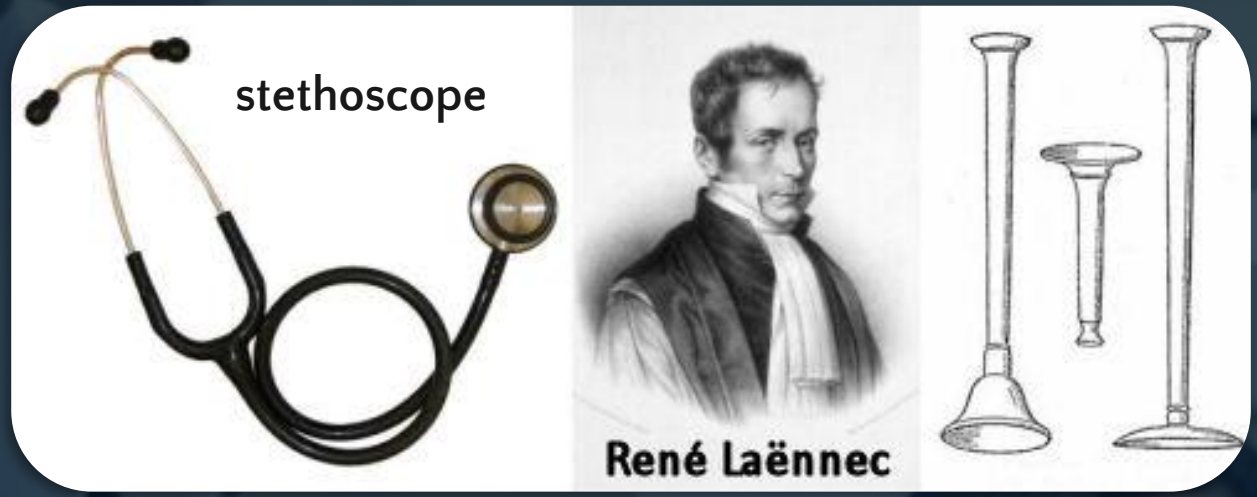
Harnessing AI for Multimodal Data Analytics

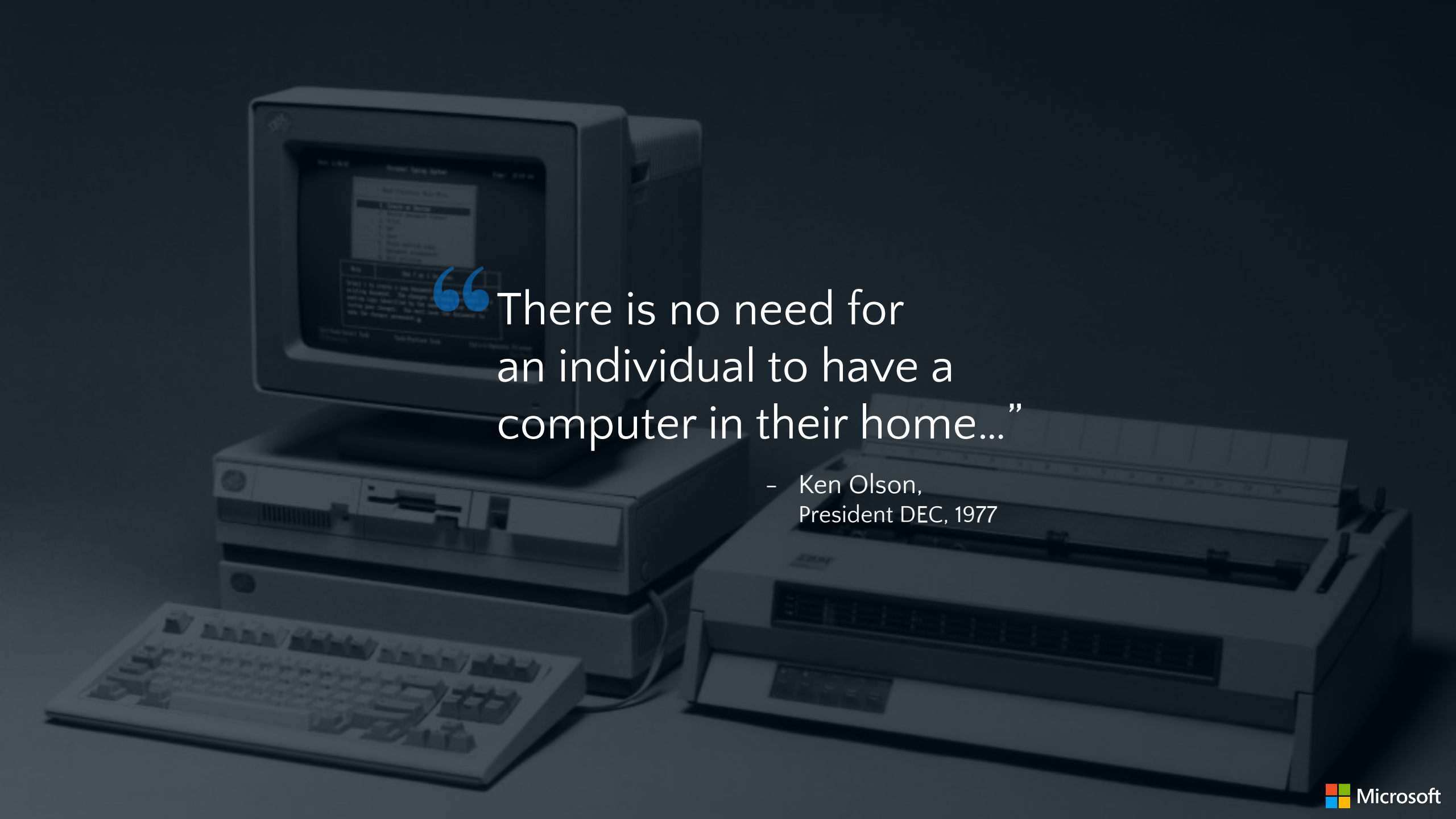
PRACTICAL APPLICATIONS IN HEALTH, SCIENCE, AND RESEARCH

Helia Mohammadi, PhD
Chief AI & Precision Health Officer
WW Health & Life Sciences
Microsoft



"... That it will ever come into general use, notwithstanding its value, I am extremely doubtful; because its beneficial application requires **much time**, and gives a good deal of **trouble** both to the patient and the practitioner; and because its whole hue and character is **foreign**, and opposed to all our habits and associations."

John Forbes MD, 1821


“There is no need for
an individual to have a
computer in their home...”
– Ken Olson,
President DEC, 1977

The Era of Copilots and Agents is Here

The potential of AI is clear

75%

of health systems see generative AI as reshaping the industry

98%

Health and life sciences organizations report having an AI strategy in place, or are planning one

For every $1 a company invests in AI, it is realizing an average return of

$3.7

13 months

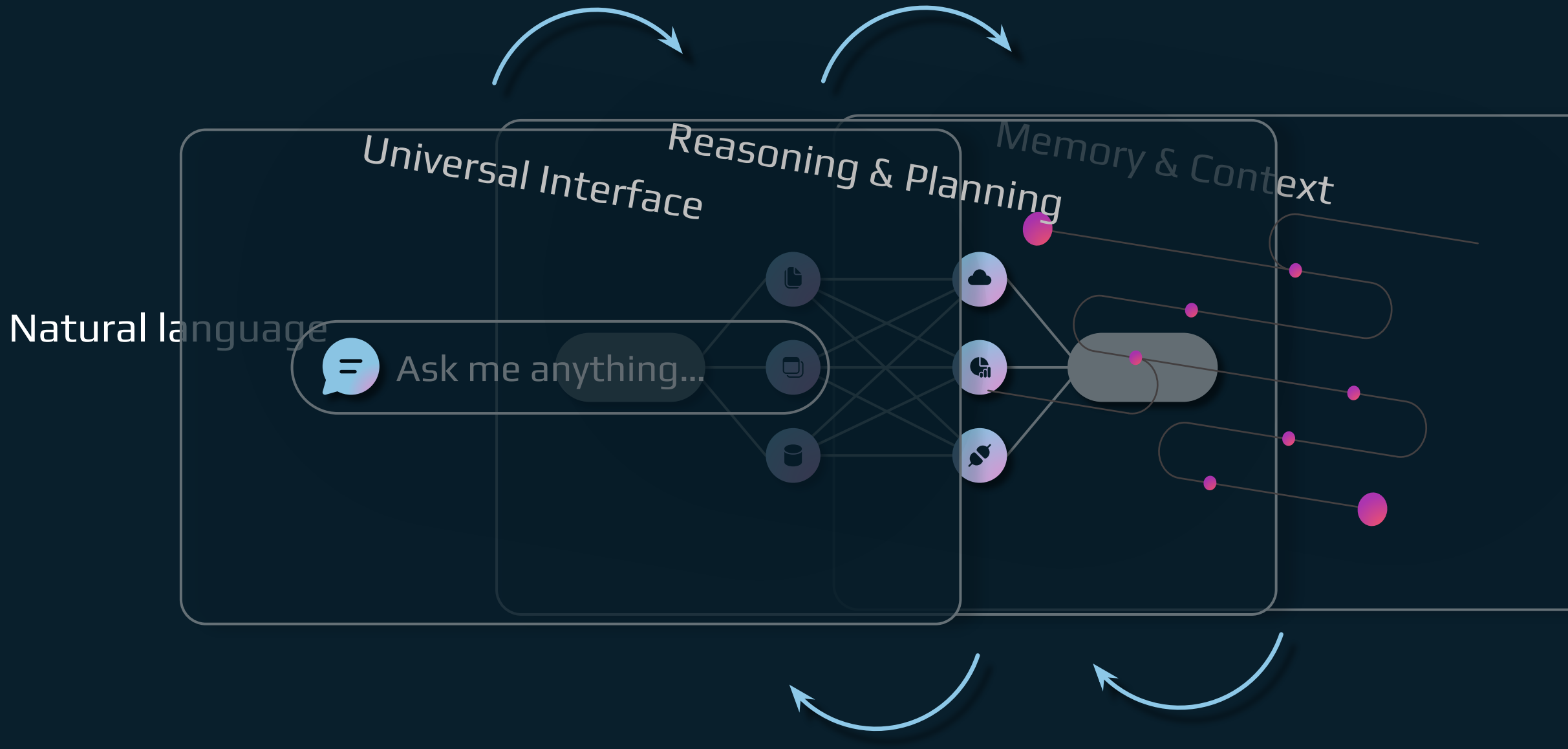
Average time it takes for organizations to realize a return on their AI investment. Average implementation time is less than 8 months

Source

Source: Forrester Artificial Intelligent Market Insights, 2023

Source: Circle Square Digital Health Trends

Microsoft


Universal Interface
Reasoning & Planning
Memory & Context
Natural language
Ask me anything...

