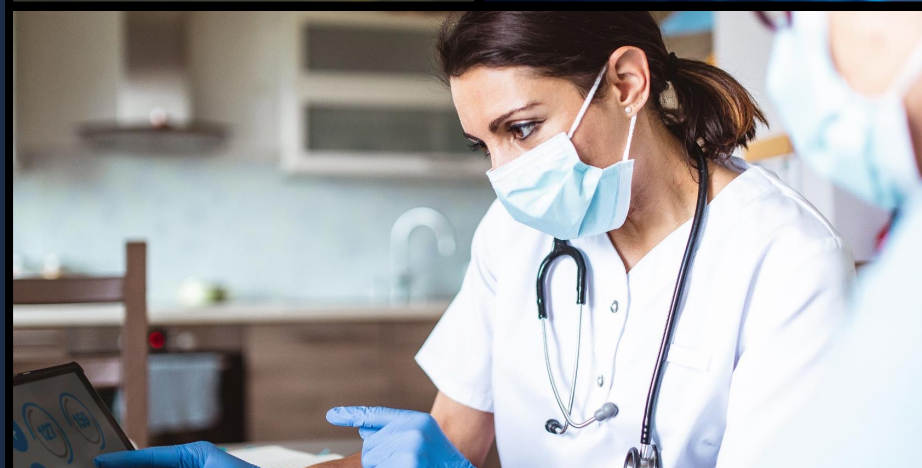
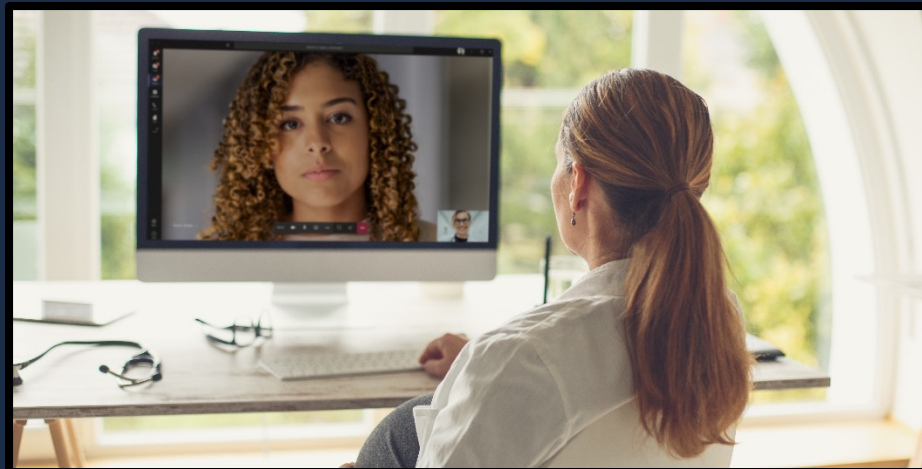




Artificial Intelligence in Health

CHIEFs

Peter Jones
Healthcare Industry Lead
Microsoft Canada



“AI is technology’s most important priority, and health care is its most urgent application”

