
AWS
re:Invent

EMB006

Make sense of health data with Amazon HealthLake

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AWS

AWS re:Invent

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Agenda – Amazon HealthLake

What is Amazon HealthLake?

How does Amazon HealthLake work?

Where do I start?



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Amazon HealthLake

A HIPAA-eligible service that enables healthcare providers, health insurance companies, and pharmaceutical companies to store, transform, query, and analyze health data on the AWS Cloud at petabyte scale



IMPORT

Quickly and easily import your health data, including clinical notes, insurance claims, and more



STORE

Store it on the AWS Cloud in a secure, compliant, and auditable way



TRANSFORM

Tag and index unstructured data using specialized machine learning (ML) models



QUERY and SEARCH

Query and search the transformed data across all of your health data or an individual patient record



ANALYZE

Understand relationships in the data and identify trends, and make predictions with integrated analytics and ML capabilities

Digital transformation in healthcare



Use <30 data points

Today's clinical models

Use 200K–300K data points

Future ML models

Extract medical data entities from text

ENTITIES

- Medications
- Medical conditions
- Tests, treatments, and procedures
- Anatomy
- Protected health information (PHI)

RELATIONSHIP EXTRACTION

- Medications and dosages
- Tests and related results
- Anatomical locations

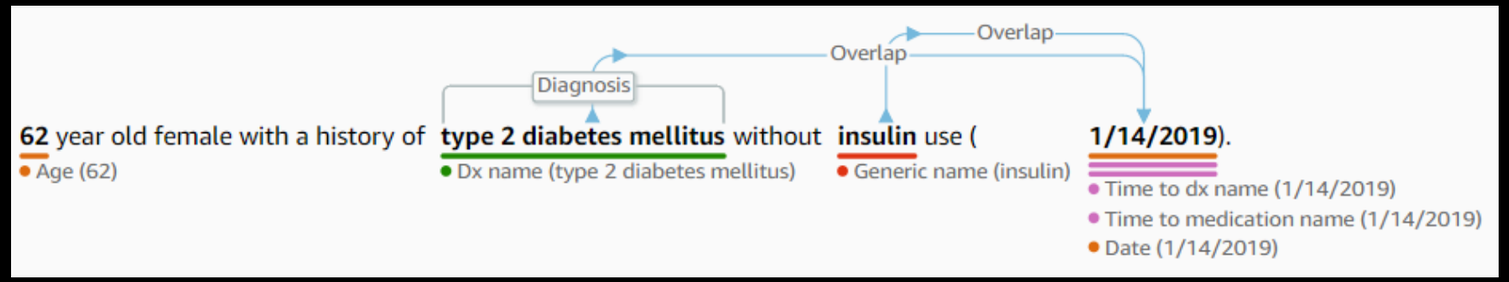
ENTITY TRAITS

- Negations
- Temporality
- Symptoms

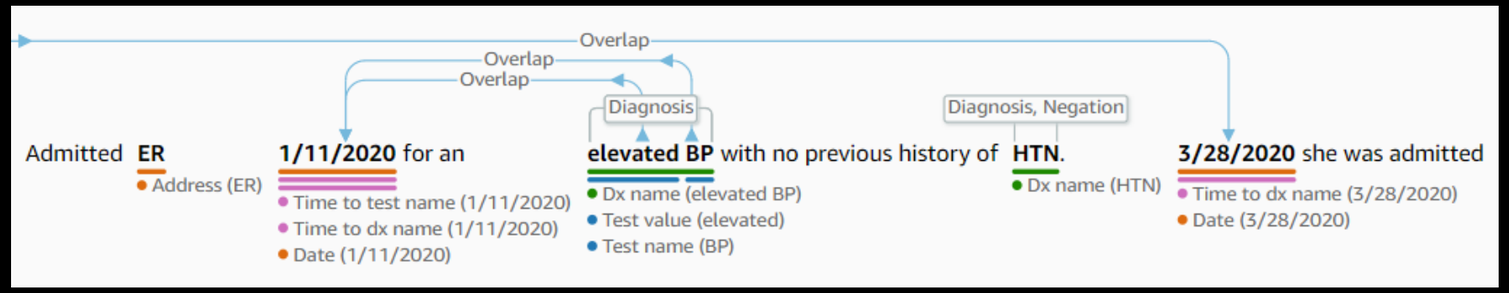
Identify medical terminology and context

patient is a 62-year-old female with a history of Type 2 diabetes mellitus without insulin use (1/14/2019). Admitted ER 1/11/2020 for an elevated BP with no previous history of HTN. 3/28/2020 she was admitted for hypothyroidism and prescribed metformin (GLUCOPHAGE) 1000 mg take daily by mouth in evening. Follow up clinic visit (9/20/2020) with A1C results of...

Medical conditions



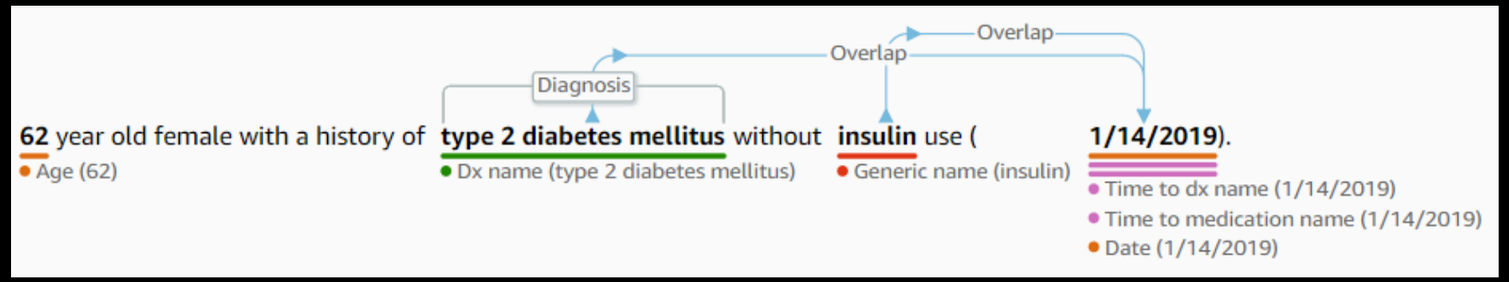
Abbreviations, and time stamps



Identify medical terminology and context

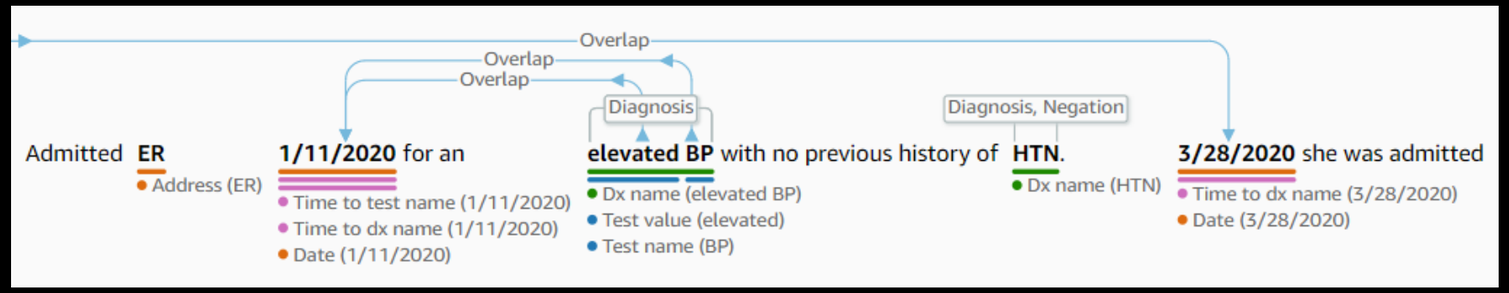
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Medical conditions




```
{
  "Id": 22,
  "BeginOffset": 93,
  "EndOffset": 102,
  "Score": 0.9999784231185913,
  "Text": "1/14/2019",
  "Category": "TIME_EXPRESSION",
  "Type": "TIME_TO_DX_NAME",
  "Traits": [],
  "Attributes": [
    {
      "Type": "DX_NAME",
      "Score": 0.9177364706993103,
      "RelationshipScore": 0.5882568955421448,
      "RelationshipType": "OVERLAP",
      "Id": 8,
      "BeginOffset": 47,
      "EndOffset": 71,
      "Text": "type 2 diabetes mellitus",
      "Category": "MEDICAL_CONDITION",
      "Traits": [
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          "Score": 0.9727892875671387
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      ]
    }
}
```