Microsoft

Responsible AI Principles

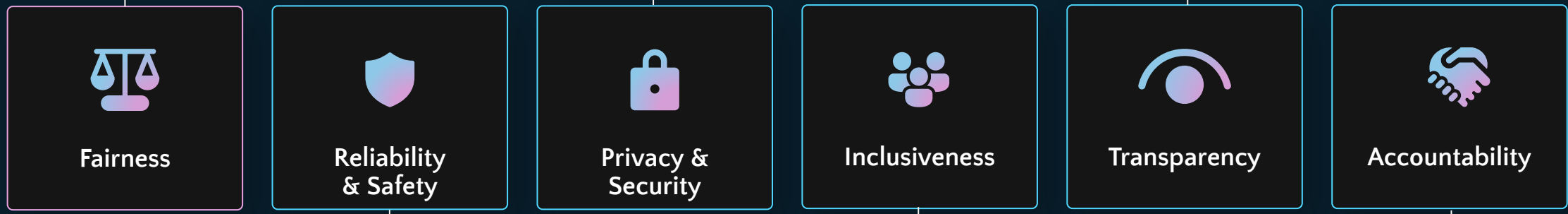
Microsoft Cloud:

- Your data is your data
- Your data is not used to train the OpenAI foundation models without permission

Guard against biases in training data (e.g., demographic biases)

Patient data used during training or fine-tuning can't be revealed

Clinical information is from verifiable sources and auditable



Ensure that AI is accessible and sensitive to all population segments

Ensure results are accurate e.g., patient chart summarization

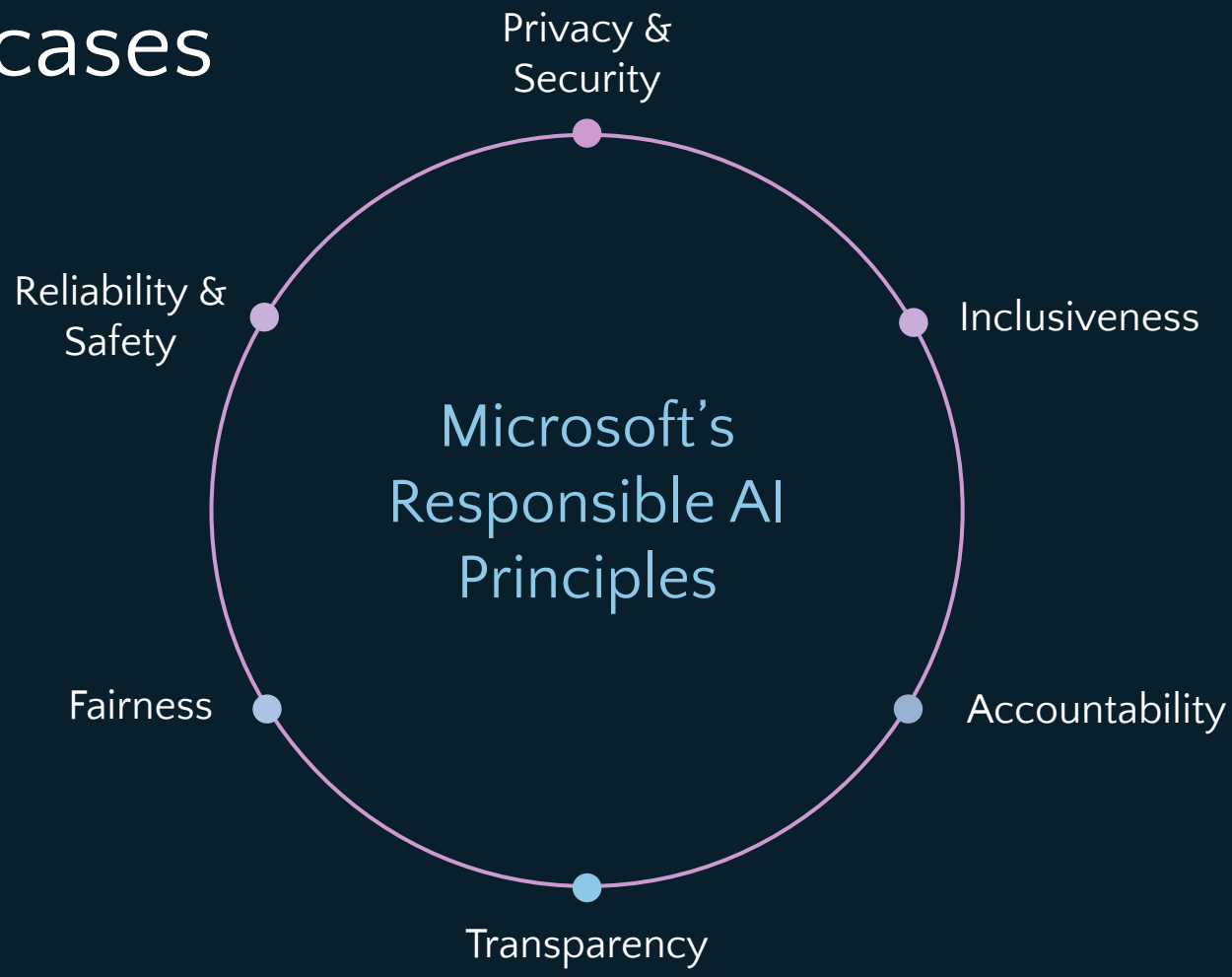
Legal, regulatory compliance, along with fairness, safety, and so on

Microsoft

Evaluating AI for health use cases

Use case ideation

- **Regulatory**: Regulated or not? *(e.g., Clinical Decision Support, Software as a Medical Device)*
- **Liability**: What could go wrong and who bears responsibility?
- **Reputational**: Building and keeping the trust of industry participants, patients, regulators, and policymakers
- **Accuracy vs. creativity**: Techniques graded and evaluated.



