



# **The Path to Zero is One**

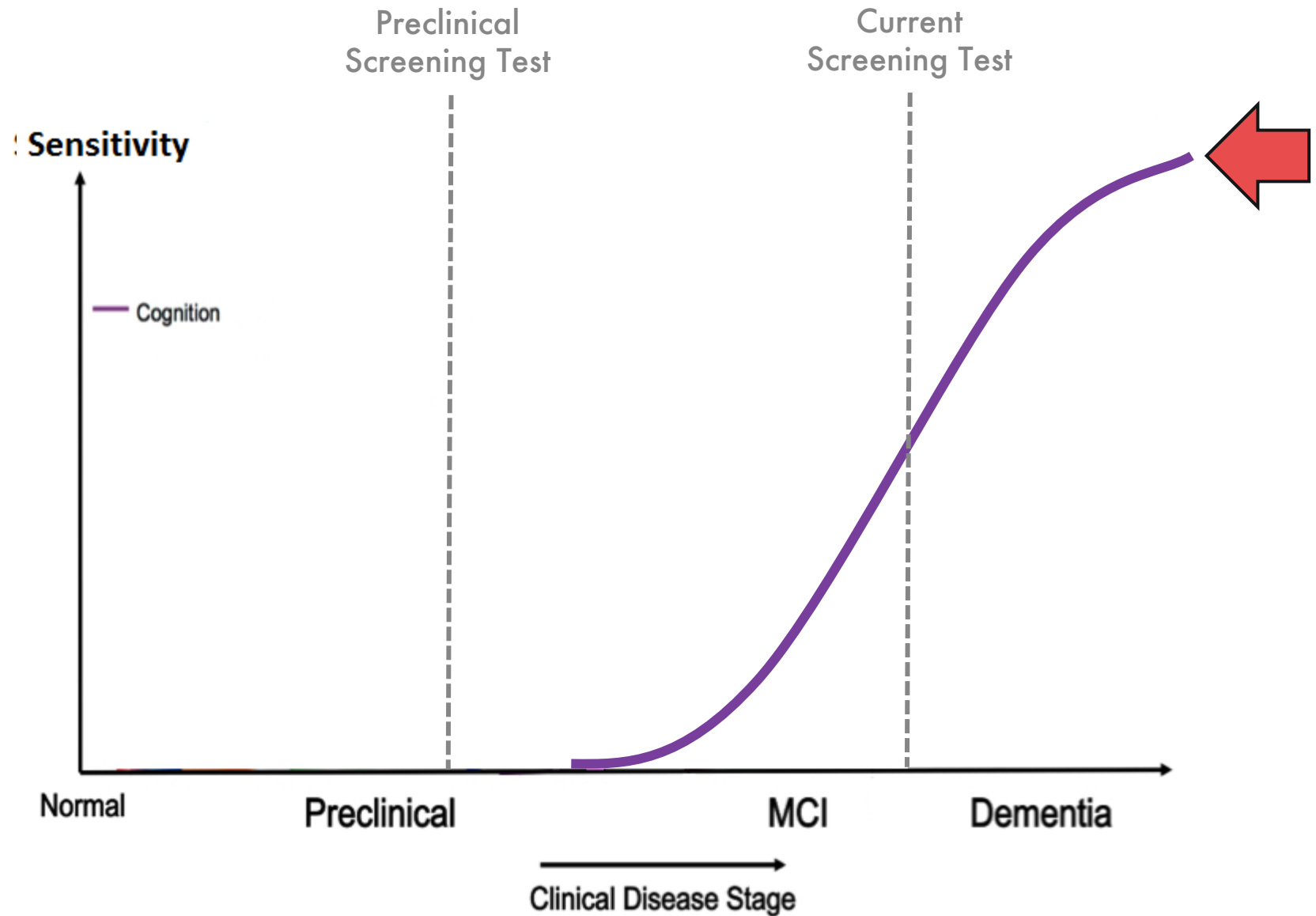
## **Detection in the Digital Era**

Rhoda Au, Ph.D.  
30<sup>th</sup> Annual Southern California  
Alzheimer's Disease Research Conference  
October 25, 2019

## RACIAL DIVERSITY IN THE UNITED STATES OF AMERICA



# Research Situation



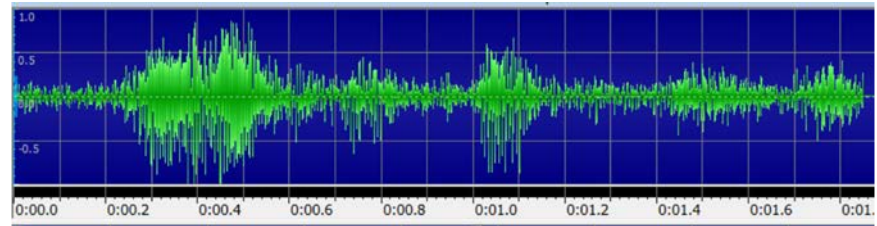
Adapted by Drs. Dana Penney and Randall Davis from Fig 3 of *Criteria For Preclinical Alzheimer's Disease*, Alzheimer's Association report (2010), which in turn cites Jack C R, et al., Hypothetical model of dynamic biomarkers of the Alzheimer's pathological cascade, *The Lancet*, 9:1, Jan 2010, pp 119-128.



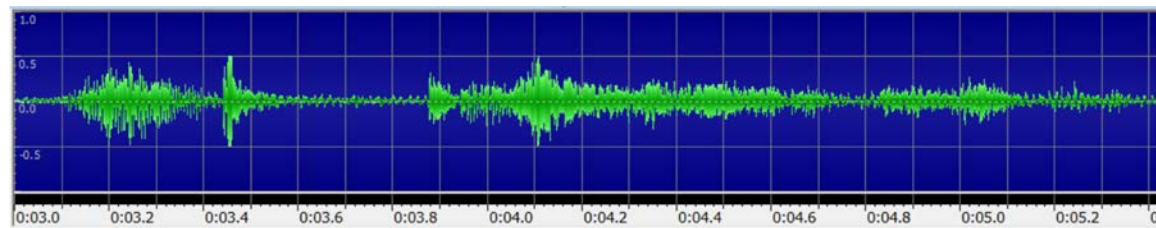
# Leveraging Digital for AD Precision Medicine

