Think Big, Start Small, Move Fast: A Blueprint for Innovation

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MAYO CLINIC

Education *Research* *Practice*

MAYO CLINIC'S MISSION

For More Than 150 Years

"The best interest of the patient is the only interest to be considered, and in order that the sick may have the benefit of advancing knowledge, ***a union of forces*** *is necessary."*

William J. Mayo, MD
1910 Commencement Address, Rush Medical College

THE NEEDS OF THE PATIENT COME FIRST
Primary Value

STRATEGIC STATEMENTS of MAYO CLINIC

Primary Value

The needs of the patient come first

Mission

To inspire hope and contribute to **health and wellbeing**
by providing the best care to every patient through integrated clinical practice, education and research

Vision

Mayo Clinic will provide an **unparalleled experience** as the most trusted partner for health care

Core Business

Create, connect and apply integrated **knowledge to deliver**
the best health care, health guidance and health information

MAYO CLINIC
A Model of Care

- A team of experts focused on one patient at a time
- Integrated clinical practice, education and research
- Living values of collaboration, compassion, and innovation
- Delivering patient care with respect, quality, and excellence

Mayo Clinic
Our Characteristics

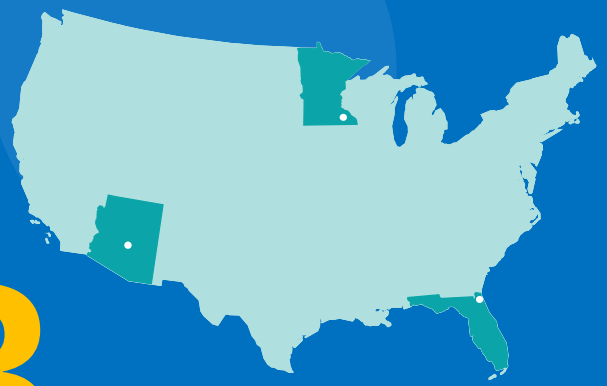
- Integrated, academic group practice
- Not-for-profit
- Salaried physicians
- Consensus decision making
- Physician led
- Leadership term limits

58,405
ADMINISTRATIVE & ALLIED HEALTH STAFF

4,729
PHYSICIANS & SCIENTISTS

5
SCHOOLS

1.3 M
UNIQUE PATIENTS FROM EVERY STATE & 135 COUNTRIES



3 PRIMARY LOCATIONS

MAYO CLINIC HEALTH SYSTEM

A system of owned clinics & hospitals in 70 communities across 3 states

MAYO CLINIC CARE NETWORK

A medical alliance of independent health care organizations collaborating with Mayo Clinic to better serve patients

U.S. News 2019-20 Best Hospitals Honor Roll

1. **Mayo Clinic**, Rochester, Minnesota
2. **Massachusetts General Hospital**
3. **Johns Hopkins Hospital**
4. **Cleveland Clinic**
5. **New York-Presbyterian Hospital-Columbia and Cornell**
6. **UCLA Medical Center**
7. **UCSF Medical Center**
8. **Cedars-Sinai Medical Center**
9. **NYU Langone Hospitals**
10. **Northwestern Memorial Hospital**

Mayo Innovation

1905: First method of freezing tissue during surgery as a means of diagnosing cancer
1915: First program in graduate-medical education
1919: First not-for-profit practice aligned with medical education and research
1920: First index to grade tumors
1935: First hospital-based blood bank
1940s: First aero-medical unit to transform aviation
1950: Nobel Prize for discovery of cortisone
1955: First series of operations with heart-lung bypass machine
1969: First FDA-approved hip joint replacement
1973: First CT scanner in North America
2001: In response to the September 11 terrorist attacks, development of a rapid diagnosis procedure to detect antrax poisoning
2002: First multisite comprehensive cancer center in the United States

WHY DO WE NEED TO CONTINUE TO INNOVATE?

Everything is changing!