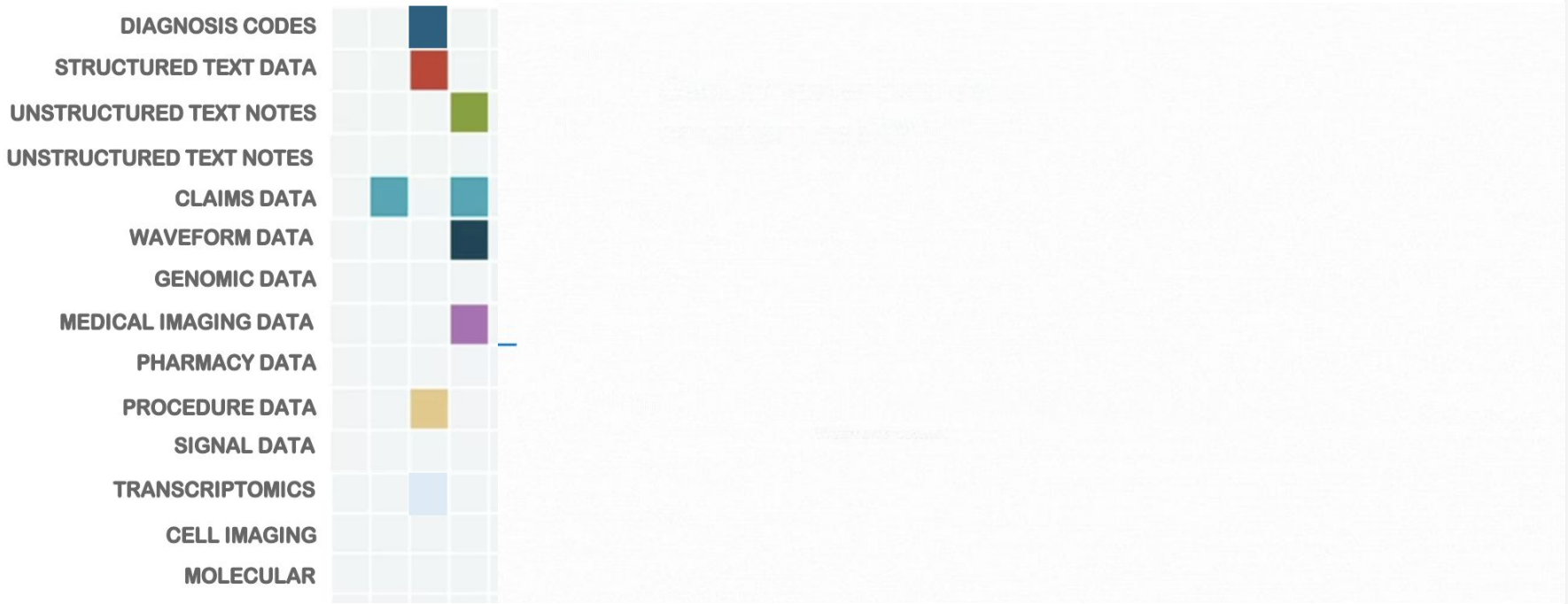
Building blocks to enact principles

Tools and processes ← Training and practices ← Rules ← Governance

Multimodal Healthcare Data

More than 95% of health data is unstructured (non-text) multimodal data

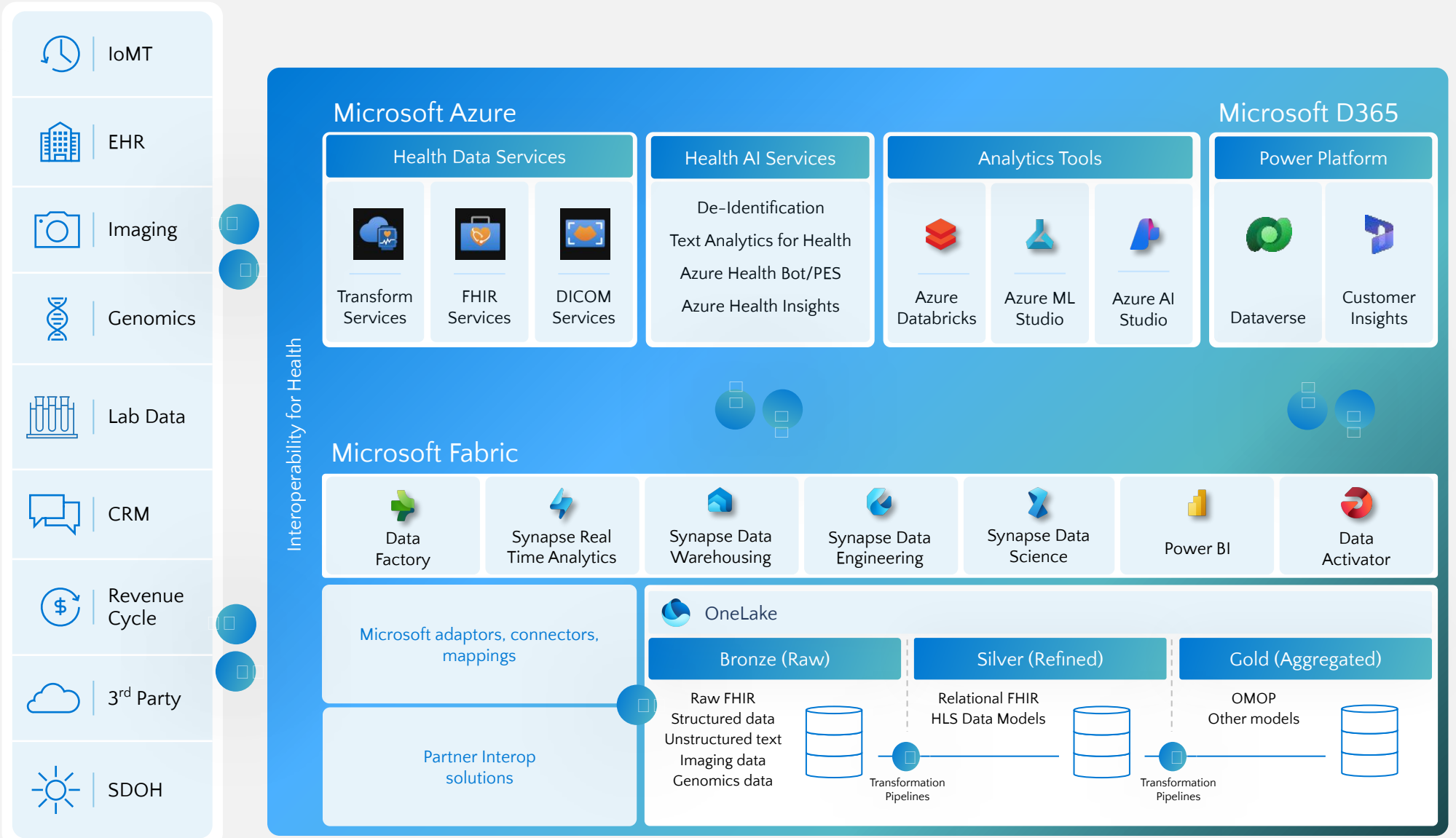
Understanding and Predicting Patient Health and Disease State requires Multiple Modalities



- Out of the box multimodal foundation models struggle with non-text multimodal health data
- Most multimodal health data is not easily available and siloed across many organizations
- Building pretrained multimodal medical foundation models is resource intensive and existing models have limited use to research

Zhou et al, Feb 2nd, 2024
A Survey of Large Language Models in Medicine
https://arxiv.org/pdf/2311.05112.pdf

Health Digital and AI Transformation Architecture



Interoperability for Health

Interoperability for HLS specific systems with re-useable Microsoft and Partner components.

OneLake

Data stored in raw form and transformed to industry common models using both Microsoft, partner, and custom transformation pipelines.

Data Governance

Microsoft Purview provides data governance across the entire data estate.

Health Data Services

FHIR and DICOM Services built on the Data Lake foundations

Health AI Services

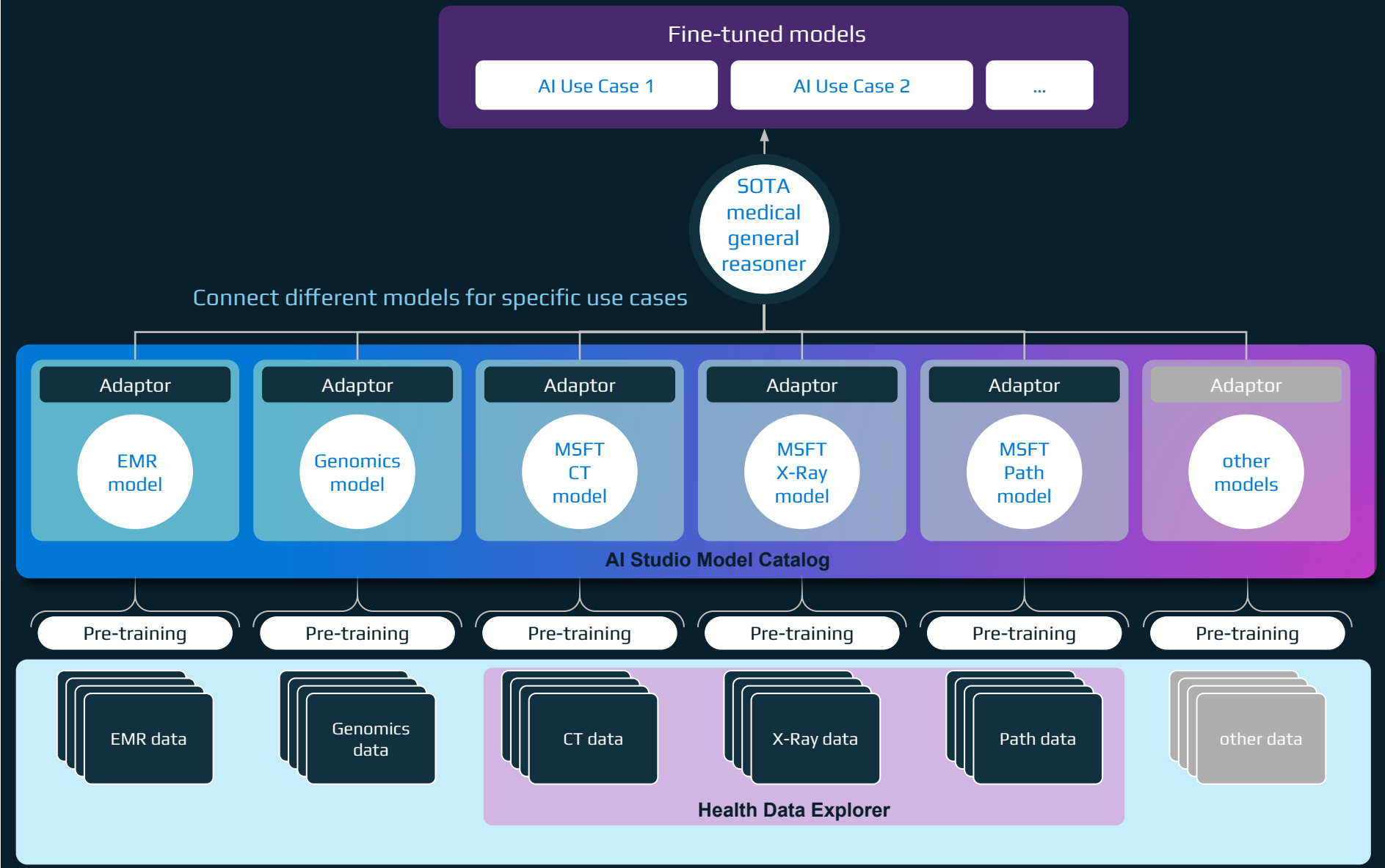
Data is infused with AI services to enrich the data and also provide layer of intelligence interaction with consumer.

Power Platform

Apps can access and update data using a low-code/no code platform.

Microsoft

Implement a Frontier Research Ecosystem



Instead of trying to build a single multimodal medical model, **build an ecosystem**

Microsoft leading with SOTA specialized medical foundation models alongside partners to cover all modalities

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Use AI Studio with tools that connect key models across modalities (via adaptors) to a SOTA medical general reasoner even with limited cross-modality data

---

Microsoft HLS is building Health Data Explorer with Fabric for healthcare data

Microsoft

Multimodal models will accelerate HLS discovery, development & delivery

Tasks

Discovery

- Biomarker identification
- Therapeutic response optimization
- Synthetic controls
- Molecular property prediction
- Disease mechanism discovery
- Protein structure prediction and optimization
- Drug repurposing
- Phenotypic screening and cellular imaging
- Cohort development
- ...

Development

- Cohort development
- Clinical trials matching, simulation, recruitment
- Virtual trials
- Label expansion
- Molecular tumor board
- Predictive drug toxicology
- Adaptive trial protocols
- ...

Delivery

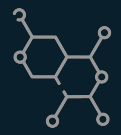
- Find similar patients
- Exam routing
- Earlier screening and quality control
- Image to report generation
- Personalized disease progression
- Personalized treatment suggestions
- Personalized screening suggestions
- Adverse effect likelihood
- Payer coverage decisions
- Prior authorization
- ...

