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Advancing public health missions with FHIR data analytics and AI/ML

CDC Health Data Innovation Summit

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Public health challenges

What we hear from customers:

Health data is vast, multi-modal, and siloed and non-interoperable. Gaining knowledge is labor intensive and error prone

Need to build **capacity for a unified public health view** that is ready for analysis and intervention
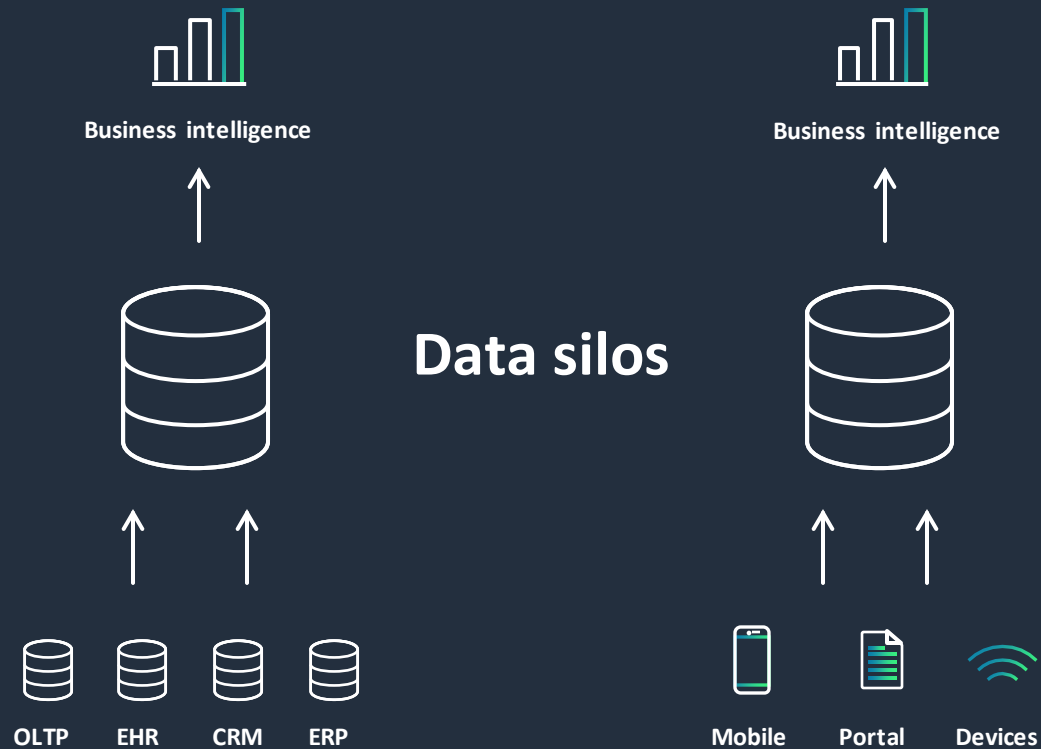
During public health threats **data velocity increases and data volumes can grow rapidly**

Make data actionable using AI/ML and advanced analytics on disparate data

Storing and organizing data so that researchers can **access, study, and cross-reference it to facilitate health related breakthroughs**

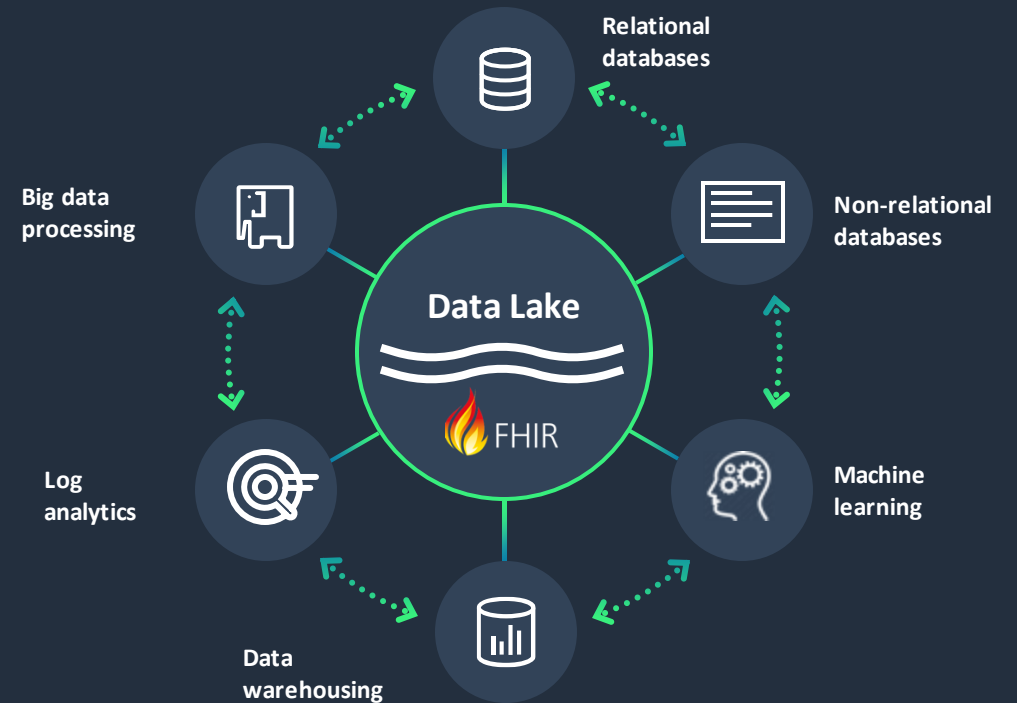**Health disparities** continue to widen and health equity remains a challenge

Breaking down silos and improving interoperability

Business intelligence

Data silos

OLTP   EHR   CRM   ERP

Business intelligence

Mobile   Portal   Devices

to

Modern health data platforms

Data Lake

FHIR

Big data processing

Relational databases

Non-relational databases

Machine learning

Log analytics

Data warehousing

AWS HealthLake

A MANAGED, SECURE, HIPAA-ELIGIBLE FHIR STORAGE, TRANSACTIONAL, AND ANALYTICS SERVICE

Transactional FHIR server to power clinical applications

Store clinical/claims data using interoperability standards
Store patient medical history from multiple data sources in the normalized common data model (FHIR-based) format

Build highly scalable interoperability solutions to meet regulatory needs
Leverage HealthLake Patient Access APIs and Bulk FHIR APIs to meet the 21st Century Cures Act for patient access and interoperability requirements

Build secure applications using SMART on FHIR
Build patient360 end user clinical applications by integrating with OAuth2 compliant authorization service and securely access HealthLake data

AWS HealthLake

A MANAGED, SECURE, HIPAA-ELIGIBLE FHIR STORAGE, TRANSACTIONAL, AND ANALYTICS SERVICE

Unlocking the potential of your health and science data at scale

Automatic transformation of FHIR data to analytics format
Empower healthcare analysts to query HealthLake FHIR data using SQL

Simplify extraction of medical information
Built-in Comprehend Medical to extract medical information from unstructured medical text for easier search and query

Apply analytics and ML on health data
Make predictions and identify trends with health data using Amazon SageMaker machine learning models and Amazon QuickSight analytics