Satya Nadella, Apr 2021



Microsoft

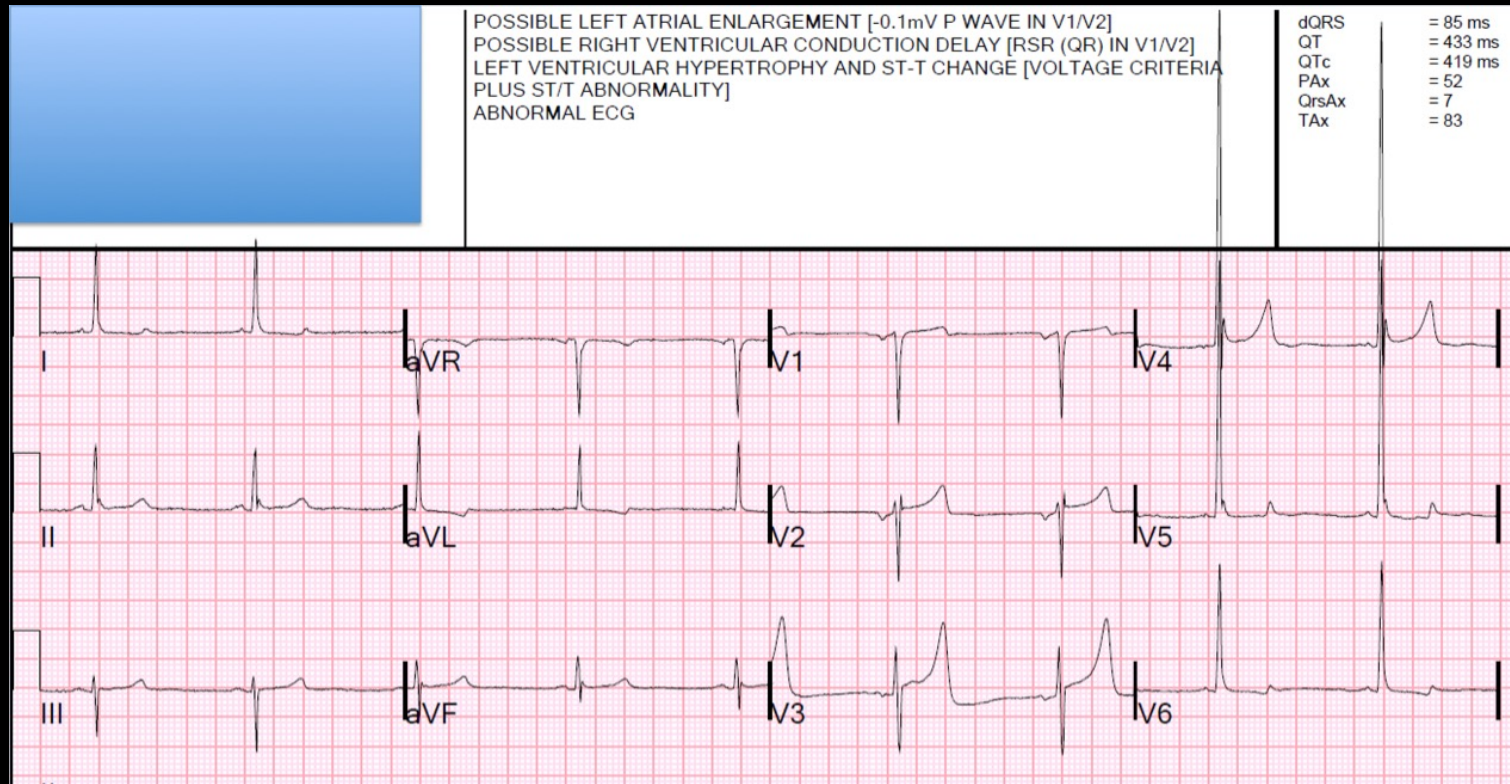


AI in popular culture

The Doctor, an **Emergency Medical Hologram Mark I** (or **EMH** for short), is a fictional character from the television series [Star Trek: Voyager](#), played by actor [Robert Picardo](#). He is an [artificial intelligence](#) manifesting as a [holographic projection](#), designed to act as a short-term supplement to the medical staff of a starship during emergency situations



AI has been in healthcare for decades



Automated ECG interpretation is the use of [artificial intelligence](#) and [pattern recognition software](#) and [knowledge bases](#) to carry out automatically the interpretation, test reporting, and [computer-aided diagnosis](#) of [electrocardiogram](#) tracings obtained usually from a [patient](#).

Epic and Microsoft

Satya Nadella at Epic UGM



Microsoft and Epic expand strategic collaboration with integration of Azure OpenAI Service