General Reasoner

Are there any signs of early-stage breast cancer or abnormalities

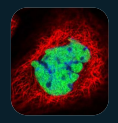
Task Adapter

Embedding FMs


Chem


Prot


Cell


Mol


Gene


EEG


Derm*


Opt*


Endo*


U/S


CT/MRI


Mam

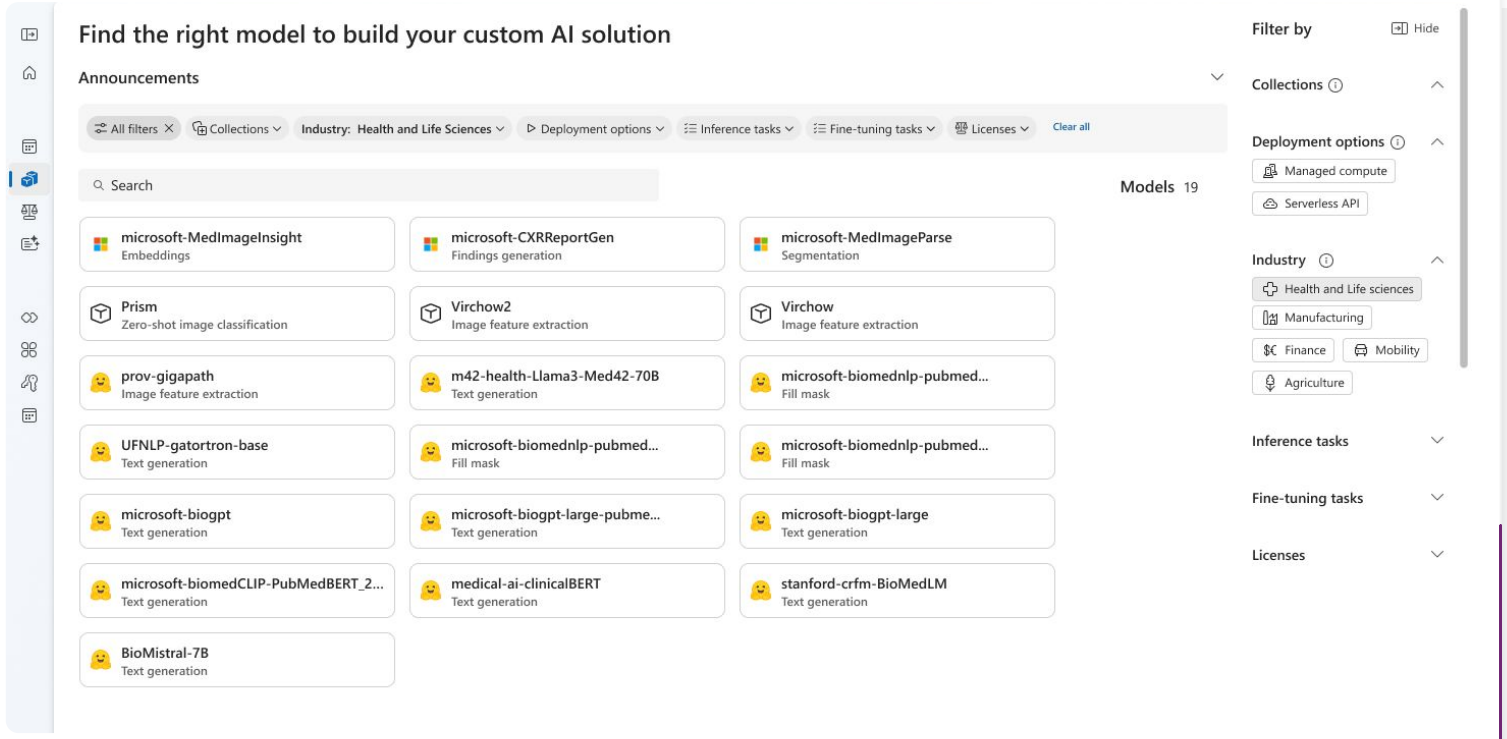

X-Ray


Path


Text

Microsoft

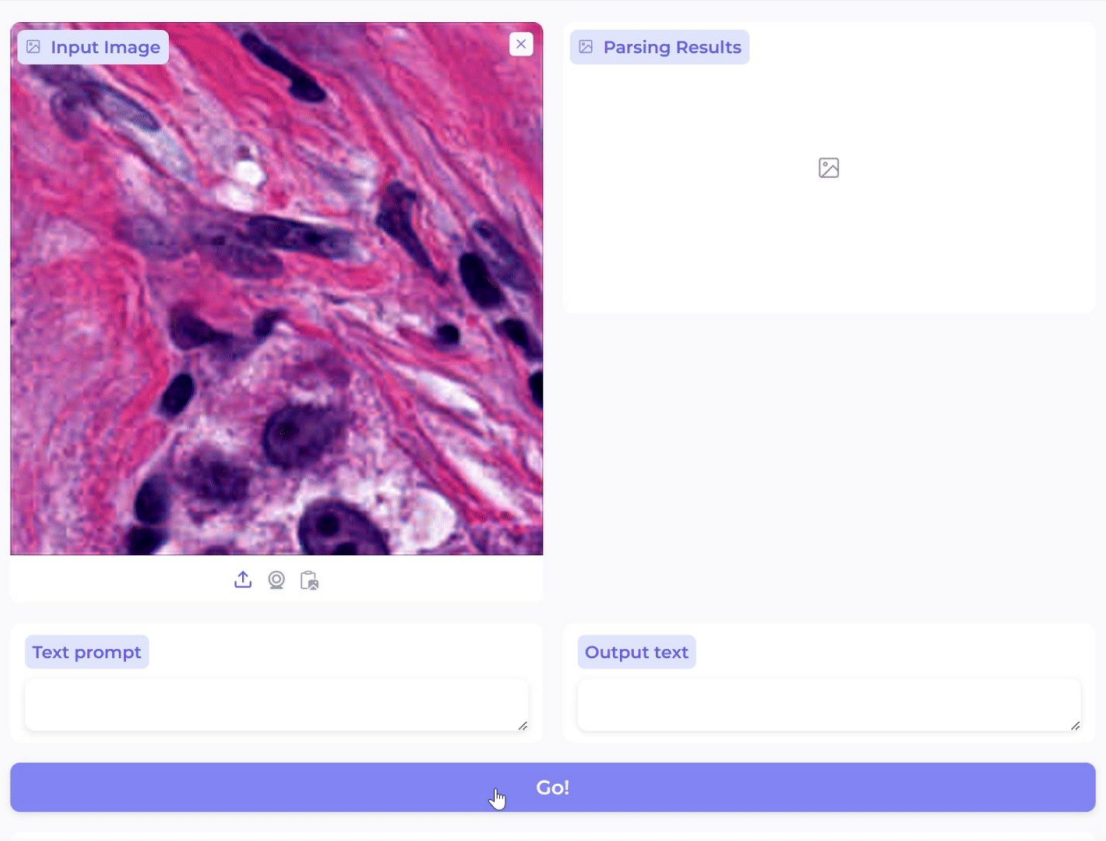
Introducing: Multimodal Healthcare AI Models in Azure AI Studio

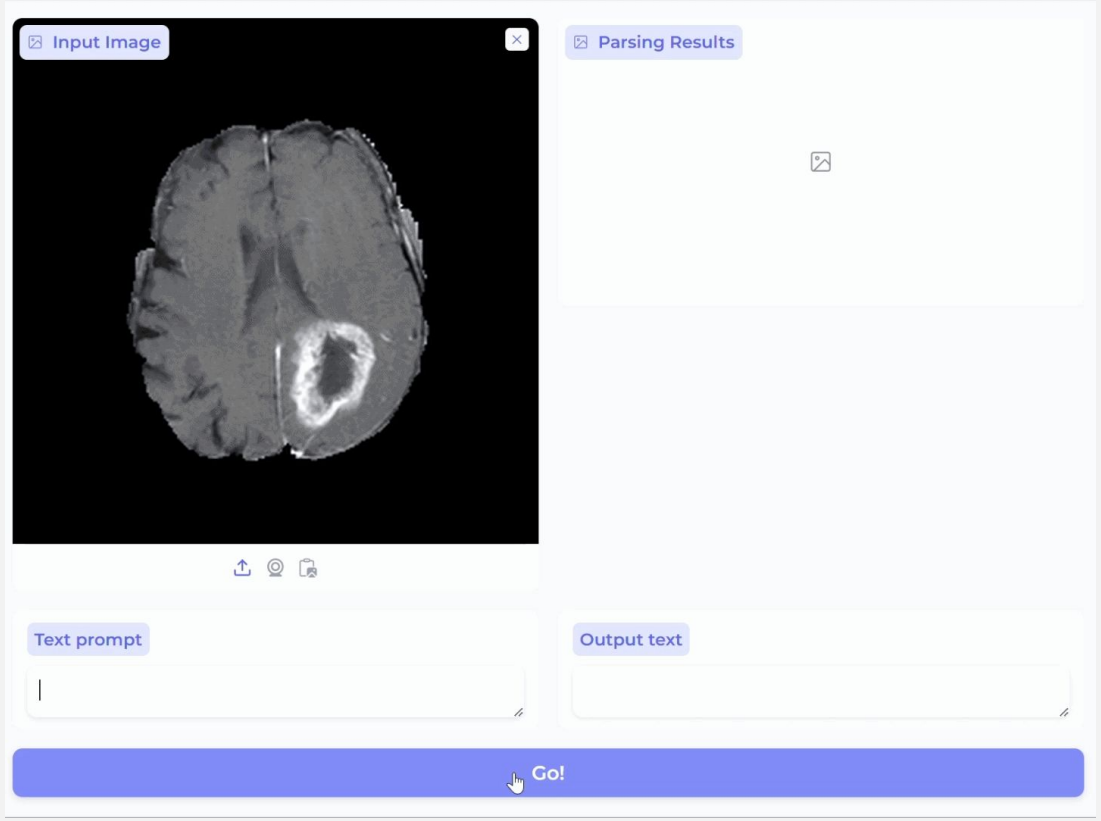


*State Of The Art (SOTA) MSFT or Partner Model in Model Catalog on 10/20/24

- Curated collection of Microsoft and partner healthcare models that are state of the art across multiple imaging modalities
- Easy to deploy and trial models in a secure environment
- Library of open-source models for full customization and adaptation to specific use cases

