

Introduction to the Data2Evidence Cohort Query Tool

Developing cohorts using Electronic Health Record Data
on the AI Ready Mount Sinai Platform

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Cohort Query Tools

- Explore data
- Get counts for research proposals
- No coding needed

Cohort query tools for Mount Sinai data

	Data2Evidence	LEAF	ATLAS	Epic SlicerDicer	Epic Cosmos
Development	Data4Life	Nick Dobbins, Univ of Washington, ISMMS	OHDSI	Epic Inc.	Epic Inc.
License	Free and open source software			Commercial	
Tradeoff	Newer, actively developed High functionality Easy to use interface	Not actively developed Limited functionality	Complexity Higher functionality	Needs Epic Hyperspace access Must not inadvertently access PHI without authorization	Needs (virtual) Epic training and registration
Capabilities	Can customize visualization Pre-defined scenario wizards	Pre-defined stats	Customized stats	Tables and graphs based on all Epic data at Mount Sinai	Tables and graphs based on all Epic data across participating Epic partners

Another multi-site tool

- TrinetX
 - Polished, commercially developed interface
 - Possible multi-institution data with institutional agreement/subscription
 - Valuable for rare diseases research

Data modalities in AIR.MS

Currently Available Modalities:

EHR-derived structured data -> transformed to the 'OMOP' common data model

Availability of digitized pathology slides

Radiology Metadata

ICU datamart

Pathology Metadata

Endoscopy reports

BioMe/Sinai Million

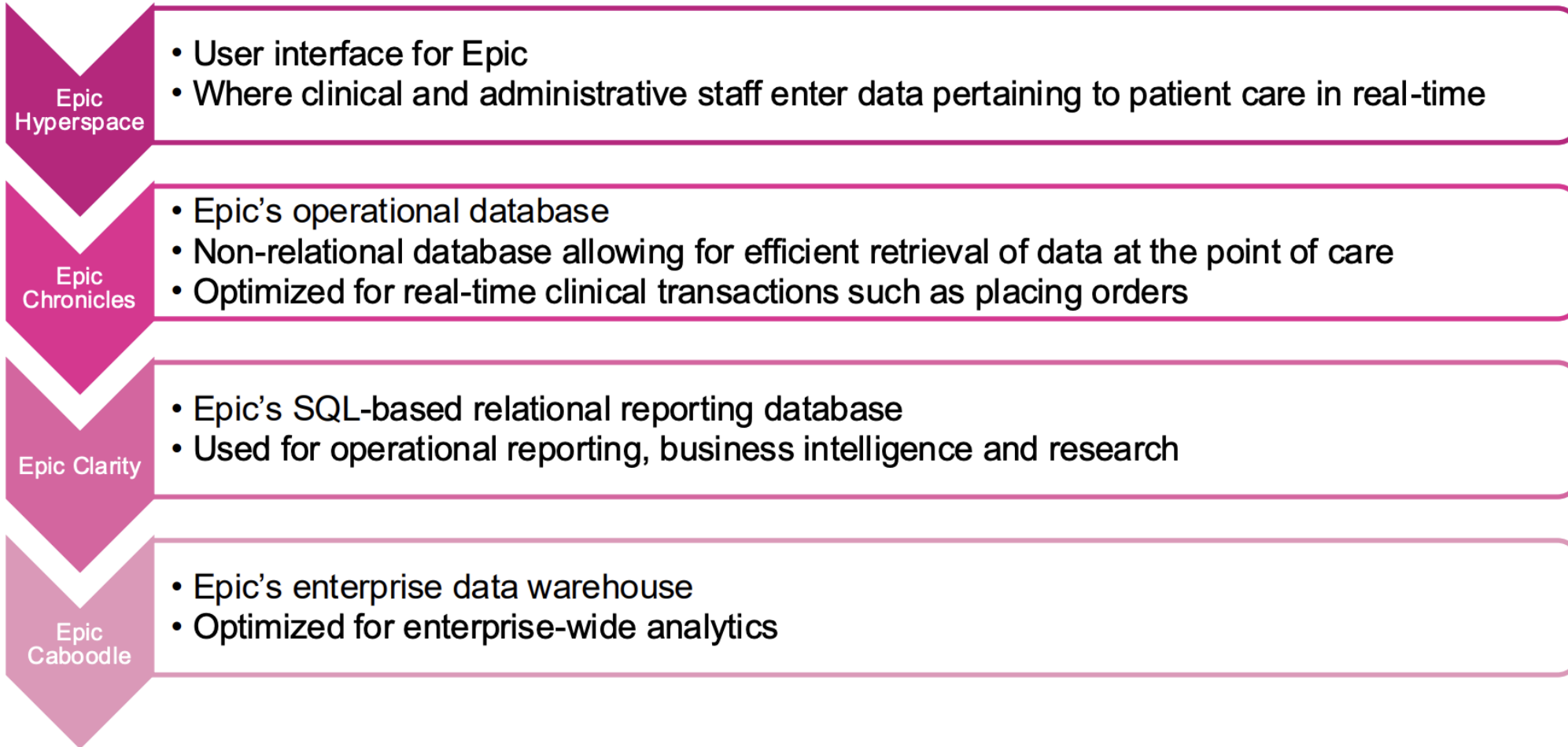
Electrocardiogram (EKG)

Echocardiography

GI Research Database

Work in progress: Electroencephalogram (EEG), , Colonoscopy, cardiac imaging reports, physiological waveform data (Bedmaster -> GE AirStrip in future?)

