

Telemedicine

How Digital Technology is Transforming the Healthcare Landscape

To connect Mayo Clinic knowledge and expertise to anyone, anywhere, anytime.

Steve Ommen, MD

**Associate Dean, Mayo Clinic Center for Connected Care
Professor of Medicine, Department of Cardiovascular Diseases**

Let me tell you a story...



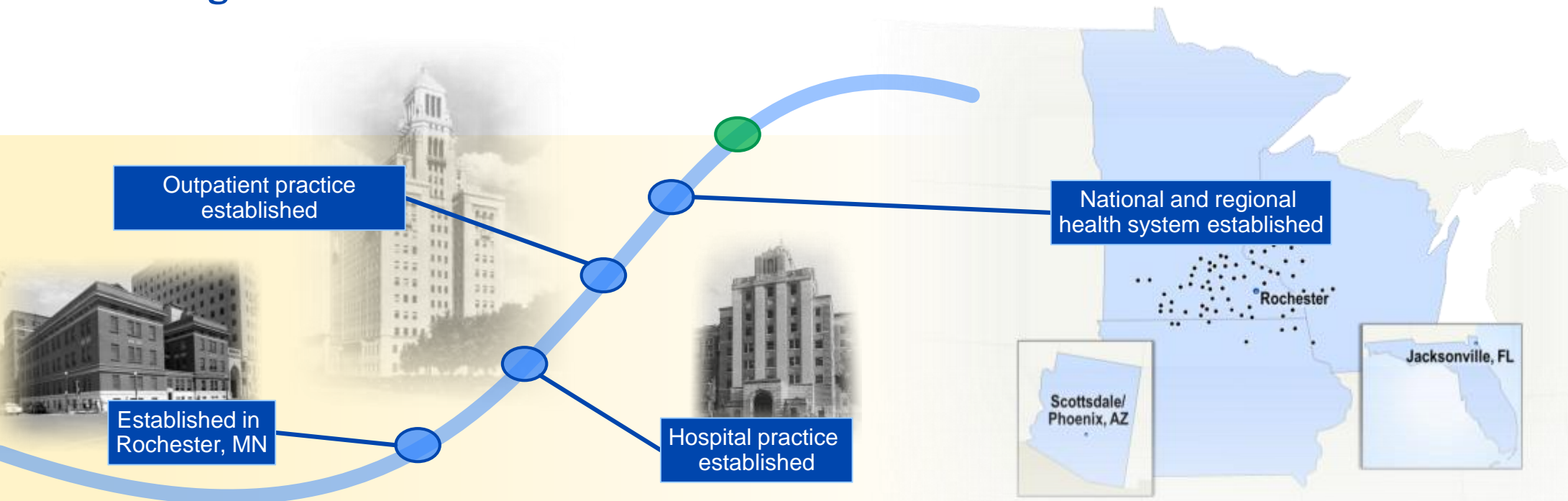
Evolution of the Mayo Clinic Model of Care

Primary Value: The needs of the patient come first

Mission: To inspire hope and contribute to health and well-being 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.**



