Building Real World Evidence on Cloud in Practice

Naoki Mashiko
Senior Solution Architect
Healthcare and Life Sciences (HCLS) Solutions
Amazon Web Services Japan K.K.

2019.10.24

Goal & Take Away

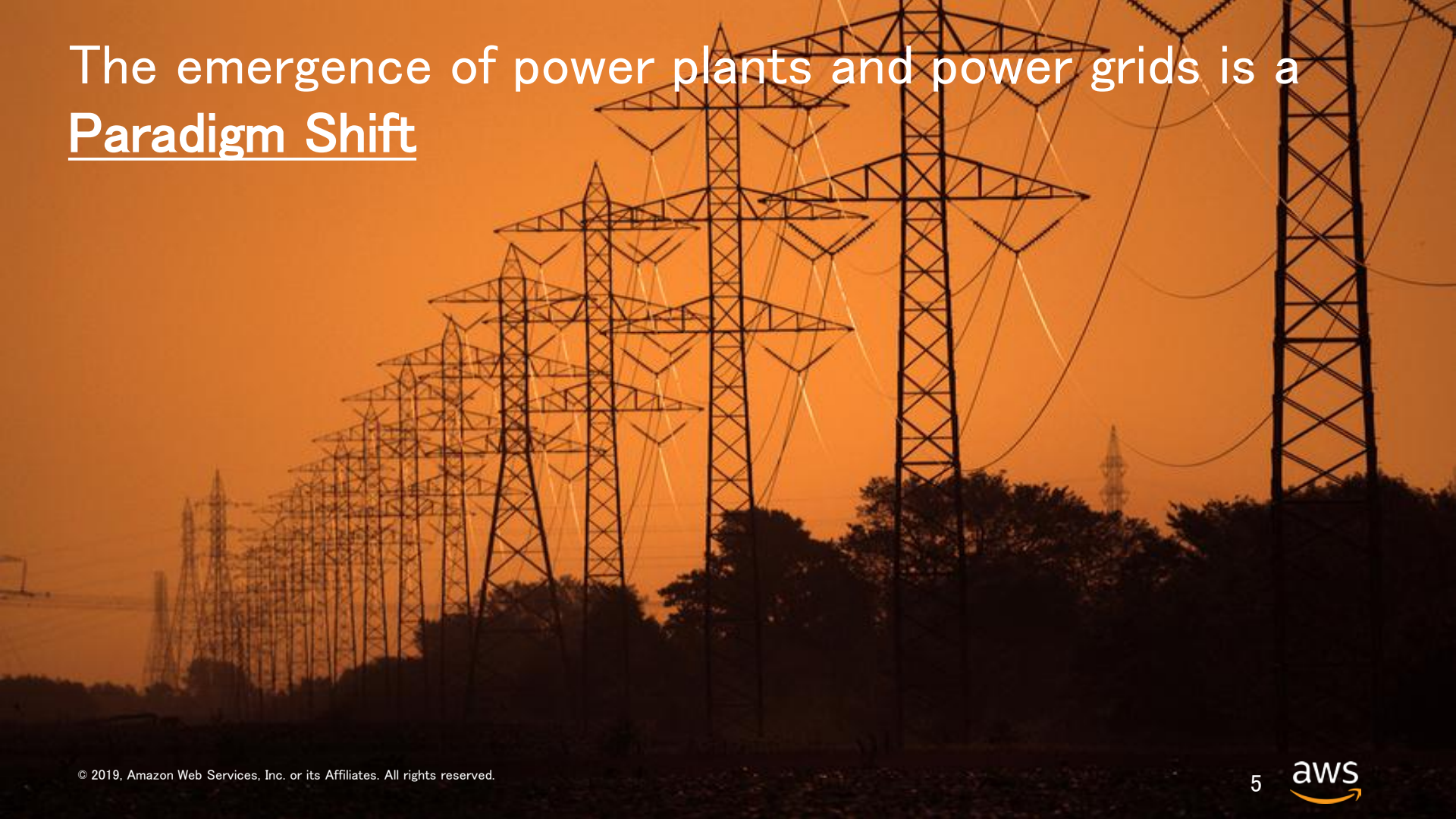
- The changing healthcare landscape requires healthcare industry companies to be data-driven organizations.
- Cloud has the enabling technologies and Quick Starts to become such organizations.
- What you want from RWE is not to have tools, but to bring out outcomes.
- Try it first anyway! In the cloud, this can be achieved with low risk.

Why Cloud?
What is the value of the cloud?

Most companies had electric generation capabilities on-site as differentiating factor

https://www.informationweek.com/software/information-management/the-cloud-electric-generator-analogy/d/d-id/1075830

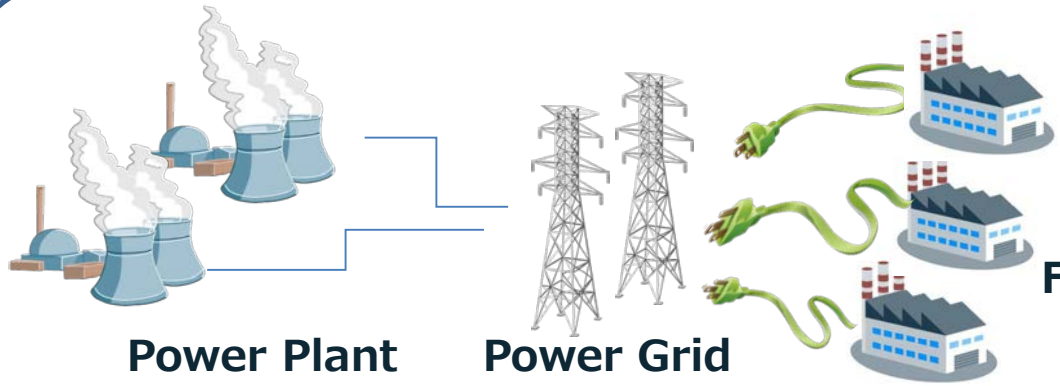
The emergence of power plants and power grids is a **Paradigm Shift**



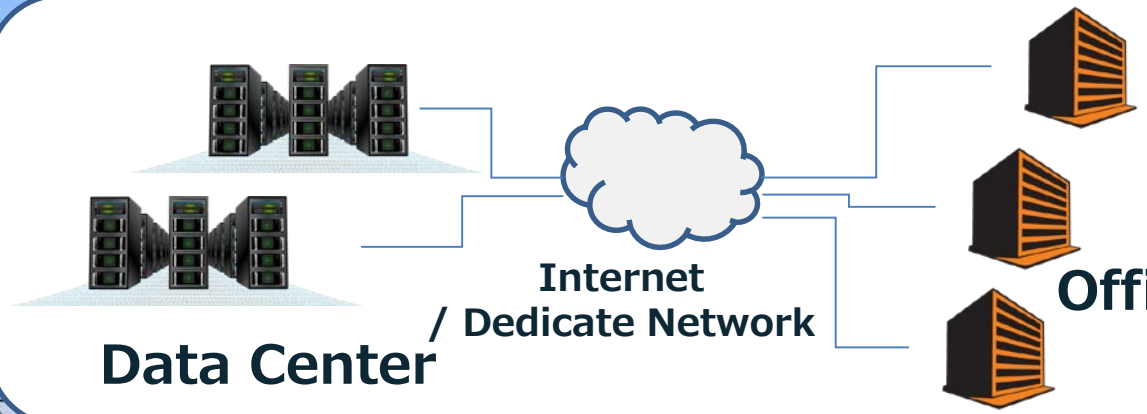
aws

When you need it, you can use it anytime with a low price

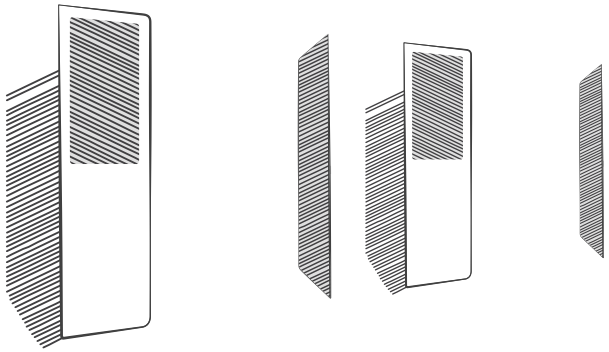
Electric Power

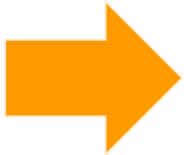


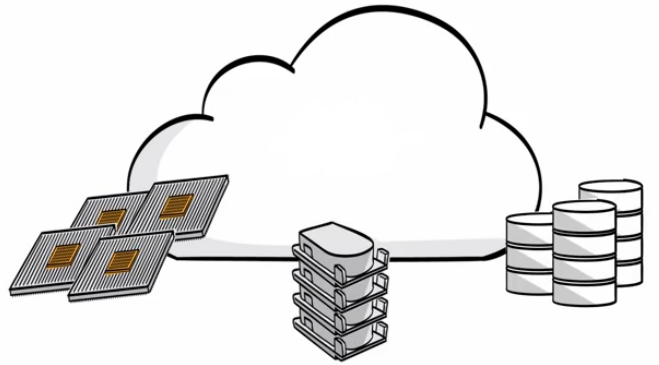
IT



The same transformation as electricity is in the IT world !







