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HCRT002

Future of digital healthcare on cloud

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Agenda

- Need & importance of digital health
- India – Ayushman Bharat Digital Mission
- Solutions for Ayushman Bharat Digital Mission
- The future of digital healthcare: cloud

Need & importance of digital health

Need for transforming health service delivery



1 in 3

adults worldwide have
multiple chronic conditions



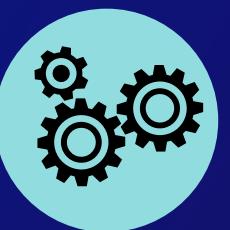
42%

physicians currently report
feeling burned out



30%

of total healthcare expenditure
is estimated to be wasted due
to administrative complexity



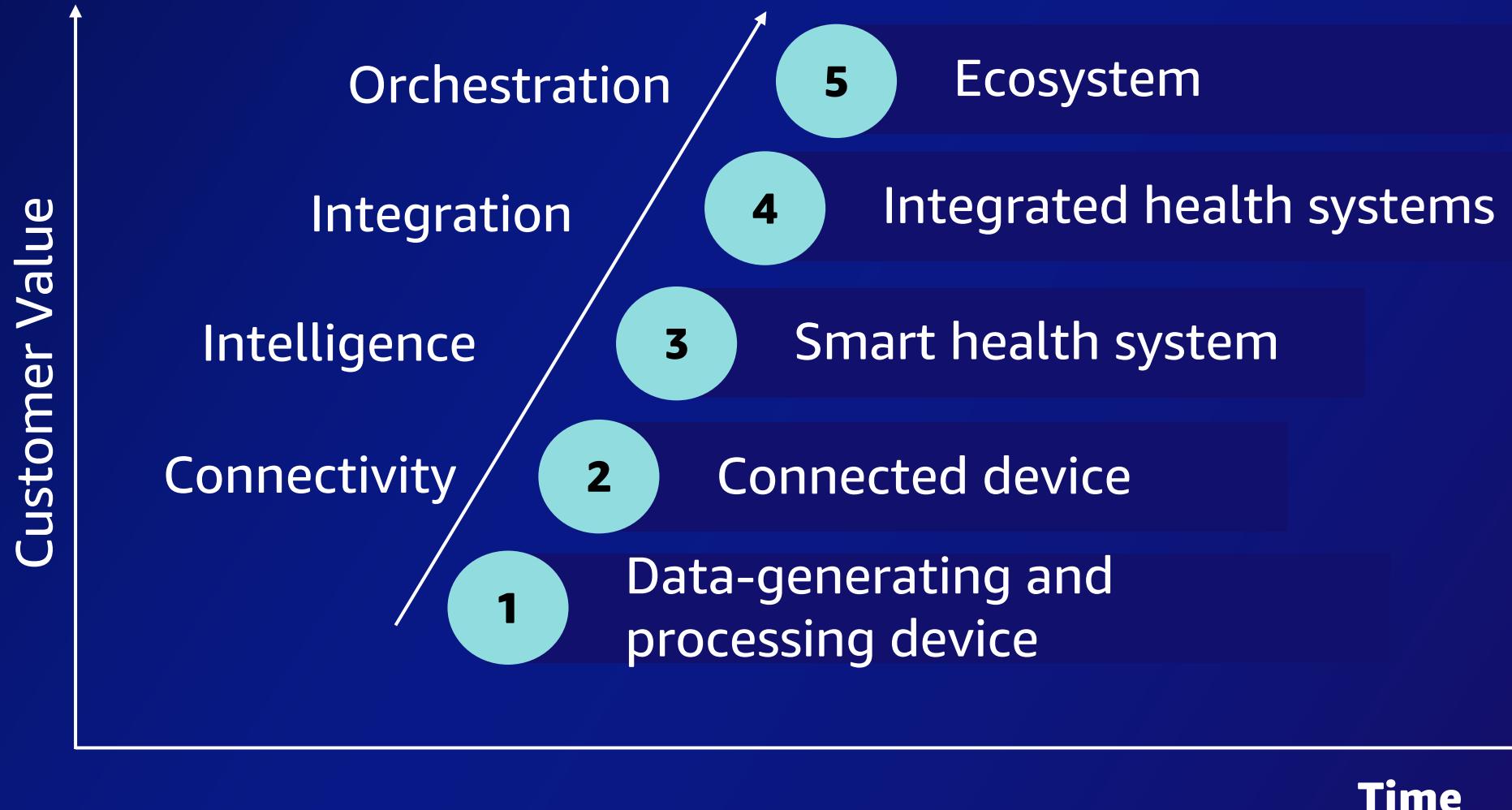
12.9 million

projected global deficit of skilled
healthcare professionals by 2025

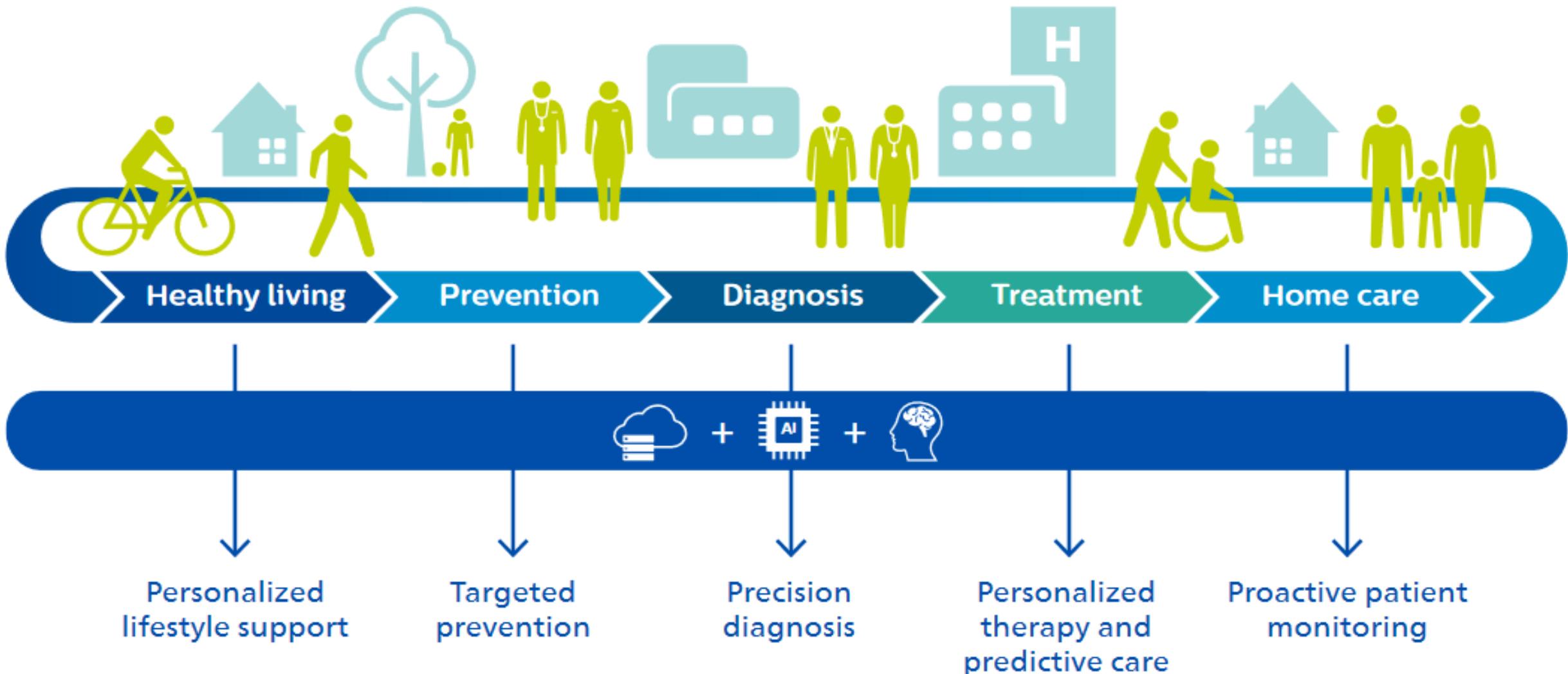
Reference:

1. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6214883/>