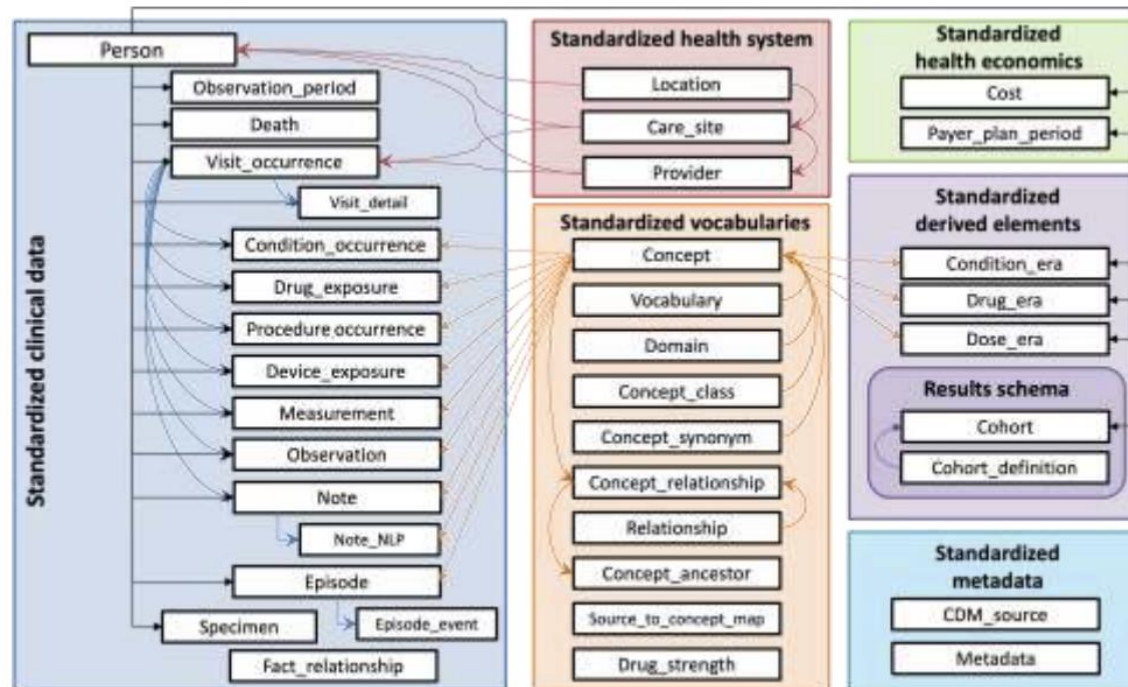
Epic is the Primary Source of Electronic Health Record Data at Mount Sinai



OMOP Common Data Model Requirements



1. Standardize **data structure** via common format



2. Standardize **data content** via mapping EHR codes to standard healthcare vocabularies

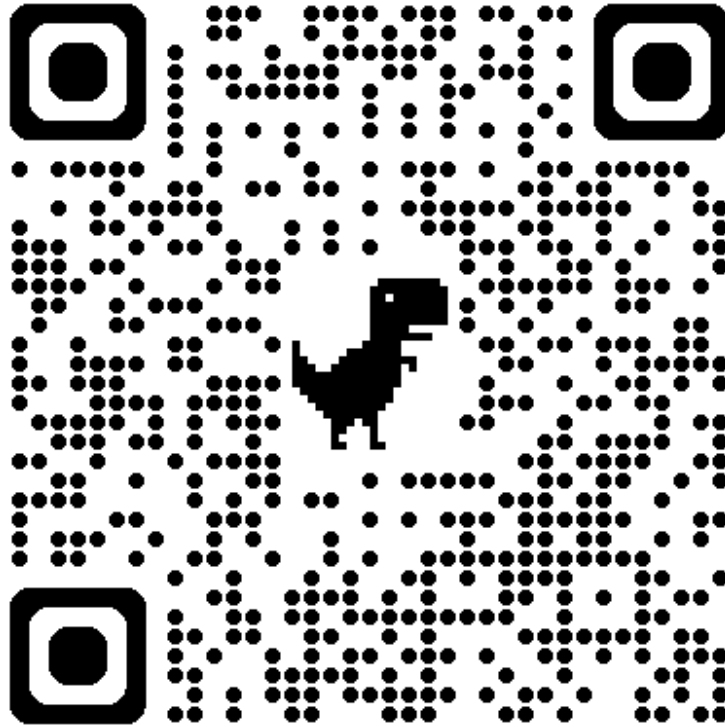
OMOP Domain	Standard Vocabularies	Non-standard Vocabularies
Condition	SNOMED-CT	ICD-10-CM, ICD-9-CM
Drug	RxNorm, CVX	ATC, NDC, Multum
Measurement	LOINC	SNOMED-CT, Nebraska Lexicon
Procedure	CPT4, HCPCS, ICD-10-PCS	ICD-9-Proc
Observation	SNOMED-CT, LOINC	ICD-10-CM, ICD-9-CM
Race, Ethnicity	OMOP Race, OMOP Ethnicity	SNOMED-CT, Nebraska Lexicon
Provider (Specialty)	NUCC, Medicare Specialty	SNOMED-CT, Nebraska Lexicon
Route	SNOMED-CT	Nebraska Lexicon
Unit	UCUM	SNOMED-CT, Nebraska Lexicon

<https://ohdsi.github.io/CommonDataModel>

Data2Evidence Limitations

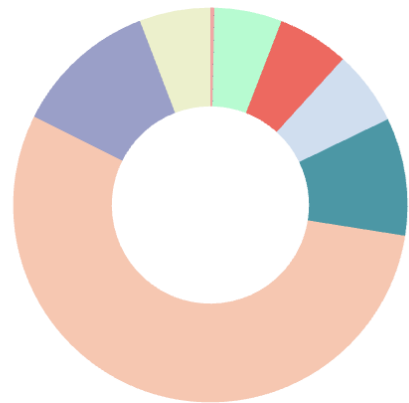
- Not all data modalities on AIR.MS are currently available for search in Data2Evidence
- Radiology study data is older than a year – a refresh is coming soon!
- Cannot filter with concept sets (also called value sets) at this time
- Filters may surface concepts in the dictionary table which are not used/mapped at Mount Sinai
 - Mitigate by searching for concepts of interest as a separate step before building cohorts
- Multiple filter criteria can degrade responsiveness

Follow along (needs VPN or on-site non-guest connection)



`d2e.airms.mssm.edu`

Datasets



Mount Sinai De-Identified Epic Electronic Health Record (EHR) Data

Click [here](#) to start analyzing AI Ready Mount Sinai (AIRMS) de-identified patient data derived from Mount Sinai's EHR, and stored in Observational Medical Outcomes Partnership (OMOP) format.