Health Promotion

Episodic
Illness
Care

Chronic
Disease
Management

Health
Checks

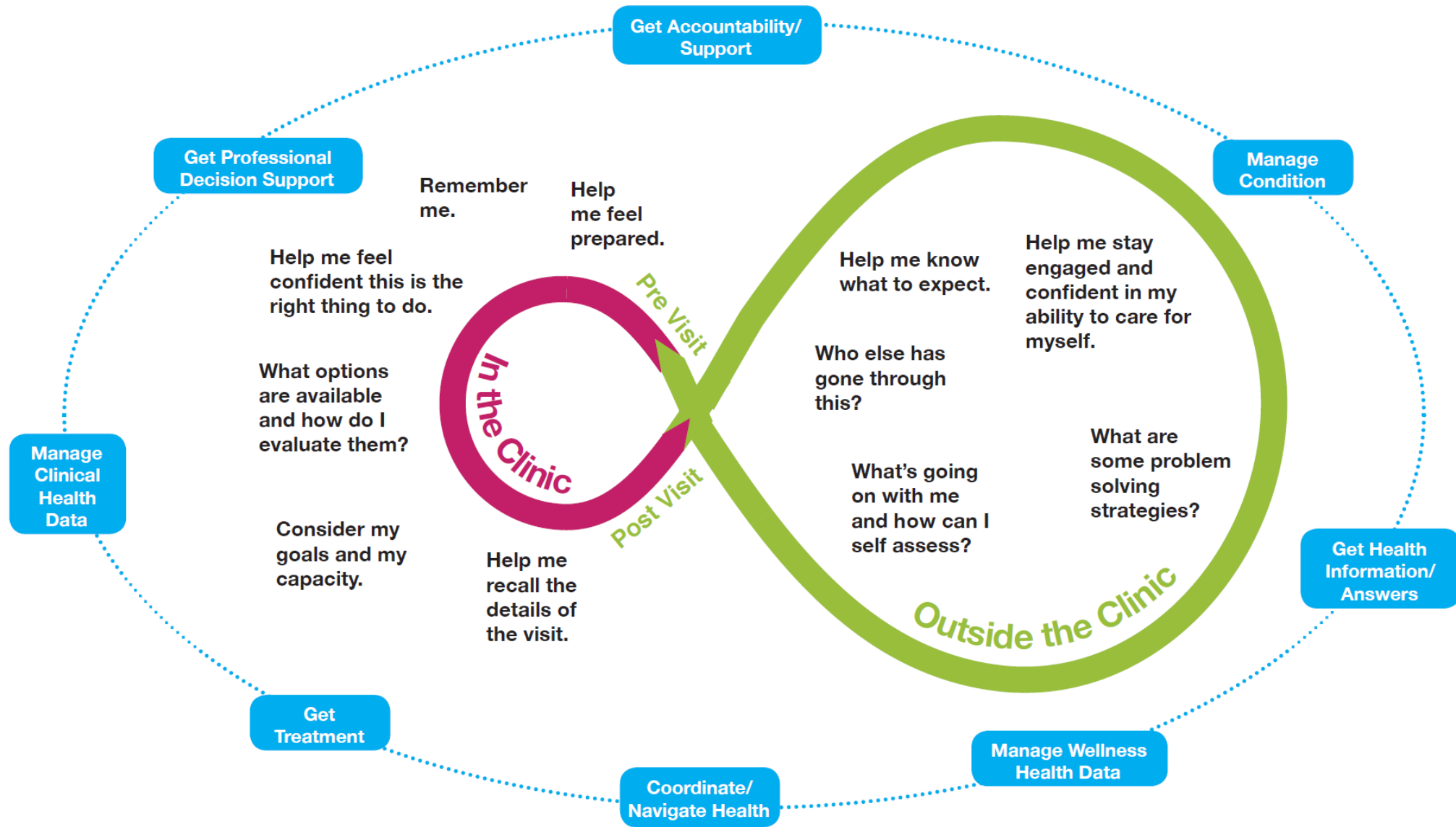
Wellness

Consumer to Patient Journey

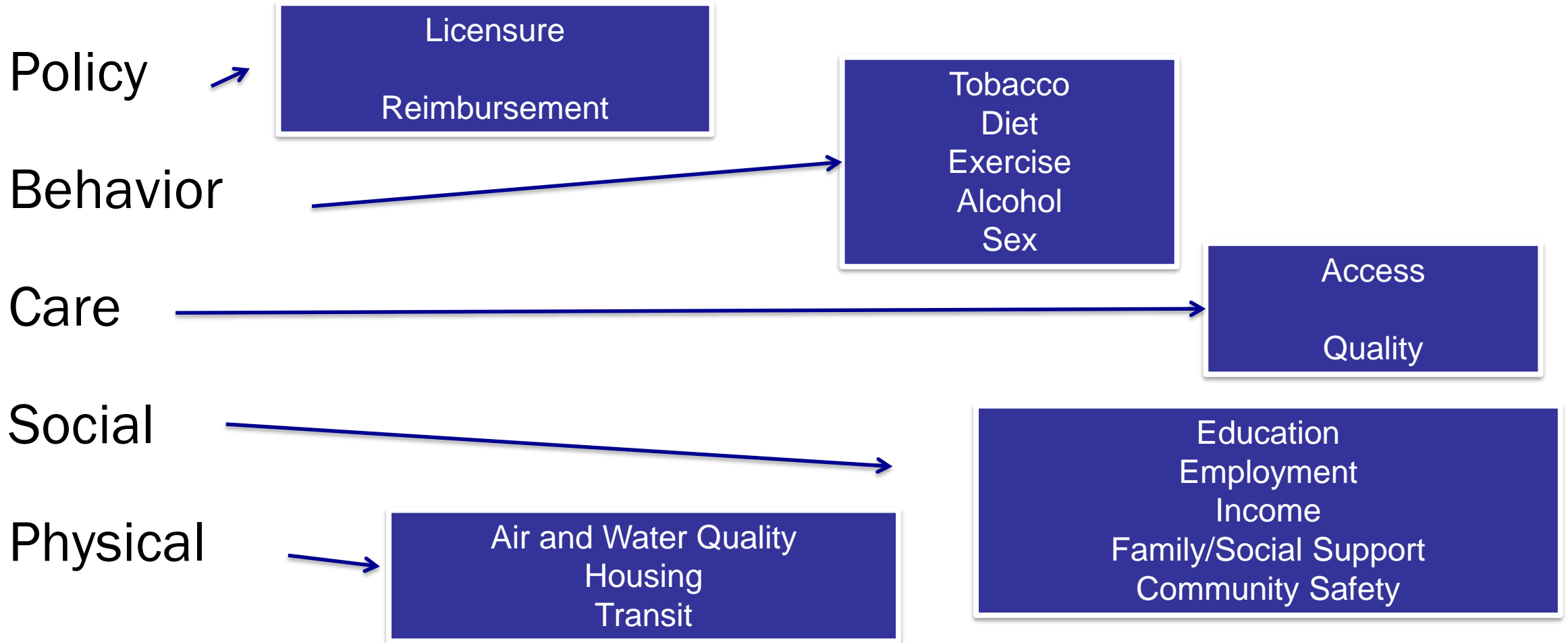
Health
Care

Health
Guidance

Health
Information



Barriers to Health





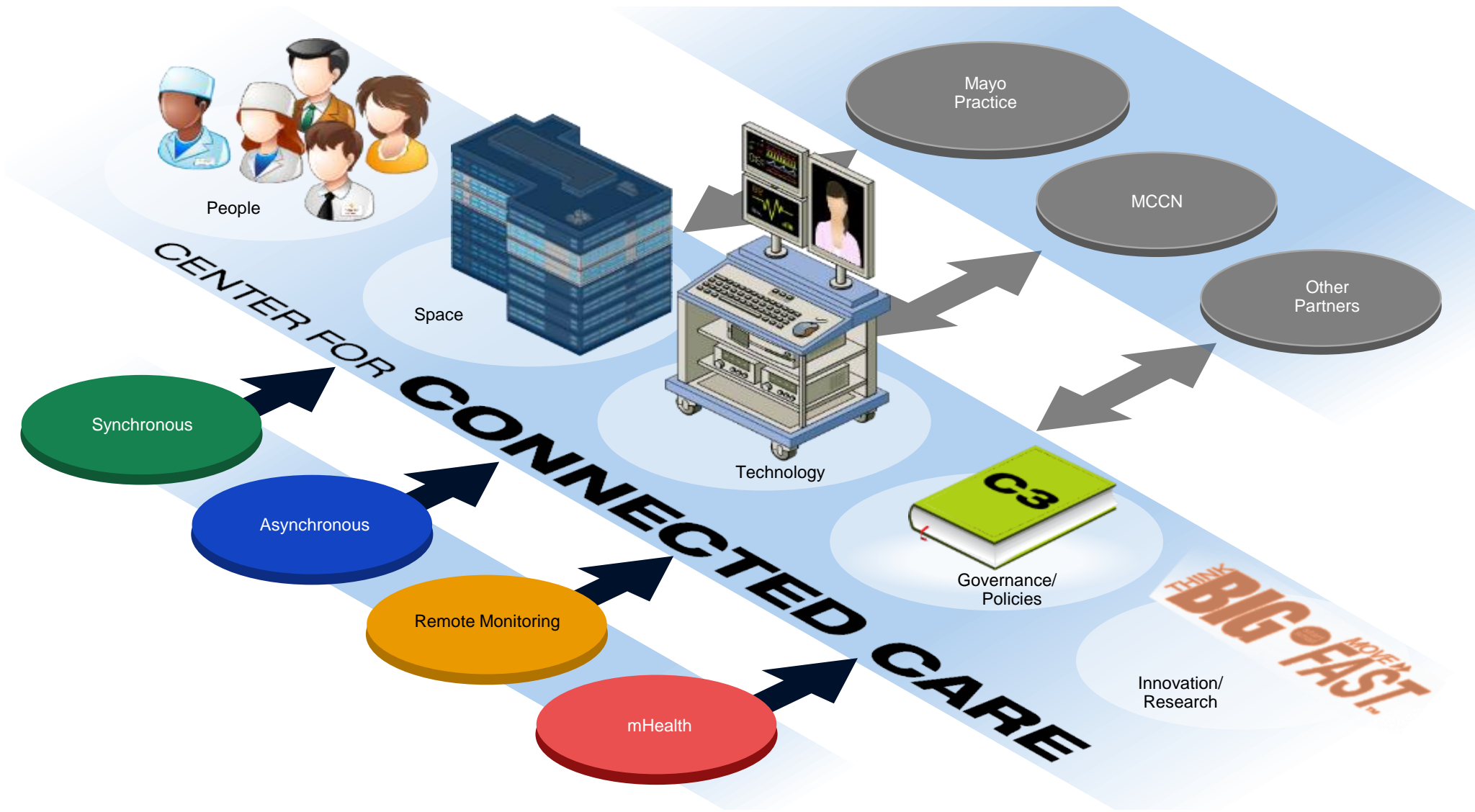
People expect that they can get their needs met in more convenient and more self-sufficient ways

