

Leveraging the OHDSI ecosystem

to run Network Studies

OMOP Team, IQVIA March 2021

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- + Session 1 : Course Introduction
 - OMOP CDM and vocabulary overview, OMOP conversion, data quality, examples of previous research and use cases, introducing ATLAS and OHDSI tools
- + Session 2: OMOP CDM/Vocabulary Tutorial
 - Concept, Concept mapping, Hierarchy, Ancestors, and OMOP CDM
- + Session 3: Cohort and Cohort Characterization
 - Concept sets, cohort definition, and cohort characterization
- + Session 4: Treatment Pathways and Incidence Rates
 - Customized features in SQL, treatment pathways, incidence rates





- + Customized Features using SQL
- + Treatment Pathways and Incidence Rates



Homework Review (Session 3)

ATLAS Characterization – Homework

Among adults hospitalized with COVID-19, how many were put on a mechanical ventilator per subgroup (age, gender)?

- COVID-19 Cohort Download the COVID-19 cohort from the OHDSI Atlas instance https://atlas.ohdsi.org/#/cohortdefinition/198
- Mechanical Ventilation Inclusion
 - > Add mechanical ventilation to the inclusion criteria during the hospital stay (between index date and end date):

https://atlas.ohdsi.org/#/conceptset/49/expression

Note that this is a multidomain concept (condition, observation and procedure). You will need to add one criteria per domain, and then select 'having ANY of the following criteria', otherwise, if the default 'ALL' is left, you will get 0 counts.

> Save the new cohort as '[UCS] Covid-19 cohort mech. vent.' or any other name of your preference.

- Characterization

- > Create a new characterization and save it as '[UCS] Covid-19 cohort mech. vent. analysis'
- > Import your new COVID-19 and mechanical ventilation cohort
- > Include the age group and gender features
- > Execute in your own database and check the results
- Compare your results with the RD2D consortium results for COVID-19 link



ATLAS Characterization – Homework

Among adults hospitalized with COVID-19, how many were put on a mechanical ventilator per subgroup (age, gender)?







ATLAS Characterization Customized Features in SQL

Customized features using SQL



- 1. Select Feature Analysis on the left
- 2. Select New Feature Analysis on the right

- 3. Choose the Visit Domain
- 4. Click on the Custom button
- 5. Click on 'Copy Analysis SQL Template to Clipboard'

| 🕈 Home | 📜 New Feature Analysis |
|---------------------|----------------------------------------------------------------------------------|
| Data Sources | |
| Q Search | New Feature Analysis |
| - Concept Sets | Description |
| Scohort Definitions | |
| Characterizations | Visit |
| Cohort Pathways | |
| Incidence Rates | |
| 🗳 Estimation | |
| Prediction | Design |
| 🖬 Jobs | Criteria |
| Configuration | Analysis SQL |
| Feedback | Copy Analysis SQL Template To Clipboard |
| | SFIECT ovvariate id, covariate name, concept id, sum value, average value FROM (|



Customized features using SQL

Template - Paste the SQL code in your editor of preference and update the code highlighted in gray accordingly



8

Customized features using SQL

Length of Visit/Top Drugs During Hospital Stay



- Make sure the index event end date is set to 0 days from end date.
- This way the patients will **exit the cohort** at the end of the hospital visit.



Customized features using SQL

Top Drugs During Hospital Stay



- Simple code to capture the drugs taken during the hospital stay.
- Since our **index event** is the **hospital stay** and the **cohort exit** is the end of the hospital stay, the **start** and **end date** of the cohort will match the **start** and **end** date of the **hospital stay**.

Create a new feature analysis, paste the code above and save with a new name.





Customized features using SQL - Length of Visit

WHERE cohort definition id = @cohort id



- Simple code to extract the length of the visit from our influenza cohort.
- Since our index event is the hospital stay, the start and end date of the cohort will match the start and end date of the hospital stay.
- Hence the length of the stay is just the difference between the two dates.



Customized features using SQL - Length of Visit

Among adults hospitalized with influenza what is the length of stay in hospital for patients with (a) Diabetes, (b) Lung Disease, (c) Cancer, (d) Immunodeficiency, (e) Heart Disease, (f) Hypertension, (g) Asthma, (h) Kidney Disease (1) Overall and (2) per subgroup >= 65 and < 65?

- Influenza Cohort: It has already been defined in the previous exercises

- Inclusion Criteria

- > Create a copy of this influenza cohort and rename as '[UCS] Influenza cohort 2008 to 2009 and diabetes'. Add the 'diabetes' condition as a new inclusion criteria any time prior to the end of the hospital stay. Use the answers from the Session #1 Exercise to build the concept set for 'diabetes'.
- > Repeat this process for all conditions in the list above (8 in total)

- Characterization 1

- > Create a new characterization
- > Import all your new influenza cohorts (8)
- > Create a customised new feature analysis for the length of the visit and import this new feature into the characterization
- > Execute and check the results

- Characterization 2

- Make a copy of Characterization 1 and rename it
- Create the subgroups for >= 65 and < 65 years old
- Execute and check the results



Design - Length of Visit

Among adults hospitalized with influenza what is the length of stay in hospital for patients with (a) Diabetes, (b) Lung Disease, (c) Cancer, (d) Immunodeficiency, (e) Heart Disease, (f) Hypertension, (g) Asthma, (h) Kidney Disease (1) Overall and (2) per subgroup >= 65 and < 65?

