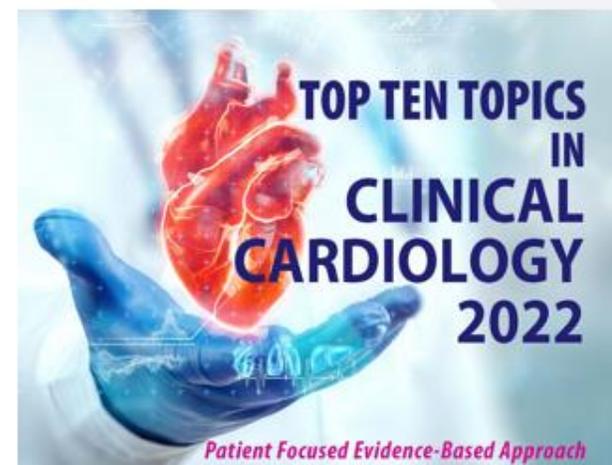


The Cardiovascular Future and the New Frontiers

B. Hadley Wilson MD FACC
Executive Vice Chair

Sanger Heart & Vascular Institute/Atrium Health
Clinical Professor of Medicine
Wake Forest University School of Medicine
Vice President
American College of Cardiology

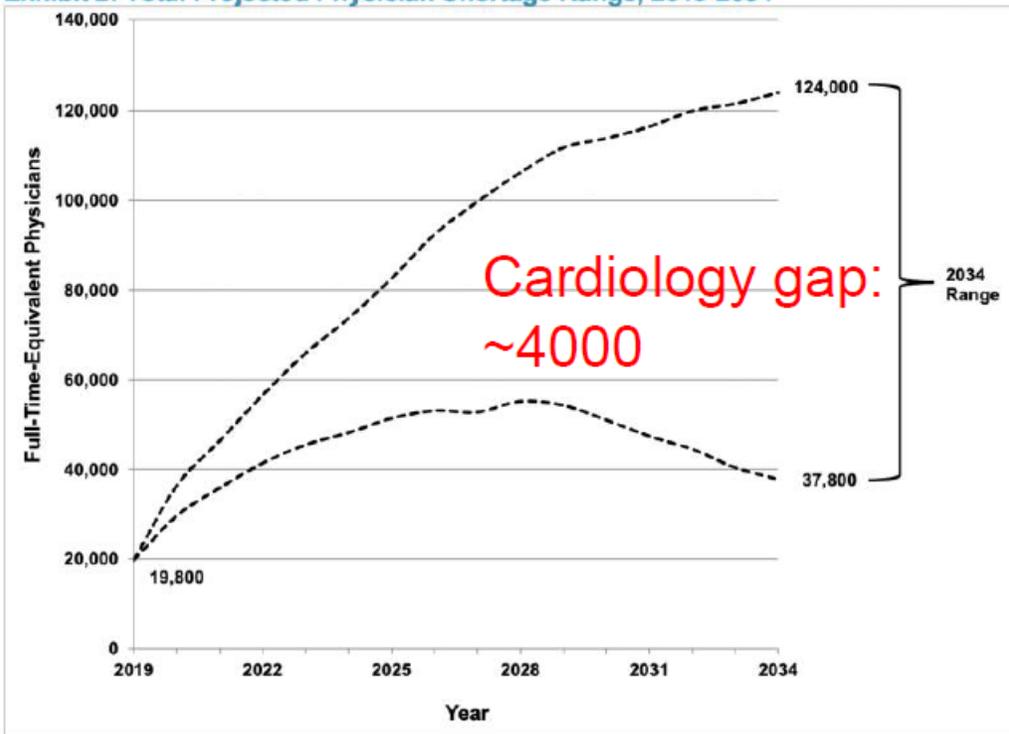


DISCLOSURE Statement of Financial Interest

I, B. Hadley Wilson, MD DO NOT have a financial interest/arrangement with one or more organizations that could be perceived as a real or apparent conflict of interest in the context of the subject of this presentation.

Physician Workforce Shortage

Exhibit 2: Total Projected Physician Shortage Range, 2019-2034



AAMC. "Complexities of Physician Supply and Demand Projections from 2019 to 2034. June 2021

SHORTAGE OF CARDIOLOGISTS



1 IN 4 CARDIOLOGISTS
(26.5%) is now over the age of 61!!

7,563 MEDIAN

wRVUs per FTE over age 61 (9,642 overall)

There's a whole FTE missing here

US CARDIOLOGY PROJECTIONS

Practicing Cardiologist ¹	32,000
Over the Age of 61 ²	8,480
Estimated Annual FTE losses ³	(2,000)
Current Total US Fellows ⁴	3,745
Annual Number Entering Workforce ⁴	1,453
Net Annual Workforce Impact	(547)

¹ Source: Joint American College of Cardiology (ACC)/MedAxiom calculations

² Source: MedAxiom Cardiovascular Provider Compensation & Production Survey

³ Source: MedAxiom projections based on both wRVU production reductions and physician departures

⁴ Source: Accreditation Council for Graduate Medical Education, 2018 - 2019

COPYRIGHT ©2021 MedAxiom – An ACC Company

1

Sauer J. MedAxiom 2021

Drivers: Aging, Burnout, Deferred Retirement

Solutions: GME, Top-of-License, Innovation



Workforce Crisis: Nursing

commitment.
courage.
compassion.

Headwinds and tailwinds – state of the nursing profession includes COVID-19 impact

Declining workforce

510K

RN shortfall by 2030
(expected to grow due to COVID pandemic).

South and West regions of the US expected to have hire shortages.

The annual growth in RN jobs projection has grown from

175,000

pre-pandemic to

200,000

per year through 2026.



The RN recruitment difficulty index has grown to

81 days

with OR and ICU nurses being the highest at

93 and 91 respectively.

However, med surg does not fall far behind at

76 days.

Clinical practice opportunities

Emerging literature regarding the growing gap for transition to practice **8% of nursing graduates** are prepared for entry level practice, dropping from **23% in 2015.**

Emerging nursing literature demonstrates **poor EHR usability leads to increased burnout, decreased job satisfaction and intention to leave.**

RN burnout has grown as a result of the pandemic to

94% of nurses

reporting some level of burnout.



National annual turnover 2020
(with COVID impact)

18.7%

with the Southeast, North Central and South Central regions of the US having turnover at

19.2 -24.9%

(These are the regions Ascension practices within.)

Changing landscape

COVID pandemic has increased the **gap in transition to practice** and

knowledge for new graduate nurses. First year turnover has grown to **30% nationally.**

Increasing **experience-complexity gap**

demonstrated through shift in CMI.

Call from the AACN, AONL, RWJ foundation and nurses have a **population health responsibility** regardless of their education level or their work assignment.



Changing economic landscape decreased interest in nursing support roles.

21% of nurses

have indicated they would **transfer to non-patient care roles** after the pandemic.

10% of nurses

are reporting plans to **leave the profession** after the pandemic.