# Digital Voice

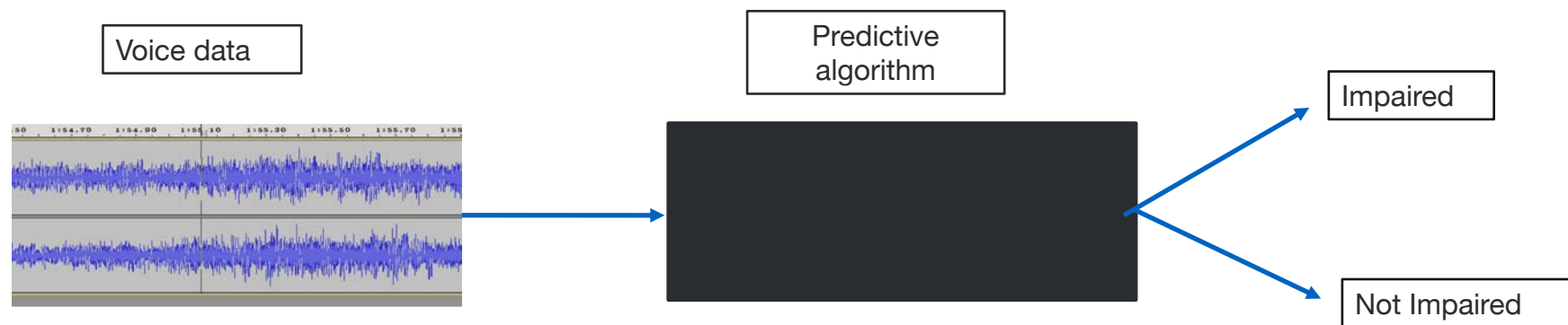
Not Demented: 2009



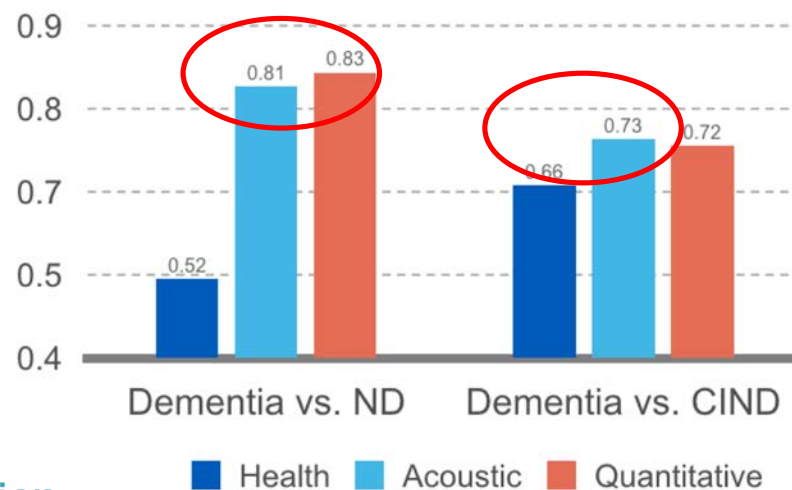
Mild Cognitive Impairment: 2015



# Digital Voice Biomarkers

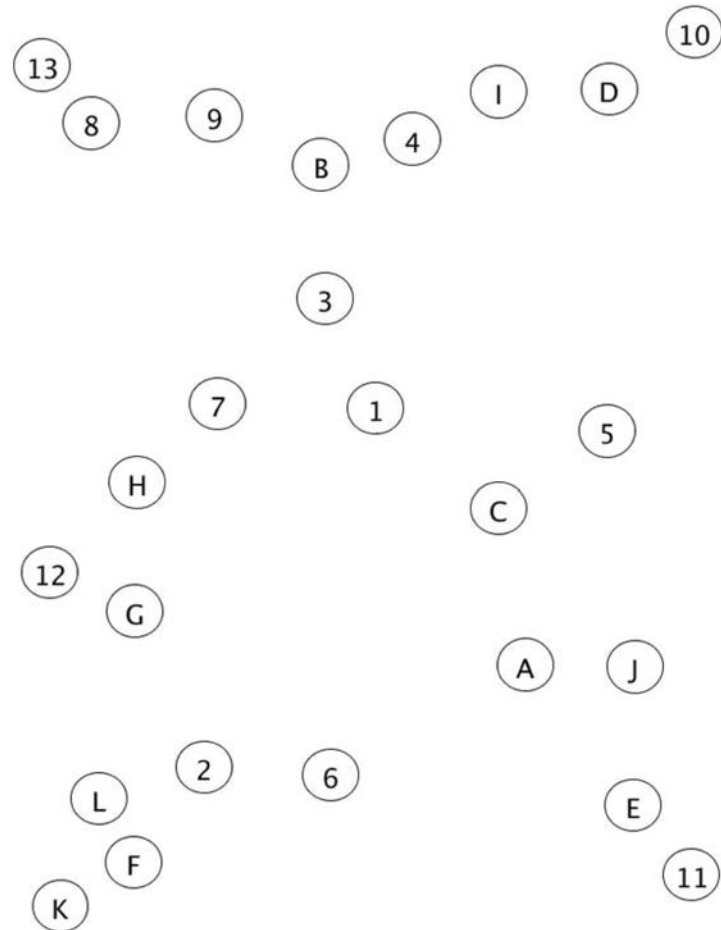


Classification Performance (AUC)



# Digital Drawing

*ANoto*



# Digital Written Biomarkers

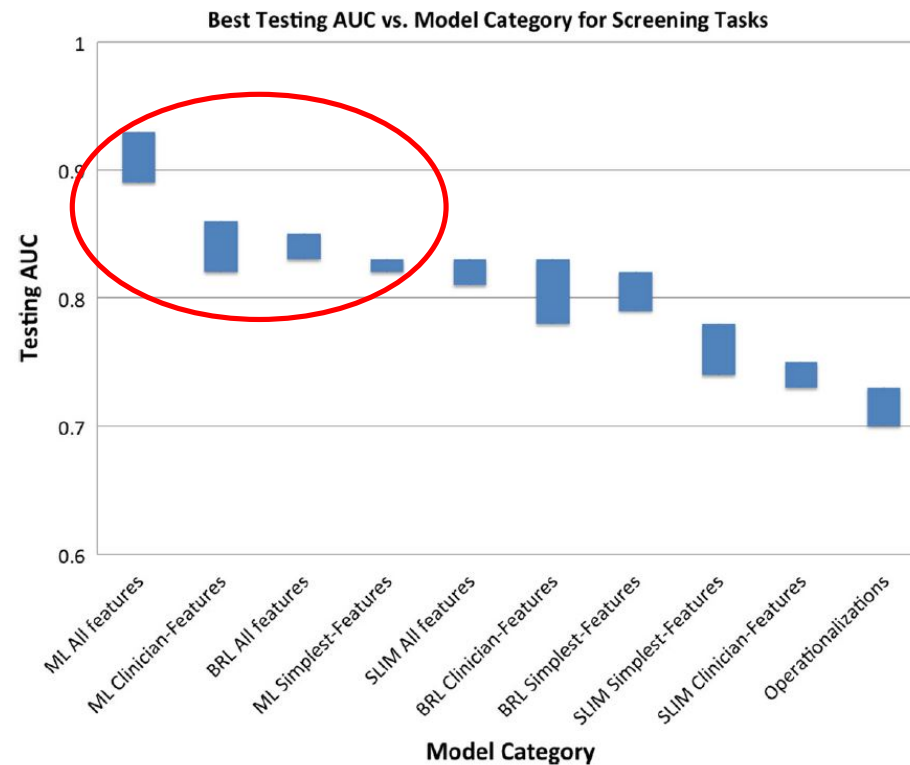


Fig. 1 Summary of results for screening

; Souillard-Mandar et al. (2015) Learning Classification Models of Cognitive Condition From Subtle Behaviors in the Digital Clock Drawing Test



# Cognitively Intact Individuals

## Digital Clock Drawing Test (dCDT)

1791 dementia- and stroke-free FHS participants

- Age:  $62 \pm 13.82$
- Education: 52% college degree
- Gender: 47% women
- Average MMSE: 29

### dCDT parameters

Total Time To Completion

Total "Ink" Time

Total "Think " Time

Total Strokes

Higher-Order Decision Making Latencies

Post clock face circle latency

Pre 1st hand latency

Pre 2nd hand latency

# Results

## Command

Total Time to Completion

80s+ > 60s, 50s, 40s, 20 & 30s

70s > 50s, 40s

60s > 40s

Total Pen Strokes

80s+ > 40s

Pre-2<sup>nd</sup> hand latency

80s+ > 60s, 50s, 40s

70s > 50s, 40s

## Copy

Total Time to Completion

80s+ > all other groups

70s > 50s, 40s

Total Pen Strokes

80s+ > all other groups

70s > 40s

60s > 40s

Post-Clock Face Latency

80s+ > all other groups

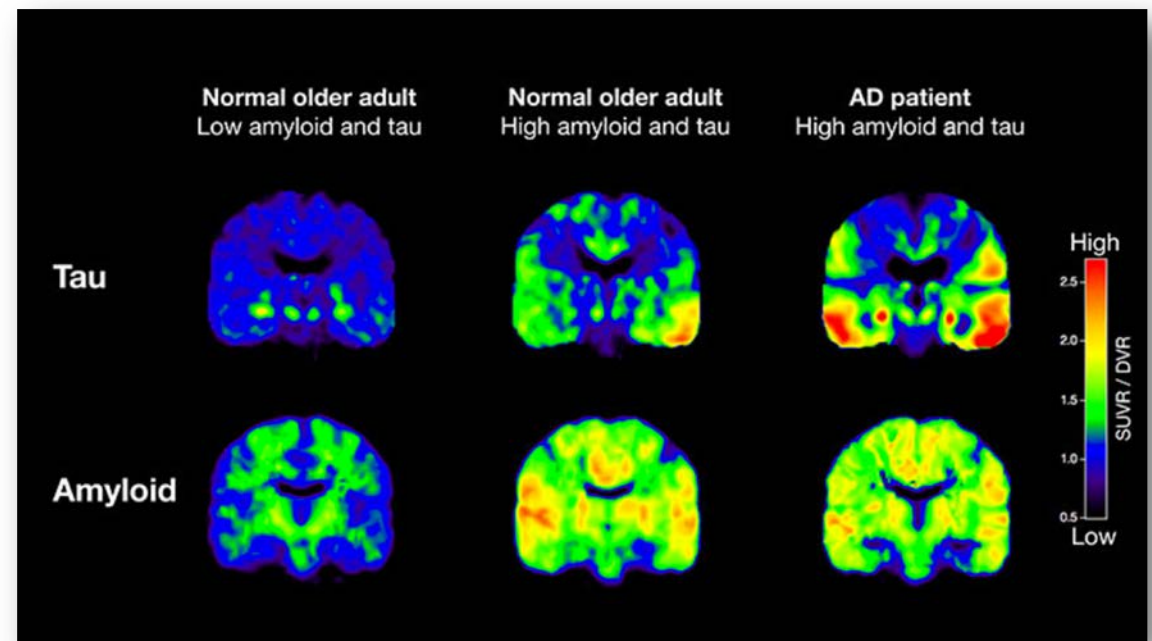
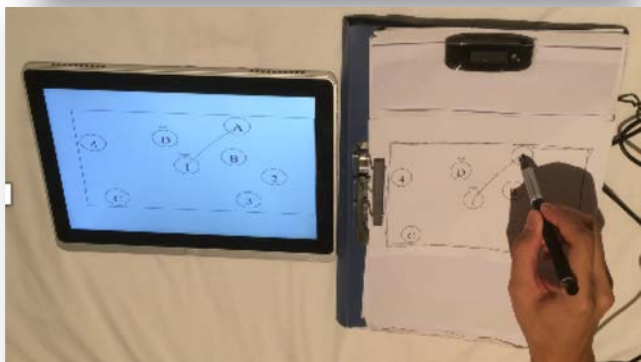
Pre-1st Hand Latency

80s+ > all other groups

Pre-2<sup>nd</sup> Hand Latency

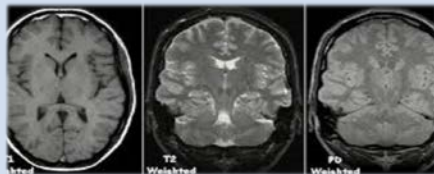
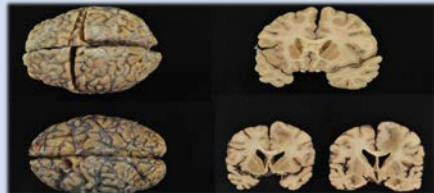
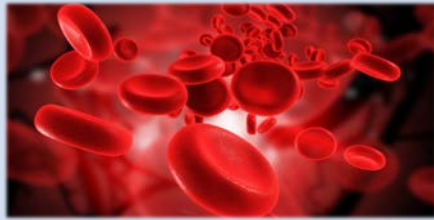
80s+ > 70s, 60s, 50s, 40s