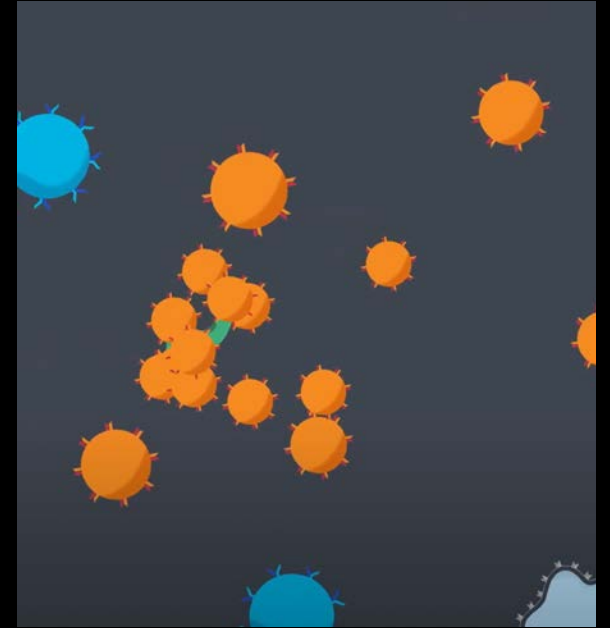
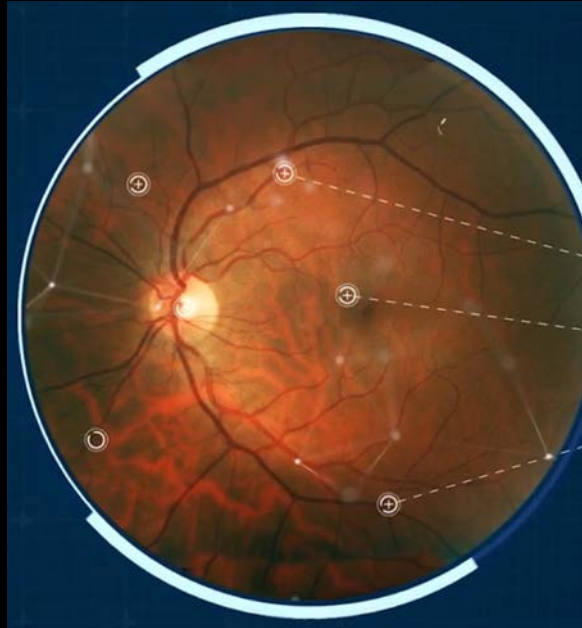
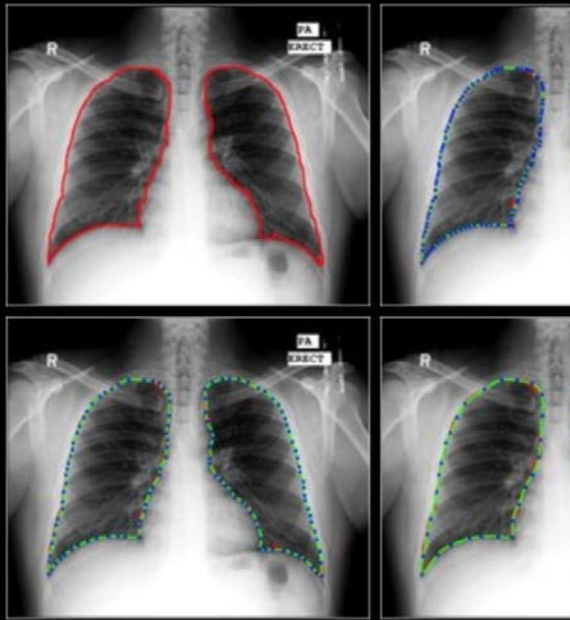
April 17, 2023 | Microsoft News Center



REDMOND, Wash., and VERONA, Wis. — April 17, 2023 — Microsoft Corp. and Epic on Monday announced they are expanding their long-standing strategic collaboration to develop and integrate generative AI into healthcare by combining the scale and power of Azure OpenAI Service¹ with Epic's industry-leading electronic health record (EHR) software. The collaboration expands the long-standing partnership, which includes enabling organizations to run Epic environments on the Microsoft Azure cloud platform.



Which medical disciplines will **change** first?



Radiology



Ophthalmology



Dermatology



Pathology

Going viral

Chat GPT has the **fastest global adoption** of any digital service in recorded history. By far