| | Utilities | | | | | | | | | |
|---------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|--------------------------------------------------------------|--|--|--|--|--|--|
| ohort characterization is d ovariates during a period ma uarter, calendar-year. | defined as the process of generating cohort level descriptive summary statistics from person lev ay be stratified into temporal units of time for time-series analysis such as fixed intervals of tim | vel covariate data. Summary statistics of these person level covariates may be count, mean, sd, e relative to cohort_start_date (e.g. every 7 days, every 30 days etc.), or in absolute calendar inte | var, min, max, median, rang rvals such as calendar-week | a, and quantiles. In addition 2, calendar-month, calendar | | | | | | |
| ohort definitions | | | | | | | | | | |
| Import | | | | | | | | | | |
| ow 10 🗸 entries | | | | Search: | | | | | | |
| ID 🔺 | Name | | | | | | | | | |
| 2305 | [UCS] Influenza cohort 2008 to 2009 and Diabetes | | Edit cohort | Remove | | | | | | |
| 2306 | [UCS] Influenza cohort 2008 to 2009 and COPD | | Edit cohort | Remove | | | | | | |
| 2307 | [UCS] Influenza cohort 2008 to 2009 and Cancer | | Edit cohort | Remove | | | | | | |
| 2308 [UCS] Influenza cohort 2008 to 2009 and Immunodeficiency Edit cohort | | | | | | | | | | |
| 2309 | [UCS] Influenza cohort 2008 to 2009 and Heart Disease | | Edit cohort | Remove | | | | | | |
| 2310 | [UCS] Influenza cohort 2008 to 2009 and Hypertension | | Edit cohort | Remove | | | | | | |
| 2311 | [UCS] Influenza cohort 2008 to 2009 and Asthma | | Edit cohort | Remove | | | | | | |
| 2312 | [UCS] Influenza cohort 2008 to 2009 and Renal Disease | | Edit cohort | Remove | | | | | | |
| nowing 1 to 8 of 8 entries | | | | Previous 1 Nex | | | | | | |
| Import Iow 10 🗸 entries | | | | Search: | | | | | | |
| ID 🔺 | Name 🔶 | Description | | Actions | | | | | | |
| 115 | [UCS] Visit Length Average | | | Remove | | | | | | |



Comorbidities - Length of Visit

Among adults hospitalized with influenza what is the length of stay in hospital for patients with (a) Diabetes, (b) Lung Disease, (c) Cancer, (d) Immunodeficiency, (e) Heart Disease, (f) Hypertension, (g) Asthma, (h) Kidney Disease (1) Overall and (2) per subgroup >= 65 and < 65?

| | CONCEPT ID | | DOMAIN |
|------------------|------------|---------------------------------------------|-------------|
| Type 2 diabetes | 201826 | Type 2 diabetes mellitus | Condition |
| Lung disease | 255573 | Chronic obstructive lung disease | Condition |
| Cancer | 443392 | Malignant neoplastic disease | Condition |
| | 4144289 | H/O: malignant neoplasm | Observation |
| Immunodeficiency | 433740 | Immunodeficiency disorder | Condition |
| Heart Disease | 321588 | Heart disease | Condition |
| Hypertension | 316866 | Hypertensive disorder | Condition |
| Asthma | 317009 | Asthma | Condition |
| | 45768812 | Anemia in chronic kidney disease | |
| | 194385 | Aneurysm of renal artery | |
| | 46271022 | Chronic kidney disease | |
| | 192279 | Disorder of kidney due to diabetes mellitus | |
| Popal Discaso | 4263367 | Glomerulonephritis | Condition |
| Relial Disease | 261071 | Glomerulosclerosis | Condition |
| | 201313 | Hypertensive renal disease | |
| | 193253 | Nephritis | |
| | 195314 | Nephrotic syndrome | |
| | 192359 | Renal failure syndrome | |

Overall - Length of Visit

Among adults hospitalized with influenza what is the length of stay in hospital for patients with (a) Diabetes, (b) Lung Disease, (c) Cancer, (d) Immunodeficiency, (e) Heart Disease, (f) Hypertension, (g) Asthma, (h) Kidney Disease (1) Overall?

| 🕋 Home | 🐂 Character | ization #141 | | | | | | | | | | | | | | | | | |
|--------------------|-------------------|-----------------|-----------------|------------------------------|--------------------------|----------------------------|-------------------------------|--------------------------|------------------------------|-----------------------------|-----------------------------|-------------------------------|--------------------------------|---------------------------------|-------------------------------|----------------------------------|-------------------------------------------|-------------------------------|--------------------------------|
| 🛢 Data Sources | [UCS] Influenza a | and Comorbiditi | es Visit Length | | | | | | | | | | | | | | | 8 | × 42 🗎 |
| Q Search | Design | Executions | Utilities | | | | | | | | | | | | | | | | |
| 😭 Concept Sets | Executions | > Reports | for SynPu | ıf 116k | | | | | | | | | | | | | | | |
| Cohort Definitions | Date: 03/23/20 | 21 6:21 PM D | Design: -12980 | 44493 Results | : 1 reports | | | | | | | | | | | | | | |
| Characterizations | Filter panel | | | | | | | | | | | | | | | | | | |
| 📥 Cohort Pathways | Cohorts | | | | | | An | alyses | | | | | | Domains | | | | | |
| 🕈 Incidence Rates | 8 items se | elected | | | | | • | UCS] Visit Leng | th Average | | | | • | Visit | | | | | • |
| 호 Estimation | | | | | | | | | | | | | | | | | | | |
| 😵 Prediction | VISIT / [UCS |] Visit Leng | h Average | | | | | | | | | | | | | | | | |
| 🚍 Jobs | Export Show | w 10 🗸 entri | es | | | | | | | | | | | | | | | Search: | |
| Configuration | Covariate | Explore | Concept | [UCS] Influe 2008 to 2009 | nza cohort and Asthma | [UCS] Influ 2008 to 200 | ienza cohort 19 and Cancer | [UCS] Infl 2008 to 20 | uenza cohort 109 and COPD | [UCS] Influ 2008 to 2009 | enza cohort and Diabetes | [UCS] Influen: to 2009 and | a cohort 2008 Heart Disease | [UCS] Influenz to 2009 and H | a cohort 2008 Typertension | [UCS] Influen to 20 Immuno | iza cohort 2008 109 and Ideficiency | [UCS] Influenz to 2009 and | a cohort 2008 Renal Disease |
| | | | | Count 🔶 | Pct 🕴 | Count | Pct | Count | Pct | Count | Pct 🔶 | Count 🕴 | Pct | Count 🔶 | Pct 👙 | Count | Pct 🔅 | Count 🍦 | Pct 👻 |
| | Visit Length | Explore 👻 | 0 | 9 | 0.00% | 9 | 0.00% | 10 | 0.00% | 8 | 0.00% | 8 | 0.00% | 6 | 0.00% | 7 | 0.00% | 9 | 0.00% |
| | Showing 1 to 1 c | of 1 entries | | | | | | | | | | | | | | | | | Previous 1 Next |