22% of nurses

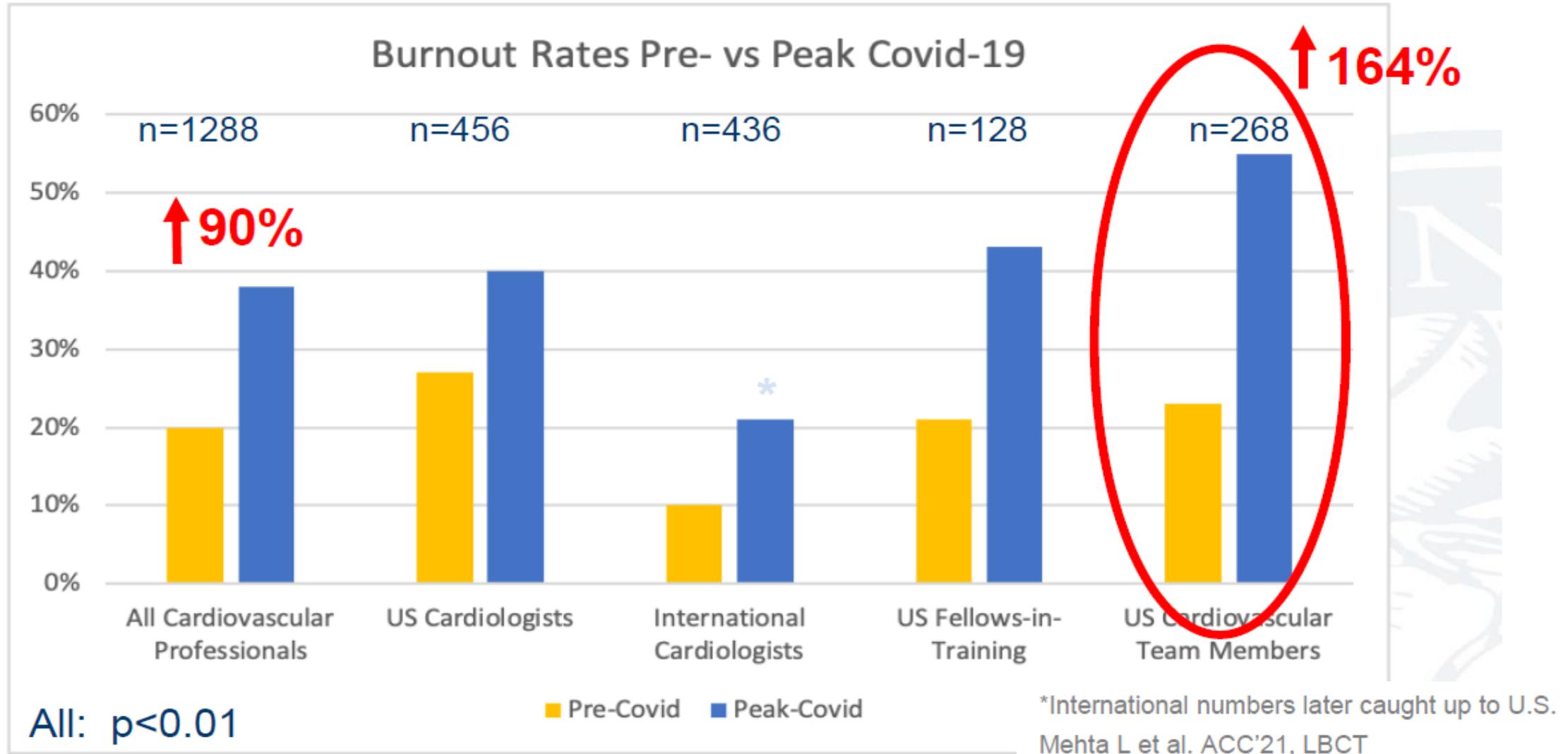
are reporting they will **retire soon** after the pandemic.

RN vacancy rate has grown to **10% nationally.**



Clinician Burnout

Care Transformation **MUST** promote clinician wellbeing



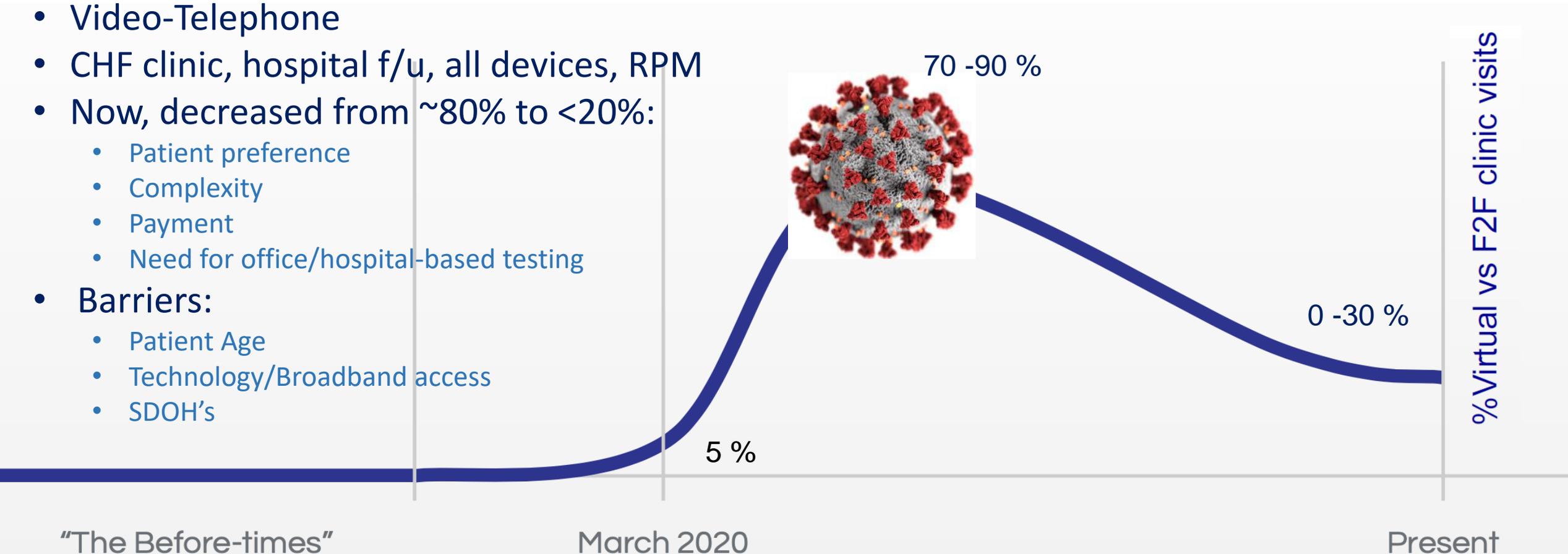
1962 ----- Innovation? ----- 2022



Courtesy of John Rumsfeld, MD, PhD, FACC

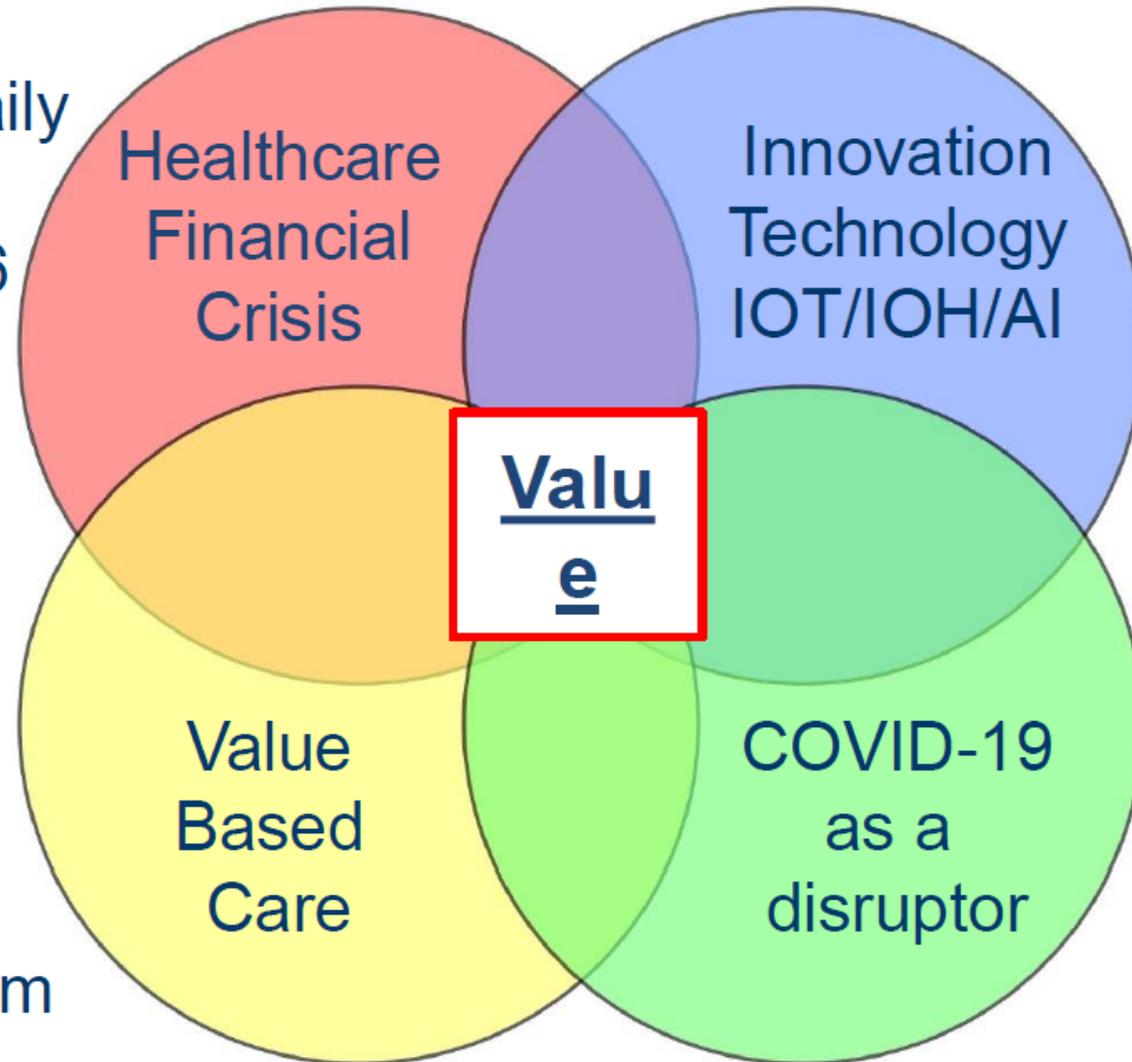
COVID-19: A Catalyst for telehealth

- Pre-Pandemic: Minimal Virtual Care
- Rapid pivot to Virtual – March 2020
- Video-Telephone
- CHF clinic, hospital f/u, all devices, RPM
- Now, decreased from ~80% to <20%:
 - Patient preference
 - Complexity
 - Payment
 - Need for office/hospital-based testing
- Barriers:
 - Patient Age
 - Technology/Broadband access
 - SDOH's



