



# The Future of Healthcare

Biljana Cabrilo – Client Executive Public Sector

Bernhard Geist – Business Development Healthcare EMEA

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# Overview

- Industry Challenges
- Global Trends
- Healthcare Key Workloads
- 4 Myths about Cloud
- Conclusion

Case Studies in Appendix

# Industry Challenges

Aging population

1/3

Proportion of population in Europe estimated to be over the age of 60 by 2050

Unmet demand/ lack of capacity

14.5M

WHO estimated healthcare workforce gap by 2030

Increasing volume of digital data

163ZB

Amount of data that will be generated globally in 2025; 10 times the 16.1ZB of data generated in 2016

Drive to improve efficiency

20%

Proportion of health spending that could be seen as non-value adding, according to the OECD

Sophisticated security breaches

93%+

Proportion of healthcare organizations that have experienced a data breach of some kind over the past 5 years

Sources: United Nations (2017): World Population Ageing; American College of Healthcare Executives (2019): Top Issues Confronting Hospitals in 2018; IDC Forecast (April 2017); OECD (2017): Tackling Wasteful Spending on Health; Back Book Market Research (2019): Health Data Security & Privacy

# Strategische und operative Ziele im GW AT 2017-2021

STRATEGISCHE DIMENSION STRATEGISCHE ZIELE		OPERATIVE DIMENSION OPERATIVE ZIELE	
<b>BESSERE VERSORGUNG</b>	<b>S1: Stärkung der ambulanten Versorgung bei gleichzeitiger Entlastung des akutstationären Bereichs und Optimierung des Ressourceneinsatzes</b>	<b>BEDARFS-GERECHTE VERSORGUNGS-STRUKTUREN</b>	1: Verbesserung der integrativen Versorgung durch gemeinsame abgestimmte verbindliche Planung und Umsetzung der folgenden Ziele (1.1 bis 1.3)  1.1: Primärversorgungsmodelle auf- und ausbauen  1.2: Bedarfsgerechte Gestaltung, Abstimmung und Weiterentwicklung der ambulanten Fachversorgung  1.3: Bedarfsgerechte Anpassung der stationären Versorgungsstrukturen
		<b>DIE RICHTIGE VERSORGUNG („THE RIGHT CARE“)</b>	2: Verfügbarkeit und Einsatz des für die qualitätsvolle Versorgung erforderlichen Gesundheitspersonals (Skill-Mix, Nachwuchssicherung, demographische Entwicklung) sicherstellen  3: Stärkere Ausrichtung des Vertragswesens und der Honorierungssysteme am Versorgungsbedarf bei gleichzeitiger Unterstützung der Zielsetzungen der ZS-G (insbesondere Versorgung am „Best Point of Service“) und der Anforderungen an die Versorgungsformen  4: Optimierung der Versorgung von Kindern und Jugendlichen in ausgewählten Bereichen

<b>BESSERE QUALITÄT</b>	<b>S2: Sicherstellen der Zufriedenheit der Bevölkerung durch Optimierung der Versorgungs- und Behandlungsprozesse</b>	<b>BESSER KOORDINIERTER VERSORGUNG</b>	5: Gezielter Einsatz von IKT zur Patientenversorgung, Systemsteuerung und Innovation  6: Verbesserung der integrierten Versorgung  7: Medikamentenversorgung sektorenübergreifend gemeinsam optimieren  8: Sicherstellung der Ergebnisqualität im gesamten ambulanten Bereich
		<b>BEHANDLUNG, ZUM RICHTIGEN ZEITPUNKT</b>	9: Zur Stärkung der Sachleistungsversorgung örtliche, zeitliche und soziale Zugangsbarrieren abbauen
<b>GESÜNDERE BEVÖLKERUNG</b>	<b>S3: Gesundheitsförderung und Prävention: Erhöhung der Zahl der gesunden Lebensjahre und Verbesserung der Lebensqualität von erkrankten Personen</b>	<b>GESUND BLEIBEN</b>	10: Stärkung der Gesundheitskompetenz der Bevölkerung
		<b>GESÜNDER LEBEN</b>	11: Stärkung von zielgerichteter Gesundheitsförderung und Prävention
<b>„BETTER VALUE“</b>	<b>S4: Gewährleistung einer nachhaltigen Finanzierbarkeit der öffentlichen Gesundheitsausgaben</b>	<b>NACHHALTIGKEIT SICHERN</b>	Messgrößen und Zielwerte siehe Finanzzielsteuerung bz

Quelle: Das österreichische Gesundheitssystem 2019 (Gesundheit Österreich GmbH): [https://jasmin.goeg.at/434/13/Das%20%C3%B6sterreichische%20Gesundheitssystem 2019.pdf](https://jasmin.goeg.at/434/13/Das%20%C3%B6sterreichische%20Gesundheitssystem%202019.pdf)

# Das österreichische Gesundheitssystem

**TABELLE 3.1** Entwicklung der Gesundheitsausgaben in Österreich (laufende Preise), 2000–2015

GESUNDHEITSAUSGABEN	2000	2005	2010	2015
Gesundheitsausgaben (in Millionen €)	19.660	24.243	29.794	35.077
Gesundheitsausgaben pro Kopf (in €)	2.454	2.947	3.562	4.072
Gesundheitsausgaben in % des BIP	9,2%	9,6%	10,1%	10,2%
<b>ÖFFENTLICHE GESUNDHEITSAUSGABEN</b>				
Öffentliche Gesundheitsausgaben (in Millionen €)	14.850	18.203	22.685	26.513
Öffentliche Gesundheitsausgaben in % der laufenden Gesundheitsausgaben	75,5	75,1	76,1	75,6
Öffentliche Gesundheitsausgaben in % des BIP	7,0	7,2	7,7	7,8
Öffentliche Gesundheitsausgaben in % der gesamten Staatsausgaben	14,1	14,5	14,9	15,6
<b>PRIVATE GESUNDHEITSAUSGABEN</b>				
Private Gesundheitsausgaben	4.809	6.040	7.109	8.564
Private Gesundheitsausgaben in % der Gesundheitsausgaben	24,5	24,9	23,9	24,4
Private Gesundheitsausgaben in % des BIP	2,3	2,4	2,4	2,5
Selbstzahlungen privater Haushalte (OOP) in % der laufenden Gesundheitsausgaben	17,8	18,6	17,7	17,9
Selbstzahlungen privater Haushalte (OOP) in % der privaten Gesundheitsausgaben	72,9	74,5	74,3	73,4
Freiwillige Gesundheitsversicherungssysteme (Krankenzusatzversicherung, POoE und Finanzierungssysteme von Unternehmen) <sup>1</sup> in % der laufenden Gesundheitsausgaben	6,6	6,4	6,1	6,5
Freiwillige Gesundheitsversicherungssysteme in % der privaten Gesundheitsausgaben	27,1	25,5	25,7	26,6

2020 → 10,4%

2060 → 1,1 Mio Menschen über 80 (doppelt so viele wie heute!)

82% der Bevölkerung sind sehr oder eher davon überzeugt, dass es in Ö ein 2-Klassen-System im Gesundheitswesen gibt.

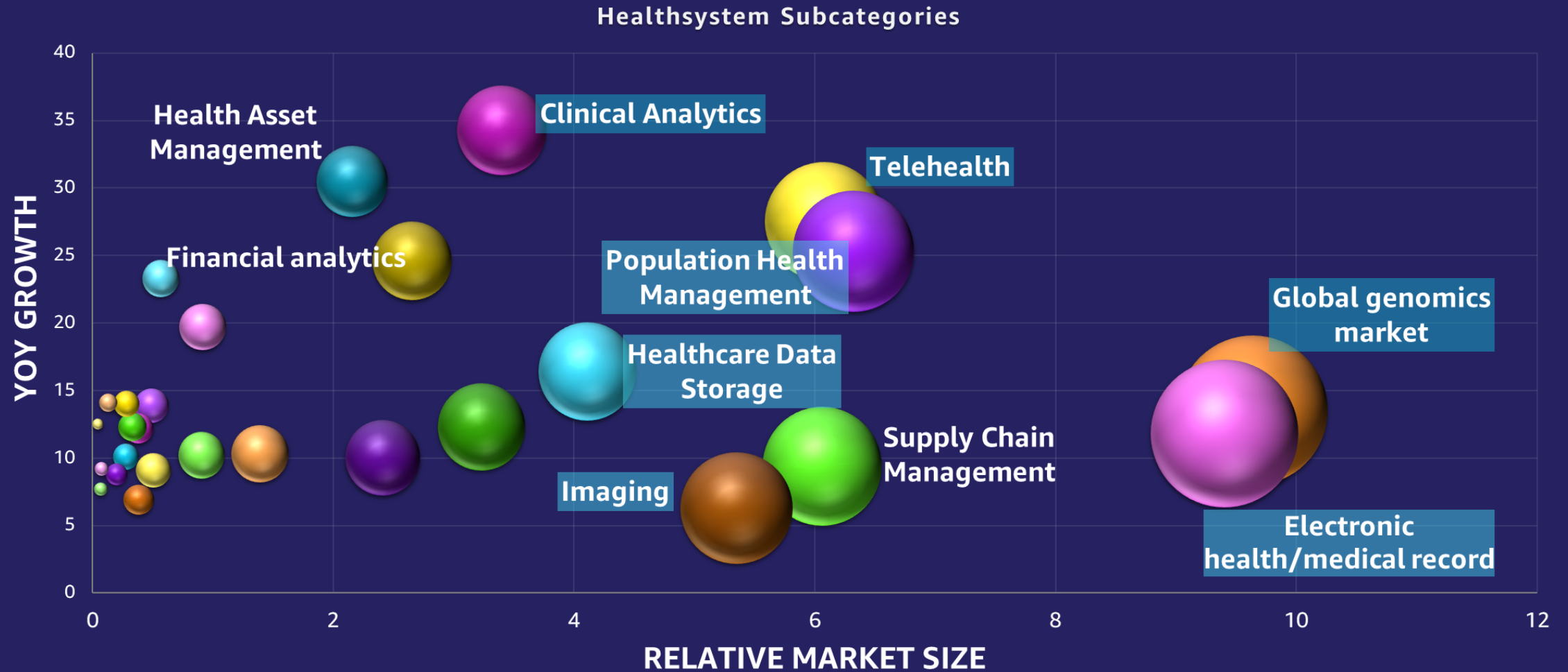
**TABELLE 1.1** Demografische Indikatoren, ausgewählte Jahre