Subgroup - Length of Visit

Among adults hospitalized with influenza what is the length of stay in hospital for patients with (a) Diabetes, (b) Lung Disease, (c) Cancer, (d) Immunodeficiency, (e) Heart Disease, (f) Hypertension, (g) Asthma, (h) Kidney Disease per subgroup >= 65 and < 65?

| C Search | Design | Executions | Utilities | | | | | | | | | | | | | | | | | | | | | | | | |
|--------------------|----------------|---------------|---------------|---------------|--------------|---------------|-------------|------------|-------|--------------------|-------------|--------------|-------------|------------|-------|-------|-------------|---------------|------------|------------|-------|---------|------------|---------------|--------------|-------------|-------|
| 🗮 Concept Sets | Executions | > Report | ts for SynF | Puf 116k | | | | | | | | | | | | | | | | | | | | | | | |
| Cohort Definitions | Date: 03/23/20 | 21 6:50 PM | Design: -1923 | 029716 Re | esults: 1 re | ports | | | | | | | | | | | | | | | | | | | | | |
| Characterizations | Filter panel | | - | | | | | | | | | | | | | | | | | | | | | | | | |
| 📥 Cohort Pathways | Cohorts | | | | | | | | Anal | yses | | | | | | | | Do | mains | | | | | | | | |
| Incidence Rates | 8 items s | elected | | | | | | • | [L | / ICS] Visit Le | ngth Ave | rage | | | | | | • | /isit | | | | | | | | • |
| 호 Estimation | | | | | | | | | | | - | _ | | | | | | | | | | | | | | | |
| Prediction | VISIT / [UCS | 5] Visit Leng | gth Average | e / stratifie | ed by >= | = 65 | | | | | | | | | | | | | | | | | | | | | |
| 🖹 Jobs | Export Sho | w 10 🗸 ent | ries | | | | | | | | | | | | | | | | | | | | | | | | |
| 📽 Configuration | | | | [U | JCS] Influe | nza cohort 20 | 008 to 2009 | and Asthma | | ſ | UCS] Influe | nza cohort 2 | 008 to 2009 | and Cancer | | | [UCS] Influ | enza cohort 2 | 008 to 200 | 9 and COPD | | [U0 | S] Influen | za cohort 200 |)8 to 2009 a | nd Diabetes | |
| 🗩 Feedback | Covariate 🍦 | Explore | Concept ID | Count 🚔 | Pct 💧 | >= | 65 | < 6 | 5 | Count | Pct 💧 | >= | 55 | < 6 | 5 | Count | Pct | >= | 55 | < 6 | 55 | Count 🚔 | Pct 💧 | >= (| 5 | < 6 | .5 |
| | | | | count | | Count 🕴 | Pct 🔅 | Count 🕴 | Pct 🔶 | count | | Count 🕴 | Pct 🔅 | Count 🕴 | Pct 🔅 | count | , et a | Count 🍦 | Pct 🔅 | Count 🕴 | Pct 🍦 | count | | Count 🕴 | Pct 🔶 | Count | Pct (|
| | Visit Length | Explore 👻 | 0 | 9 | 0.00% | 5 | 0.00% | 20 | 0.00% | 9 | 0.00% | 8 | 0.00% | 12 | 0.00% | 10 | 0.00% | 9 | 0.00% | 12 | 0.00% | 8 | 0.00% | 8 | 0.00% | 12 | 0.00% |
| | Showing 1 to 1 | of 1 entries | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |



Subgroup – Length of Visit

Among adults hospitalized with influenza what is the length of stay in hospital for patients with (a) Diabetes, (b) Lung Disease, (c) Cancer, (d) Immunodeficiency, (e) Heart Disease, (f) Hypertension, (g) Asthma, (h) Kidney Disease per subgroup >= 65 and < 65?

