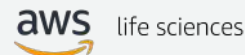# Analytics and ML for Life Sciences

Julien Simon
Global Evangelist, AI & Machine Learning, AWS
@julsimon

Selection of life sciences and genomics customers

AWS Partner Network Life Sciences Competency Partners

Pillars of life sciences on AWS

Global infrastructure

Security and compliance

Advanced analytics and AI/ML

Life science enterprise solutions

Partner ecosystem

aws life sciences

AWS global infrastructure

AWS global infrastructure

22 Regions | **69** Availability zones | **105** Edge locations

Region and number of availability zones

AWS GovCloud
East (3), West (3)

US West
Oregon (4), Northern California (3)

US East
N. Virginia (6), Ohio (3)

Canada
Central (2)

EU
Ireland (3), Frankfurt (3), London (3), Paris (3), Stockholm (3)

Asia Pacific
Singapore (3), Sydney (3), Tokyo (4), Seoul (2), Mumbai (2), Osaka-Local (1), Bahrain (3)

China
Beijing (2), Ningxia (3)

South America
São Paulo (3)

🔵 **Announced regions**
Cape Town, Jakarta, Milan

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AWS Positioned as a Leader in the Gartner Magic Quadrant for Cloud Infrastructure as a Service, Worldwide*

AWS is positioned highest in execution and furthest in vision within the Leaders Quadrant.

Figure 1. Magic Quadrant for Cloud Infrastructure as a Service, Worldwide

Source: Gartner (July 2019)

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Security and compliance

AWS compliance programs

FedRAMP

irap®

ISO 270 1
International Organization for Standardization

ISO 270 7
International Organization for Standardization

ISO 90 1
International Organization for Standardization

ISO 270 8
International Organization for Standardization

AWS Artifact
AWS Artifact is a free, online portal for self-service access to download AWS compliance reports and manage select agreements

Getting Started>>
FAQ>>
Documentation>>
All Assurance Programs>>

CSA cloud security alliance

AICPA SOC

HIPAA

CISPE DECLARED

AWS compliance resources

AWS GxP Site

AWS GxP Whitepaper

Intro to DevSecOps

Automating Security in the Cloud w DevSecOps

Merck GxP Whitepaper

PhUSE GxP Whitepaper

AWS Compliance Site

Data Center Overview

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AWS is GDPR ready

All AWS Services GDPR ready

by Chad Woolf | on 26 MAR 2018 | in Amazon GuardDuty, Amazon Inspector*, Amazon Macie*, AWS Config*, Compliance*, Security, Identity, & Compliance*, Webinars* |
Permalink | Comments | Share

Today, I'm very pleased to announce that AWS services comply with the General Data Protection Regulation (GDPR). This means that, in addition to benefiting from all of the measures that AWS already takes to maintain services security, customers can deploy AWS services as a key part of their GDPR compliance plans.

This announcement confirms we have completed the entirety of our GDPR service readiness audit, validating that all generally available services and features adhere to the high privacy bar and data protection standards required of data processors by the GDPR. We completed this work two months ahead of the May 25, 2018 enforcement deadline in order to give customers and APN partners an environment in which they can confidently build their own GDPR-compliant products, services, and solutions.