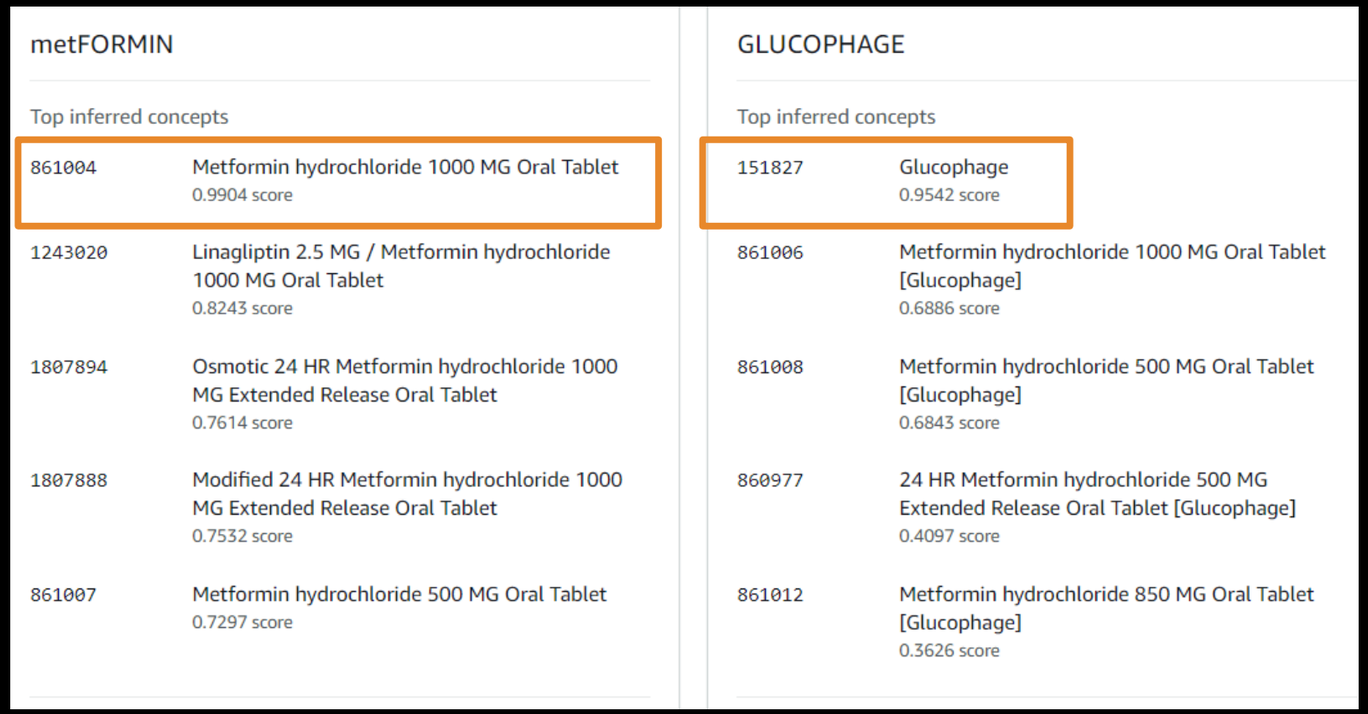

Abbreviations, and time stamps



Assign medical codes to text

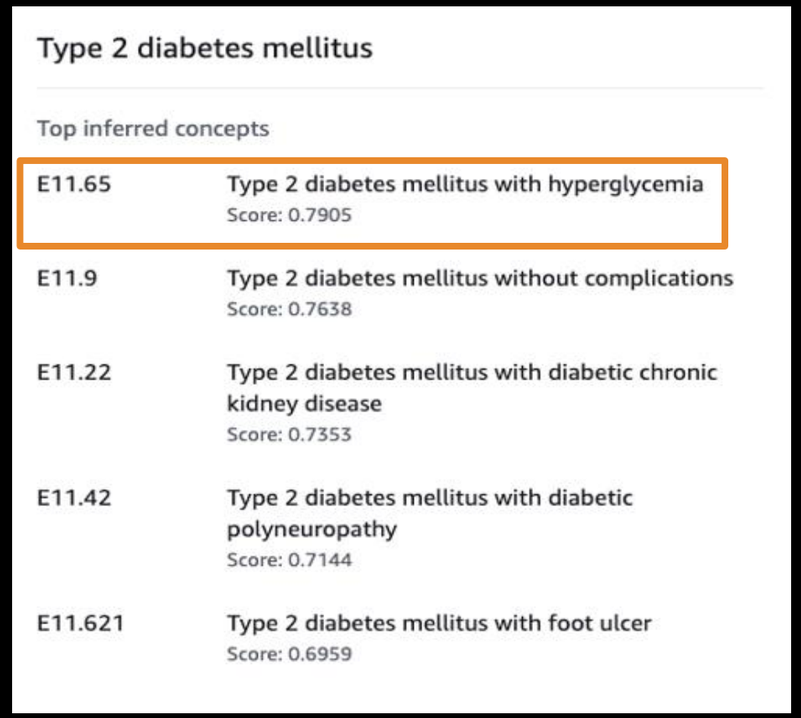
“METFORMIN (GLUCOPHAGE) 1,000 mg tablet E 1 AND 1/2 TABLETS BY MOUTH IN THE MORNING... “

RxNorm



“Type 2 diabetes mellitus with hyperglycemia, without long-term current use of insulin (HCC)...”

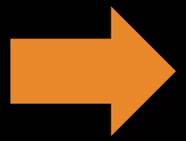
ICD-10



Access all the information on a patient

Conditions from Structured Data

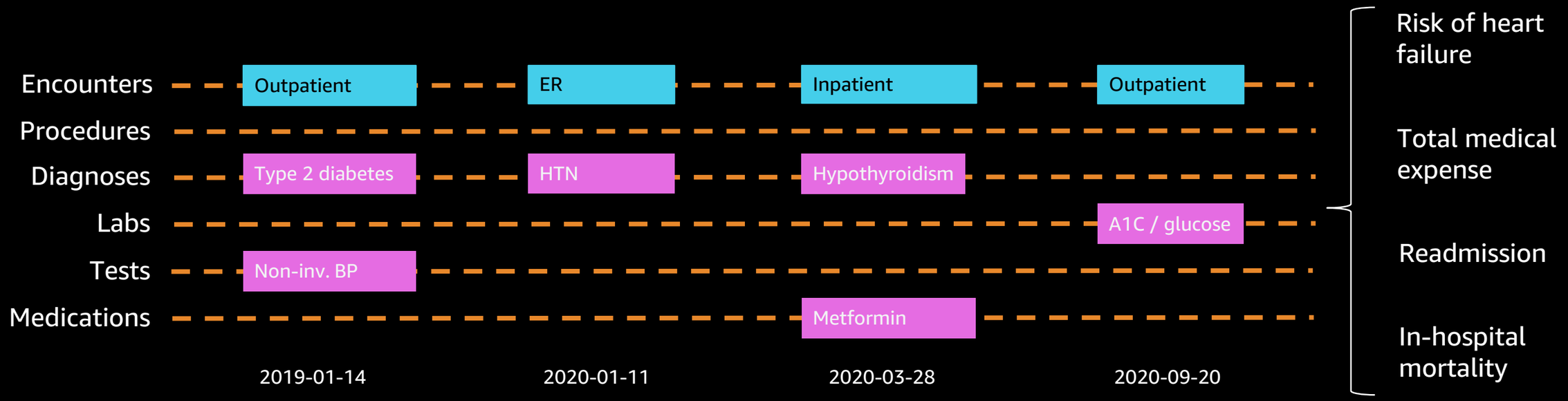
patient_name	start	condition
Patient_13033	Apr 28, 2182	Acute kidney failure, unspecified
		Background diabetic retinopathy
		Diabetes with neurological manifestations, type I [juv...
		Diabetes with ophthalmic manifestations, type I [juve...
		Diabetes with renal manifestations, type I [juvenile ty...
		Gastroparesis
		Nephritis and nephropathy, not specified as acute or c...
		Peripheral autonomic neuropathy in disorders classifi...
		Unspecified essential hypertension



Conditions from Parsed Text

patient_name	enc_start	condition	entity_score	code_score
Patient_13033	Apr 28, 2182	Functional dyspepsia	0.8731	0.6138
			0.8745	0.7055
		Changes in skin texture	0.9314	0.6374
		Disease of digestive system, unspecified	0.8745	0.617
		Epidermal thickening, unspecified	0.7258	0.6156
		Nausea	0.9884	0.8028
			0.9977	0.7311
		Nausea with vomiting, unspecified	0.9884	0.7823
			0.9955	0.7233
			0.9977	0.7713
		Other specified symptoms and signs inv...	0.8731	0.6676
			0.8745	0.7547
		Paragonimiasis	0.9904	0.6055
		Type 2 diabetes mellitus without compli...	0.9786	0.785
			0.9872	0.7744
		Umbilical hernia without obstruction or ...	0.8594	0.6466
		Unspecified abdominal hernia with obst...	0.9086	0.6121
			0.9556	0.6442
		Unspecified abdominal hernia without o...	0.7469	0.6066
			0.8449	0.6492
			0.9086	0.6741
			0.9556	0.6931
		Unspecified abdominal pain	0.7953	0.62
		Ventral hernia without obstruction or ga...	0.7469	0.784
			0.8449	0.8102
			0.9086	0.8072
		Xerosis cutis	0.6962	0.6654
		Acute respiratory distress	0.8731	0.6797
			0.8745	0.7625
		Other specified diseases of intestine	0.7258	0.7219
		Personal history of other diseases of the...	0.9556	0.6074
		Type 2 diabetes mellitus with diabetic c...	0.9786	0.7396
			0.9872	0.7193

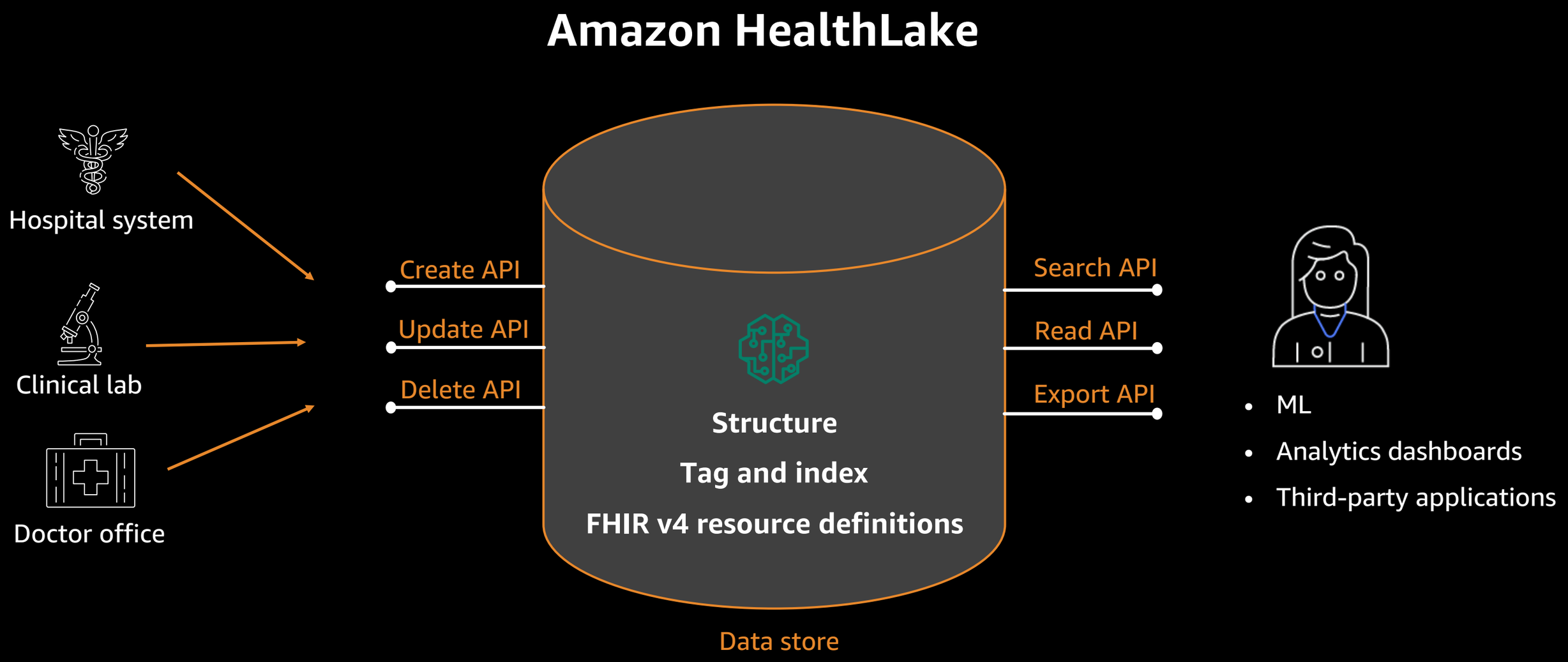
Create a complete view of your health information