	1980	1990	2000	2010	2016
<b>GESAMTBEVÖLKERUNG</b>	<b>7.549.433</b>	<b>7.677.850</b>	<b>8.011.566</b>	<b>8.363.404</b>	<b>8.747.358</b>
Wachstum der Gesamtbevölkerung (durchschn. jährliche Wachstumsrate) <sup>1</sup>	–	0,2	0,4	0,4	0,8
Bevölkerung 0–14 Jahre (% der Gesamtbevölkerung)	20,5	16,9	16,8	14,7	14,2
Bevölkerungswachstum bei 0–14-Jährigen (durchschn. jährliche Wachstumsrate) <sup>1</sup>	–	-1,9	-0,1	-1,3	-0,6
Bevölkerung 15–64 Jahre (% der Gesamtbevölkerung)	64,3	68,2	67,8	67,5	66,9
Bevölkerungswachstum bei 15–64-Jährigen (durchschn. jährliche Wachstumsrate) <sup>1</sup>	–	0,6	-0,1	0,0	-0,2
Bevölkerung ab 65 Jahre (% der Gesamtbevölkerung)	15,1	14,8	15,3	17,7	18,9
Bevölkerungswachstum bei Personen 65+ (durchschn. jährliche Wachstumsrate) <sup>1</sup>			-0,2	0,3	1,5
Altersabhängigkeitsquotient (% der Bevölkerung im arbeitsfähigen Alter) <sup>2</sup>	55,4	46,6	47,4	48,1	49,5
Frauen (% der Gesamtbevölkerung)	52,7	52,2	51,5	51,3	50,8
Fertilitätsrate, gesamt (Lebendgeburten pro Frau)	1,7	1,5	1,4	1,4	1,5
Bruttogeburtenziffer (pro 1.000 Personen)	12	11,8	9,8	9,4	10,0
Bruttosterbeziffer (pro 1.000 Personen)	12,2	10,8	9,6	9,2	9,2
Bevölkerungsdichte (Einwohner pro km <sup>2</sup> )	91,4	93,0	97,0	101,3	106,0
Anteil der Landbevölkerung in %	34,6	34,2	34,2	34,1	34,0

Quelle: Das österreichische Gesundheitssystem 2019 (BMASGK): <https://broschuerenservice.sozialministerium.at/Home/Download?publicationId=636>

Quelle: Das österreichische Gesundheitssystem 2019 (Gesundheit Österreich GmbH): <https://jasmin.goeg.at/434/13/Das%20%C3%B6sterreichische%20Gesundheitssystem%202019.pdf>

# Global Trends



# How do healthcare customers benefit from moving to cloud?

- Security
- Agility
- Cost savings
- Elasticity
- Innovate faster
- Ability to deploy globally in minutes

# Healthcare Key Workloads



# Electronic health records



"With AWS we've been able to migrate multiple Electronic Patient Record solutions to the cloud, which increases the security, performance and reliability for our hospital customers, and allows us to offer these solutions as a managed service."

**Andrea Fiumicelli**  
CEO, Dedalus Group

## Featured AWS Partners

PHILIPS



Deloitte.



accenture



# Medical imaging

## PHILIPS

"By running Philips HealthSuite Platform on AWS, we're able to provide our customers with the power, security, and flexibility of AWS services with the healthcare-specific added value we've built on top."

**Dale Wiggins**

VP & GM of Philips HealthSuite Platform

## Featured AWS Partners



GE Healthcare

## PHILIPS

Hyland  
creator of OnBase®



Visage  
Technologies

# ML for Medical Imaging to Solve Heavy Workloads



## Challenge

- fast, accurate medical imaging to quickly diagnose and treat patients affected by the COVID-19 pandemic

## Solution

- migration of Grand-Challenge.org platform to AWS
- usage of the services Amazon CloudFront and S3, to create a scalable environment to build, test, and deploy medical imaging algorithms

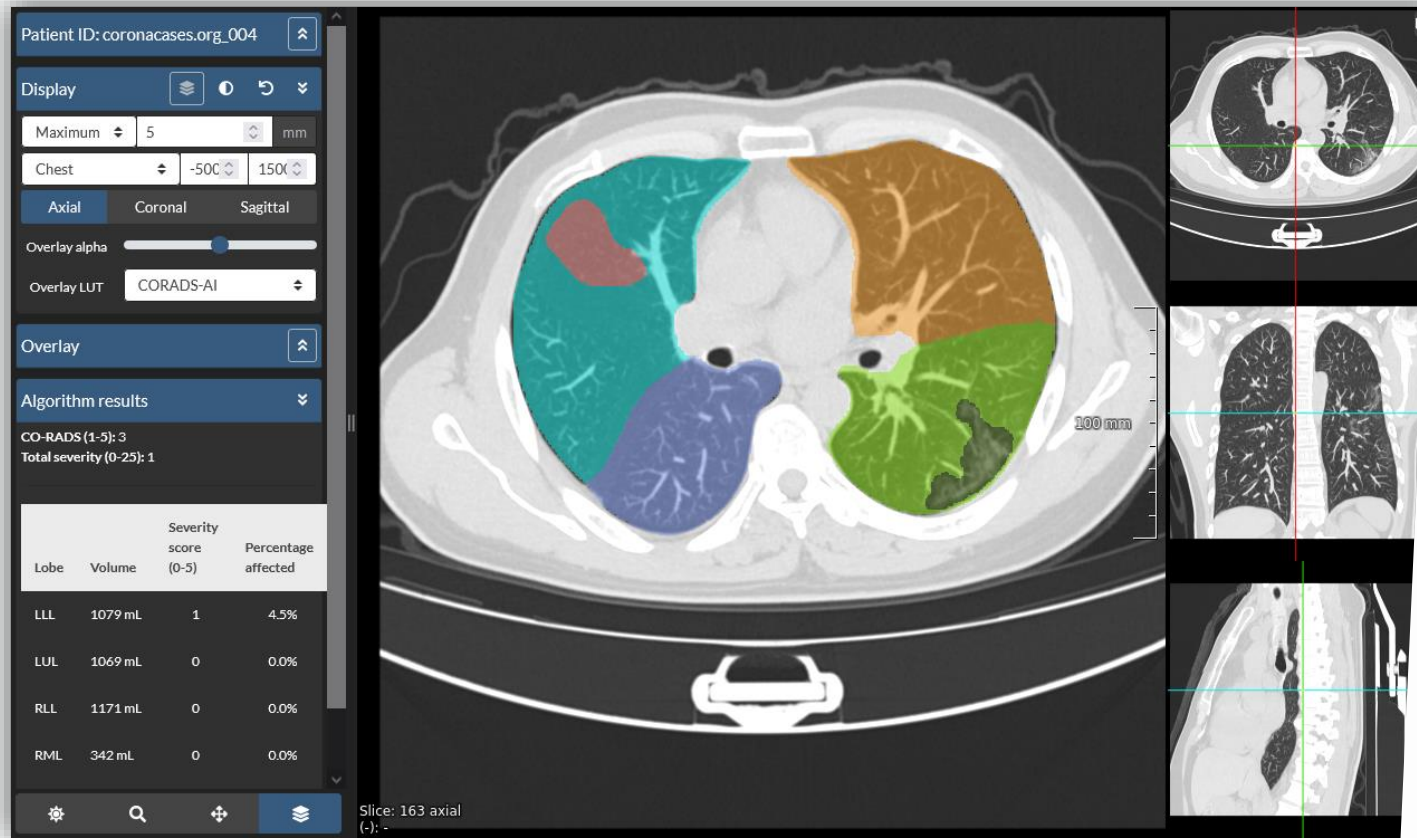
## Benefits

- deploy machine learning models at scale for critical clinical applications
- easier development of algorithms to better classify lung anomalies

# Clinical Innovation on AWS

# ML for Medical Imaging to Solve Heavy Workloads

Radboud University



RSNA  
Radiology

Most Viewed | Most Cited

- CO-RADS: A Categorical CT Assessment Scheme for Patients Suspected of Having COVID-19—Definition and Evaluation**  
Mathias Prokop...  
Apr 27 2020
- Chest CT Findings in Coronavirus Disease-19 (COVID-19): Relation Duration of Infection**  
Adam Bernheim...Michael Chung  
Feb 20 2020
- Time Course of Lung Changes at Chest CT during Recovery from Coronavirus Disease 2019 (COVID-19)**  
Feng Pan...Chuansheng Zheng
- Correlation of Chest CT and RT-PCR Testing for Coronavirus Disease (COVID-19) in China: A ...**  
Tao Ai...Liming Xia



# Genomics

<https://youtu.be/FUPPO44kueM>



“Es kostete drei Milliarden US-Dollar und dauerte 13 Jahre, um das erste menschliche Genom zu sequenzieren. In den vergangenen zehn Jahren sind die Kosten zur Sequenzierung eines einzigen Genoms auf 1.000 US-Dollar gefallen und die Dauer beläuft sich inzwischen auf zwei Tage.“

**Dr. Torsten Haferlach**

Chief Executive Officer, Munich Leukemia Laboratory

Featured  
AWS Partners

DNAexus®

illumina®



SevenBridges

# Healthcare Analytics, AI / ML



“Our health system has reaped the benefits of Cerner’s HealthIntent. Transforming the HealthIntent data and loading it on AWS has allowed us to leverage big data and sophisticated data science tools, along with the elastic compute environment on AWS. This has accelerated our data science work at CHOC.”