# Surrogate Cognitive Biomarkers



# Expanding FHS for AD Precision Medicine

## Biomarkers



## Analytics

Deep Machine Learning

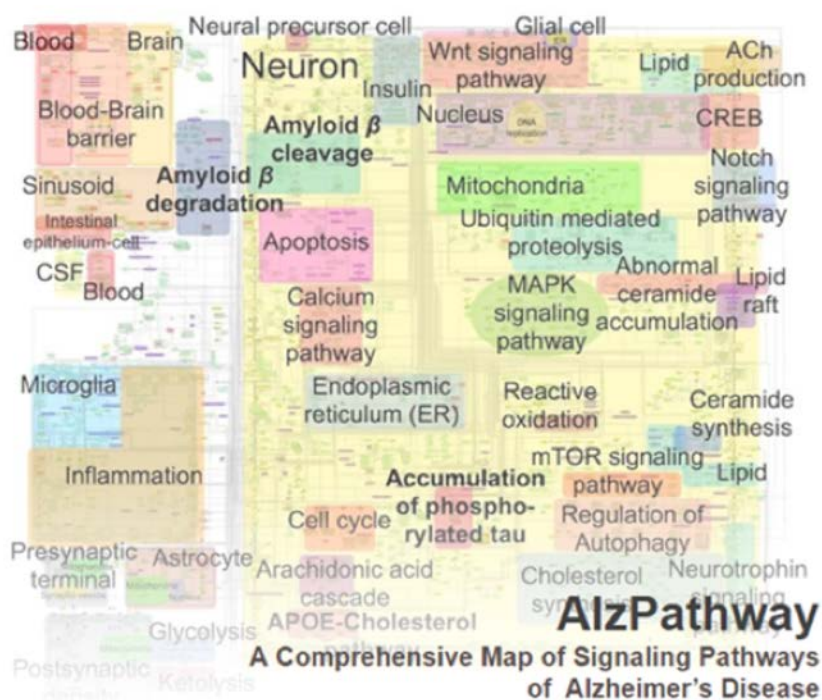
Quantum Mathematics

Bioinformatics

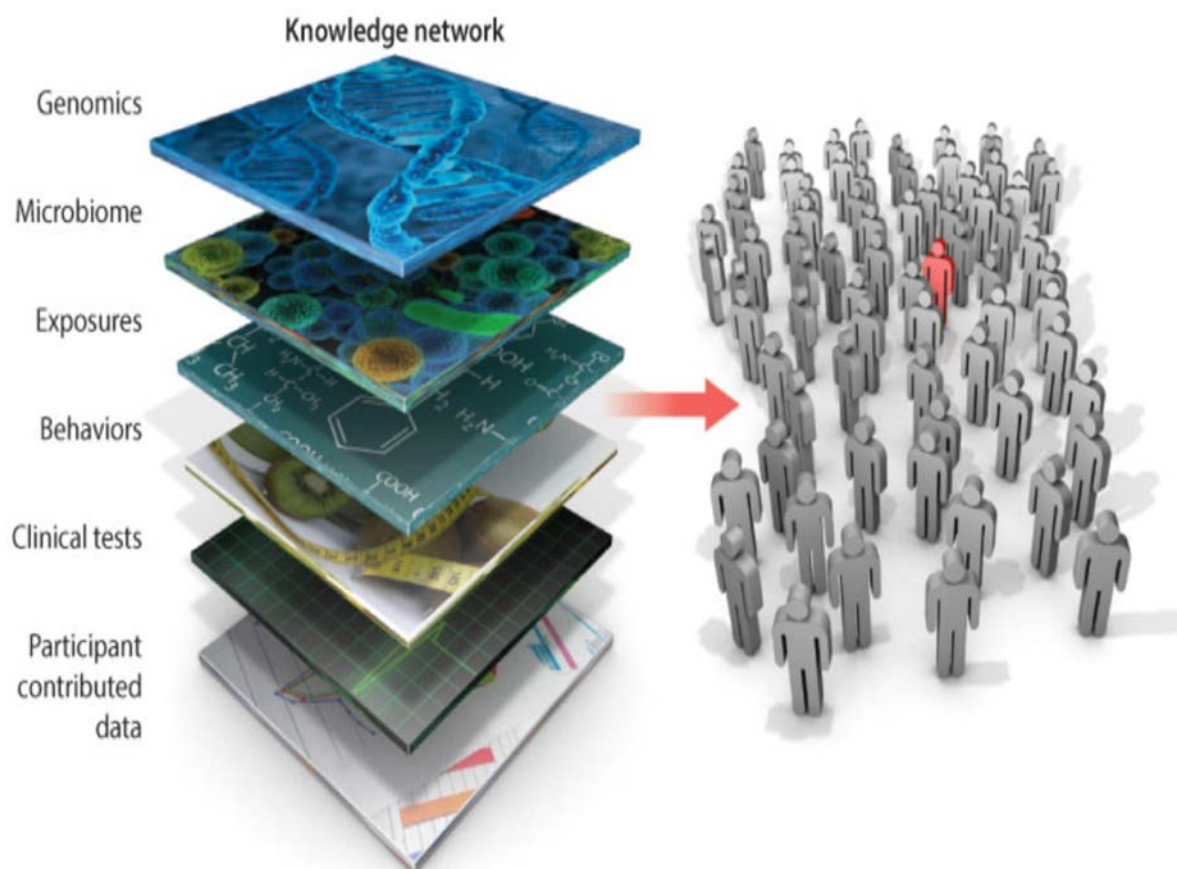
## Novel Phenotypes



# Richest Molecular/Phenotypic Data Resource for Alzheimer's Disease Drug Discovery



<http://alzpathway.org/AlzPathway.html>





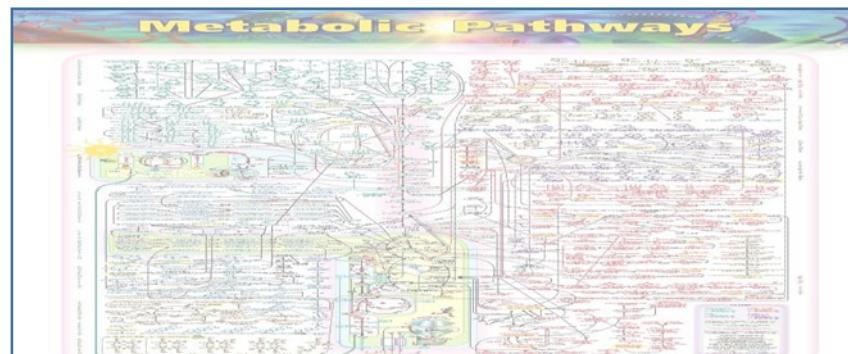
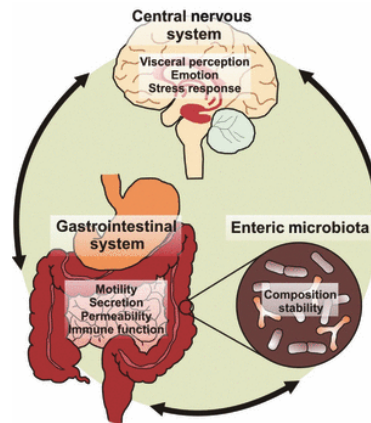
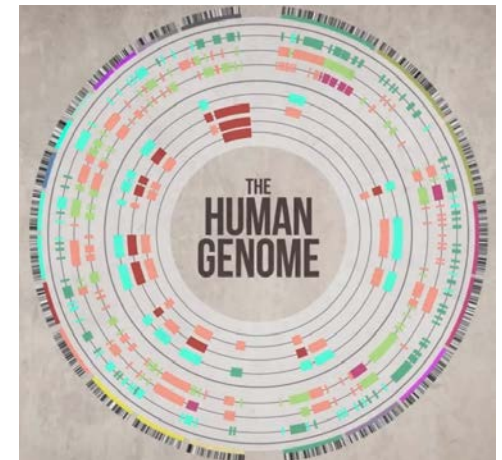
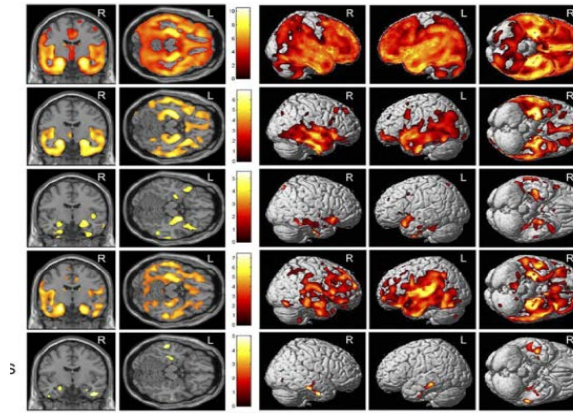
# What Next?