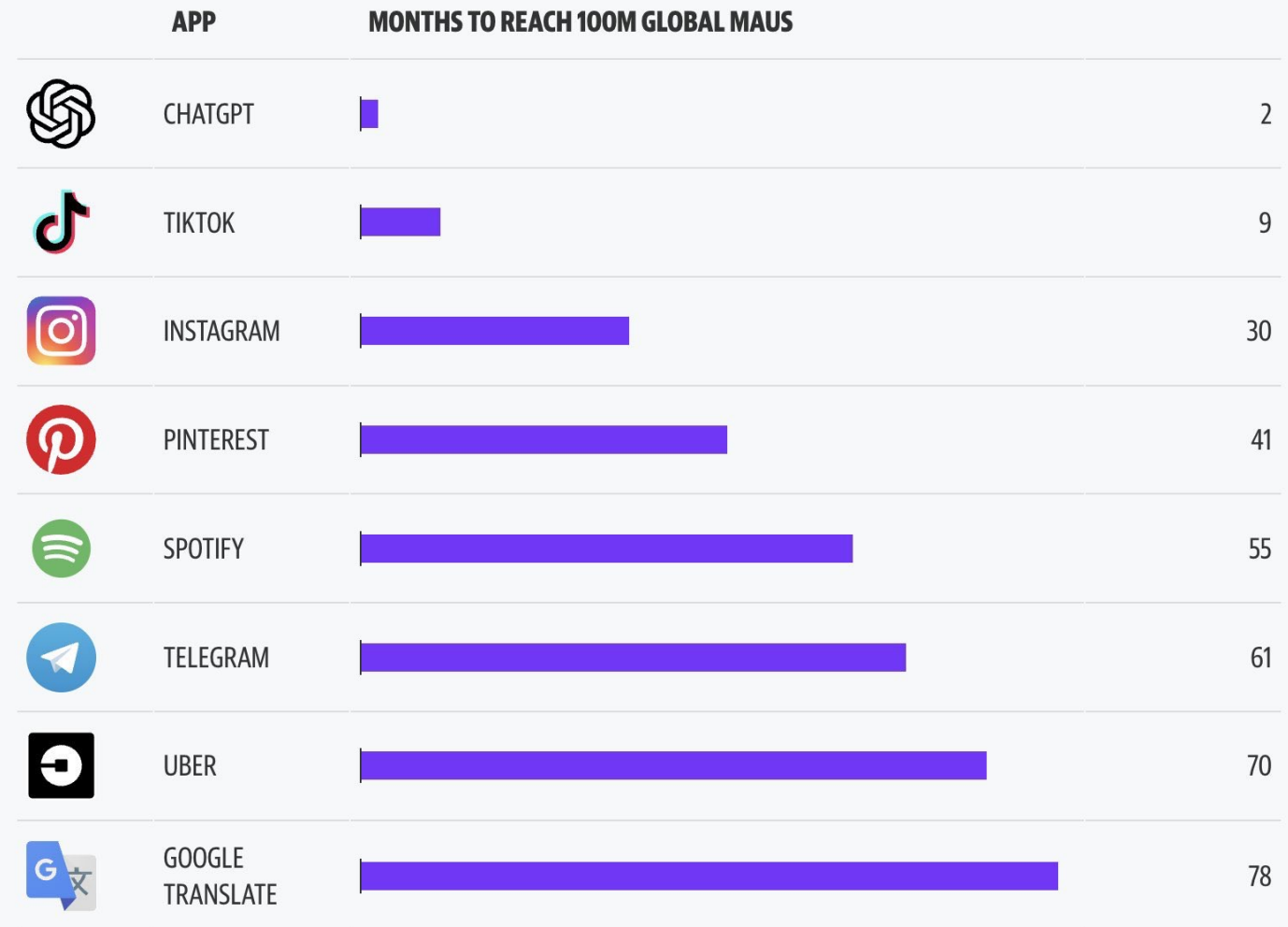
Fundamentally different to prior AI models that require laborious (and expensive) training to do a narrowly specific task

Can take **unstructured data in**, interpret it via a pre-trained Large Language Model, then provide structured insights as an output.

<https://finance.yahoo.com/news/chatgpt-on-track-to-surpass-100-million-users-faster-than-tiktok-or-instagram-ubs-214423357.html>

HOW LONG IT TOOK TOP APPS TO HIT 100M MONTHLY USERS

ChatGPT is estimated to have hit 100M users in January, 2 months after it's launch. Here's how long it took other top apps to reach that:



SOURCE: UBS

Artificial Intelligence

Machine Learning

Deep Learning

Generative AI



Artificial Intelligence

the field of computer science that seeks to create intelligent machines that can replicate or exceed human intelligence



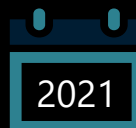
Machine Learning

subset of AI that enables machines to learn from existing data and improve upon that data to make decisions or predictions



Deep Learning

a machine learning technique in which layers of neural networks are used to process data and make decisions



Generative AI

Create new written, visual, and auditory content given prompts or existing data.

| Azure OpenAI | Top 4 Capabilities & Use Cases



Content Generation

Call Center Analytics: Automatically generate responses to customer inquiries

Generate personalised UI for your website



Summarization

Call Center Analytics: Summary of customer support conversation logs

Subject Matter Expert Document Summarization (e.g. financial reporting, analyst articles)

Social Media Trends Summarization



Code generation

Convert Natural Language to SQL (or vice versa) for telemetry data

Convert Natural Language to Query Proprietary Data Models

Code Documentation



Semantic Search

Search reviews for a specific product / service

Information Discovery and Knowledge Mining

Examples of Multiple Model Use Cases

End to End Call Center Analytics: Classification, Sentiment, Entity Extraction, Summarization and Email Generation

Customer 360: Hyper-personalisation using timely Summarization of customer queries & trends, Search, and Content Generation

Business Process Automation: Search through structured & unstructured documentation, Generate Code to query data models, Content Generation

Responsible AI built into Azure AI



Fairness

Assess fairness and mitigate fairness issues to build models for everyone.