| | | | | | | | | | | | | | | | | | | | | | | | | | Search: | | |
|---------------|------------|-------------|-------|---------|--------------|---------------|--------------|----------------|-------|---------|--------------|---------------|------------|--------------|-------|-----------------|-------------|---------------|----------|-------------|-------|-------|--------------|---------------|------------|--------------|-----------|
| nza cohort 20 | 08 to 2009 | and Diabete | 5 | [UC | S] Influenza | a cohort 2008 | 8 to 2009 an | nd Heart Disea | ase | [UCS | [] Influenza | a cohort 2008 | to 2009 an | d Hypertensi | on | [UCS] | Influenza c | ohort 2008 to | 2009 and | Immunodefic | iency | [UCS | 6] Influenza | a cohort 2008 | to 2009 an | d Renal Dise | ease |
| >= (| 55 | < | 65 | Count | Det Å | >= | 65 | < 6 | 5 | Count Å | Det 着 | > = | 65 | < 65 | | Count 🏝 🛛 Ret 着 | >= 65 | | < 65 | | Count | Det Á | >= 65 | | < | 65 | |
| Count 🔅 | Pct | Count | Pct | Count # | PCI 🖗 | Count 🕴 | Pct 🍦 | Count 🕴 | Pct 🕴 | count | PCI 👳 | Count 🕴 | Pct 🔅 | Count 🔶 | Pct 🍦 | Count | PCI 🖗 | Count 🍦 | Pct 🕴 | Count 🔶 | Pct 🕴 | count | PCL | Count 🔶 | Pct 🔶 | Count | Pct 🔻 |
| 8 | 0.00% | 12 | 0.00% | 8 | 0.00% | 7 | 0.00% | 11 | 0.00% | 6 | 0.00% | 6 | 0.00% | 0 | 0.00% | 7 | 0.00% | 7 | 0.00% | 7 | 0.00% | 9 | 0.00% | 8 | 0.00% | 11 | 0.00% |
| 2 | | | | | | | | | | | | | | | | | | | | | | | | | | Previo | ous 1 Neo |



Customized features using SQL - Top Drugs

• Among adults hospitalized with influenza what are the top drugs taken during the hospital stay?

Influenza Cohort

- As already defined during this session

Characterization

- Create a new characterization
- Import your influenza cohort
- Create a customised new feature analysis for the drugs below taken during the hospital stay as shown in the slide and import this new feature into the characterization
- Execute and check the results

| | S] Drugs During Hospital Stay.sql 🔀 | |
|----|------------------------------------------------------------------------------------------|------|
| 1 | SELECT | |
| 2 | CAST (drug_concept_id AS BIGINT) * 1000 + @analysis_id AS covariate | id, |
| 3 | c.concept_name AS covariate | name |
| 4 | drug_concept_id AS concept_id | i, |
| 5 | COUNT (*) AS sum_value | , |
| 6 | COUNT(*) * 1.0 / stat.total_cnt * 1.0 AS average_va | lue |
| 7 | FROM (| |
| 8 | SELECT DISTINCT | |
| 9 | drug_concept_id, | |
| 10 | cohort.subject_id, | |
| 11 | cohort.cohort_start_date | |
| 12 | FROM @cohort_table cohort | |
| 13 | INNER JOIN @cdm_database_schema.drug_exposure ON cohort.subject_id = drug_exposure.perso | n_id |
| 14 | WHERE drug_exposure_start_date >= cohort.cohort_start_date | |
| 15 | AND drug_exposure_start_date <= cohort.cohort_end_date | |
| 16 | AND drug_concept_id != 0 | |
| 17 | AND cohort.cohort_definition_id = @cohort_id | |
| 18 |) drug_entries | |
| 19 | JOIN @cdm_database_schema.concept c ON drug_entries.drug_concept_id = c.concept_id | |
| 20 | CROSS JOIN (SELECT COUNT (*) total_cnt | |
| 21 | FROM @cohort_table | |
| 22 | WHERE cohort_definition_id = (cohort_id) stat | |
| 23 | GROUP BY drug_concept_id, c.concept_name, stat.total_cnt | |

Customized features using SQL

Top Drugs

| UCS] Influenza and Pneumonia Top Drugs | | | | | | | | | | | | | |
|---------------------------------------------------------------------|---------|----------|-----------------------|----------------------|---------------|------------------|----------|--|--|--|--|--|--|
| Design Executions Utilities | | | | | | | | | | | | | |
| kecutions > Reports for SynPuf 116k | | | | | | | | | | | | | |
| ate: 03/23/2021 7:20 PM Design: 206769270 Results: 1 reports | | | | | | | | | | | | | |
| Filter panel | | | | | | | | | | | | | |
| Cohorts | | | Analyses | ; | | | | | | | | | |
| [UCS] Influenza cohort 2008 to 2009, [UCS] Pneumonia 2008 to 2009 🔹 | | | | | | | | | | | | | |
| UCSJ Influenza conort 2008 to 2009, [UCS] Pheumonia 2008 to 2009 🔹 | | | | | | | | | | | | | |
| DRUG / [UCS] Drugs During Hospital Stay | | | | | | | | | | | | | |
| Export Export comparison Show 10 V entries Search: | | | | | | | | | | | | | |
| Covariate | Explore | Concept | [UCS] Influenza 20 | cohort 2008 to 09 | [UCS] Pneumor | iia 2008 to 2009 | Std diff | | | | | | |
| | | ID | Count 🔺 | Pct 🕴 | Count 🔶 | Pct 🕴 | | | | | | | |
| Epoetin Alfa | Explore | 1301125 | 0 | 0.00% | 7 | 1.10% | 0.0000 | | | | | | |
| Triamcinolone 10 MG | Explore | 40950844 | 0 | 0.00% | б | 0.94% | 0.0000 | | | | | | |
| Hydrochlorothiazide 50 MG Oral Tablet | Explore | 19019044 | 0 | 0.00% | 4 | 0.63% | 0.0000 | | | | | | |
| atorvastatin 10 MG Oral Tablet | Explore | 1545997 | 0 | 0.00% | 4 | 0.63% | 0.0000 | | | | | | |
| Omeprazole 20 MG Delayed Release Oral Capsule | Explore | 19019418 | 0 | 0.00% | 4 | 0.63% | 0.0000 | | | | | | |
| Enalapril Maleate 20 MG Oral Tablet | Explore | 40165773 | 0 | 0.00% | 4 | 0.63% | 0.0000 | | | | | | |
| Cefazolin 500 MG Prefilled Syringe | Explore | 36889829 | 0 | 0.00% | 4 | 0.63% | 0.0000 | | | | | | |
| Metolazone 5 MG Oral Tablet | Explore | 907020 | 0 | 0.00% | 3 | 0.47% | 0.0000 | | | | | | |
| Acetaminophen 650 MG / propoxyphene napsylate 100 MG Oral Tablet | Explore | 1129105 | 0 | 0.00% | 3 | 0.47% | 0.0000 | | | | | | |
| Spironolactone 50 MG Oral Tablet | Explore | 970283 | 0 | 0.00% | 3 | 0.47% | 0.0000 | | | | | | |





