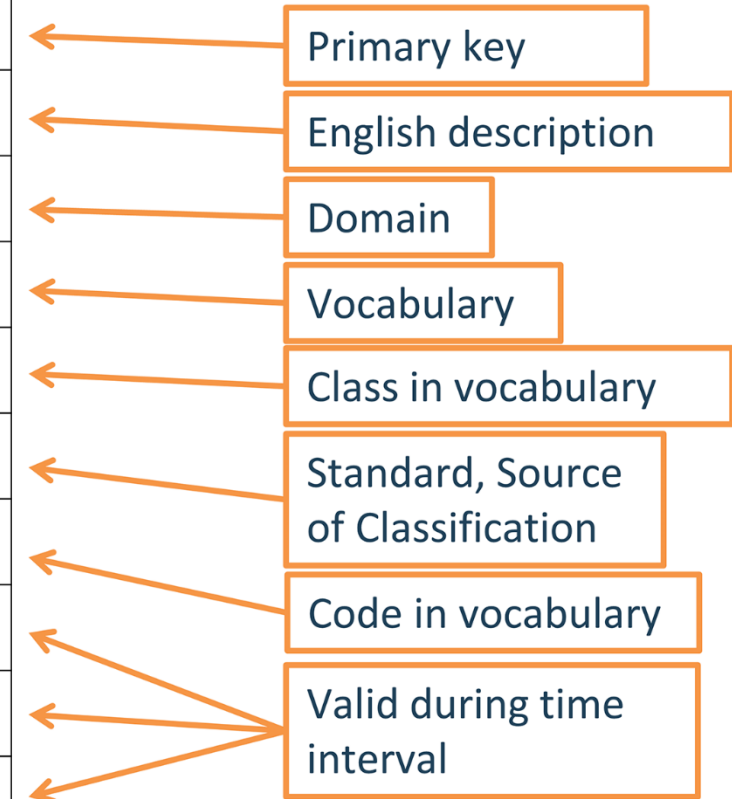
22 of 40 OMOP tables
(versions 5.3, 5.4, 6.0)