2. <https://www.businesswire.com/news/home/20200218005006/en/75-of-U.S.-Consumers-Wish-Their-Healthcare-Experiences-Were-More-Personalized-Redpoint-Global-Survey-Reveals>
3. <https://www.mckinsey.com/industries/healthcare/our-insights/telehealth-a-quarter-trillion-dollar-post-covid-19-reality>
4. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10001574/#:~:text=The%202021%20Medscape%20National%20Physician,11%2C12%2C13%5D.>
5. <https://pubmed.ncbi.nlm.nih.gov/31589283/>
6. <https://apps.who.int/mediacentre/news/releases/2013/health-workforce-shortage/en/index.html>

Pathways of digital transformation



Transforming the patient lifecycle



Issues faced by digital health in India

01

**REGULATORY AND
LEGAL
FRAMEWORKS**
THAT CANNOT KEEP
PACE WITHIN
INNOVATION,
ADOPTION AND USE.

02

**CONSUMER CONCERN
ABOUT SECURITY
AND PRIVACY.**

03

**ETHICAL
QUESTIONS** THAT IN
THE ADOPTION
OF NEW TECHNOLOGIES,
ESPECIALLY REGARDING
THE ROLE OF
COMMERCIALISM AND
MONETIZATION.

04

USABILITY ISSUES
FOR PATIENTS AND
PROVIDERS ALIKE.