Care Transformation: Crystallized Crisis

Workforce crisis: MD's,
RN's, CVT's
11K people >65 y/o daily
Health care inflation
CMS insolvent in 2026



Increased connectivity
Need for inter-operability
Digital economy/world
Need digital health tools

70% public payer
Employers' demands
Patient consumerism
Silo'ed delivery system

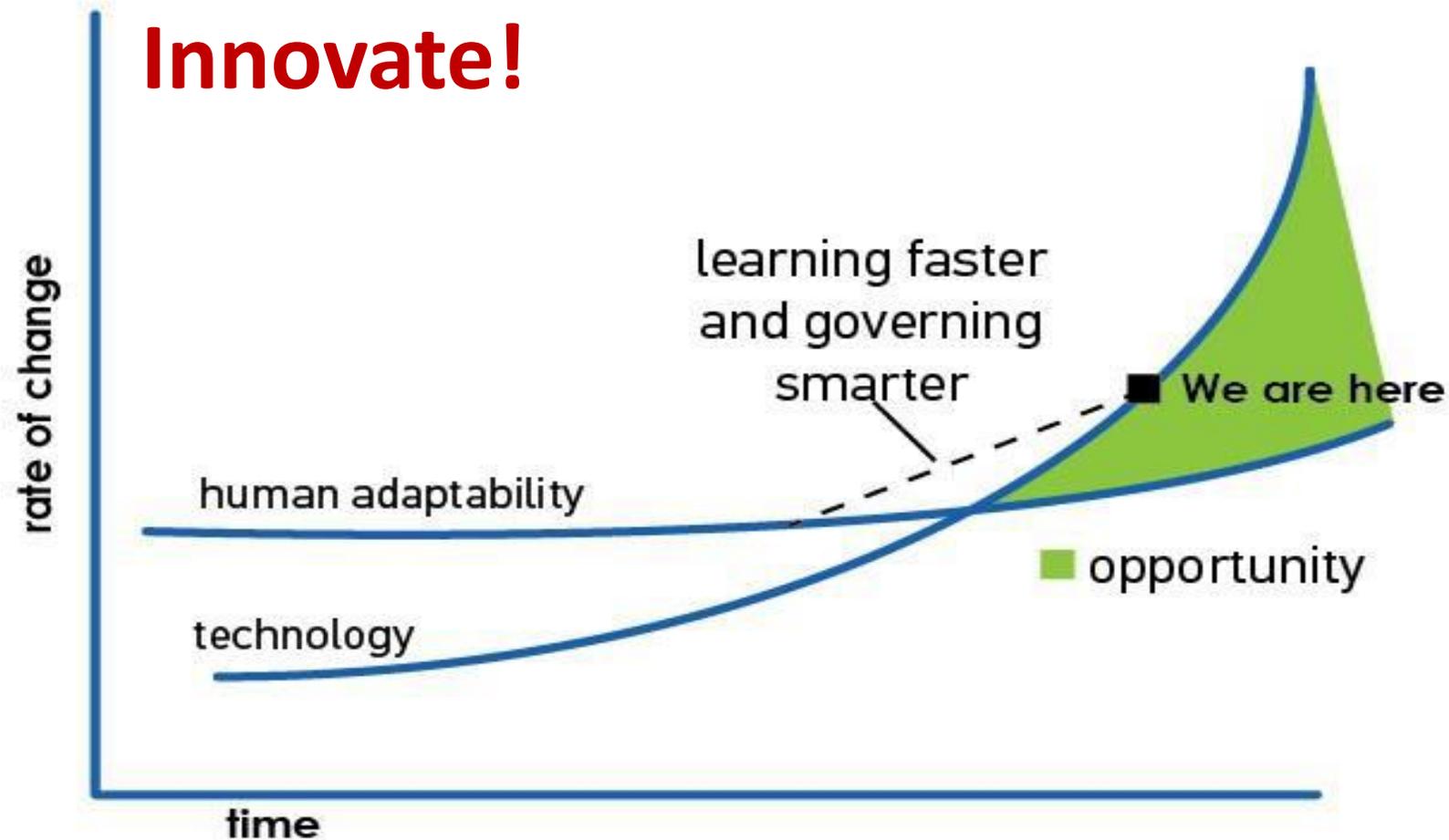
Declining life-expectancy
Impact of SDOH's
Lack of Health Equity
Unsustainable FFS model



AMERICAN
COLLEGE of
CARDIOLOGY®

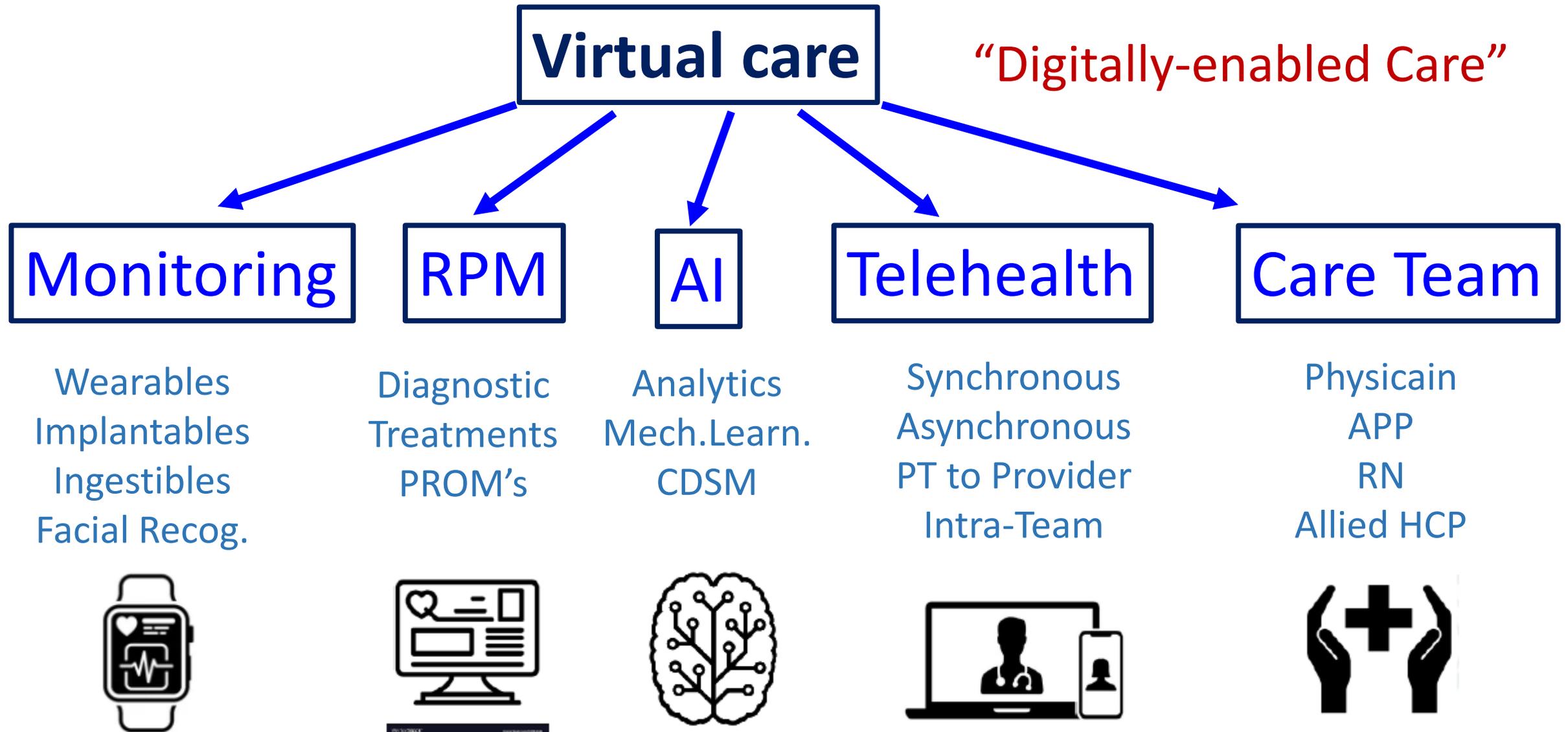
Change as the new constant: Acceleration of Change: Eric “Astro” Teller’s Curve