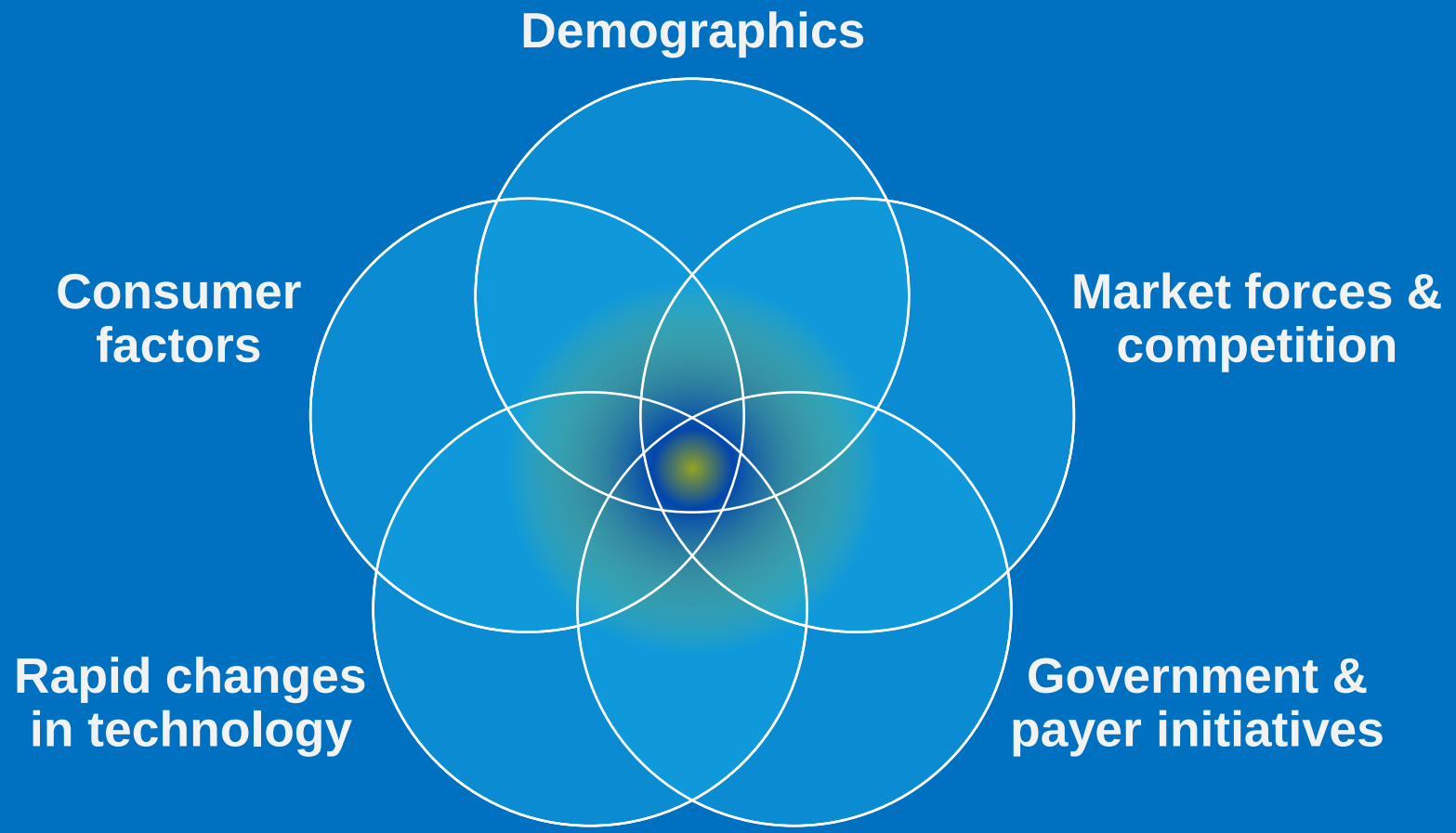
“ TODAY THE ONLY THING THAT IS PERMANENT IS CHANGE. ”

Dr. Charles H. Mayo, 1931

The ‘VUCA’ World

Volatile, Uncertain, Complex, Ambiguous

Environmental Scan



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It is not the strongest of the species that survive, nor the most intelligent, but the **ones most responsive to change.**

Innovation!

Charles Darwin

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Who are the INNOVATORS?

- Innovators question, observe, experiment and network more than typical executives
  - They actively desire to change the status quo
  - They display courage and regularly take risks to make that change happen
- Our ability to think creatively comes one-third from genetics; two-thirds through learning

The Innovator's DNA: Harvard Business Review

"The nature of innovation – the inherent definition of innovation – has changed…It's no longer individuals toiling in a laboratory, coming up with some great invention….

It's not an individual….It's multidisciplinary. It's global. It's collaborative."

Sam Palmisano, Former CEO, IBM

“Innovation that works is a disciplined process. The real frontier is to not think of it as just a creative exercise, but to think about it as being disciplined in using the right methods.”

Larry Keeley

“Innovation simply isn’t as unpredictable as many people think. There isn’t a cookbook yet, but we’re getting there.”

Clayton Christensen

Innovation is a Discipline

Defer judgment

Move from centralized entities to distributed networks

Move from financial

Encourage wild ideas

Stay focused on the topic

Build on the ideas of others

One conversation at a time

Be visual

Go for quantity

Focus on capabilities (not just needs)

SUSTAINING INNOVATION

Evolutionary, incremental, linear, or non-disruptive innovation…
improves something that already exists

MAYO CLINIC

DISRUPTIVE INNOVATION

Radical, revolutionary, transformational…. disrupt systems, create new markets, deliver new opportunities