Microsoft MedImageParse






Derm*


Fund/OCT*


U/S


CT/MRI*


Mam


X-Ray*

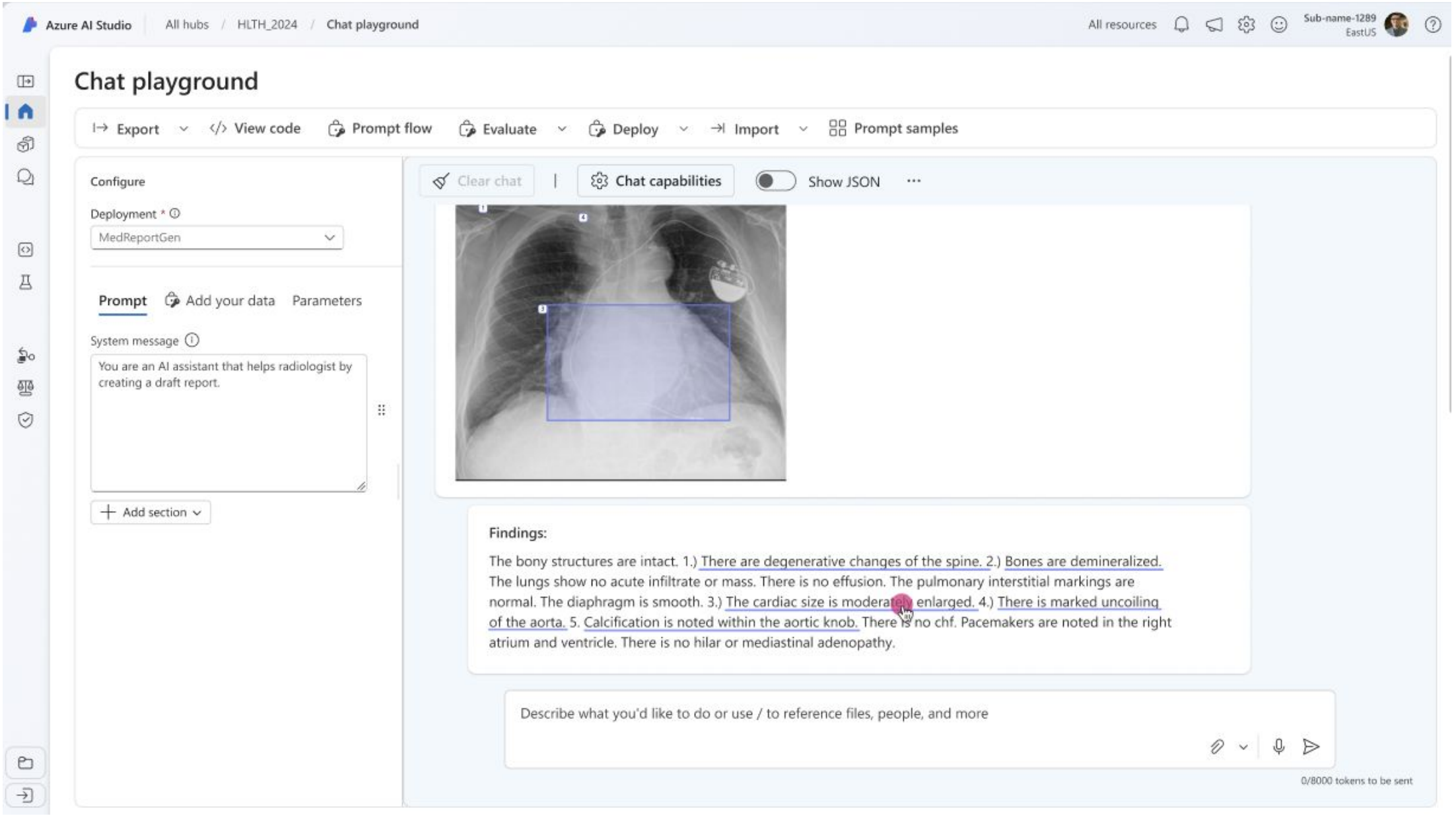

Path*

https://arxiv.org/pdf/2410.06542

*State Of The Art (SOTA)

Radiology Report Generating with Provenance

Microsoft



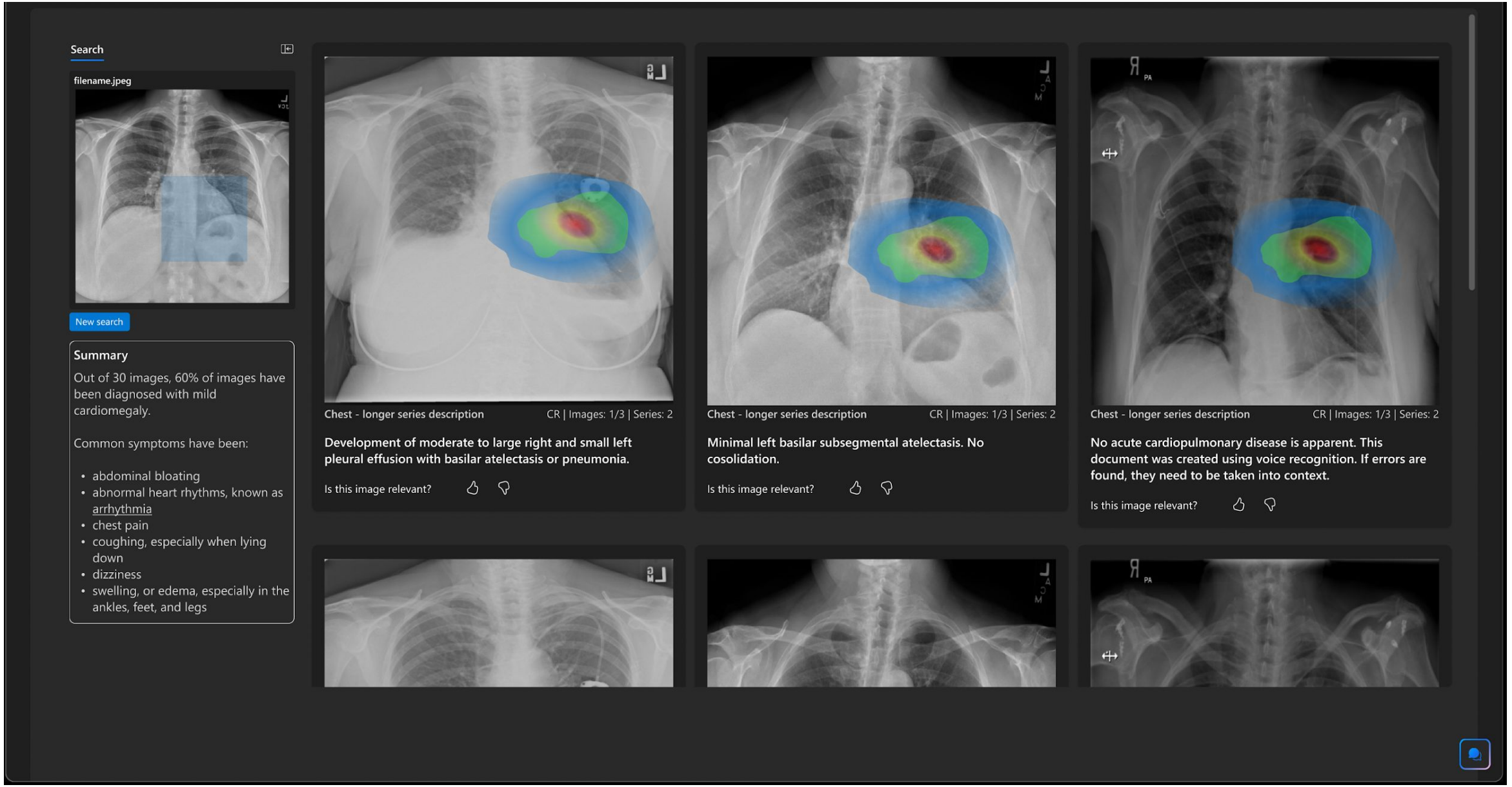
X-Ray*

Pixel Insights

LLM*

*State Of The Art

Find patients like mine with MedImageInsight




Derm*


Opt*


U/S


CT/MRI*


Mam


X-Ray*

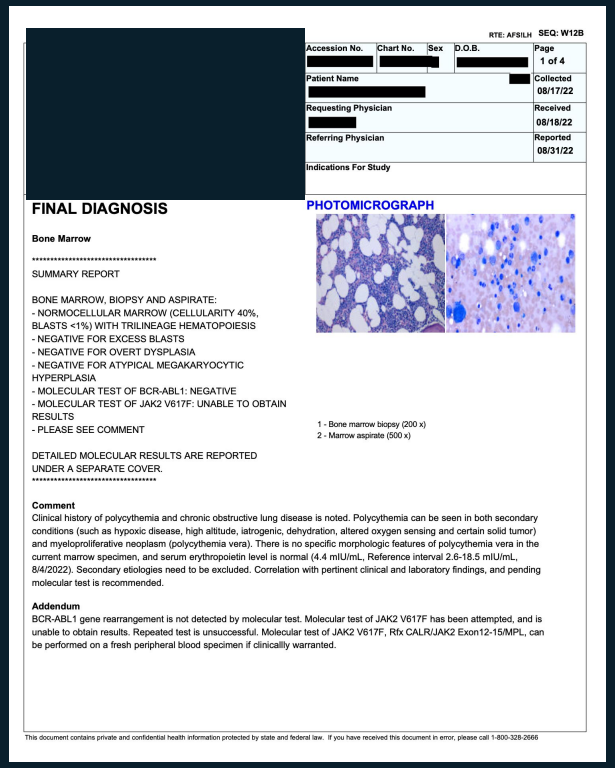

Path*

*State Of The Art

Lab Results

Prompt

Extract the key information into a table



RTE: AFSILH SEQ: W12B

Accession No.	Chart No.	Sex	D.O.B.	Page
[redacted]	[redacted]		[redacted]	1 of 4

Patient Name [redacted] Collected 08/17/22

Requesting Physician [redacted] Received 08/18/22

Referring Physician Reported 08/31/22

Indications For Study

FINAL DIAGNOSIS

Bone Marrow

****

SUMMARY REPORT

BONE MARROW, BIOPSY AND ASPIRATE:
- NORMOCELLULAR MARROW (CELLULARITY 40%, BLASTS <1%) WITH TRILINEAGE HEMATOPOIESIS
- NEGATIVE FOR EXCESS BLASTS
- NEGATIVE FOR OVERT DYSPLASIA
- NEGATIVE FOR ATYPICAL MEGAKARYOCYTIC HYPERPLASIA
- MOLECULAR TEST OF BCR-ABL1: NEGATIVE
- MOLECULAR TEST OF JAK2 V617F: UNABLE TO OBTAIN RESULTS
- PLEASE SEE COMMENT

DETAILED MOLECULAR RESULTS ARE REPORTED UNDER A SEPARATE COVER.

****

PHOTOMICROGRAPH

1 - Bone marrow biopsy (200 x)
2 - Marrow aspirate (500 x)

Comment

Clinical history of polycythemia and chronic obstructive lung disease is noted. Polycythemia can be seen in both secondary conditions (such as hypoxic disease, high altitude, iatrogenic, dehydration, altered oxygen sensing and certain solid tumor) and myeloproliferative neoplasm (polycythemia vera). There is no specific morphologic features of polycythemia vera in the current marrow specimen, and serum erythropoietin level is normal (4.4 mIU/mL, Reference interval 2.6-18.5 mIU/mL, 8/4/2022). Secondary etiologies need to be excluded. Correlation with pertinent clinical and laboratory findings, and pending molecular test is recommended.

Addendum

BCR-ABL1 gene rearrangement is not detected by molecular test. Molecular test of JAK2 V617F has been attempted, and is unable to obtain results. Repeated test is unsuccessful. Molecular test of JAK2 V617F, Rfx CALR/JAK2 Exon12-15/MPL, can be performed on a fresh peripheral blood specimen if clinicallly warranted.