Explainability

Understand model predictions by generating feature importance values for your mode.



Counterfactuals

Observe feature perturbations and find the closest datapoints with different model predictions.



Causal analysis

Estimate the effect of a feature on real-world outcomes.



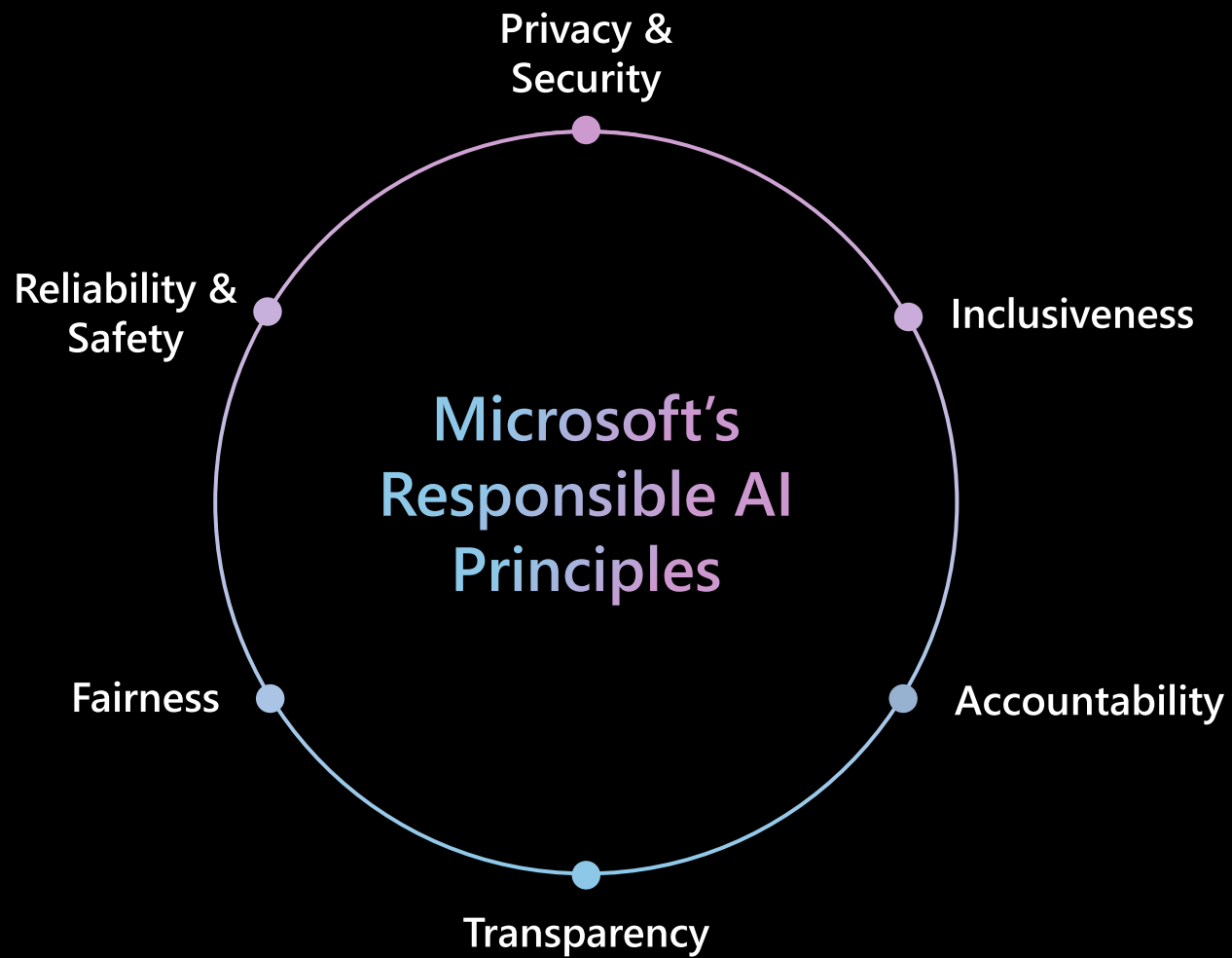
Error analysis

Identify dataset cohorts with high error rates and visualize error distribution in your model.



Responsible AI scorecard

Get a PDF summary of your Responsible AI insights to share with your technical and non-technical stakeholders to aid in compliance reviews.