 Total subjects: 12,441,531  Date: 2023-06-08  Version: 5.3

 Data model: omop5-3



Dataset Overview





← Datathon ▾

Dataset

Concepts

Cohorts

Wizards

Account

Dataset info

Data characterization

Data quality

Datathon

The dataset consists of EHR data from ~5,000 patients with diagnoses relevant to the hackathon. The dataset is designed for participants to develop ECG representations that can identify patient matches, detect individuals outside the cohort, and extract clinical signals that provide information beyond the electronic health record. The dataset is a subset of the Mount Sinai De-Identified Epic Electronic Health Record (EHR) Data, structured with the OMOP Common Data Model format. Data includes patient demographics, conditions, encounters, procedures, vitals, medications, and lab results. We also provide the count of ECGs each patient has.

Metadata

Resource type	Dataset
Dataset ID	b74a57f2-026a-4f46-ba7f-3a59d5c67250
Entity Count Distribution	{"Observation Period Count": "4855", "Death Count": "604", "Visit Occurrence Count": "967358", "Visit Detail Count": "0", "Condition Occurrence Count": "1305352", "Drug Exposure Count": "2250423", "Procedure Occurrence Count": "2269754", "Device Exposure Count": "0", "Measurement Count": "17820345", "Observation Count": "2395372", "Note Count": "1521567", "Specimen Count": "0"}
Entity Count	28,535,630
Version	5.3
Schema Version	5.3
Latest Available Schema Version	5.3