DERIVE TRENDS

Having a complete view of your normalized data leads to better clinical decisions

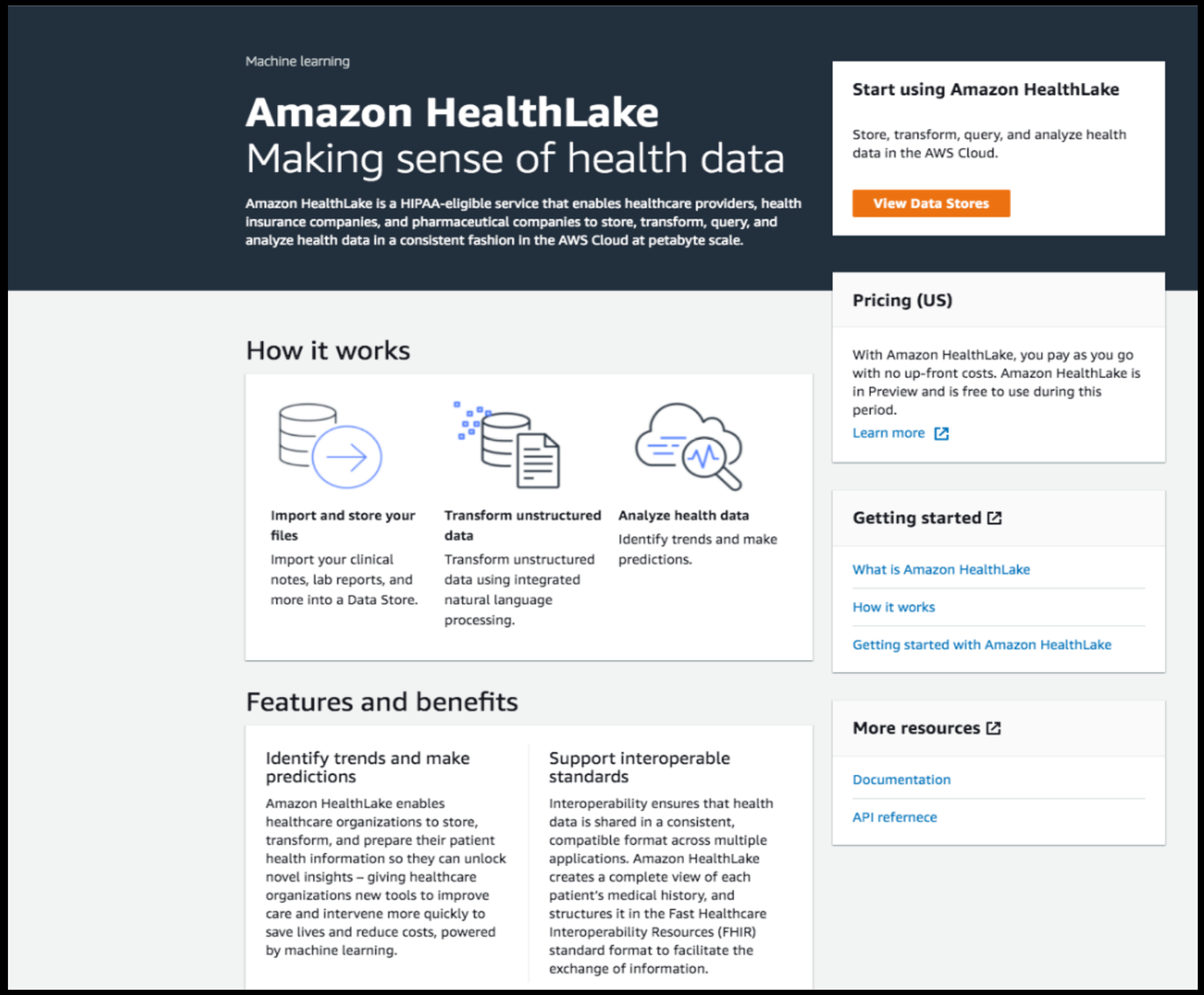
How it works


Amazon HealthLake
Hospital system
Clinical lab
Doctor office
Create API
Update API
Delete API
Structure
Tag and index
FHIR v4 resource definitions
Search API
Read API
Export API
Data store
ML
Analytics dashboards
Third-party applications

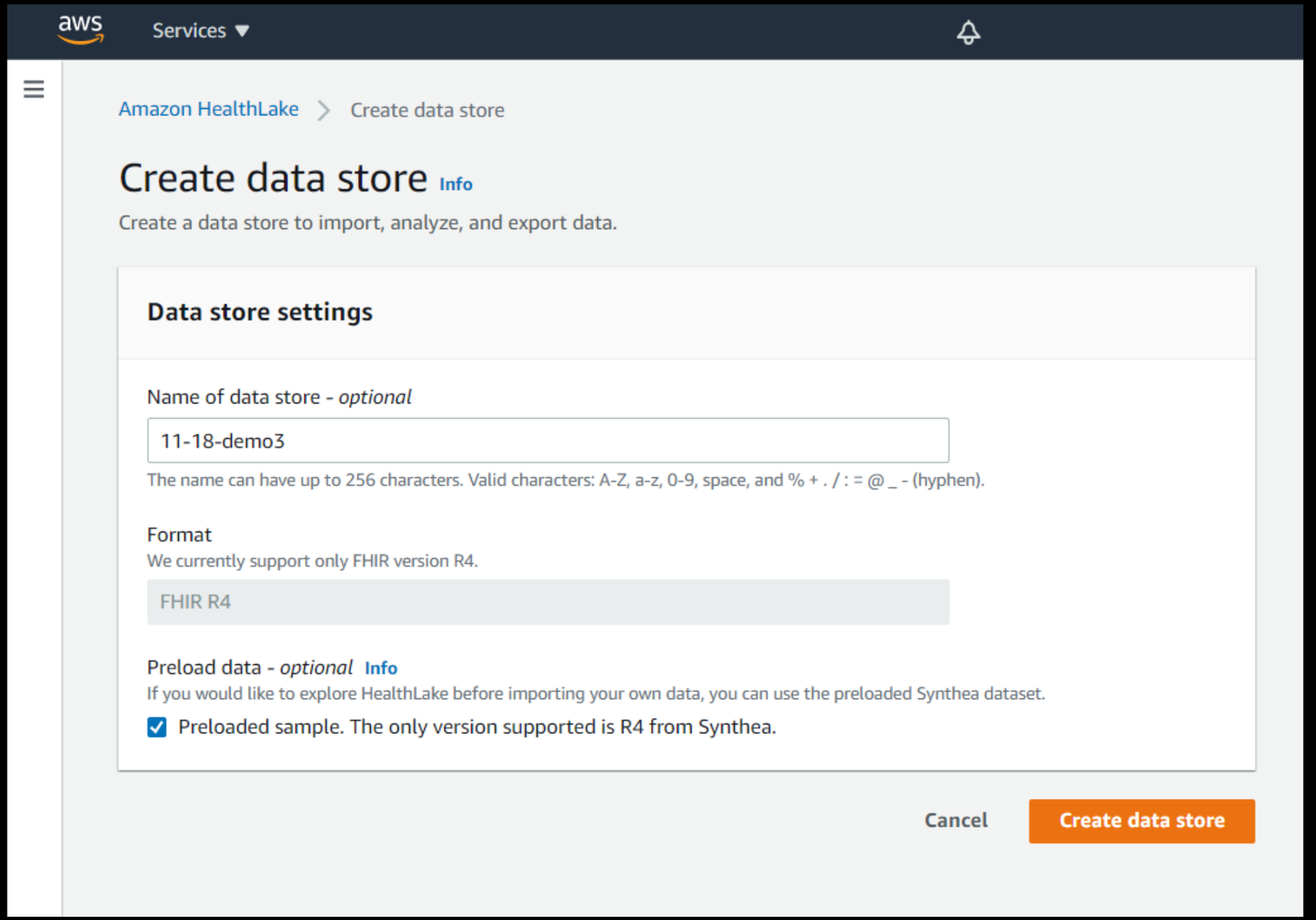
Getting started

1. Create a data store and import your health data
2. Create, update, or delete your health data
3. Read or search across all your health data
4. Create dashboards or build ML models on all your health data