AWS HealthLake analytics and AI/ML integration

NATIVE INTEGRATION WITH ANALYTICS SERVICES ENABLED THROUGH SQL ACCESS TO DATA WITHIN AMAZON HEALTHLAKE OR RETRIEVING DATA FROM AMAZON S3
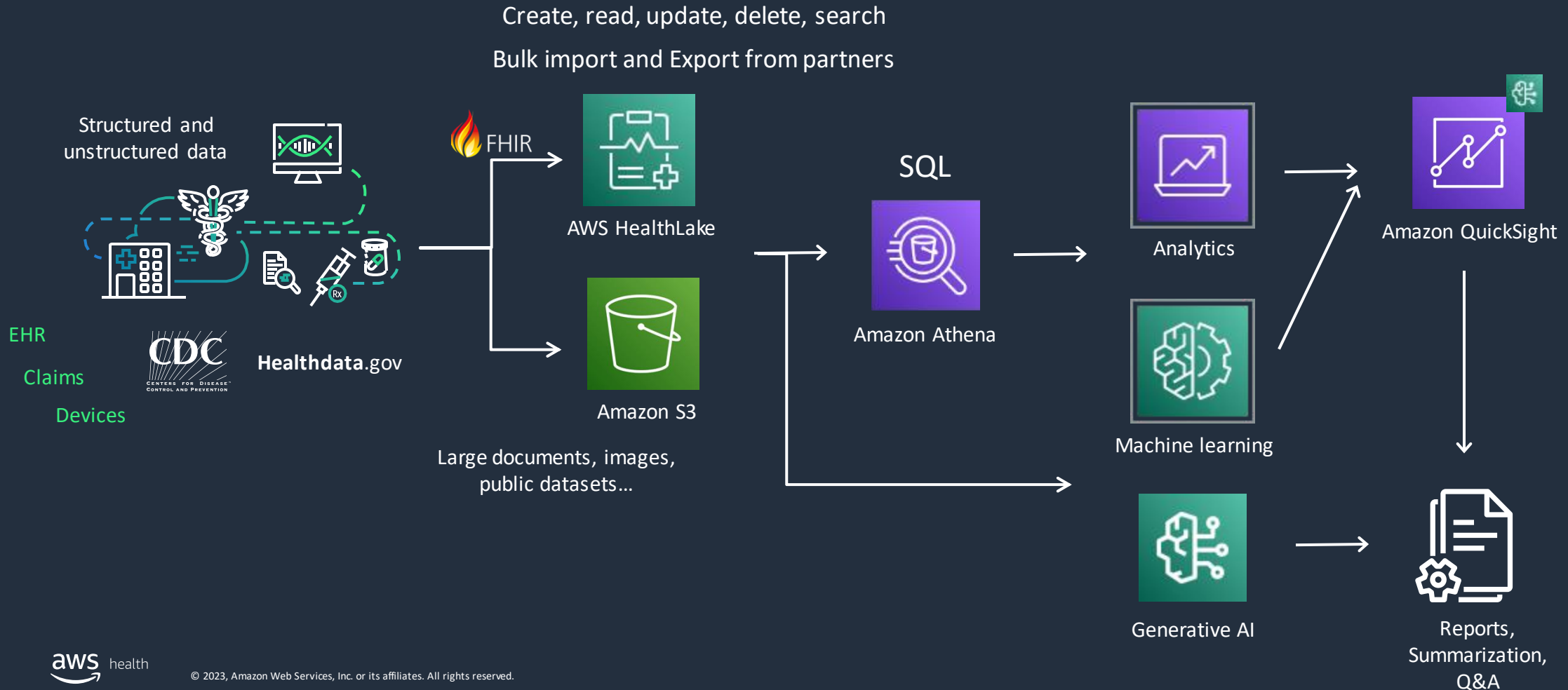
Generative AI for
Public Health
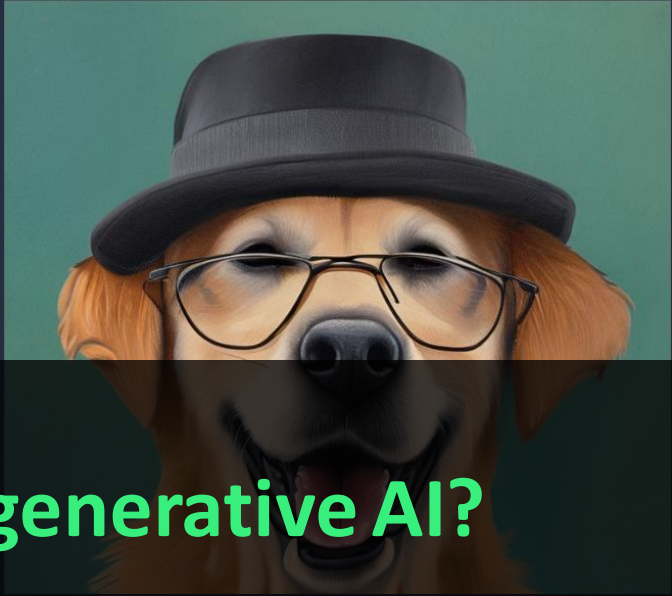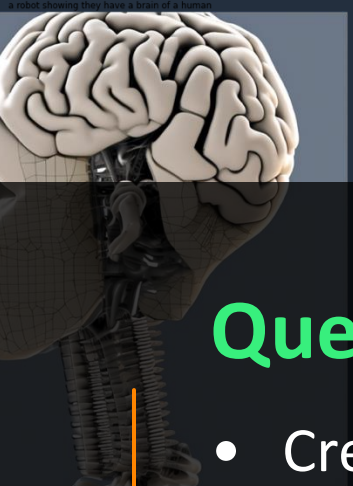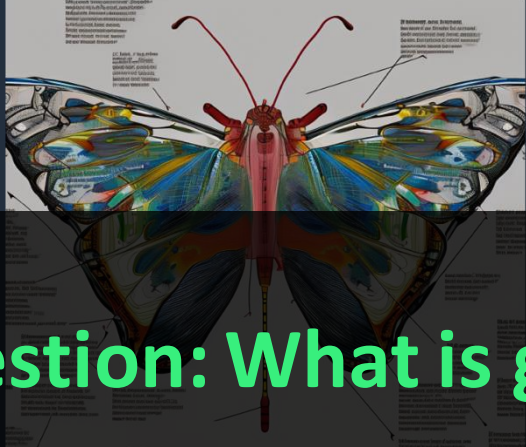
Question: What is generative AI?