Thank You for Being Late – Thomas Freidman, 2016, p. 34



AMERICAN
COLLEGE of
CARDIOLOGY®

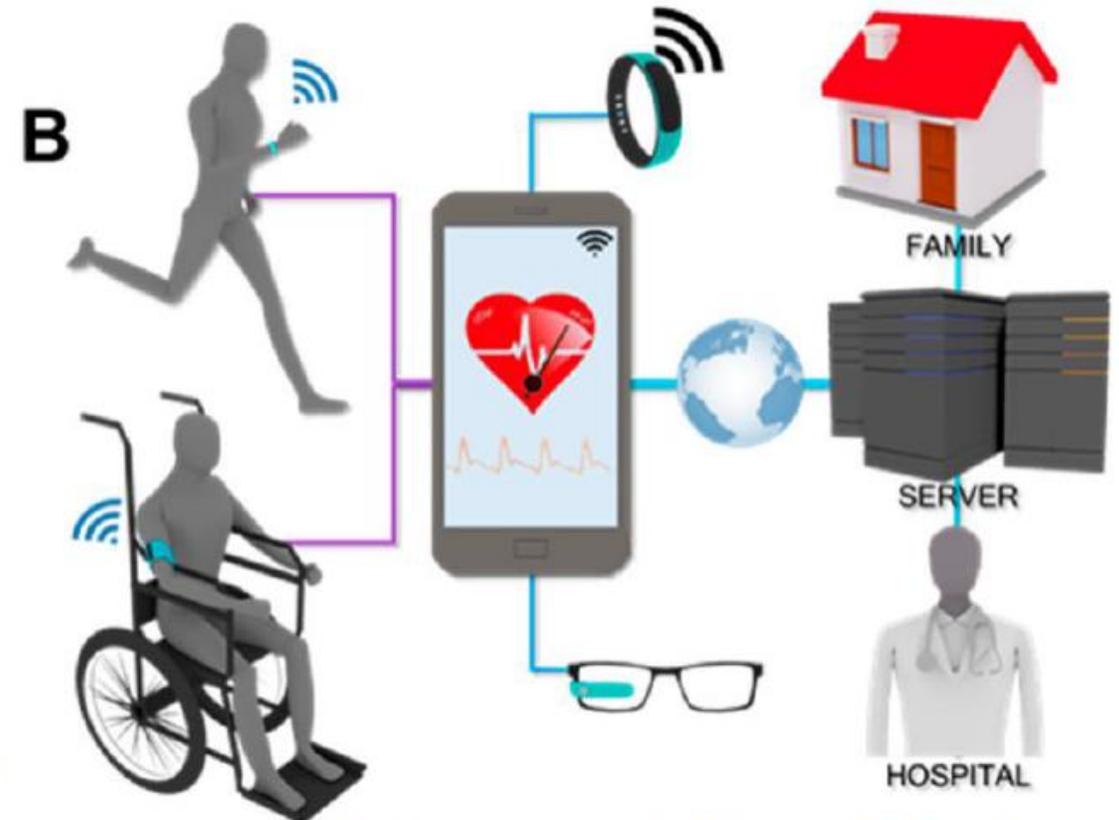
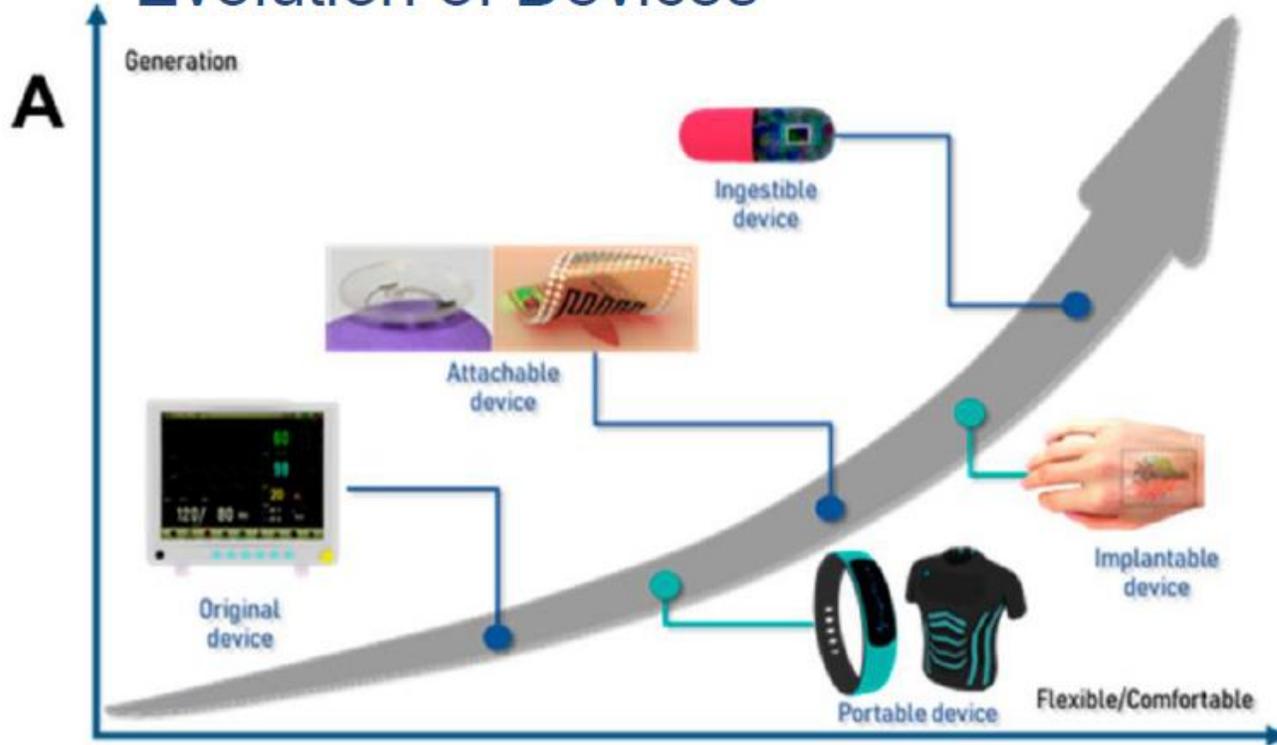
Transformation of Care



Use Cases:

- Personal Use – Fitness, Wellness, Risk assessment
- Shared with HCP (push) – Rhythm monitor
- Monitored by HCP (pull) – PM/ICD/CMEMMS
 - Synchronous
 - Asynchronous

Evolution of Devices



Mobile Devices and Digital Health

Ida Sim. Mobile Devices and Health. NEJM 2019;381:956-68

- **Sensors:**

- Passive
- Active
- Functional

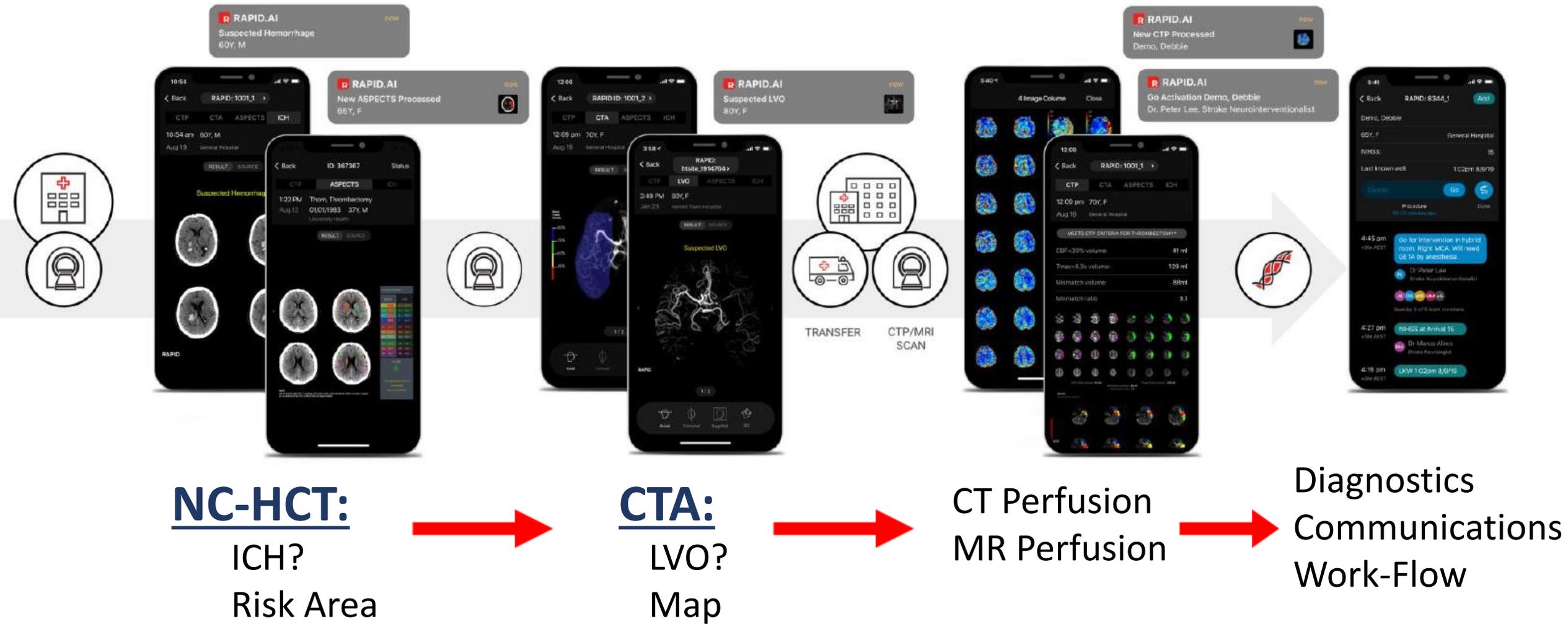


- **Digital Biomarkers (voice, face)**
- **Digital Dnx-ics and Rx**
- **Care Integration**
 - EHR, FHIR standard
 - IOT/IOH