Initial investment

Surplus / shortage risk

Fixed Cost

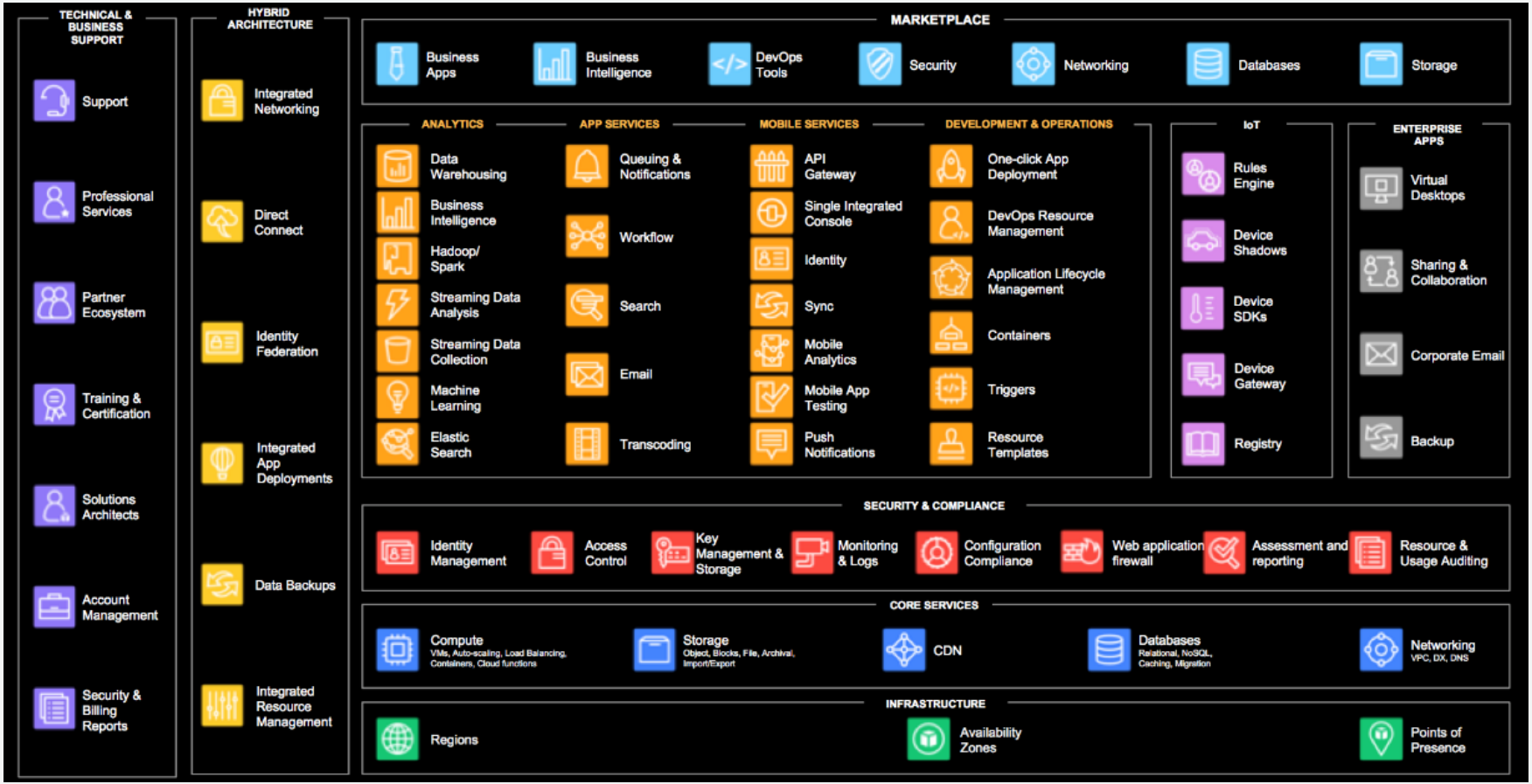
No initial investment required

Pay as you go

Variable costs

aws

Provide over 165 services



Customer of Healthcare & Life Sciences in Japan

[Excerpt]

aws

Real World Evidence on AWS

Why is the industry investing in Real World Evidence?

Sustainability

Creating pressure on the healthcare system to produce better overall outcomes

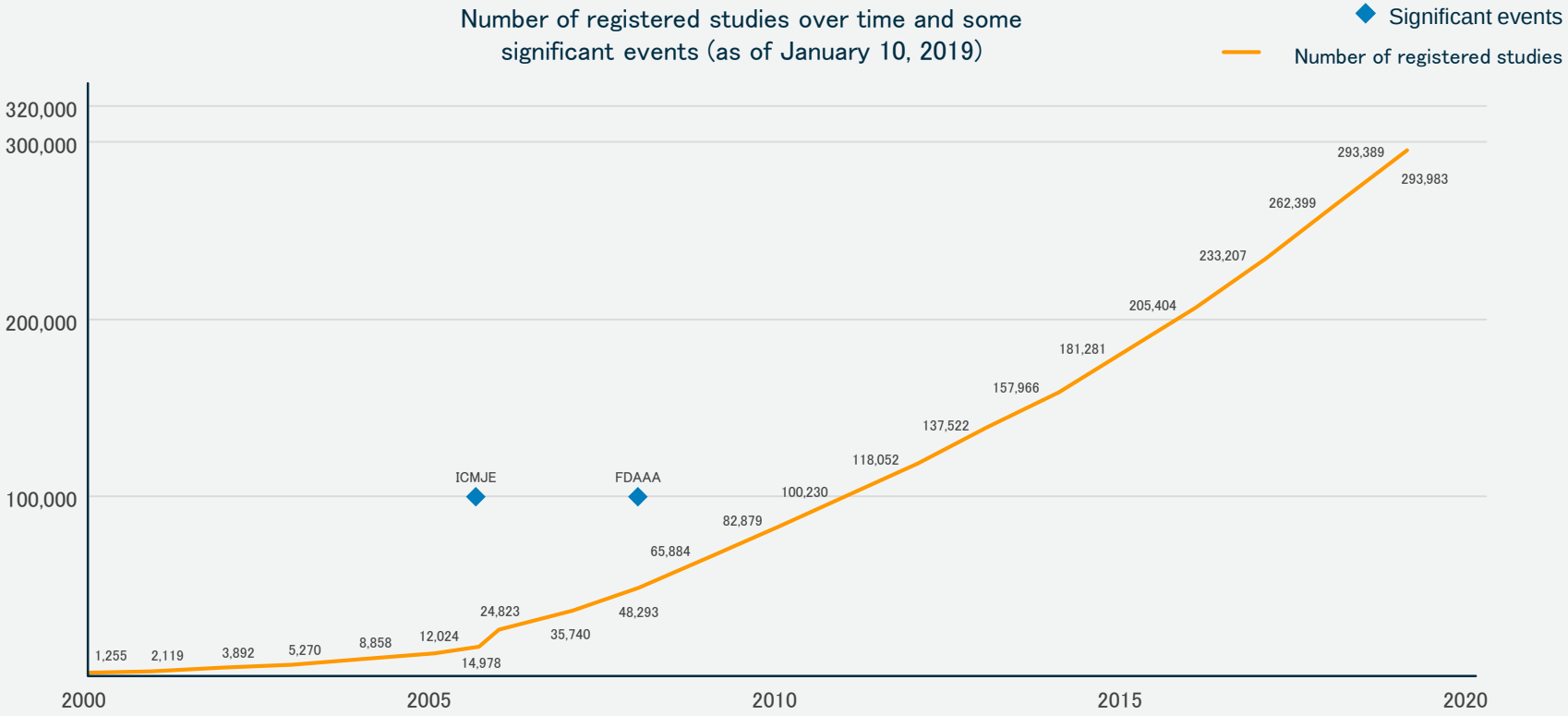
Reimbursement

Payers utilizing new data sources to redefine value based payment models and formulary preference

Healthcare Data is Exploding

44 fold increase from 2009, growing to 35ZB[1] fueling new insights and raising bar for proving outcomes

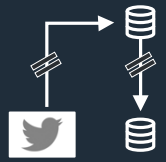
Clinical trials activity is increasing across industry



Source: https://ClinicalTrials.gov

aws healthcare and life sciences

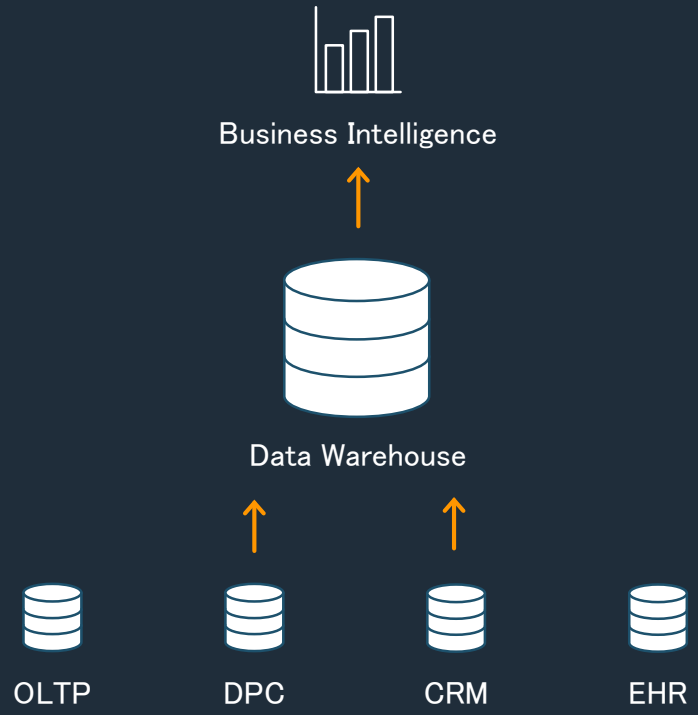
New requirements break the traditional approach