**Dr. William Feaster**

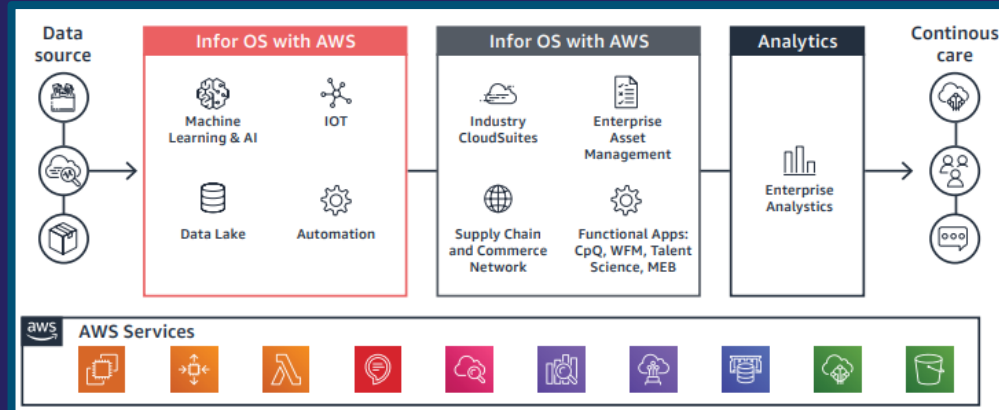
CHIO, CHOC

## Featured AWS Partners

**Deloitte.**



# Healthcare data interoperability



**infor**

" The digital foundation of Infor CloudSuite Healthcare gives hospital and health systems the power to synchronize their business and clinical operations through integrated and connected platforms, resulting in better healthcare delivery."

**Matt Wilson**

SVP Infor Healthcare

**Featured  
AWS Partners**

**cloudticity**

**infor**


**REDOX**  **ORION**   
HEALTH



# Mythos #1 – Cloud ist teuer



# Was ist Cloud Computing?



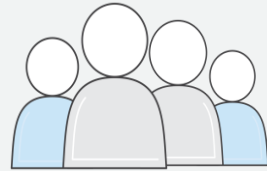
„Cloud Computing“ ist die bedarfsabhängige Bereitstellung von IT-Ressourcen und -Anwendungen über das Internet mit nutzungsabhängigen Preisen.

# Gründe für den Weg in die Cloud

## Traditionelle Infrastruktur



Hardware



Administratoren  
und Ressourcen



Verträge &  
Preispolitik



Kosten



## AWS Cloud



Keine Vorabkosten,  
Pay as you go



Kürzere  
Projektanlaufzeiten  
und Agilität



Skalierbarkeit



Self-Service-  
Infrastruktur

# Warum unsere Kunden AWS nutzen



**Erfahrung**

Cloud-Anbieter seit 2006



**Service Breite und Tiefe**

200+ Dienste für jegliche Cloud-Workloads



**Globaler Footprint**

25 Regionen, 81 Availability Zones, 230+ Edge Locations



**Preis Philosophie**

106 proaktive Preisreduktionen seit 2006



**Community**

Tausende Partner; 8000+ Marketplace Angebote

# Healthcare Whitepaper

- 28 Healthcare Providers
- 39,965 Servers
- 44% forecast cost savings
- €5,665 per hospital bed
- €14.4B all UK & EU providers  
(AT → €364 Mio EUR)

<b>Compute</b>
Server/Host HW & Overhead
Servers and Hosts
Maintenance
Provision for spare servers
Labor: Rack & stack deployment
<b>Rack</b>
Rack Hardware
Rack Maintenance
<b>Facilities</b>
Power & Cooling
Space
<b>Software</b>
Licenses (OS, hypervisor)
Maintenance
<b>Storage</b>
Primary
Backup
Maintenance
Software
Operations
<b>Networking</b>
Hardware/Software
Maintenance
Bandwidth
<b>Total On Prem</b>

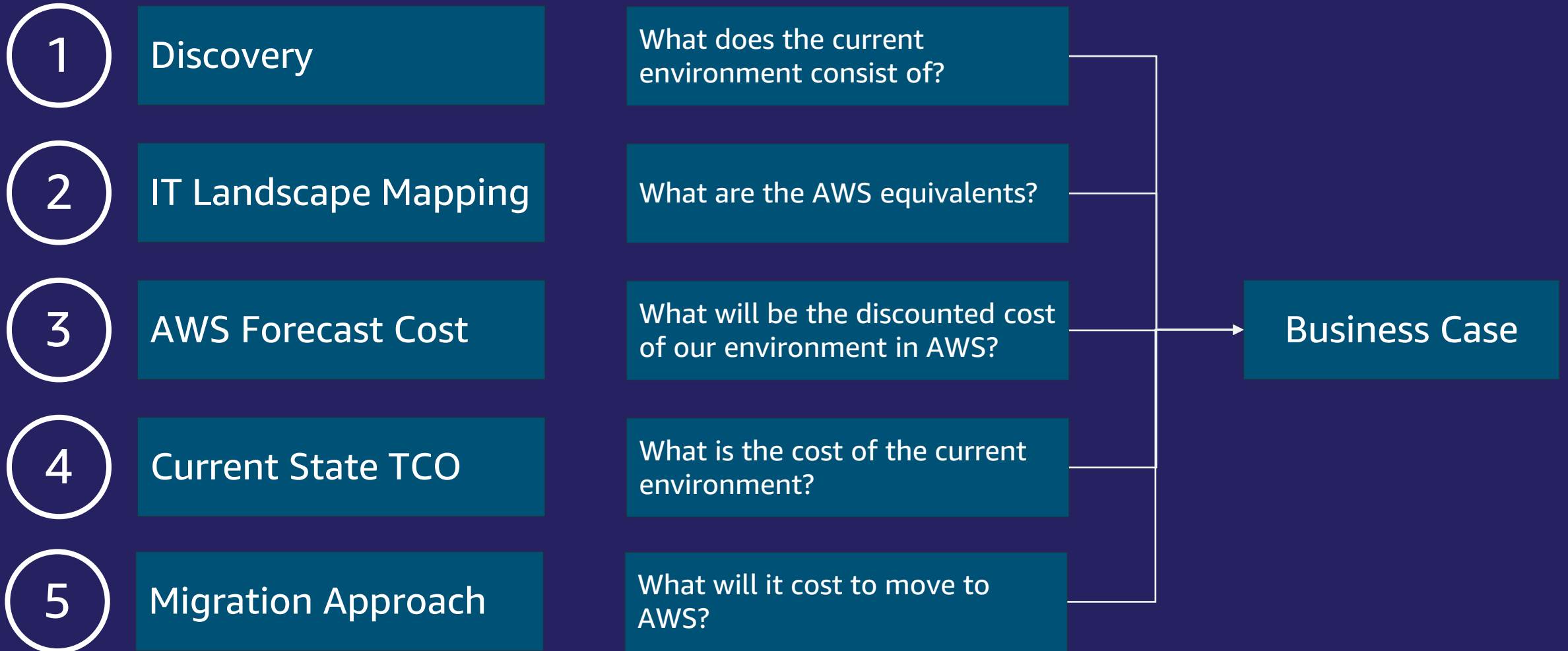
Report: [https://qrco.de/bd6pKo?trk=public\\_post\\_share-update\\_update-text](https://qrco.de/bd6pKo?trk=public_post_share-update_update-text)