- Creates new content and ideas, including conversations, stories, images, videos, and music

- Powered by large models that are pretrained on vast corpora of data and commonly referred to as foundation models (FMs)
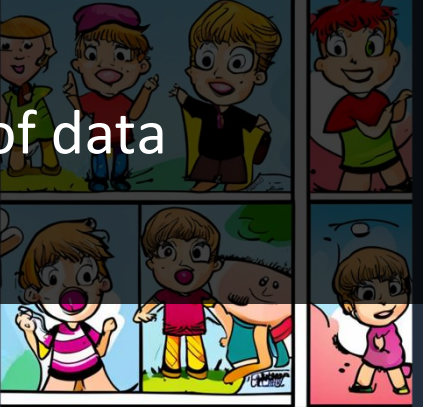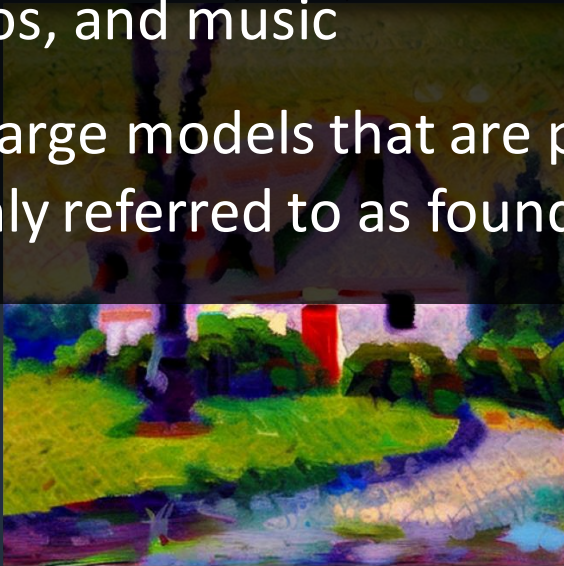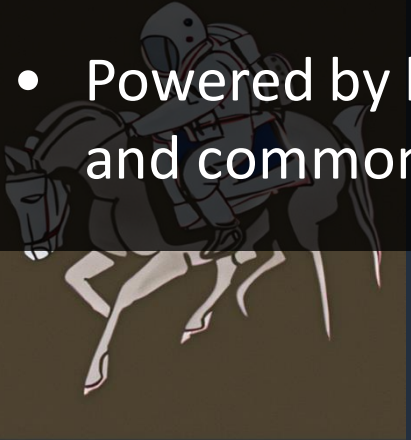
Generative AI is used for a wide range of public health use cases

Research and discovery

Multi-modal data analysis

Patient to trial matching

Generate synthetic data for testing

Data analytics

Analytics and visualization

Automated report generation

Operational Efficiency

Intelligent document processing

Document Q&A and summarization

Citizens Experience

Patient outcome prediction

Personalize patient discharge instructions and treatment plans
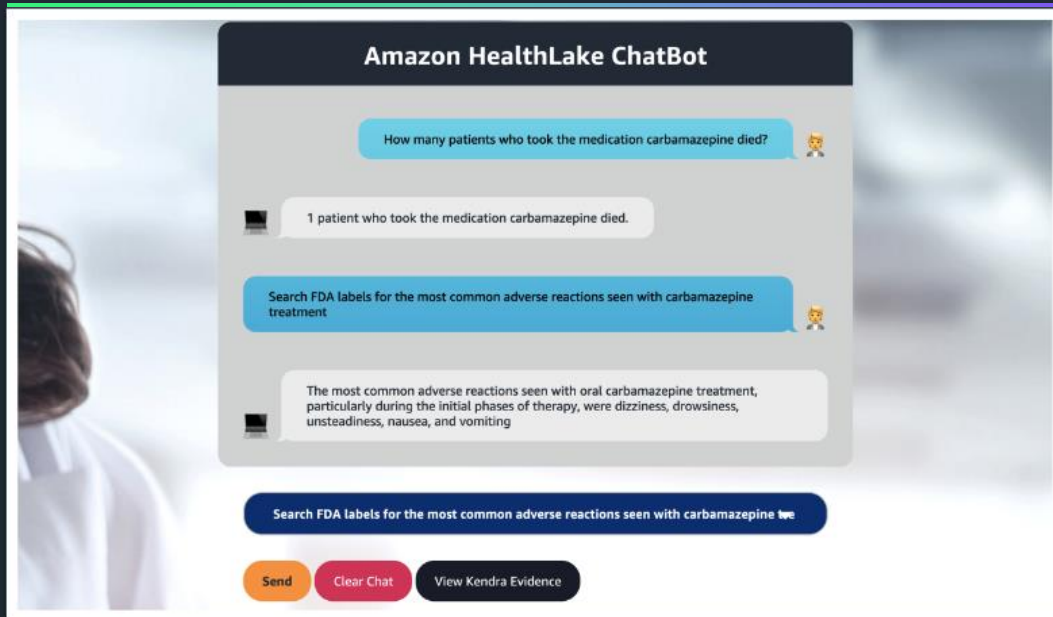
Digital Health

Patient care concierge

Chatbots

Q&A with research data

Traceability into decision making and data generation

Gather new insights from of unstructured data with RAG

Search across large volumes of documents

Use natural language to identify important sections of relevant documents

Summarize key points in unstructured records

Allowing analysts to quickly comprehend large amounts of data

Add insights from unstructured data to improve machine learning

Augment structured data with key insights from unstructured records

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Create BI dashboards with Natural Language

A NEW DASHBOARD BUILDING EXPERIENCE POWERED BY GENERATIVE BI

## Natural language visual creation

Use vague or precise language to generate and add visuals to a dashboard

Quick calculations

Accelerate analysis by easily creating calculations without looking up or learning specific syntax

Visual fine-tuning

Tailor visuals by describing the formatting changes in natural language

Design and functionality are conceptual and can change
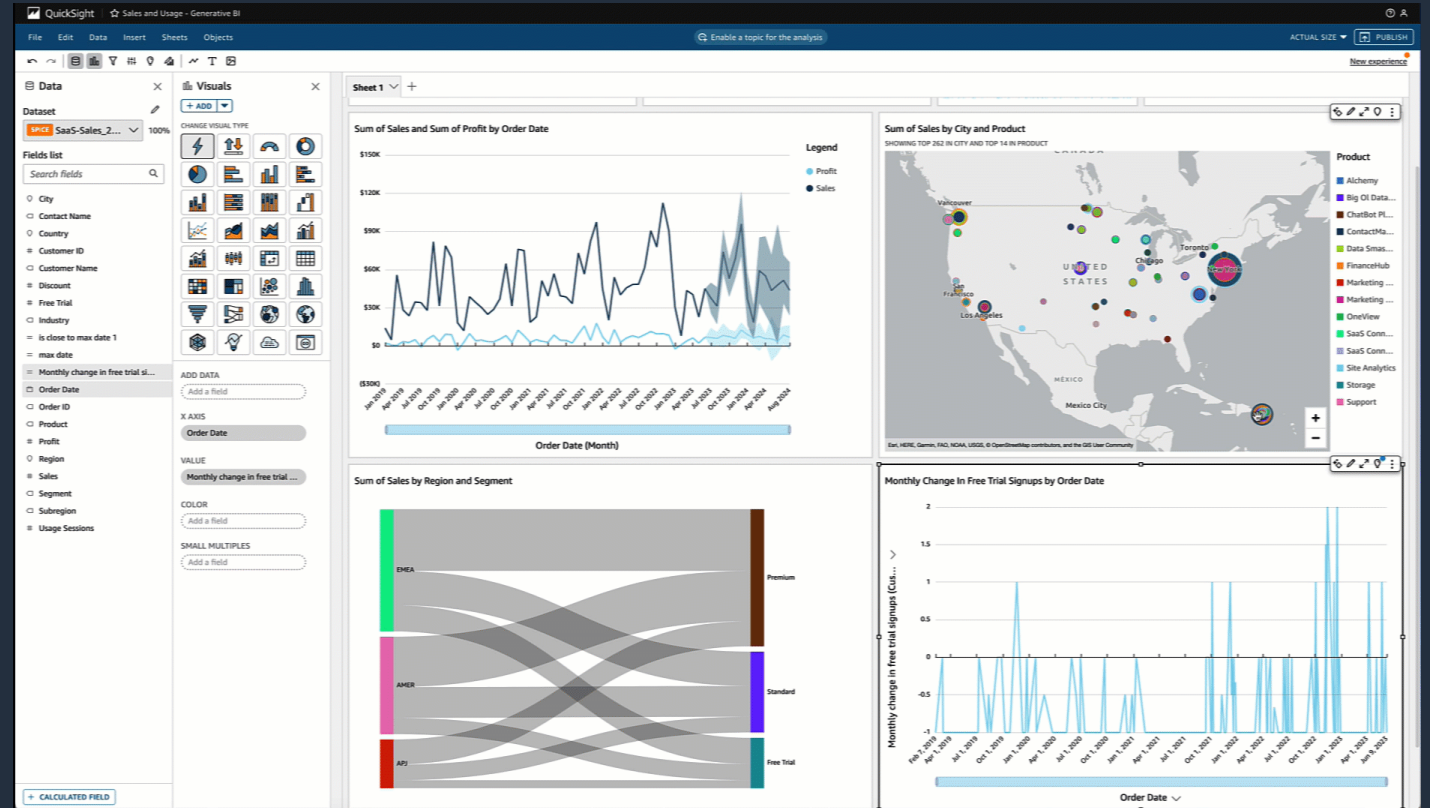
Data stories and reports generated in and by QuickSight