**Cognitive Impairment**

**Cognitive Health**

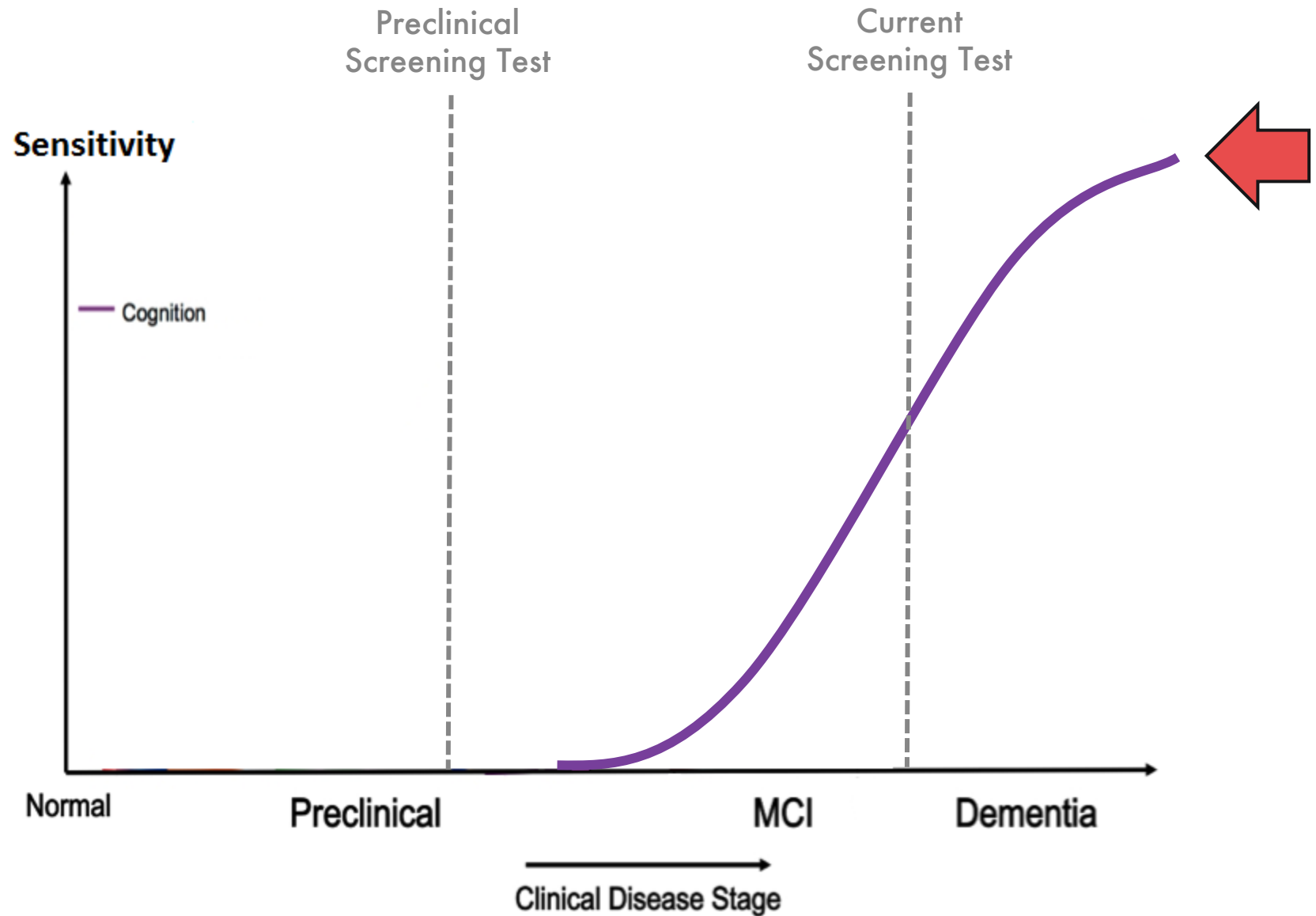


# Sustaining brain health across life span



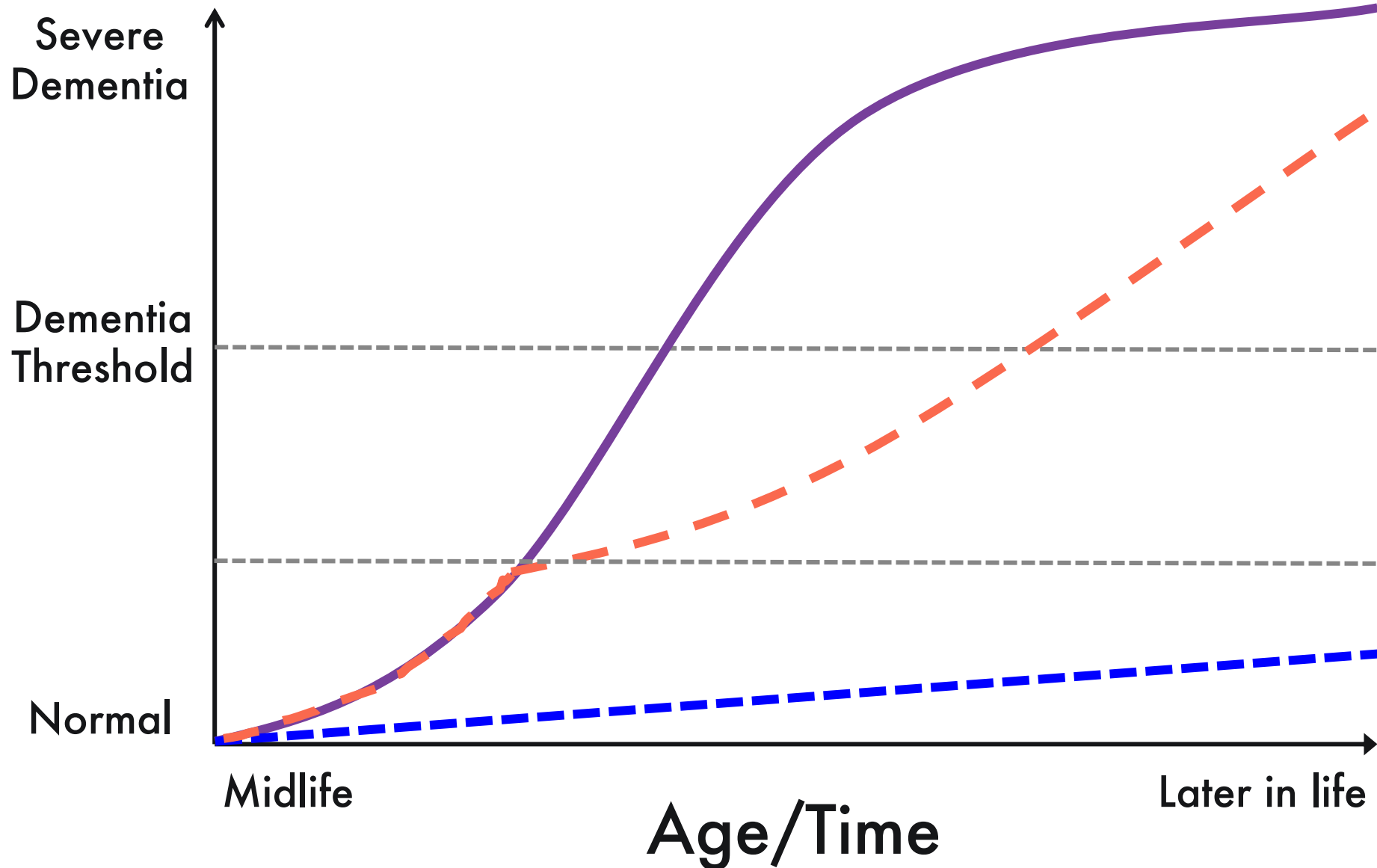


# Alzheimer's Strategy



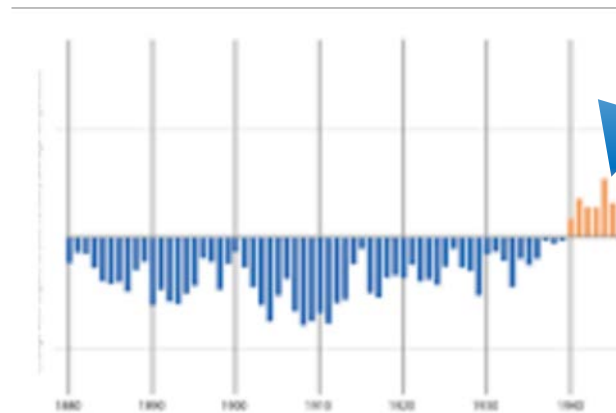
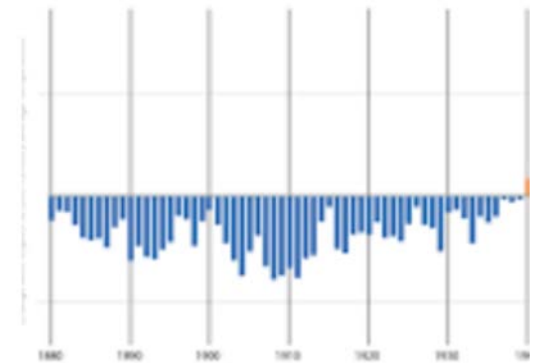
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# The Impact