Banking

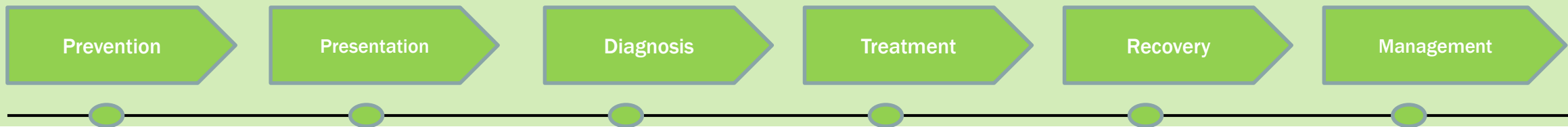
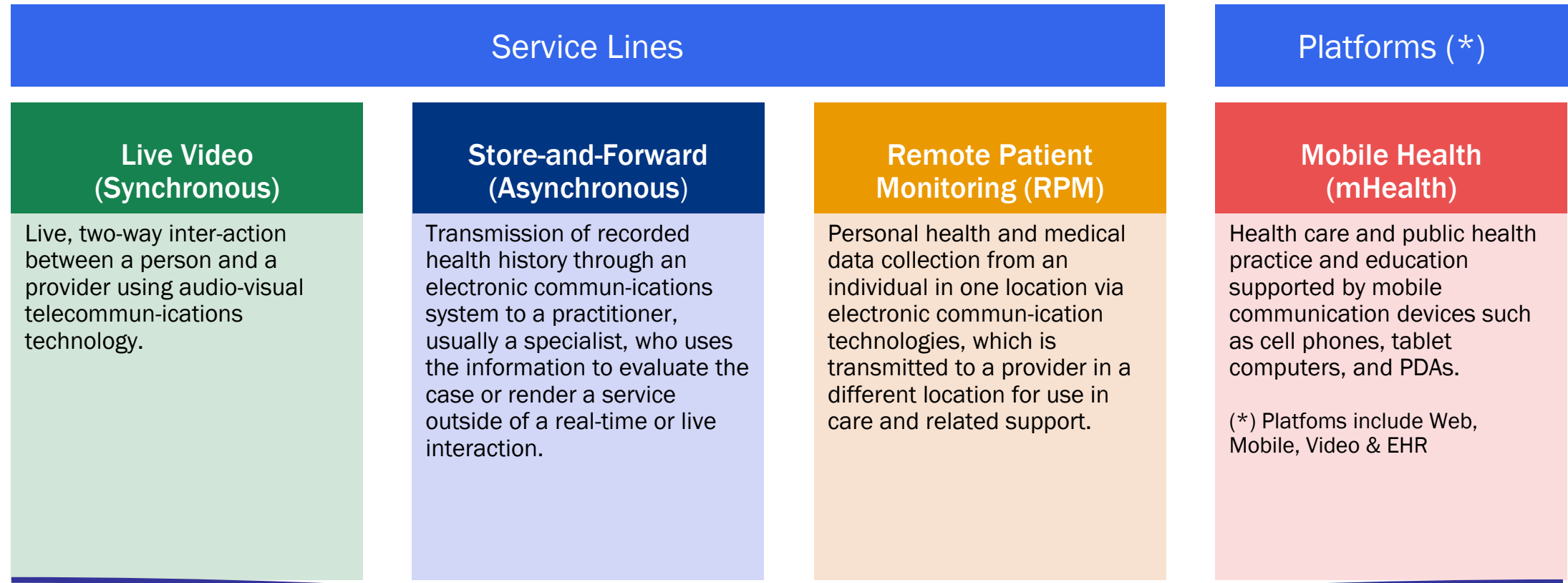
Travel

Gas Stations

Relationships



Connected Care Domains

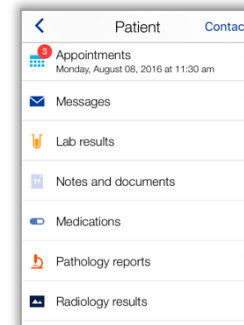
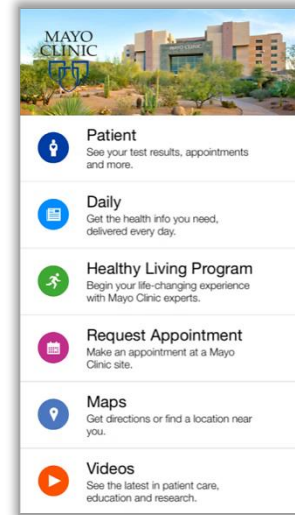
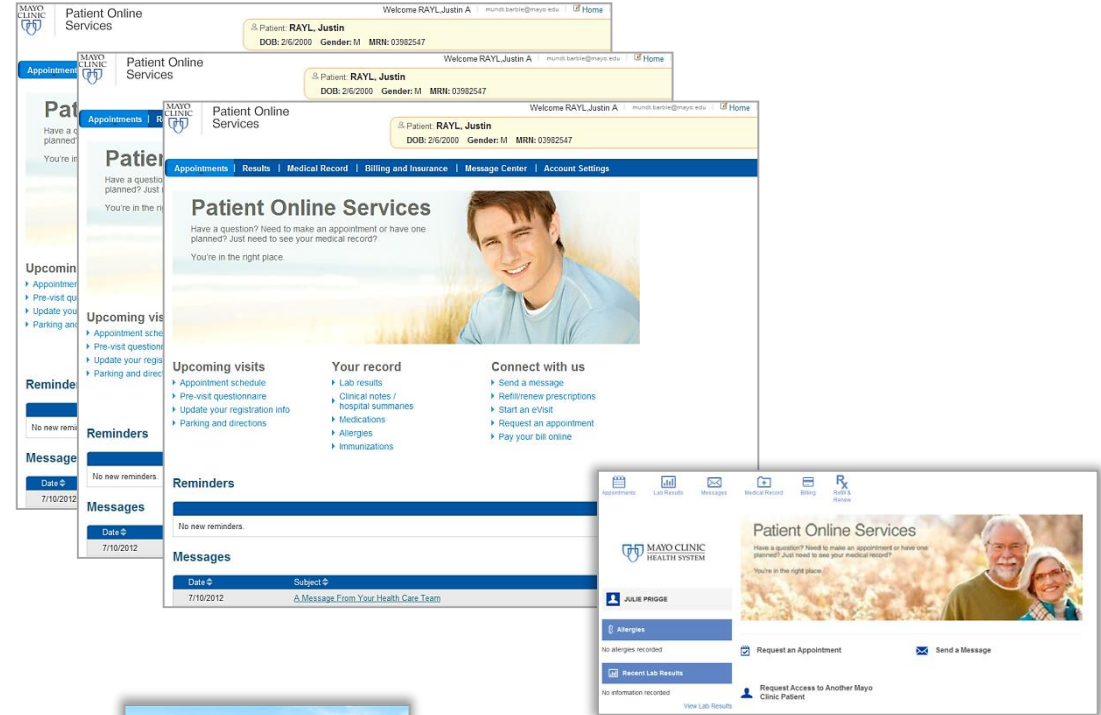