05

**COMPETING
MOTIVATIONS
AND
MISALIGNMENTS**
(WHAT ARE THE
PRIORITIES AND HOW
CAN THEY BE AGREED
UPON).

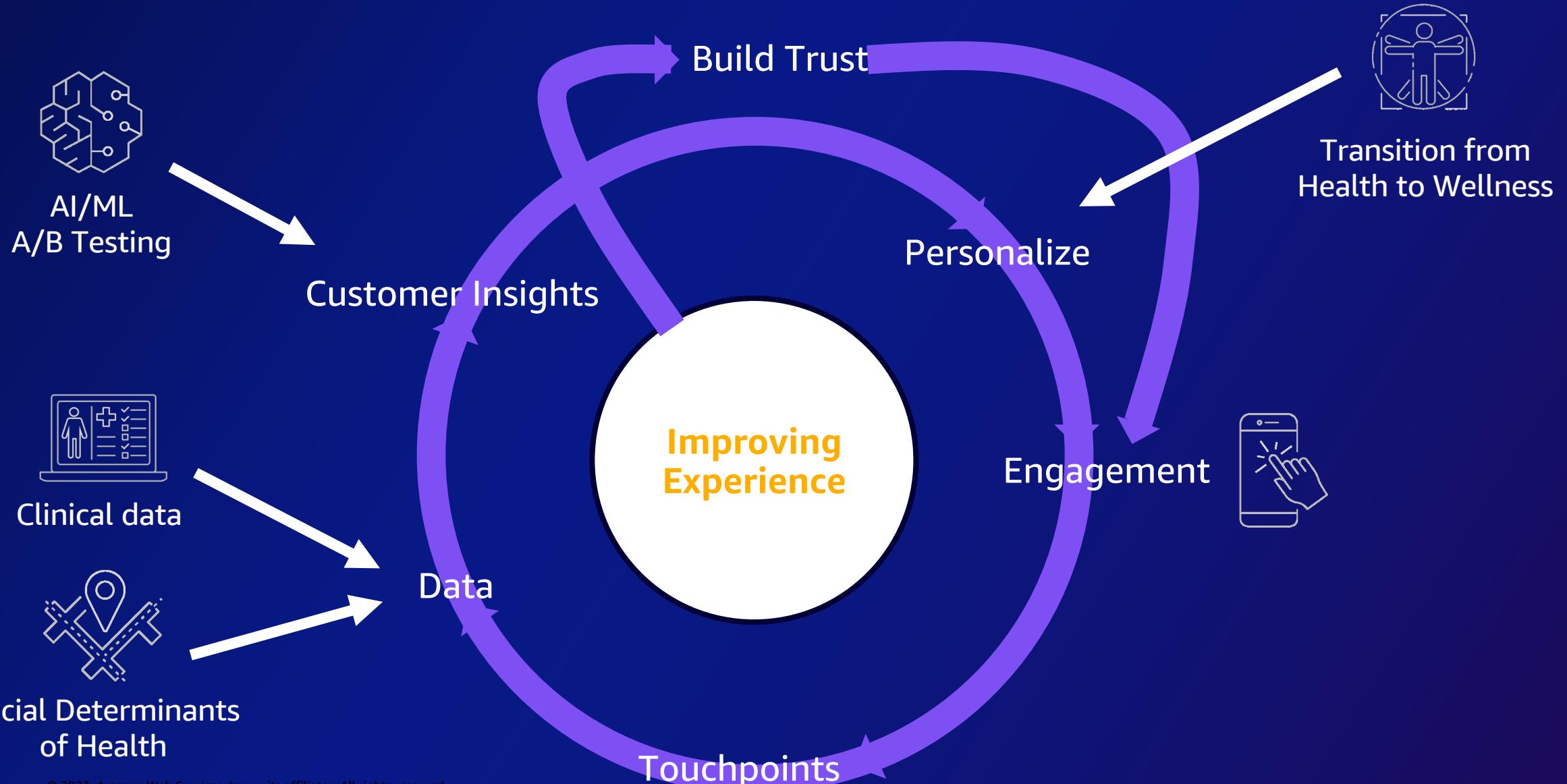
06

EQUITY ISSUES THAT CAN ESPECIALLY ARISE FROM SWIFT
DIGITAL IMPLEMENTATIONS – E.G. DIGITAL LITERACY ISSUES,
DIGITAL ACCESS ISSUES ('**DIGITAL DIVIDE**') AND THE
IMPACT
ON VULNERABLE GROUPS (E.G. SENIORS – THE '**GREY
DIVIDE**')

07

**INTEROPERABILITY ISSUES AND FRAGMENTED
SYSTEMS**
BOTH TECHNICAL (SOFTWARE, AND 'SYSTEM STRUCTURE'
(PROVIDER, PAYER, REGULATOR))

Patient experience flywheel



India Ayushman Bharat Digital Mission

Health digitization challenges in India



Citizens
don't have:

1. **Access to all health records**
2. **Information about doctors, hospitals and labs**
3. **Knowledge about qualification of doctor**
4. **Choice to consult doctors remotely**



Hospitals/ Labs/ Doctors
don't have:

1. **Access to patient's medical history**
2. **Ability to ensure follow up after treatment**
3. **Feature to remotely consult patients**
4. **Ease of doing business**



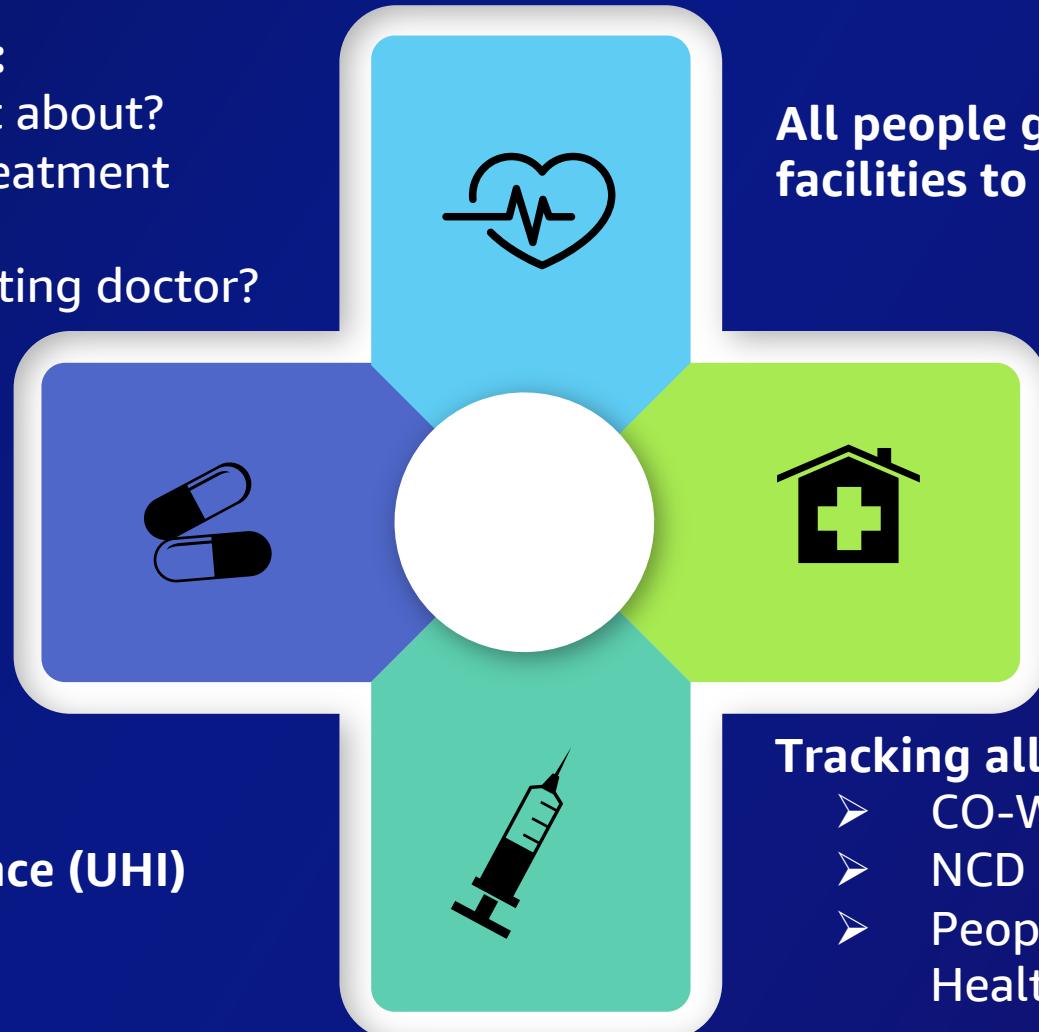
Stakeholders including State Governments, Central Ministries and Programmes don't have:

1. **Aggregated information about Health facilities, clinicians on click of button**
2. **Complete monitoring and control in unified manner**

Digital building blocks for healthcare

To have a health record:

- Whose health is it about?
- Where was the treatment done?
- Who was the treating doctor?



