



Health Systems: The Next Generation 2018

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#HSNG18 #GT_HealthSystems

November 9th, 2018

Pinar Keskinocak, PhD

Georgia Institute of Technology

William W. George Chair, School of Industrial and Systems Engineering,

Co-director, Center for Health & Humanitarian Systems

ADVANCE Professor, College of Engineering, Georgia Tech



Welcome

***Thank you to our generous
sponsors!***



Rapid Fire Presenters



Jennifer R DuBose, MS

Georgia Institute of Technology
Associate Director of the
SimTigrate Design Lab, Principal
Research Associate



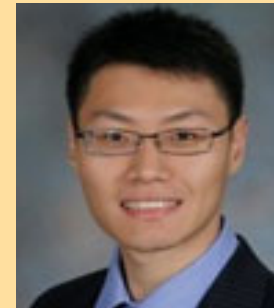
Danny Hughes, PhD

Georgia Institute of Technology
Professor in the School of
Economics and Director of Georgia
Tech's Health Economics and
Analytics Lab (HEAL)



Omer T. Inan, PhD

Georgia Institute of Technology
Associate Professor of Electrical and Computer
Engineering and Adjunct Associate Professor of
Biomedical Engineering



Zihao Li, PhD

Centers for Disease Control and Prevention
Prevention Effectiveness Fellow, Division of
HIV/AIDS Prevention



Mark Styczynski, PhD

Georgia Institute of Technology
Associate Professor, School of Chemical &
Biomolecular Engineering

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Mission: To transform the process of the design of the healthcare built environment, clinical processes, and technology, and establish a new field of academic healthcare research which is trans-disciplinary.

Vision: We will be the leader in integrated, trans-disciplinary healthcare simulation design and research.

Using the Built Environment to Improve Healthcare Systems

Analyze Problems

- Build Evidence Base
- Link Design to Key Outcomes
- Collaborate with major government & industry partners
- Evaluate Issues Impacting Healthcare Design

Conduct Research

- Field Studies
- Simulation Tools
- Explore & Test Solutions
- Improving Care Coordination
- Improving Well-being through the Built Environment

Speed up Learning and Innovation

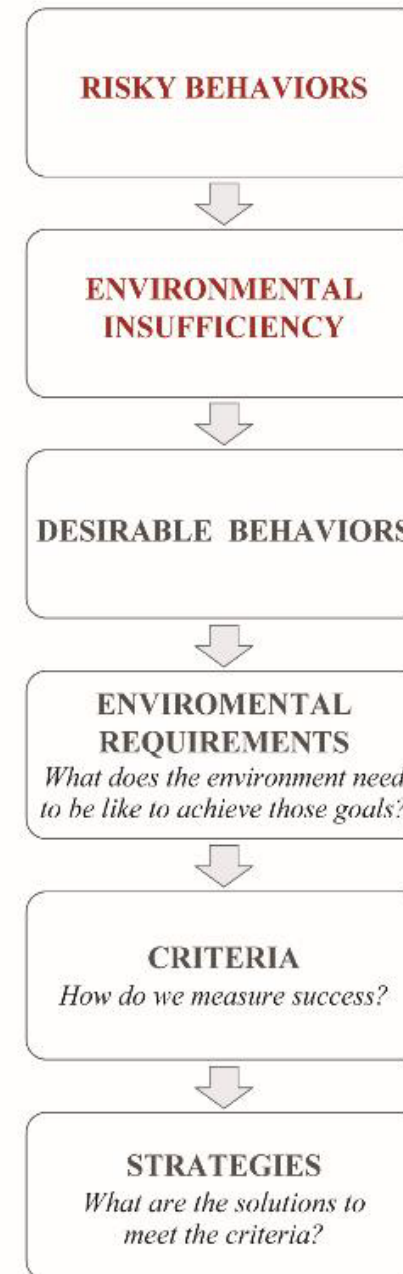
- Optimizing Space Utilization and Care Process Using Simulation Modeling
- Predict Design Models through Evidence-Based Design
- Precision Planning