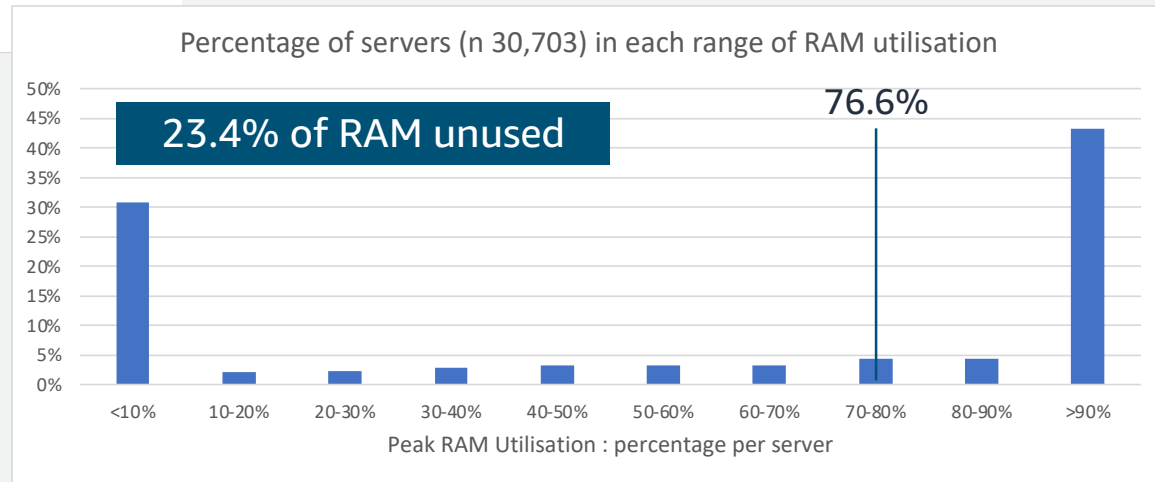
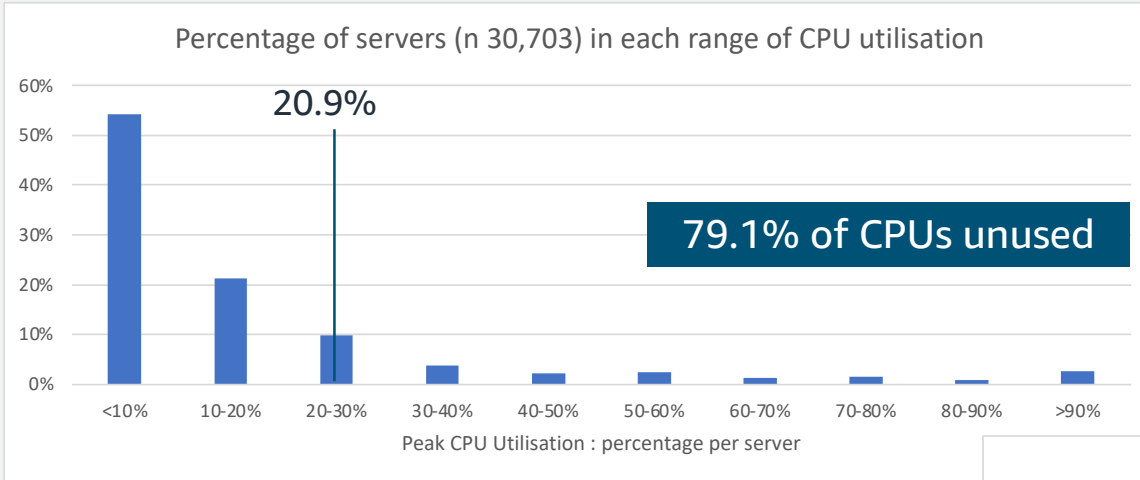
## An Economic Analysis of the Cost Savings for Healthcare Providers from AWS Cloud



# Healthcare Whitepaper : Methodology



# Healthcare Whitepaper : Key Statistics



# Healthcare Whitepaper: Cloud is a Cost Benefit

AWS  
Economies  
of Scale

Evidenced  
Price  
Reductions

Transparent  
Pricing

Cloud Drives  
FinOps

AWS  
Innovation

Pay (only)  
for what you  
use / need

Flexibility vs  
Commitment

Remove  
Over-  
Provisioning

Benefits  
beyond Cost  
Savings

Sustainability

Reduced  
License Costs

Remove  
License Costs

Right tool for  
the job

Scalability and  
innovation

Ongoing  
Optimization



# Mythos #2 – Cloud ist ein Security Problem





Sie entscheiden wo Ihre Daten liegen



Rasche und intelligente Verschlüsselung



Einhaltung lokaler Datenschutzgesetze



Nutzung einer gesetzeskonformen Infrastruktur

# Sicherheit: Unsere Priorität seit dem ersten Tag



Identity & access management



Monitoring & Verwaltung



Schutz der Infrastruktur



Datensicherung

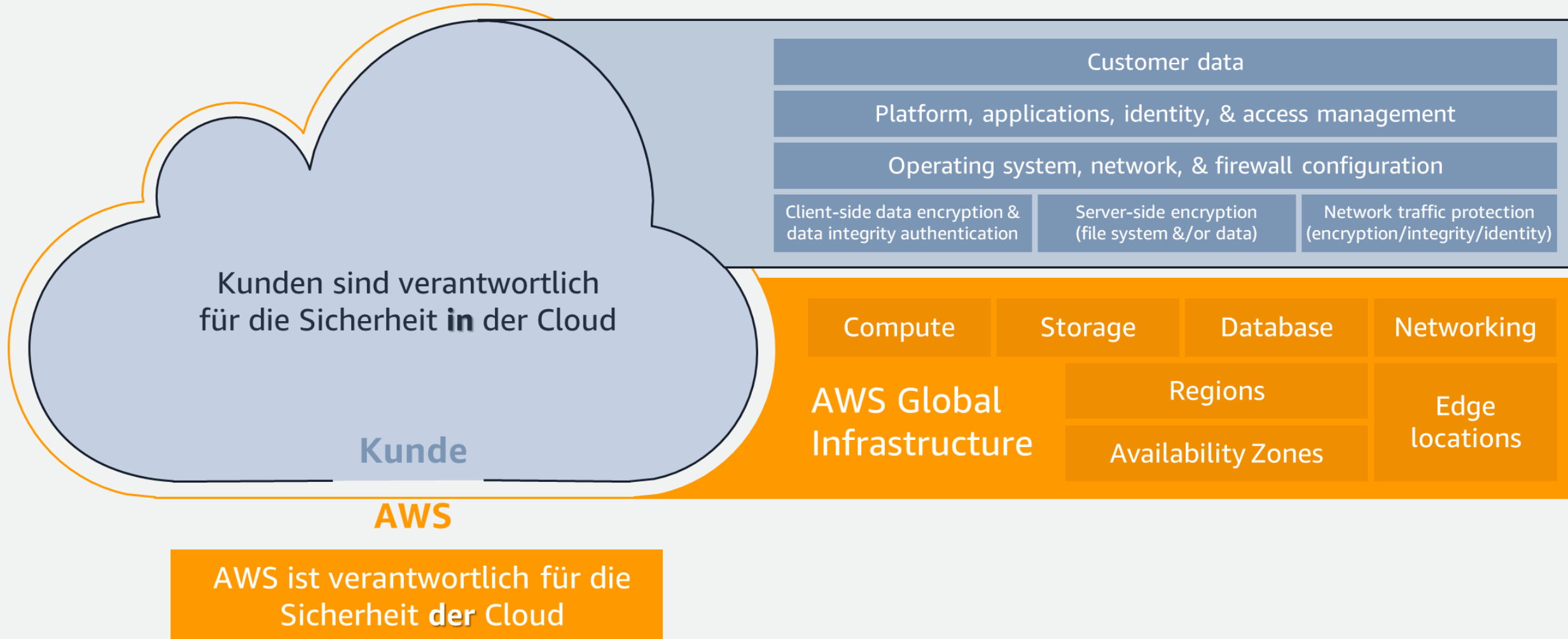


Incident response



Compliance

# Sicherheit ist eine **geteilte Verantwortung**



# NIST Cybersecurity Framework

is the industry standard,  
...but most companies lack  
a recovery strategy



## IDENTIFY

Identify an organization's critical functions, assets and processes and how cybersecurity risks could disrupt them



## PROTECT

Define safeguards necessary to protect critical infrastructure services



## DETECT

Implement the right measures to identify threats and cyber risks promptly



## RESPOND

Define the measures necessary to react to an identified threat



## RECOVER

Strategic plans to restore and recover any capabilities damaged during a cybersecurity incident