Unified Health Interface (UHI)

All people generating in public health facilities to be ABDM complaint

Tracking all public health programs

- CO-WIN
- NCD
- People who develop software: Live Health (data per 1,000 beds)

ABDM vision and objectives

OBJECTIVES:

Citizen-centric
Digital Health
Ecosystem

-  Establish state-of-the-art digital health systems and managing health data
-  Improve the quality of health data collection, storage and dissemination
-  Provide a platform for interoperability of health care data
-  Verified and accurate Health Registries to refer as single source of truth
-  Create provision to measure quality of care, progress against policies and SDGs

Gaps that need frontier technology solutions

- Lack of integrated data systems
 - Hospital/ICU utilization and capacity
 - Key Assets (ventilators)
 - Staffing levels by Skillsets
 - Public health, disease surveillance
 - Contact tracing
 - Scalable vaccine booking and tracking
 - National vaccine records
- Disconnected patient records
 - Primary care systems
 - Public hospital systems
 - Private hospital
 - Pharmacy systems
 - Pathology
 - Aged Care
 - Allied Health
- Lack of preparation for Telehealth and remote care
 - Physical infrastructure
 - Standards
 - Reimbursement
- Lack of public trust in health data systems – leads to non-compliance and hesitancy
 - Contact Tracing
 - Venue Check-in/ QR Codes
 - Vaccine passports

ABDM: structural framework

GOVT & PRIVATE APPS & PLATFORMS
Diverse user experiences & innovative solutions

CONSUMER APPS/PORTALS

Arogya Setu

e-Sanjeevani

Other Apps

HEALTH PROVIDER APPS/PLATFORMS

HIMS/ LIMS

Other Platforms



UHI: Unified Health Interface
APIs for Health services

Telemedicine APIs
Discover Doctor
Book Appointment

Lab & Medicine APIs
Discover Lab
Discover Pharmacy

Other Health Service APIs
Discover Bed Availability
Discover Hospital facilities



Health Data Exchange Layer
Streamlining flow of patients, health information and money

ELECTRONIC REGISTRIES

Health ID
Health Professionals Registry
Health Facility registry
Drug registry
...

HEALTH RECORDS

- Consent Manager
- Health Document standards (FHIR resources)
- Terminology / Coding standards (SNOMED CT, LOINC, ...)

...

HEALTH CLAIMS

E-claims specification
Health Claims Switch
Policy Markup Language
Bill Markup Language
...



JAM & INDIA STACK
Cross domain generic building blocks

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INDIA STACK -- Aadhaar, UPI, e-Sign, Digilocker ...

Private Innovation

Digital Public Infrastructure

ABDM key components

COMPONENT	DETAILS
 ABHA ID <small>Health ID</small>	Individual health identifier to allow seamless flow of health information with consent
 DigiDoctor/Healthcare Professionals Registry <small>DigiDoctor</small>	Comprehensive repository of doctors / healthcare professionals in the country
 Health Facility Registry <small>Health Facility Registry</small>	Repository of health facilities in the country including /includes hospitals, clinics, diagnostic laboratories and imaging centers, pharmacies, etc.
 ABDM Personal Health Records	Mobile application to view longitudinal digital health records of an individual and share with consent
 ABDM Electronic Medical Records Application	Digital version of a patient's chart. It contains the patient's medical and treatment history from a single health facility
 e-Hospital/similar HMIS <small>e-Hospital</small>	HMIS solution for Government sector hospitals
 Sandbox <small>NDHM Sandbox</small>	Framework that allows technologies or products to be tested in the contained environment in compliance with ABDM standards
 aws	

Enabling continuum of care

- Late detection and lack of adherence are two of the biggest drivers for chronic illnesses like TB and diabetes
- Effective monitoring through the **care continuum cycle (Preventive – Primary – Secondary/Tertiary – Post Treatment)** of a patient can help overcome both of these challenges
- Successful examples include innovative adherence solutions for Diabetes, including preventive checks and proactive, predictive healthcare actions



“Health is a #Global #PublicGood. We have to use myriad approaches and diverse paths to achieve a unified Goal of #OneHealth for everyone on the planet.”