Develop Guidance

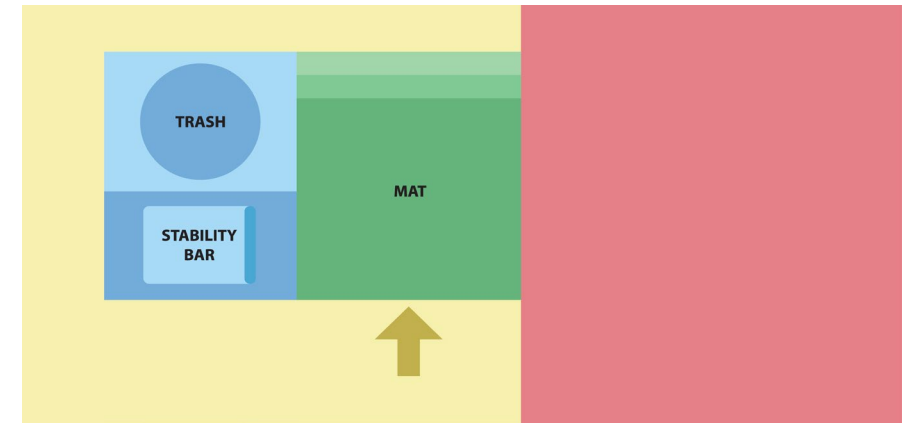
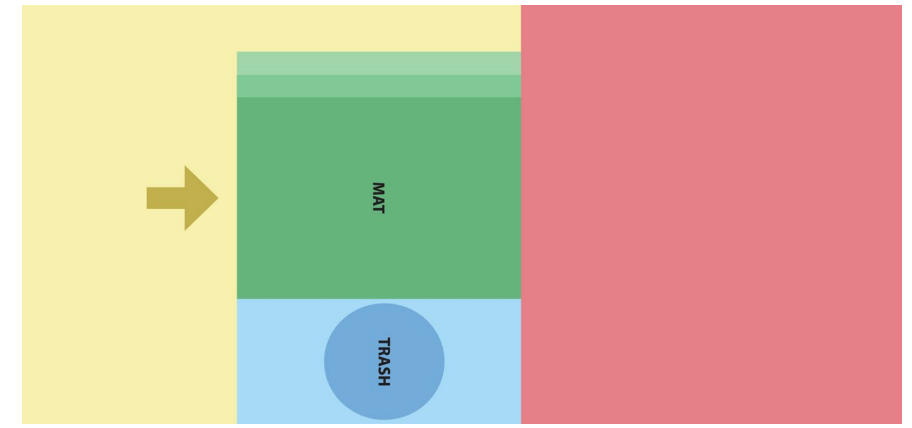
- Translate Evidence Base
- Solve Real World Problems
- Provide Consistent Experience and Quality of Care across Sites



b) Framework



Conduct
Research
in the
Field



Speeding up Learning
and Innovation Through
Rapid Prototyping

Assessing the Design of Outpatient Clinics for Team-based Care

Functional Scenario Method

“ RNs and rooming staff need to be aware of the status of the overall clinic”



Develop
functional
scenarios



Develop metrics
& criteria for
analysis



Analyzing each
case study



Compare
across
cases



Extract
design
features

Mild Cognitive Impairment Empowerment Program



**Provide Scaffolding and Stimulation:
Safe Smart Kitchen**
to increase independence





Craig Zimring, Ph.D.

Director, SimTigrate Design Lab

Professor of Architecture, College of Design, Georgia Institute of Technology

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Jennifer DuBose, M.S., EDAC

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HEALTH ECONOMICS & ANALYTICS LAB (HEAL)



DANNY R. HUGHES
PROFESSOR, SCHOOL OF ECONOMICS
DIRECTOR, HEAL

CREATING THE NEXT®



HEALTH ECONOMICS & ANALYTICS LAB (HEAL)



- \$3 million, 5 year partnership with Harvey L. Neiman Health Policy Institute
 - Apply big data analytics and AI to large scale medical claims databases
 - Policy focused research
 - Payment models
 - Health care delivery systems
 - Predictive indicators of medical risk
- HEAL provides
 - Funding for students, faculty, and post-docs
 - Research and training opportunities
 - Access to large scale databases:



HEAL OPPORTUNITIES



- Extensive collaborations with leading medical centers:



- Foundation for other research:
 - \$3 million NIH-funded grant with University of Washington
 - International reach:



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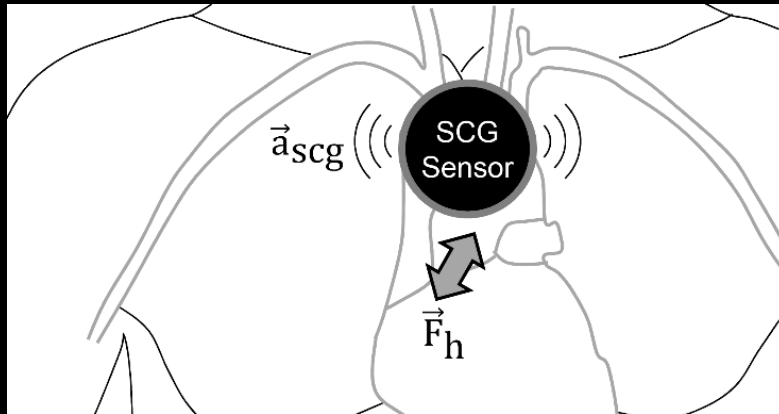
PHYSIOLOGICAL SENSING & MODULATION FOR HUMAN HEALTH & PERFORMANCE

**OMER T. INAN, PHD
ASSOCIATE PROFESSOR, ECE**

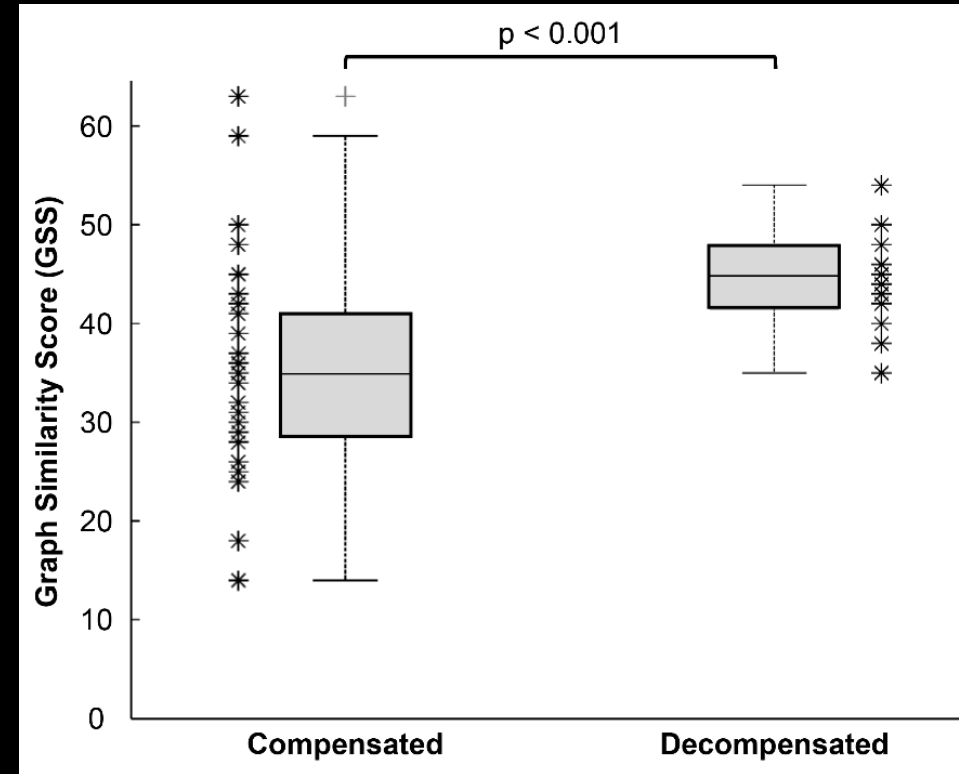
CREATING THE NEXT®

WEARABLE SEISMOCARDIOGRAM SENSING FOR PATIENTS WITH HEART FAILURE

Collaboration with Dr. Liviu Klein at UCSF and Dr. Mozzi Etemadi at Northwestern



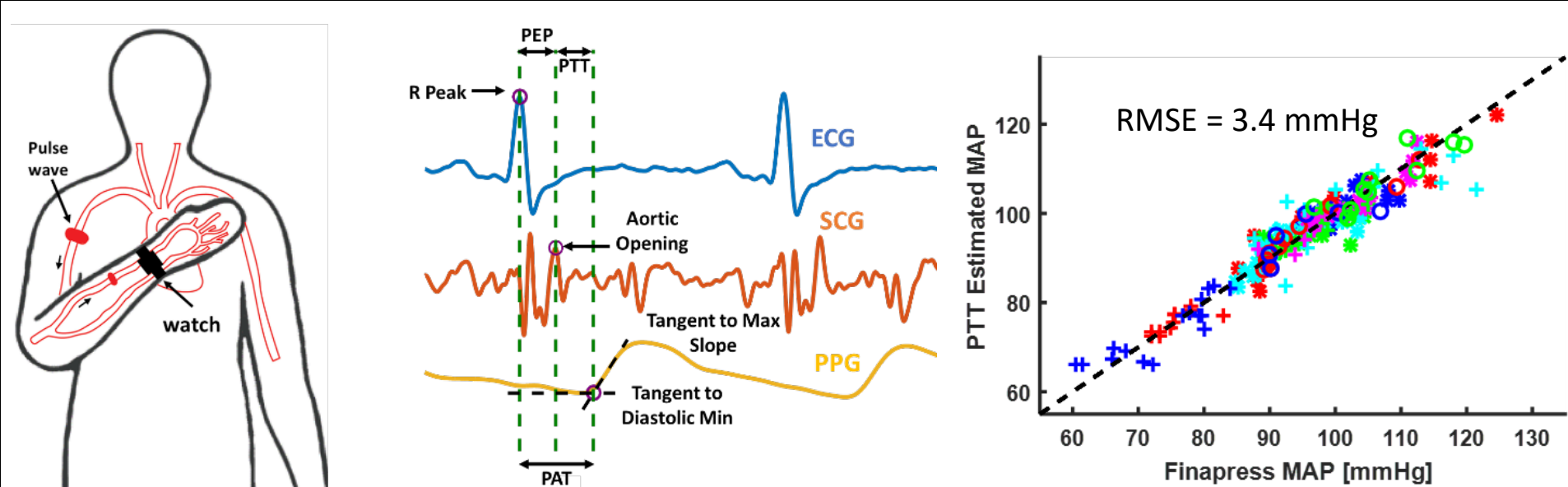
- Seismocardiogram (SCG) signals are measured with a wearable chest patch
- Measurements before and after six minute walk test exercise are used to assess patients' clinical state