# Alzheimer's Disease Onset is Insidious

## Pre-symptomatic Monitoring

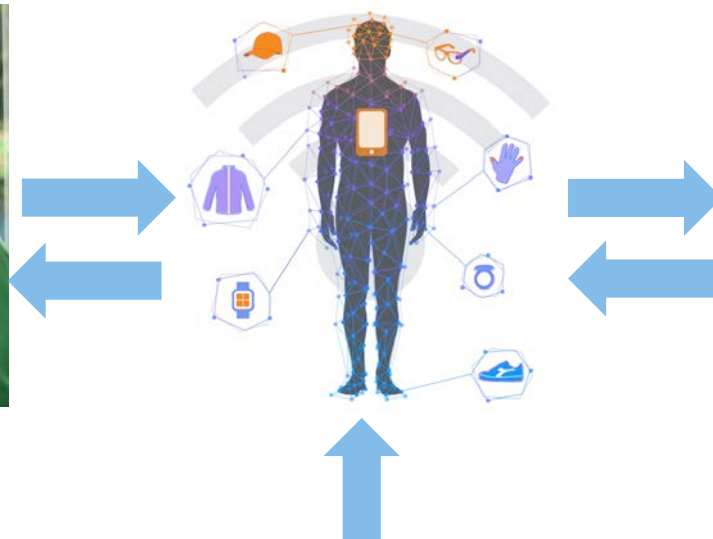


# Brain Health Monitoring Platform

Clinic

Mobile

Home



# Traditional Data Collection: Clinic

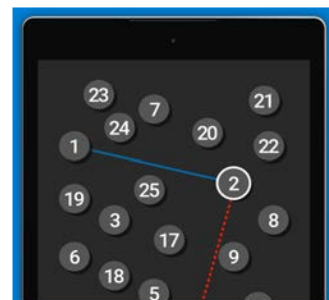
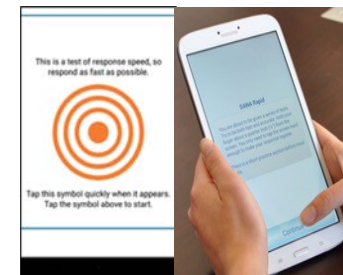
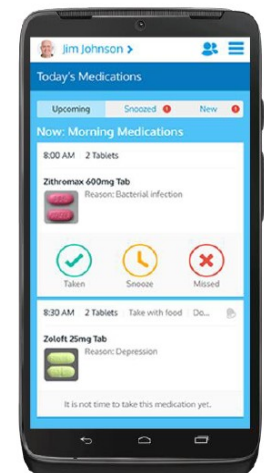
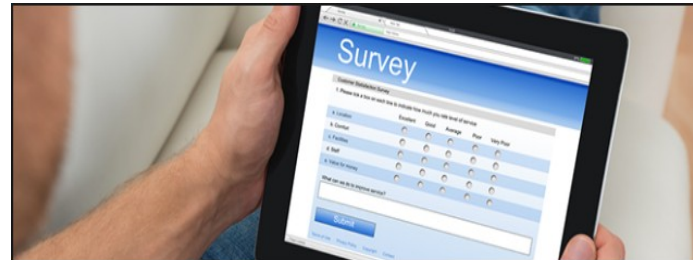
## Maximize Digital Capture of Health Metrics