Customers need to:	Capture and store new non-relational data at EB scale	Secure and combine data from new and existing sources	Do new types of analysis (ML, big data & real-time)
Traditional approach:	DW is optimized for relational data at PB scale	Data exists in silos, ETL does not scale at EB data volumes	Operational and ad hoc on relational only

aws

Traditionally, analytics look like this



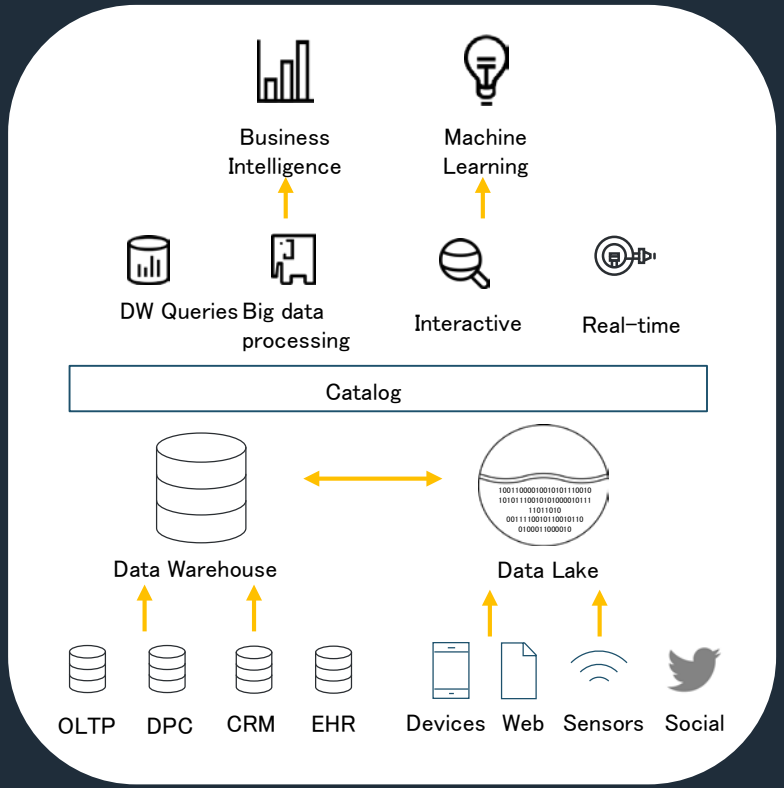
- Relational data
- TBs–PBs scale
- Schema defined prior to data load
- Operational reporting and ad hoc
- Large initial CAPEX + $10K–$50K/TB/Year

aws


COLLECT
COLLECT
PROCESS / ANALYZE
CONSUME
STORE
Data Lake

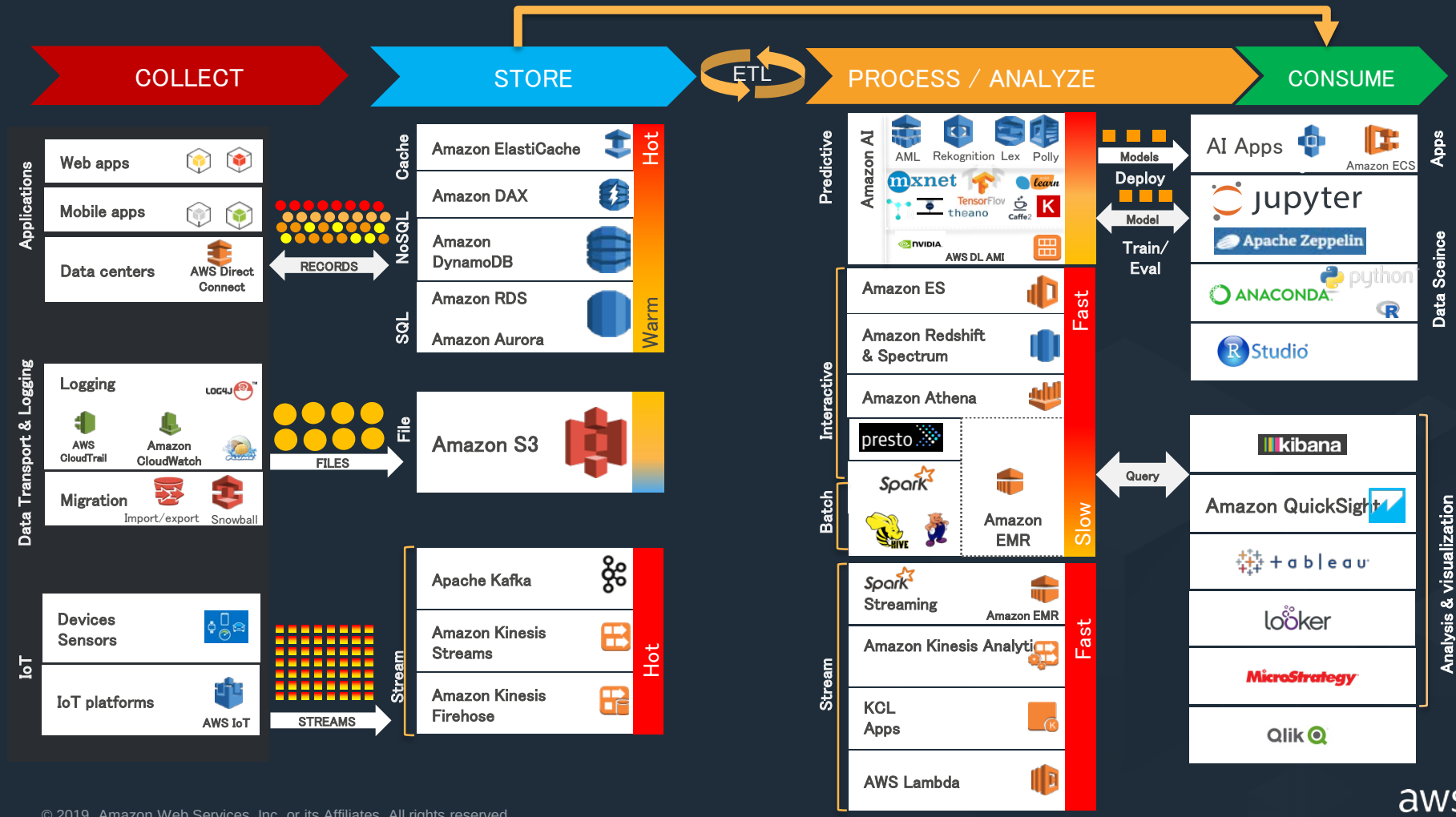
Building a Data Lake on AWS

Data Lakes extend the traditional approach

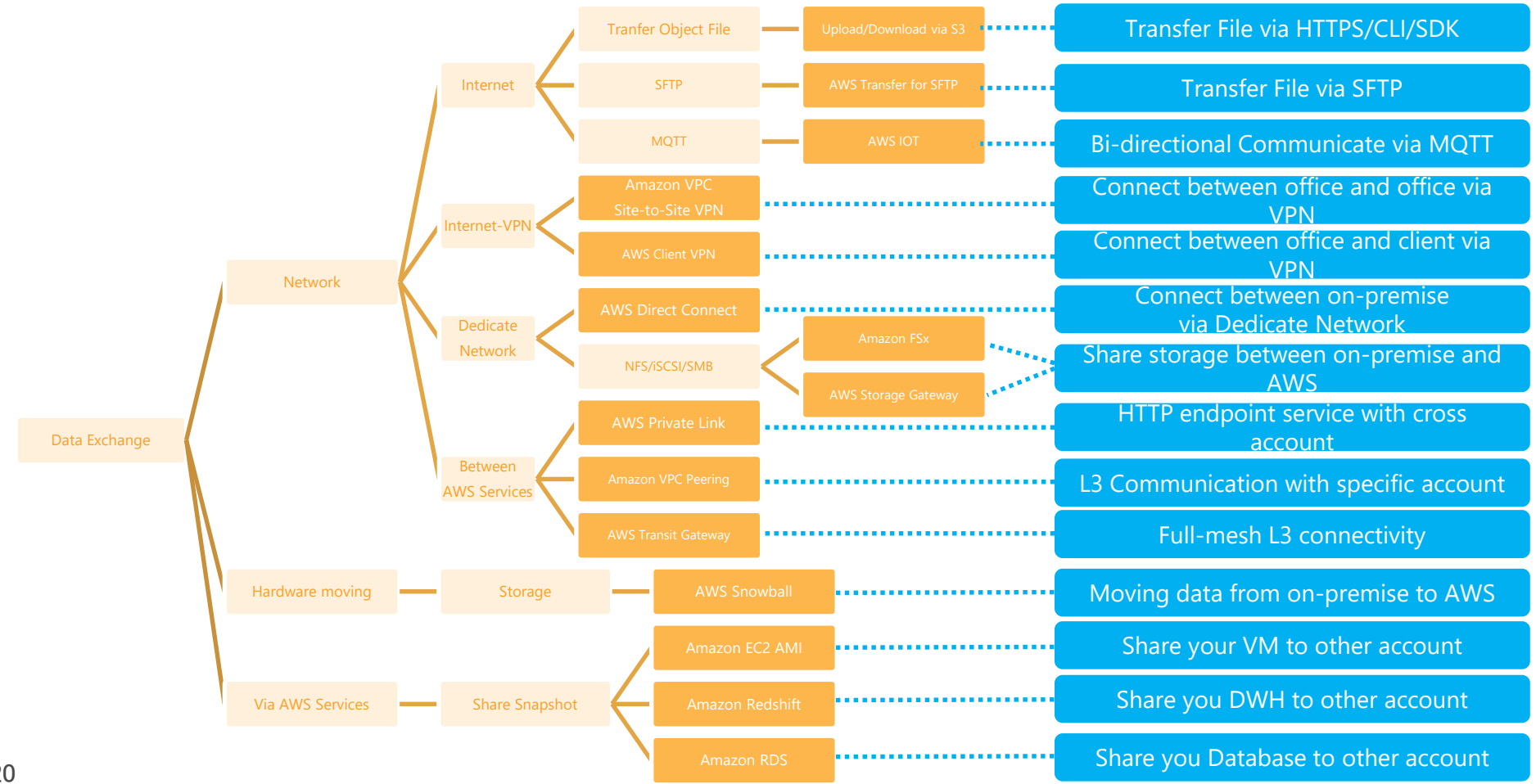


- Relational and non-relational data
- TBs–EBs scale
- Schema defined during analysis
- Diverse analytical engines to gain insights
- Designed for low cost storage and analytics