Building blocks to enact principles



Tools and processes



Training and practices



Rules



Governance

A.I. TURNS THIS SINGLE
BULLET POINT INTO A
LONG EMAIL I CAN
PRETEND I WROTE.



A.I. MAKES A SINGLE
BULLET POINT OUT OF
THIS LONG EMAIL I CAN
PRETEND I READ.



TOM
FISH
BURNE

Autopilot

vs

Co-pilot



Clinical governance!
Ethical oversight!
Operational supervision!

Key Areas for AI in Healthcare

Clinical Analytics

Leverage Analytics to:

- Identify at-risk Patient and Improve clinical treatment
- Detect trends and predictors
- Enable precision medicine



Predictive care guidance



Behavioral analytics



Population health



Medical image intelligence



Telehealth

Compliance Analytics

Leverage Analytics to:

- Increase operational effectiveness
- Increase Patient Satisfaction
- Manage regulatory risks



Rules-based monitoring



Anomaly detection



Network analysis



Text analysis



Visual analytics

Cost-Based Analytics

Leverage Analytics to:

- Increase operational effectiveness
- Optimize expensive resources
- Modernize supply chain



Readmissions management



Cost management



Staffing management



Throughput management



Claims management

Operational Analytics

Leverage Analytics to:

- Increase operational effectiveness
- Optimize expensive resources
- Modernize supply chain



Forecast patient volumes



Decrease costs



Reduce length of stay

Era of Copilots



Microsoft 365



Viva Sales Insights



GitHub



Security



Dynamics



Bing



Power Platform

Azure AI

Scenario-Based Services

Applied AI Services



Bot Service



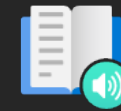
Cognitive Search



Form Recognizer



Metrics Advisor



Immersive Reader



Video Indexer

Customizable AI Models

Cognitive Services



Vision



Speech



Language



Decision

ML Platform



Azure Machine Learning



Microsoft 365 Copilot

**Copilot
in Word**

Write, edit,
summarize,
and create

**Copilot in
Excel**

Analyze &
explore
your data

**Copilot in
PowerPoint**

Turn ideas
into stunning
presentations

**Copilot in
Outlook**

Clean up
your inbox
& messages

**Copilot in
Teams**

Run more
effective
meetings

Consumer GPT services vs. Enterprise GPT services

- Free (or paid)
- Uses cost-effective models
- Data over the public internet
- Feedback reinforcement
- No citations (response accuracy)
- Many cannot be “fine tuned”

- Paid service
- Choose your model (incl GPT-4)
- Service runs in your secure tenant
- Your data remains yours
- Responses can be grounded in data
- “Fine-tuning” with your extensions

Convert medical shorthand to a clinical note

- John Brown, 73 M
- Sx: CPOE and SOBOE 3/12 typical
- PMHx:
- STEMI 2002. PCI LAD HREF.
- CKD
- CVA
- AF on NOAC
- MEDS bicor, aspirin, statin, rivaroxaban, entresto
- OE
- Well, BMI+ ECG NSR 80. BP 120/75
- JVPNR. Nil pedal edema. HSDNM. Chest clear.
- Imp
- Stable.
- Plan
- Lifestyle. Diet. GP f/u. PHT clinic because why not

John Brown, a 73-year-old male, presented with symptoms of chest pain on exertion and shortness of breath on exertion for the past three months, typical of angina. His past medical history included ST-segment elevation myocardial infarction in 2002, for which he underwent percutaneous coronary intervention of the left anterior descending artery with high residual stenosis. He also had chronic kidney disease, cerebrovascular accident, and atrial fibrillation on non-vitamin K antagonist oral anticoagulant. His medications were bisoprolol, aspirin, statin, rivaroxaban, and sacubitril/valsartan. On examination, he appeared well, with a high body mass index. His electrocardiogram showed normal sinus rhythm at 80 beats per minute. His blood pressure was 120/75 mmHg. His jugular venous pressure was not raised. He had no pedal edema. His heart sounds were normal and no murmurs were detected. His chest was clear. The impression was that he was stable. The plan was to advise him on lifestyle modifications and diet, follow up with his general practitioner, and refer him to the pulmonary hypertension clinic for further evaluation.