# Mythos #3 – Cloud ist ein Compliance Problem

# AWS is architected for government security requirements

## Certifications and accreditations for workloads that matter – Compliant Solutions



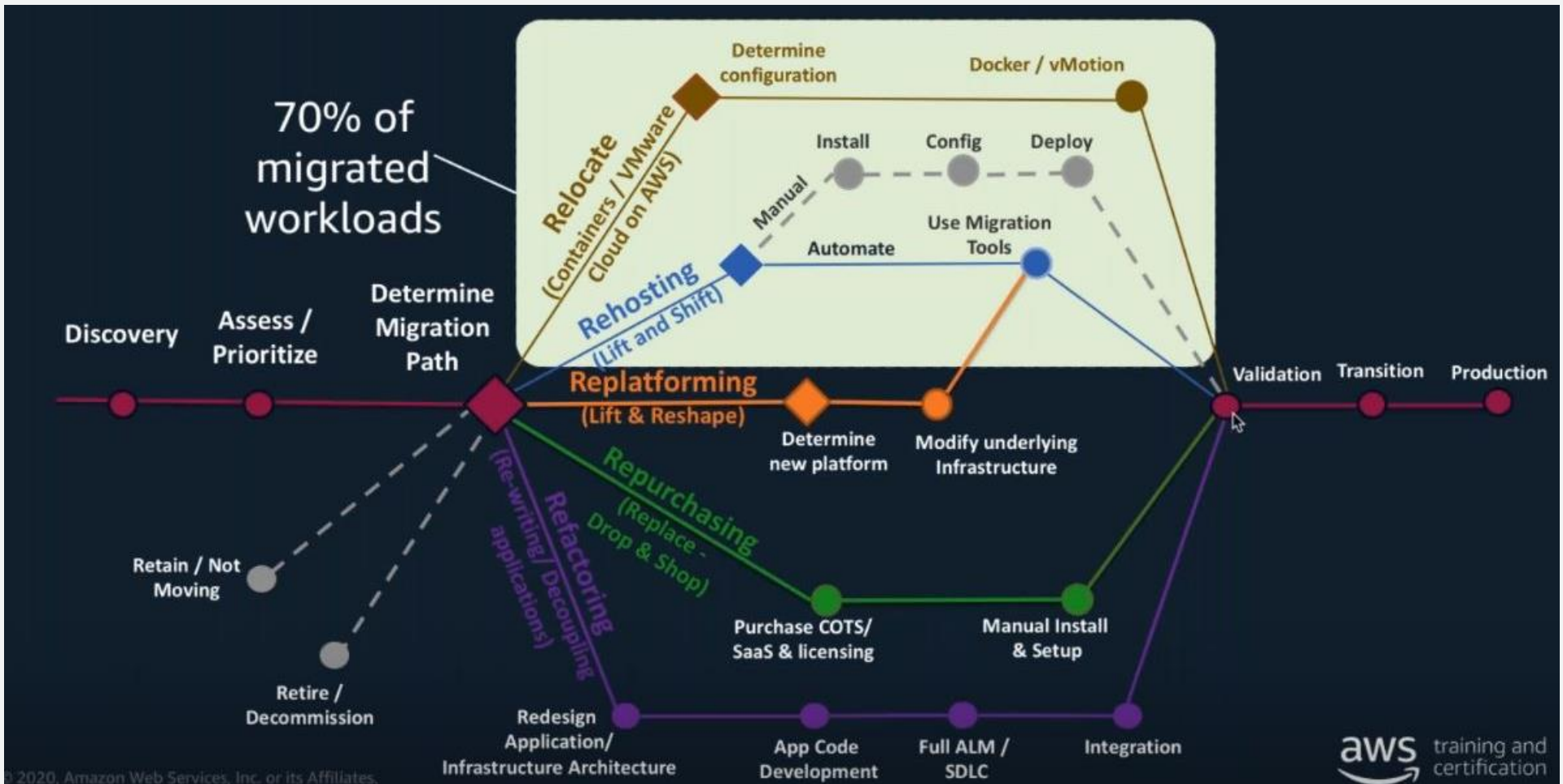
## AWS CloudTrail and AWS Config – Call logging and configuration management for governance and compliance



- Log, review, alarm on all user actions
- Browse-and-query database of current and previous state of cloud resources