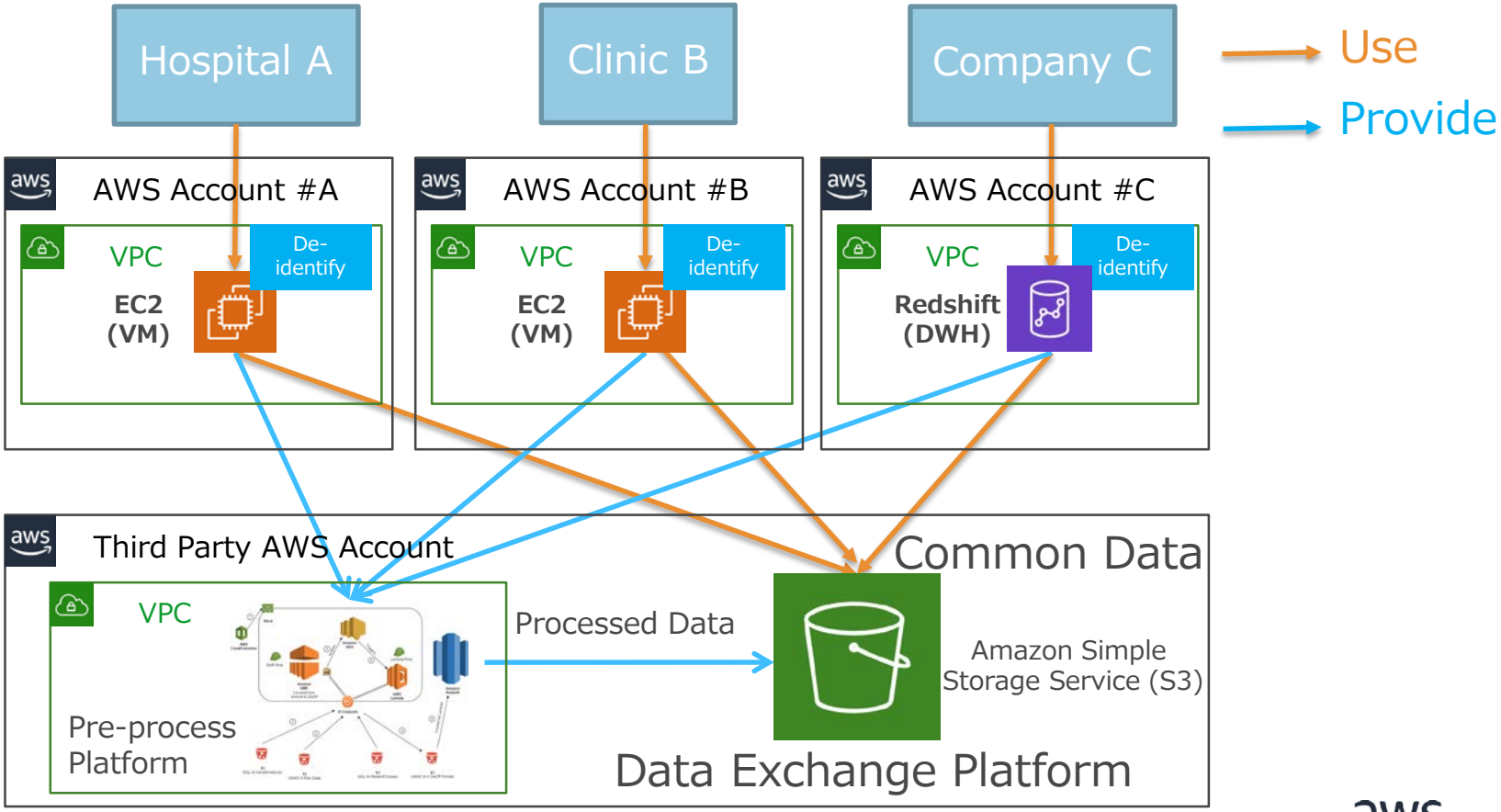
aws



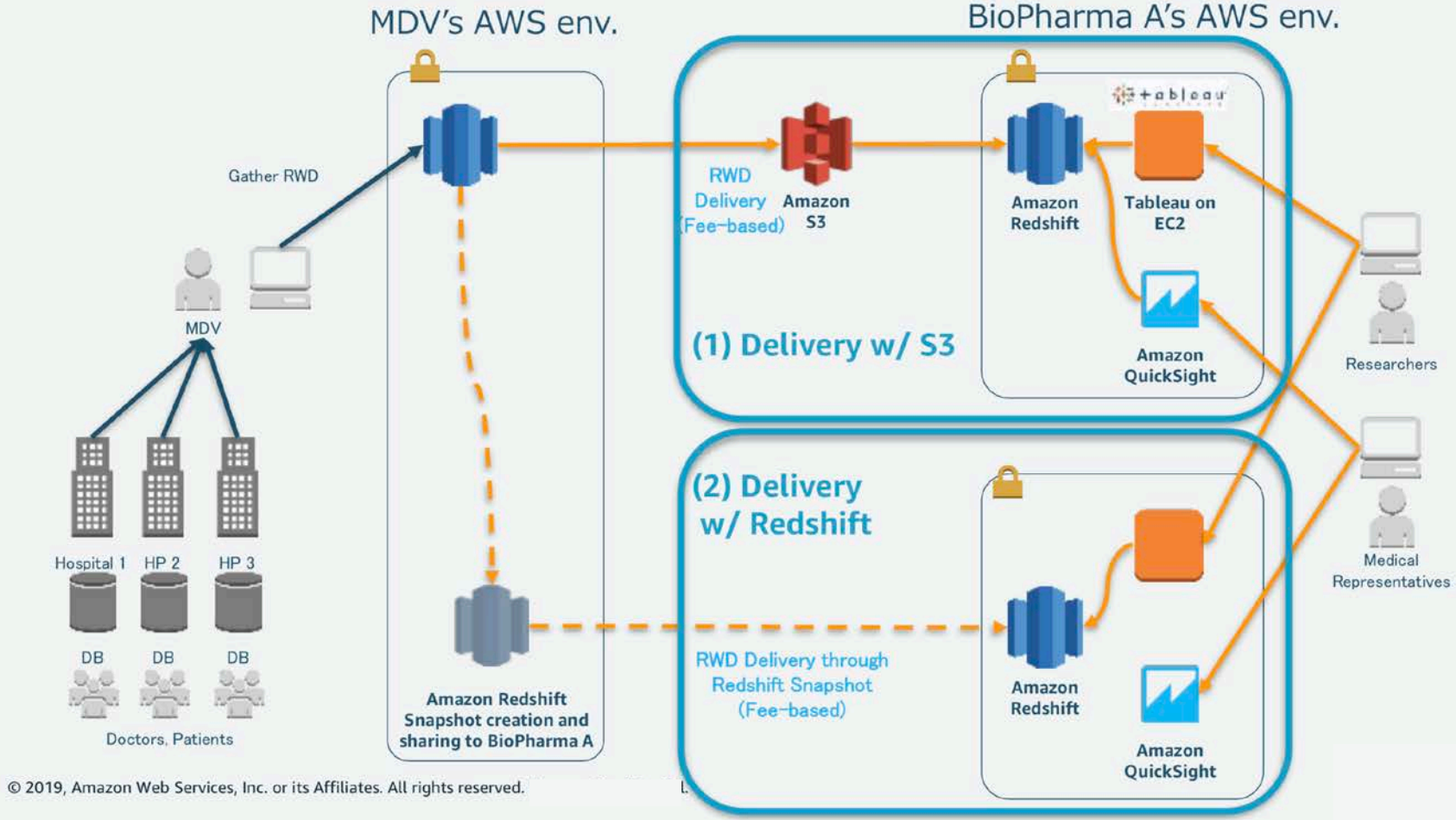
Functions that enable Data Exchange



Data Exchange Platform

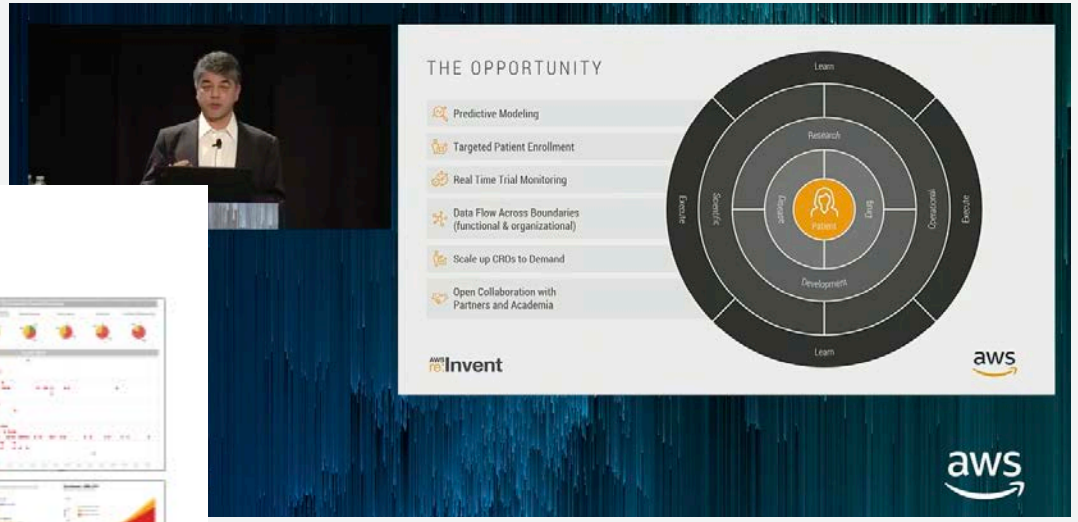


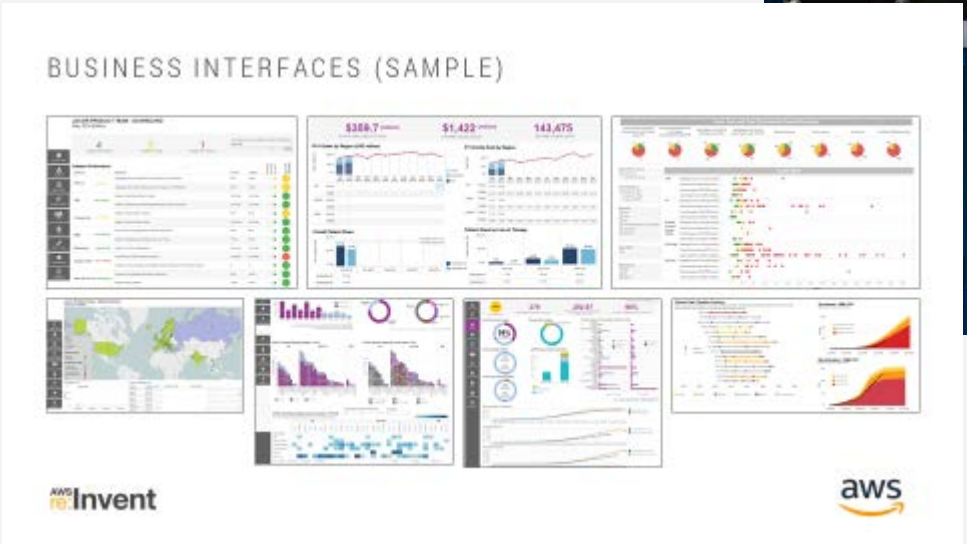
Provide data (MDV's online delivery of Real World Data (RWD)



Use Case: Takeda Pharmaceutical Company / Data Hub

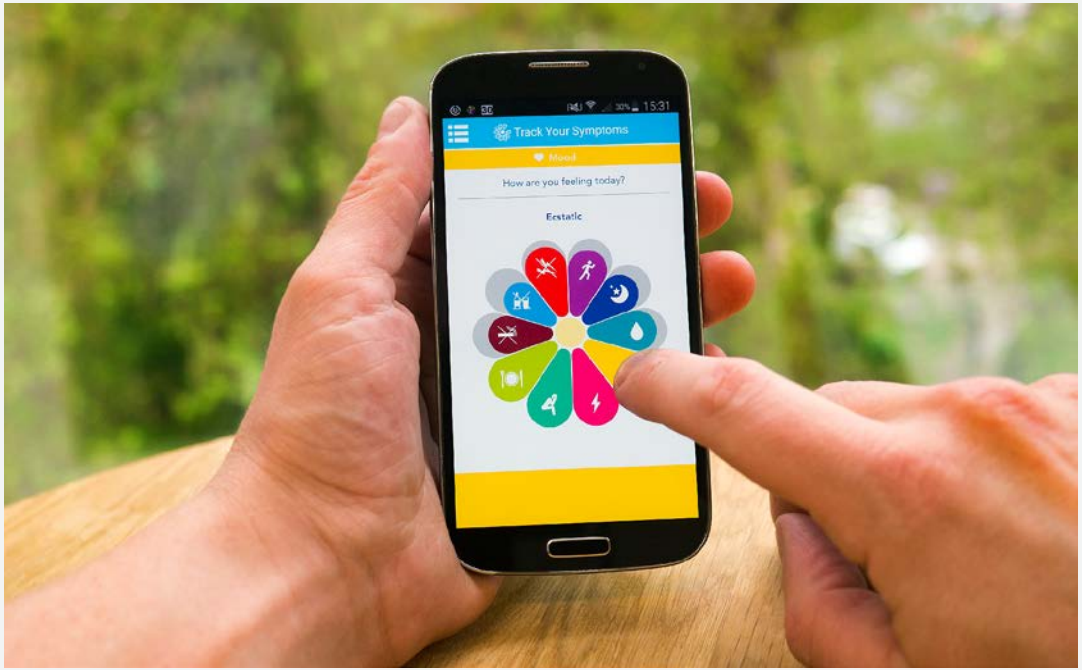
- AWS is adopted as a data analysis infrastructure.
- Provides data transparency, data-driven decision making, analytical standardization, and automation.





- ✓ https://www.youtube.com/watch?v=chDWhbAfFp8
- ✓ https://www.slideshare.net/AmazonWebServices/abd209accelerating-the-speed-of-innovation-with-a-data-sciences-data-analytics-hub-at-takeda

uMotif drives research and increases data quality



> We had 5,000 people register to join the clinical study in the first seven days, and we scaled the AWS infrastructure accordingly, no problem. In total, **13,500 people participated.**