cdc_race_ethnicity_xtn
provider_attribute_xtn
date_xtn
time_xtn

Using the Data: Querying and Retrieving Data

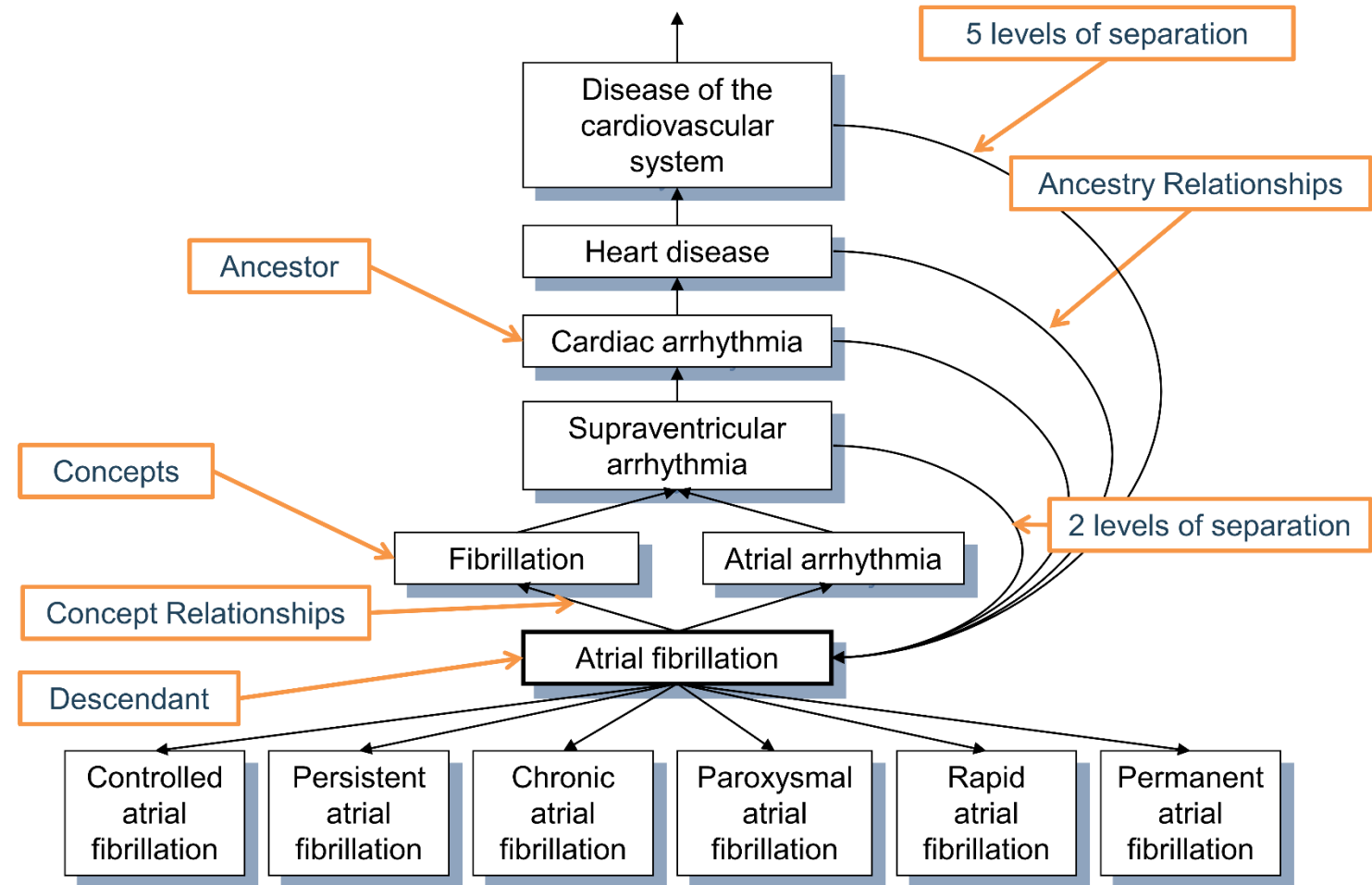
- Foundational to OMOP is a “Concept” (stored in the CONCEPT table)
- Concept domains: “Condition,” “Drug,” “Procedure,” “Visit,” “Device,” “Specimen,” etc.

CONCEPT_ID	313217
CONCEPT_NAME	Atrial fibrillation
DOMAIN_ID	Condition
VOCABULARY_ID	SNOMED
CONCEPT_CLASS_ID	Clinical Finding
STANDARD_CONCEPT	S
CONCEPT_CODE	49436004
VALID_START_DATE	01-Jan-1970
VALID_END_DATE	31-Dec-2099
INVALID_REASON	