- **Challenges**

- Regulation/Certification
- Validation/Accuracy
- Digital Formularies
- Compliance/ Pt. Acceptance
- Equity of access
- Privacy/Security

AI Facilitated Acute Stroke Care



Norton Health (KY) Pilot: Reduced Door-to-Thrombectomy 119 min to 90 min

Cardiac CT and AI



Stenosis Map

3D Reconstruction

Structure/Function

Analytics

AI = “Augmented Intelligence”, facilitated reads more efficient, reduced cost, increased accuracy.

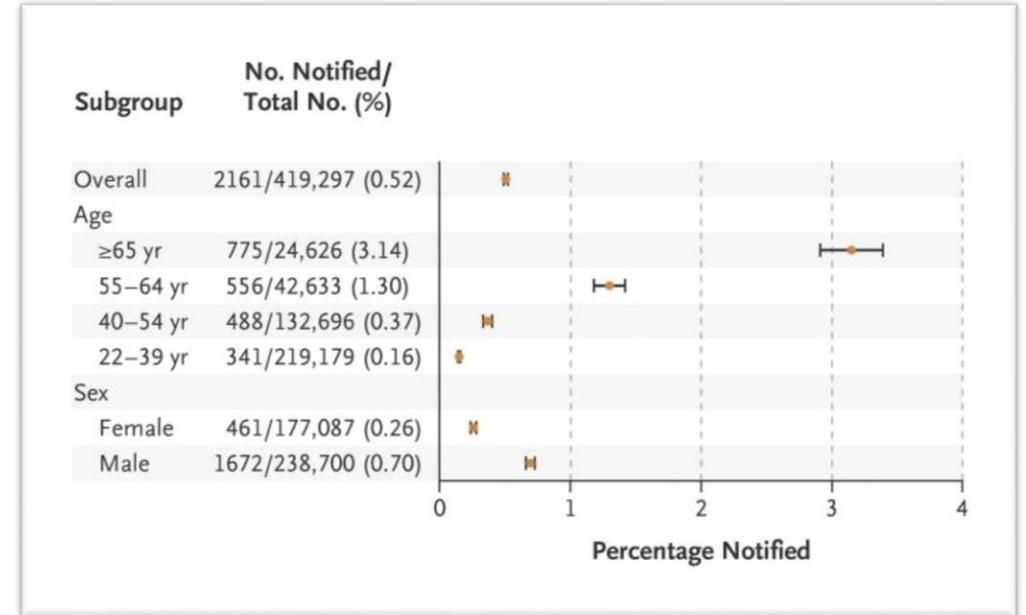
Wearables: Clinical Trials

Apple Heart Study

- **Scale: >400K Apple Watch owners**
- “Site-less”, virtual trial
- Low incidence AF
- “Proof of Concept”, High PPV

Alcohol and Atrial Fibrillation

- 100 patients with PAF x 4 weeks
- **Dual monitors: EKG and EtOH levels**
- Risk of PAF proportional to total EtOH levels
- Risk: 1 drink = 2X, ?2 drinks = 3.6X within the following 4 hrs



Perez MV, et al. NEJM 2019;381:1909-1917 (ACC2019)



Continuous EKG monitoring patch

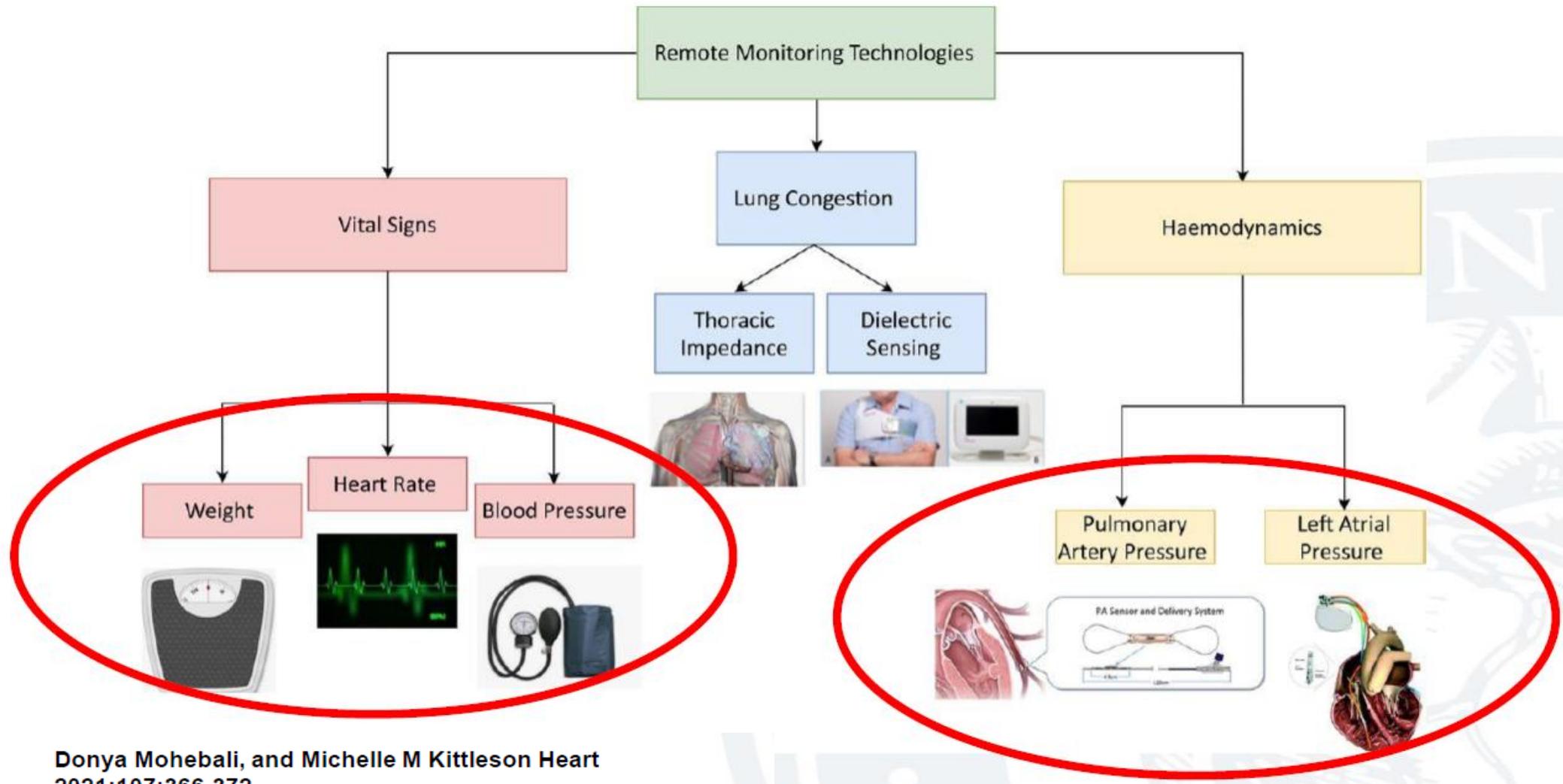


Secure Remote Continuous Alcohol Monitoring

Marcus GM, et al. Ann Int Med. 2021;174:1503 (ACC2021)

Summary of remote monitoring technologies and devices.