>28M entities



Dataset Characterization

Dataset info

Data characterization

Data quality

Mount Sinai De-Identified Epic Electronic Health Record (EHR) Data

Select data characterization report

Show all reports

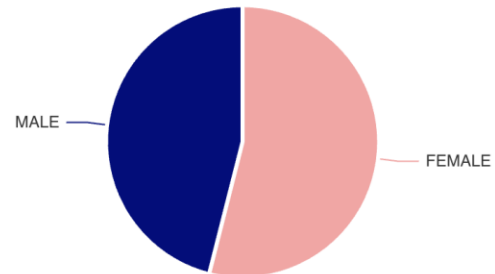
CDM Summary

Source name: CDMDEID

Number of persons:
12,441,531

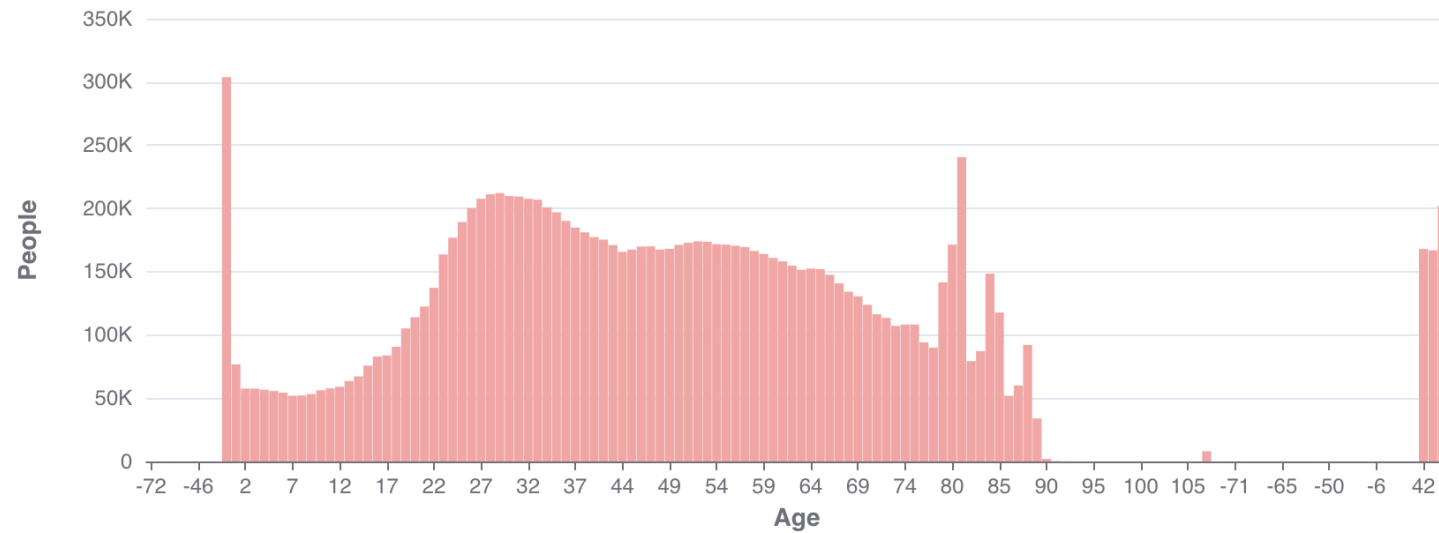
Gender

FEMALE MALE

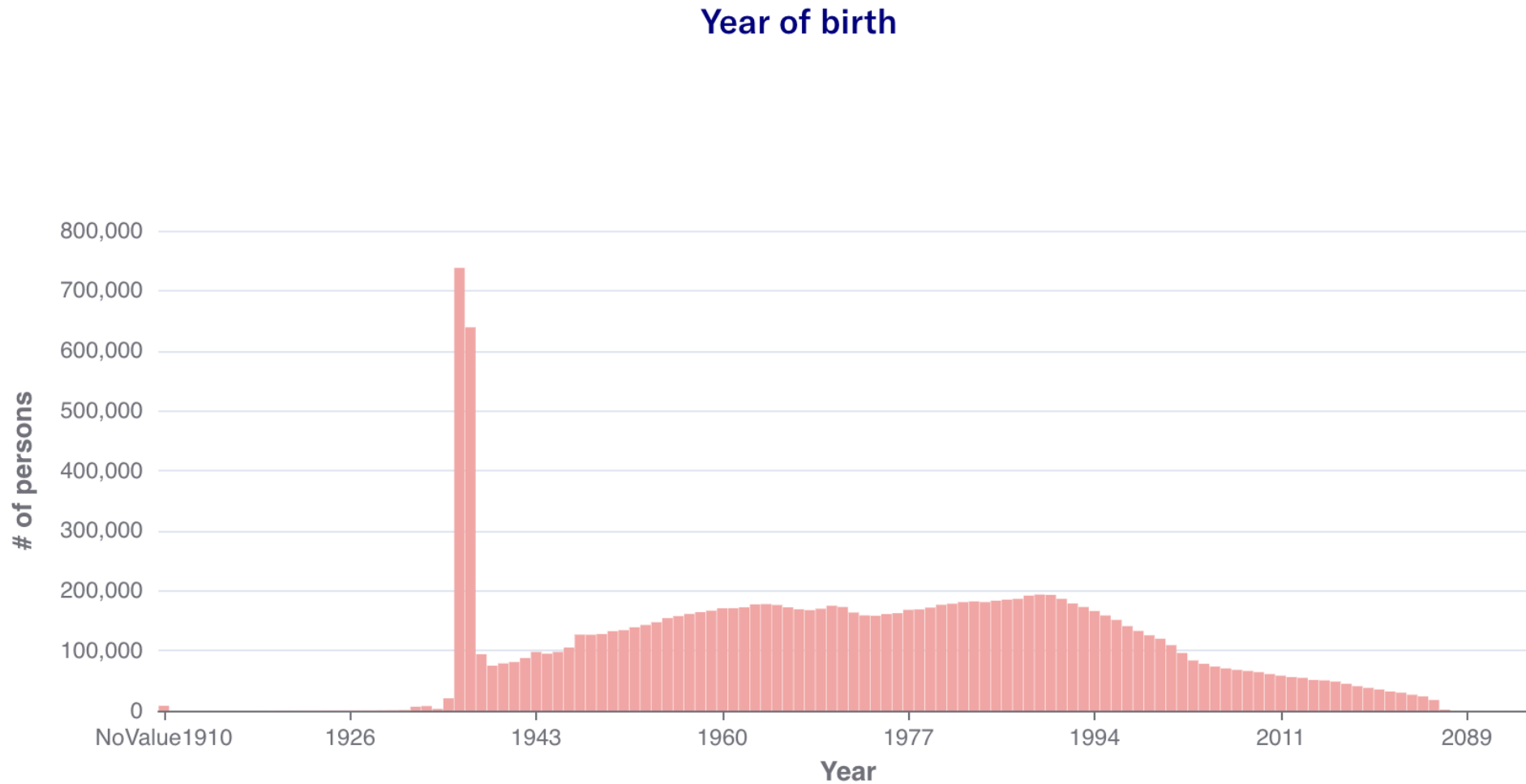


Dataset Characterization

Age at first observation



Dataset Characterization



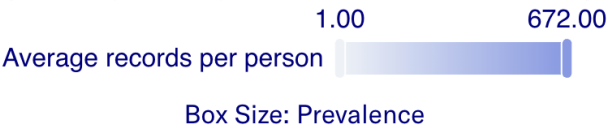
Dataset Characterization

Measurement Prevalence

Treemap Table



Leukoc...	Alanine ...	Aspartat...	Body te...	Bilirub...	Body s...	Bl...	Bi...	pH...	La...	Ox...	Er...	Tr...	Pa...	Ox...	Glo	
Platele...	Glucose ...	Carbon ...	Prothro...	Oxygen...	Neutro...											
				Respira...	Body h...	Glome...	Po...	Li...	H...	C...	Bl...	Cho	Plat	ABO	Thy	
Creatin...	Order set Platelets panel Blood Hematology and Cell Count Panels Platelets Number Concentration (count/vol) Moment in time Blood Platelets [#volume] in Blood by Automated count Prevalence: 0.00508 Number of persons: 63,250 Average records per person: 50.4								Bac	He	pH	Car	Ins	Ani	Ba	Ba
Urea ni...									Spec...	Ery	Glu	Cr	La	Ba	Ba	Ch
Potassi...									Calci...							
Sodium...									Mono...	Natr...	Al	Ca	A	H	Ca	H
MCV [E...		Systol...	Nitrite...	Body m...	Specif...	Leuk...										
	Erythro...	Basophil...	Diastol...	Urobili...	Sodium...	Gluco...	Oxyg...									
Albumi...	Alkaline...	Eosinop...	Phosph...	Leukoc...	Glucos...	Trigly...	Rh [T...									
Bilirub...	Chloride...	Basophil...	Body w...	Bilirub...	Carbon...	Carbo...	Chlor...									