Sustaining

Doing what we do today, better

Comfort Zone

Spectrum of INNOVATION

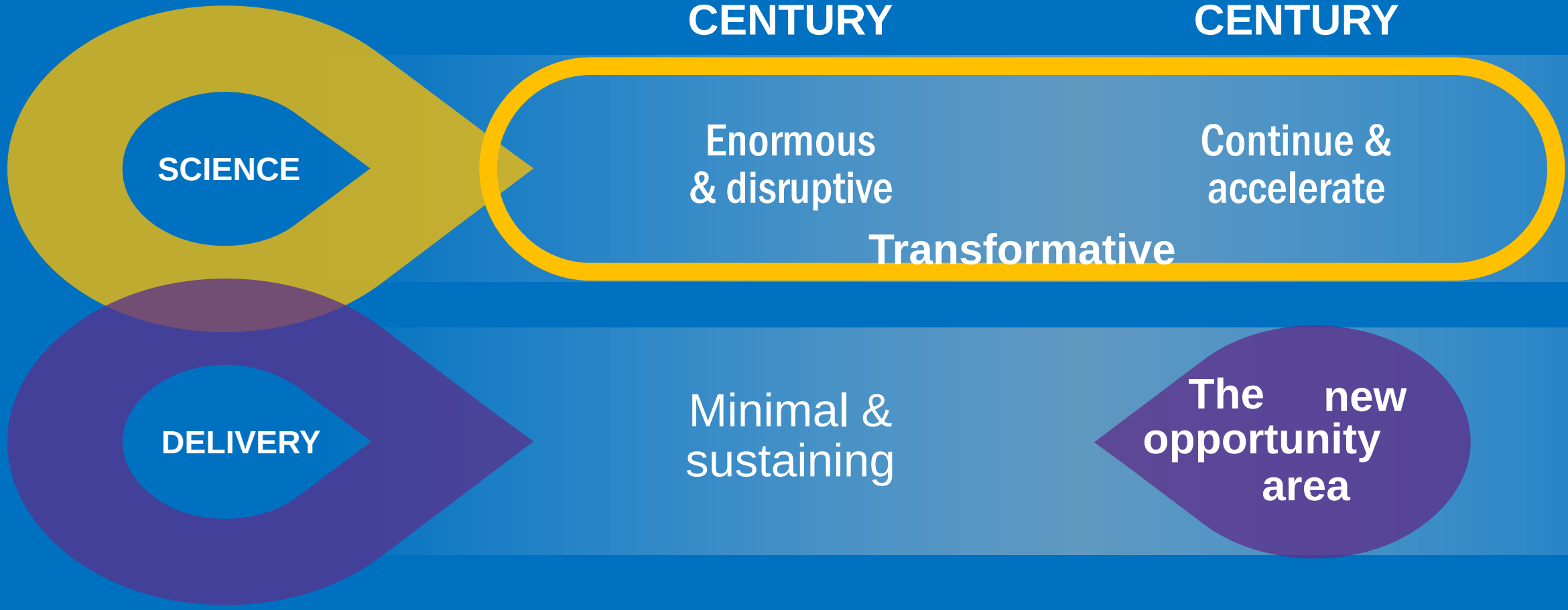
Disruptive

Developing what we will be doing tomorrow

Risk Taking

Center for Innovation

Health Care



Center for Innovation

Mission – CENTER FOR INNOVATION

Transforming the **delivery** and **experience** of health and health care

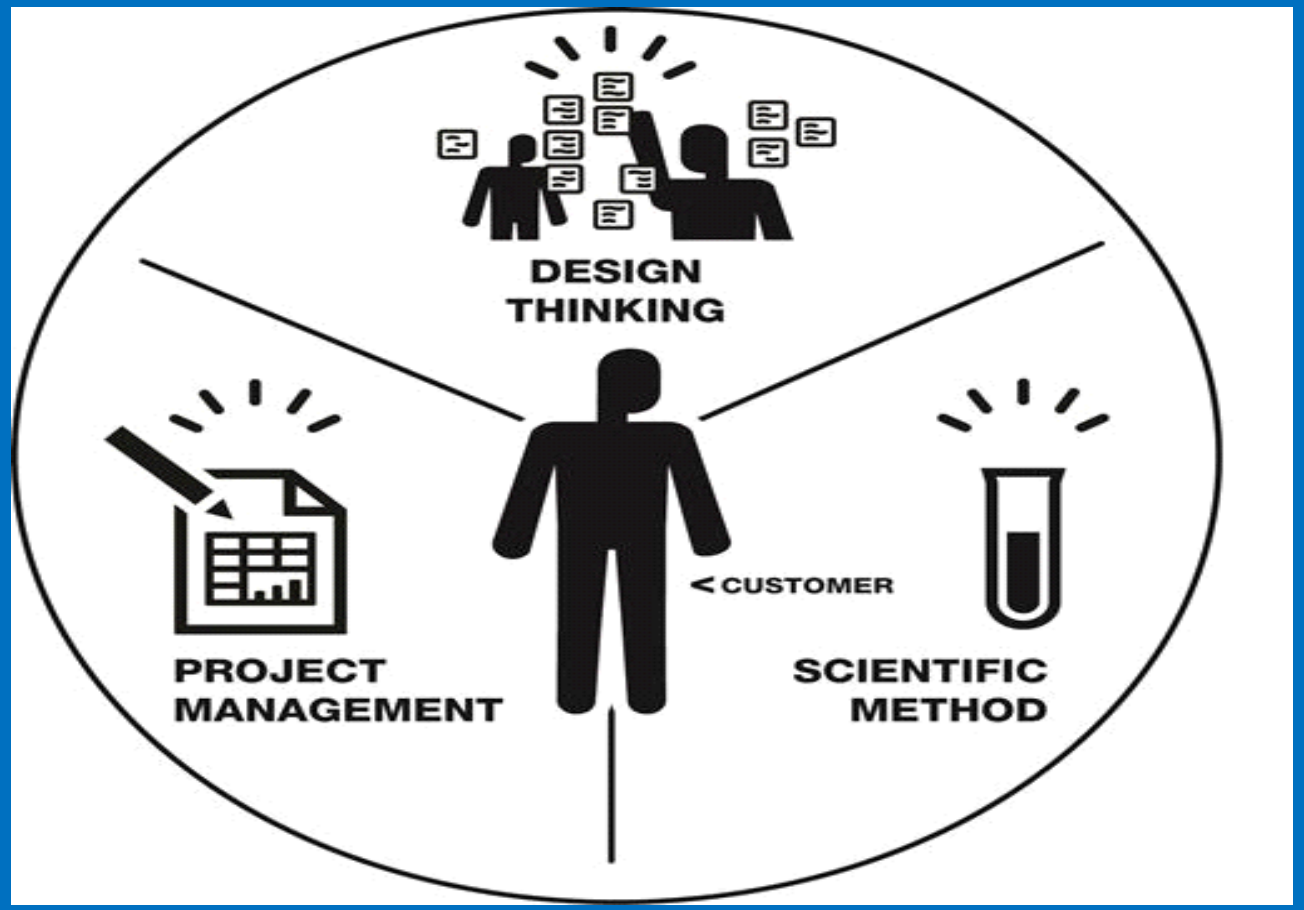
Definition of Innovation

Thinking Differently

"...innovation requires focus and a lot of disciplines."

Steve Jobs

Mayo Model of Innovation



Lessons ~~Learned~~ Learning about Innovation

- Build a **Discipline of Innovation**
- Recruit a **Diverse Team**
- Embrace **Design Thinking, Creativity** and **Experimentation**
- **Co-Create** with your **Customers** and **Stakeholders**
- Organize around **Big Idea Platforms**
- **Collaborate** **inside and outside**

LaRusso, Spurrier, Farrugia…Think Big, Start Small, Move Fast

DISRUPTION!

Social Disruptors

- Explosion of world-wide middleclass
- Consumer control of data – health and health care at home
- Globalization of health care delivery across borders
- Online education for more people & taught by physicians
- Job displacement from automation/machine-based learning
- Physician burnout

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Medical Disruptors

- Robotics – miniaturization, aiding complicated or repetitive tasks
- Nanomedicine
- Bioelectronics – implants for monitoring, event prediction and treatment
- CRISPR gene editing
- Epigenetics – altering gene expression
- Regenerative medicine – altering stem cell signaling
- Portable medical imaging – digital, easy to use

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Company Disruptors

- Amazon – Web services, health at home services, drug/supply delivery