Bruce Hellman,
Chief Executive Officer

umotif

aws healthcare and life sciences

Customer Problems

1.2 B unstructured clinical documents created per year

Critical information “trapped” in these documents

Difficult to extract insights

aws

Amazon Comprehend Medical

Named Entities

aws comprehend-medical detect-entities --region us-east-1 --text "<Insert Text Here>"

Mr. Smith is a 63-year-old gentleman with coronary artery disease and hypertension. CURRENT MEDICATIONS: taking a dose of LIPITOR 20 mg once daily

Protected Health Information (PHI)

Mr. Smith: **Name**

63: **Age**

Anatomy

Coronary artery: **System Organ Site**

Medical Condition

Coronary artery disease: **Dx Name**

Hypertension: **Dx Name**

Medication

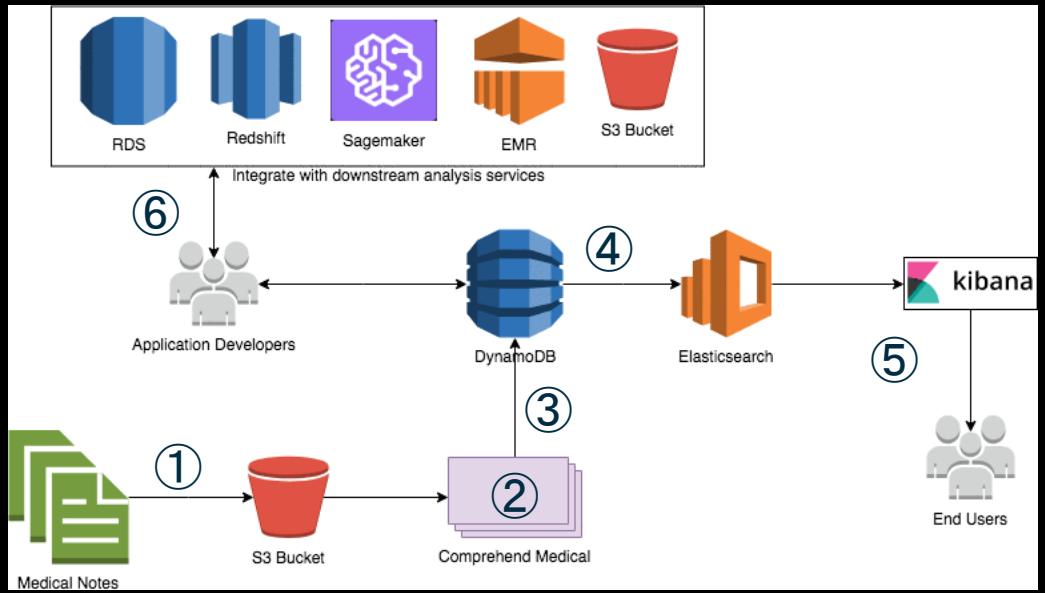
Lipitor: **Brand Name**

20 mg: **Dosage**

Once Daily: **Frequency**

aws

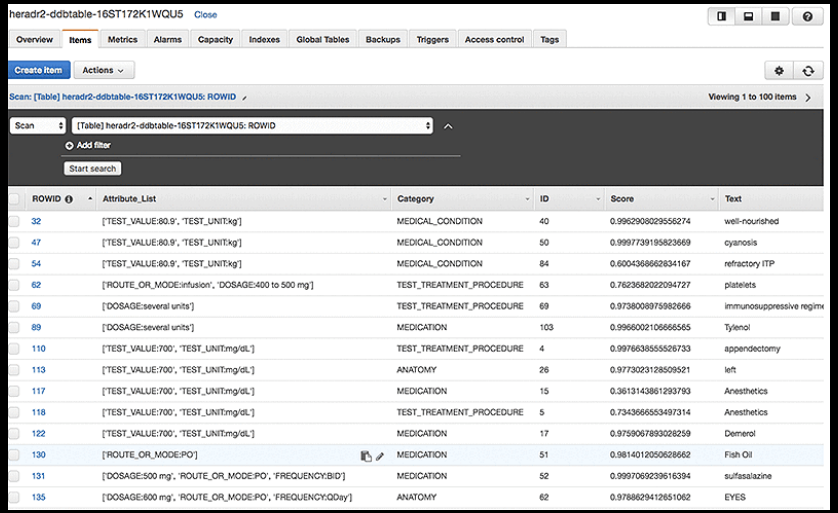
Extract and visualize clinical entities using Amazon Comprehend Medical