=

Prompt

Rewrite it for a patient at a 5th grade reading level

Section	Information
1. Specimen Details	Bone marrow biopsy and aspirate were conducted on the patient.
2. Tissue Description	The bone marrow core measured 0.7 cm in length x 0.2 cm in diameter and was homogeneous.
3. Microscopic Description	The marrow was normocellular (40% cellularity) with trilineage hematopoiesis, and blasts were below 1%. No overt dysplasia, atypical megakaryocytic hyperplasia, or excess blasts were observed. Molecular tests showed BCR-ABL1 was negative, but JAK2 V617F results could not be obtained.
4. Diagnosis	The bone marrow specimen was benign, with no specific morphologic features of polycythemia vera. Secondary etiologies should be considered.
5. Diagnosis (for GYN report)	N/A
6. Abnormalities (for FLOW and BONE MARROW reports)	No significant abnormalities were detected.
7. Synoptic Report/Summary	The bone marrow biopsy and aspirate showed normocellular marrow with trilineage hematopoiesis, negative for excess blasts, overt dysplasia, and atypical megakaryocytic hyperplasia. BCR-ABL1 was negative, but JAK2 V617F results were not obtained.
8. Comments	The clinical history of polycythemia and chronic obstructive lung disease is noted. Correlation with pertinent clinical and laboratory findings and pending molecular tests is recommended. Further molecular testing of JAK2 V617F, Rfx CALR/JAK2 Exon12-15/MPL can be performed on a fresh peripheral blood specimen if clinically warranted.
9. Sampling Differences	N/A

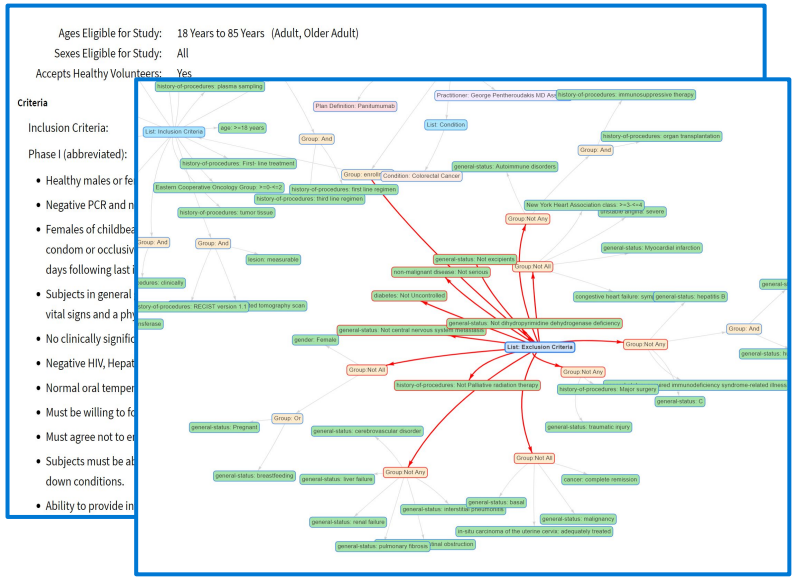
=

Result

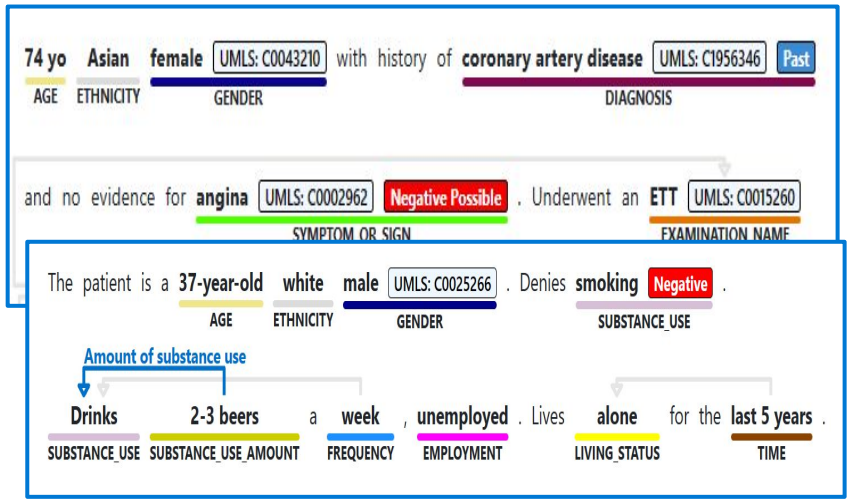
The doctors took a small sample from your bone marrow, which is the soft tissue inside your bones. They found that your bone marrow is normal and healthy, and they didn't see any unusual cells. They also did some tests to look for specific changes in your genes, but they couldn't get one of the results. They didn't find any signs of a blood condition called polycythemia vera. However, they think it's important to keep checking and do more tests if needed, especially since you have a history of having too many red blood cells and a lung condition. They can do these tests using a sample of your blood.