# Mythos #4 – bestehende Landschaft abbilden nicht möglich

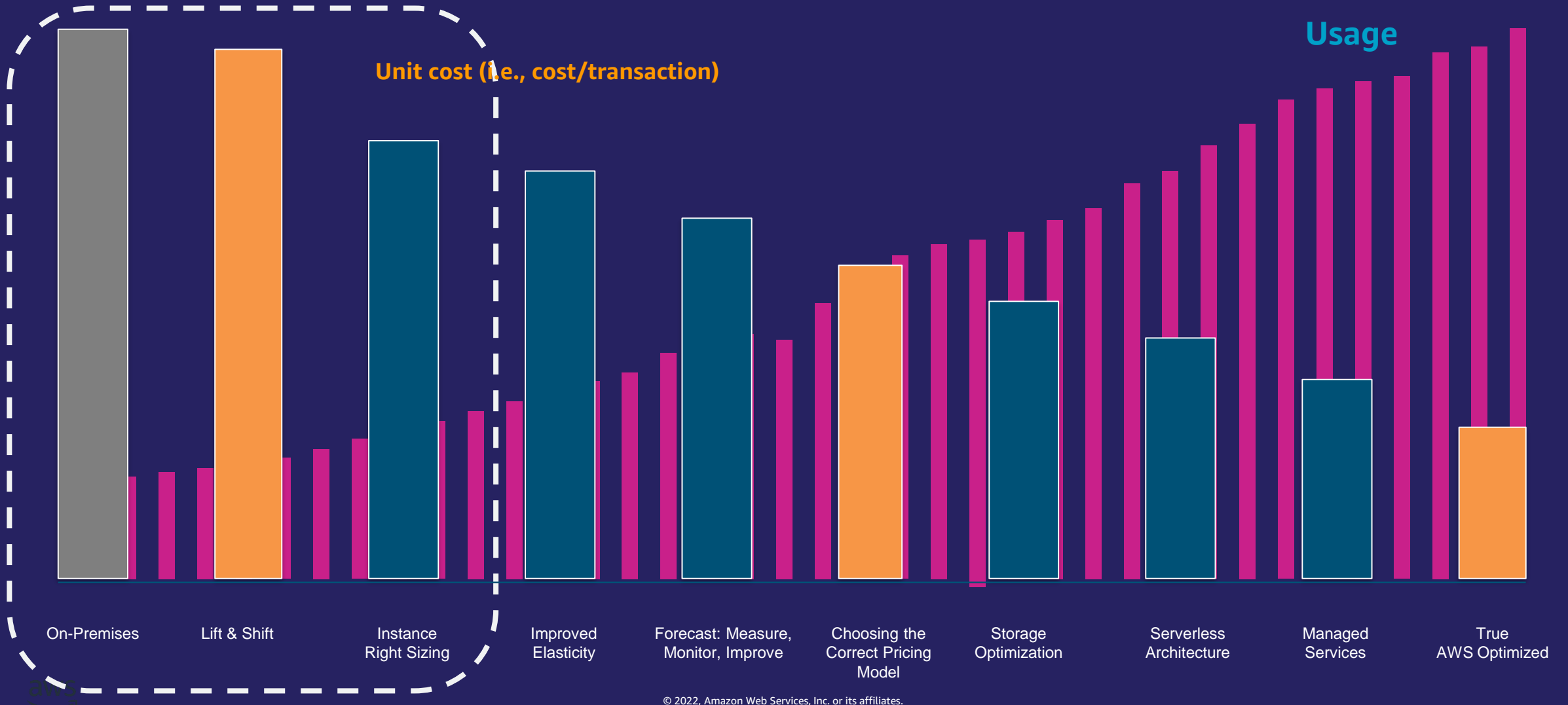
# 7R's of Migration



# Cloud Economics

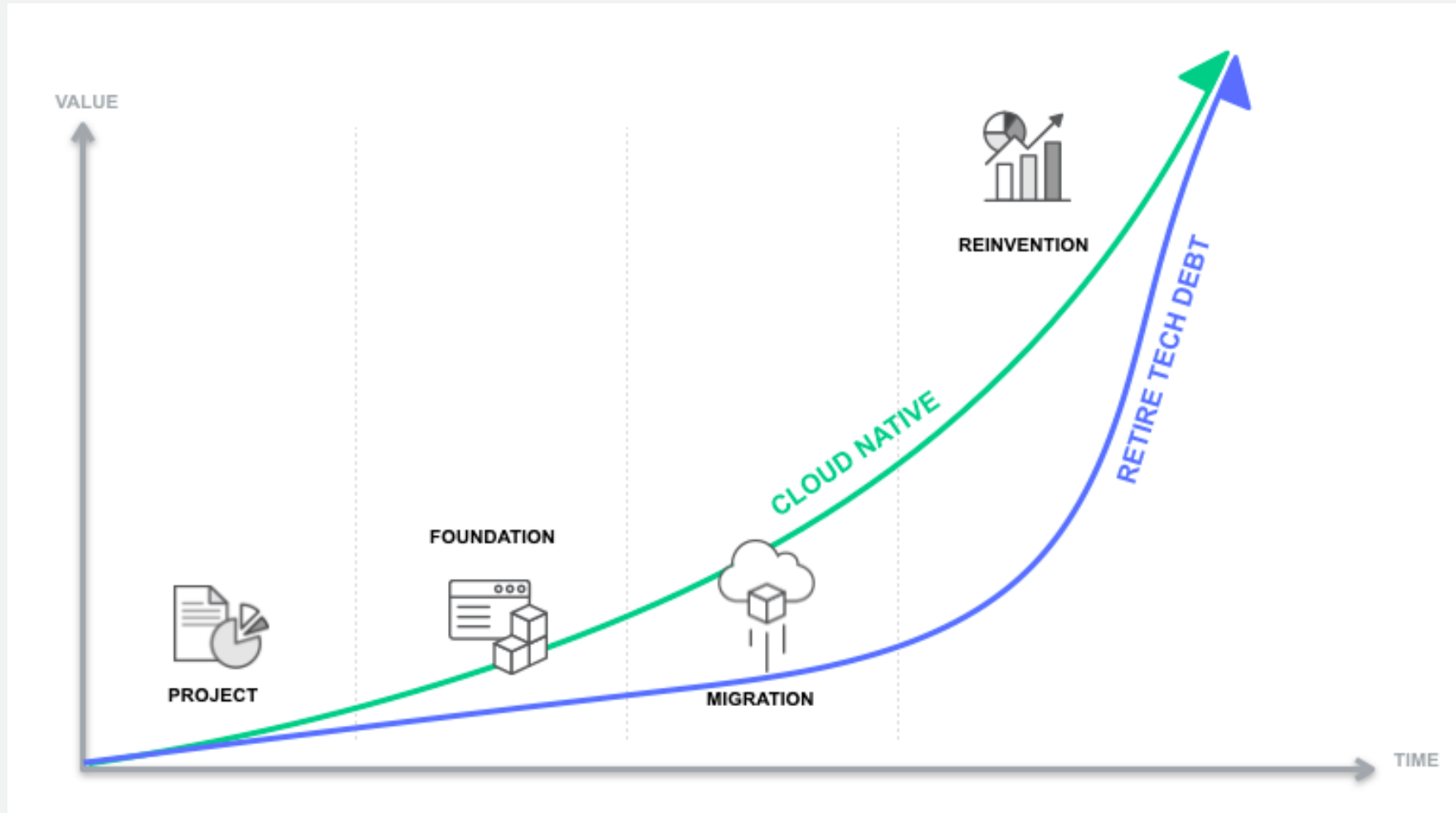
## Business Case

## Financial Management

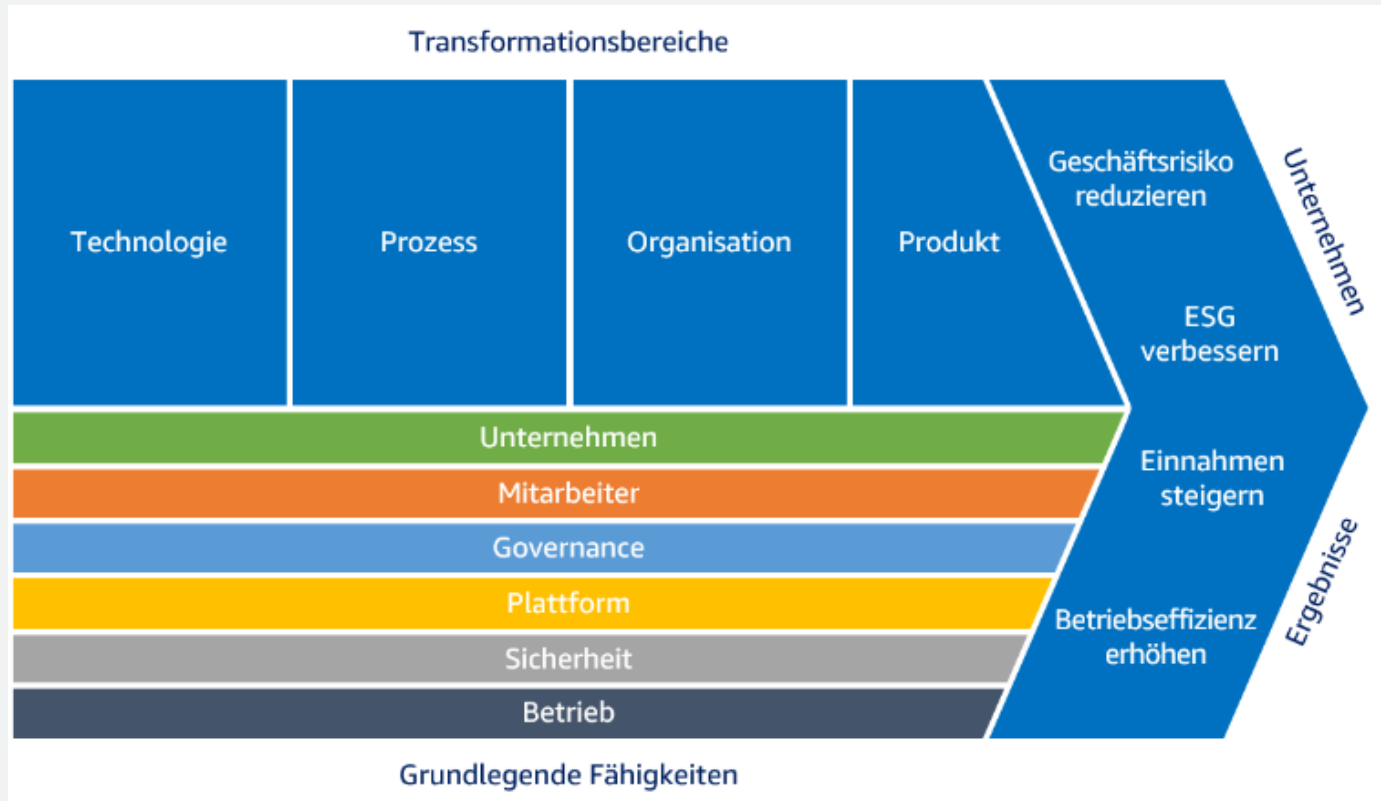




# Cloud Journey



# Cloud Adoption Framework



Website: [https://aws.amazon.com/de/professional-services/CAF/?nc1=h\\_ls](https://aws.amazon.com/de/professional-services/CAF/?nc1=h_ls)

CAF Dokument: <https://d1.awsstatic.com/whitepapers/International/de/aws-cloud-adoption-framework-de.pdf>



# Conclusions

- Cloud is ideally suited for healthcare data
  - Secure
  - Modern architecture
  - Agile
- AWS as the enabler
- AWS allows partners to go faster and support customers to concentrate on the mission

# Case Studies



# In-Home Skin Health Self-Assessments



## Challenge

- early detection and awareness
- users scan moles and own bodies
- in comfort of the own home

## Solution

- AWS stores large amounts of data securely
- process data at scale
- machine learning (for risk assessment and training networks)

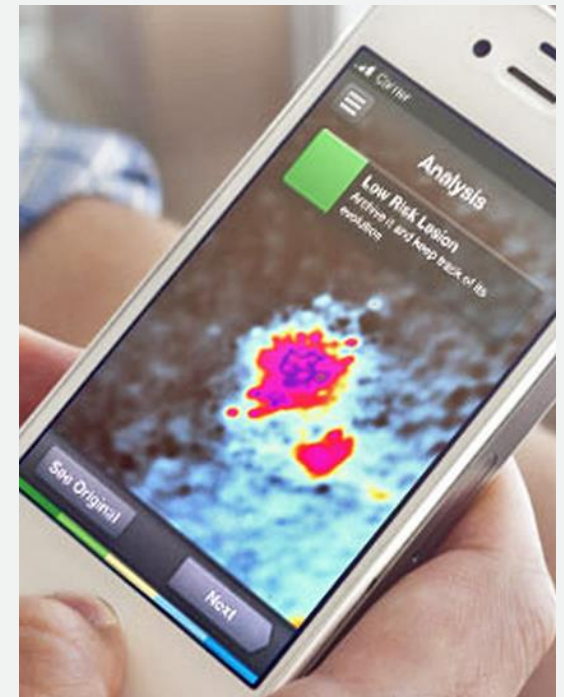
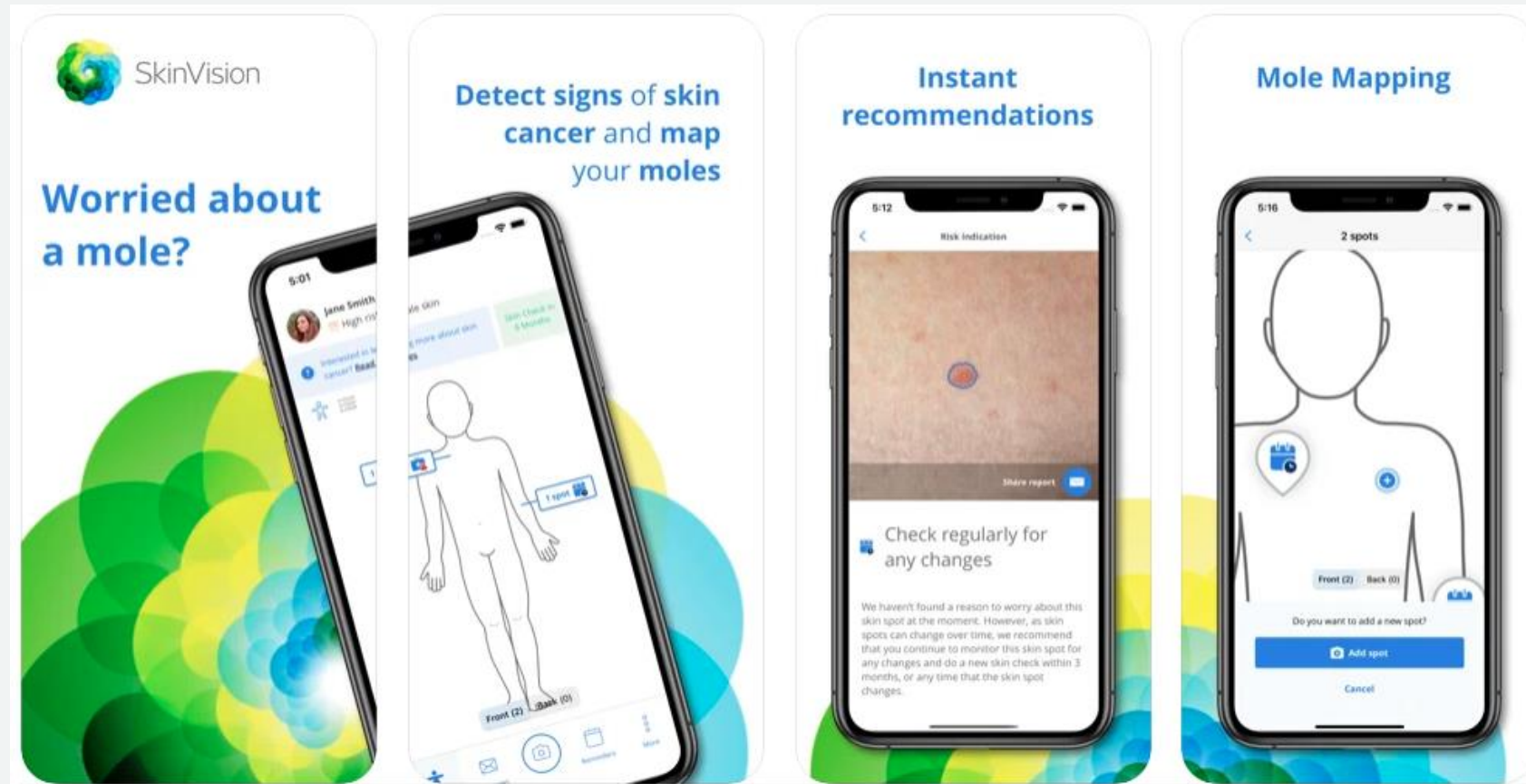
## Benefits