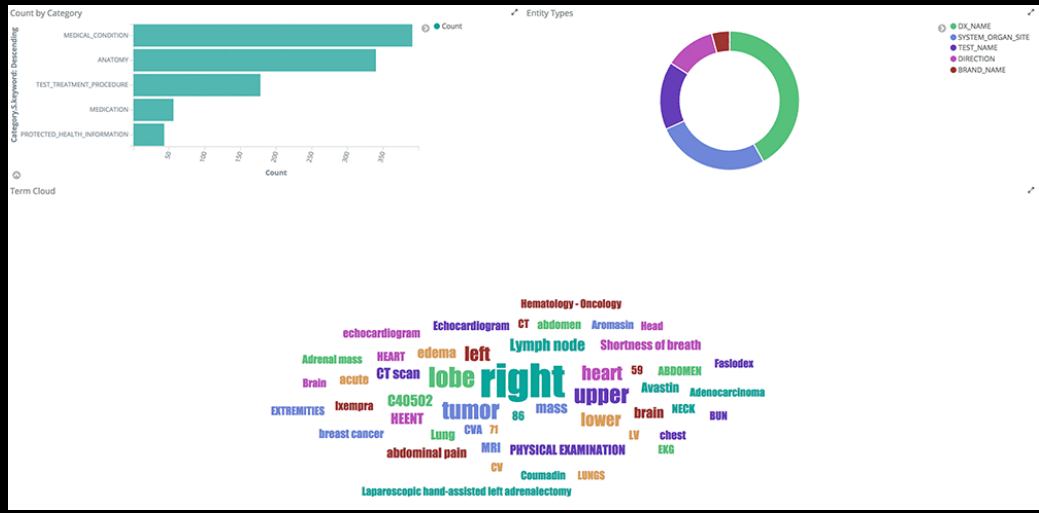
1) Upload Clnical notes to Amazon S3
2) Use Comperehend Medical API to extract various clinical entities
3) Extracted entities file is parsed and insert into Amazon DynamoDB table
4) DynamoDB has a stream attached to it. This stream is parsed using an AWS Lambda that is triggered by stream evnet
5) Lambda function inserts the records into Amazon Elasticsearch Service
6) Kibana dashboard visualize the clinical entities.

https://aws.amazon.com/jp/blogs/machine-learning/extract-and-visualize-clinical-entities-using-amazon-comprehend-medical/

Extract and visualize clinical entities using Amazon Comprehend Medical

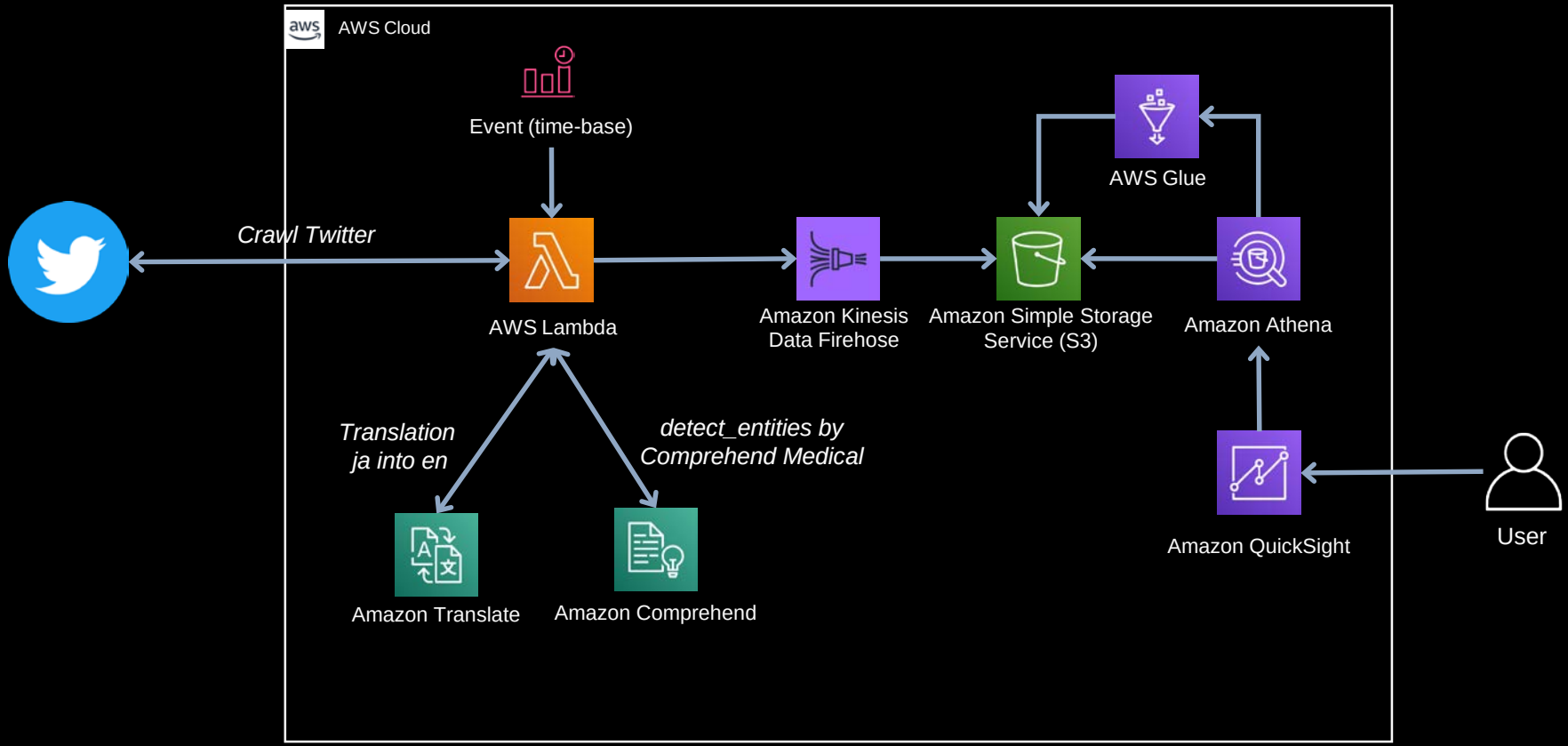


You can see the extracted entities from the notes. We get the attributes like Category, Type and also a confidence score.



You will see the dashboard with visualizations generated from the extracted entities.