BREAK

10 mins

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Treatment Pathways and Incidence Rates

Cohort Pathways Study Example

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COLLOQUIUN

Characterizing treatment pathways at scale using the OHDSI network

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Edited by Richard M. Shiffrin, Indiana University, Bloomington, IN, and approved April 5, 2016 (received for review June 14, 2015)



Cohort treatment pathways study

- Examined treatment pathways for type 2 diabetes, hypertension and depression
- Large scale study 4 countries, 250 million patients
- Goal: what proportion of patients had 1 drug, how many had 2, 3, 4 etc. and sequence
- Treatment pathways becoming more consistent over time, but still significant variation
 - Diabetes most likely to see a single first-line medication, metformin
 - About 10% of diabetes and depression patients and almost 25% of hypertension patients followed a treatment pathway that was unique within the cohort.
- Electronic health records and administrative claims data revealed similar results
- Large scale international observational research is feasible

Source: Characterizing treatment pathways at scale using the OHDSI network | PNAS

Heterogeneity in treatments



Japan differs in use of Metformin (due to genetics)

No agreement on depression



Treatment pathways for diabetes



≣IQVIA

Data partners: 250 million records

| Data Name | Name | Description | Records (M) |
|-----------|--------------------------------------------------------------------|----------------------------------------|----------------|
| AUSOM | Ajou University School of Medicine | South Korea; inpatient hospital EHR | 2 |
| CCAE | MarketScan Commercial Claims and Encounters | US private-payer claims | 119 |
| CPRD | UK Clinical Practice Research Datalink | UK; EHR from general practice | 11 |
| CUMC | Columbia University Medical Center | US; inpatient EHR | 4 |
| GE | GE Centricity | US; outpatient EHR | 33 |
| INPC | Regenstrief Institute, Indiana Network for Patient Care | US; integrated health exchange | 15 |
| JMDC | Japan Medical Data Center | Japan; private-payer claims | 3 |
| MDCD | MarketScan Medicaid Multi-State | US; public-payer claims | 17 |
| MDCR | MarketScan Medicare Supplemental and Coordination of Benefits | US; private and public-payer claims | 9 |
| OPTUM | Optum ClinFormatics | US; private-payer claims | 40 |
| STRIDE | Stanford Translational Research Integrated Database Environment | US; inpatient EHR | 2 |
| HKU | Hong Kong University | Hong Kong; EHR | 1 |