- picture assessment in 30 sec
- accuracy >90 %
- staff dermatologists examine images as a control and to improve the solution

Reference: <https://aws.amazon.com/de/solutions/case-studies/skinvision/>

# Clinical Innovation on AWS

## In-Home Skin Health Self-Assessments



# Voice Technology to Improve Clinical Workflows

## Objective

- comply with strict medical documentation rules
- electronic medical record is click-heavy process
- distracts medical staff from providing patient care

## Result

- voice automation and natural language processing
- simplified demanding tasks, automatic data capture, clinical workflow transformation

## Outcome

- save time and reduce clicks for hospital staff
- automatic completion of patient documentation



Reference: <https://aws.amazon.com/de/solutions/case-studies/houston-methodist/>

## Clinical Innovation on AWS

# AI/ML Optimizing Schedules for Operating Rooms

## Objective

- optimize scheduling of 41 operating rooms
- Identify top reasons for rescheduling
- proactively address with AWS technology

## Result

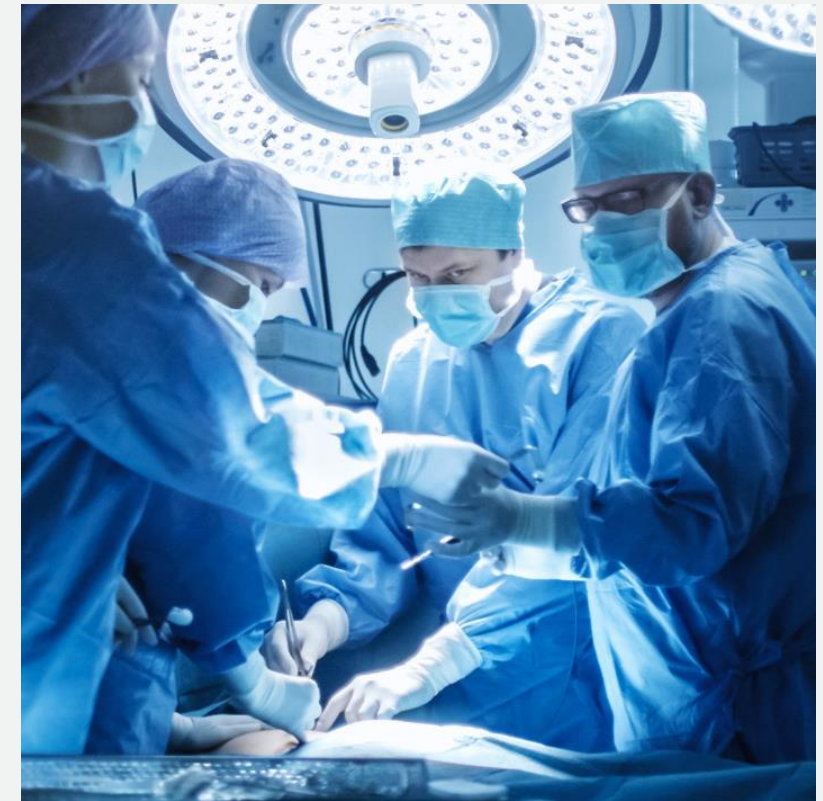
- reduced OR rescheduling by 18%

## Outcome

- improved patient satisfaction
- increased hospital revenue
- improved clinician satisfaction



Beth Israel Deaconess  
Medical Center



Reference: <https://aws.amazon.com/de/blogs/machine-learning/improving-patient-care-with-machine-learning-at-beth-israel-deaconess-medical-center/>



# Monitor a Patient's Vital Signs at Home



## Challenge

- monitor patients while at home during clinical trials, normal care, across countries and between visits
- avoid risk of changed patient conditions
- limited capacity during Covid-19

## Solution

- platform to monitor digital biomarkers
- collected by portable, wearable, and implantable digital devices

## Benefits

- increase in patient confidence
- care for 50% more patients at a time
- analysis helps doctors monitor individual patients
- identify trends in populations

# Clinical Innovation on AWS

## Monitor a Patient's Vital Signs at Home



The screenshot displays a patient's profile for Katherine Pooler (F, 43) with a DOB of 17 Jun 1978. The interface includes a video call window with Dr. Gupta, a 'Patient Call' overlay, and a 'Vital Signs' section with the following data:

Vital Sign	Value
Resting Heart Rate	60-75 bpm
Heart Rate	120/80 bpm
Blood Pressure	120/80 mmHg
Temperature	42 °C

Overview of All patients by Priority

Status: Any status, Continue monitoring, Flagged, Needs admission, Inpatient

NAME	STATUS	BLOOD GLUCOSE (MMOL/L)	BLOOD PRESSURE (MMHG)	RHR (BPM)
Katherine Pooler (43, F) 7567992655	Needs admission	11.1	165/85 ↑	68 ↑
Farrokh Rastegar (29, M) 8826458156	Needs admission	4.0	160/89 ↑	65
Azaka Chimako (39, F) 8957883524	Inpatient	10.0	130/55 ↓	56
Riley Cooper (40, M) 096582676	Continue Monitoring	3.5	120/80	67
Uesugi Suzuki (43, M) 3324514438	Continue Monitoring	11.0	120/80	62
John Flynn (29, M) 9956713323	Inpatient	4.0	115/72	75
Krina Patel (38, F) 9467154767	Continue Monitoring	4.0	131/56	72
Jake Bambridge (45, M) 9978678995	Needs admission	10.0	119/99	65
Kate Holman (F, 39) 6572543664	Inpatient	4.0	130/55	68

Reference: <https://www.youtube.com/watch?v=LHO-XB1Mw6o>



# How Philips Turns AWS Cloud into Telehealth Business



References: <https://aws.amazon.com/de/solutions/case-studies/philips/>

## Objective

- reduce inefficiencies in every aspect; from prevention to diagnosis, treatment and home care

## Result

- reduce hospitalizations by 45%
- cut acute and long-term care costs by 32%
- overall cost of care reduced by 27%

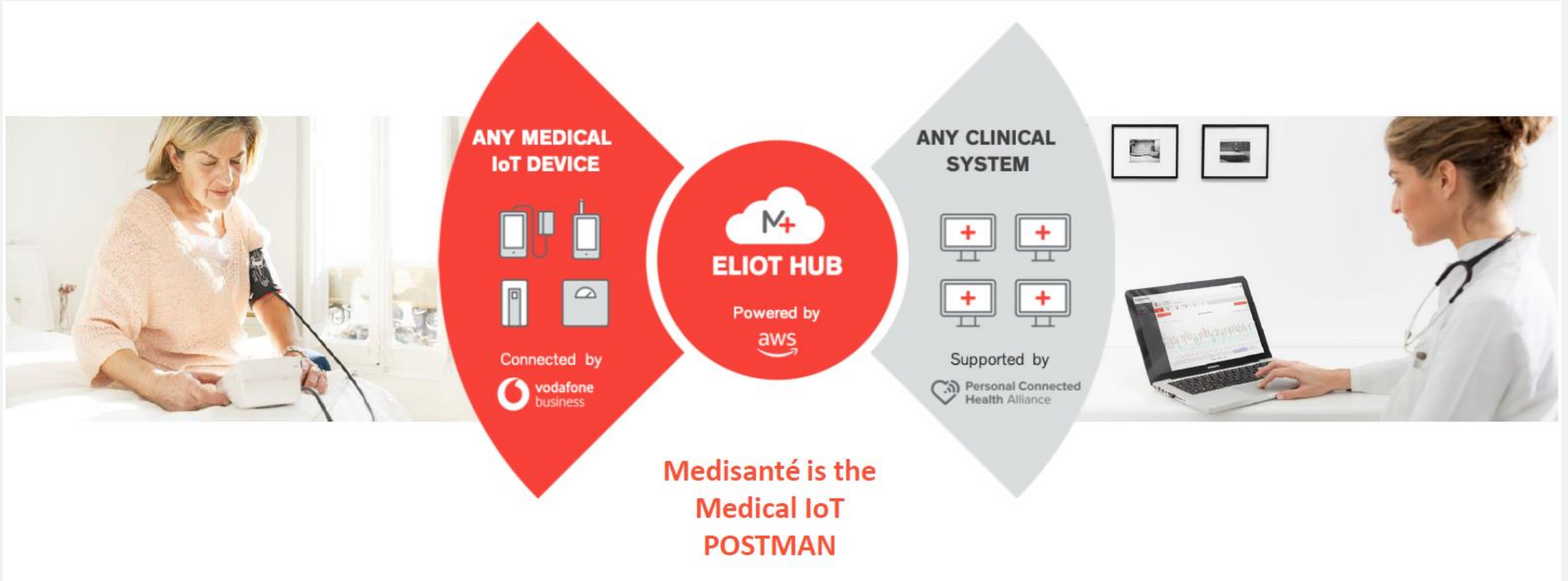
## Outcome

- easy connection of devices to collect, store, analyze, and share electronic health data
- with telemedicine it's possible to offer care in remote regions