Asynchronous Services Portals

849,180 Patient accounts

3,655 active practices using Online Services for Referring Providers service with 30,981 active users

15,495 e-consults in 2015 (on track for 17,352 in 2016)



Asynchronous Services

Mobile

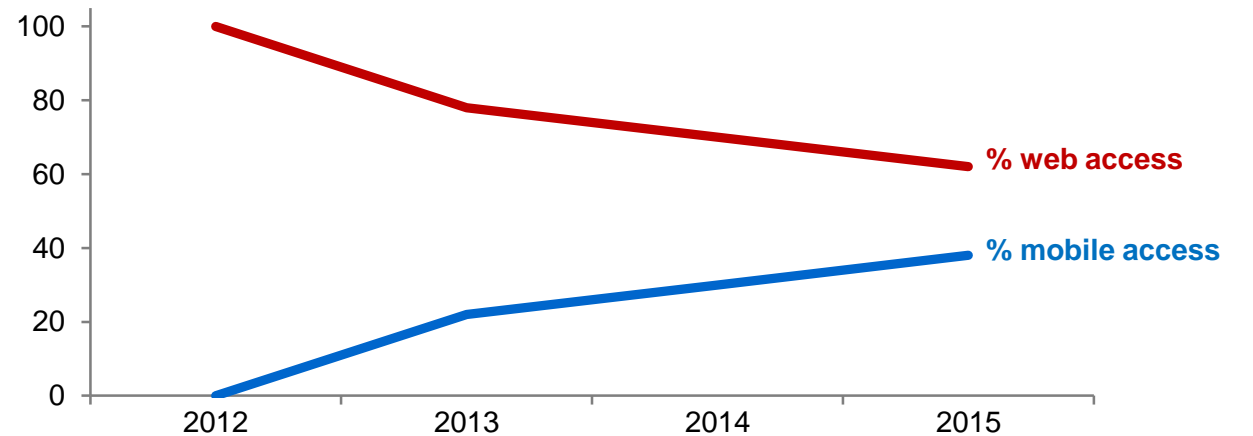
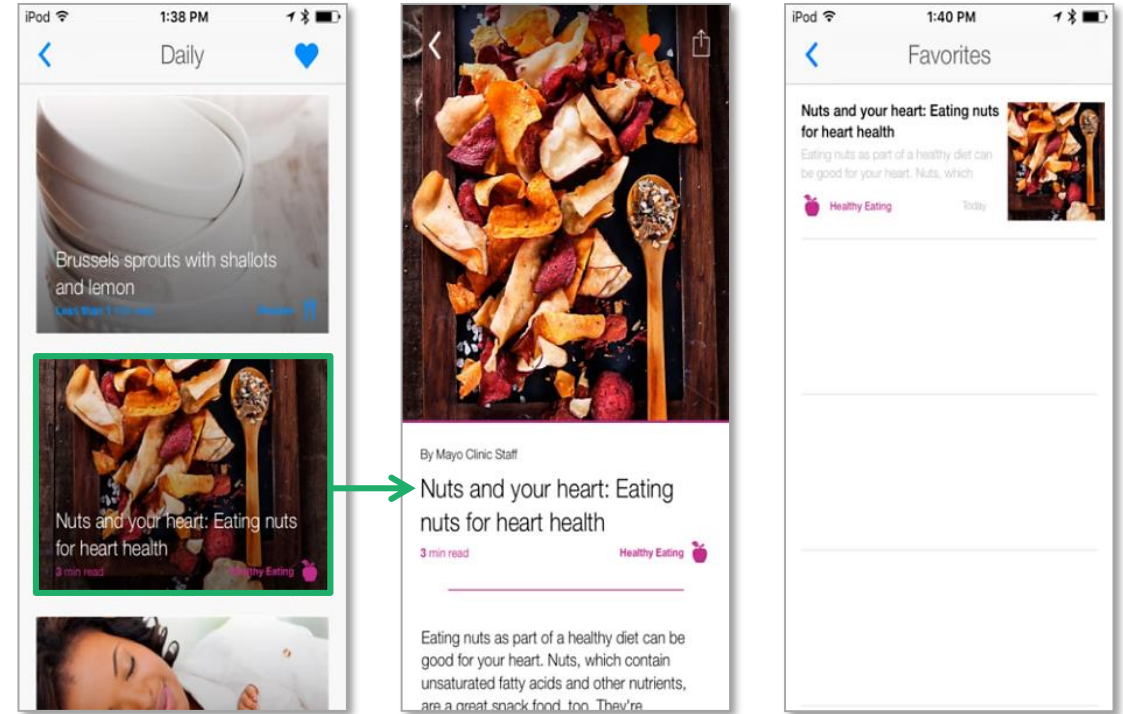
Interactive Care Plans
(in development)

MCCN Provider App

Mayo Clinic App*
(patient & consumer)

Consumer Feature: Daily**

- *Mayo Clinic App: Mayo Clinic patient portal access is 60% web based and 40% mobile based, with mobile continuing to increase
- **Daily: An average of 2,200 users have engaged each day for 2-minutes (median) and 36% returning the next week



Synchronous – Emergency Tele-Stroke

Mayo Clinic Tele-stroke Metrics

Service

>10,000 patients served

Effectiveness

98% accuracy for diagnosis and
correct clinical decision making

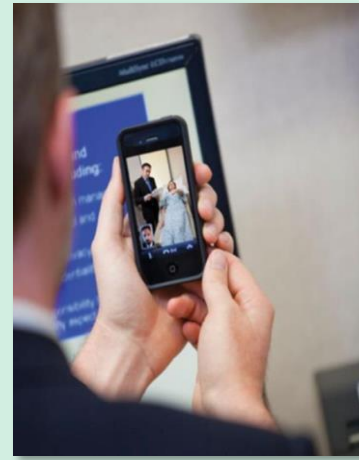
10-fold increase in thrombolysis
rates (from 2% to 20%)