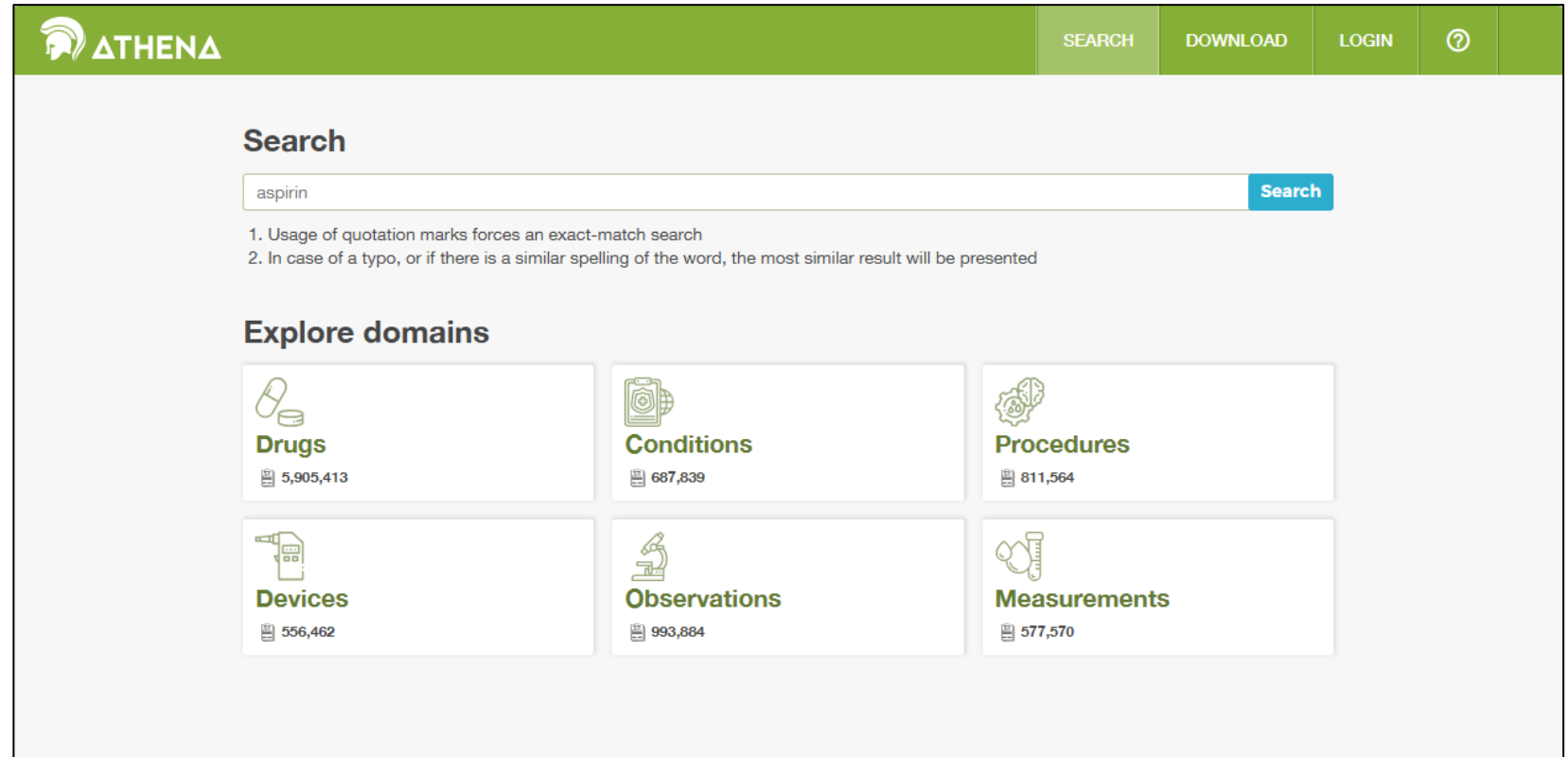
Using the Data: Querying and Retrieving Data (Cont'd)

- Different terminologies are mapped to the Systematized Nomenclature of Medicine (SNOMED), and there is an ontology which defines concept relationships



Exploring the OMOP Mapping

- There's a tool called Athena which contains concept mappings
- Contains standard mappings between several coding systems
- When you're building a list of codes to look for, you can start here to explore the concepts
- OMOP in Mount Sinai uses several of the Athena mappings