- *Goal: Predicting and preventing heart failure exacerbations with home monitoring*



Inan, et al. Circulation: Heart Failure, 2018.

CUFFLESS BLOOD PRESSURE MEASUREMENT USING SEISMOWATCH

Collaboration with Dr. Rama Mukkamala at MSU and Dr. Jin-Oh Hahn at UMD

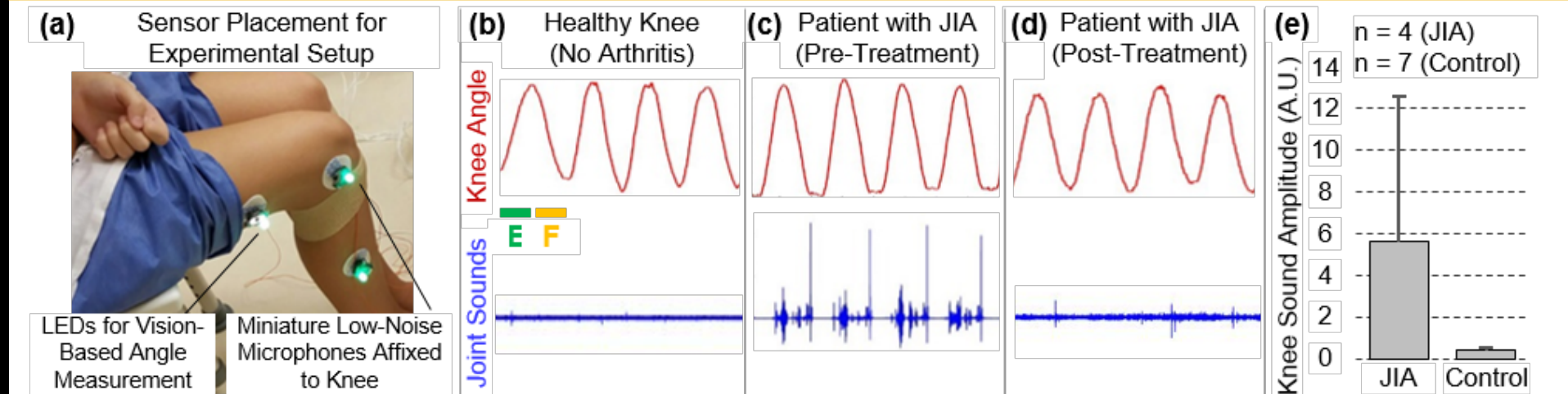


- Pulse transit time (PTT) is measured using a watch form factor with the user placing the device against the chest.
- After initial calibration, PTT based blood pressure estimation yields low error for a wide range of perturbations.

Carek, et al. ACM IMWUT, 2017.