Architecture : SNS Analytics using Comprehend Medical Demo

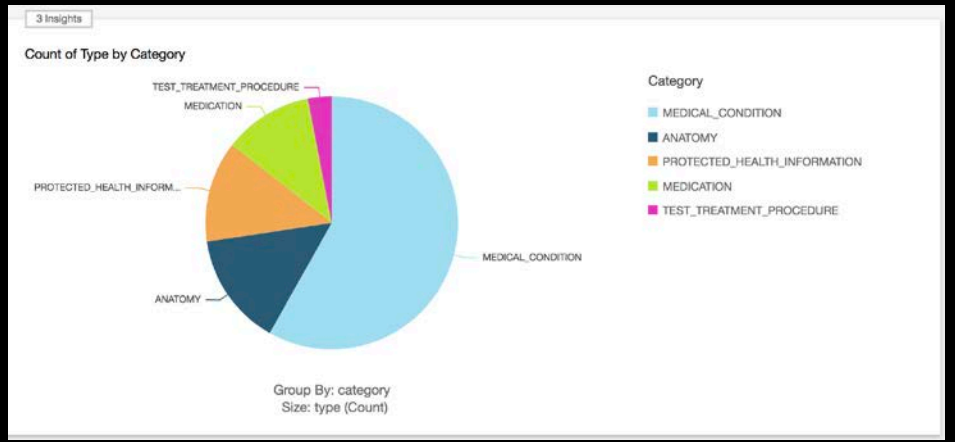


Demo - Comprehend Medical

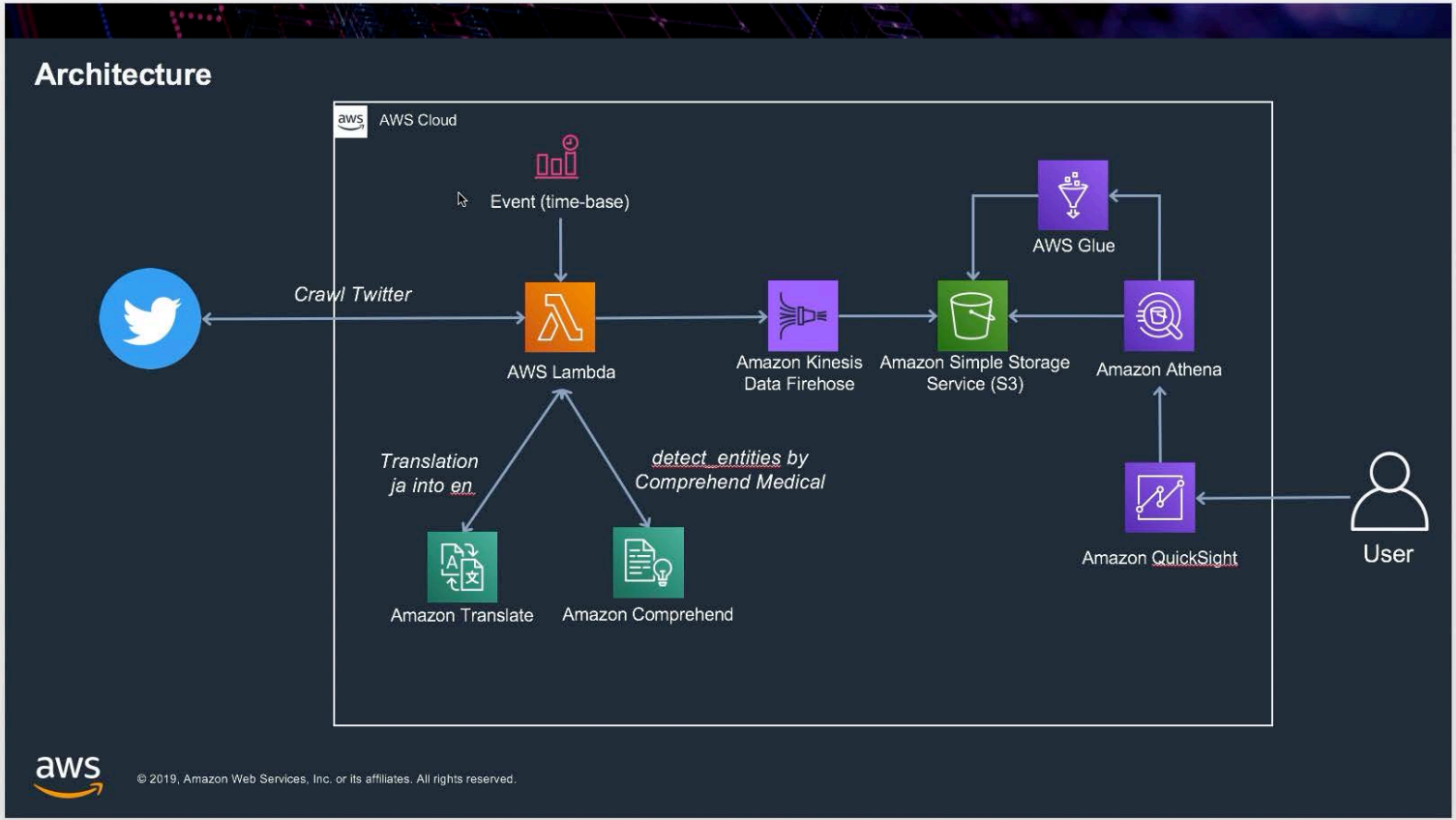
- Twitter (in this demo, # anticancer drug side effects, #hay fever) is crawled regularly, and natural language processing specialized in the medical field is performed at Amazon Translate and Amazon Comprehend Medical

- Analyze and visualize results with Amazon Athena, Amazon QuickSight

score	text	category	type
0.820244550704956	U.S. National Complementary	PROTECTED_HEALTH_INFORMATION	ADDRESS
0.9708576202392578	Ishigaki Island	PROTECTED_HEALTH_INFORMATION	ADDRESS
0.2258729189634323	Glaxo	MEDICATION	BRAND_NAME
0.2956674098968506	ADhMy3oqhe	MEDICATION	BRAND_NAME
0.5027686357498169	Mylan	MEDICATION	BRAND_NAME
0.6231828331947327	Elprat	MEDICATION	BRAND_NAME
0.656606137752533	Allerbi	MEDICATION	BRAND_NAME
0.8726202845573425	Ryupurin	MEDICATION	BRAND_NAME
0.9988677501678467	Adriamycin	MEDICATION	BRAND_NAME
0.6272539496421814	2019	PROTECTED_HEALTH_INFORMATION	DATE
0.4394994676131287	inner	ANATOMY	DIRECTION
0.916235089302063	below	ANATOMY	DIRECTION
0.9232311844825745	posterior	ANATOMY	DIRECTION
0.2681172490119934	cold ones	MEDICAL_CONDITION	DX_NAME
0.31557729840278625	cold	MEDICAL_CONDITION	DX_NAME
0.35009491443634033	foreign objects are easily penetrating	MEDICAL_CONDITION	DX_NAME
0.3520383834838867	terrible side effects	MEDICAL_CONDITION	DX_NAME
0.37599289417266846	colon and rectal cancer	MEDICAL_CONDITION	DX_NAME

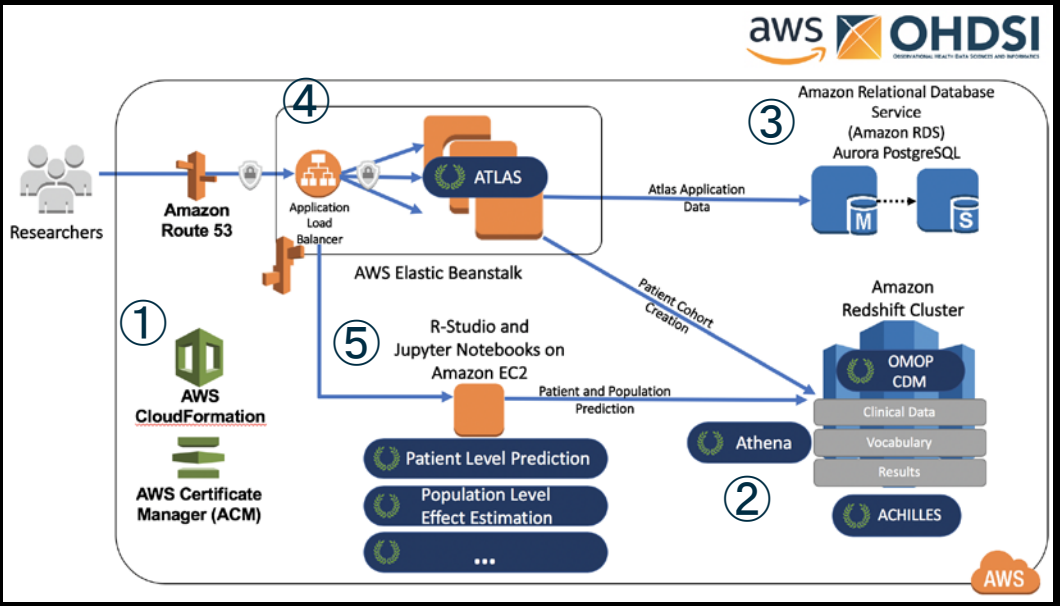


Demo: Twitter analysis using Comprehend Medical



Create data science environments on AWS for health analysis using OHDSI

※ The Observational Health Data Sciences and Informatics (OHDSI) program and community are working toward this goal by producing data standards and open-source solutions to store and analyze observational health data.

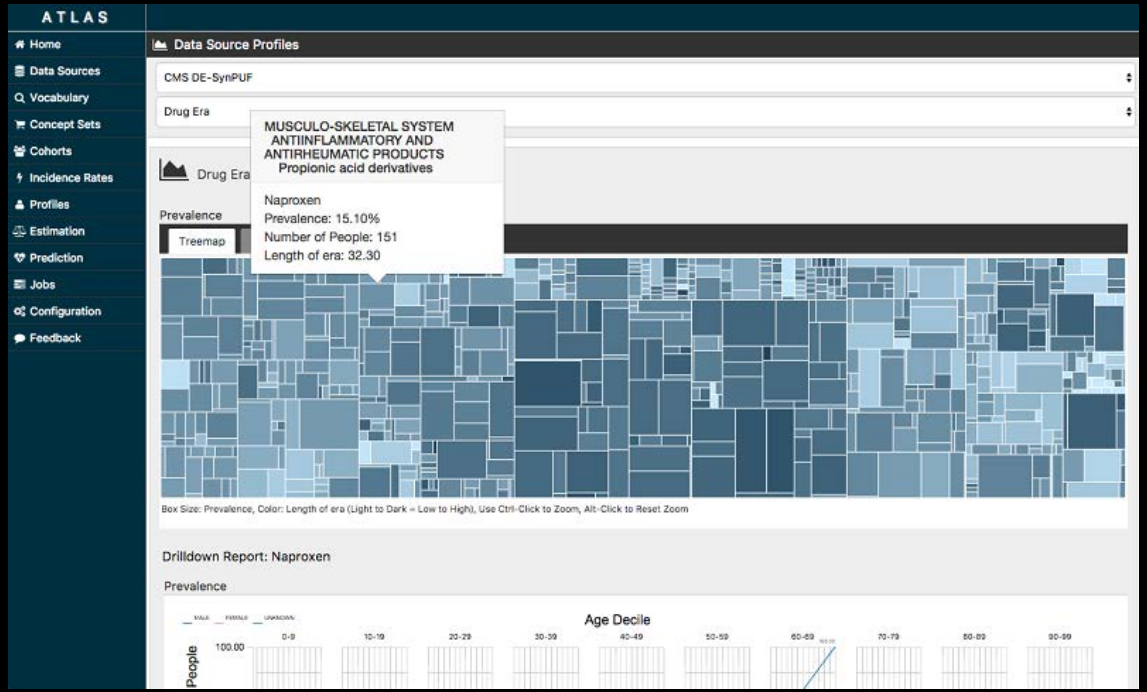


1) CloudFormation build this architecture automatically in about 30min.
2) Load data as OMOP format.
3) Build DB for Atlas application.
4) Use ATLAS for visualization
5) Excecute prediction using R-Studio and Jupyter notebook.