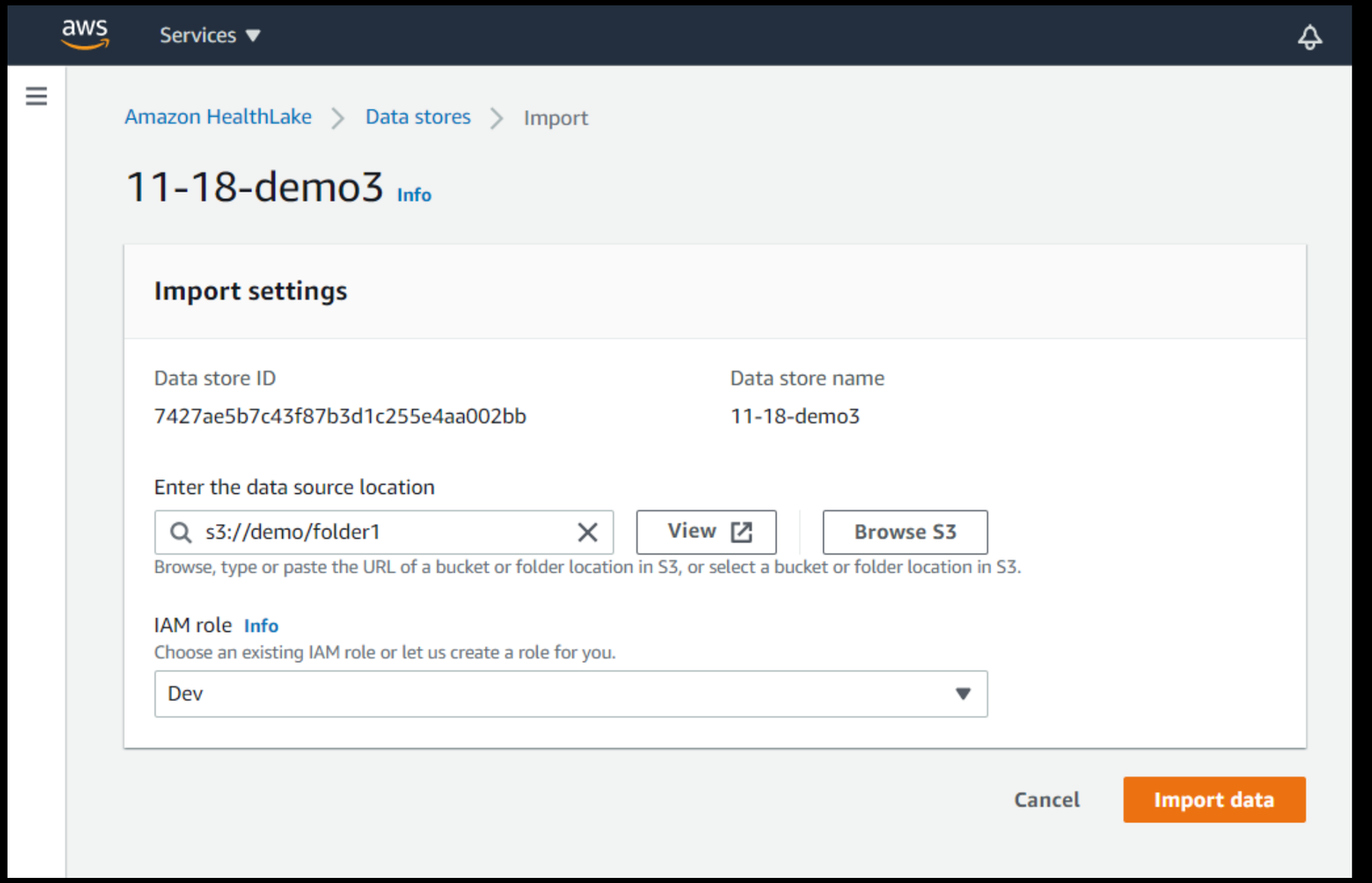
Navigate to Amazon HealthLake



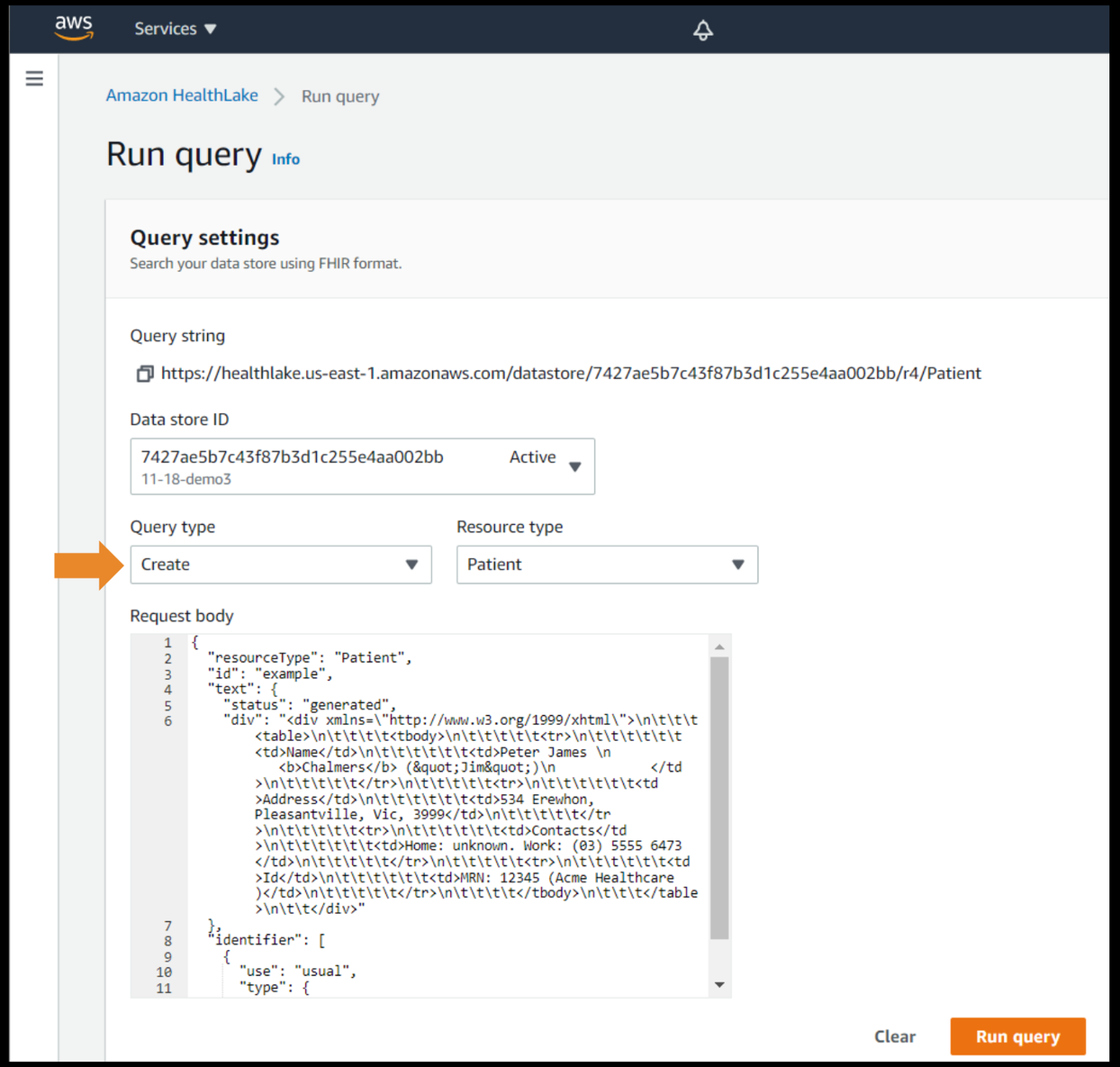
Create data store(s)