Dr Basant Garg

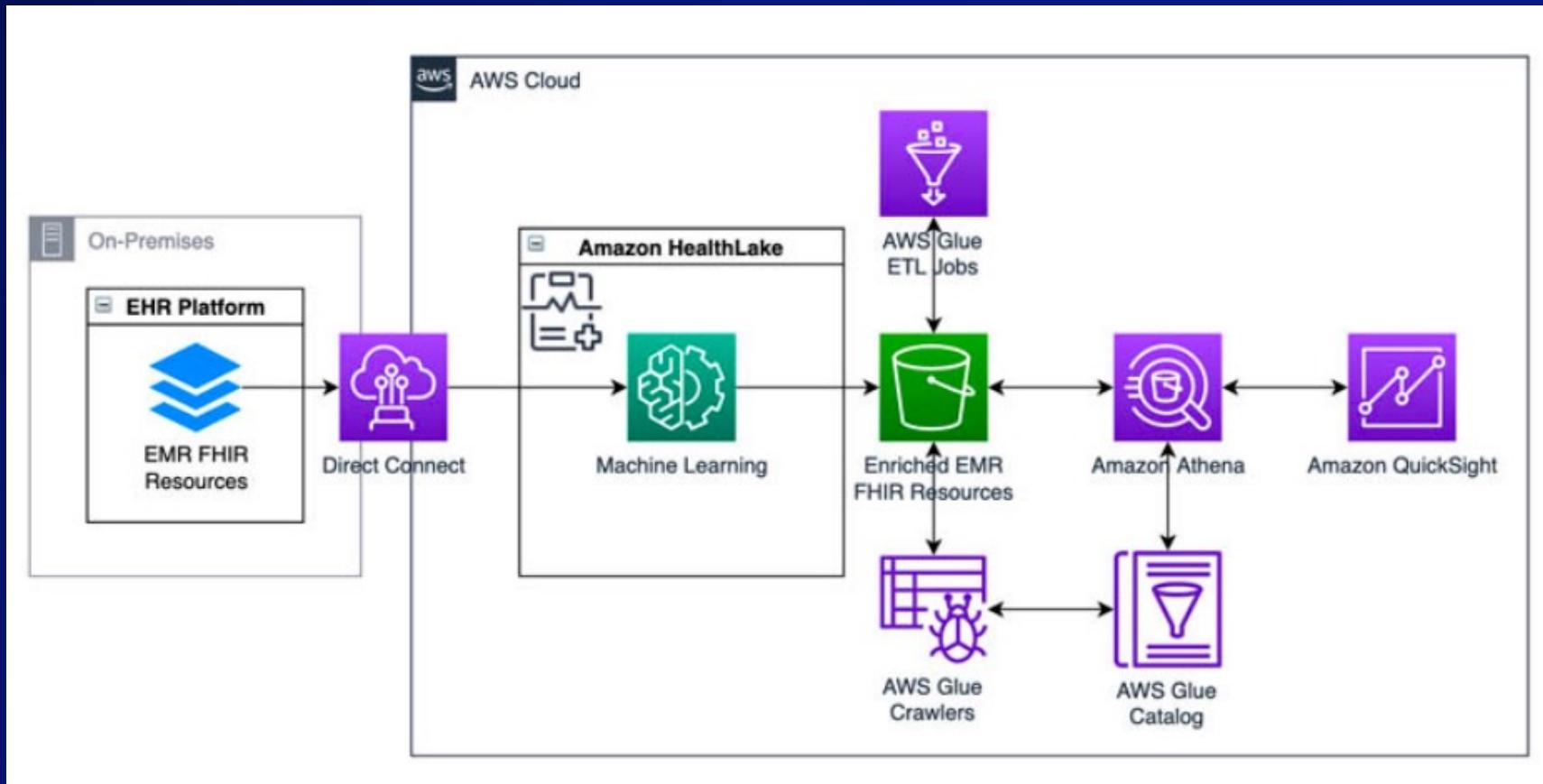
Additional CEO & Mission Director ABDM

National Health Authority, Government of India

Solutions for Ayushman Bharat Digital Mission

Track 1 : Health lake and AI

POPULATION DASHBOARD AND PREDICTIVE DISEASE MODEL



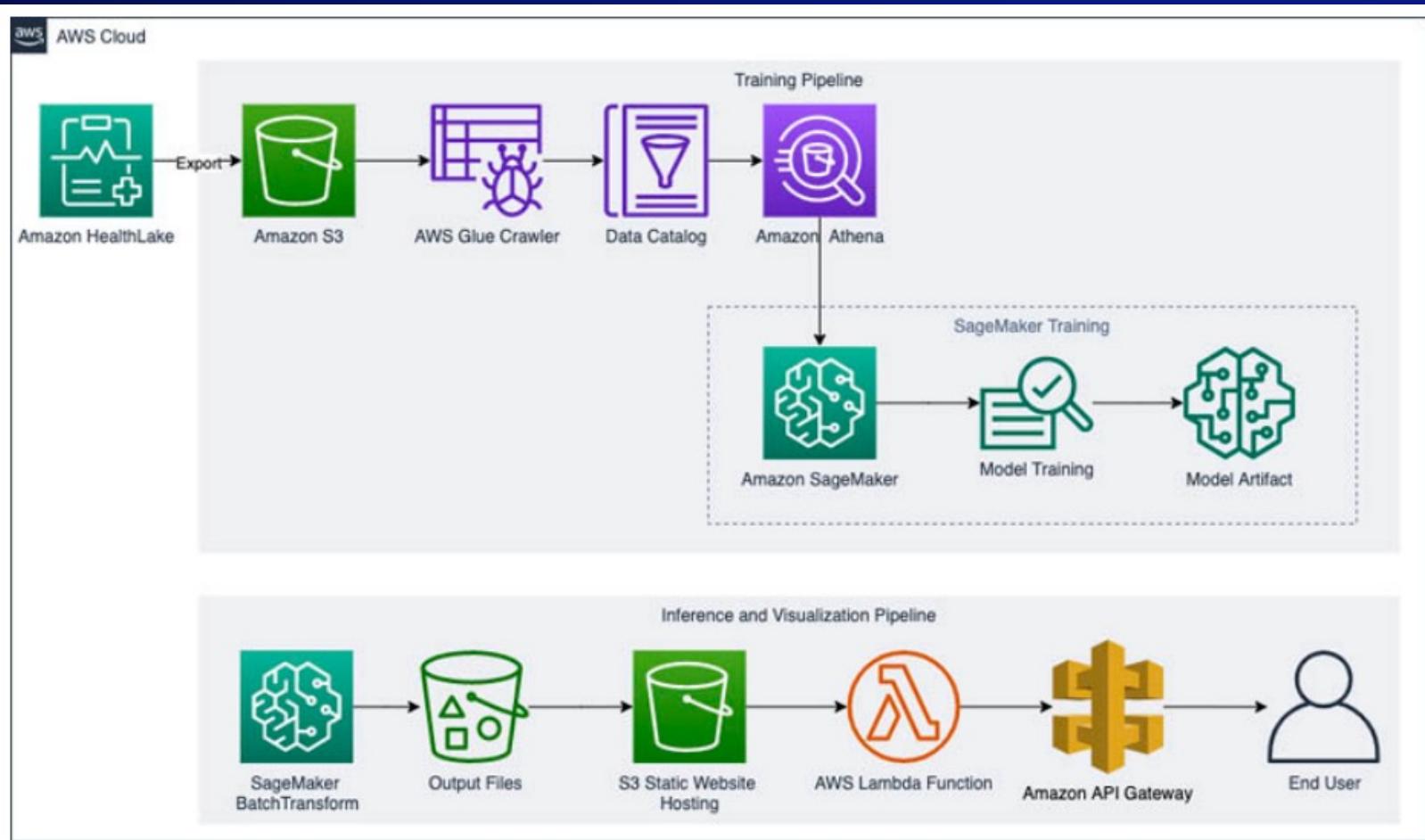
Use Cases:

- Population Health Dashboard
- Predictive Disease Models

Requirements:

- Scalable FHIR store
- Data ingested from front-ends, HIMS and other systems to FHIR store
- Dashboards with drill down to local territory level
- Custom models to be trained on unstructured data (discharge summary, scan images)
- Role based access to users

Track 2 : Building predictive disease models



Use Cases:

- Building predictive disease models

Challenges:

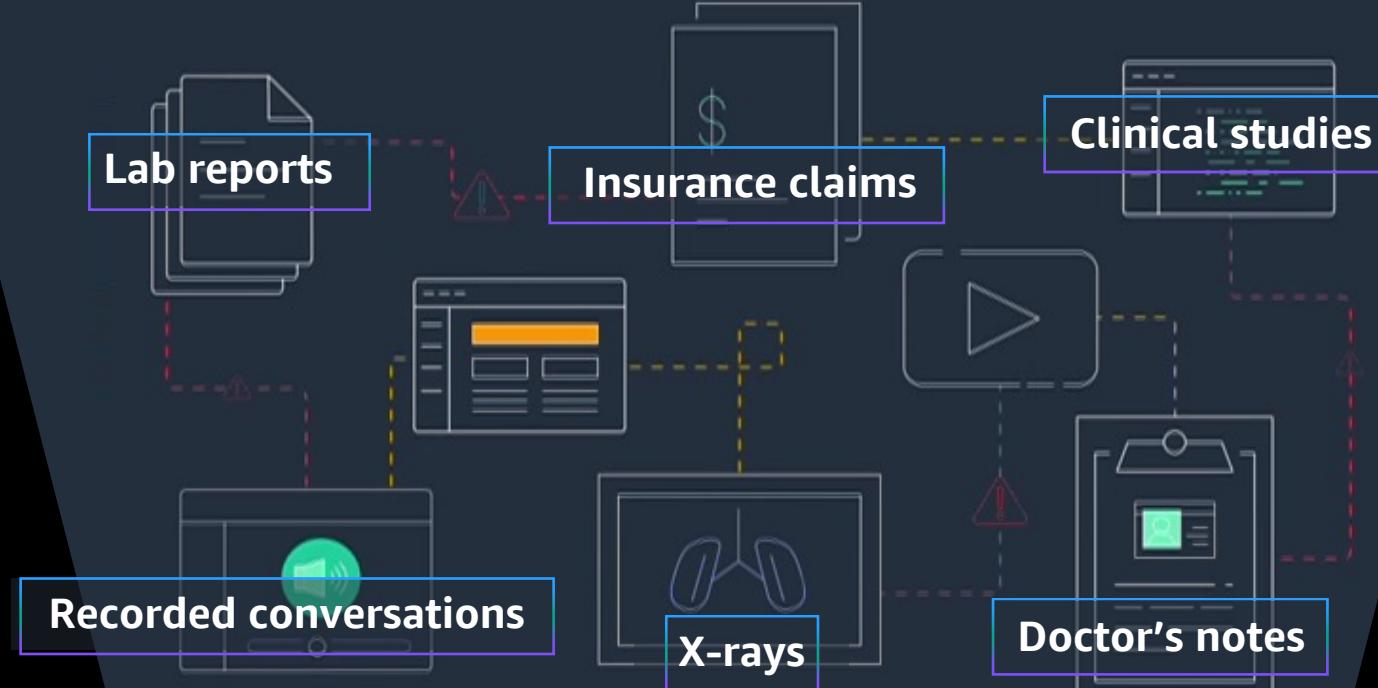
- How to effectively use both structured and unstructured data to get a complete view of the data
- How to intuitively interpret the prediction results

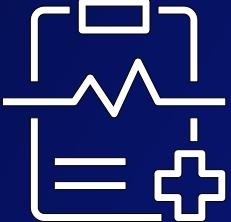
Solution:

- Build population scale predictive disease models using the dataset that includes structured data about the patients

The future of digital healthcare: cloud

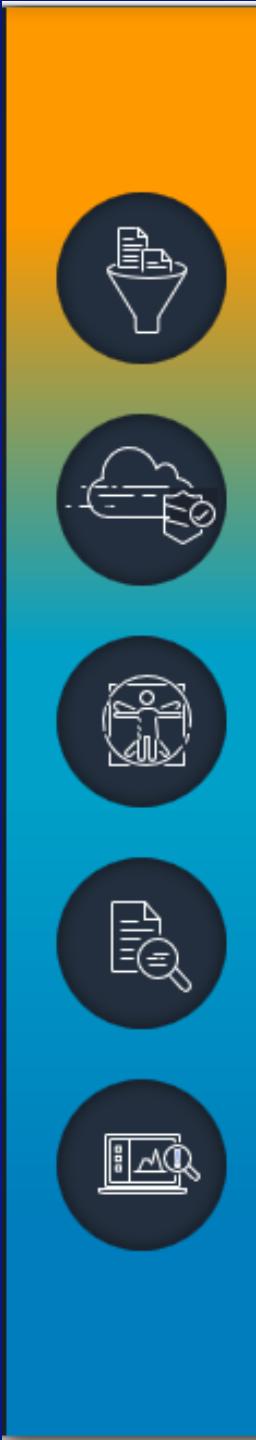
Health data is inconsistent, unstructured, and complex





Amazon HealthLake

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



- **IMPORT**

- Quickly and easily import clinical notes, lab reports, insurance claims, and more

- **STORE**

- Stored in the AWS Cloud in a secure, compliant, and auditable way

- **TRANSFORM**

- Tag and index unstructured data using specialized ML models

- **QUERY & SEARCH**

- Powerful query and search capabilities

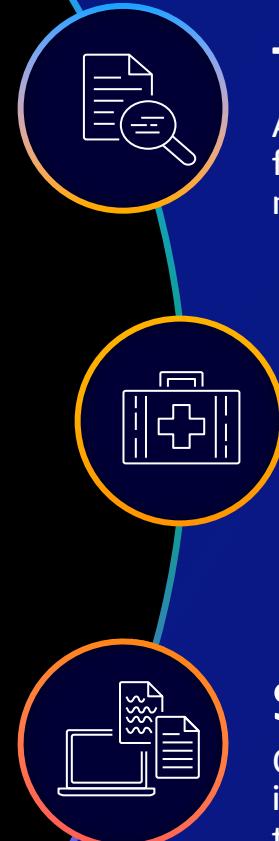
- **ANALYZE**

- Understand relationships in the data with pre-built ML models



Making sense of health data

**See how you can
benefit from
Amazon
HealthLake**



Transform data seamlessly

Automatically understand and extract meaningful medical information from raw, disparate data. Revolutionize a process that was traditionally manual, error-prone, and costly