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HIPAA eligibility

Business Associate Addendum (BAA) available
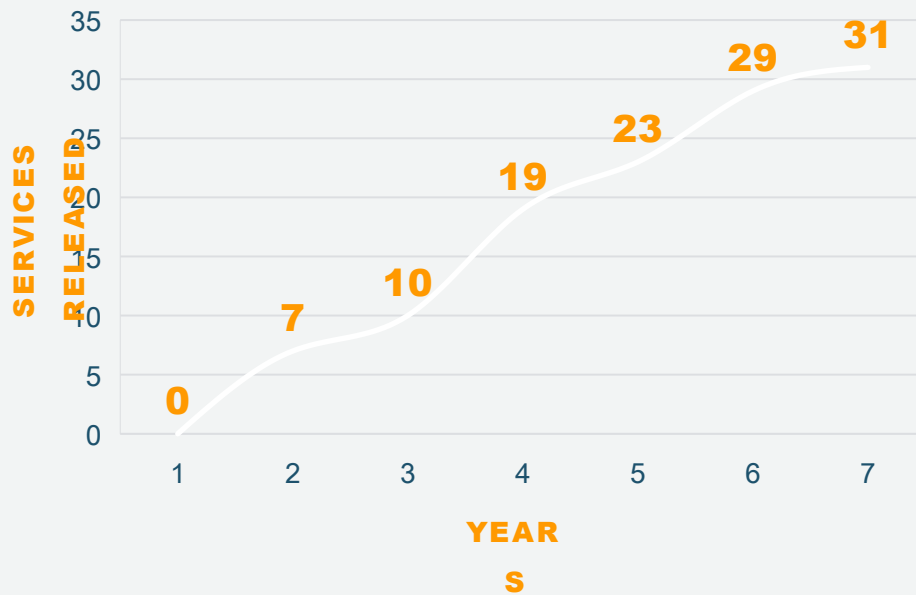
Accelerated launches of HIPAA-eligible services

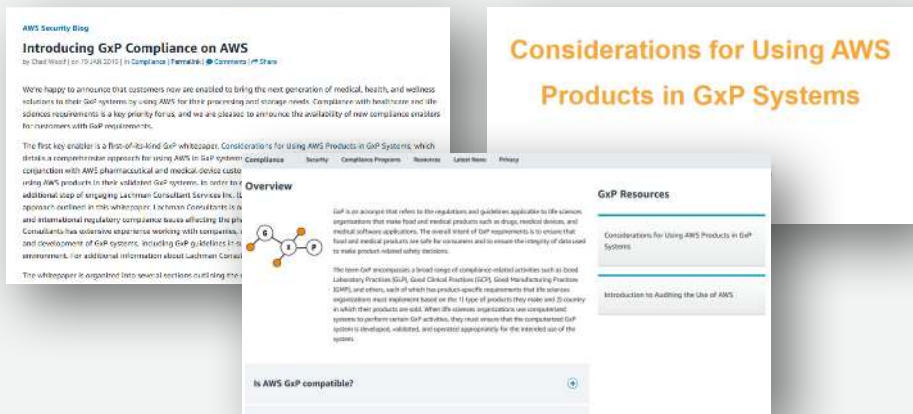>110 HIPAA-eligible services offered to date

GxP regulated workloads

moderna™
messenger therapeutics

"The validation process was greatly helped not only by AWS security controls and isolation capabilities, but also by the assistance of AWS consultants."

Dave Johnson
Director, Moderna Therapeutics

Enhance your compliance posture

- Rules-based, automated compliance
- Tools to continually test, monitor and log events
- Consistent environment for development, testing, production, and validation
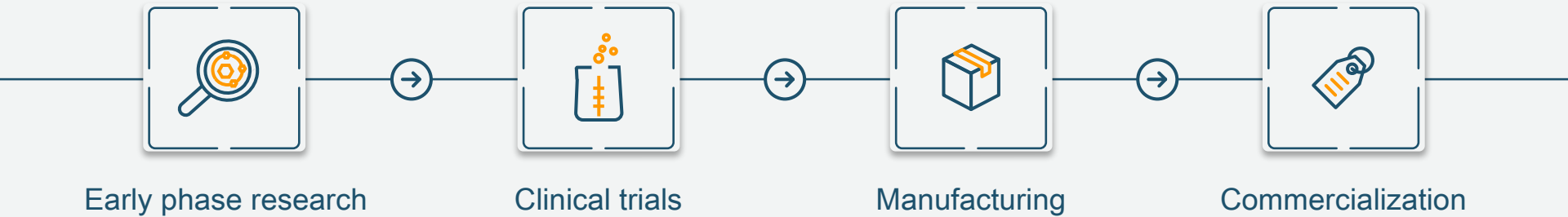
AWS as your trusted partner