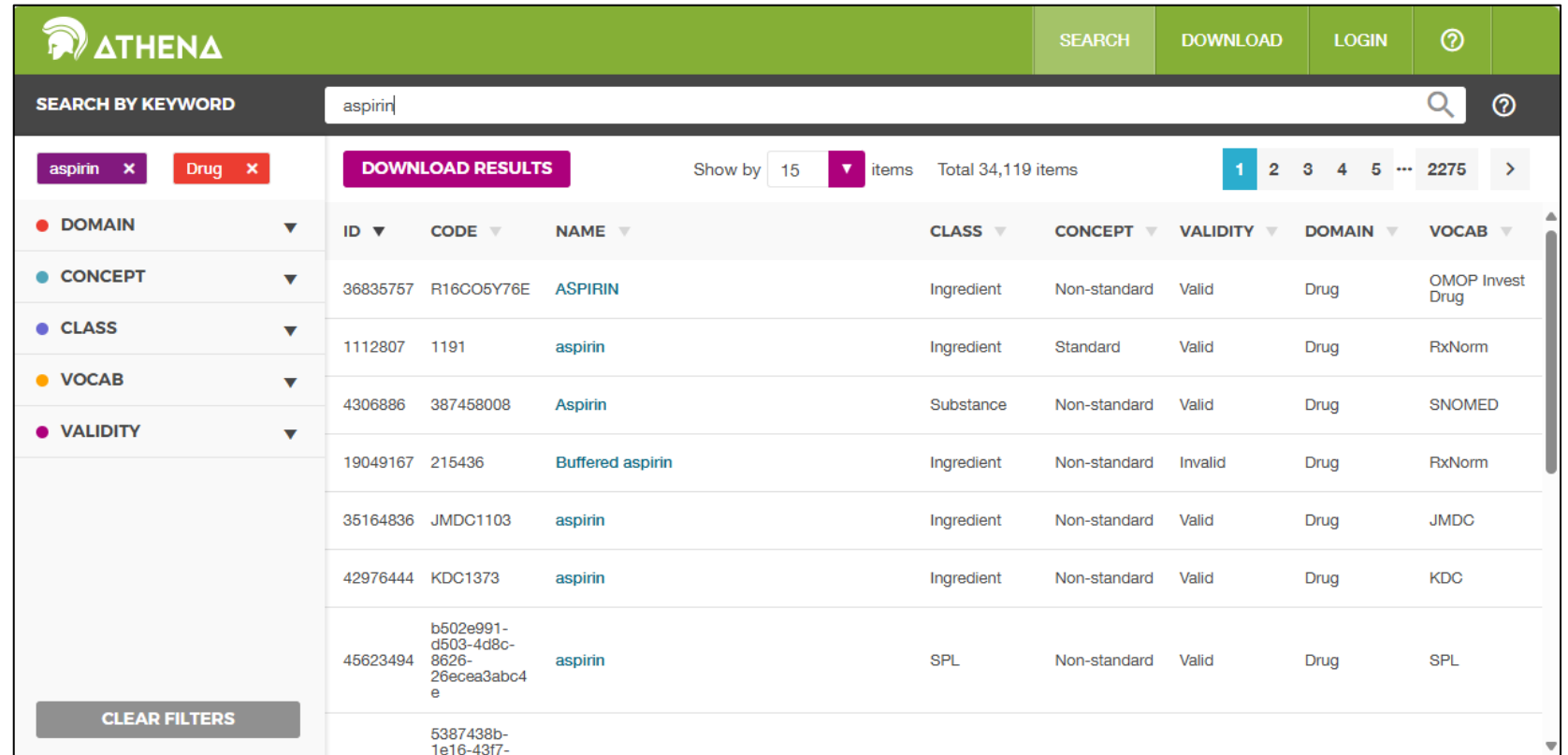


The screenshot shows the Athena web application interface. At the top is a green navigation bar with the Athena logo and the word 'ATHENA' on the left, and buttons for 'SEARCH', 'DOWNLOAD', 'LOGIN', and a help icon on the right. Below the navigation bar is a search section with a search box containing the text 'aspirin' and a blue 'Search' button. Underneath the search box are two numbered instructions: '1. Usage of quotation marks forces an exact-match search' and '2. In case of a typo, or if there is a similar spelling of the word, the most similar result will be presented'. Below the search section is an 'Explore domains' section with six cards, each representing a different domain with an icon, a title, and a count: 'Drugs' (5,905,413), 'Conditions' (687,839), 'Procedures' (811,564), 'Devices' (556,462), 'Observations' (993,884), and 'Measurements' (577,570).