NSF CAREER: WEARABLE JOINT SOUNDS SENSING FOR KIDS WITH ARTHRITIS

Collaboration with Dr. Sampath Prahalad at Children's Healthcare of Atlanta



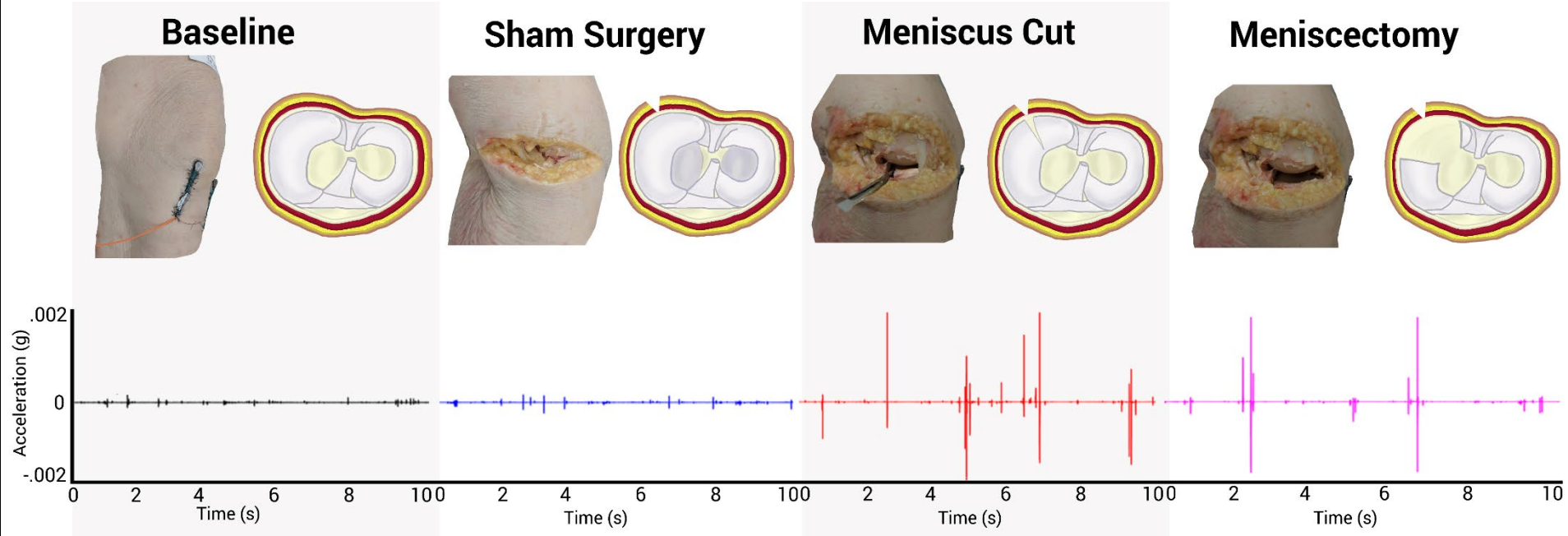
- 50,000 children in US have juvenile idiopathic arthritis (JIA)
- Many therapies exist, but matching a therapy to each patient is currently based on trial and error
- Continuous monitoring would allow for therapies to be personalized to each patient using objective data
- *Wearable joint sounds measurements can address this clinical need*



Joint swelling is common for JIA

Semiz, et al. IEEE Sensors Journal, 2018.