- Apple – Medical records, device based care, employer-based care
- Google Health
- Microsoft – Cloud computing
- Aetna-CVS – Merger of financing and delivery at large scale
- Walmart and partners
- Start-ups focusing on single conditions
- IBM-Watson Healthcare

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Artificial Intelligence!

The [illegible] of all?

Some Definitions

- Artificial Intelligence---automation of activities we associate with human thinking (e.g., decision making, problem solving, learning)

- Machine Learning---algorithms that allow computer programs to automatically improve through experience

- Natural Language Processing---the ability of computers to read and understand written or spoken language

Good News

- AI will add $13 trillion to global economy over next decade
- AI will transform every industry

Bad News

- 92% of firms not engaged in core practices that support wide spread adoption

Why progress slow?

- View AI as plug and play technology with immediate returns
- Difficulty moving from pilots to companywide programs
- Think too narrowly about AI requirements

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AI

The "What's"

(Strategies)

- Go from siloed work to interdisciplinary collaborations
- Move from experience-based, leader-driven decision making to data-driven decision making at front line
- Move from rigid and risk-averse to agile, experimental, and adaptable

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AI

The "How's"

(Tactics)

- Explain why (compelling story)
- Anticipate unique barriers to change
- Budget as much for integration and adoption as for technology (if not more)
- Balance feasibility, time investment, and value
- Organize for scale
- The hub and spokes model