<https://athena.ohdsi.org/search-terms/start>

Exploring the OMOP Mapping

- If we do a search for aspirin, you can see the concepts that correspond (there are 34,119 items)
- Will find different vocabularies that are mapped to concepts – you can build a list of identifiers to search for
- Athena does not contain a mapping between Epic ID codes and other coding systems – due to commercial / license issues with Epic



The screenshot shows the Athena search interface. The search bar contains 'aspirin' and the results are displayed in a table. The table has columns for ID, CODE, NAME, CLASS, CONCEPT, VALIDITY, DOMAIN, and VOCAB. The results show various mappings for aspirin across different vocabularies and domains.

ID	CODE	NAME	CLASS	CONCEPT	VALIDITY	DOMAIN	VOCAB
36835757	R16CO5Y76E	ASPIRIN	Ingredient	Non-standard	Valid	Drug	OMOP Invest Drug
1112807	1191	aspirin	Ingredient	Standard	Valid	Drug	RxNorm
4306886	387458008	Aspirin	Substance	Non-standard	Valid	Drug	SNOMED
19049167	215436	Buffered aspirin	Ingredient	Non-standard	Invalid	Drug	RxNorm
35164836	JMDC1103	aspirin	Ingredient	Non-standard	Valid	Drug	JMDC
42976444	KDC1373	aspirin	Ingredient	Non-standard	Valid	Drug	KDC
45623494	b502e991-d503-4d8c-8626-26ecea3abc4e	aspirin	SPL	Non-standard	Valid	Drug	SPL
5387438b-1e16-43f7-							

<https://athena.ohdsi.org/search-terms/start>

Patients



	observation	person	location	death
Patient A	Race Ethnicity Language Preference Sexual Orientation	Patient A	Patient A Home Address A	Patient A Death date
Patient B	Race Marital Status Gender Identity	Patient B	Patient B Home Address B	
Patient C	Ethnicity Religious Affiliation	Patient C		

Patient Demographics Variables

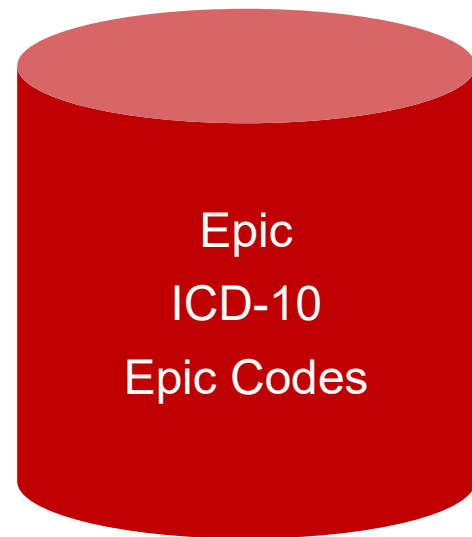


observation_concept_id	observation_concept_name	category_count	patient_count	row_count
4148886	Confidential patient data held	7	14,267	14,432
4136468	Ethnic background	45	5,423,669	5,484,600
4271761	Ethnic group	42	81,419	81,419
4110772	Gender identity finding	9	1,047,144	1,047,144
432453	General clinical state finding	2	12,051,324	12,051,324
4181605	Language preference	134	5,922,499	5,922,499
4053609	Marital status	7	10,531,938	10,531,938
4013886	Race	96	7,235,748	7,383,325
3050381	Race or ethnicity	8	8,943,318	8,943,318
4052017	Religious affiliation	31	5,264,641	5,264,641
4283657	Sexual orientation	7	532,407	532,407
21494233	Tabulated ethnicity [CDC]	43	2,969,196	2,990,029
21494232	Tabulated race [CDC]	66	3,943,939	3,986,784

```
[5]: # Quick smoke test: peek at PERSON table
sql = """
SELECT TOP 5 person_id, gender_concept_id, year_of_birth
FROM CDMDEID.PERSON
"""
airms.conn.sql(sql).collect()
```