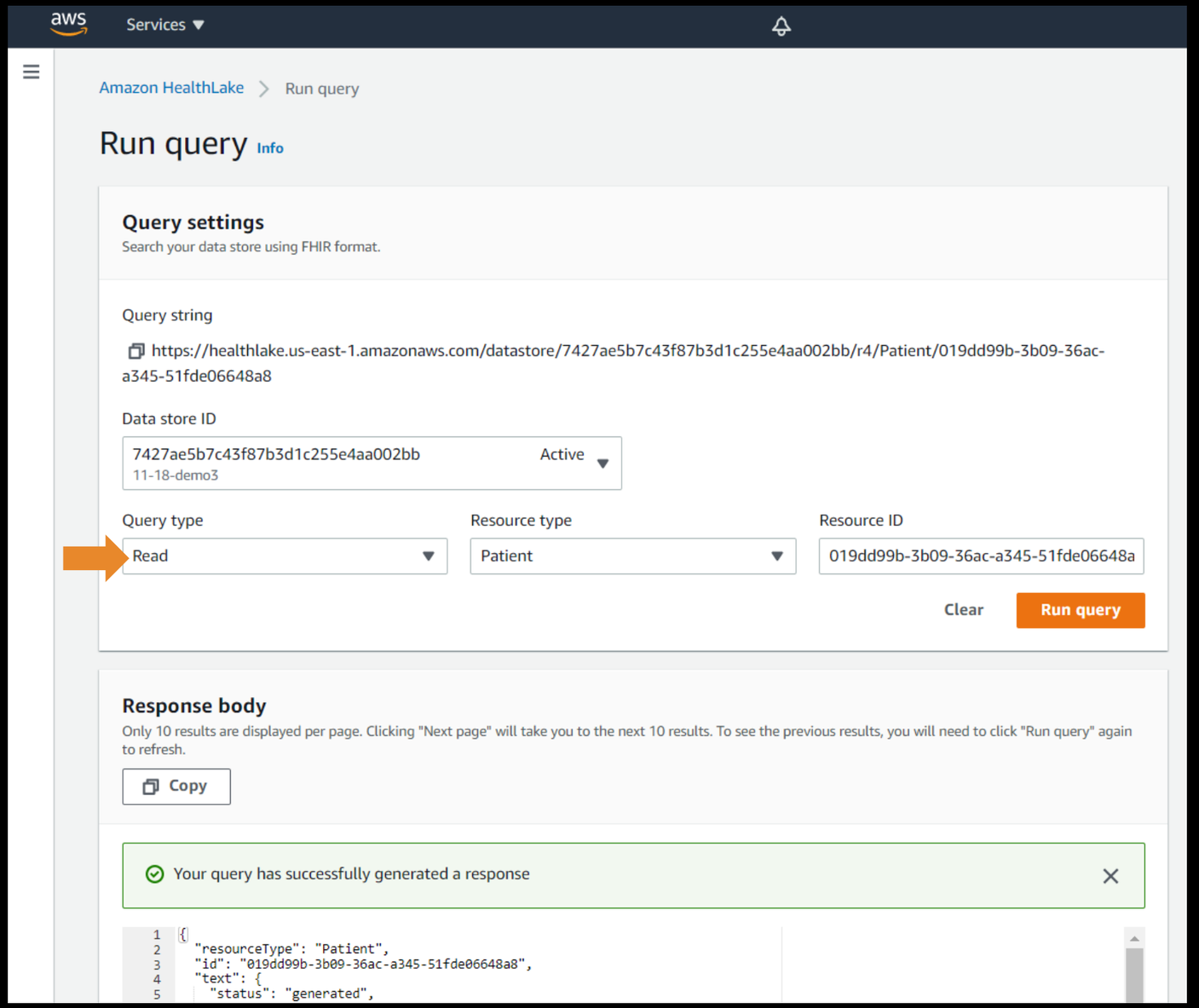
Import your health data



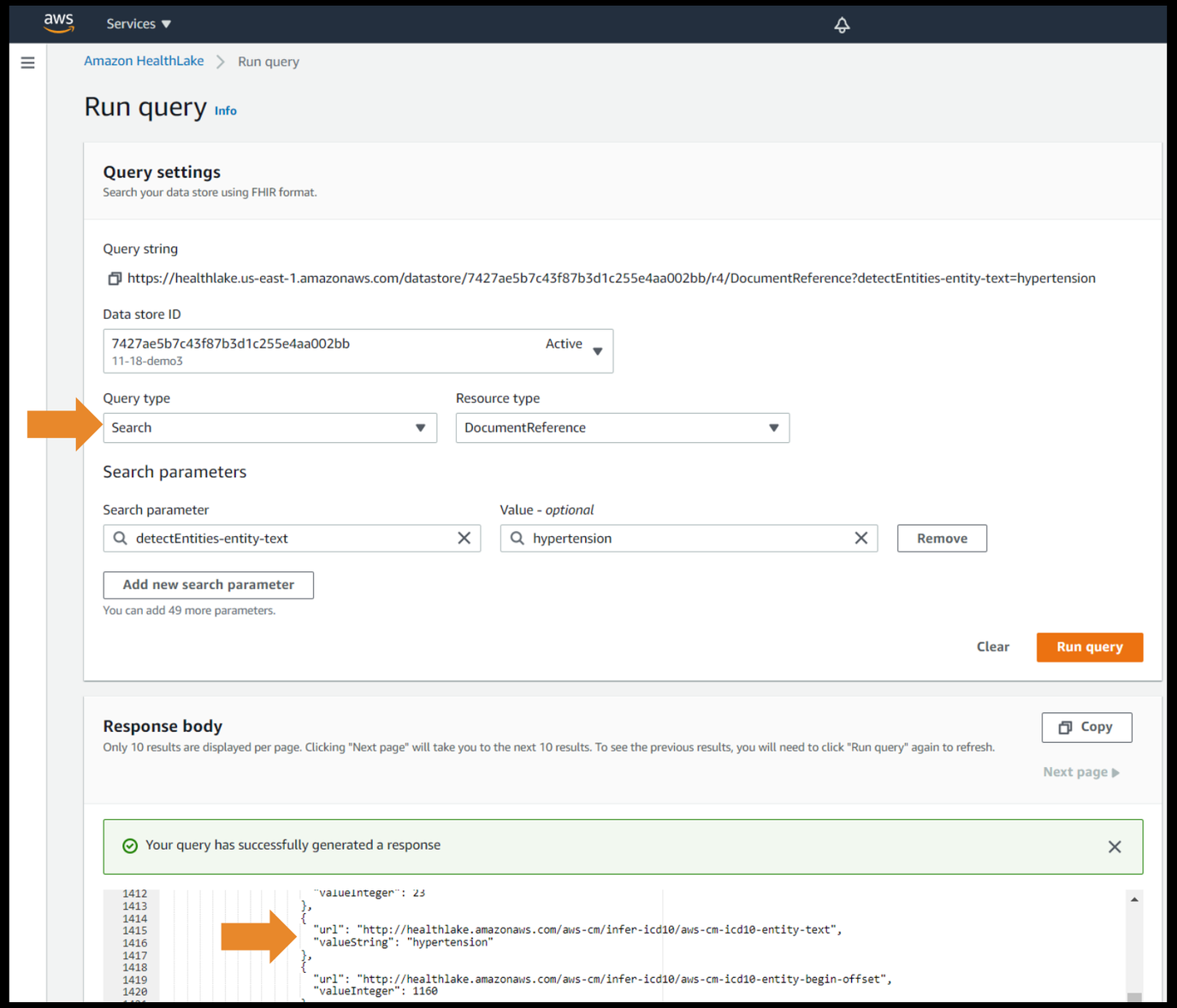
Create, update, or delete your health data