Performance

1 min median stroke neurologist
response time

20 min median consult time

Demaerschalk B M et al: Stroke 2012;43:3271-3277



Safety

3% post thrombolysis symptomatic intracranial hemorrhage

Disposition

65% reduction in patient air/ground ambulance
transfers from spoke to hub

Morbidity & Mortality

Tele-stroke treated patients have approx. the
same outcomes as those treated at a Mayo Clinic campus stroke
centers

Synchronous – Emergency Tele-Neonatology

~10% of newborns will require some assistance to begin breathing after birth

Estimated cost savings per patient

\$16,000 helicopter lift charge

\$125/mile helicopter mileage charge

\$3,500/NICU day

\$35,500 saved for each transfer avoided
(assuming 100 mile round trip flight and 2 day NICU stay)

TOTAL: \$1,065,000 in three years



Synchronous

Video Visits/Consults

Reduce overall service costs with primary savings from reduced physician travel time



- Cost savings for patient through reduced travel time and transportation costs
- Improve access to care



>2300 Video Consults/Visits a year

Top Practice Areas

- Infectious Disease
- Gastroenterology & Hepatology
- Endocrine
- Nephrology & Hypertension
- Cardiovascular Diseases
- General Internal Medicine

Remote Patient Monitoring

- Easy to use Tablet
- 3G Cellular
- Peripheral Devices – weight scale, pulse oximeter, blood pressure cuff
- Easy to use dashboard
- Allows monitoring staff to hone in on most urgent issues
- Ability to extract data/reports



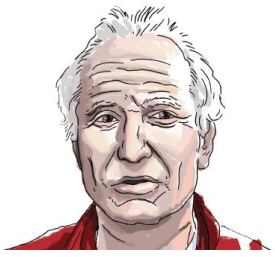
Expanding programs in NW WI, SW WI and establishing new program in SW MN

Capacity to monitor 150 patients daily by end of 2016 and 250 by end of 2017

Civilization advances by extending
the number of important
operations which we can perform
without thinking about them.

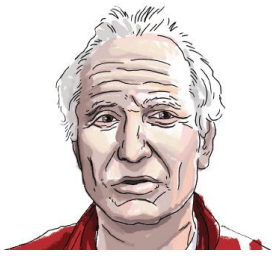
Alfred North Whitehead,
An Introduction to Mathematics, 1911





Richard's Heart Failure

A better story....



Richard's Case



Online Portal for Reporting Symptoms

When Richard develops symptoms, he goes into the patient portal and describes them. His primary care provider and cardiologist immediately see the symptoms and order a chest x-ray and electrocardiogram

Provider Alerted

Based on test results, the system alerts the cardiologist and primary care provider that the patient has onset of atrial fibrillation and evidence of pulmonary congestion or heart failure

Clinical Decision Support

Clinical Decision Support automatically calculates risk score for both risk of stroke as well as risk of bleeding, and presents this to the physician. Richard's primary care physician and the cardiologist collaborate and utilize a shared decision-making process to determine that the patient should start anticoagulation

KEY



UDP



API



Identity Management



Knowledge Management



Data Acquisition Mechanism

UDP aggregates patient demographics and background information once entered and allows provider to make decisions on appropriate tests to order



Proactive Alerts

By trending and analyzing remote monitoring data, in the context of the patient's past medical history, analytics can be used to alert providers of potential adverse events



Decision Support

Analytics can be used to calculate risk scores, recommend treatment options and present these to the physician in the EMR to facilitate informed decision making

Richard's Case



Device Integration

After the procedure, Richard returns home with a home INR monitor. This allows him to check the level of blood thinning and make adjustments to dosage accordingly. Using the Connected Care Warfarin Protocol, data from INR is sent directly to the centralized system and the system notifies Richard the proper dosage of warfarin to take.



Device Integration

Data from remote monitoring devices is aggregated and analyzed, enabling automated updates to the patient's care plan and medication dosage

Remote Monitoring

Unfortunately, atrial fibrillation has also resulted in heart failure. Therefore, titration of diuretics and heart failure medication will need to be implemented. Richard uses a wearable device to report necessary metrics (e.g., exercise and sodium intake) for titration. The device communicates with the nurse practitioners to enable very careful titration of the medication

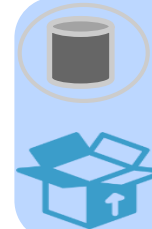


Remote Monitoring

Data from wearables and remote monitoring solutions is automatically aggregated and providers can access this to make remote adjustments to care plan

Self-reporting

In atrial fibrillation, it is essential to determine whether or not the patient has returned back to sinus rhythm. Thus, every week, Richard sends in his remote monitoring electrocardiographic strip to allow assessment of sinus rate and rhythm.



Continuous Monitoring

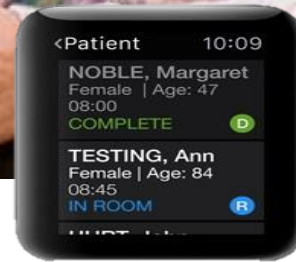
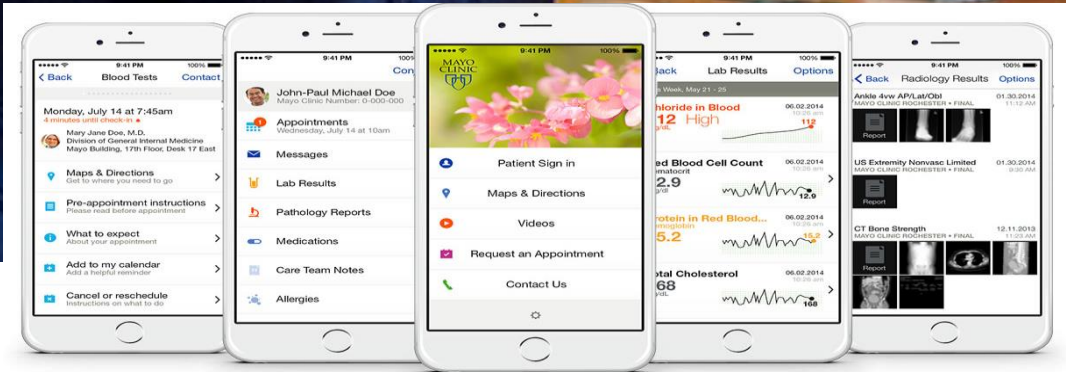
Patient's activities and performance are remotely monitored and analyzed, to provide ongoing care and proactive interventions

The more advanced the control system is, so the more crucial may be the contribution of the human operator