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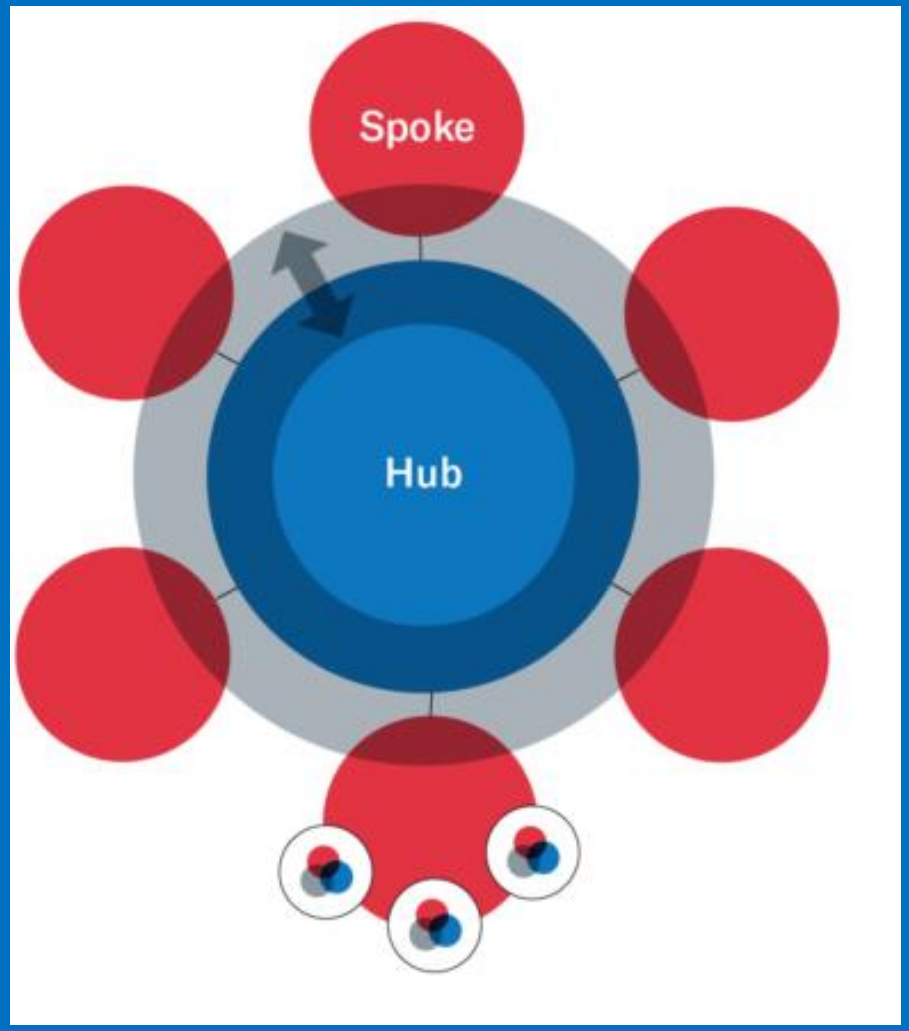
GOVERNING COALITION



Hub
A central group headed by a C-level analytics executive who aligns strategy

Spoke
A business unit, function, or geography, which assigns a manager to be the AI production owner and a business analyst to assist him or her

Gray area
Work that could be owned by the hub or spokes or shared with IT

Execution teams
Assembled from the hub, spoke, and gray area for the duration of the project

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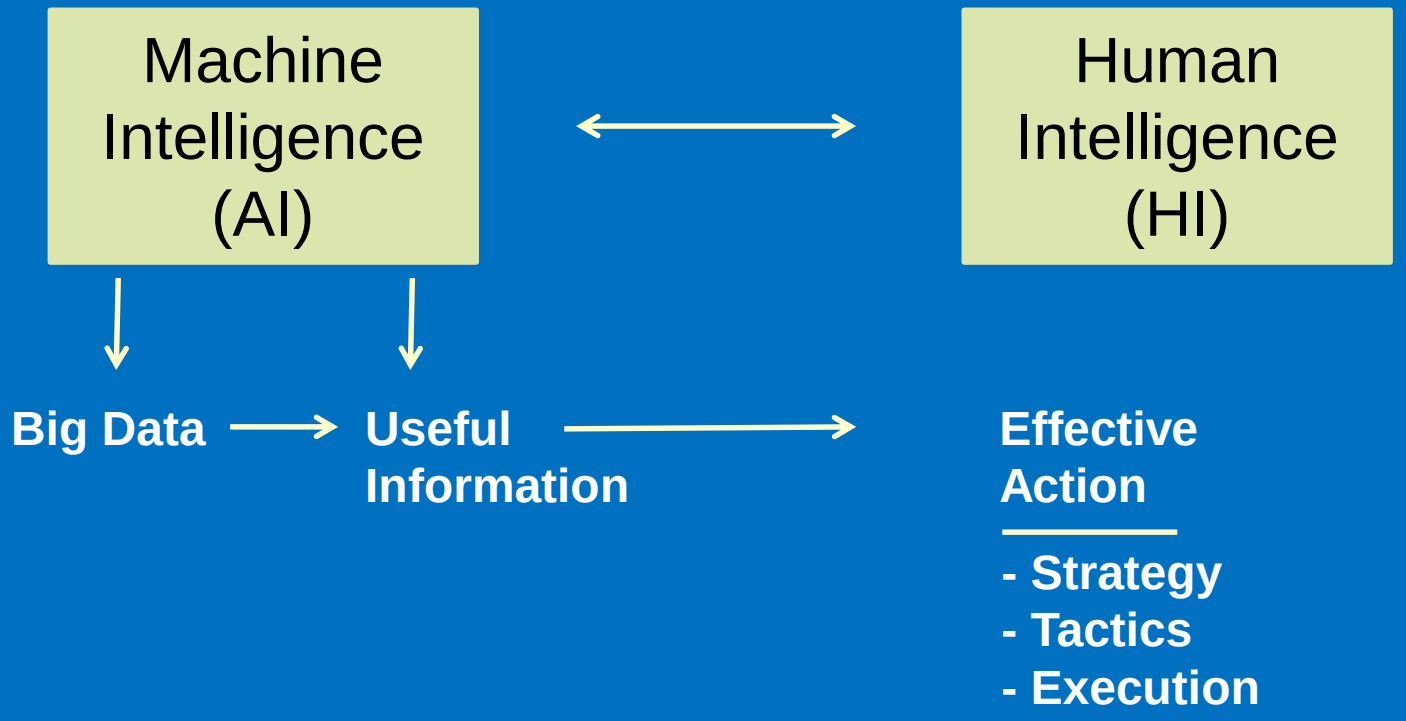
A CONCEPTUAL FRAMEWORK



LaRusso…unpublished

The conceptual framework operationalized

LETTERS | FOCUS
https://doi.org/10.1038/s41591-018-0240-2
nature medicine

Screening for cardiac contractile dysfunction using an artificial intelligence–enabled electrocardiogram

Application of AI to the ECG-a ubiquitous, low-cost test-permits the ECG to serve as a powerful screening tool in asymptomatic individuals to identify ALVD.