Read an individual record



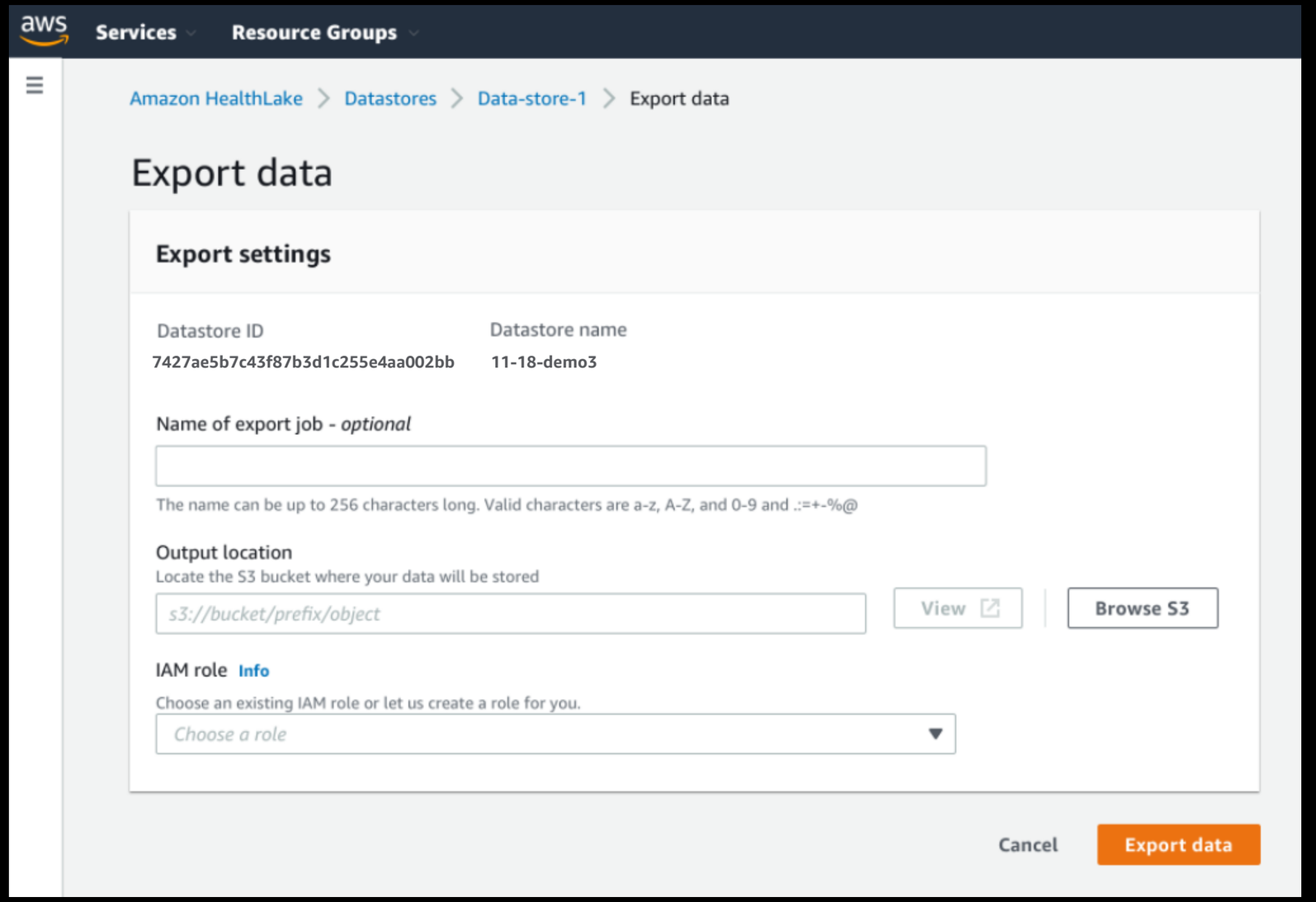
Search across all your health data



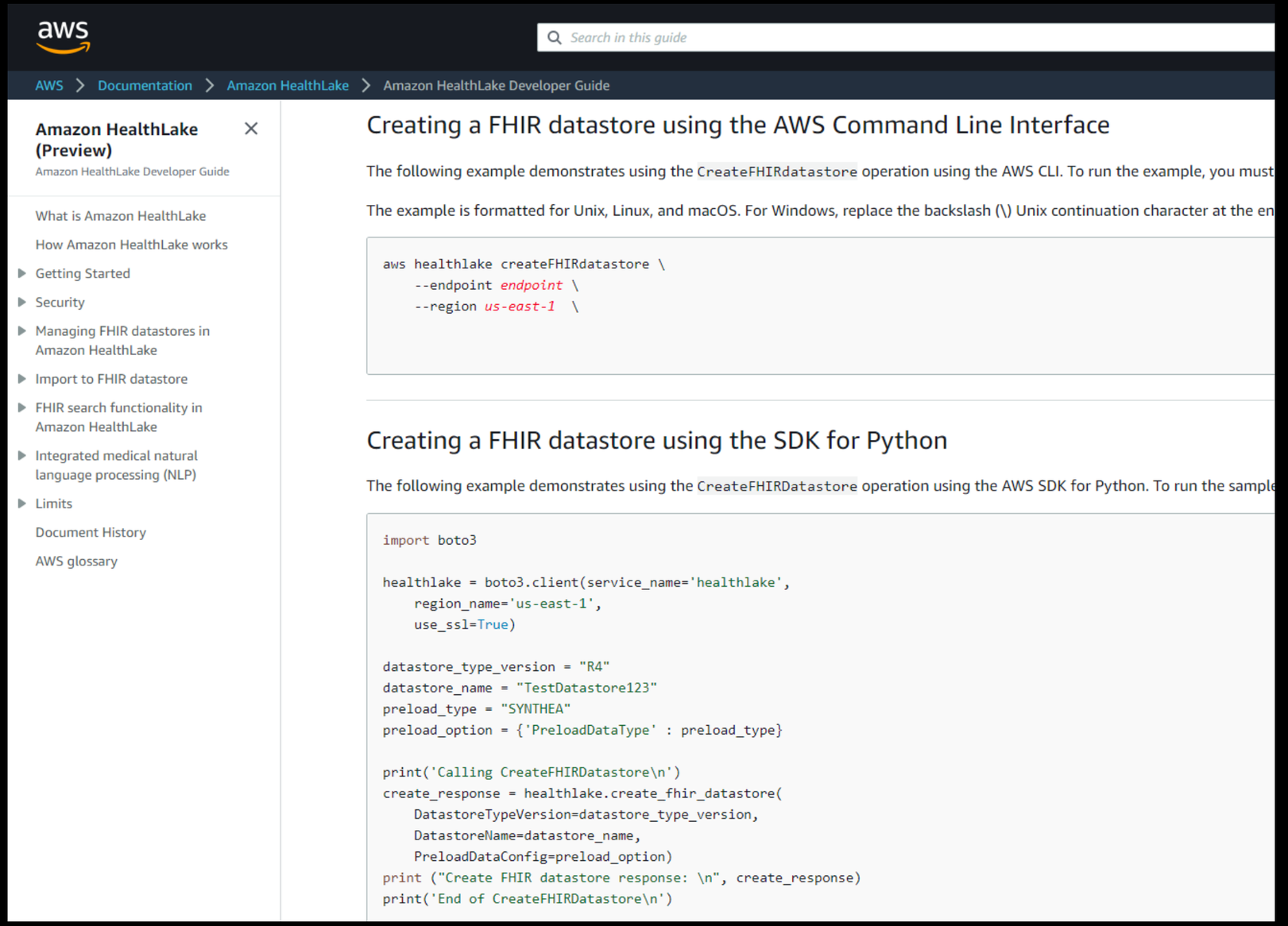
Search all entity extensions

- detectEntities-entity-text-category
- detectEntities-entity-type-score
- detectEntities-entity-text-score
- detectEntities-entity-text-type
- detectEntities-entity-category-score
- infer-icd10cm-entity-text-concept-code
- infer-icd10cm-entity-text-concept-score
- infer-icd10cm-entity-concept-description-concept-score
- infer-rxnorm-entity-text-concept-code
- infer-rxnorm-entity-text-concept-score
- infer-rxnorm-entity-concept-description-concept-score
- authenticator
- author
- category
- contenttype