IMPACTFUL DATA STORYTELLING TO DRIVE ACTIONS AND INSIGHT SHARING WITH PARTNERS

Generate stories using AI
Generate cohesive, powerful, and insightful narratives analyzing data with only a few words

Create refined content
Control AI verbosity, customize narrative text, and apply stunning visual themes to bring content to life

Interpret data for others
Help others derive meaning from data and reach conclusions to drive decisions

Governed and always up to date
Quickly and easily share with people who already have access to the data and update data any time

CHOP Accelerates Pediatric Research Using AWS-Powered Data Resources

Challenge:

The Children's Hospital of Philadelphia (CHOP) wanted to address the challenge of storing and organizing increasing amounts of clinical data so that researchers could access, study, and cross-reference it to facilitate medical breakthroughs.

Solution:

CHOP used AWS to build the Gabriella Miller Kids First Data Resource Center (KFDRC), a transformative healthcare discovery solution for multi-disciplinary care. The Center harnesses genomic, clinical, and imaging data to derive insights for children globally across a wide spectrum of diseases.

Benefits:

- Provides the research community with access to genomic and associated clinical data
- Indexed 1.5 PB of genomic, clinical, and imaging data within 1 year
- Increased KFDRC's collaborative potential

Children's Hospital of Philadelphia℠

"Our entire system is built on AWS... we went from zero to managing a few petabytes of genomic data within a year using this setup."

Rush University System for Health Creates a Population Health Analytics Platform on AWS

Challenge:

Rush University System for Health (RUSH) is committed to addressing the underlying causes of the 16-year life expectancy gap among minority and lower-income residents of Chicago's West Side. RUSH sought to build a comprehensive analytics solution to identify and inform scalable interventions for equitable healthcare based on clinical, cardiometabolic, and social needs.

Solution:

With support from Amazon Web Services (AWS), RUSH developed the Health Equity Care & Analytics Platform (HECAP). This platform transforms, aggregates, and harmonizes data from different sources to reflect the complex interplay of clinical and social factors on patient health.

Benefits:

- Aggregates data from multiple sources using HIPAA-eligible services
- Builds a complete patient profile using clinical, social, and patient-generated data
- Produces risk scores and prediction modeling to guide clinical and community intervention
- Advances health equity for minority and underserved patient populations

"We have a great opportunity to start bringing in more data from different sources and use the power of AWS to scale massively across our system, significantly benefiting the care of our patients in Chicago."
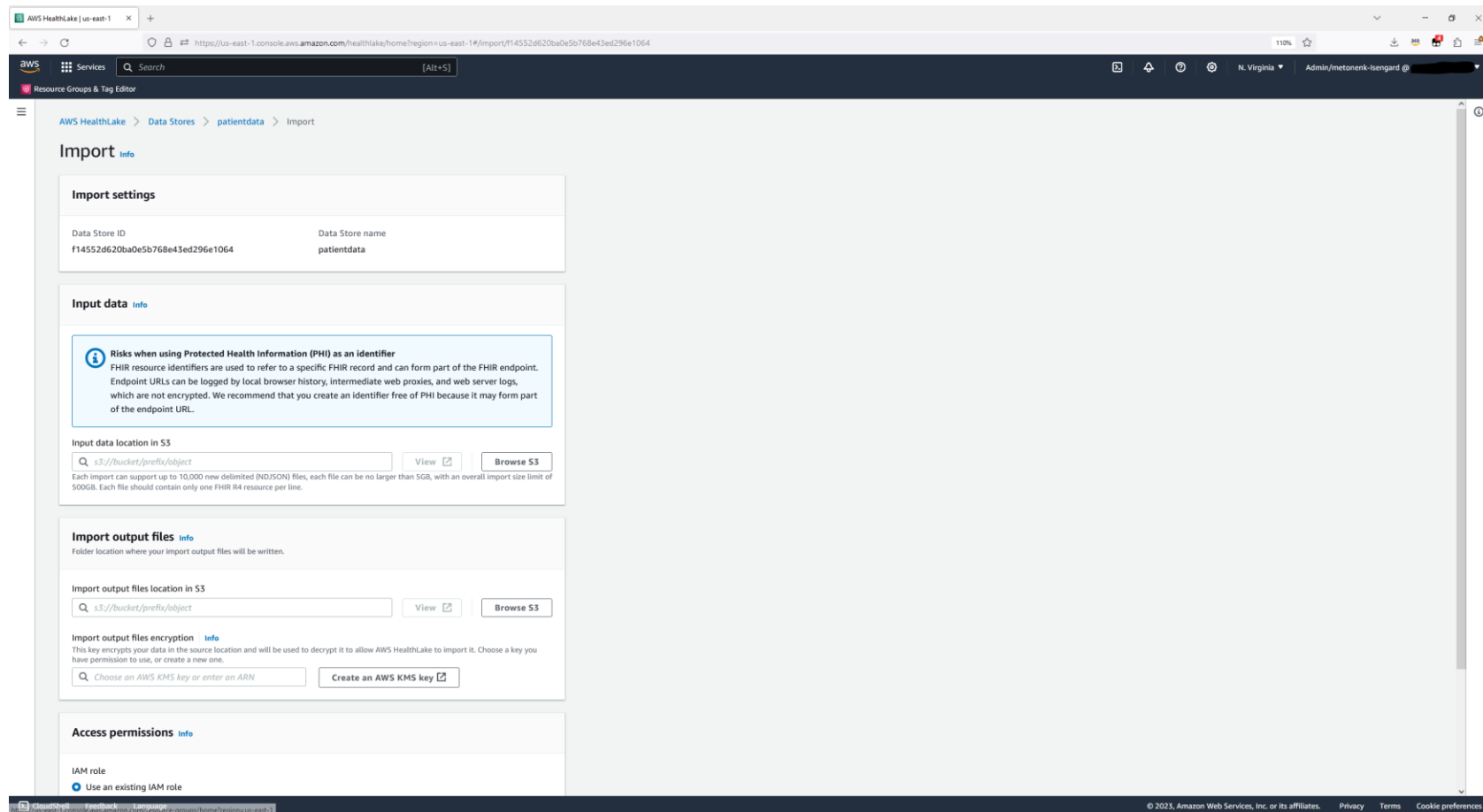
Learn more

aws

Let's derive new insights by combining FHIR health data in AWS HealthLake with non-FHIR environmental data