Abstr
Asymp and
longev e
tested eart's
electri on (a
measure of contractile function), from 44,999 patients at the Mayo Clinic, we trained a convolutional neural network to identify patients with ventricular dysfunction, defined as ejection fraction ≤35%, using the ECG data alone. When tested on an independent set of 52,870 patients, the network model yielded values for the area under the curve, sensitivity, specificity, and accuracy of 0.93, 86.3%, 85.7%, and 85.7%, respectively. In patients without ventricular dysfunction, those with a positive AI screen were at 4 times the risk (hazard ratio, 4.1; 95% confidence interval, 3.3 to 5.0) of developing future ventricular dysfunction compared with those with a negative screen. Application of AI to the ECG-a ubiquitous, low-cost test-permits the ECG to serve as a powerful screening tool in asymptomatic individuals to identify ALVD.

THE LANCET

Articles

An artificial intelligence-enabled ECG algorithm for the identification of patients with atrial fibrillation during sinus rhythm: a retrospective analysis of outcome prediction

Zachi I Attia, Peter A Noseworthy*, Francisco Lopez-Jimenez, Samuel J Asirvatham, Abhishek J Deshmukh, Bernard J Gersh, Rickey E Carter, Xiaoxi Yao, Alejandro A Rabinstein, Brad J Erickson, Suraj Kapa, Paul A Friedman*

Summary

Background Atrial fibrillation is frequently asymptomatic and thus underdetected but is associated with stroke, heart failure, and death. Existing screening methods require prolonged monitoring and are limited by cost and low yield. We aimed to develop a rapid, inexpensive, point-of-care means of identifying patients with atrial fibrillation using machine learning.

fibrillation with an AUC of 0·87 (95% CI 0·86–0·88), sensitivity of 79·0% (77·5–80·4), specificity of 79·5% (79·0–79·9), F1 score of 39·2% (38·1–40·3), and overall accuracy of 79·4% (79·0–79·9). Including all ECGs acquired during the first month of each patient's window of interest (ie, the study start date or 31 days before the first recorded atrial fibrillation ECG) increased the AUC to 0·90 (0·90–0·91), sensitivity to 82·3% (80·9–83·6), specificity to 83·4% (83·0–83·8), F1 score to 45·4% (44·2–46·5), and overall accuracy to 83·3% (83·0–83·7).

Interpretation An AI-enabled ECG acquired during normal sinus rhythm permits identification at point of care of individuals with atrial fibrillation.

Interpretation: An AI-enabled ECG acquired during normal sinus rhythm permits identification at point of care of individuals with atrial fibrillation.

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J Digit Imaging (2017) 30:469–476
DOI 10.1007/s10278-017-9984-3

CrossMark

Predicting Deletion of Chromosomal Arms 1p/19q in Low-Grade Gliomas from MR Images Using Machine Intelligence

Multi-scale CNN with their self-learning capability provides promising results for predicting 1p/19q status non-invasively based on T1C and T2 images.

Abstra
Severa
longer
the 1p
and his
status
codele
data was balanced for equal class probability and was then augmented with iterations of random translational shift, rotation, and horizontal and vertical flips to increase the size of the training set. We shuffled and augmented the training data to counter overfitting in each epoch. Finally, we evaluated several configurations of a multi-scale CNN architecture until training and validation accuracies became consistent. The results of the best performing configuration on the unseen test set were 93.3% (sensitivity), 82.22% (specificity), and 87.7% (accuracy). Multi-scale CNN with their self-learning capability provides promising results for predicting 1p/19q status non-invasively based on T1C and T2 images. Predicting 1p/19q status non-invasively from MR images would allow selecting effective treatment strategies for LGG patients without the need for surgical biopsy.