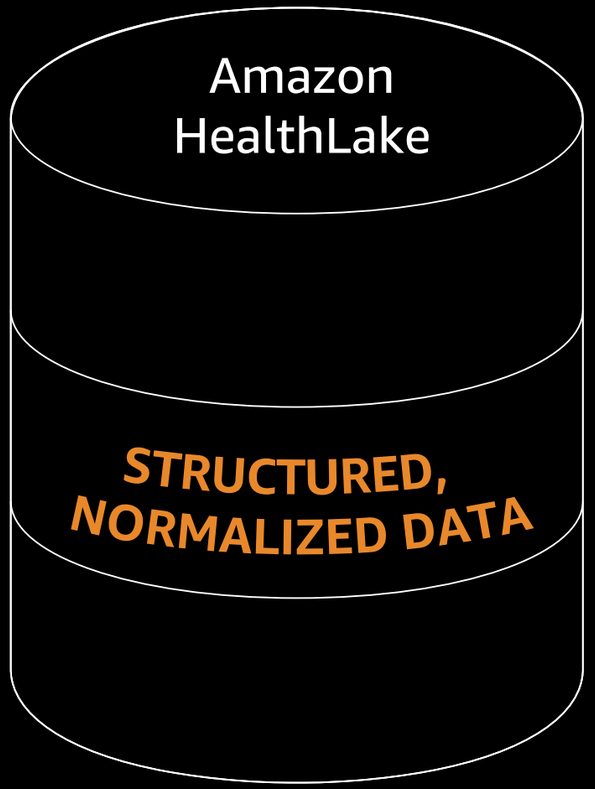
Exporting your data to Amazon S3

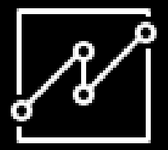


Command line APIs



Identify trends and make predictions

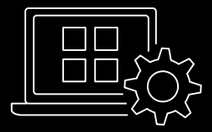




Amazon QuickSight



Amazon SageMaker



Third-party applications

IDENTIFY TRENDS

Easily search and query the data

Develop interactive dashboards

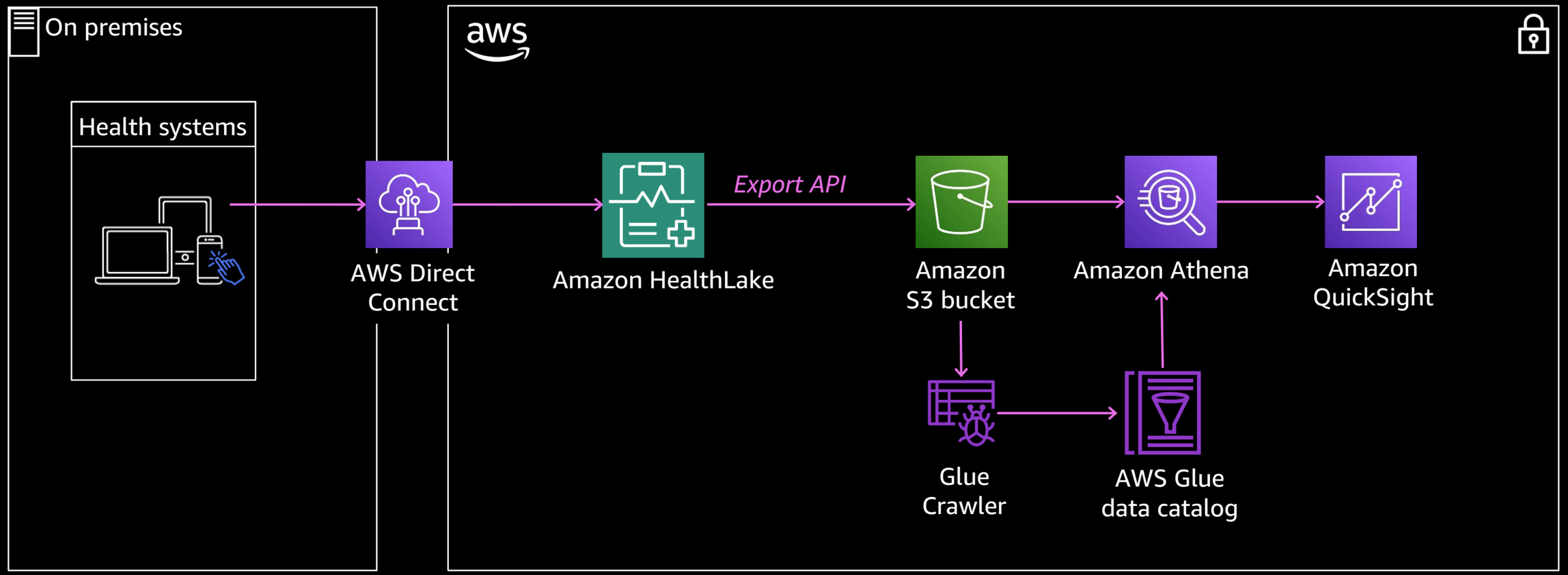
MAKE PREDICTIONS

Integrate normalized datasets and create predictive models

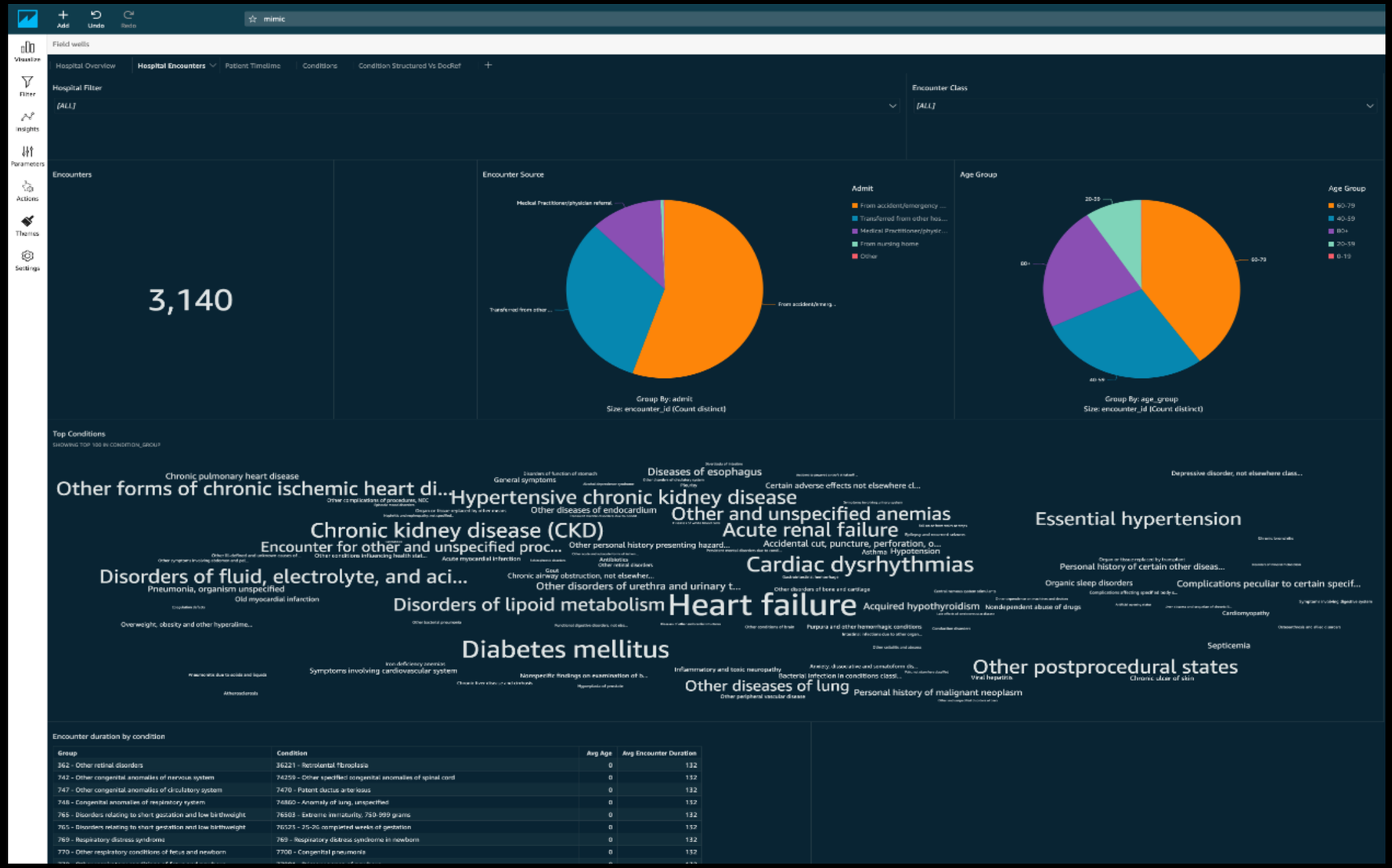
SHARE DATA SECURELY

Healthcare providers and patients alike can easily share and access their data

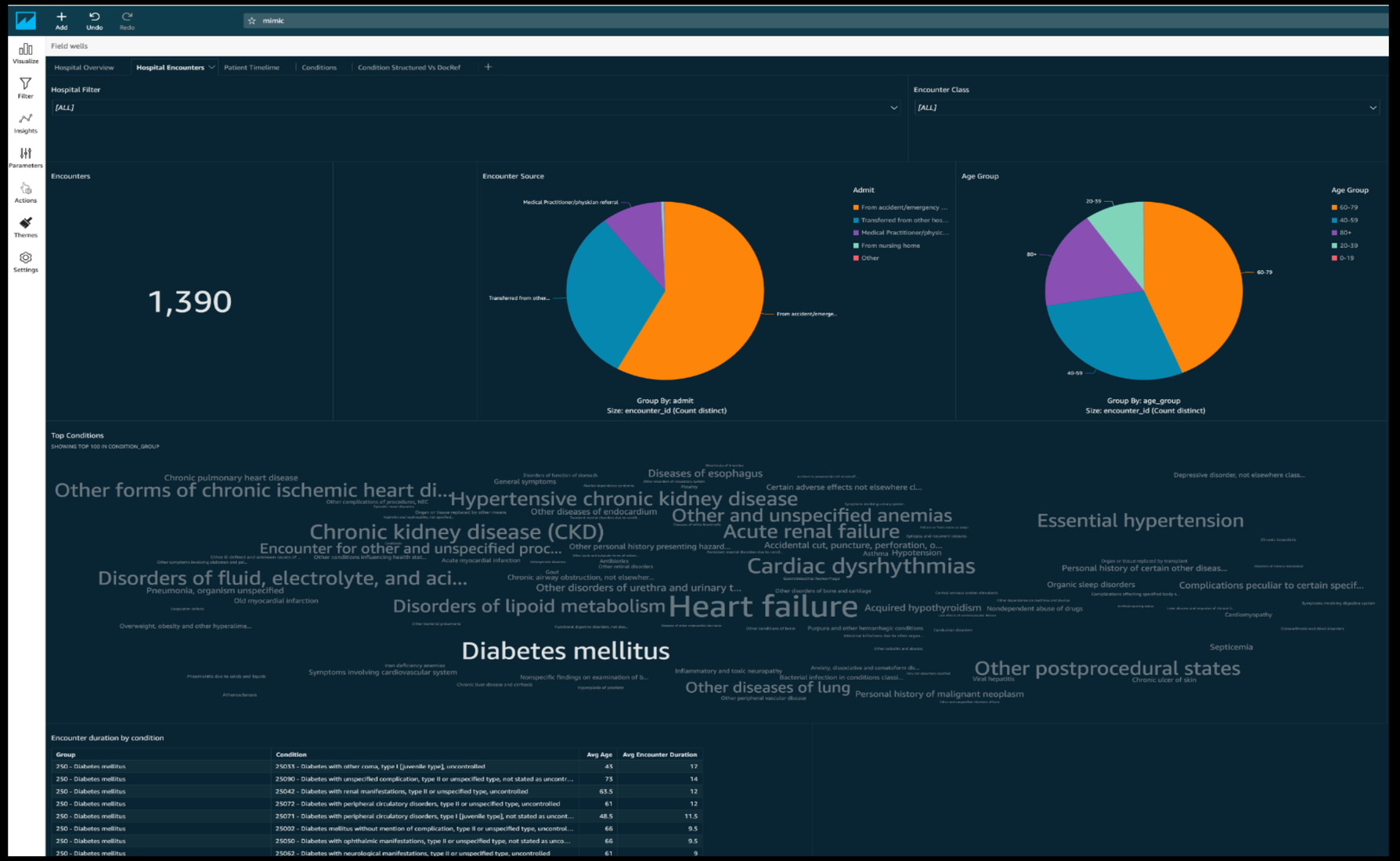
Integrate dashboards



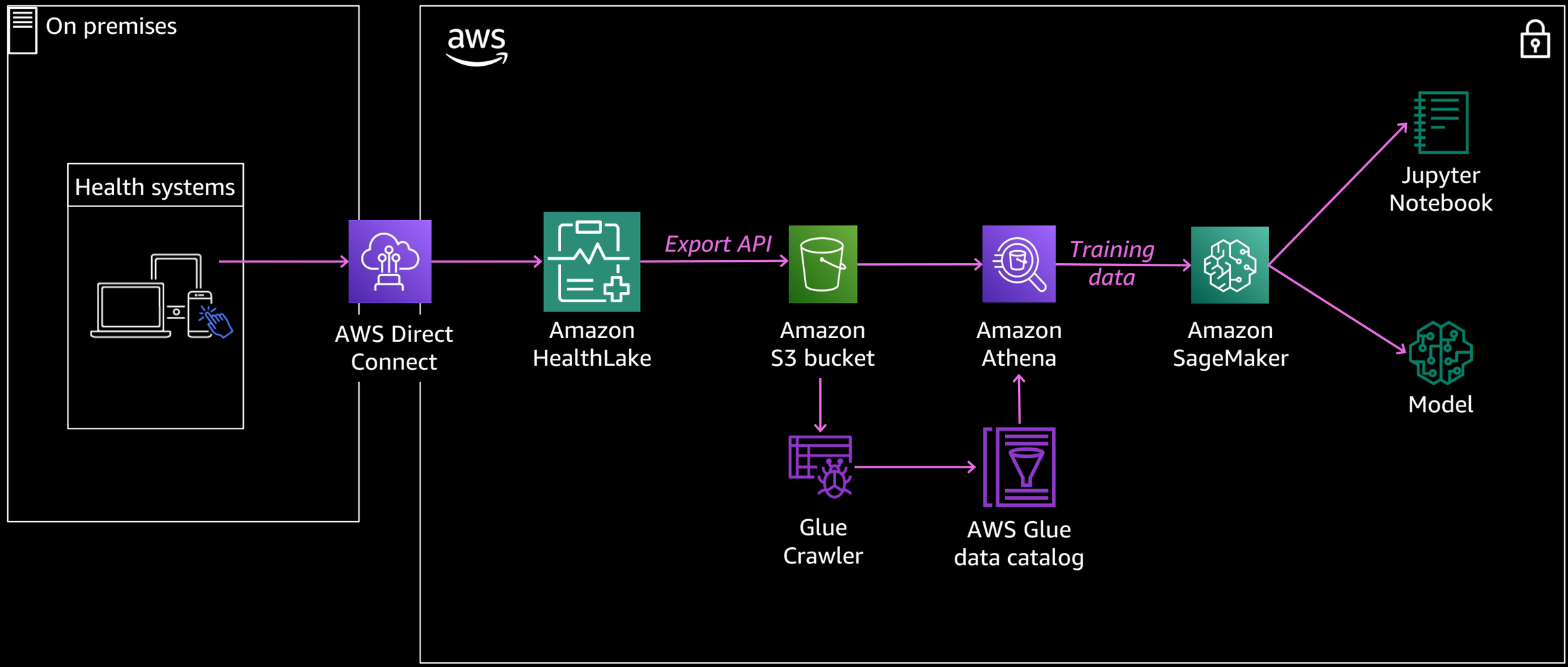
View your entire population of patients



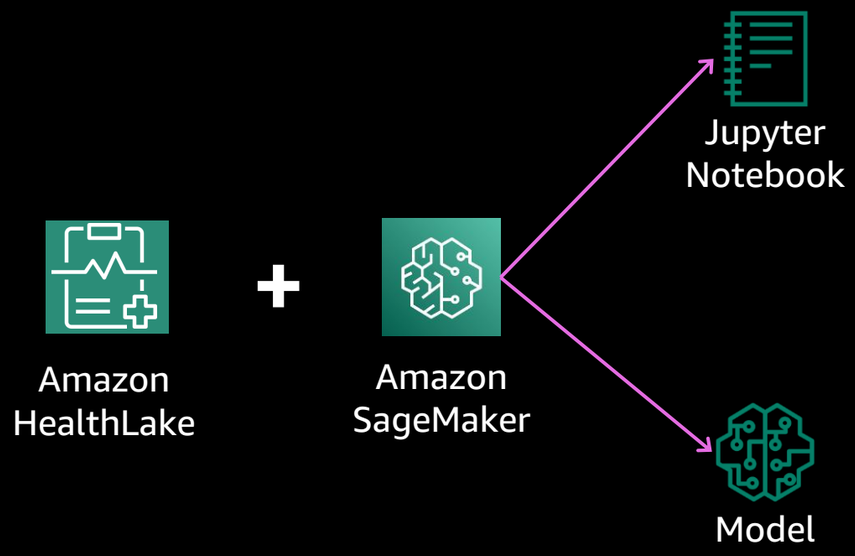
Drill down on the data



Integrate ML models



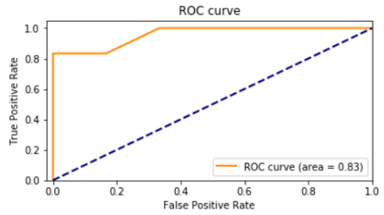
Amazon SageMaker



Predictive models

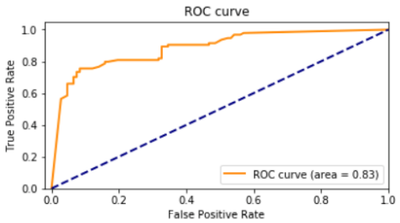
For example: Sepsis models

```
In [990]: import matplotlib.pyplot as plt
fpr, tpr, _ = roc_curve(y_test_exp, predict_proba_exp[:,1])
roc_auc = auc(fpr, tpr)
plt.figure()
lw = 2
plt.plot(fpr, tpr, color='darkorange',
         lw=lw, label='ROC curve (area = %0.2f)' % roc_auc_score(y_test_exp, predictions_exp))
plt.plot([0, 1], [0, 1], color='navy', lw=lw, linestyle='--')
plt.xlim([-0.02, 1.0])
plt.ylim([0.0, 1.05])
plt.xlabel('False Positive Rate')
plt.ylabel('True Positive Rate')
plt.title('ROC curve')
plt.legend(loc="lower right")
plt.rcParams["figure.figsize"] = (6, 3)
plt.show()
```



For example: CHF models

```
In [752]: import matplotlib.pyplot as plt
fpr, tpr, _ = roc_curve(y_test, predict_proba[:,1])
roc_auc = auc(fpr, tpr)
plt.figure()
lw = 2
plt.plot(fpr, tpr, color='darkorange',
         lw=lw, label='ROC curve (area = %0.2f)' % roc_auc_score(y_test, predictions))
plt.plot([0, 1], [0, 1], color='navy', lw=lw, linestyle='--')
plt.xlim([-0.02, 1.0])
plt.ylim([0.0, 1.05])
plt.xlabel('False Positive Rate')
plt.ylabel('True Positive Rate')
plt.title('ROC curve')
plt.legend(loc="lower right")
plt.rcParams["figure.figsize"] = (6, 3)
plt.show()
```

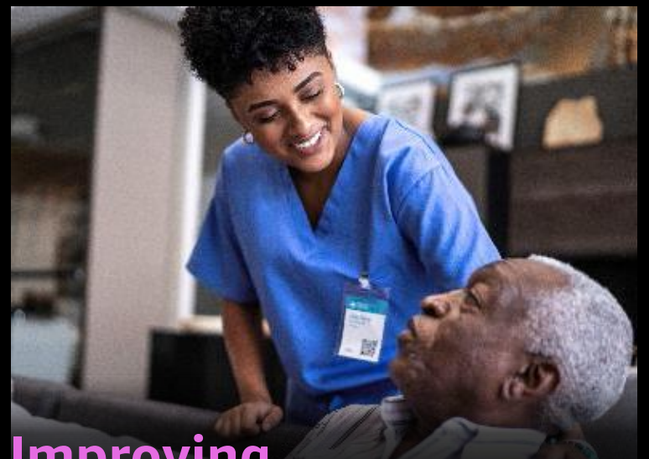


It always starts with our customers



Population health management

Analyze population health trends, outcomes, and costs to identify the most appropriate intervention for a patient population with pretrained ML algorithms



Improving quality of care

Close gaps in care, improve quality, and reduce cost by bringing together a complete view of a patient's medical history



Optimize hospital efficiency