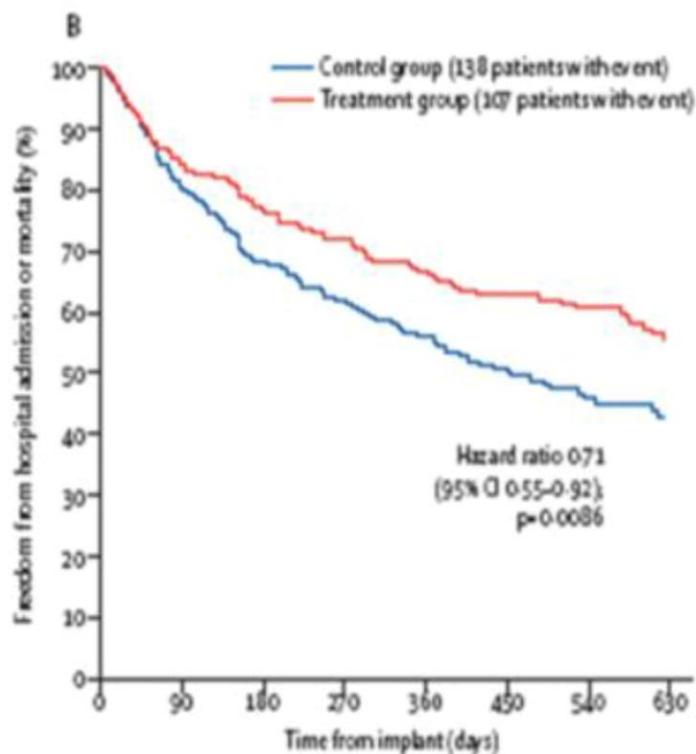
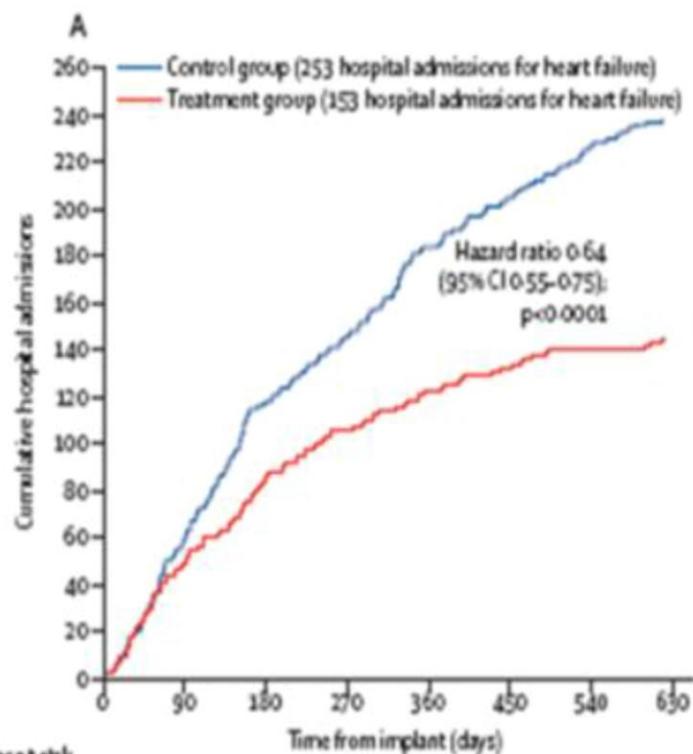
Focus = Titration of GDMT



Donya Mohebali, and Michelle M Kittleson Heart
2021;107:366-372

CHAMPION Trial

CHAMPION Trial



36% RRR for Hospitalisation

- 550 pts, 64 US sites
- All Class III
- HFrEF or HFpEF
- GDMT +/- CMEMMS
- Pt. blinded
- PEP: HFH at 6 mon
- SEP: DSRC's
- 36% reduction HRH
- 98.7 DSRC free
- No mortality benefit

Biometrics: Biosensing + PROM's + AI



Wear the BioButton for continuous vital sign measurement and/or contact tracing



Download the BioMobile iOS or Android App, which auto-detect the BioButton for quick and easy setup



Complete the daily health screener survey based on the latest CDC guidelines



BioCloud™ applies advanced analytics to detect subtle physiological changes and delivers an electronic BioReport



Cleared for entry to work of school

Enterprise protocols and/or 3rd party service providers provide care pathways and guidance on follow-up actions

Pilots: COVID-19 Infection – ACC2021 and Univ. of Oakland

Future of Patient Monitoring: Facial/Voice Recognition and Ingestibles



FACE

- Pain
- Depression
- PE
- Genetics



Voice

- Vocal “biomarker”
- 2.6x more ACS
- 3x more CAD



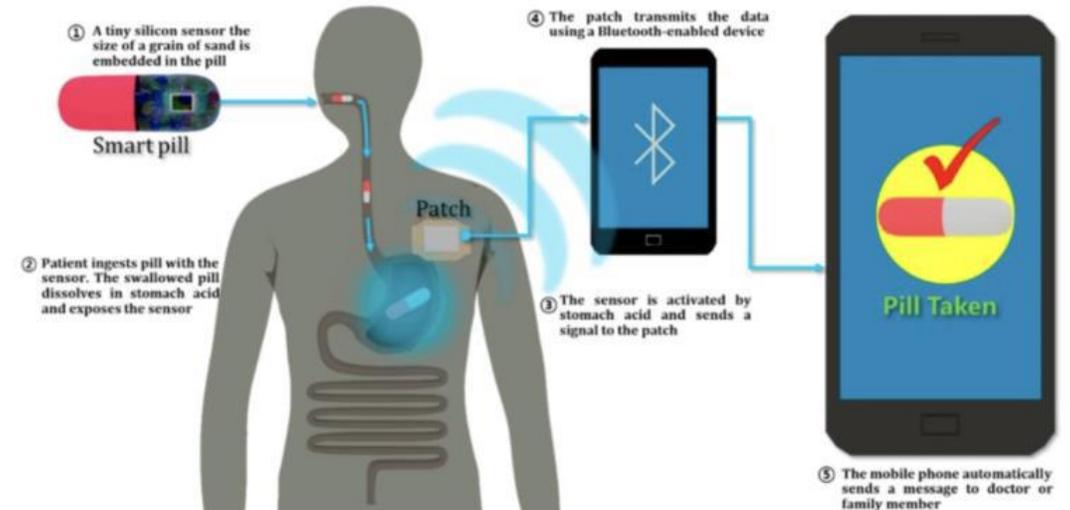
Home / News & Events / FDA Newsroom / Press Announcements / FDA approves pill with sensor that digitally tracks if patients have ingested their medication

Ingestibles

FDA NEWS RELEASE

FDA approves pill with sensor that digitally tracks if patients have ingested their medication

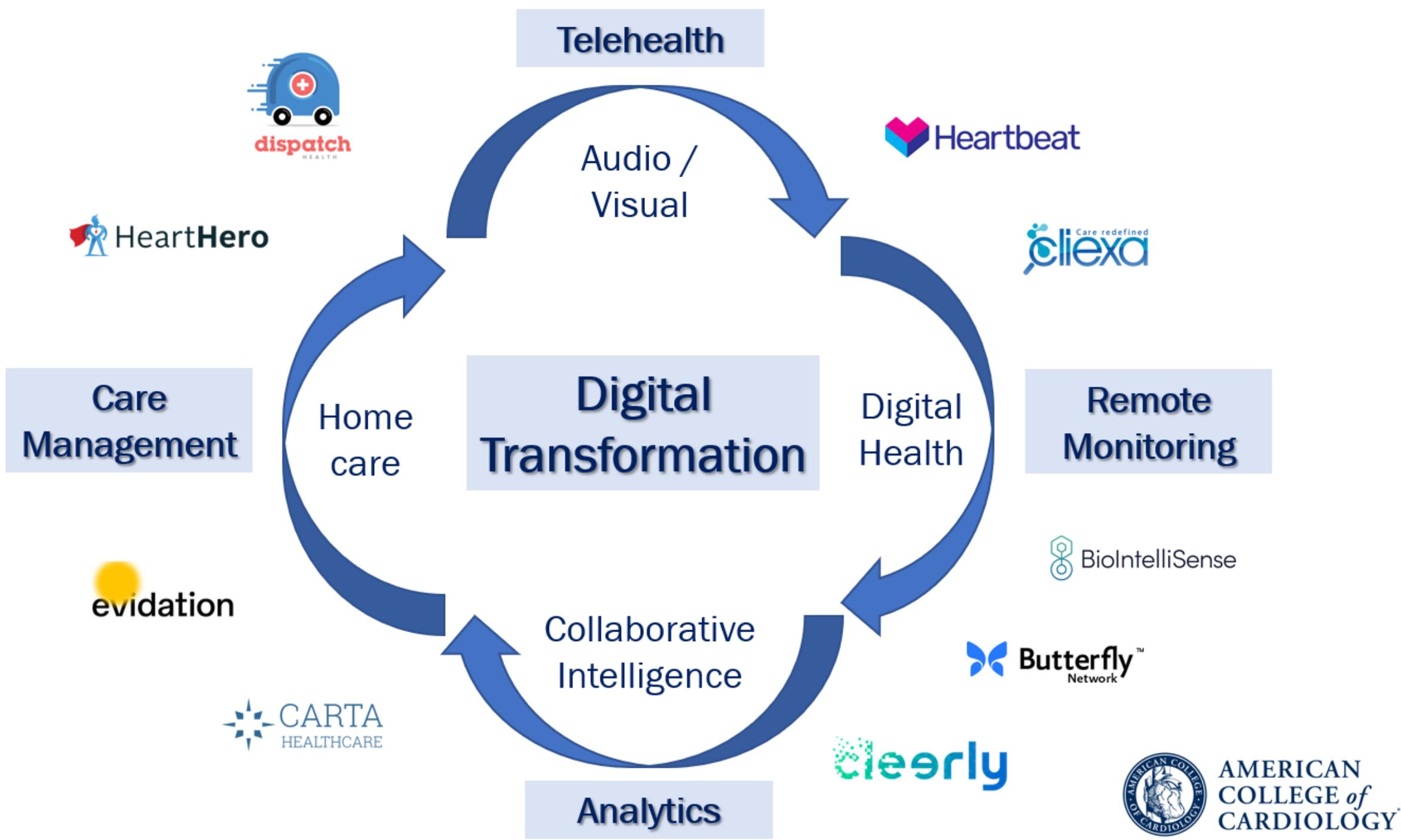
- Medication Compliance
- Microbiome Analysis
- Virtual Endoscopy