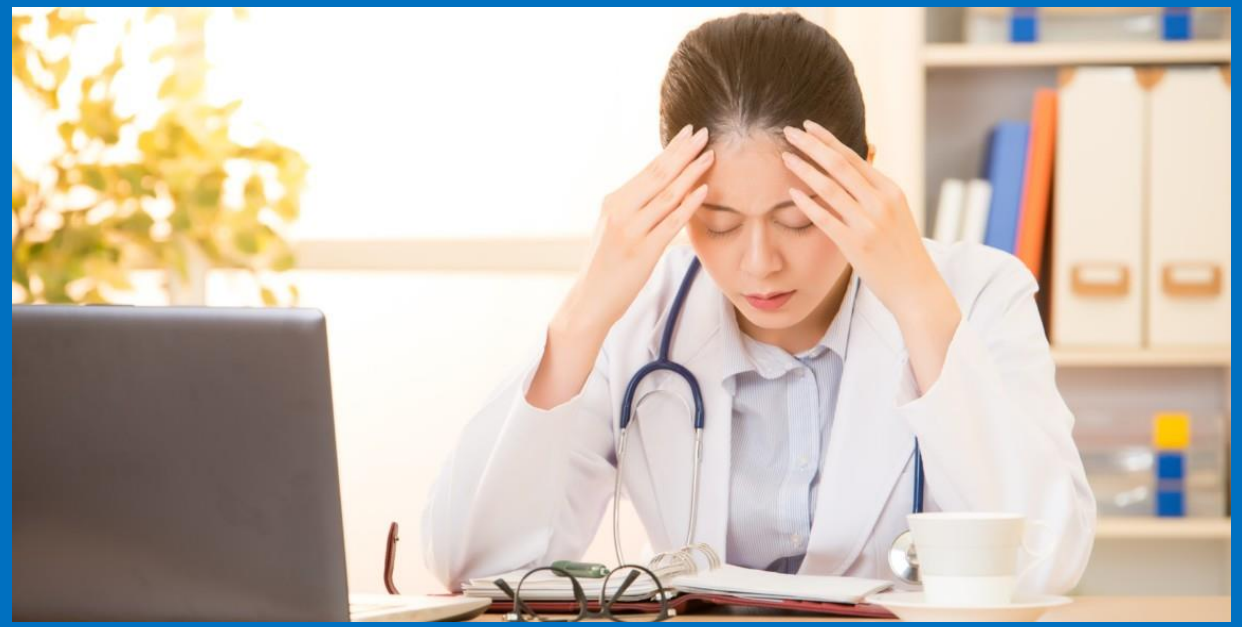
Operative report

Medications

Surgical pathology report

Genomics

Diagnostic core needle biopsy



Mammogram, US, MRI reports

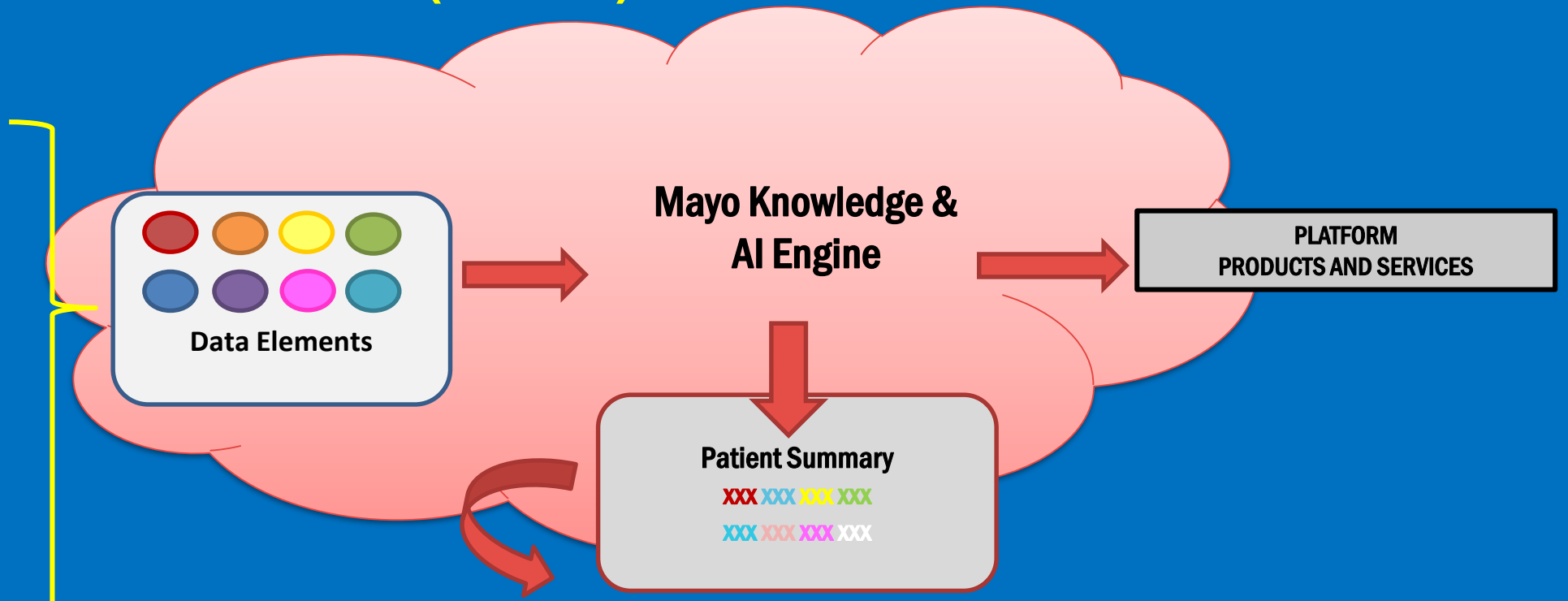
Demographic

Staging calculator

Clinician Engagement Efficiency and Effectiveness Project (CEEEP)