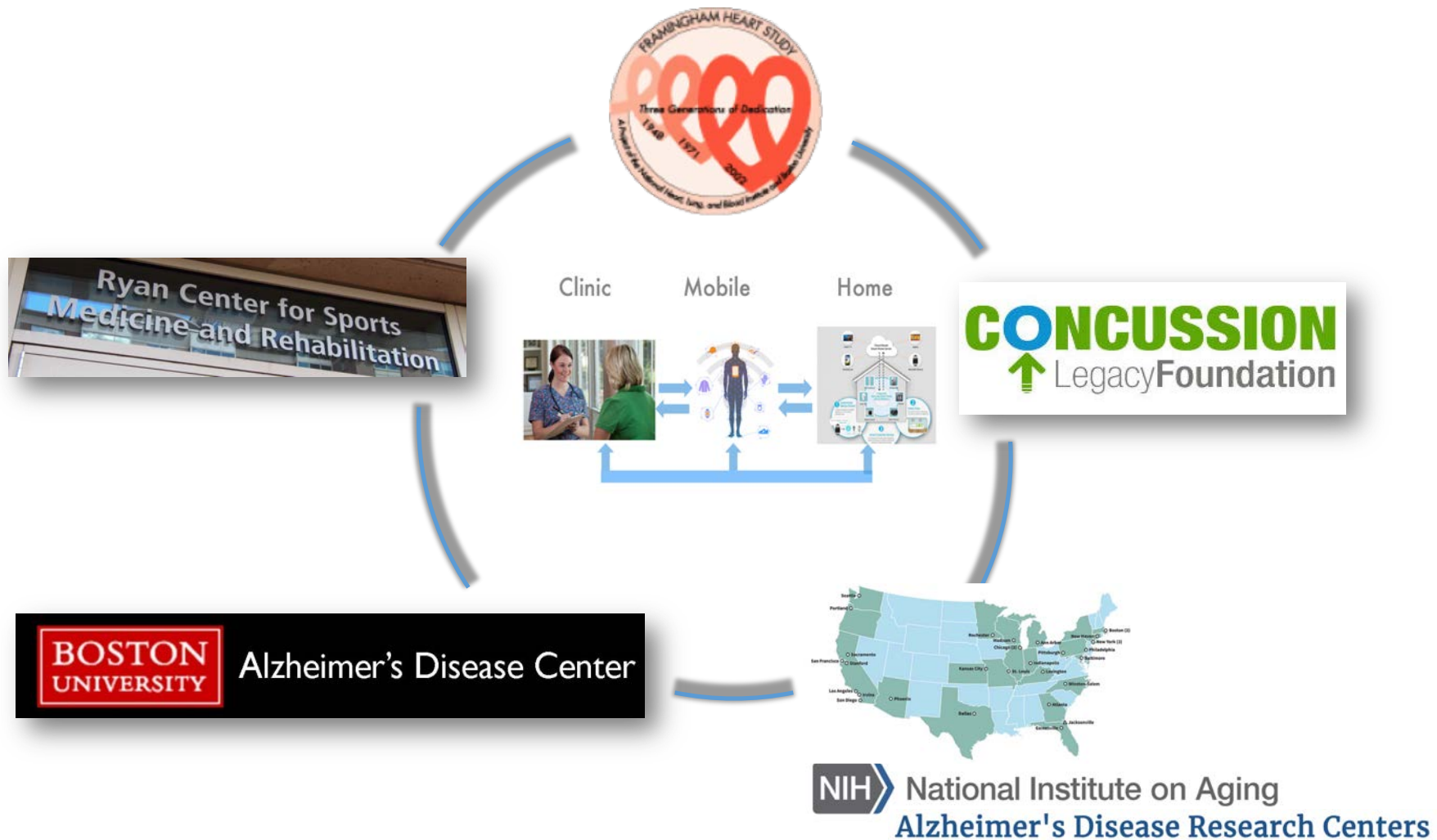


# Active Engagement Technology

## Remote Monitoring



# Testing & Validating Brain Health Monitoring Platform

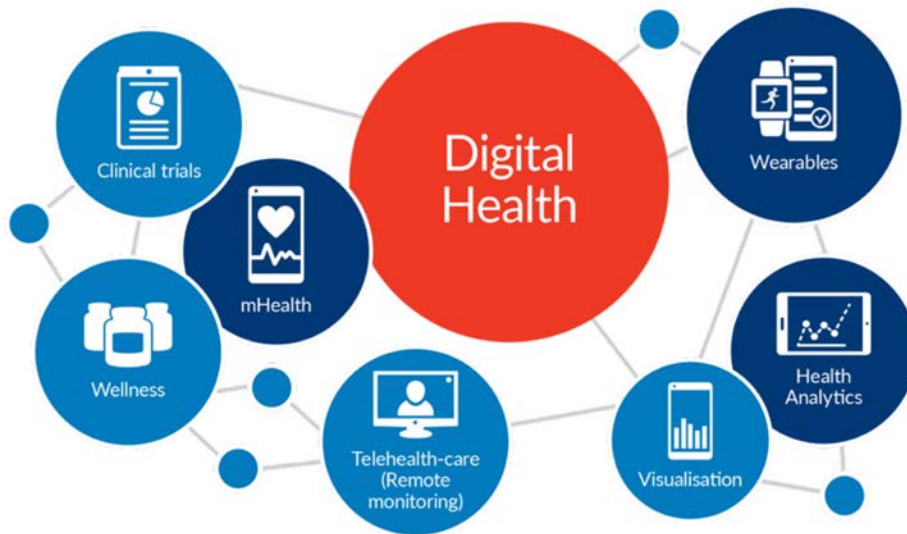




# Digital Biomarkers An Innovative Path



# FDA Digital Health Innovation Action Plan



Promote the development and use of digital health technologies

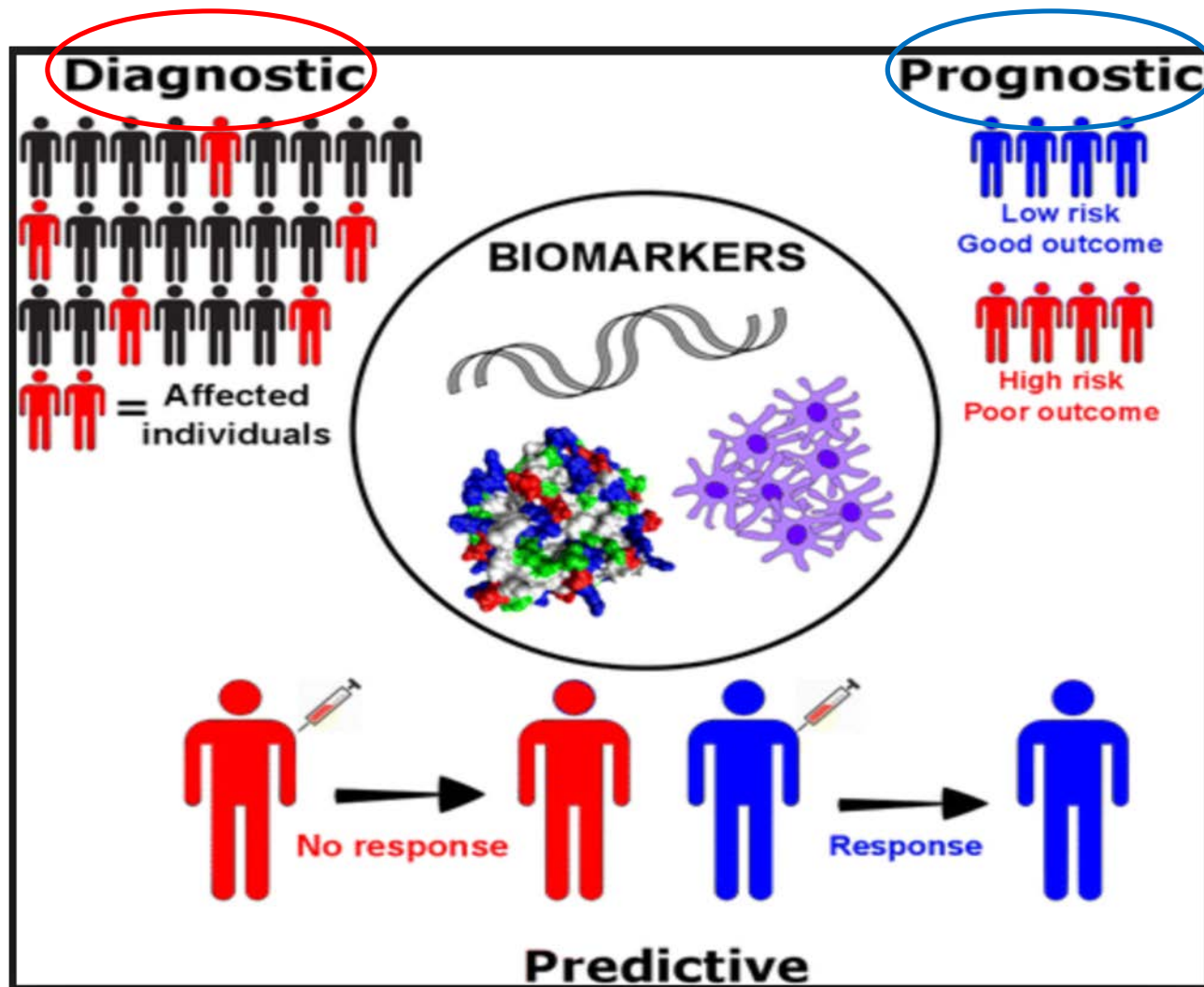
Digital health technologies may act as **susceptibility/risk biomarkers**



Source: <https://www.fda.gov/MedicalDevices/DigitalHealth/default.htm>;

[https://www.ncbi.nlm.nih.gov/books/NBK326791/pdf/Bookshelf\\_NBK326791.pdf](https://www.ncbi.nlm.nih.gov/books/NBK326791/pdf/Bookshelf_NBK326791.pdf)