# Clinical Innovation on AWS

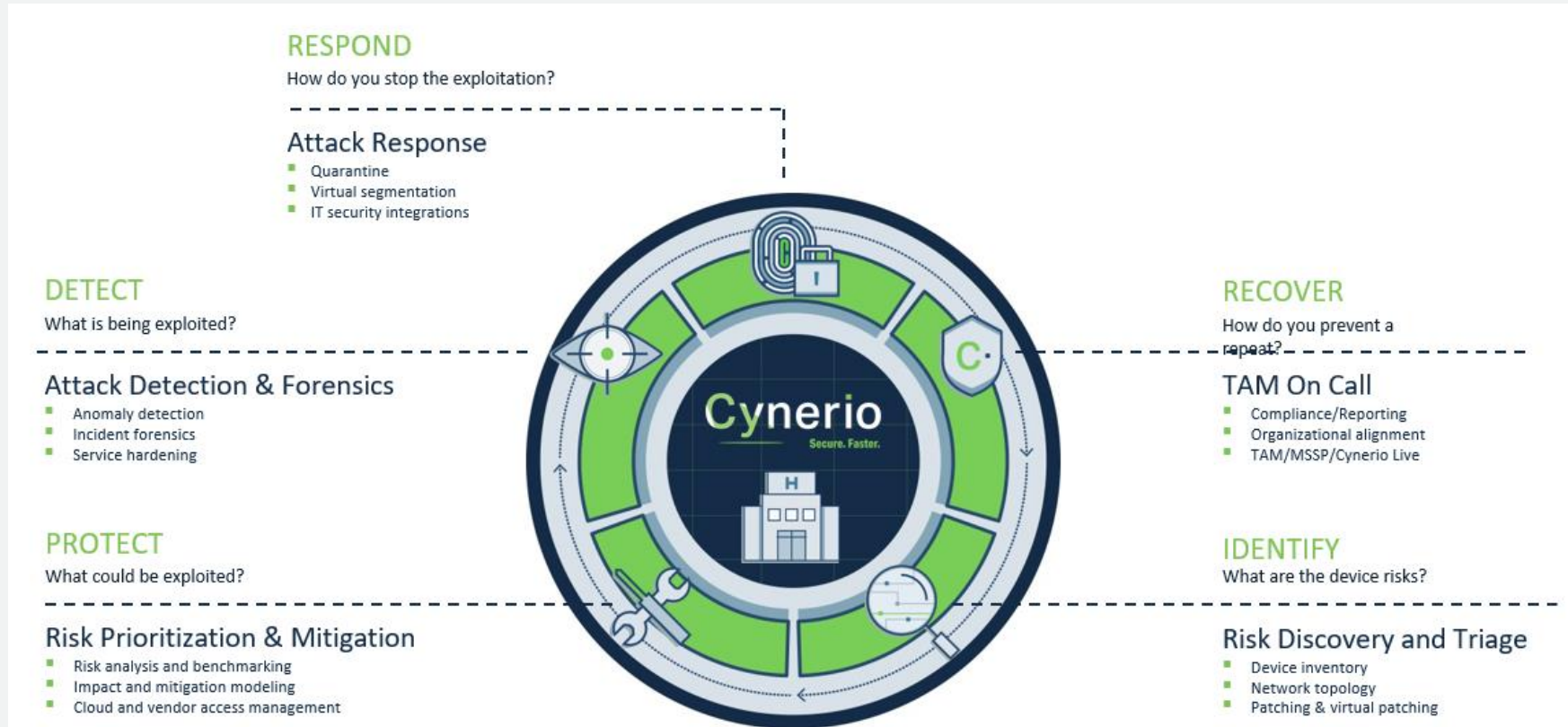
## Extending the NIST Cybersecurity Framework to Healthcare IoT



Reference: [https://aws.amazon.com/de/partners/success/gnomon-medisante/?nc1=h\\_ls](https://aws.amazon.com/de/partners/success/gnomon-medisante/?nc1=h_ls)



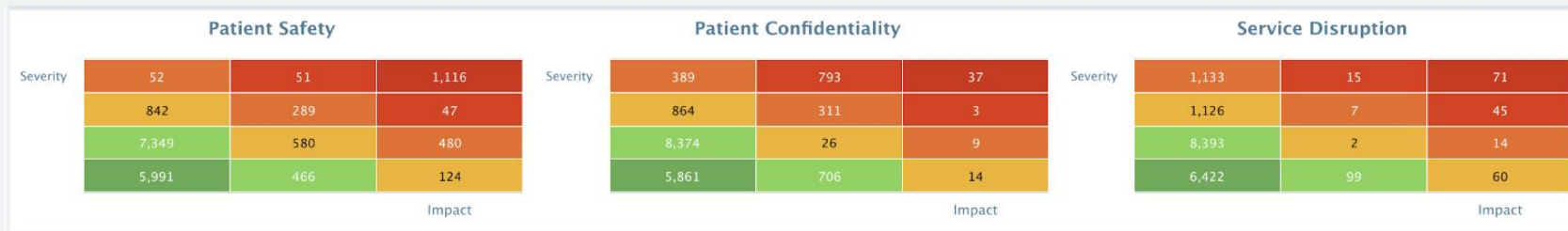
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AWS Marketplace: <https://aws.amazon.com/marketplace/seller-profile?id=ba985364-9888-40cc-a8b5-cb7573456790>

# Clinical Innovation on AWS

## Extending the NIST Cybersecurity Framework to Healthcare IoT



### Quick Insights

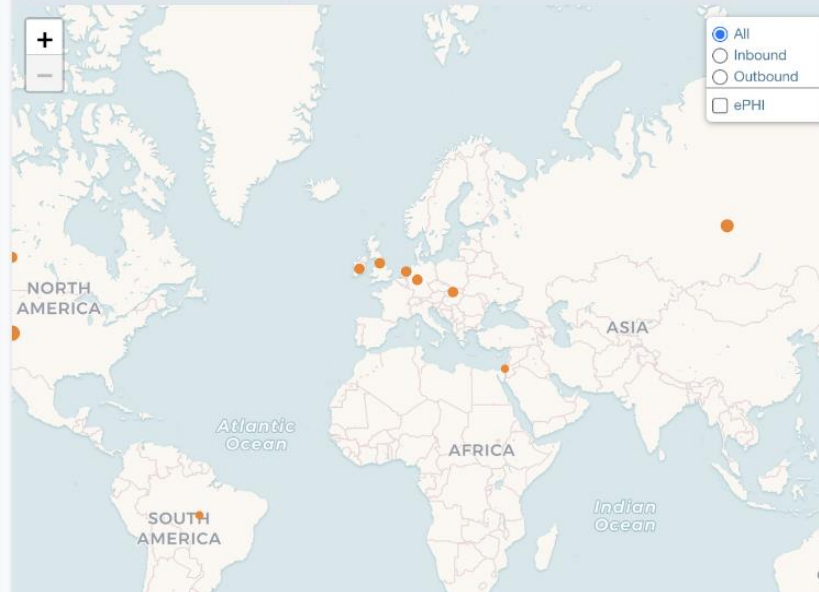
#### Assets

Assets with inbound Internet access	352
Assets lack endpoint protection; option to install	111
Assets with legacy OS and unrestricted Internet access	203
Assets with legacy OS that can be patched based on MDS2	279
FDA Class III devices with critical severity score	3
Assets that communicate ePHI	447
Assets that use public Windows Update services	157
Assets used for web browsing	1
Assets that communicate with the vendor	78
Assets with endpoint protection	267

#### Risks

Risks known to be exploited by ransomware	51
Asset services with default passwords	724

### External Connections Map



# Change Healthcare Delivery with Video Collaboration



## Challenge

- most care happens accross several appointments
- many images need to be reviewed incl multi-view cameras, simultaneous data review, radiology investigations, video from diagnostic devices

## Solution

- video collaboration tool built on AWS that aims to change the way in which care is delivered
- multi-disciplinary team (MDT) meetings

## Benefits

- patient focused care
- collaboration saves time for staff and patients
- involve various healthcare professionals at once

# Fighting Cancer with Organized Data



## Objective

- connect cancer centers to share learnings
- derive right insights from real-world cancer data sets to inform cancer research

## Result

- cloud-based system on AWS
- analyzes more than 1.6 million cancer patients

## Outcome

- speeds development of oncology-data software
- improves the organization and overall quality of cancer data
- HIPAA compliant applications

Reference: <https://aws.amazon.com/de/solutions/case-studies/flatiron-health/>



Cancer is smart.  
Together, we can  
be smarter.