Record counts as of April 21, 2025

Epic to OMOP Condition Mapping



Epic

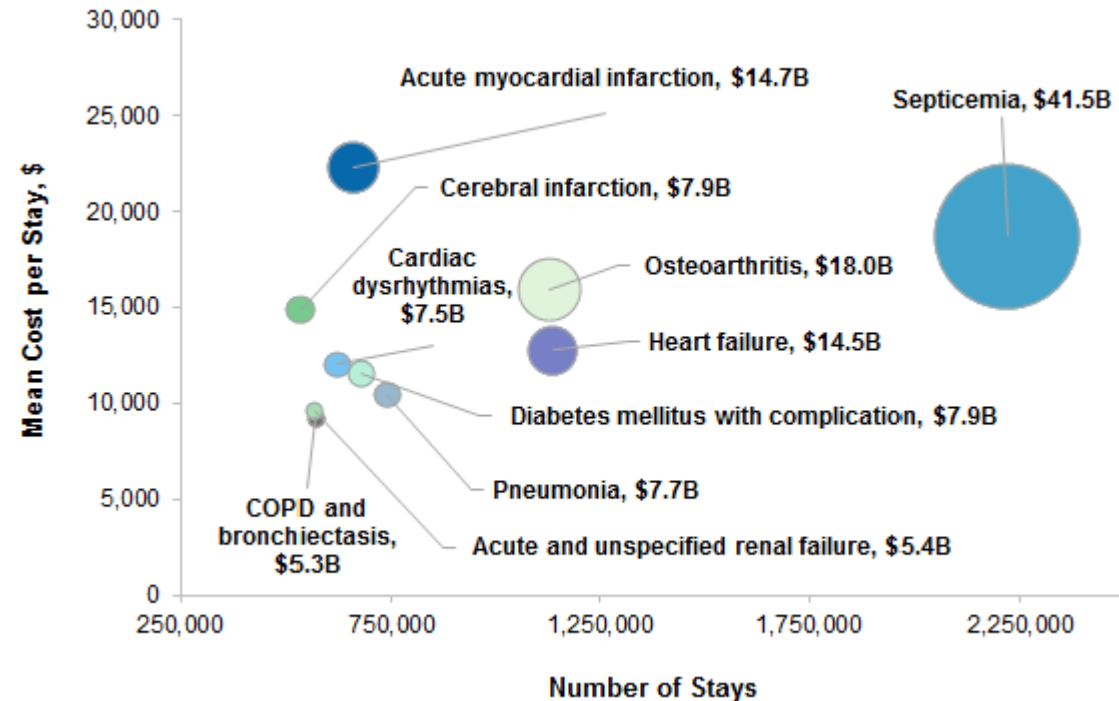


*Custom OMOP Mapping
Table*



Diagnosis Information

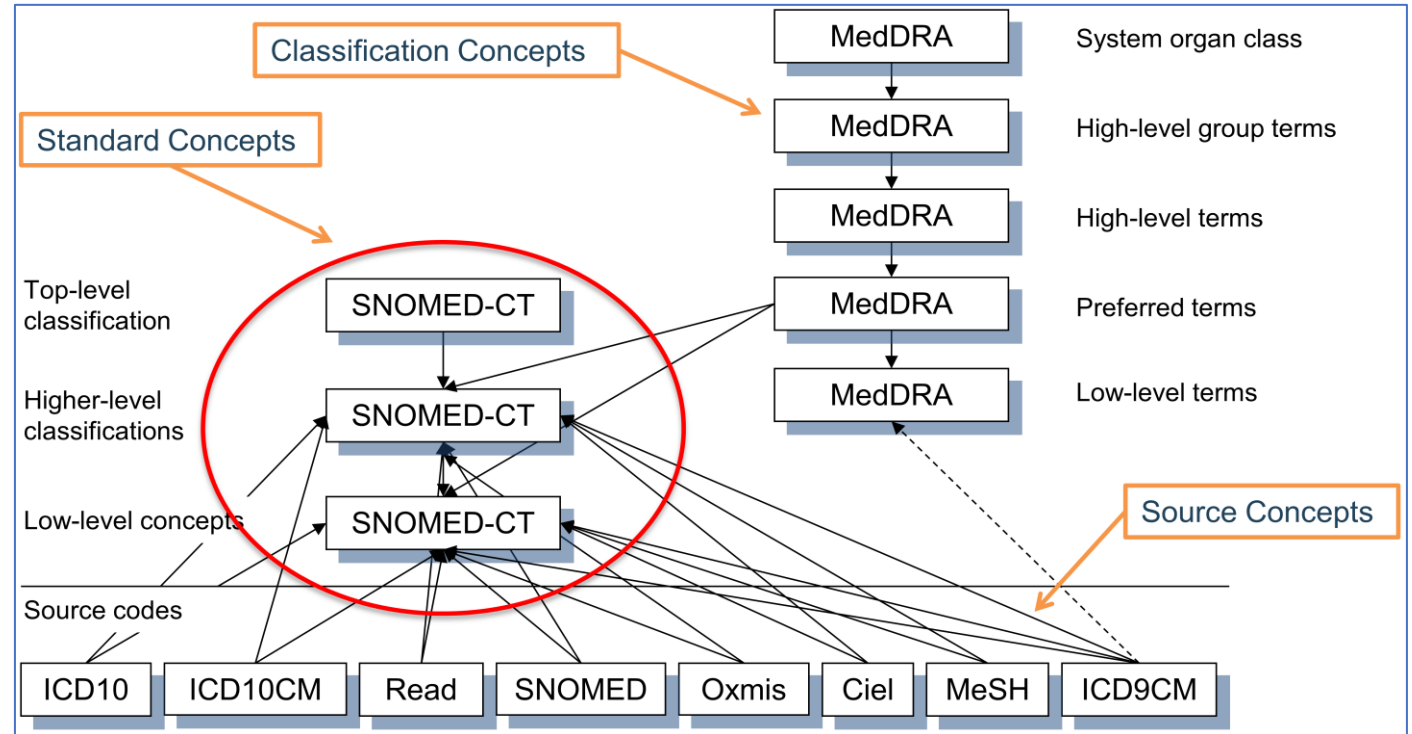
- During a visit (encounter) to the hospital, a patient may be diagnosed with a condition, such as diabetes, pneumonia, etc.
- Typically, diagnoses are stored using standard coding systems such as SNOMED and ICD-10
- These coding systems have been built over years by international consortia (for ICD-10) and are constantly being revised
- **When you look for diagnoses and pull up lists of conditions, you can consult with clinicians (physicians, specialists, etc) who will have a good idea of how frequent conditions are, how they rank, etc. – this is the process of clinically validating your query results**



<https://hcup-us.ahrq.gov/reports/statbriefs/sb277-Top-Reasons-Hospital-Stays-2018.jsp>

ICD-10 and SNOMED

- ICD-10: International Classification of Diseases, version 10 (developed internationally by the WHO)
- SNOMED: Systematized Nomenclature of Medicine (developed in the USA)
- There are 357,000 unique concepts in SNOMED, ICD-10-CM has about 70,000
- ICD codes are mapped to the low level and higher-level SNOMED-CT codes
- **AIRMS has a custom mapping produced by a 3rd party vendor between Epic IDs and SNOMED / ICD codes**



<https://ohdsi.github.io/TheBookOfOhdsi/StandardizedVocabularies.html>

Examples – ICD-10



E11: Diabetes mellitus without complications

E11.0: Diabetes mellitus with hyperosmolarity

E11.1: Diabetes mellitus with ketoacidosis...

W61.62: Struck by duck

W61.62XA: Struck by duck, initial encounter

W61.62XD: Struck by duck, subsequent encounter...