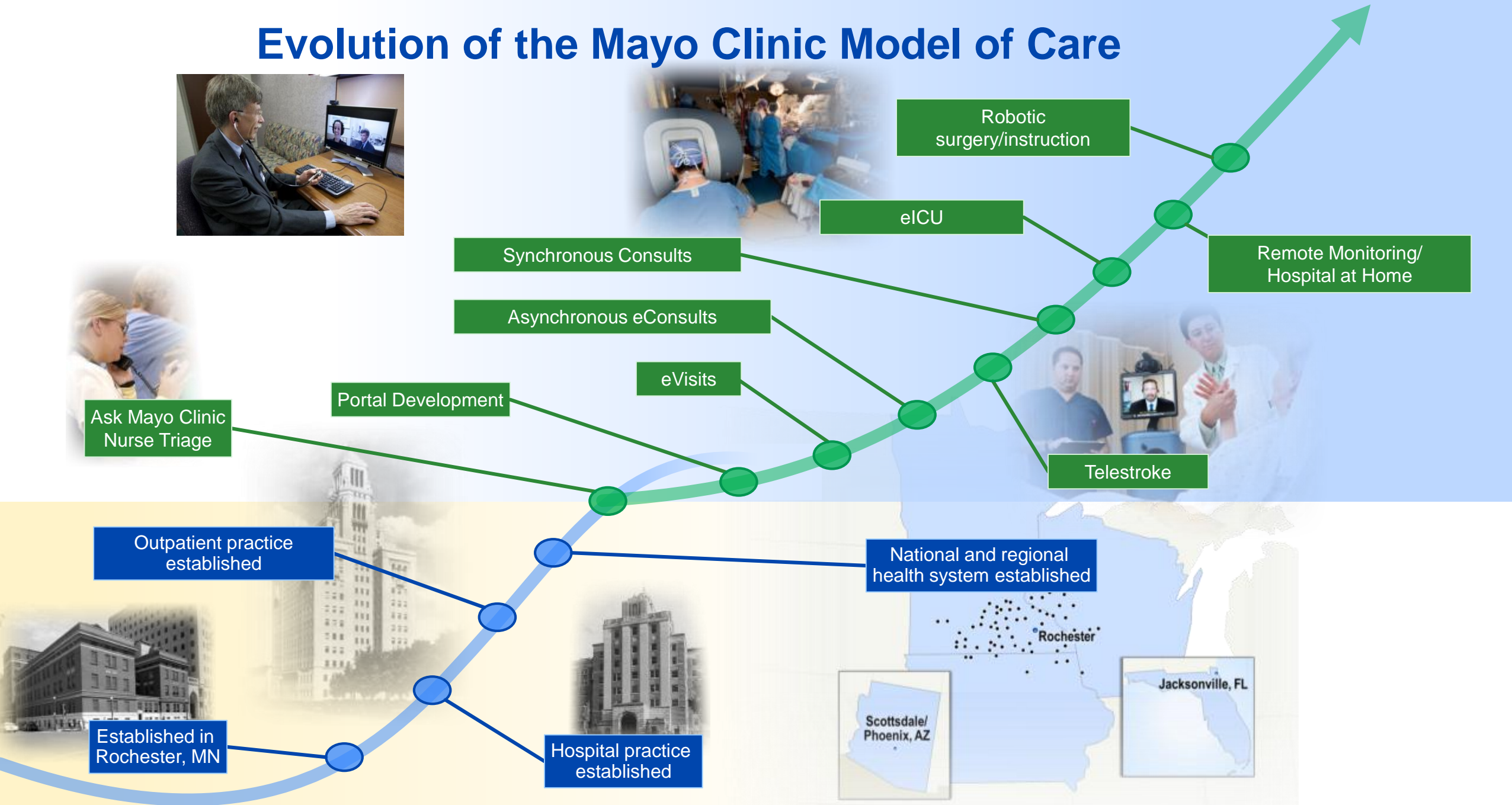
Lisanne Bainbridge
1983







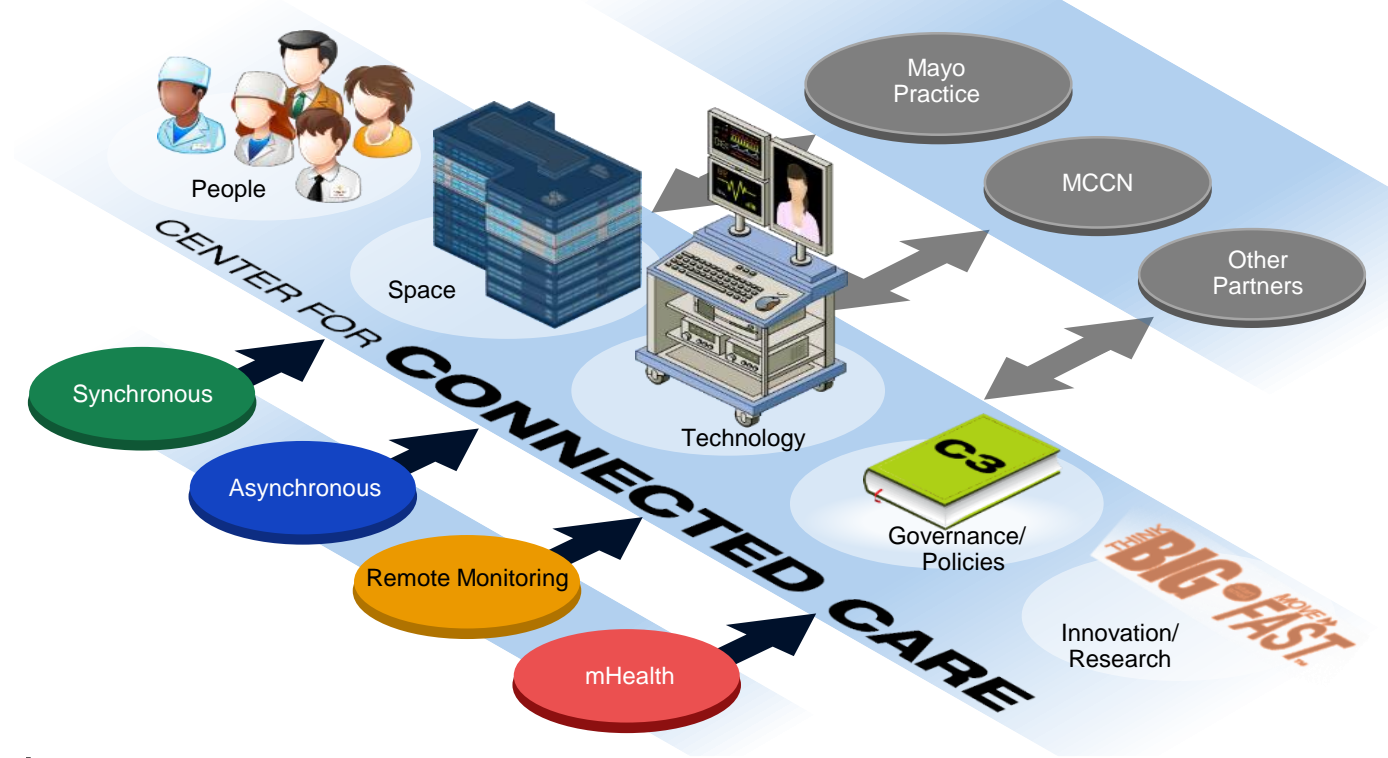
Evolution of the Mayo Clinic Model of Care