# Digital Biomarkers



# What We Are Doing

## Build Plug and Play System



**LiNUS** HEALTH

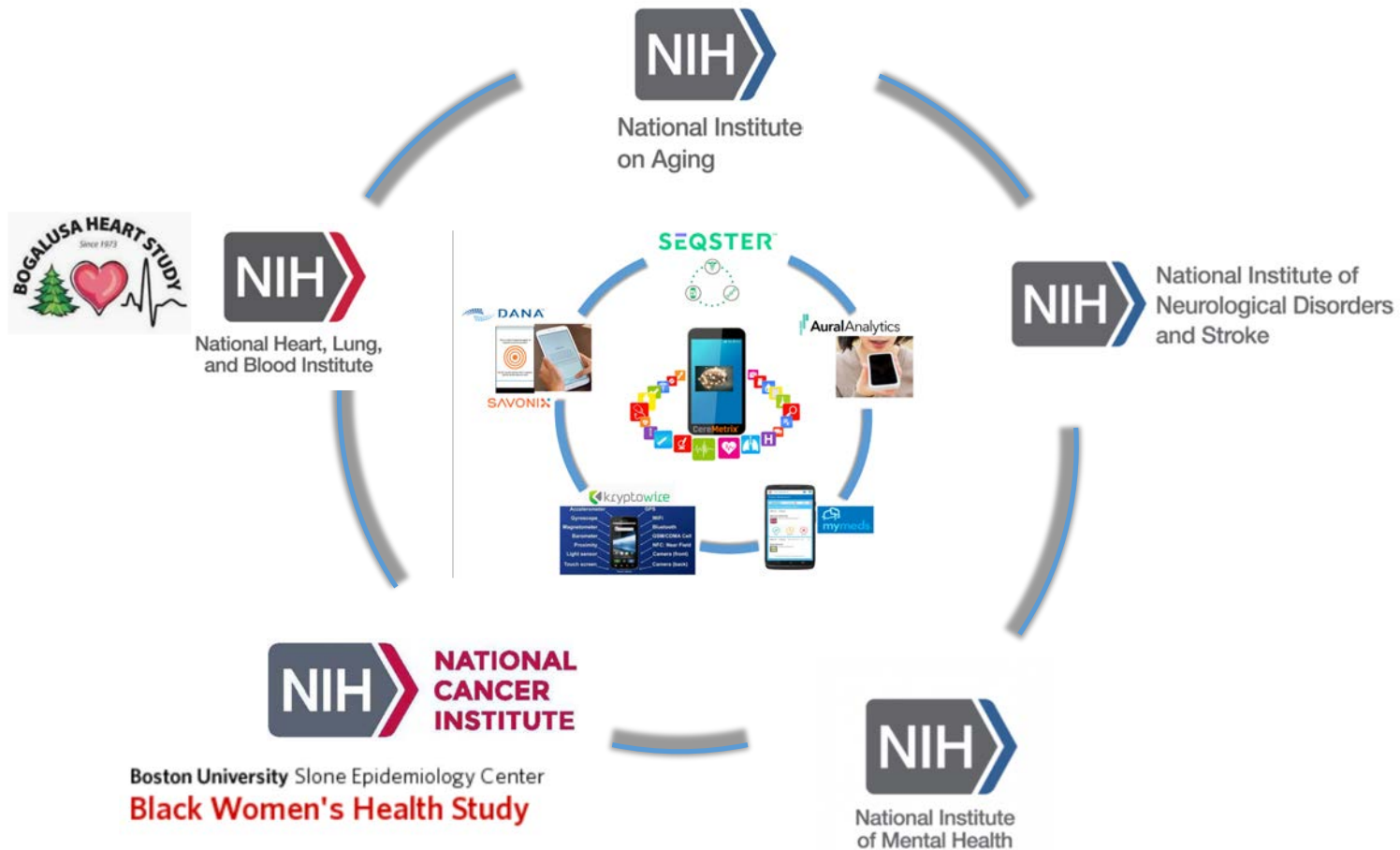
# Test Platform Robustness

## Diverse Study Sites



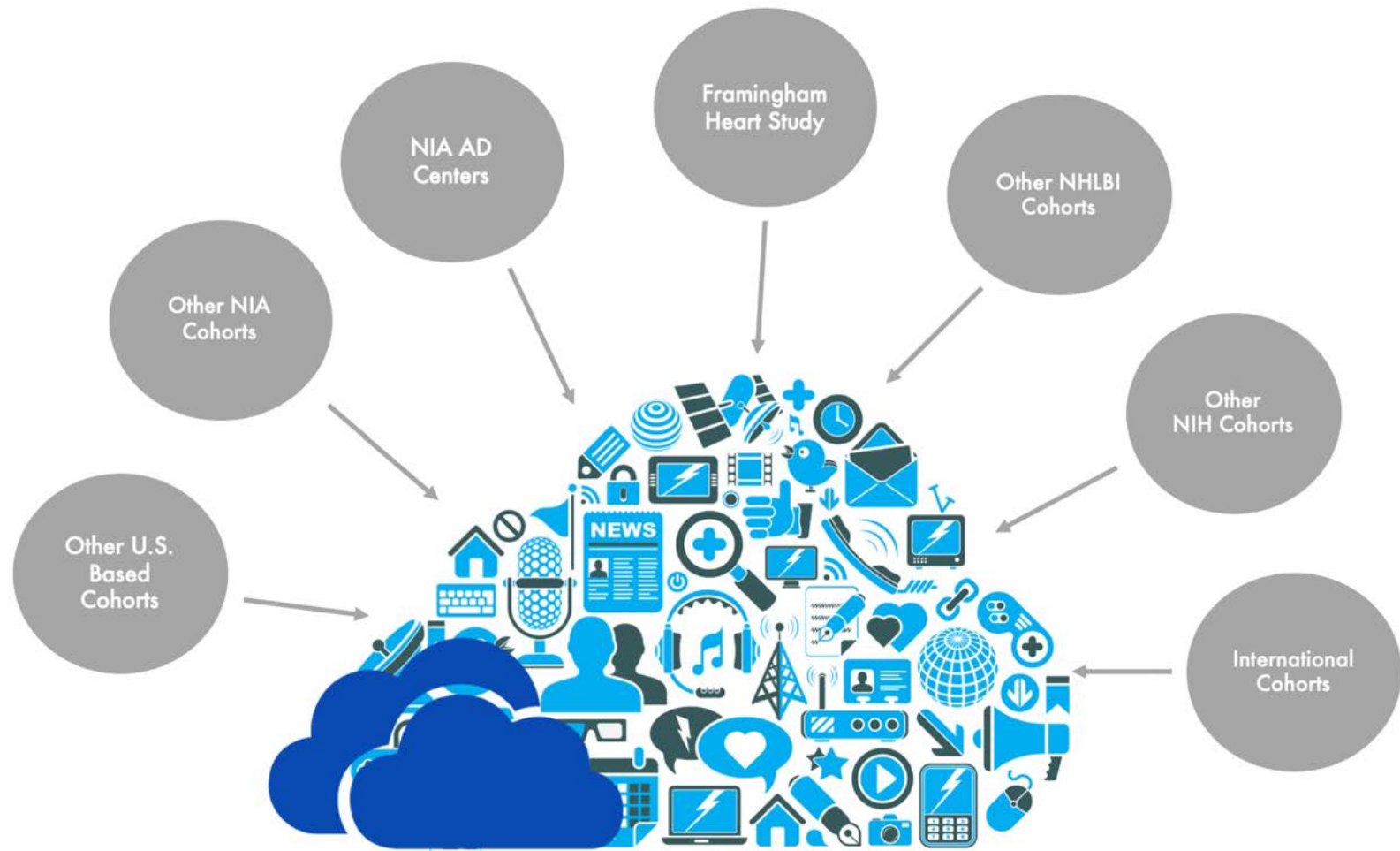
# Leverage NIH Investments

## Deploy in Diverse Cohorts



# What We Will Build

## Open Science Data Sharing Platform



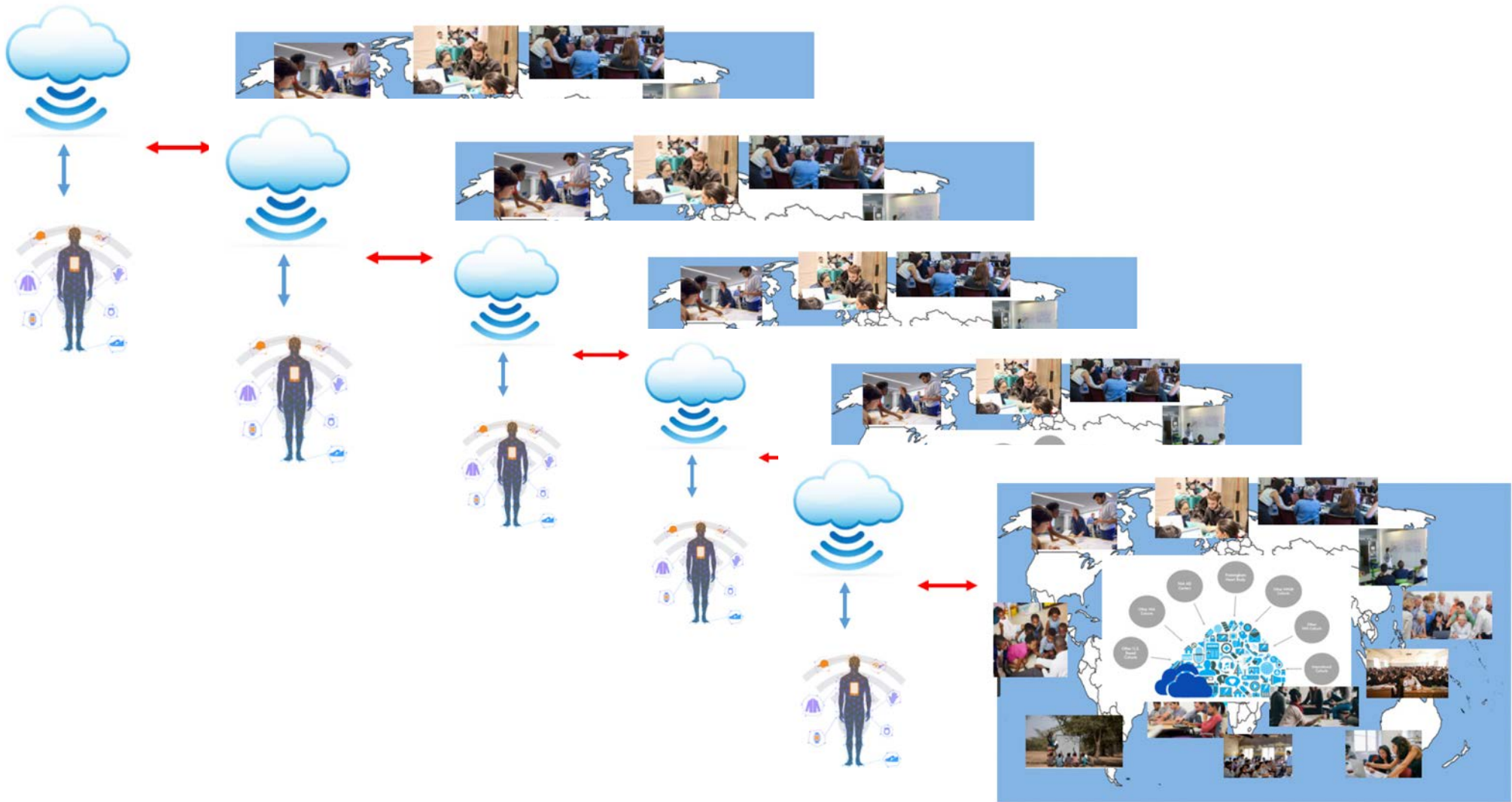


# How We Will Discover Digital Biomarkers

## Open Science Data Challenge



# How We Will Accelerate Digital Biomarker Discovery





# Who We Are Doing it With

More in  
Pipeline



Always Seeking More

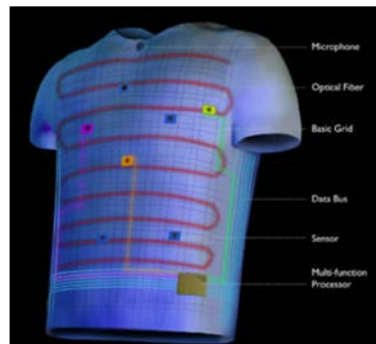
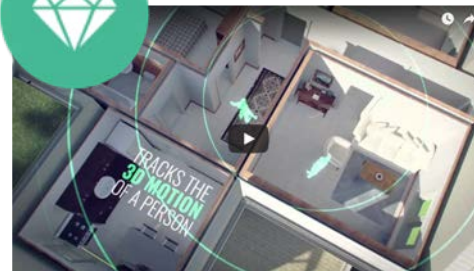