Data Quality Dashboard (DQD)

Mount Sinai De-Identified Epic Electronic Health Record (EHR) Data

Overview

	Verification				Validation				Total			
	Pass	Fail	Total	% Pass	Pass	Fail	Total	% Pass	Pass	Fail	Total	% Pass
Plausibility	327	125	452	72%	286	5	291	98%	613	130	743	83%
Conformance	638	90	728	88%	102	4	106	96%	740	94	834	89%
Completeness	374	22	396	94%	12	5	17	71%	386	27	413	93%
Total	1,339	237	1,576	85%	400	14	414	97%	1,739	251	1,990	87%
570 out of 1,739 passed checks are not applicable, due to empty tables or fields. 28 out of 251 failed checks are SQL errors. Corrected pass percentage for NA and Errors: 84% (1,169/1,392).												

Kahn MG, Callahan TJ, Barnard J, et al. A Harmonized Data Quality Assessment Terminology and Framework for the Secondary Use of Electronic Health Record Data. eGEMs (Generating Evidence & Methods to improve patient outcomes). 2016;4(1):18. doi:10.13063/2327-9214.1244

Concept Search



The screenshot shows the 'Concept Search' interface of the D2E platform. The navigation bar at the top includes 'Datathon', 'Dataset', 'Concepts' (selected), 'Cohorts', 'Wizards', and 'Account'. Below the navigation bar, there are tabs for 'Concept search' and 'Concept sets'. A search bar with a magnifying glass icon and a plus icon is present. The main content area displays a table with columns: ID, Code, Name, Vocabulary, Concept, Domain, Class, Validity, and RC. Each column has a filter icon (X) next to it. The table lists 15 concepts, all with 'Read' as the Vocabulary, 'Non-standard' as the Concept, and 'Invalid' as the Validity. The RC column shows values of 0 for all concepts.