Convert medical shorthand to a structured clinical note

- John Brown, 73 M
- Sx: CPOE and SOBOE 3/12 typical
- PMHx:
- STEMI 2002. PCI LAD HREF.
- CKD
- CVA
- AF on NOAC
- MEDS bicor, aspirin, statin, rivaroxaban, entresto
- OE
- Well, BMI+ ECG NSR 80. BP 120/75
- JVPNR. Nil pedal edema. HSDNM. Chest clear.
- Imp
- Stable.
- Plan
- Lifestyle. Diet. GP f/u. PHT clinic because why not

Patient: John Brown, 73-year-old male

Symptoms: Chest pain on exertion and shortness of breath on exertion for 3 months, typical of angina

Past medical history:

- ST-segment elevation myocardial infarction in 2002. Percutaneous coronary intervention to left anterior descending artery with high residual ejection fraction
- Chronic kidney disease
- Cerebrovascular accident
- Atrial fibrillation on non-vitamin K antagonist oral anticoagulant

Medications:

- Bisoprolol (beta-blocker)
- Aspirin (antiplatelet)
- Statin (lipid-lowering)
- Rivaroxaban (anticoagulant)
- Entresto (angiotensin receptor-neprilysin inhibitor)

Objective examination:

- Well-appearing, overweight. Electrocardiogram shows normal sinus rhythm at 80 beats per minute. Blood pressure 120/75 mmHg
- Jugular venous pressure not raised. No pedal edema. Heart sounds normal, no murmurs. Chest clear.

Impression:

- Stable angina

Plan:

- Lifestyle modification. Dietary advice. Follow-up with general practitioner. Refer to pulmonary hypertension clinic for further evaluation.

Convert clinical note to a referral letter

John Brown, a 73-year-old male, presented with symptoms of chest pain on exertion and shortness of breath on exertion for the past three months, typical of angina. His past medical history included ST-segment elevation myocardial infarction in 2002, for which he underwent percutaneous coronary intervention of the left anterior descending artery with high residual stenosis. He also had chronic kidney disease, cerebrovascular accident, and atrial fibrillation on non-vitamin K antagonist oral anticoagulant. His medications were bisoprolol, aspirin, statin, rivaroxaban, and sacubitril/valsartan. On examination, he appeared well, with a high body mass index. His electrocardiogram showed normal sinus rhythm at 80 beats per minute. His blood pressure was 120/75 mmHg. His jugular venous pressure was not raised. He had no pedal edema. His heart sounds were normal and no murmurs were detected. His chest was clear. The impression was that he was stable. The plan was to advise him on lifestyle modifications and diet, follow up with his general practitioner, and refer him to the pulmonary hypertension clinic for further evaluation.

Dear Dr. Alfred Wong,

I am writing to refer John Brown, a 73-year-old male, to your care. Mr. Brown has presented with symptoms of chest pain on exertion and shortness of breath on exertion for the past three months, typical of angina. His past medical history includes a ST-segment elevation myocardial infarction in 2002, for which he underwent percutaneous coronary intervention of the left anterior descending artery with high residual fractional flow reserve. He also has chronic kidney disease, a cerebrovascular accident, and atrial fibrillation on a novel oral anticoagulant. His medications are bisoprolol, aspirin, a statin, rivaroxaban, and sacubitril/valsartan. On examination, he appears well, with a high body mass index. His electrocardiogram showed normal sinus rhythm at 80 beats per minute. His blood pressure was 120/75 mmHg. His jugular venous pressure was not raised. He had no pedal edema. His heart sounds were normal, with no murmurs. His chest was clear. The impression was that he was stable.

I have advised Mr. Brown on lifestyle modifications and diet, and he will follow up with his general practitioner. I am referring him to your pulmonary hypertension clinic for further evaluation.

Sincerely,

Dr. Simon Smith

Mark up SNOMED Terms and billing codes

John Brown, a 73-year-old male, presented with symptoms of chest pain on exertion and shortness of breath on exertion for the past three months, typical of angina. His past medical history included ST-segment elevation myocardial infarction in 2002, for which he underwent percutaneous coronary intervention of the left anterior descending artery with high residual stenosis. He also had chronic kidney disease, cerebrovascular accident, and atrial fibrillation on non-vitamin K antagonist oral anticoagulant. His medications were bisoprolol, aspirin, statin, rivaroxaban, and sacubitril/valsartan. On examination, he appeared well, with a high body mass index. His electrocardiogram showed normal sinus rhythm at 80 beats per minute. His blood pressure was 120/75 mmHg. His jugular venous pressure was not raised. He had no pedal edema. His heart sounds were normal and no murmurs were detected. His chest was clear. The impression was that he was stable. The plan was to advise him on lifestyle modifications and diet, follow up with his general practitioner, and refer him to the pulmonary hypertension clinic for further evaluation.