ATLAS Cohort Treatment Pathways process – part 1

| ATLAS | | | | | | | | 👃 <u>elizab</u> | <u>peth.betts@iqvia.com</u> | Cohort pathways – | New Pathway |
|--------------------|---------------------------------------|-----------------------------------------------------------------------|---------------------------------------------------------|--------------|----------------------------------------|---------------------|-----------------|----------------------|----------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|--------------------------------------|
| Home | ♦ Influenza cohort | | | | | | | | | analysis | |
| Data Sources | 🛓 Cohort Pathways | | | | | | | | | anaryoio | |
| Search | | | | | | | | | New Pathway Analysis | | |
| Concept Sets | | Show 15 v entries | | | | | | | Filter | | |
| Cohort Definitions | | Showing 1 to 15 of 58 entries | | | | | | | Previous 1 2 3 4 Next | Import – select coh | orts from list |
| | ▼ Created | Id 🍦 Name | | Created | | Updated | ¥ Author | | | | |
| Characterizations | 2+ Weeks Ago (58) | 124 pioneer_as | | 02/24/2021 4 | k17 PM | 02/24/2021 4:19 PM | gargyrio | u@uk.imshealth.com | | | |
| Cohort Pathways | ▼ Updated | 123 pioneer | | 02/22/2021 1 | 2:53 PM | 02/22/2021 12:55 PM | gargyrio | u@uk.imshealth.com | | | |
| | 2+ Weeks Ago (58) Y Author | 122 DN_Training_G/GEJ | | 02/19/2021 8 | 859 AM | 02/19/2021 8:59 AM | jli2@cn.ir | mshealth.com | | | |
| Incidence Rates | hmorgan ATLAS | | | | | | | | | | |
| Profiles | jii2@cn.ir 🖀 Home | ← Influenza cohort | Choose a Cohort d | efinition | | | | | × | Give the New Coh | ort Pathway a |
| Estimation | kristin.ko: Lazendo 🗧 Data Sources | 🛔 New Cohort Pathway | | Show 1 | 15 💙 entries | | | F | iiter: | descriptive name a | |
| | Q Search | New Cohort Pathway | | Showin | g 1 to 15 of 3,371 | | | Previous | 1 2 3 4 5 225 Next | descriptive name a | |
| Prediction | Constant Sata | Desires Descriptions Individual | ▼ Last Modified | Id | Name 🤅 | Created | Updated | + Author | \$ | (areen button) | |
| Jobs | Cohert Definitions | Design Executions Ountries | 2+ Weeks Ago (3289) Last Week (52) This Week (30) | 4225 | Influenza cohort | 03/18/2021 4:25 PM | 03/18/2021 4:28 | 8 PM elizabe | th.betts@iqvia.com | (groon batton) | |
| Configuration | Conore Demittions | Cohort Pathway is defined as the process of generating an aggregate | T Author | 3782 | ITT (Nov19 - | 01/14/2021 5:47 PM | 03/18/2021 10: | 37 AM gargyri | iou@uk.imshealth.com | | * |
| | Characterizations | Target Cohorts | hmorganstewart@uk. (587) | 4224 | tttest | 03/18/2021 8:49 AM | 03/18/2021 8: | ATLAS | | | 🐥 <u>elizabeth.betts@iqvia.com</u> |
| Feedback | 📥 Cohort Pathways | Each of the Target Cohorts will be analyized for the pathways through | ctorre@quintiles.onm | ¥ 4223 | <u>710716</u> | 03/17/2021 6:02 PM | 03/17/2021 6: | # Home | € Influenza cohort | | |
| | Incidence Rates | Import | | 4201 | Mitch deKovens | 02/12/2021 7:12 PM | 02/17/2021 4 | Data Sources | Cohort Pathway #125 | | |
| | | Show 10 V entries | | 4201 | HCC-2 | 05/12/2021 7:12 PW | 05/17/2021 4 | Q Search | Influenza Cohort pathway | | 🖻 × 🖉 🧰 |
| | Profiles | ID A Name | | | Mitch deKovens | | | 🛱 Concept Sets | Design Executions Utilities | | |
| | 🖧 Estimation | | | 4222 | HCC other way | 03/17/2021 4:30 PM | 03/17/2021 4: | Cohort Definitions | Cohort Pathway is defined as the process of generating an aggregated se | sequence of transitions between the Event Cohorts among those people in the Target Cohorts. | |
| | 😻 Prediction | Chaming One Oref Orenhing | | | Mitch deKovens | | Ŀ | Characterizations | Target Cohorts | | |
| | n loba | showing 0 to 0 or 0 entries | | 4221 | cabozantinib in HCC one way | 03/17/2021 4:26 PM | 03/17/2021 4: , | 📥 Cohort Pathways | Each of the Target Cohorts will be analyized for the pathways through the | e event cohorts. | |
| | Jobs | Event Cohorts | | | Mitch deKovens | | | Incidence Rates | Import | | |
| | 📽 Configuration | Each Event Cohort defines the step in a pathway that may occur for a | p | 4211 | cabozantinib in HCC-3 | 03/15/2021 6:44 PM | 03/17/2021 4: | Profiles | Show 10 v entries | | Search: |
| | Feedback | Import | | | Mitch deKovens | | ٥ | A Estimation | 4225 Influenza cohort | | Edit cohort Remove |
| | | Show 10 Y entries | | 4220 | <u>cabozantinib in</u> <u>HCC-4</u> | 03/17/2021 3:55 PM | 03/17/2021 4: | Prediction | Showing 1 to 1 of 1 entries | | Previous 1 Nex |
| | | ID A Name | | 1210 | COPY OF: | 02/17/2021 0.57 444 | 02/17/2021 1/ | 🗄 Jobs | Event Cohorts | | |
| | | | | 4219 | Covid base | 03/17/20219:57 AM | 03/17/2021 1 | Configuration | Each Event Cohort defines the step in a pathway that may occur for a perso | rson in the Target Cohort. | |
| | | | | 4116 | [ECORE GS] | 03/01/2021 11:18 AM | 03/17/2021 9: | Feedback | Import | | |
| | | Showing 0 to 0 of 0 entries | | | [PASC] COVID | | | | Show 10 v entries | | Search: |
| | | Analysis Settings | | 4218 | with post-acute sequela | 03/16/2021 9:31 PM | 03/16/2021 9: | | ID A Name | | |
| | | The following set of parameters will be used when performing the pat | th | | conditions | | | | Showing 0 to 0 of 0 antriar | No data available in table | Previous Nex |
| | Anache 2.0 | Combination Window: 0 Window of time when two e | w | map to ou co | IPASCI COVID | unorn. | | | Analysis Settings | | |
| | Apartine Log | | | | | | | | The following set of parameters will be used when performing the pathway | vay analysis. | |
| | | | | | | | | Apache 2.0 | Combination Window: 0 Window of time when two event | nt cohorts need to overlap to be considered a combination. | |
| | | | | | | | | open source software | Minimum cell count: 0 Minimum number of subjects in | n the target cohort for a given event in order to be counted in the pathway. | |
| | | | | | | | | CHDSI | Maximum path length: 5 Maximum number of steps in a g | given pathway to be included in the sunburst plot. | |
| | | | | | | | | join the journey | | | |