https://aws.amazon.com/jp/blogs/news/creating-data-science-environments-on-aws-for-health-analysis-using-ohdsi/

aws

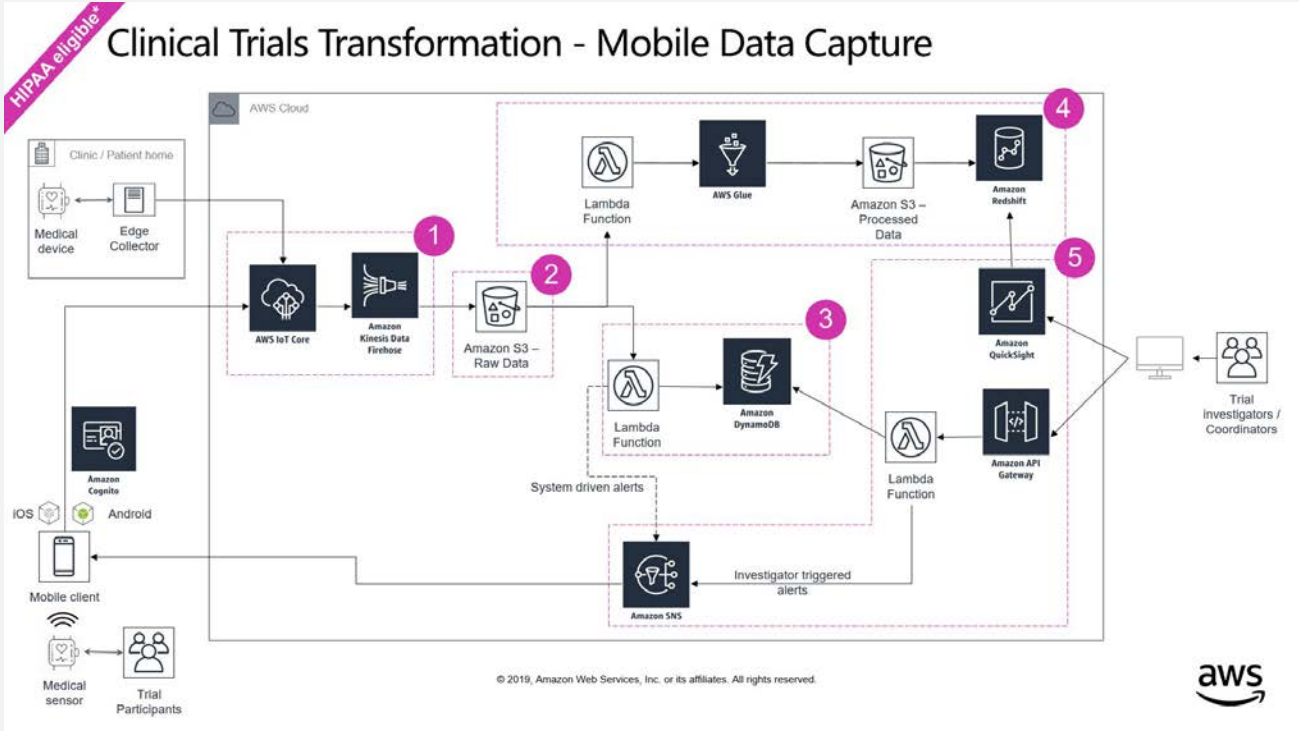
Sample: Healthcare data visualization using ATLAS



・The following screenshot is just one example of the population health analysis that is possible with the OHDSI tools. This Atlas visualization shows the prevalence of various drugs within the given population of people. This information helps researchers and clinicians discover trends and make informed decisions about patient health.

Mobile data capture with AWS

Clinical trials transformation: mobile data capture (HIPAA eligible)



1. Collect data

Collect real-time, streaming data from medical devices and personal wearables

2. Store data

Store raw data on Amazon S3 for future analysis

3. Data processing—fast lane

Process and move actionable KPIs in Amazon DynamoDB (real-time, sliding window basis)

4. Data processing—batch

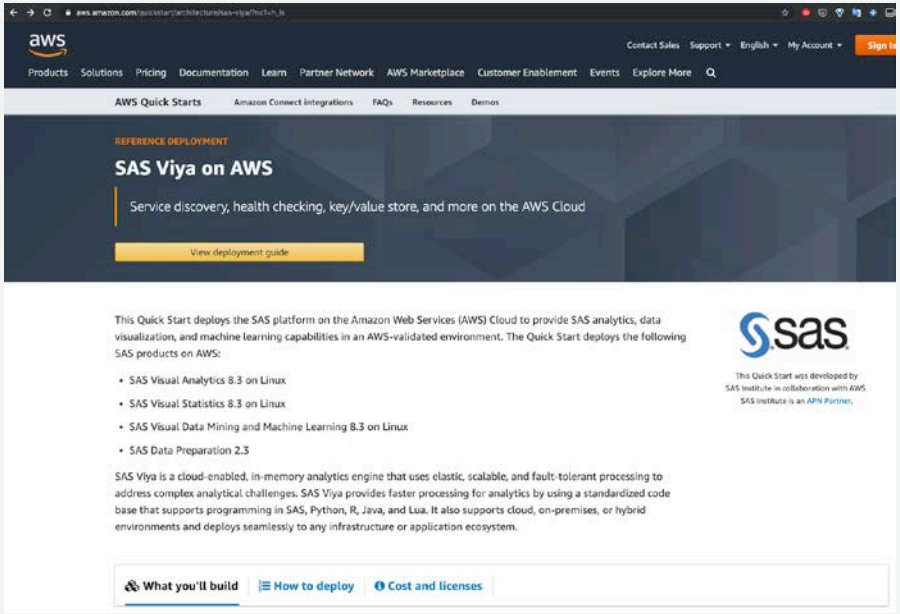
Extract, transform, and load (ETL) data using AWS Glue and move to Amazon S3. Load data in Amazon Redshift for detailed analysis

5. Visualize and act on data

Leverage Amazon QuickSight (or other BI tools) for data visualization. Provide real-time feedback via emails and text messages using Amazon SNS

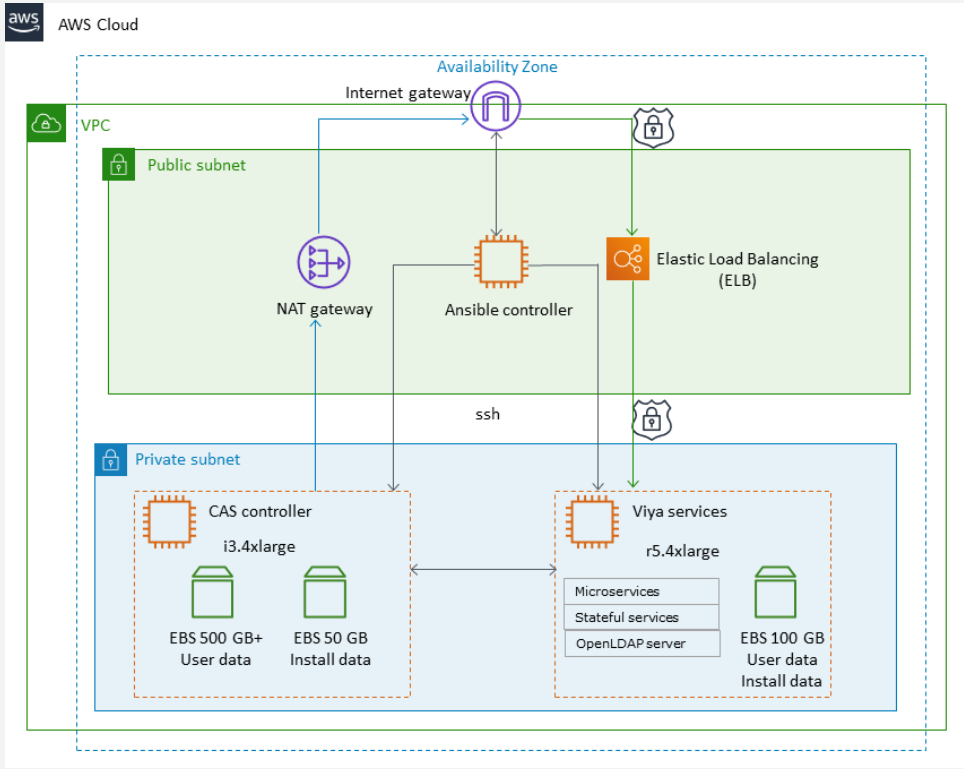
aws healthcare and life sciences

SAS Viya on AWS



https://aws.amazon.com/jp/quickstart/architecture/sas-viya/

It will take just 30 min !



Security / Compliance

How Does AWS Approach Compliance?

A COMBINATION OF AWS CERTIFICATIONS, RESOURCES AND SUPPORT IN ADDITION TO CUSTOMER DUE DILIGENCE

Customer

Compliance Programs

Verticals

GxP on AWS (Japanese Version)

Considerations for Using AWS Products in GxP Systems

CSV on AWS Reference From Partners

Reduce risk.


Move fast.
OR
Stay secure.


Move fast.
AND
Stay secure.

Access a deep set of cloud security tools

Networking

Virtual Private Cloud
Isolated cloud resources

Web Application Firewall
Filter Malicious Web Traffic

Shield
DDoS protection

Certificate Manager
Provision, manage, and deploy SSL/TSL certificates

Encryption

Key Management Service
Manage creation and control of encryption keys

CloudHSM
Hardware-based key storage

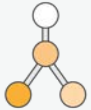
Server-Side Encryption
Flexible data encryption options

Identity & Management

IAM
Manage user access and encryption keys

SAML Federation
SAML 2.0 support to allow on-prem identity integration

Directory Service
Host and manage Microsoft Active Directory



Organizations
Manage settings for multiple accounts

Compliance

Service Catalog
Create and use standardized products

Config
Track resource inventory and changes

CloudTrail
Track user activity and API usage

CloudWatch
Monitor resources and applications

Inspector
Analyze application security

Macie
Discover, Classify & Protect data

aws

Goal & Take Away

- The changing healthcare landscape requires healthcare industry companies to be data-driven organizations.
- Cloud has the enabling technologies and Quick Starts to become such organizations.
- What you want from RWE is not to have tools, but to bring out outcomes.
- Try it first anyway! In the cloud, this can be achieved with low risk.

Thank you!

aws