- Guidance documents available
- Access to AWS Compliance experts

Accelerating transformation in life sciences

Modernizing the value chain

Early phase research → Clinical trials → Manufacturing → Commercialization

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Early phase research

Early phase research · Clinical trials · Manufacturing · Commercialization

Key industry trends

- HPC for computational chemistry
- Lab notebooks in the cloud
- Managing new data types via data lakes

- "Smart" lab instruments (IoT)
- Secure, global collaboration platforms
- Plug-and-play tools

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AWS AI/ML in early phase research

Numerate

Can search across tens of billions
of molecules, using thousands of
models. Shortened time from
years to days using AWS Cloud

"We used our AWS-based ML platform to
discover and optimize candidate drugs
faster than the industry average"
-
Brandon Allgood
CTO and Co-founder
Numerate

Top AI/ML use case trends

- Assay optimization
- Predictive toxicology
- Predictive computational chemistry

| Amazon EC2 | Amazon SageMaker | AWS Deep Learning AMIs |

AWS IoT in early phase research

Thermo Fisher SCIENTIFIC

Connected research equipment and medical devices

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illumina®

Connected genomics equipment to automate sequencing through data analysis

Top IoT use case trends

- Connected lab equipment
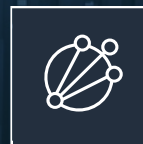- Auto-ordering of lab supplies

AWS IoT Core

AWS IoT Device Management

AWS IoT Device Defender

AWS IoT Analytics

AWS HPC in early phase research

"By spinning up hundreds or even thousands of nodes on AWS and getting results in hours vs weeks, our scientific researchers have a lot more freedom to ask questions that weren't even possible before."

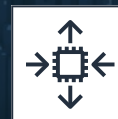**Lance Smith**
Associate Director of IT, Celgene

Top HPC use case trends

- Computational chemistry
- *In silico* drug modeling
- High throughput genomics data processing

Amazon EC2

Spot Instance

Auto Scaling

Secure and simplify global collaborations
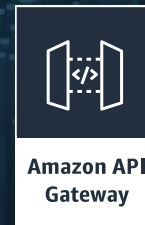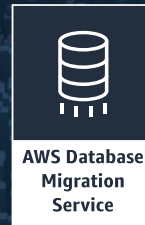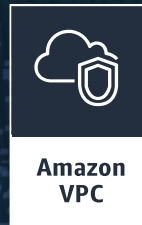
BCM Baylor College of Medicine

DNAnexus

300 researchers across 5 global institutions studying genetic variation to prevent and treat stroke and heart disease

- Controlled data access globally
- Massive scale databases
- Data analytics

Amazon VPC

AWS Database Migration Service

AWS Identity and Access Management

Amazon API Gateway

AWS Data Exchange: find and subscribe to third-party data

CHANGE HEALTHCARE

14 billion healthcare transactions, $1 trillion in claims

Medisafe

Daily medication consumption patterns of patients taking opioids

- Hundreds of data sets (commercial and free)

- Analyze data immediately with AWS analytics services

- Automatically consume new revisions

- Publish your own data

https://aws.amazon.com/data-exchange

Clinical trials

Key industry trends

- AI driven protocol design and patient recruiting

- Mobile technologies for enhanced data capture

- Advanced analytics for risk monitoring, adaptive trials, etc.

- AI to automate manual processes

- Enhanced collaboration with CROs

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AWS advanced analytics in clinical trials

medidata

Synthetic Control Database™— data from thousands of trials, millions of patients around the world with visualization tool to improve decision making in trials

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Bristol-Myers Squibb

Reduced total analysis time by 98% by running a clinical trial simulation on the AWS Cloud. Reduced the number of subjects by one-third, and the length of the study by almost a year

Top analytics use case trends

- Clinical data lakes
- Risk-based monitoring and visualization
- Synthetic control arms
- Clinical trial simulations

| Amazon Athena | Amazon QuickSight | Amazon Redshift | Amazon EC2 |

# AWS AI/ML to shorten trials and reduce costs

Knowledgent | accenture

Intelligent Trial Planning (ITP) application uses AI/ML to predict the feasibility of clinical trials and forecast recruitment timelines