ATLAS Cohort Treatment Pathways process – part 2

| ATLAS | | 🐥 🛛 <u>elizabeth.betts@iqvia.com</u> 😢 |
|--------------------|-----------------------------|----------------------------------------------------------|
| 🕆 Home | ♦ Influenza cohort | |
| 🛢 Data Sources | A Cohort Pathway #126 | |
| Q Search | Influenza cohort | B × 42 6 |
| 📮 Concept Sets | Design Executions Utilities | |
| Cohort Definitions | Executions | |
| Characterizations | AmbEMR. 2020/08 | Cancel View latest result I All executions(1) |
| 🔒 Cohort Pathways | AmbEMR. 2020/11 | ► Generate ● View latest result i All executions(0) |
| Incidence Rates | Australia. LPD 2020/09 | ► Generate ● View latest result I All executions(0) |
| Profiles | Belgium. LPD 2020/06 | ► Generate ● View latest result i All executions(0) |
| 🖞 Estimation | Brazil. 2018/07 | ► Generate ● View latest result i All executions(0) |
| Prediction | France. LPD 2020/05 | ► Generate ● View latest result i All executions(0) |
| 킄 Jobs | France. DA 2020/Q4 | ► Generate |
| Configuration | Germany. DA 2020Q3 | ► Generate |

- On Executions tab, click Generate to gather data from chosen data source
- View Latest Result
 when finished running



Incidence Rates

| ATLAS | | | | | | 👃 <u>elizabeth.betts@iqvia.com</u> Q | | Select Incidence |
|---------------------|---------------------------------------|--------------------------------------------------------------------------|----------------------------------------------------------------------|----------------------------------------|---------------------|----------------------------------------|------------------------------|----------------------|
| A Home | 🔶 Influenza cohort | | | | | | | rates nonn menu |
| 🛢 Data Sources | 🕴 Incidence Rate Analysis | 1 | | | | | | Click 'now on obvio' |
| Q Search | | La companya con con com | M antice | | | New Analys | is | |
| 😭 Concept Sets | | Column visibility Copy CSV 310W 13 | enuies | | | Previous 1 2 3 4 5 12 N | | DULION |
| Scohort Definitions | | Showing 1 to 15 of 171 entries | | Created | Updated | Author | ÷ | |
| | ▼ Last Modified 2+ Weeks Ago (171) | 230 <u>COPY OF: [China Study] Mania in bipolar</u> | disorder IR analysis -long term effect (2) | 03/03/2021 6:48 AM | 03/03/2021 6:51 AM | jli2@cn.imshealth.com | | |
| Characterizations | ▼ Author | 229 AML an Heart toxicity | | 02/08/2021 6:51 PM | 02/08/2021 6:51 PM | denys.kaduk@odysseusinc.com | | |
| 🚠 Cohort Pathways | hmorganstewart@uk.imshealth.com | m (26) 228 <u>Shingrix GBS</u> | | 12/07/2020 6:28 PM | 12/07/2020 6:28 PM | mgoodman2@us.imshealth.com | | Import select |
| | kristin.kostka@iqvia.com (23) | 223 [Takeda] Androgen Therapy AE | | 11/12/2020 7:26 AM | 11/27/2020 6:21 AM | xialin.wang@cn.imshealth.com | | import – select |
| Incidence Rates | gargyriou@uk.imshealth.com (23) | 17. Z26 [Takeda] Androgen Therapy AE 1 year inclusion | cidence rate analysis | 11/18/2020 7:07 AM | 11/27/2020 2:32 AM | xialin.wang@cn.imshealth.com | | cohorts from list |
| Profiles | | 227 <u>contraception</u> | | 11/25/2020 2:13 PM | 11/25/2020 2:14 PM | ctorre@quintiles.onmicrosoft.com | | |
| | | 222 <u>Influenza ana</u> | | 11/11/2020 1:24 AM | 11/12/2020 6:40 PM | mgoodman2@us.imshealth.com | | |
| A Estimation | | 192 <u>OT2DSI -1 days</u> | | 10/13/2020 2:49 PM | 11/11/2020 12:06 PM | gargyriou@uk.imshealth.com | | |
| Prediction | | 129 <u>OT2DSI</u> | | 07/29/2020 12:16 PM | 11/11/2020 12:06 PM | gargyriou@uk.imshealth.com | | |
| * Frediction | | 221 <u>OT2DSI -1 days (1)</u> | | 11/09/2020 7:35 PM | 11/09/2020 7:35 PM | admin@odysseusinc.com | | |
| 📑 Jobs | ATLAS | | | | | 🐥 <u>eliz</u> | <u>abeth.betts@iqvia.com</u> | |
| Configuration | 🕆 Home | ← Influenza cohort | | | | | | |
| 🗩 Feedback | 🛢 Data Sources | 9 New Incidence Rate Analysis | | | | | | Give the New |
| | Q Search | New Incidence Rate Analysis | | | | | | Incidence rates |
| | 🍹 Concept Sets | Definition Concept Sets Generation Utilities | | | | | | analysis a |
| | Cohort Definitions | Study Cohorts | | | | | | descriptive name |
| | | | Target Cohorts | | Outcome Cohorts | | | |
| | Characterizations | | Add Target Cohort | | Add Outcome Cohort | | | and SAVE |
| | 🚠 Cohort Pathways | Time At Risk | | | | | | |
| | | Time at risk defines the time window relative to the cohort start or end | date with an offset to consider the person 'at risk' of the outcome. | | | | | |
| | Incidence Rates | Time at risk starts with start date ✓ plus 0 ▼ days. | | | | | | |
| | Profiles | Time at risk ends with start date ♥ plus 0 ♥ days. | | | | | | Coloct toward and |
| | Tromes | | | | | | | Select target and |
| | اللهِ Estimation | No study window defined. Add Study Window | | | | | | outcome cohorts, set |
| | Prediction | Stratify Criteria: You can provide optional stratification criteri | a to the analysis that will divide the population into unique group | os based on their satisified criteria. | | | | Time at Risk and |
| | Jobs | New stratify criteria Please select a qualifying inclu | usion criteria to edit. | | | | | Stratify criteria |
| | 🎕 Configuration | | | | | | | Oranny ontena |
| | Feedback | | | | | | | |
| | | I | | | | | | |