ID	Code	Name	Vocabulary	Concept	Domain	Class	Validity	RC
			Filter by Vocabulary	Filter by Concept	Filter by Domain	Filter by Class	Filter by Validity	
45426237	9982.00		Read	Non-standard	Condition	Read	Invalid	0
45489629	9C3..12		Read	Non-standard	Observation	Read	Invalid	0
45426233	98Bn.00		Read	Non-standard	Condition	Read	Invalid	0
45429577	9E3..12		Read	Non-standard	Procedure	Read	Invalid	0
45422998	9DA..11		Read	Non-standard	Observation	Read	Invalid	0
45476340	92...11		Read	Non-standard	Observation	Read	Invalid	0
45486357	9N1F.13		Read	Non-standard	Observation	Read	Invalid	0
45489627	999Z.00		Read	Non-standard	Condition	Read	Invalid	0
45422994	98Bj.00		Read	Non-standard	Condition	Read	Invalid	0
45486335	9991.00		Read	Non-standard	Condition	Read	Invalid	0
45432915	9Ndr.00		Read	Non-standard	Condition	Read	Invalid	0
45486356	9K4..00		Read	Non-standard	Observation	Read	Invalid	0
45483694	K522		Read	Non-standard	Condition/Procedure	Read	Invalid	0
45423012	9F2..11		Read	Non-standard	Observation	Read	Invalid	0
45479742	9Ndr.00		Read	Non-standard	Condition	Read	Invalid	0

Example Scenario

How many patients who identify as White do we have with multiple myeloma who were treated with bortezomib, and had a whole body MRI?



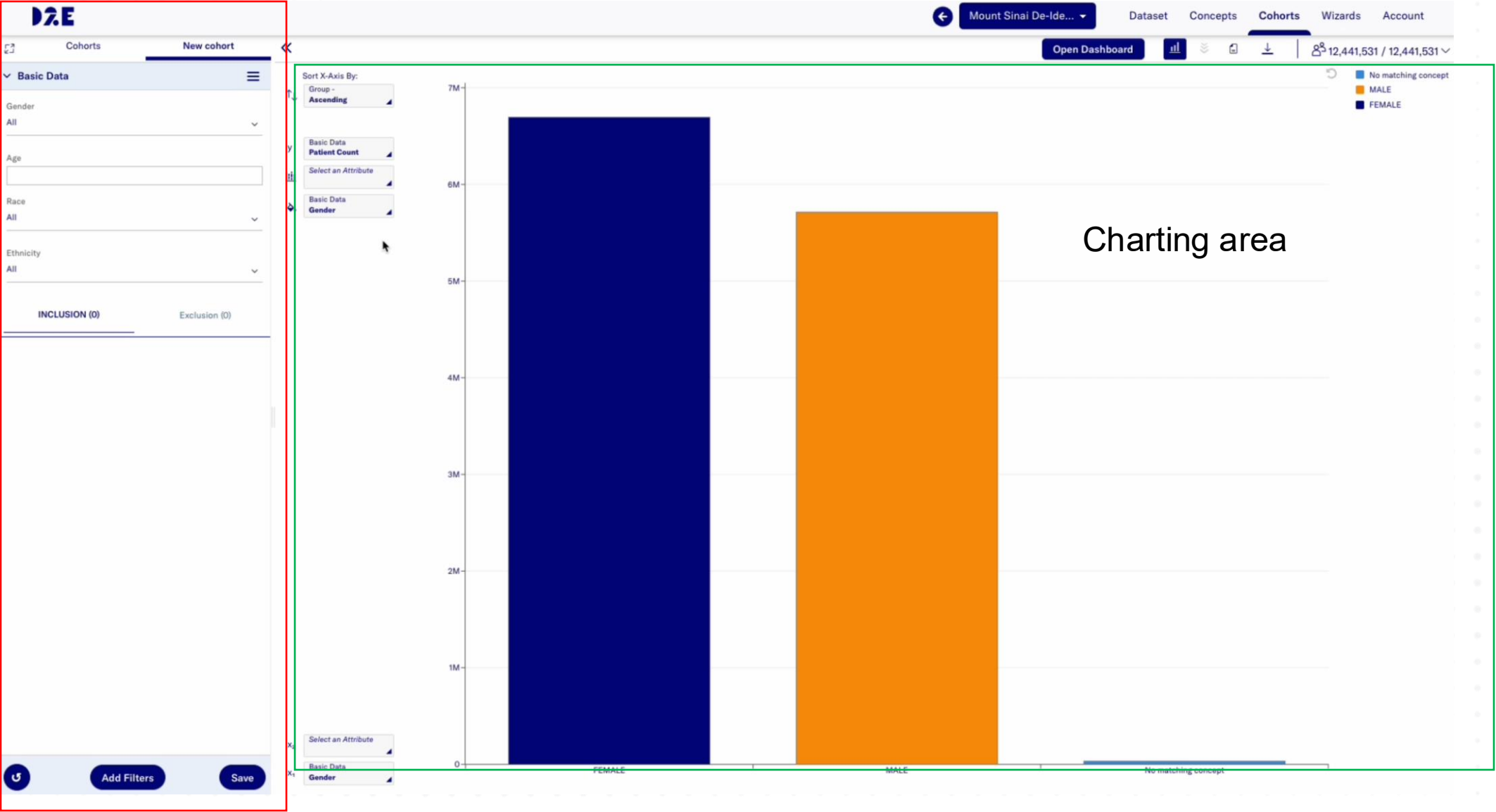
Cohort Building

The screenshot displays the 'Cohorts' section of the D2E application. At the top, a navigation bar includes a back arrow, a 'Datathon' dropdown, and tabs for 'Dataset', 'Concepts', 'Cohorts' (which is active), 'Wizards', and 'Account'. Below the navigation bar, the 'Cohorts' title is centered. The main area is titled 'Create Cohort:' and features a dark blue button labeled 'D2E', a light blue button labeled 'Compare', and a 'Shared' toggle switch. A message below the buttons states: 'You have not yet saved any filters. You can save your current filter settings.' Two blue arrows with numbered circles indicate a workflow: arrow 1 points down to the 'Cohorts' tab, and arrow 2 points from the right side of the screen to the 'D2E' button.