Use Amazon S3 as data lake for FHIR and non-FHIR data
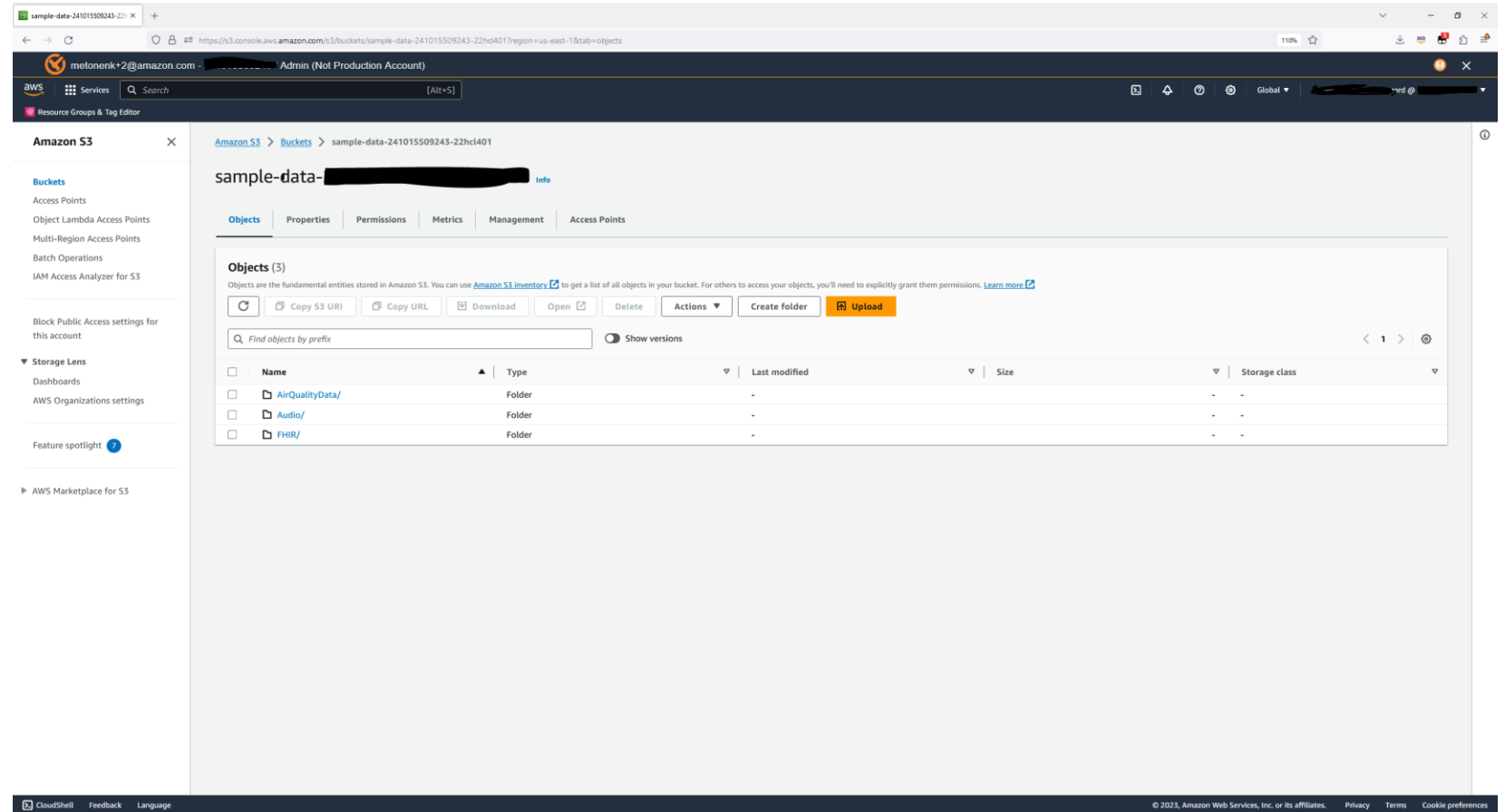
Import files from an Amazon S3 bucket into AWS HealthLake data store