Incidence Rates - Example

Among adults hospitalized with pneumonia, how many died within 90 days of hospitalization? What is the mortality rate?

| $\leftrightarrow \rightarrow G$ | training.atlasplus.imshealth.com/#/iranalysis/243 | | | | | | | | | |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|-------------------|-----------------|--|--|--|--|--|--|
| ATLAS | | | | | | | | | | |
| 🖶 Home | Incidence Rate Analysis #243 | | | | | | | | | |
| 🛢 Data Sources | [UCS] Pneumonia Death Rate | | | | | | | | | |
| Q Search | Definition Concept Sets Generation Utilities | | | | | | | | | |
| 😭 Concept Sets | Study Cohorts | Treast Cobaste | [| Outroma Cabasta | | | | | | |
| Cohort Definitions | × | #2316:[UCS] Pneumonia | #2277:[UCS] Death | | | | | | | |
| Characterizations | Add Target Cohort Add Outcome Cohort | | | | | | | | | |
| 📥 Cohort Pathways | Time At Risk Time at risk defines the time window relative to the cohort start or end date with an offset to consider the person 'at risk' of the outcome. | | | | | | | | | |
| Incidence Rates | Time at risk starts with start date ✓ plus 0 ▼ days. Time at risk ends with start date ✓ plus 90 ▼ days. | | | | | | | | | |
| රාර් Estimation | | | | | | | | | | |
| Prediction | No study window defined. Add Study Window | | | | | | | | | |
| E Jobs | itratify Criteria: You can provide optional stratification criteria to the analysis that will divide the population into unique groups based on their satisified criteria. New stratify criteria Please select a qualifying inclusion criteria to edit. | | | | | | | | | |



Incidence Rates - Example

Among adults hospitalized with pneumonia, how many died within 90 days of hospitalization? What is the mortality rate?

Answer: out of 2,222 patients hospitalized with pneumonia, 2 patients died within 90 days of hospital admission. The mortality rate is 3.72 per 1k year.

| j.atlasplus.imshealth.com/#/iranaly | sis/243 | | | | | Q & (|) 📫 🖸 🔚 | 1 🖈 M 🗄 |
|-------------------------------------|---------------------------|-------|------------------------------------|-------------------------|----------------------------|--------------------|-----------------|------------------------|
| | | | | | | | mfernandezchas@ | Duk.imshealth.com |
| ate Analysis #243 | | | | | | | | |
| Death Rate | | | | | | | | 🗈 🗙 省 💼 |
| Concept Sets Generation Utilities | | | | | | | | |
| əhort: [UCS] Pneumonia 🗸 and ou | tcome cohort: [UCS] Death | ~ | | | | | ► Generate | Legent Analysis to CSV |
| Source Name | Persons | Cases | Proportion [+ -] per 1k persons | Time At Risk (years) | Rate [+ -] per 1k years | Started | Duration | |
| SynPuf 116k | 2,222 | 2 | 0.90 | 538 | 3.72 | 03/24/2021 5:29 PM | 00:01:25 | Reports |
| | | | | | | | | |



ATLAS Treatment Pathways – Exercise

Among adults hospitalized with pneumonia, how many received a combination of any the following drugs (1) acetaminophen (painkiller) (2) amoxicillin (antibiotic) (3) triamcinolone (corticosteroid) and (4) inhaled oxygen prior to hospital admission?

Target Cohort - Pneumonia

Already created during the training or just follow these steps (1) create a copy of the influenza cohort and rename as '[UCS] Pneumonia' (2) Replace the condition 'influenza' by the condition 'pneumonia' and delete the measurement criteria (3) Remove the dates 2008-2009 to capture more patients. You will need a new concept set for 'pneumonia' (concept_id = 255848 and descendants).

Events Cohort – 4 Drugs of Interest

- Create a new cohort for the drug exposure, one for each of the 4 drugs of interest (4 cohorts in total)
- You will need a new concept set for each of these 4 drugs (903963 triamcinolone, 1713332 amoxicillin, 1713332 acetaminophen, 19025274 oxygen)

Treatment Pathway

- Create a new cohort pathway and save it as '[UCS] Pneumonia Treatments'
- Import your target cohort (pneumonia)
- Import your events cohorts (your 4 drug cohorts)
- Execute and check the results



ATLAS Treatment Pathways – Exercise Answer

Among adults hospitalized with pneumonia, how many received a combination of any the following drugs (1) acetaminophen (painkiller) (2) amoxicillin (antibiotic) (3) triamcinolone (corticosteroid) and (4) inhaled oxygen prior to hospital admission?

Answer: only 1.9% received a combination of inhaled oxygen and acetaminophen. Overall, 52 out of 2,234 patients were treated as follows: 46.2% received acetaminophen, 25% received triamcinolone, 15.4% received amoxicillin and 13.5% received inhaled oxygen.







Thank You