<https://www.face2gene.com/>

<https://www.acc.org/About-ACC/Press-Releases/2022/03/23/18/04/Speaking-from-the-Heart-Could-Your-Voice-Reveal-Your-Heart-Health>

<https://www.prescouter.com/2019/01/ingestible-sensors-innovations>



Innovation in Action

Parlaying learning from co-development to develop frameworks that guide clinician tech adoption

Telehealth Workbook

The American College of Cardiology's (ACC) Innovation Program is focused on the digital transformation of care delivery. One aspect of this digital transformation is the move to virtual care, which reflects an increase in care taking place outside of traditional hospital or clinic settings. In 2020, the ACC held a Heart House Roundtable, to gain a better understanding of the challenges, needs, and actions required to effectively manage cardiovascular patients remotely. Additionally, the ACC held its first Applied Health Innovation Consortium (AHIC) Summit focused on the optimization of virtual care. This telehealth workbook was developed as a response to clinician and patient needs identified from these two meetings.

The goal of this workbook is to provide guidance on conducting telehealth visits to effectively manage cardiovascular care, including what should happen prior to, during, and post-visit. The workbook includes sections on the management of **heart failure**, **atherosclerotic cardiovascular disease**, and **atrial fibrillation**. Additionally, it also includes resources to existing ACC tools that may complement your telehealth visits.

To learn more about the ACC Innovation Program, please visit: [ACC.org/InnovationProgram](https://www.acc.org/InnovationProgram)

AMERICAN COLLEGE of CARDIOLOGY

Consumer Technology Association

ANSI/CTA Standard
Best Practices for Consumer Cardiovascular Technology Solutions

ANSI/CTA-2105

AMERICAN COLLEGE of CARDIOLOGY

January 2022

World Heart Federation Roadmap for Digital Health in Cardiology

WHF ROADMAP

JASPER TROMP* ●
DEVRAJ JINDAL* ●
JULIE REDFERN
AMI BHATT
TANIA SÉVERIN
AMITAVA BANERJEE
JUNBO GE
DIPTI ITCHHAPORIA
TINY JAARMA
FERNANDO LANAS
FRANCISCO LOPEZ-JIMENEZ

AWAD MOHAMED
PABLO PEREL
GONZALO EMANUEL PEREZ
FAUSTO PINTO
RAJESH VEDANTHAN
AXEL VERSTRAEL
KHUNG KEONG YEO
KIM ZULFIYA
DORAIRAJ PRABHAKARAN ●
CAROLYN S. P. LAM
MARTIN R. COWIE ●

u[ubiquity press

CORRESPONDING AND CO-FIRST AUTHORS:
Jasper Tromp
National University of Singapore, SG
jasper_tromp@nus.edu.sg
Devraj Jindal
Centre for Chronic Disease Control, New Delhi, IN
djindal@ccdcindia.org

ABSTRACT

More than 500 million people worldwide live with cardiovascular disease (CVD). Health systems today face fundamental challenges in delivering optimal care due to ageing populations, healthcare workforce constraints, financing, availability and affordability of CVD medicine, and service delivery.

Digital health technologies can help address these challenges. They may be a tool to reach Sustainable Development Goal 3.4 and reduce premature mortality from non-communicable diseases (NCDs) by a third by 2030. Yet, a range of fundamental barriers prevents implementation and access to such technologies. Health system governance, health provider, patient and technological factors can prevent or distort their implementation.

World Heart Federation (WHF) roadmaps aim to identify essential roadblocks on the pathway to effective prevention, detection, and treatment of CVD. Further, they aim to provide actionable solutions and implementation frameworks for local adaptation. This WHF Roadmap for digital health in cardiology identifies barriers to implementing digital health technologies for CVD and provides recommendations for overcoming them.

KEYWORDS:
digital health interventions for CVD, e-health, health system governance

TO CITE THIS ARTICLE:
Tromp J, Jindal D, Redfern J, Bhatt A, Severin T, Banerjee A, Ge J, Itchhaporia D, Jaarman T, Lanas F, Lopez-Jimenez F, Mohamed A, Patel P, Perez GE, Pinto F, Vedanthan R, Verstrael A, Yeo KK, Zulfiya K, Prabhakaran D, Lam CSP, Cowie MB. World Heart Federation Roadmap for Digital Health in Cardiology. *Global Heart*. 2022; 17(1): 59. DOI: <https://doi.org/10.5334/gh.1141>



Arrhythmia Detection using PPG (Photoplethysmography)



Advancing Technology Use Cases



**INFRASONIC
HEMODYNOGRAPHIC
TECHNOLOGY**



Remote cardiovascular monitoring systems for actionable real time data

Submit oxygen saturation reading
You'll need your pulse oximeter
9:00 AM
TAP TO START

Complete eDiary
Take medication and record details
8:00 AM - 10:00 AM
TAP TO START