Mayo/Non-Mayo PATIENT

- Patient Profile
- EHR data
  - Notes
  - Meds
  - Labs
  - Procedures
  - Path reports
  - Imaging reports
  - Family history
- Genomics
- Images
- Pharmacy data
- Wearables/Sensors/Apps
- ePROs



MAYO CLINIC OPERATIONS

- Patient summary record
- Clinical documentation
- Patient/condition registries
- Smart Scheduling
- Smart Billing/Coding

MAYO CLINIC TREATMENT

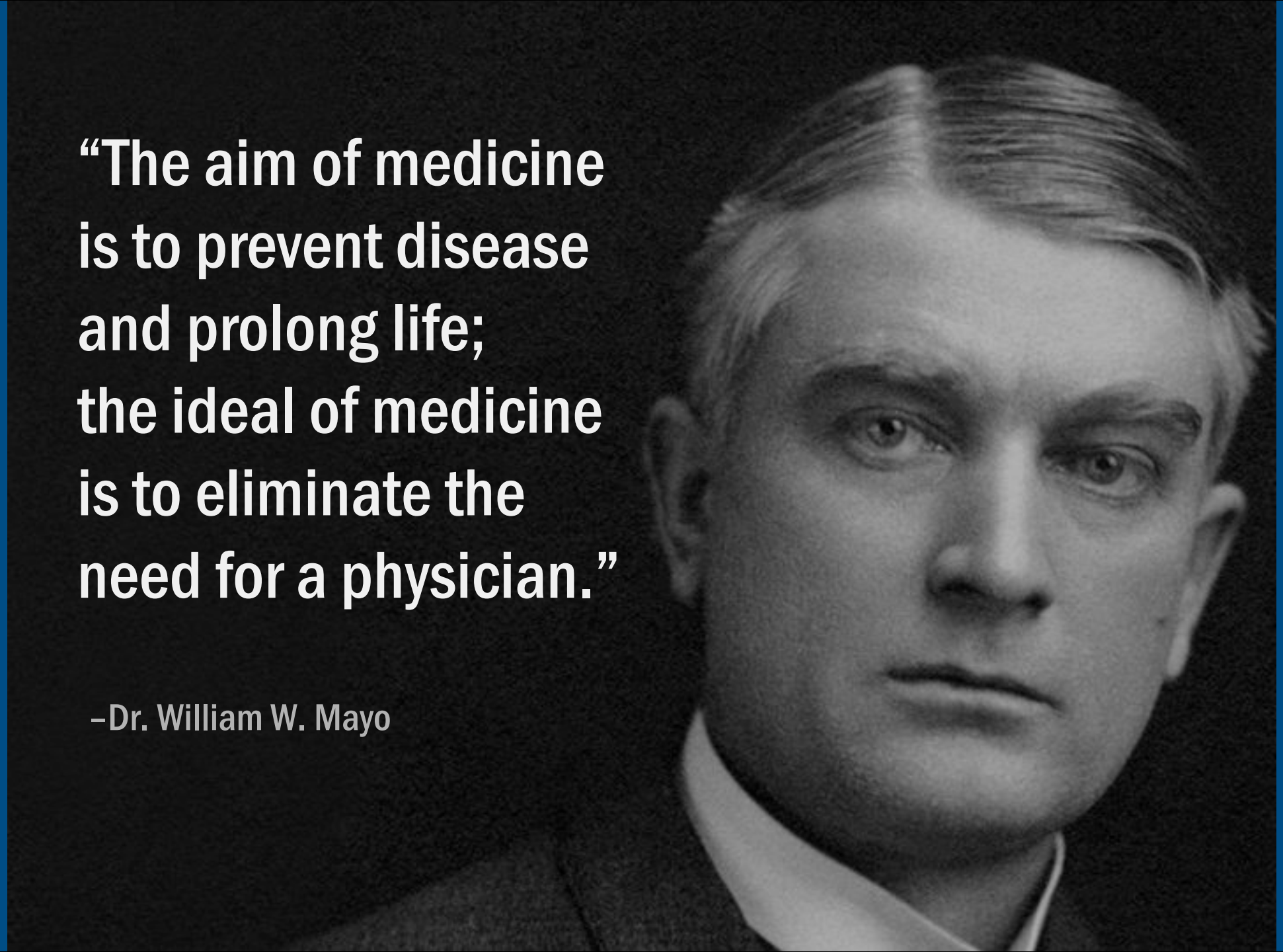
- Clinical Trial Matching
- Treatment Advisor/AME-MEA
- AI-driven Therapy Rec

One-click Patient Summary Enabled by AI

Breast Oncology Summary

Oncology Summary generated by the AI Engine

"The patient is a 49 year old woman with a history of pT2pN0 Stage IA left breast cancer. The tumor resected was a grade 2, invasive lobular carcinoma, measuring 2.3 cm, and 4 sentinel nodes were negative for malignancy. The invasive tumor cells were ER+ 75%, PR+ 11%, and HER2- with an Oncotype DX RS of 18. Treatment included mastectomy and adjuvant anastrozole. The patient has a positive family for breast cancer and tested negative for a BRCA1 and BRCA2 gene mutation."


“The aim of medicine
is to prevent disease
and prolong life;
the ideal of medicine
is to eliminate the
need for a physician.”
–Dr. William W. Mayo

Thank you !!!

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