The ITP platform enables study design teams at pharma organizations to run predictive analysis in minutes, not weeks

Top AI/ML use case trends

- Optimization of patient recruitment and forecasting trial timeline

- Patient cohort identification

- Prediction of best trial site locations

Amazon SageMaker

AWS Deep Learning AMIs
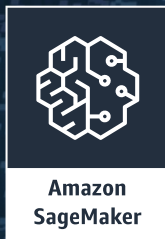
Life science manufacturing

Key industry trends

- GxP workloads in the cloud for scalable applications and agile control

- Unlocking new insights from historical data via data lakes and analytics

- Shift from reactive to predictive operations with machine learning

- Enhancing shop floor visibility and connecting data siloes via IoT

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# AWS IoT and AI/ML in life science manufacturing

bigfinite

Develop ML models leveraging organizational IOT data to improve manufacturing efficiency

Identified root cause of VOC emission violations, allowing them to reduce VOCs and reduce energy consumption by 17%, and avert plant shutdown

Top IoT and AI/ML use case trends

- Real-time failure diagnostics
- Predictive maintenance
- Reducing inefficiencies with data visualization

| AWS IoT Core | AWS IoT Analytics | Amazon SageMaker | Amazon EMR |
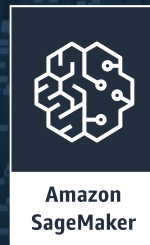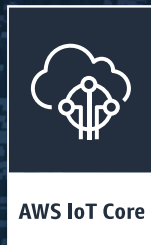
SAP HANA on AWS Cloud

Bristol-Myers Squibb

Reduced costs and application build times by changing its deployment strategy for SAP

AMGEN

Migrated SAP to the cloud to gain agility and give global team ability for on-demand self-service

- Reliability of mission-critical workloads
- Iterate faster and scale automatically
- Automated traceability and audit processes enable continuous compliance

SAP HANA

Quick Start available

AWS advanced analytics in manufacturing

novo nordisk®

GMP validated environment for pharmaceutical production. IoT enabled equipment for real-time monitoring and AI/ML for predictive maintenance. Utilization of ML to understand and identify golden batches of drug product

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MERCK

Took all manufacturing data for a vaccine and placed into cloud data lake. Analytics through 15 billion calculations and 5.5 million batch-to-batch comparisons uncovered production characteristics tied to final yield

Top analytics use case trends

- Real-time failure diagnostics
- Predictive maintenance
- Reducing inefficiencies with data visualization
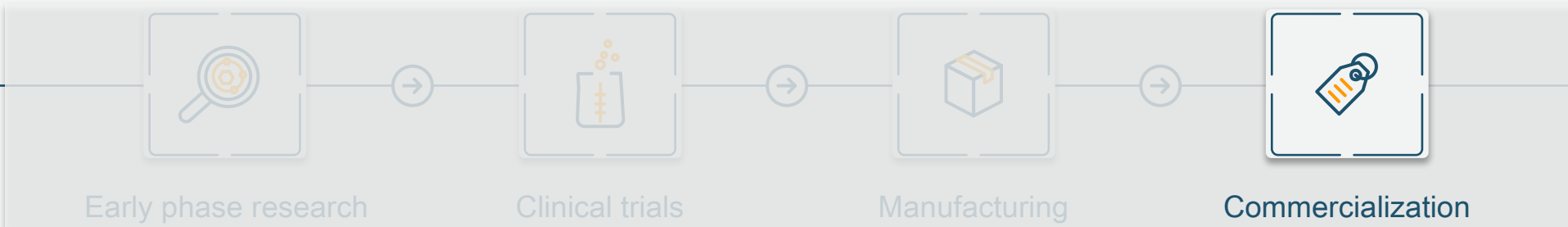
| Amazon QuickSight | Amazon Redshift | Amazon EMR |

Commercialization

Early phase research → Clinical trials → Manufacturing → **Commercialization**

Key industry trends

- Mobile technologies to create the digital feedback loop to drive greater adherence and lifestyle changes

- Real world evidence to increase market access

- Compliant sharing of data and analytics to increase healthcare team's ability to drive greater outcomes

- Increasing brand engagement

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Democratizing real-world evidence

ConvergeHEALTH by
Deloitte.