Value Propositions

Extend Mayo Clinic knowledge and expertise to people in the right place using the right channel

- Increase Mayo Clinic patient access to clinical care services at a distance
- Assist in reducing low-yield in-person visits to increase access for high-yield top of pyramid patients across the destination and community practices
- Assist in decreasing cost of care in the Community Population health practice



Barriers to Connected Health

Tradition

Technology

Reimbursement

Licensure

Unparalleled Experience

Needs are understood and met

Tools are clear and easy to use

Simple to the point of elegance

Consistent

Predictable

Professional

Trusted

Connected Health

FUTURE STATE





DELOS™
INNOVATE WELL



Human
Centered

Building
Science



Health
Science

The Well Living Lab connects building science and health science to discover ways to improve human health in the indoor environment

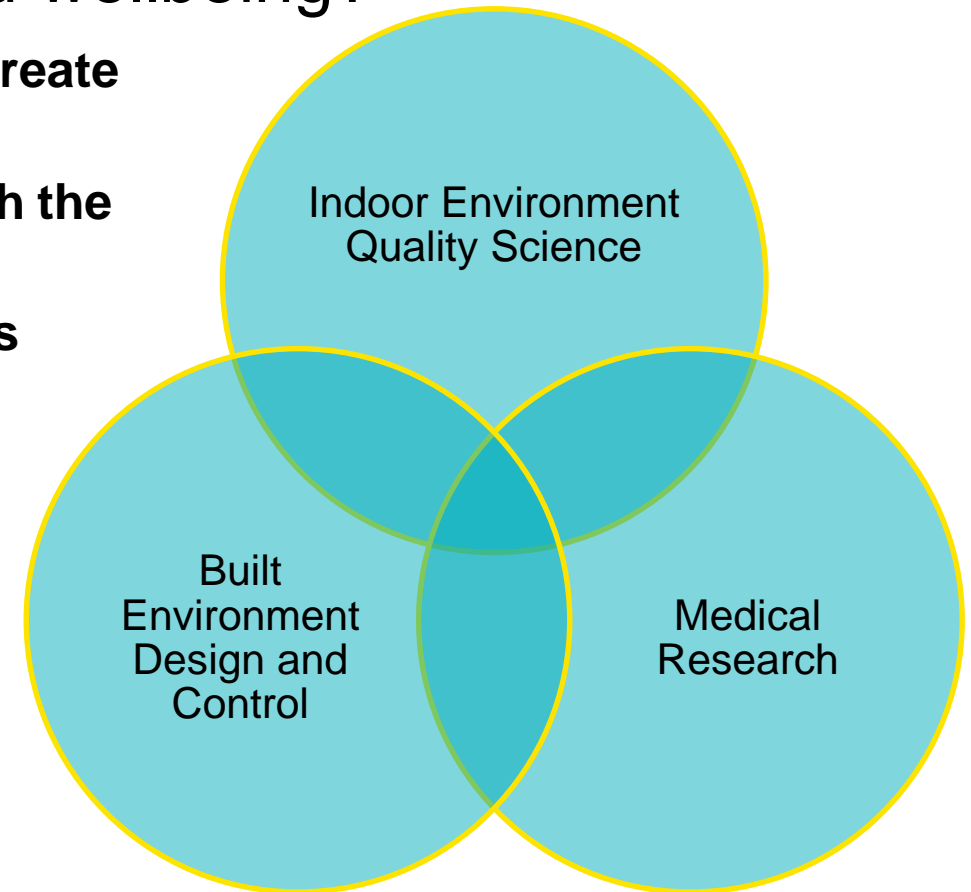
+ Well Living Lab

A Delos™ and Mayo Clinic Collaboration



How can we measure and enable health and wellbeing?

- + **Goal:** Conduct actionable, human-centered research to create healthier indoor environments
- + **How:** Simulate and measure real world environments with the use of state-of-the-art technologies
- + **Who:** Scientists and experts from multiple research fields
 - + Medical (e.g. sleep, microbiome, nutrition, posture, etc.)
 - + Behavior (physiology, psychology, and performance)
 - + Indoor Environmental Quality (e.g. air, sound, light, etc.)
 - + Architectural Design
 - + Building Systems and Internet of Things Infrastructure
- + **What:** Produce high-quality data to determine the best approaches to improve occupant wellness in the built environment