SNOMED-CT terms:

- Chest pain on exertion: 29857009
- Shortness of breath on exertion: 230145002
- Angina: 194828000
- ST-segment elevation myocardial infarction: 22298006
- Percutaneous coronary intervention: 415070008
- Left anterior descending artery: 45723007
- High residual ejection fraction: 276361009
- Chronic kidney disease: 709044004
- Cerebrovascular accident: 230690007
- Atrial fibrillation: 49436004
- Novel oral anticoagulant: 722912003
- Bisoprolol: 387517004
- Aspirin: 387458008
- Statin: 408908000
- Rivaroxaban: 428357008
- Sacubitril/valsartan: 731018008
- High body mass index: 238131007
- Electrocardiogram: 163030003
- Normal sinus rhythm: 251168008
- Blood pressure: 163030003
- Jugular venous pressure: 250020007
- Pedal edema: 434912009
- Heart sounds: 271594007
- Murmurs: 3415004
- Pulmonary hypertension: 70995007

Suggested billing codes:

- ICD-10-CM: I20.9 (Angina pectoris, unspecified)
- CPT: 99214 (Office or other outpatient visit for the evaluation and management of an established patient)

Convert to a FHIR message

Dear Dr. Alfred Wong,

I am writing to refer John Brown, a 73-year-old male, to your care. Mr. Brown has presented with symptoms of chest pain on exertion and shortness of breath on exertion for the past three months, typical of angina. His past medical history includes a ST-segment elevation myocardial infarction in 2002, for which he underwent percutaneous coronary intervention of the left anterior descending artery with high residual fractional flow reserve. He also has chronic kidney disease, a cerebrovascular accident, and atrial fibrillation on a novel oral anticoagulant. His medications are bisoprolol, aspirin, a statin, rivaroxaban, and sacubitril/valsartan. On examination, he appears well, with a high body mass index. His electrocardiogram showed normal sinus rhythm at 80 beats per minute. His blood pressure was 120/75 mmHg. His jugular venous pressure was not raised. He had no pedal edema. His heart sounds were normal, with no murmurs. His chest was clear. The impression was that he was stable.

I have advised Mr. Brown on lifestyle modifications and diet, and he will follow up with his general practitioner. I am referring him to your pulmonary hypertension clinic for further evaluation.

Sincerely,

Dr. Simon Smith

FHIR Message:

```
{
  "resourceType": "ReferralRequest",
  "status": "active",
  "intent": "order",
  "type": {
    "coding": [
      {
        "system": "http://snomed.info/sct",
        "code": "359615001",
        "display": "Referral to cardiology service"
      }
    ]
  },
  "subject": {
    "reference": "Patient/John Brown",
    "display": "John Brown"
  },
  "requester": {
    "agent": {
      "reference": "Practitioner/Simon Smith",
      "display": "Dr. Simon Smith"
    }
  },
  "recipient": [
    {
      "reference": "Practitioner/Alfred Wong",
      "display": "Dr. Alfred Wong"
    }
  ],
  "reasonCode": [
    {
      "coding": [
        {
          "system": "http://snomed.info/sct",
          "code": "195967001",
          "display": "Chest pain"
        },
        {
          "system": "http://snomed.info/sct",
          "code": "267036007",
          "display": "Shortness of breath"
        }
      ]
    }
  ],
  "description": "I am writing to refer John Brown, a 73-year-old male, to your care. Mr. Brown has presented with symptoms of chest pain on exertion and shortness of breath on exertion for the past three months, typical of angina. His past medical history includes a ST-segment elevation myocardial infarction in 2002, for which he underwent percutaneous coronary intervention of the left anterior descending artery with high residual fractional flow reserve. He also has chronic kidney disease, a cerebrovascular accident, and atrial fibrillation on a novel oral anticoagulant. His medications are bisoprolol, aspirin, a statin, rivaroxaban, and sacubitril/valsartan. On examination, he appears well, with a high body mass index. His electrocardiogram showed normal sinus rhythm at 80 beats per minute. His blood pressure was 120/75 mmHg. His jugular venous pressure was not raised. He had no pedal edema. His heart sounds were normal, with no murmurs. His chest was clear. The impression was that he was stable. I have advised Mr. Brown on lifestyle modifications and diet, and he will follow up with his general practitioner. I am referring him to your pulmonary hypertension clinic for further evaluation."
}
```

Thank you