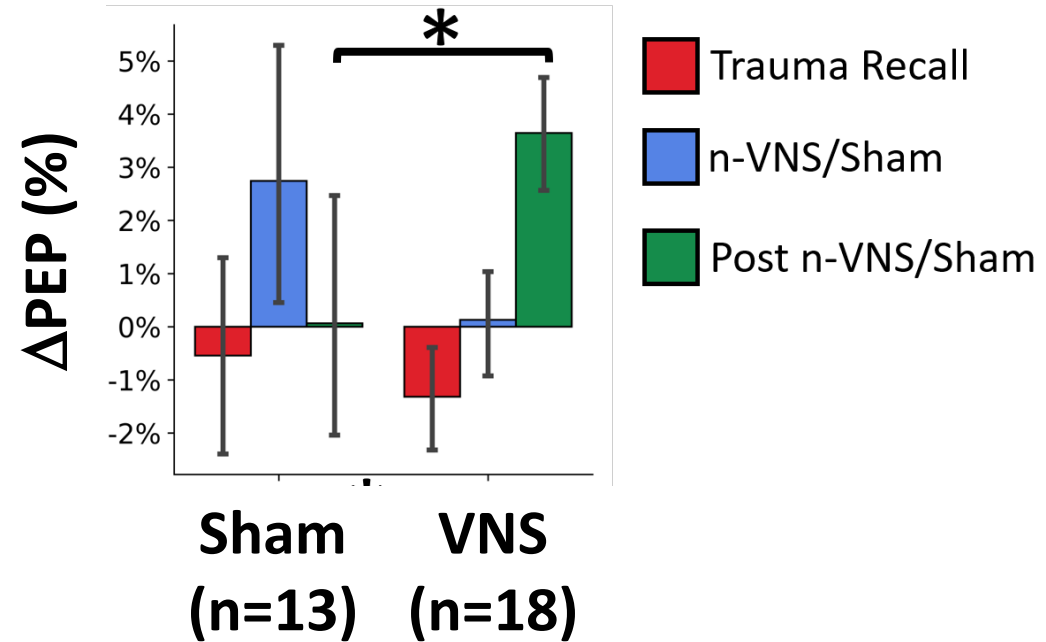
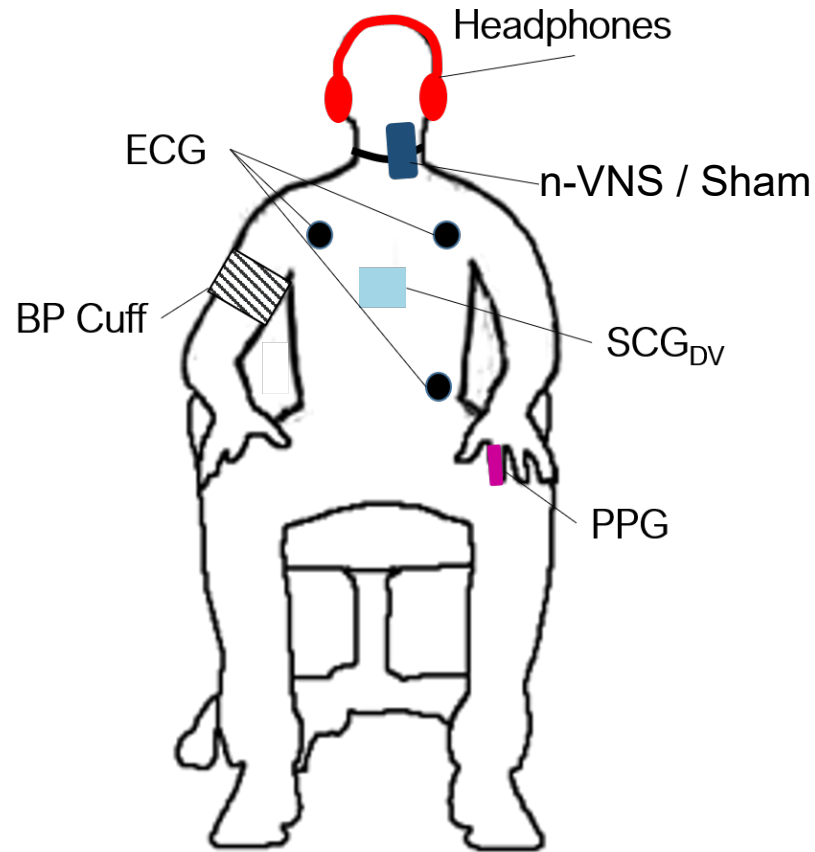
ELUCIDATING THE MECHANISMS OF JOINT SOUNDS WITH A CADAVER MODEL



- We used fresh frozen cadaver models such as those employed in training for orthopedic surgery.
- A total of $n=9$ limbs were studied to better understand the origin of joint acoustic emissions and to provide a clean dataset for algorithm development.

NON-INVASIVE VAGUS NERVE STIMULATION IN PATIENTS WITH PTSD

Collaboration with Dr. Doug Bremner at Emory University



- Sympathetic arousal in response to the recall of the traumatic event is blunted with VNS
- Brain imaging results show similar patterns

Gurel, et al. IEEE Body Sensor Networks Conf, 2018.