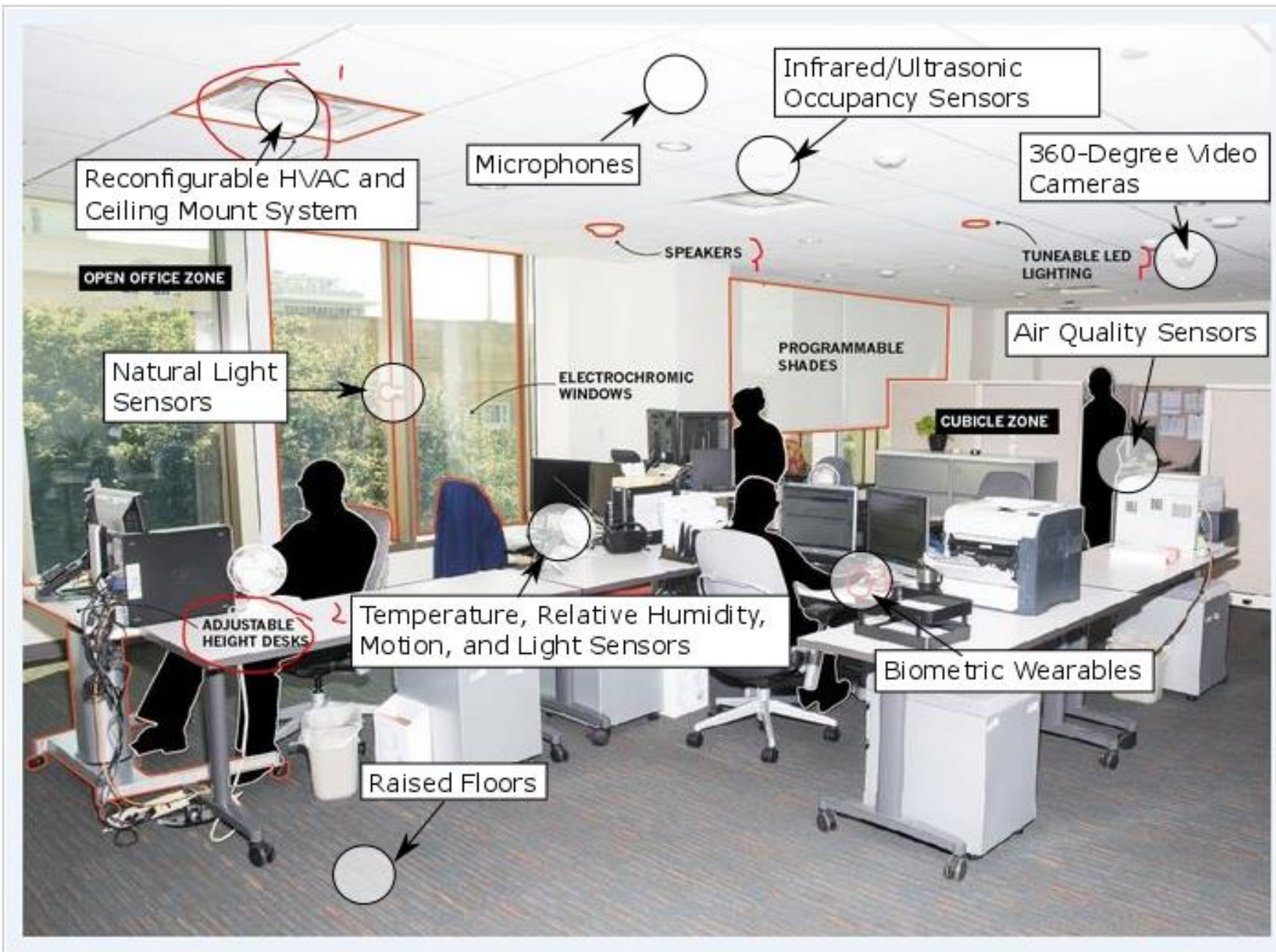
+ Research Approach

Areas of Study	Outcomes of Interest	Types of Simulated Spaces	Methods of Measurement	Study Populations
Air	Sleep	Bedroom	Wearable sensors	Healthy individuals
Thermal	Performance	Bathroom	Cognitive tests	Working adults
Light	Reduced exposure	Kitchen	Environmental sensors	Students
Acoustics	Stress	Office	Observation and ethnography	Recovering patients
Ergonomics	Fitness	Classroom	Auto-ethnography and self reports	Seniors
Behavior & physiology	Nutrition	Hotel room		At-risk populations
Physical activity	Comfort			



TECHNOLOGY

State-of-the-art, HIPAA compliant, secure, highly scalable, and highly available unique system for acquiring sensor based information (environmental & biometric), providing commands to alter an environment (temperature, humidity, air flow, lighting, etc), and facilitate a command-and-control function (with decision support and massive data storage) that can be operated from any location in the world with an internet connection.

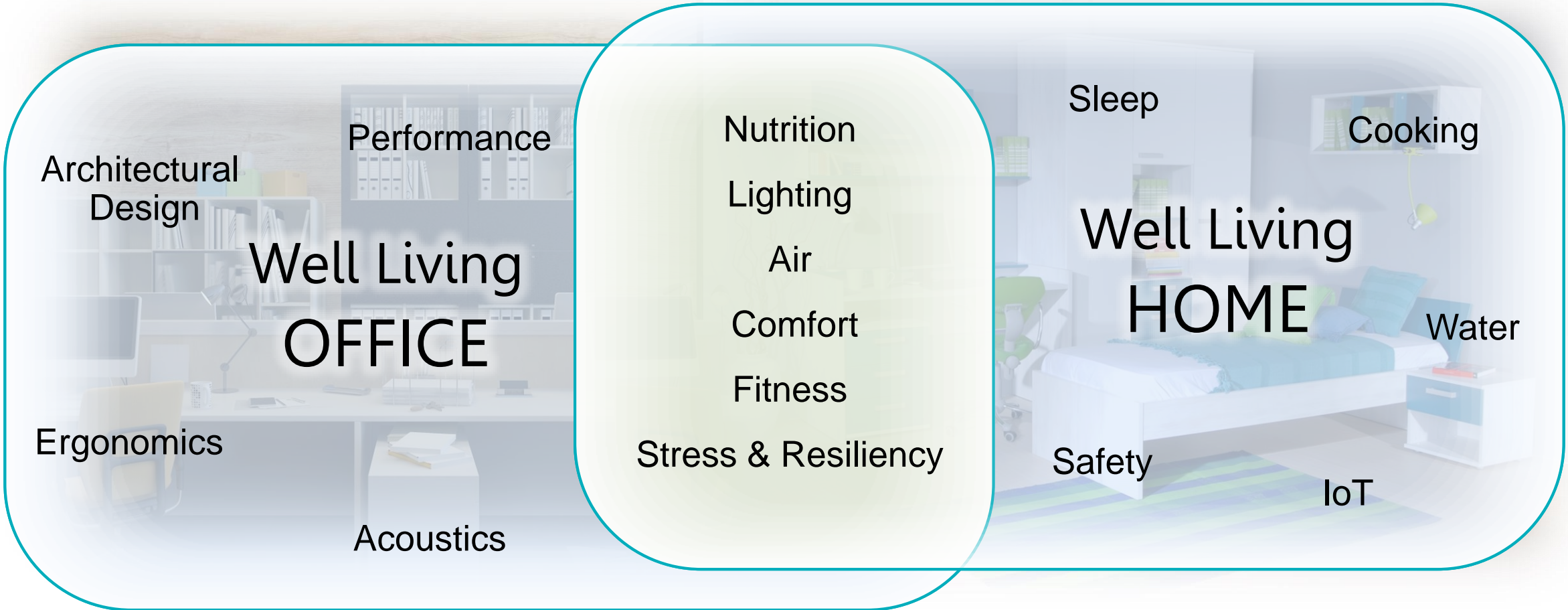


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THE OFFICE EXPERIMENT
CAN SCIENCE BUILD THE PERFECT WORKSPACE?
BY EMILY ANTHES

MISSION Transforming human health in the indoor environment



Civilization advances by extending the number of important operations which we can perform without thinking about them.

Alfred North Whitehead,
An Introduction to Mathematics, 1911

The more advanced the control system is, so the more crucial may be the contribution of the human operator

Lisanne Bainbridge
1983

From *The Digital Doctor: Hope, Hype, and Harm at the Dawn of Medicine's Computer Age*

by Robert Wachter



Why does this magnificent applied science, which saves work and makes life easier, bring us so little happiness?

The simple answer runs: Because we have not yet learned to make sensible use of it.

*Albert Einstein,
Speech to Students at California Institute of Technology, 1931*

Connected Care is integrating, extending, and enhancing the relationship between the health-seeker and Mayo Clinic using better communication methods