# Where Next?



# Ambient Technology

## Sustainable Remote Monitoring



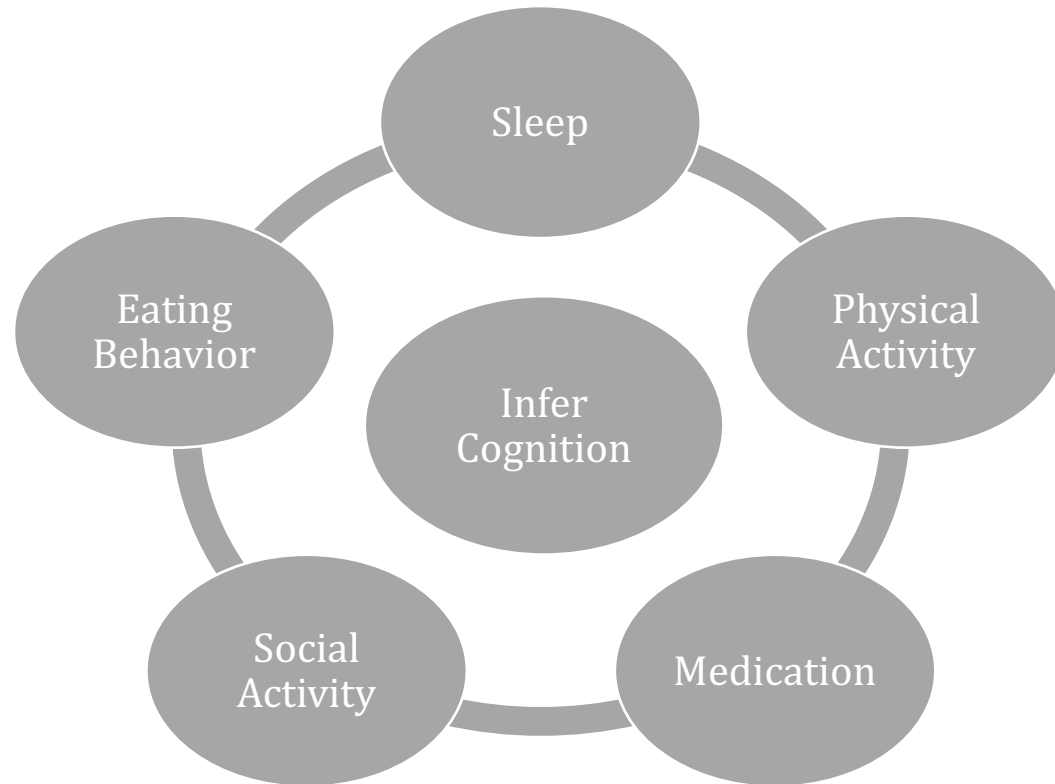
# What We Need to Do

## Precision Brain Health





# Translational Impact



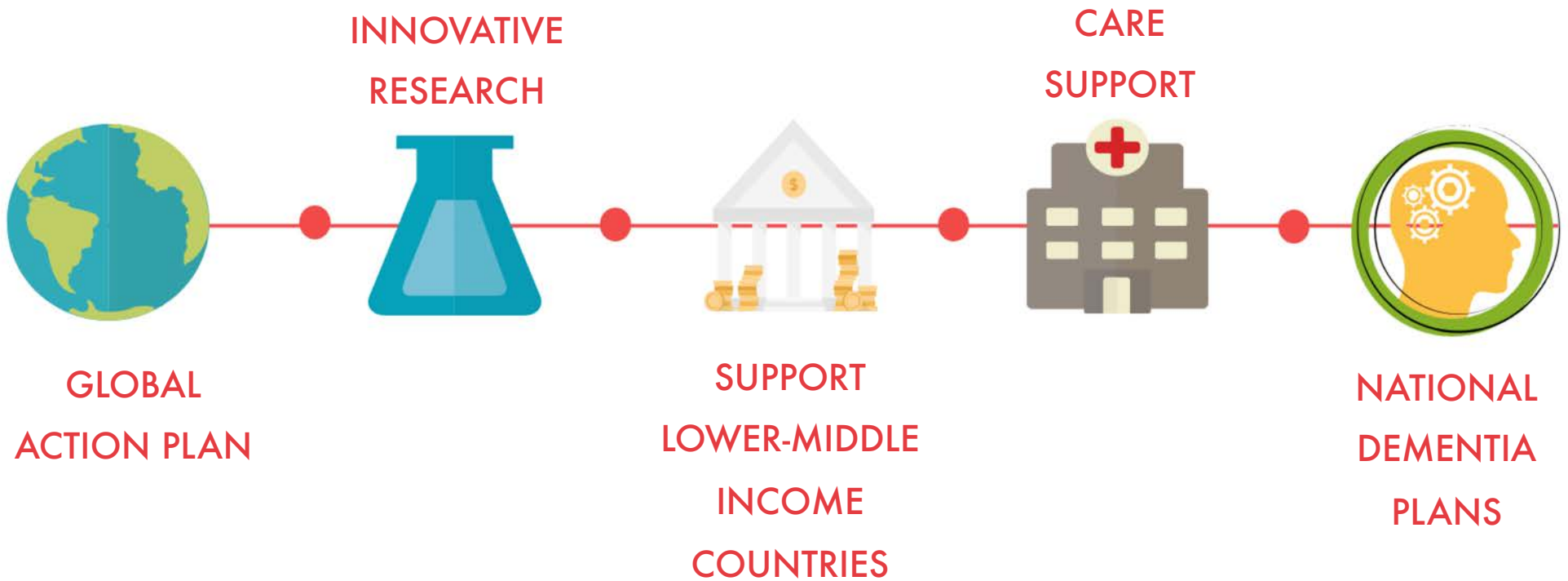


# Achieve Representativeness



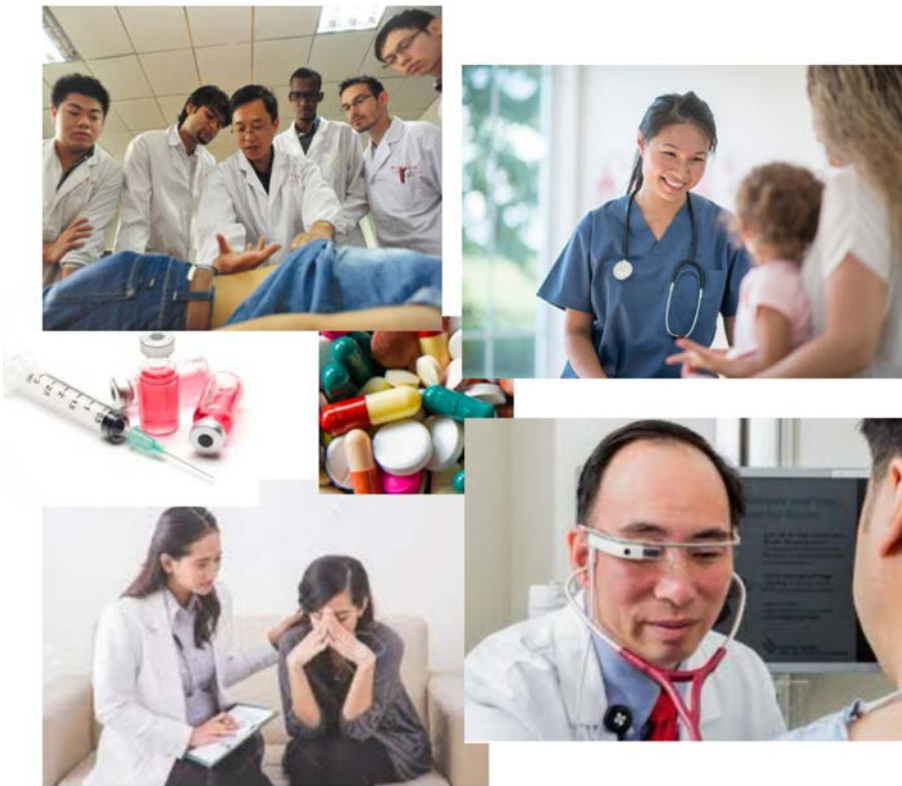


# Global Citizen



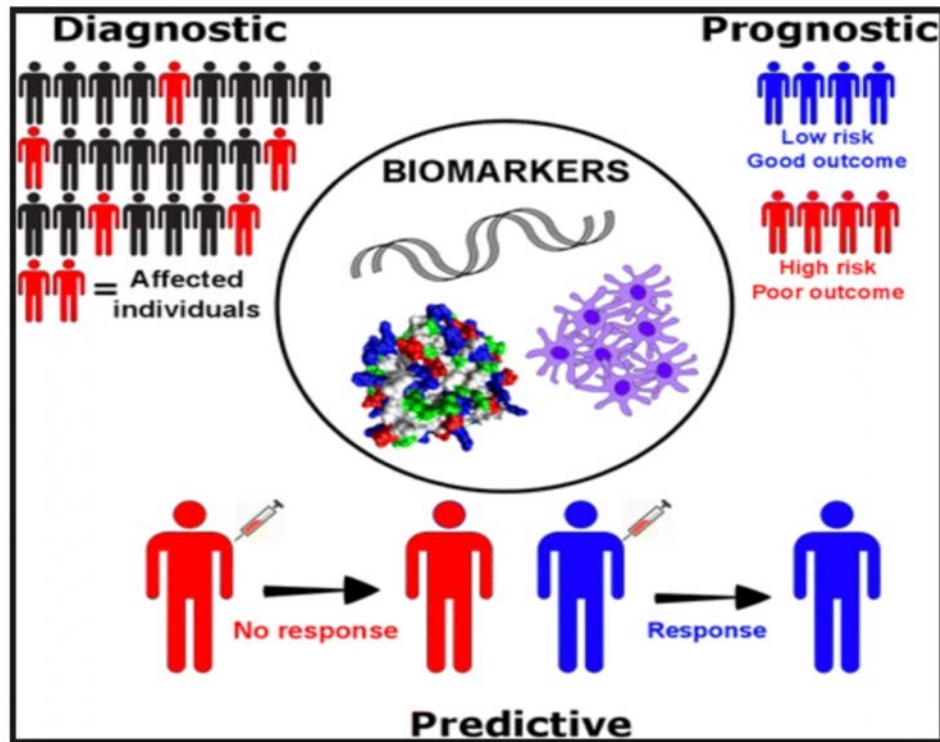
# New Healthcare Solutions

## Earlier Treatments & Therapies



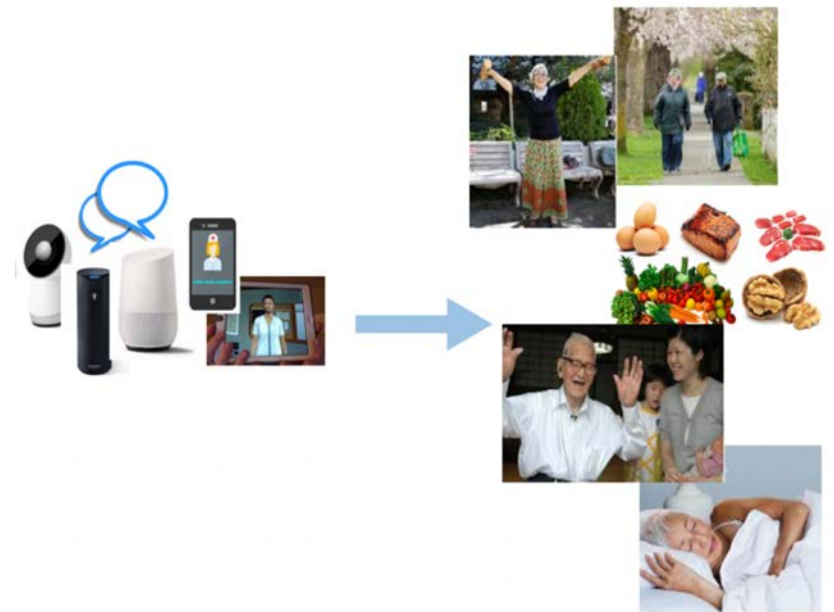
## Enhanced Telehealth Clinical Interventions

# Novel Market Opportunities



Digital Biomarkers

## Automated "High Touch" Solutions



# Impact of Success



**Think Different, Be Different**





## ...and Never Give Up



**When a fast shot forces 15-year-old Chris Chen to the floor, it seems like the point is over**



# Thank you.