Amazon HealthLake removes the heavy lifting and reduces operational overhead using document classification and natural language understanding

Drive precision medicine



Konica Minolta Precision Medicine (KMPM)

KMPM is a life science company dedicated to the advancement of precision medicine to more accurately predict, detect, treat and ultimately cure disease

“We are building a multi-modal platform at KMPM to handle a significant amount of health data inclusive of pathology, imaging, and genetic information. Amazon HealthLake will allow us to unlock the real power of this multi-modal approach to find novel associations and signals in our data. It will provide our expert team of data scientists and developers the ability to integrate, label, and structure this data faster and discover insights that our clinicians and pharmaceutical partners require to truly drive precision medicine.”

Kiyotaka Fujii, President, Global Healthcare, Konica Minolta & Chairman, Ambry Genetics

Improve health outcomes



Orion Health

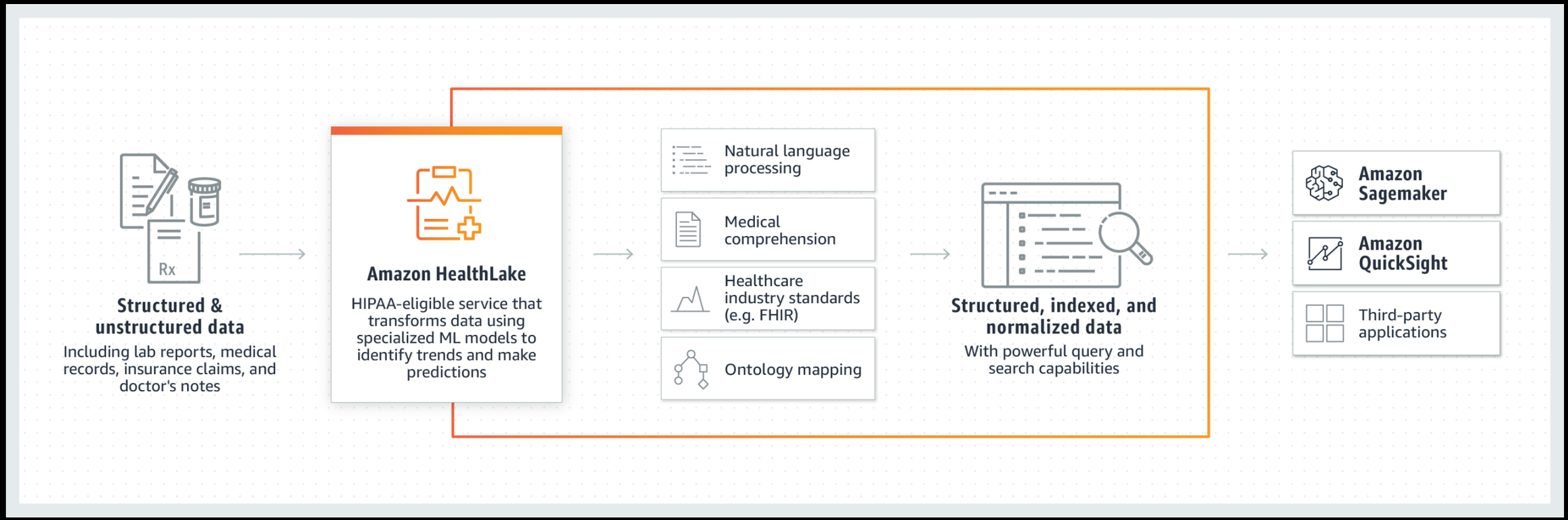
Orion Health is a global, award-winning provider of health information technology, advancing population health and precision medicine solutions for the delivery of care across the entire health ecosystem

“At Orion Health, we believe that there is significant untapped potential to transform the healthcare sector by improving how technology is used and providing insights into the data being generated. We are pleased to find a like-minded company in AWS, who with Amazon HealthLake is now taking the next step in using machine learning to help make sense of health data in a secure, complaint and auditable way. Data is frequently messy and incomplete, which is costly and time consuming to clean up. We are excited to work alongside AWS to deliver new ways for patients to interact with the healthcare system, supporting initiatives such as the 21st Century Cures Act designed to make healthcare more accessible and affordable, and Digital Front Door, which aims to improve health outcomes by helping patients receive the perfect care for them from the comfort of their home.”

Anne O'Hanlon, Product Director, Orion Health

Amazon HealthLake

MAKING SENSE OF ALL YOUR DATA



Purpose-built, HIPAA-eligible services

NEW



Amazon HealthLake

aws.amazon.com/HealthLake



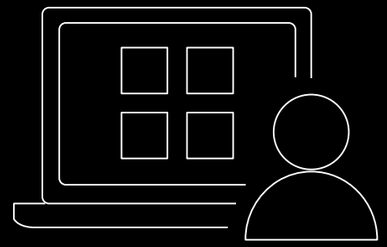
Amazon Comprehend Medical



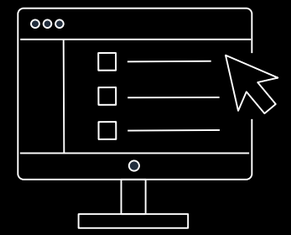
Amazon Transcribe Medical

Get started with
Amazon HealthLake

DEVELOPER GUIDE



API REFERENCE



aws.amazon.com/HealthLake

Thank you!



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