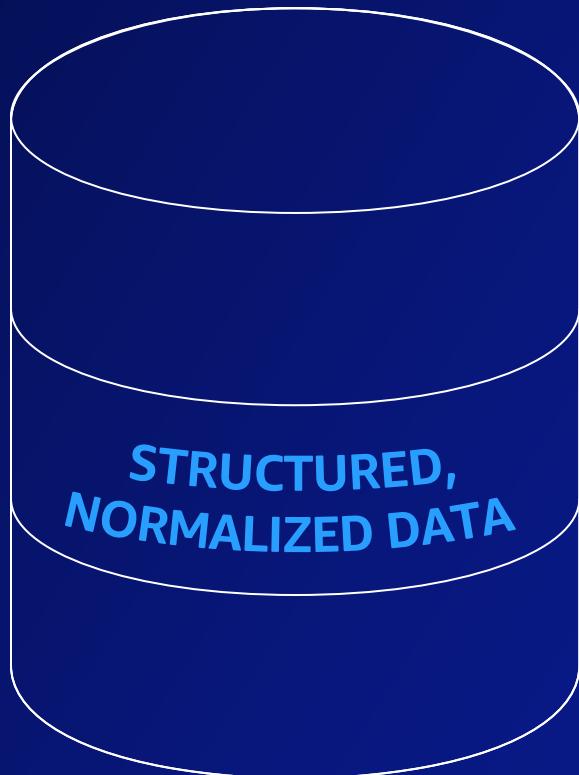
Identify trends and make predictions

Store, transform and prepare patient health information to unlock novel insights to improve care and reduce costs

Support interoperability

Create a complete view of each patient's medical history and structure it in the Fast Healthcare Interoperability Resources (FHIR) standard format to facilitate the exchange of information across multiple applications

Identify trends and make predictions



Amazon SageMaker



Amazon QuickSight



3rd party applications

IDENTIFY TRENDS

Easily search and query the data

Develop interactive dashboards

MAKE PREDICTIONS

Create predictive models, like predicting Sepsis in a hospital ICU

SHARE DATA SECURELY

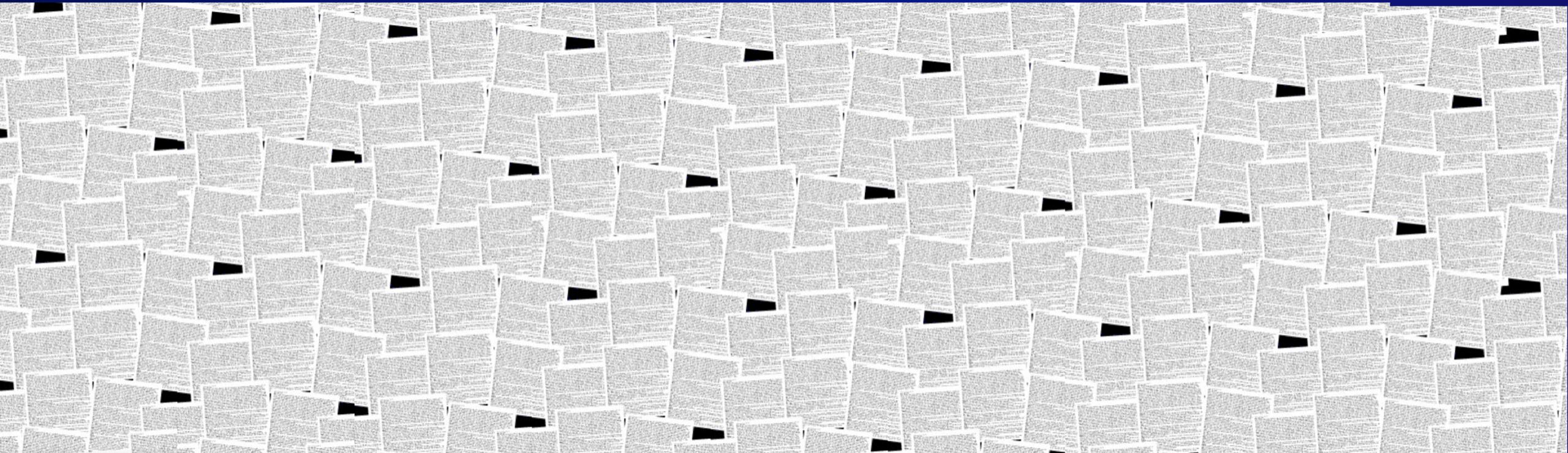
Healthcare providers and patients alike can easily share and access their data

Support interoperability



Unstructured medical documents

1.2B created / year, critical information trapped, difficult to extract insights



Demographics

Geography

Gender

Age

Health history

Disease indicators

Anatomy

Symptoms

Diagnosis

Treatment

Test Name

Test Result

Rx

Medication Name

Strength

Route

Frequency

IDENTIFICATION/CHIEF CONCERN:

Ms. Doe is a 54 yo woman with metastatic breast cancer, she was initially ER pos PR pos HER2 neg but as of May 2016 presented with metastatic disease to her peritoneum and omentum as well as L pleural effusion ER neg, PR neg, HER2 neg. Patient has been on Xeloda then Doxil. She also had a new ER pos PR neg AR neg HER2 neg in her bladder and put on anastrazole. Now with rapidly accumulating ascites switched to nab-paclitaxel and pembrolizumab. Presenting to switch over olaparib and carboplatin.

Problem List:

1. Breast Cancer
 - diagnosed in 11/08 T2N3c invasive lobular carcinoma with a 3.5 cm L lobular cancer ER pos PR pos HER2 neg with a positive supraclavicular lymph node.
 - received neoadjuvant dose dense Adriamycin and cytoxan (12/23/08 to 2/7/09) and then received taxol X4 (2/18/09-3/29/09).
 - bilateral mastectomy and SLNB with reconstruction 4/27/09. She had no malignancy on the R and L with residual disease 2.5 cm ILC Nottingham grade 2 with LCIS; she had 8/11 SLNB positive.
 - radiation with concurrent Xeloda (1000 mg BID) and then went on tamoxifen from 9/2009-12/2014 when she was switched to letrozole.
 - no evidence of progression until 5/2/2016 when she was found to have abdominal pain and swelling found to have a thickened bladder from peritoneal implants and ascites. Her biopsy showed weak ER pos (2%) PR negative HER2 negative.
 - bilateral uterine stents placed.
 - Ibrance and faslodex 6/11/16 - 11/20/2016 with stable disease although needing about monthly paracetamol.
 - PET 11/20/16 which showed a large L pleural effusion and small R with multiple bilateral rib mets, R hilar LN, and extensive omental implants.
 - therapy held from 11/20-12/1 to go on a study with androgen inhibitor avasertinib V746. While off all therapy for wash out and while waiting for androgen receptor staining she had worsening symptoms, going to requiring paracetamol weekly (she had one on 11-23 and a second on 11-31 with 3.7 L along with a thoracentesis 1.2L). She was found to be AR positive (she had one on 12/6/16 removed 1600 mL found to be malignant (ER neg PR neg HER2 neg) and 12/9/16 paracentesis removed 1500 mL fluid found to be malignant (ER neg PR neg HER2 neg).
 - Xeloda 1500 mg BID moved to 7 days on and 7 days off on 4/10 because of hand/foot
 - patient presented with dyspnea on the week of 7/21, removed 2L fluid found to be metastatic cancer ER neg PR neg HER2 neg AR neg
 - 7/25 had ureteral stents replaced and found 2.5 cm velvety lesion on bladder wall, biopsy ER pos 90% PR neg HER2 neg AR pos most consistent with breast cancer (but not consistent with her primary ILC from 2008)
 - Doxil 40 mg/m² 1/4/17 - 12/3/17
 - vinorelbine 1/8/18-1/15/18 (admitted with worsening ascites)
 - nab-paclitaxel 1/22/18-present, added pembrolizumab on 3/16, but on 4/9 she got urosepsis so abraxane held and on 4/16 got pembrolizumab only
 - on admission had pleurx placed for ascites on 1/20/18 but clogged so was removed.
 - post menopausal, she had menarche at 15 yo and menopause after chemo at 45 yo. She has G3P3 and had first pregnancy at 27 yo. She took OCPS from 18 yo until her 30s.
 - mother had multiple myeloma but no other history of breast, prostate, colon, or ovarian cancer.
 - patient states BRCA negative in genetics

2. PNA: cough and dyspne on first arriving, improved with course of azithromycin 12/5/16-12/10/16

3. Weight loss: patient came in at 53.5 kg, once disease control gained weight to 61.9 kg. Her weight back down to 52.3 kg

4. ARF on 1/23/18, she was admitted on 2/13/18 because creatinine increased 4.25 from 0.9 on 1/23. She had her stents replaced and creatinine now down to 2.6. Creatinine bumped again to 3.95 on 4/9. Chemo held and patient admitted. L stent malpositioned and enterococcus faecalis growing in the urine and port.

REVIEW OF SYSTEMS:

Ms. Doe has not had any fevers since day 2 of her admission but has severe fatigue. She is very fatigued and came in a wheelchair. She has had rapid accumulation of her ascites and is very distended therefore not eating well. She also is having continued shortness of breath and has difficulty walking to the bathroom. Nephrostomy tubes are draining, R bag clear yellow L bag slightly darker but mostly clear. No pain in her back, no CVA tenderness. No chills or coughs. Complete review of systems otherwise negative in detail. Patient is ECOG performance status 2.

Current Concerns:

Ms. Doe Busch reports severe fatigue. She reports improved breathing but is still having trouble walking around the house and to the bathroom. She did not get blood in the hospital and continue to drop. She also has abdominal distension from her ascites. She is frustrated because she was feeling well until she had the chemo held. She is also worried about the chemo making her feel fatigued and not able to live her life. She does understand the poor prognosis but wants to keep trying.

Allergies

No Known Medication Allergies

Home Medications

calcium carbonate 1000 mg daily
fish oil 1000 mg daily
multivitamin
comazine 10 mg q6h prn nausea
anastrazole 1 mg daily

GENERAL: women of stated age, pale, cachexic, AAOX3, distended abdomen

IDENTIFICATION/CHIEF CONCERN:

Ms. [REDACTED] is a [REDACTED] yo woman with [REDACTED] breast cancer, she was initially [REDACTED] but as of [REDACTED] presented with [REDACTED] breast cancer, she was initially [REDACTED] but as of [REDACTED] presented with [REDACTED]. Patient has been on [REDACTED] then [REDACTED]. She also had a [REDACTED] ER pos PR neg AR neg HER2 neg in her [REDACTED] and put on [REDACTED]. Now with rapidly accumulating ascites switched to [REDACTED] and [REDACTED]. Presenting to switch over [REDACTED] and [REDACTED].

Problem List:

1. Breast Cancer
 - diagnosed in [REDACTED] T2N3c invasive [REDACTED] carcinoma with a 3.5 cm L [REDACTED] cancer ER pos PR pos HER2 neg with a positive [REDACTED] supraclavicular lymph node.
 - received neoadjuvant dose dense Adriamycin and cytoxan (12/23/08 to 2/7/09) and then received taxol X4 (2/18/09-3/29/09).
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comazine 10 mg q6h prn nausea
anastrazole 1 mg daily

women of stated age, pale, cachexic, AAOX3, distended abdomen



Extracting from images – Amazon Rekognition

- Enables customers to build their own specialized machine learning based image analysis capabilities using Auto ML. No machine learning experience required.

SIMPLIFY DATA LABELING

- The Rekognition Custom Labels console provides a visual interface to make labeling your images fast and simple.

AUTOMATED MACHINE LEARNING

- No machine learning expertise is required to build your custom model. Rekognition Custom Labels includes AutoML capabilities that take care of the machine learning for you.

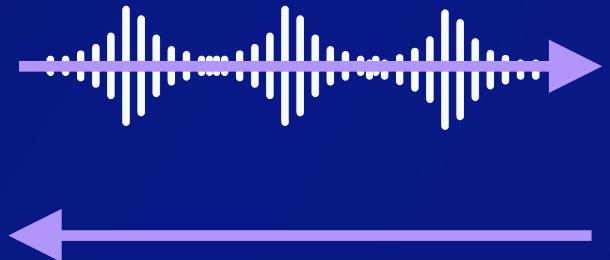
SIMPLIFIED MODEL EVALUATION, INFERENCE AND FEEDBACK

- Evaluate your custom model's performance on your test set. For every image in the test set, you can see the side by side comparison of the model's prediction vs. the label assigned.

Extracting from audio transcriptions – Amazon Transcribe Medical



Microphone-enabled
Client



"Patient is 37 year old female with..."



Amazon Transcribe Medical

- 1) Call the API
- 2) Pass an audio stream
- 3) Get a stream of text

skillbuilder.aws 

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Build in-demand cloud skills your way



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Thank you!



Please complete the
session survey

Manu Shukla

Head, Government Transformation (India & South Asia)

AWS India