Clinical Trials Matching

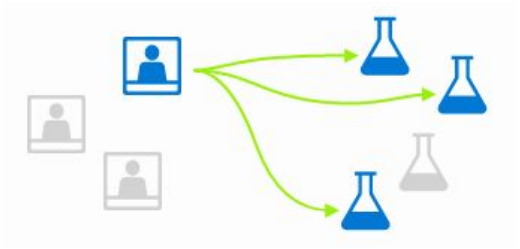
Trial Eligibility Criteria

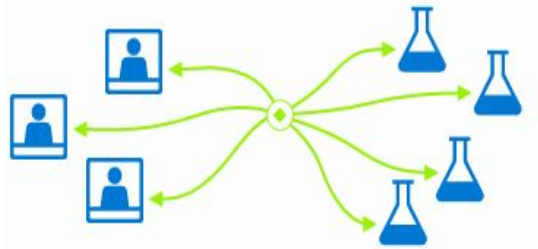


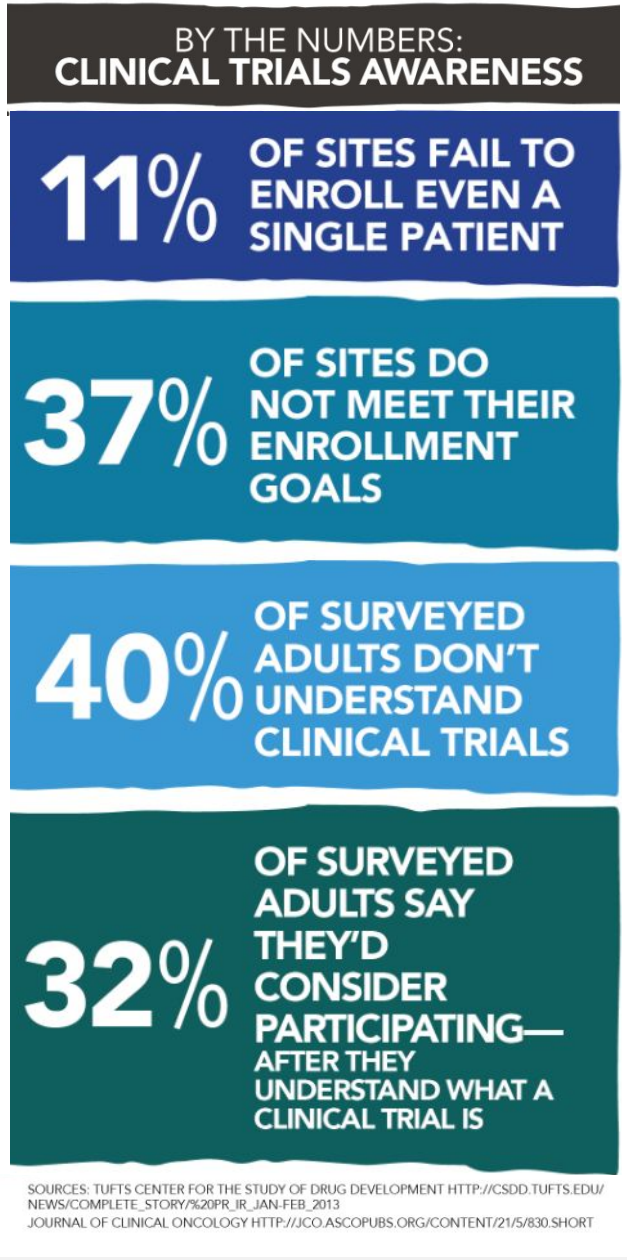
Patients Records



Matching Patients to Clinical Trials

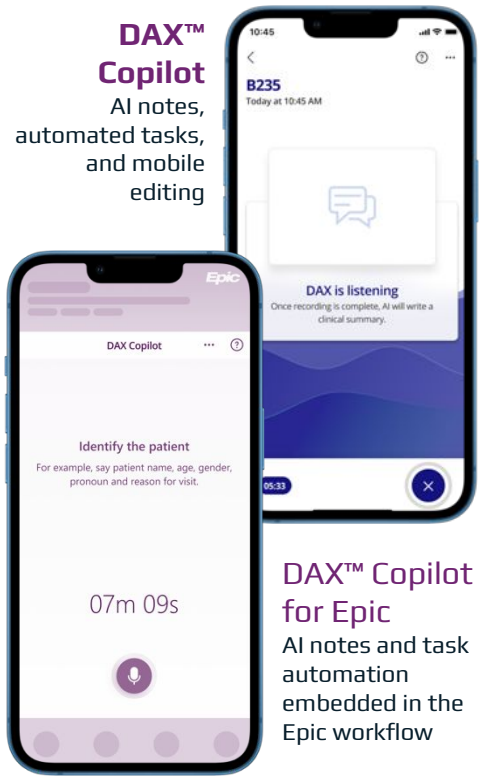






Dragon Copilot – A New Approach to Today's Challenges

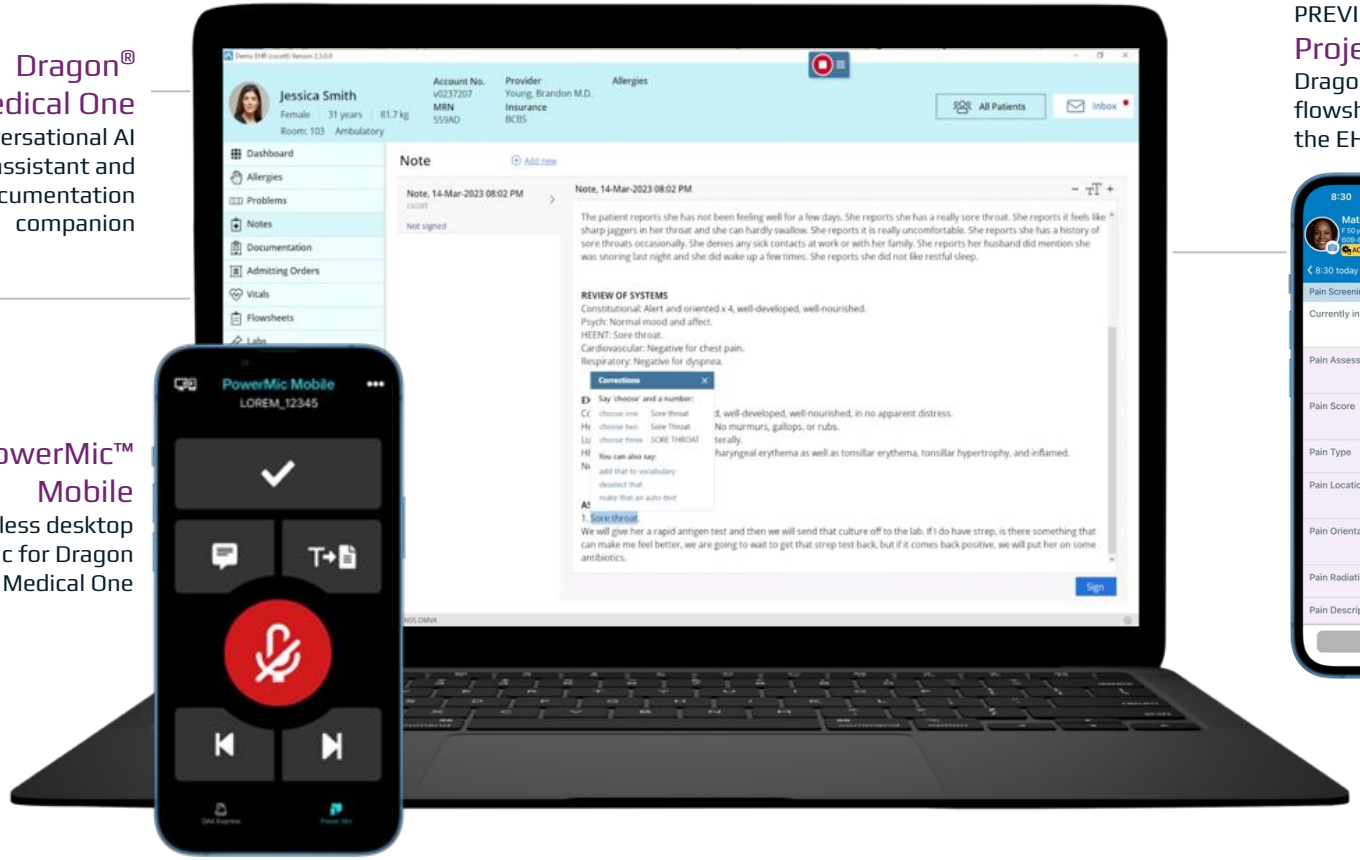
DAX™ Copilot
AI notes, automated tasks, and mobile editing



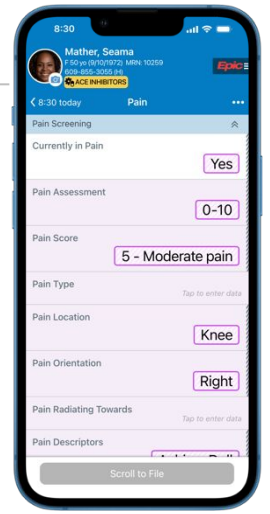
DAX™ Copilot for Epic
AI notes and task automation embedded in the Epic workflow

Dragon® Medical One
Conversational AI workflow assistant and documentation companion

PowerMic™ Mobile
Wireless desktop mic for Dragon Medical One

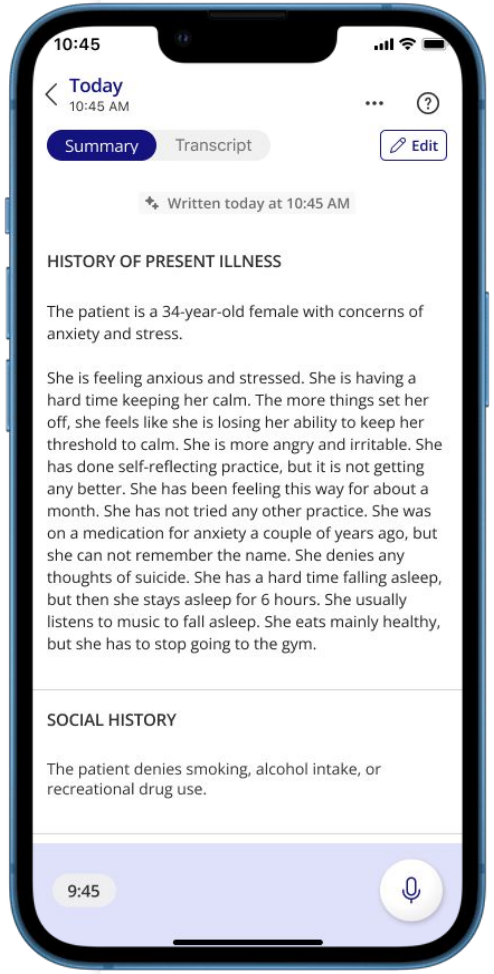


PREVIEW
Project Nursing
Dragon-based ambient flowsheet capture in the EHR



Fully automated, workflow-integrated clinical documentation that delivers a draft patient note for clinician review, editing, and signature

Outcomes delivered at scale with text LLMs: DAX CoPilot



Operational efficiency

- 5 min saved per clinician per encounter on average[1]
- 13-26 additional appointment slots, per provider, per month[1]

Clinician satisfaction

- 70% say it improves work-life balance, and reduces feelings of burnout and fatigue[1]
- 80% say it reduces feelings of cognitive burden[1]
- 75% say it improves patient experience[1]
- 62% say they are less likely to leave medicine and their organization[1]
- 100M fewer clicks per day saves thousands of hours[4]

Patient experience

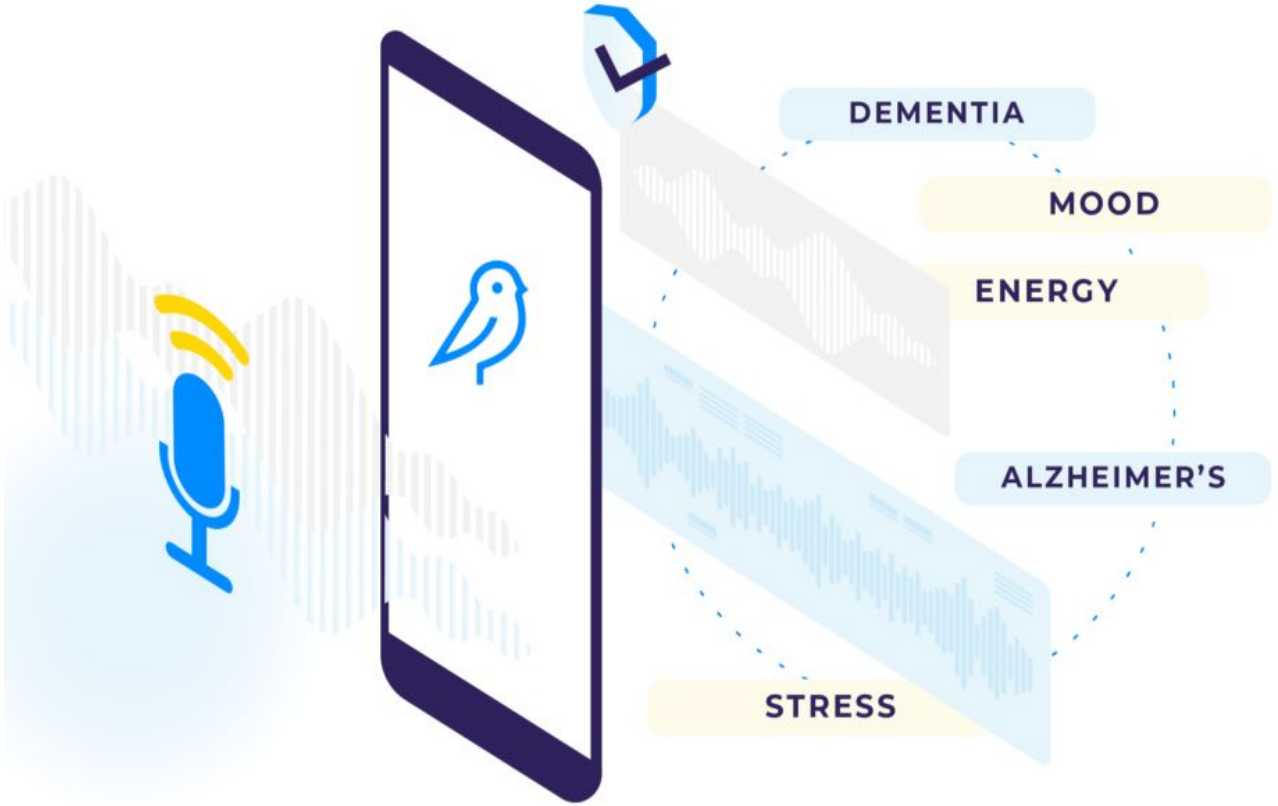
- 93% of patients say their physician is more personable and conversational[2]
- 90% say they spend less time on the computer[2]
- 85% say their clinician is more focused[2]

Financial outcomes

- $50-500K incremental revenue potential per provider, per year[3] (varies by specialty)
- 77% say it improves documentation quality[1]

Microsoft

CANARY SPEECH



92%

92% of expected MCI cases remained undiagnosed.

$7.9T

Early diagnosis of Alzheimer's and dementia can save up to $7.9 trillion in medical and care costs in the U.S. alone.

13M

The number of Americans aged 65 and older with Alzheimer's is expected to double from 6.7 million today to 13 million by 2050.

21%

21% of adults are experiencing a mental illness (50m Americans).

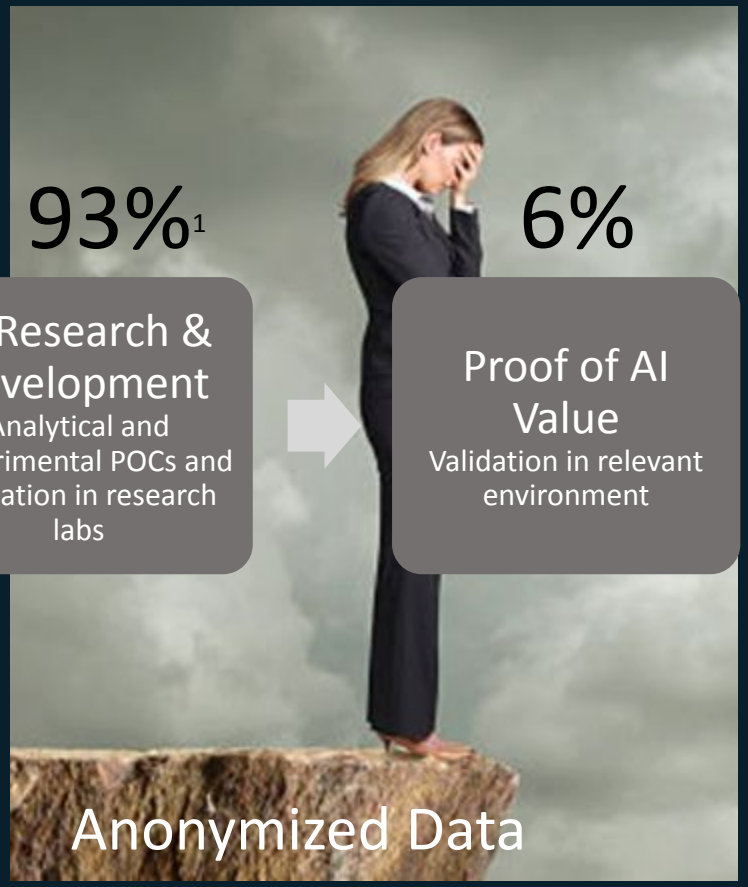
30%

Early detection and treatment of anxiety and depression can reduce hospital admissions by up to 30%.