INAN RESEARCH LAB AT GEORGIA TECH



Active Grants / Contracts

ONR YIP
NSF CAREER 1749677
NIH NHLBI 1R01HL130619
NIH NIBIB 1R01EB23808
NIH NIBIB 1U01EB018818
DARPA BTO N66001-16-2-4054
Children's Healthcare of Atlanta
Craig H. Neilsen Foundation
Georgia Research Alliance
NextFlex

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Jin-Oh Hahn (UMD)
Lalit Mestha (GE)
Shuvo Roy (UCSF)
Teresa De Marco (UCSF)

Collaborators

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Michael Sawka (GT)
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Jim Rehg (GT)
Farrokh Ayazi (GT)

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HIV Prevention Modeling at the Centers for Disease Control and Prevention

Zihao Li, PhD

Prevention Effectiveness Fellow

Prevention Modeling and Economics Team

Health Systems: The Next Generation 2018

Atlanta, GA

November 9, 2018

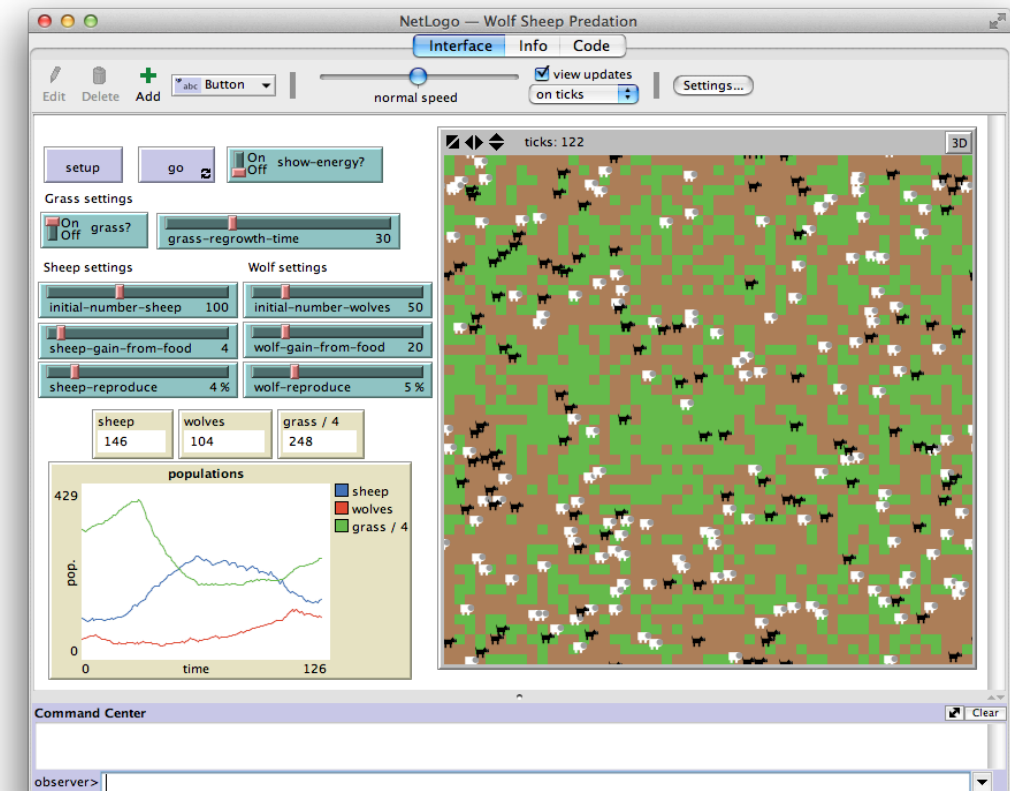
Prevention Modeling for HIV

- Apply quantitative science to prevent HIV infection and reduce HIV-related illness and death
- Focus on effectiveness of prevention efforts
 - HIV testing
 - HIV care engagement/retention
 - Treatment as prevention
 - Pre-exposed prophylaxis (PrEP)
 - Behavioral interventions



Agent-based Model

- **Progression and Transmission of HIV (PATH)**
 - Track disease progression, treatment, and transmission at individual level
- **Estimate HIV transmission rate**
 - Population risk group
 - HIV care continuum
 - Age group
- **Replicate transmission networks/clusters**