Filtering area

Cohort creator interface

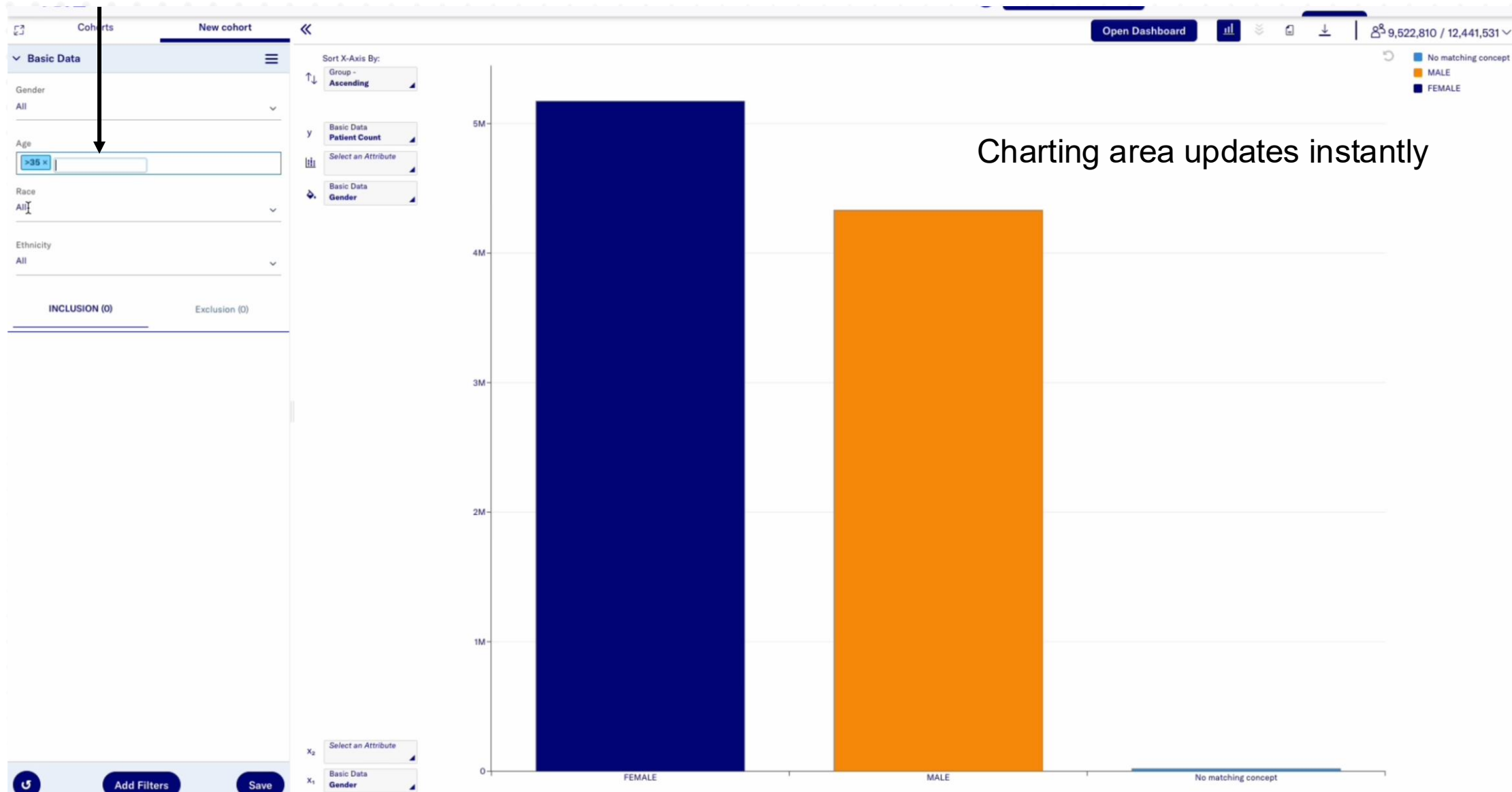


Hover over bars to see counts

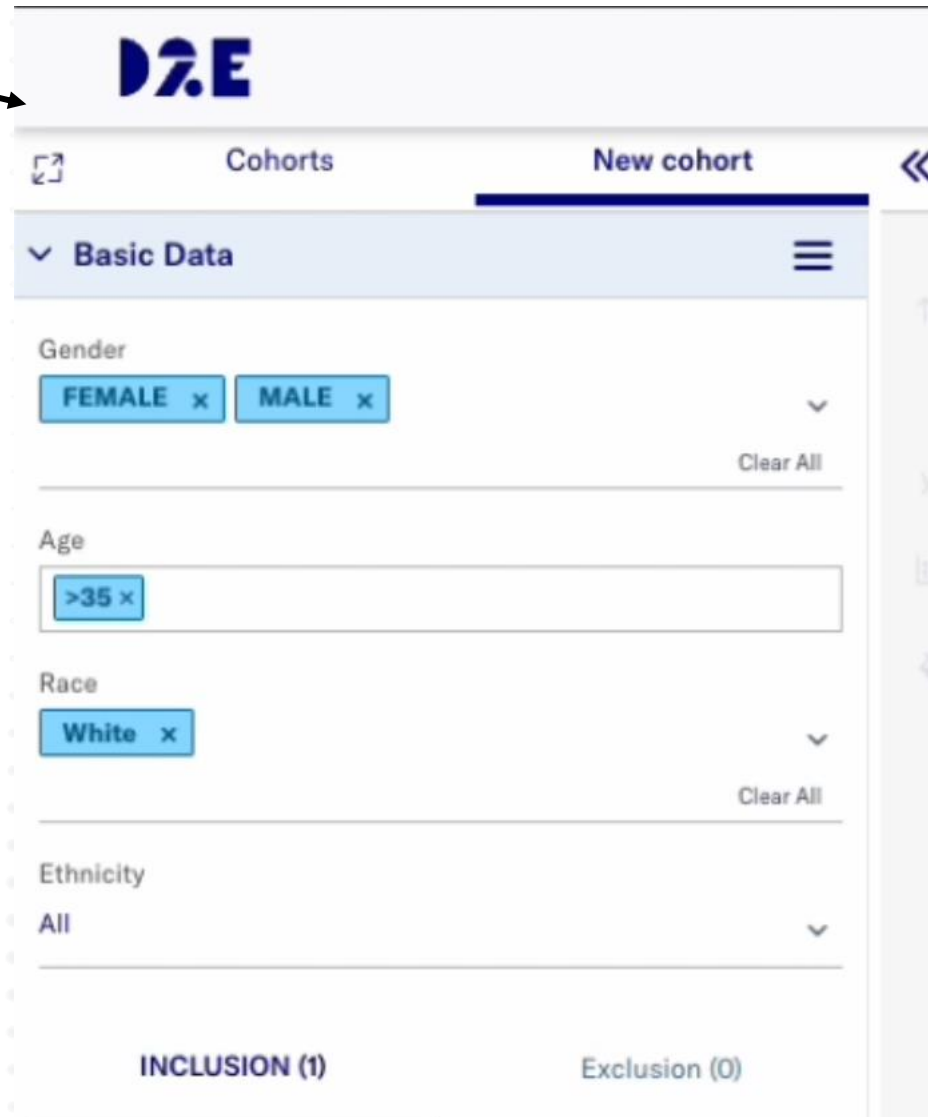
Current cohort size



Add filter Age > 35



Add more demographic filters



The screenshot shows the D2E Cohorts interface. At the top, there's a header with the D2E logo and tabs for 'Cohorts' and 'New cohort'. Below the header, there's a section titled 'Basic Data' with a dropdown arrow and a menu icon. Under 'Basic Data', there are four demographic filter sections: 'Gender' with 'FEMALE x' and 'MALE x' buttons, 'Age' with '>35 x' button, 'Race' with 'White x' button, and 'Ethnicity' with 'All' button. Each section has a 'Clear All' link. At the bottom, there's a summary bar showing 'INCLUSION (1)' and 'Exclusion (0)'.

D2E

Cohorts New cohort

Basic Data

Gender

FEMALE x MALE x

Clear All

Age

>35 x

Race

White x

Clear All

Ethnicity

All

INCLUSION (1) Exclusion (0)

Condition filtering by ICD-10

Cohorts

New cohort

<<

Basic Data

Gender

FEMALE x MALE x

Clear All

Age

>35 x

Race

White x

Clear All

Ethnicity

All

INCLUSION (1)

Exclusion (0)

Conditions (ICD10CM) A

Condition Source concept code

C90.0

C90.0

Loading suggestions...

INCLUSION (1)

Exclusion (0)

Conditions (ICD10CM) A

Condition Source concept code

Multiple myeloma not having achieved remission x

Multiple myeloma in remission x

Multiple myeloma in relapse x

Enter search term

C90.0 - Multiple myeloma

Condition filtering by ICD-10

Cohorts **New cohort** <<

Basic Data

Gender

FEMALE x MALE x

Clear All

Age

>35 x

Race

White x

Clear All

Ethnicity

All

INCLUSION (1) Exclusion (0)

Conditions (ICD10CM) A

Condition Source concept code

C90.0

C90.0 Loading suggestions...

INCLUSION (1) Exclusion (0)

Conditions (ICD10CM) A

Condition Source concept code

Multiple myeloma not having achieved remission x

Multiple myeloma in remission x

Multiple myeloma in relapse x

Enter search term

C90.0 - Multiple myeloma

Search for medications by code

INCLUSION (2)

Exclusion (0)

▼ Conditions (ICD10CM) A

Condition Source concept code

Multiple myeloma not having achieved remission x

Multiple myeloma in remission x

Multiple myeloma in relapse x

Clear All

AND

▼ Medications A

Medication Source concept code

L01xg01

L01xg01

L01XG01 - bortezomib

We can flip the Boolean relationship between filter cards

INCLUSION (2)

Exclusion (0)

▼ Conditions (ICD10CM) A

Condition Source concept code

Multiple myeloma not having achieved remission x ▼

Multiple myeloma in remission x

Multiple myeloma in relapse x

Clear All

OR

▼ Medications A

Medication Source concept code

bortezomib x ▼

Clear All

Add temporal relationship
between filters

INCLUSION (2)

Exclusion (0)