$3,109

Early treatment of anxiety and depression can help reduce overall health costs by as much as $3,109 per person over a 2 year period.

The challenge facing AI models in healthcare and research



93%[1]

AI Research & Development
Analytical and experimental POCs and validation in research labs

6%

Proof of AI Value
Validation in relevant environment

0%

Deployment Testing
Prototype demo in operational environment

1%

Commercial Deployment
Clinical trial implementation and comparison to relevant clinical outcomes

0%

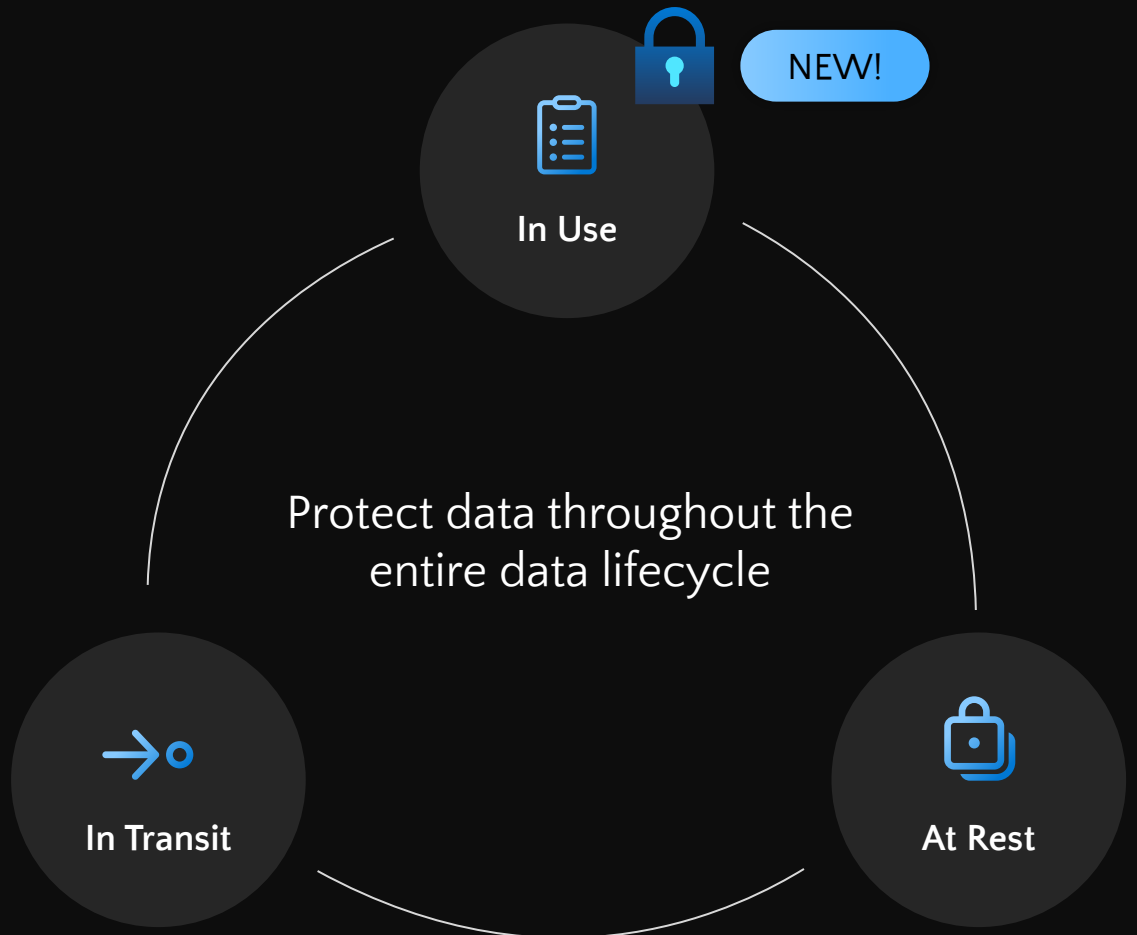
Monitoring & Optimization
Integration in a clinical workflow and model evaluation

Market validation & deployment requires computing on protected health information (PHI)

Getting access to PHI, if even possible, is time consuming (9-18mo) and costly!

[1]Fleuren, L., et al. (2020). Machine learning in intensive care medicine: ready for take-off? *Intensive Care Medicine*, *46*(7), 1486–1488. https://doi.org/10.1007/S00134-020-06045-Y

Azure Confidential Computing



Privacy

Migrate highly sensitive workloads to Azure

Unlock Value

Enable insights from multi-party data while maintaining data privacy

Be Compliant

Meet increasingly stringent privacy and security requirements

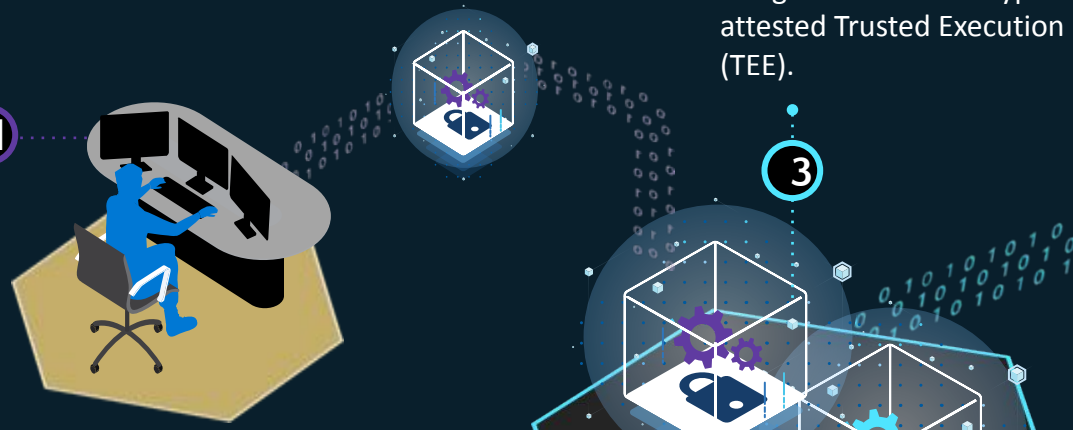
Trust and Verify

Data is processed only after the cloud environment is verified

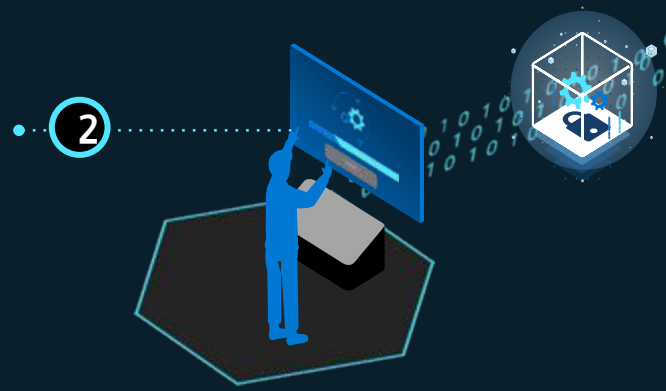
EscrowAI confidential workflow

US Patents #11,531,904 & #11,748,633 (confidential federation)

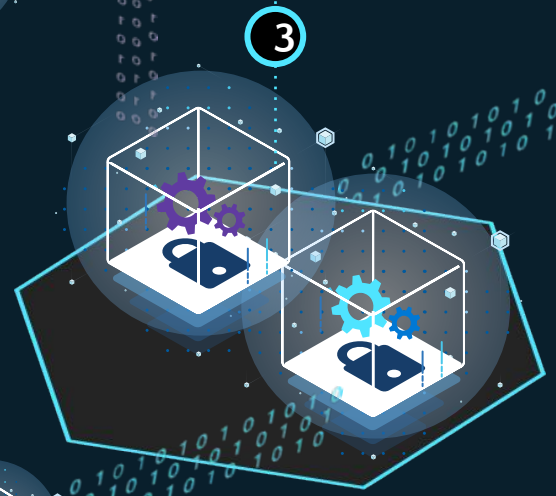
1. Model Developer submits an encrypted model to EscrowAI where it is wrapped in a secure computing container.



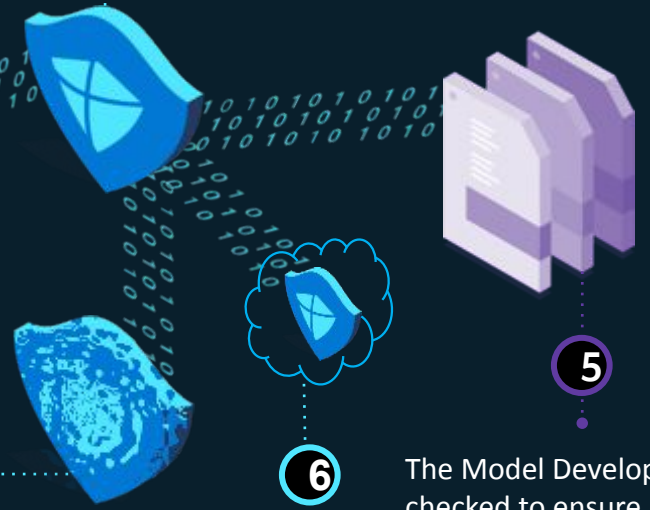
2. Data Steward curates a data set to the algorithm requirements, encrypts it, and uploads it to blob storage within their secure, HIPAA compliant cloud.



3. The model container moves into the Data Steward's secure cloud where it is merged with the encrypted data in an attested Trusted Execution Environment (TEE).



4. Within the (TEE), the data set and model are decrypted, the model runs, and a confidential performance report is created.



5. The Model Developer's report is checked to ensure no PHI leaves the computing enclave and is delivered.

6. If computing artifacts are required, they are moved into blob or cold storage.

7. If no additional runs are required, the enclave is decommissioned.

Microsoft

Thank you