Query HealthLake data from FHIR data source to get the gender count

Query HealthLake data with Athena to get patient demographics

Use patient demographics dataset to visualize the demographic snapshot of patients. Get insights on age, race, and gender
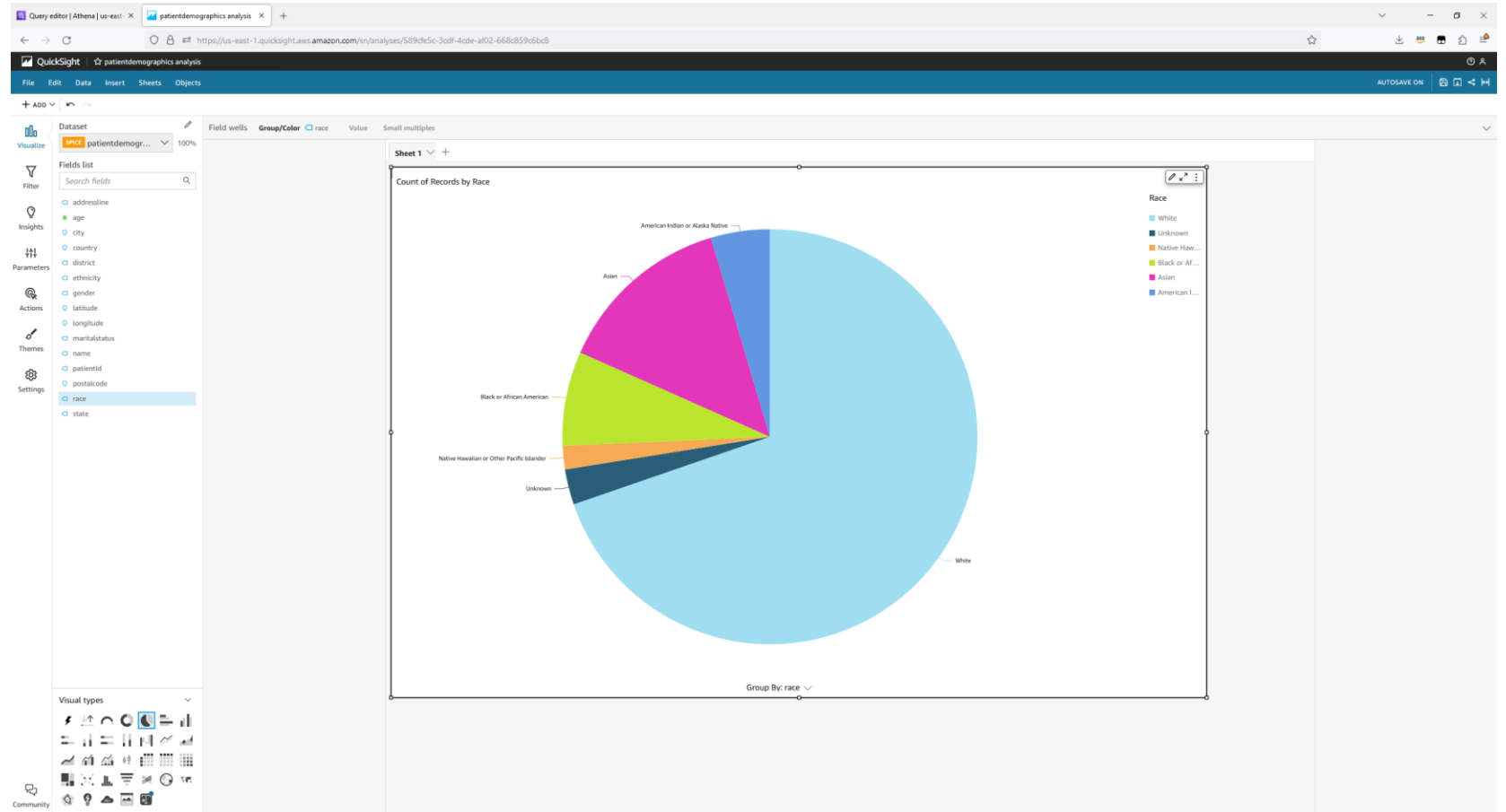
Visualize the location of the patient population from the zip codes table
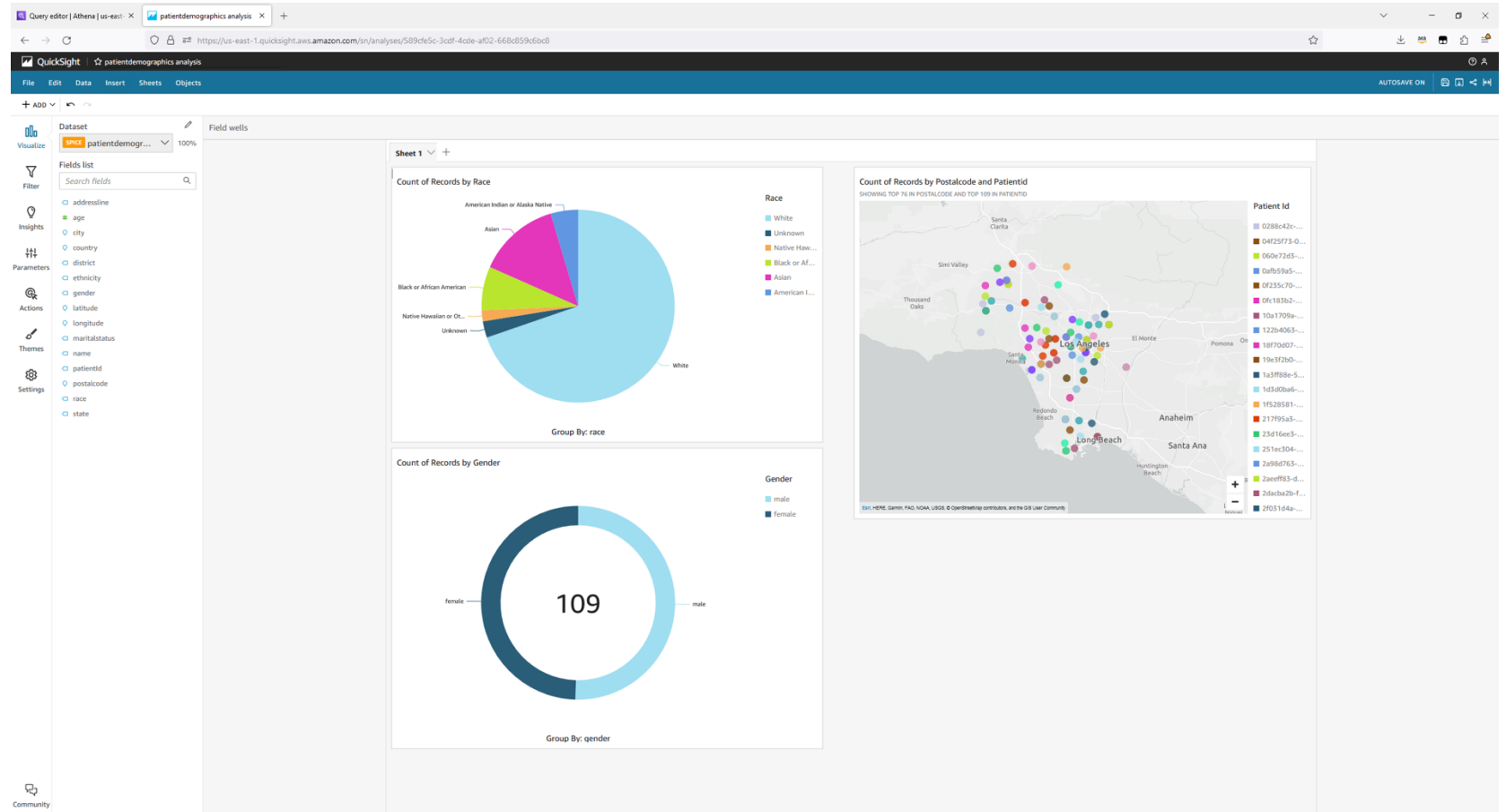
Join the FHIR data in HealthLake with non-FHIR data in Amazon S3