> Conditions (ICD10CM) A

≡

AND

↺

Medications A

≡

Medication Source concept code

bortezomib x

▼

Clear All

Medications A - Conditions (ICD10CM) A

+

Started

▼

1

Days

After Start

▼

of

Conditions (ICD10CM) A

▼

Filter by radiology studies

> Conditions (ICD10CM) A

AND

> Medications A

AND

> Imaging Research Warehouse A

Imaging Modality

MAGNETIC RESONANCE x

Clear All

Body Part

WHOLE BODY x

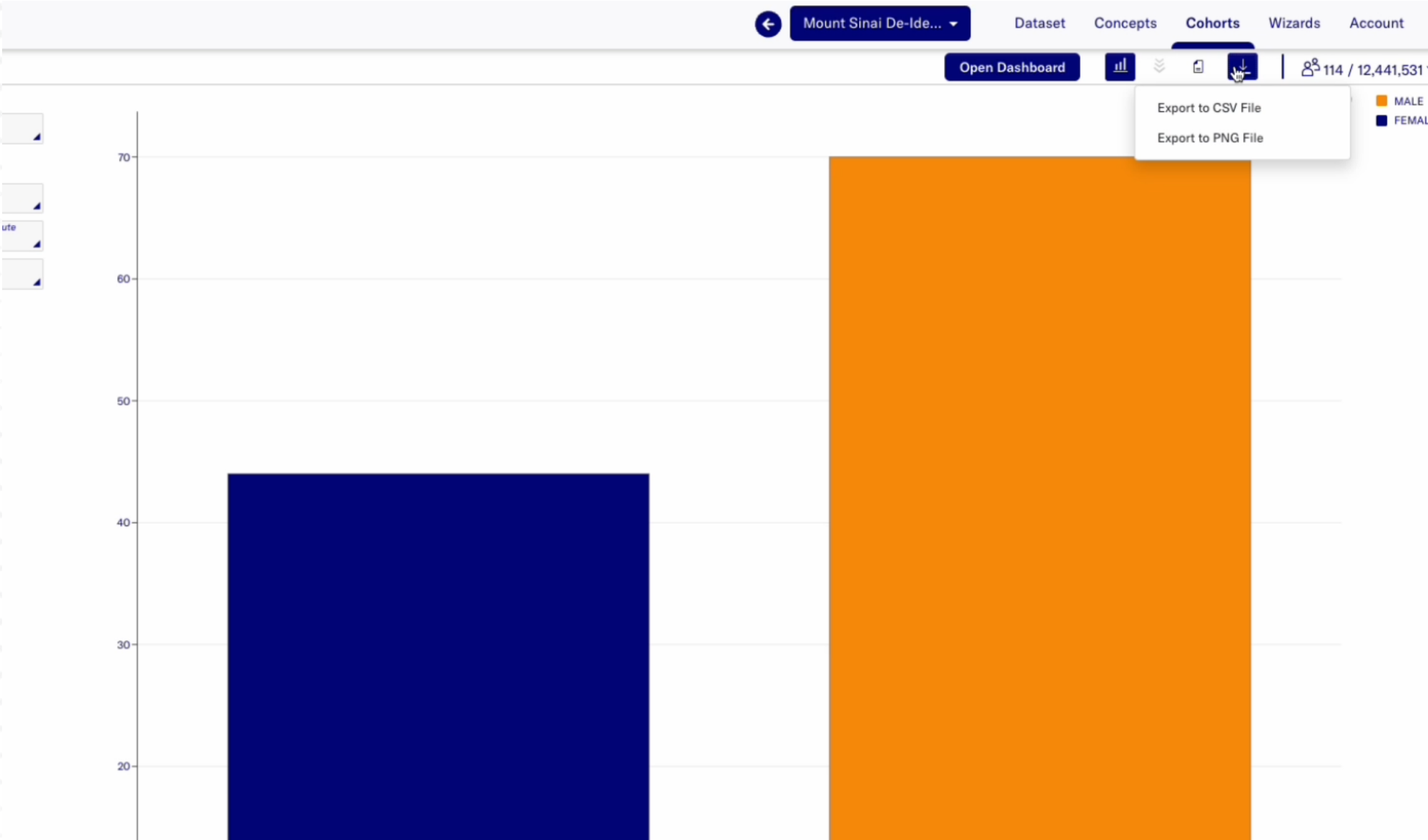
Clear All

Frequency

Study Description

All

Download the chart



Download the SQL query

DatasetConceptsCohorts Wizards Account

Dashboard

114 / 12,441,531

MALE
FEMALE

Filter Summary

Showing patients with:

Basic Data

Gender: FEMALE, MALE
Age: >35
Race: White

AND

Conditions (ICD10CM) A

Condition Source concept code: C90.00, C90.01, C90.02

AND

Medications A

Medication Source concept code: L01XG01
Started 1 Days after_startdate of Conditions (ICD10CM) A

AND

Imaging Research Warehouse A

Imaging Modality: MAGNETIC RESONANCE
Body Part: WHOLE BODY

Download SQL

Copy SQL

Download SQL

Copy SQL

Wizards

Dashboard

Incidence rate dashboard

Calculated as the percentage of the cohort that had these conditions as an incidence during the years 2010 to 2020 based on condition start date, and did not have the conditions a year prior.





Getting started

We've built some pre-configured scenarios to get you started

Calculate Incidence

This wizard will calculate the incidence (the number of new cases) for a condition or multiple co-occurring conditions, such as diabetes, stroke, or COVID-19. It will find patients with a particular diagnostic code or codes for a set of criteria you define for the patient cohort (dates, patient age, gender, weight, systolic blood pressure, etc).

Calculate Prevalence

Prevalence (the number of existing cases) for a particular condition or multiple co-occurring conditions, such as diabetes, stroke, or COVID-19 can be easily calculated using this wizard. Other criteria (such as patient age, weight, systolic blood pressure, etc) can also be set to further refine the prevalence rate calculation.

Calculate Mortality

This will determine the mortality rate for a specific condition or multiple co-occurring conditions. Mortality is determined by finding specific death dates that co-occur with a range of dates that you specify, as well as additional patient criteria you set (such as visit dates, patient age, gender, etc).

Cross sectional Demographics

The cross-sectional demographics analysis executed by this wizard will create a set of graphs describing a specific cohort of patients you define based on different criteria, such as age, gender, race, etc. This is useful to provide a quick exploration of data and generate hypotheses.



Calculate Incidence

This wizard will calculate the incidence (the number of new cases) for a condition or multiple co-occurring conditions, such as diabetes, stroke, or COVID-19. It will find patients with a particular diagnostic code or codes for a set of criteria you define for the patient cohort (dates, patient age, gender, weight, systolic blood pressure, etc).

Note: this is a very rough approximation that is just a starting point for a more comprehensive analysis.

Age Range*:

Gender:

Ethnicity:

Race:

Height:

Weight:

BMI:

Resp Rate:

Pulse Rate:

Systolic Blood Pressure:

Diastolic Blood Pressure:

>=60

Male

Pulse Rate:

Systolic Blood Pressure:

Diastolic Blood Pressure:

Years*: -

Condition 1*:

Condition 2:

Condition 3:

Condition 4:

Condition 5:

- ☒ Include descendants
- ☒ Include descendants

Back

Open cohort

«

MALE X

Clear All

 $\geq 60\%$

All

All

Exclusion (O)

Add Filters

Save

Group -
Ascending

Patient Count

Gender

Basic Data

2.5M -

2M-

1.5M-

IM-

0.5M -

0-

MALE

Dashboard

Prevalence rate dashboard

Calculated as the percentage of the cohort that had these conditions during the years 2010 to 2020 based on condition start date



A photograph of two medical professionals in full personal protective equipment (PPE), including gowns, masks, and hairnets. They are in a clinical setting, possibly a hospital room. The image is overlaid with a blue-to-purple gradient and a pattern of small white dots. The text 'Thank you!' is written in white on the left side.

Thank you!