Aggregate patient data from multiple sources to connect both clients and external vendor data into a single view for al patient interactions

Takeda

Incorporated deep learning models to provide insights on burden of disease and patient unmet needs; enhanced ability to effectively target eligible patients

Real-world evidence trends

- Identify unmet patient needs using real-world evidence and AI/ML
- Identify other applications for medications—drug repurposing
- Identify next best action with personalization

Comprehend Medical

AWS Deep Learning AMIs

Amazon Personaliz
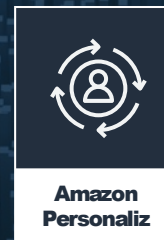
Technology enabled pharmacovigilance

pwc

Extract information to identify medically relevant events with significantly faster throughput than in the past

- Unlocking valuable data locked in clinical notes
- Adverse event detection
- Handle massive increase in volume of data
- Social media feeds

Amazon SageMaker

Amazon Textract

AWS Lambda

Comprehend Medical

Delivering personalized care

Roche Diagnostics

Quickly extract information from medical documents to build a longitudinal view of patients and enable personal decision support

NAVIFY®

Digital diagnostic tool that uses analytics to match patients' tumor type so oncology care teams can quickly select the right therapy for each patient

Top personalization trends

Identify next best action with AI/ML for personalization
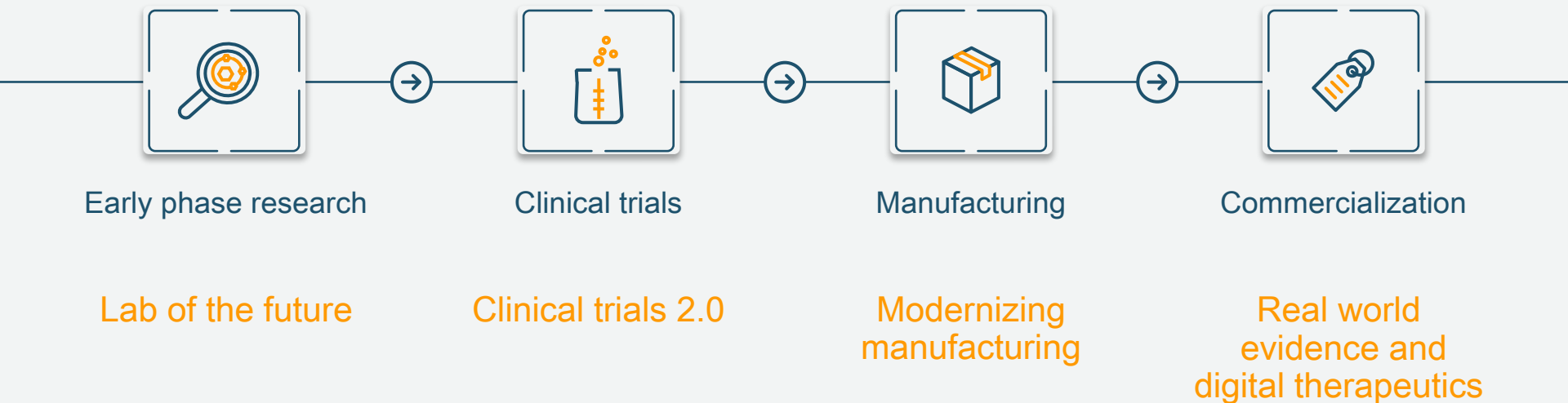
AWS Deep Learning AMIs

Amazon Personaliz

Amazon Pinpoint

Solutions for our enterprise customers

Early phase research

Clinical trials

Manufacturing

Commercialization

Lab of the future

Clinical trials 2.0

Modernizing manufacturing

Real world evidence and digital therapeutics

AWS is your trusted partner
to accelerate your transformation

aws life sciences

Thank you!