Visualize joined FHIR FHIR and non-FHIR data with QuickSight

Visualize the trends for asthma diagnosis cases and the air quality
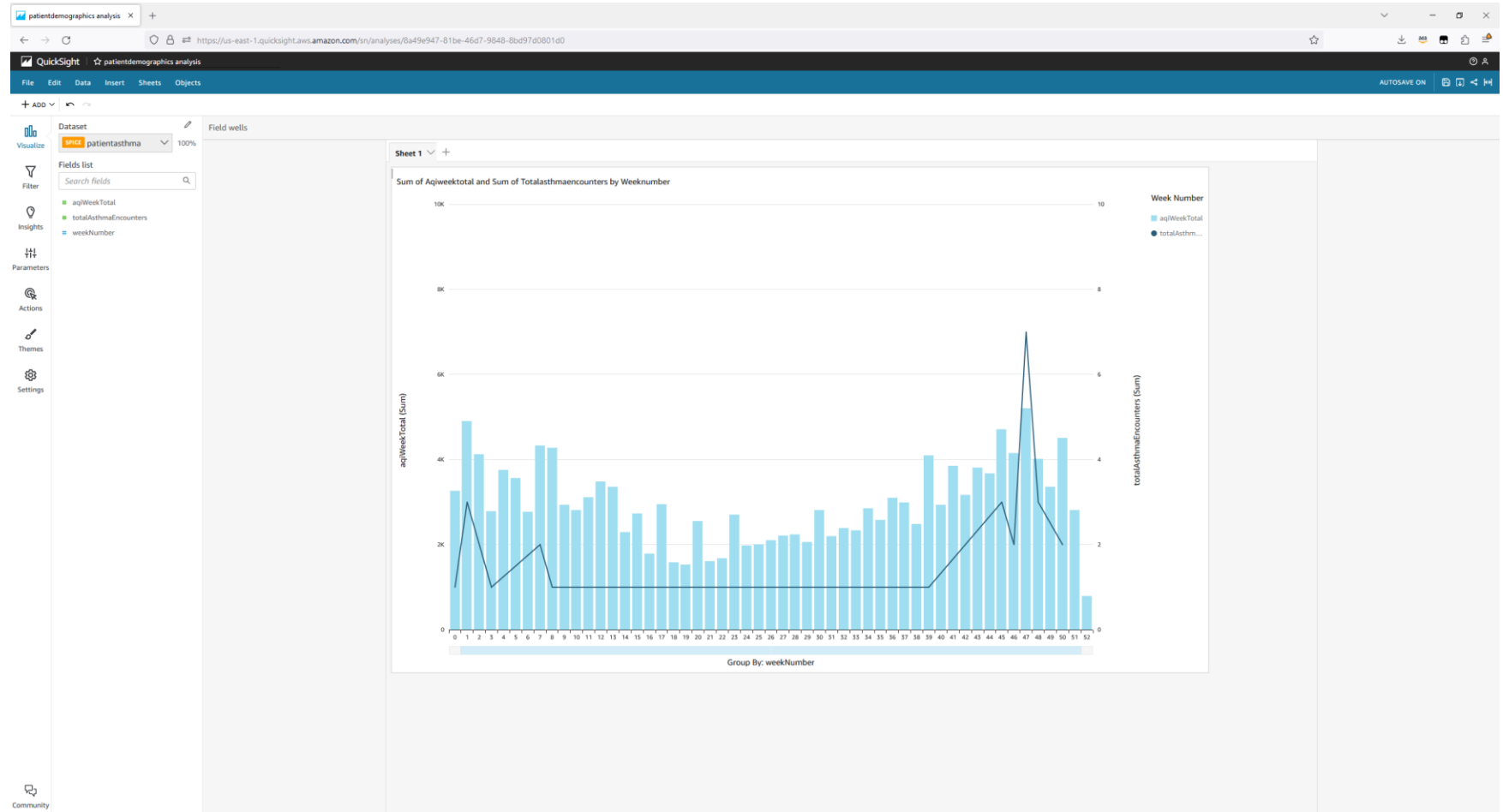
Visual of population demographics with combined FHIR and non-FHIR data sources
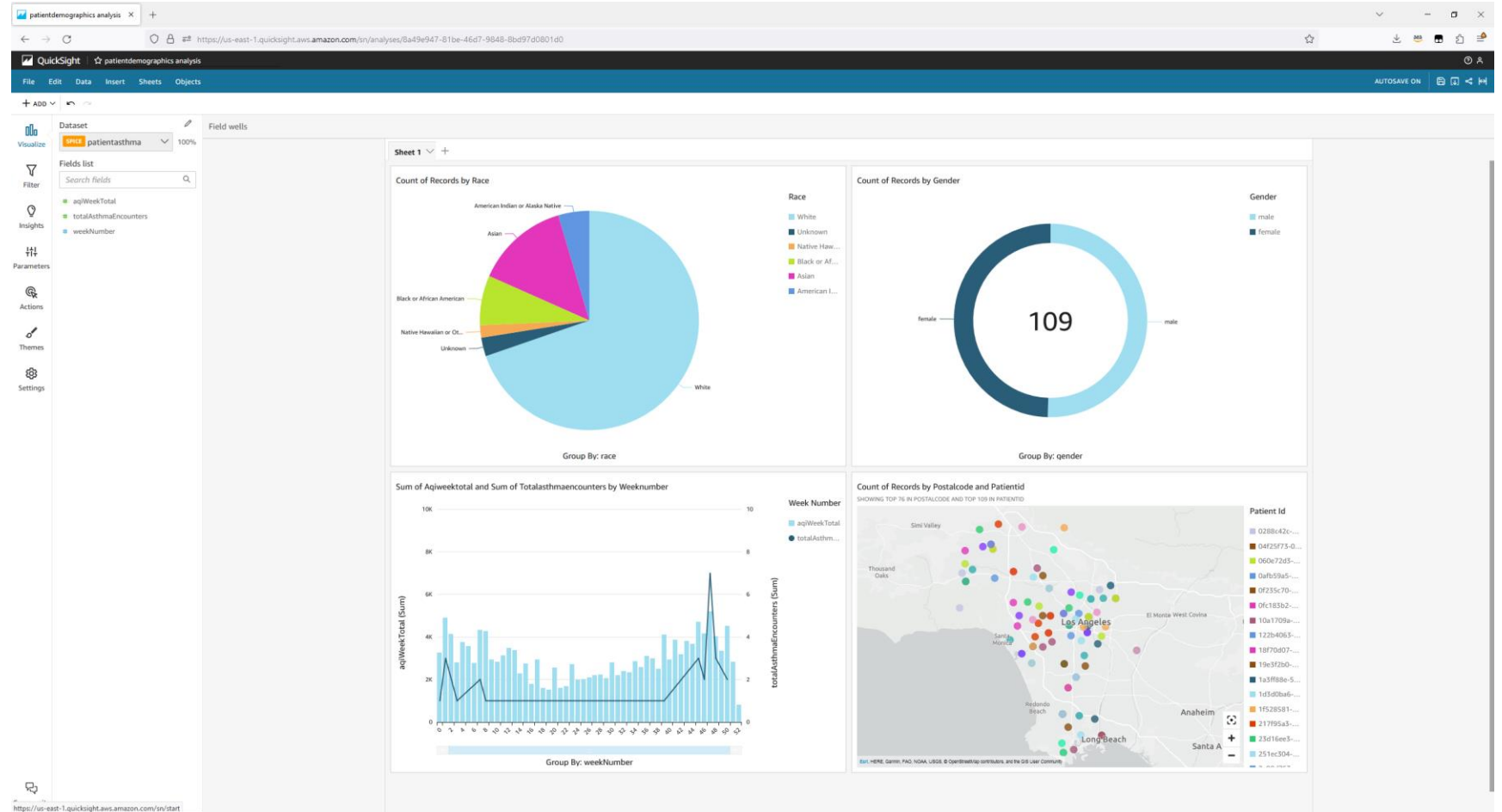
Next steps

How to get started

Schedule a technical deep dive
with AWS Healthcare SMEs and Solution Architects to enable a well-architected design

Develop and deploy a proof of concept
implementation with AWS and APN partners

Training
to educate your workforce in supporting population health infrastructure

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Thank you!

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FHIR based data sharing across the Interconnected Public Health Ecosystem

States, tribes, localities, territories (STLTs)

Federal public health (CDC, Federal partners)

Healthcare (Labs, Providers)