Reminder: Urine collection
Prepare your sample for collection
11:00 AM
DONE

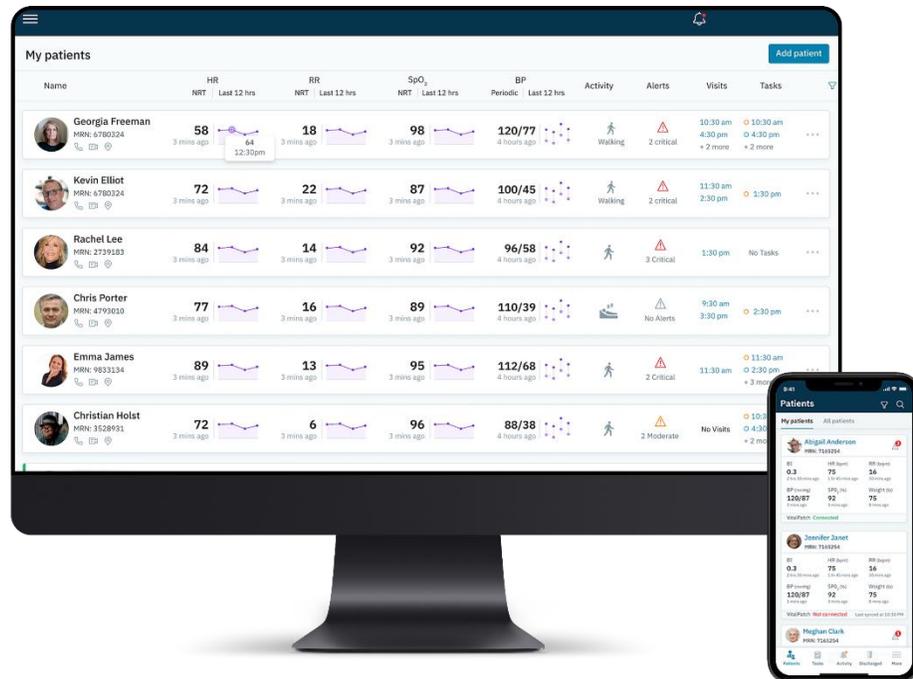
I need help

Navigation icons: Pulse line, Heart, O₂, Pill, Chart



Platforms for Comprehensive Home Monitoring

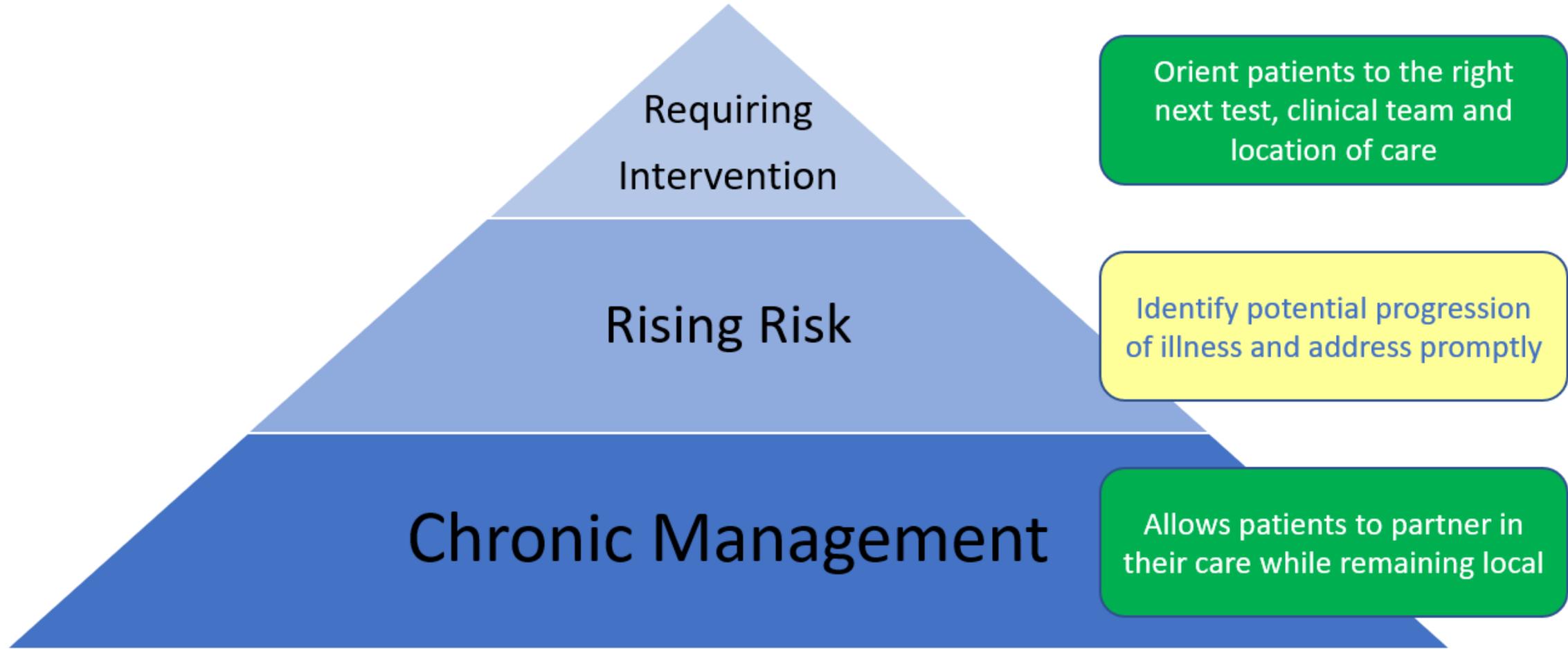
Examples: IntelliH, Biofourmis, CareMindr, Current Health, Hello Heart, Livongo, Medical Innovations, Myia, Orma Health

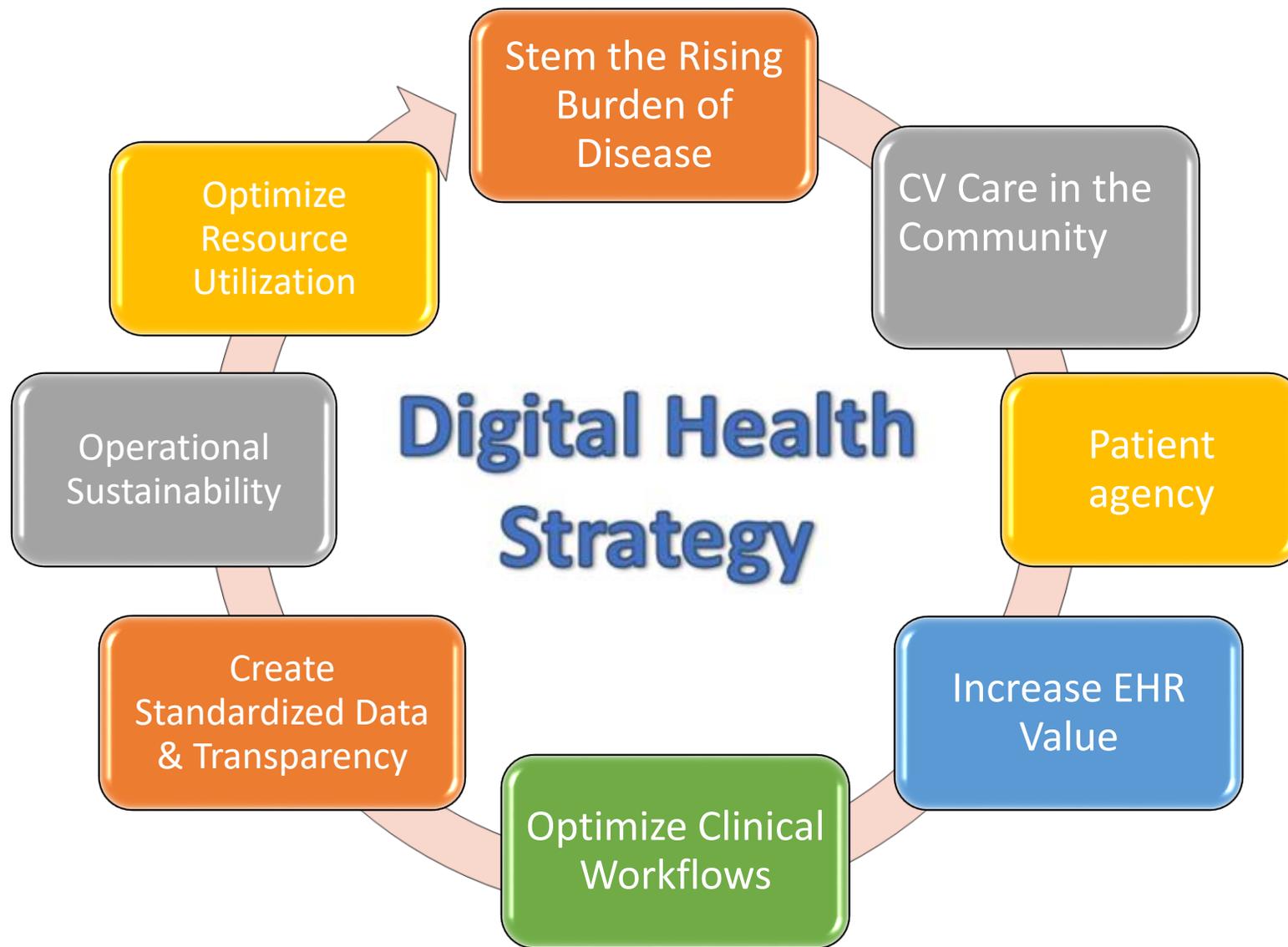


Myia



A Digital Health Strategy Personalizes Population Health





The Transformative Potential of Digital Health Strategy

The New Cardiovascular Landscape

Asynchronous
Communication:
PROMs, Electronic
Consultation

Blended Care: In-
person and Virtual
synchronous visits

Clinical remote
monitoring,
medical grade
devices

Digital tracking
and wearables

Emerging
analyses: Data
and Artificial
Intelligence



Advancing Heart Care Worldwide

ACC INNOVATION PROGRAM





The Future is
Now

Thank you!



AMERICAN
COLLEGE of
CARDIOLOGY®



AMERICAN
COLLEGE of
CARDIOLOGY®

Advancing Heart Care Worldwide

ACC INNOVATION PROGRAM



Virtual Care



Tele-In-Home Care

Novel Med. Hardware

Digital Care



CDSM

NLP/AI-Abstraction



Audio/
Visual



Digital
Transformation
Eco-System



Home
Care

Payment
model

Care
pathways



Digital
Health

Cardio-Telehealth

AI-linked PROM RPM

Digital "Prescriptions"

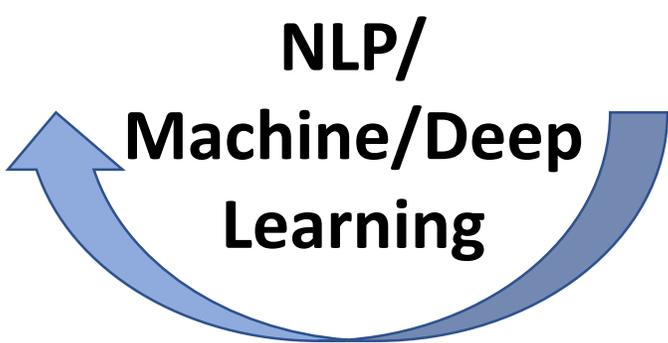
Remote Monitoring

Bio-sensor monitoring

POC Imaging

RPM Software

AI-Assisted CTA



NLP/
Machine/Deep
Learning

Analytic