Public

How foundation models differ from other ML models

Traditional ML models

Labeled data → ML model → Text generation
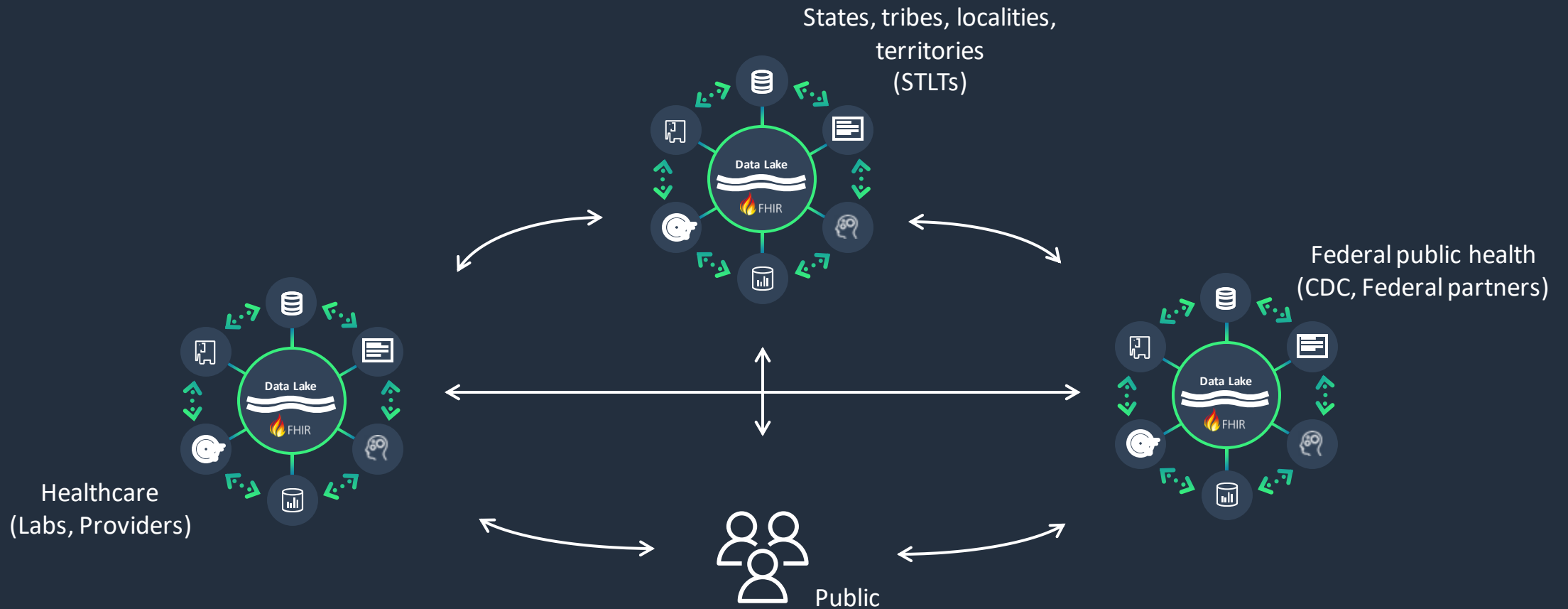
Labeled data → ML model → Summarization

Labeled data → ML model → Information extraction

Labeled data → ML model → Q&A

Labeled data → ML model → Chatbot

Tasks

Train   Deploy

Foundation models

Unlabeled data → Foundation model → Text generation / Summarization / Information extraction / Q&A / Chatbot

Tasks

Pre-train   Adapt

Visualize patient and population data in QuickSight
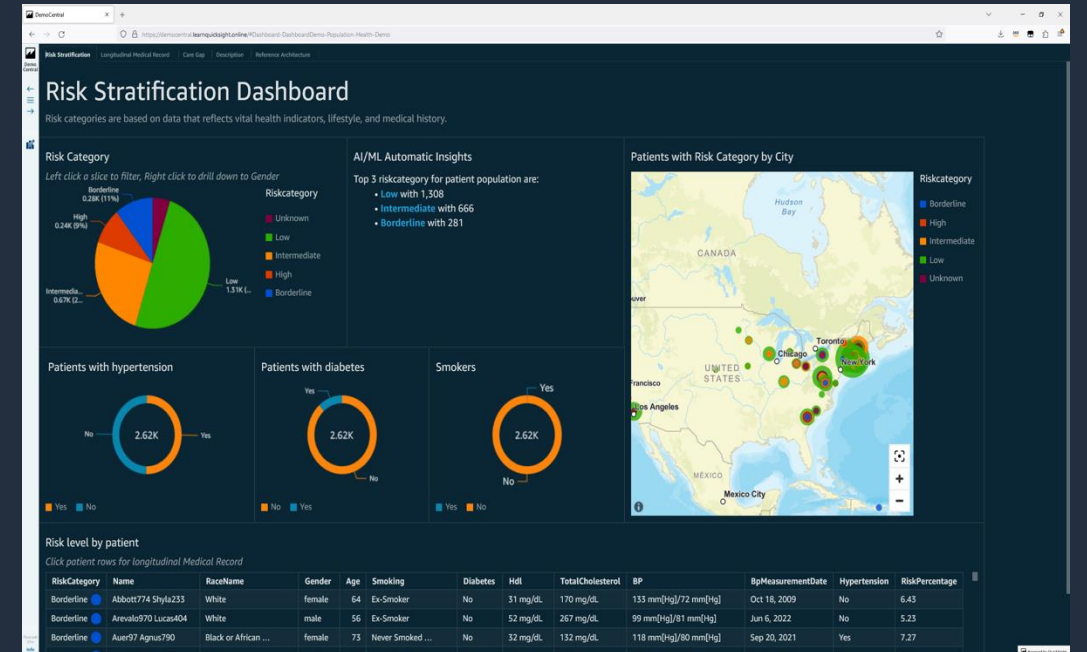
Longitudinal patient dashboard
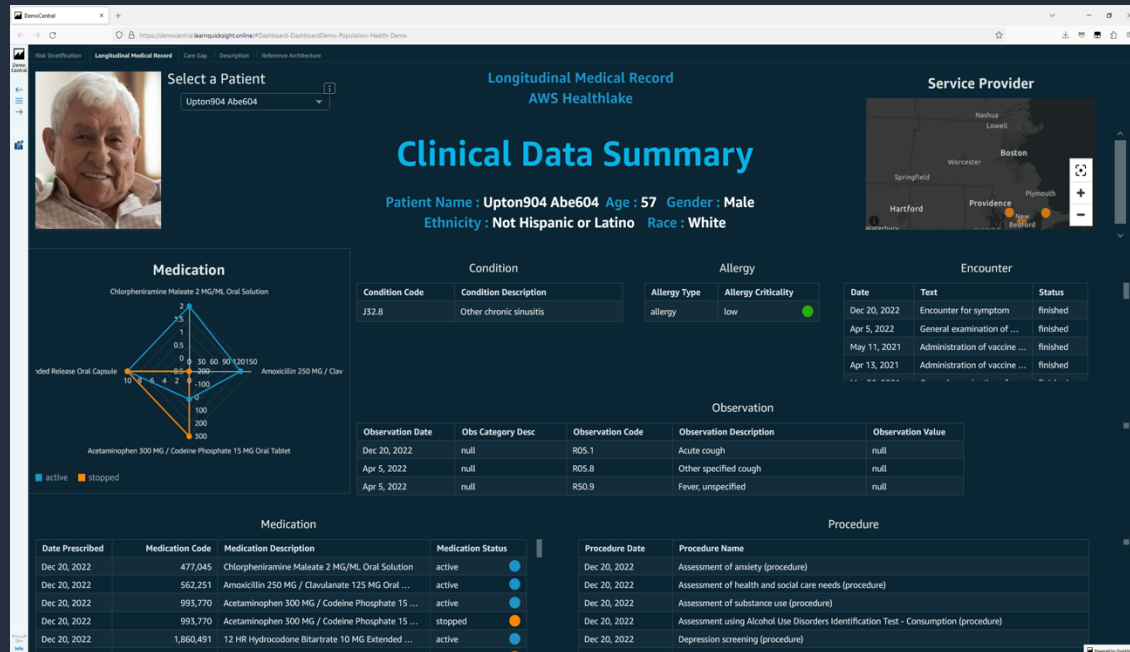
Risk stratification for population

Public Health with AWS HealthLake Demo Architecture

Amazon S3

Synthetic data in FHIR format

FHIR

AWS HealthLake

Amazon S3

Air Quality data in non-FHIR format

AWS Lake Formation

SQL

Amazon Athena

Analytics

Machine learning

Amazon QuickSight

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