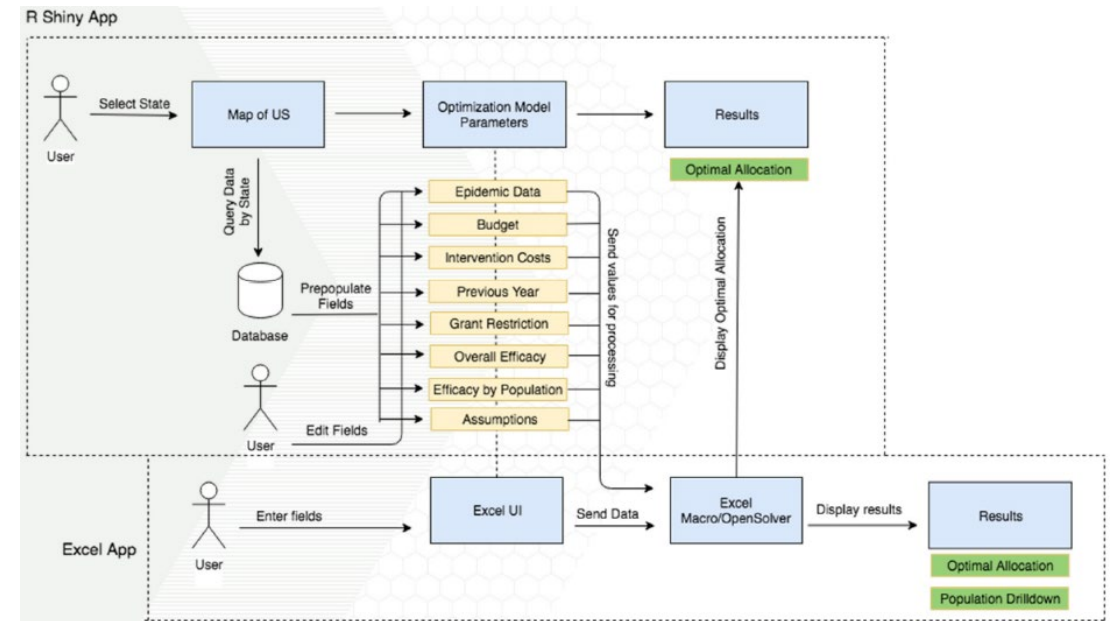
Compartmental Model

- **HIV Optimization and Prevention Economics Model (HOPE)**
 - Population-level analysis
 - age group, risk level, transmission group, sex, race/ethnicity
 - System of differential equations solved in Matlab
- **Effects of Reaching National HIV/AIDS Strategy goals**
- **Analyze the cost effectiveness of different interventions**
 - Increasing testing frequency
 - Increasing adherence to HIV treatment
 - Increasing coverage of PrEP

Optimization Model

■ Resource allocation

- Excel-based tool for state/local health departments to allocate HIV funding
- Input:
 - Efficacy of intervention programs
 - Epidemiological/clinical data
 - Budget
- Use linear program to find the optimal fund allocation to each intervention program



Thank you!

For more information:

Zihao Li


nzv6@cdc.gov

Findings and conclusions in this presentation are those of the author and do not necessarily represent the views of the CDC

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Low-cost, equipment-free, low-volume, quantitative diagnostic blood tests

Mark Styczynski

Georgia Tech
School of Chemical & Biomolecular Engineering
Health Systems: The Next Generation

November 9, 2018



Georgia Institute
of **Tech**nology®

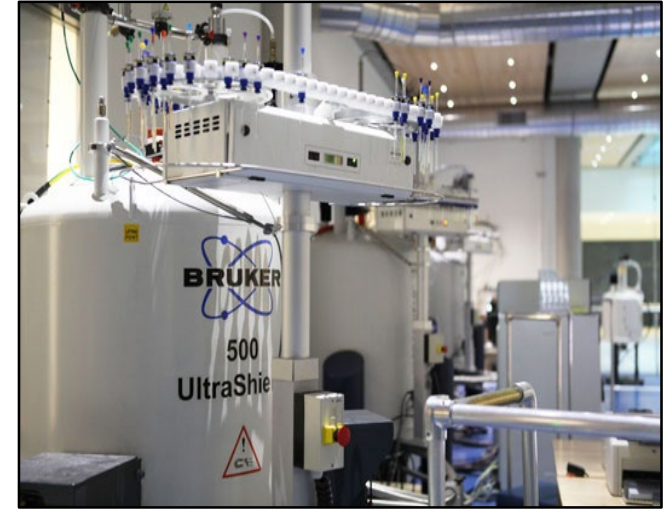
When you think of medical diagnostic tests, you may think of...



Big needles and
blood draws



Trained lab personnel



Expensive lab equipment



Waiting days for results

\$\$\$

High costs

We are developing diagnostic tests that instead entail...



Drops of blood



Ease of use



No analytical equipment



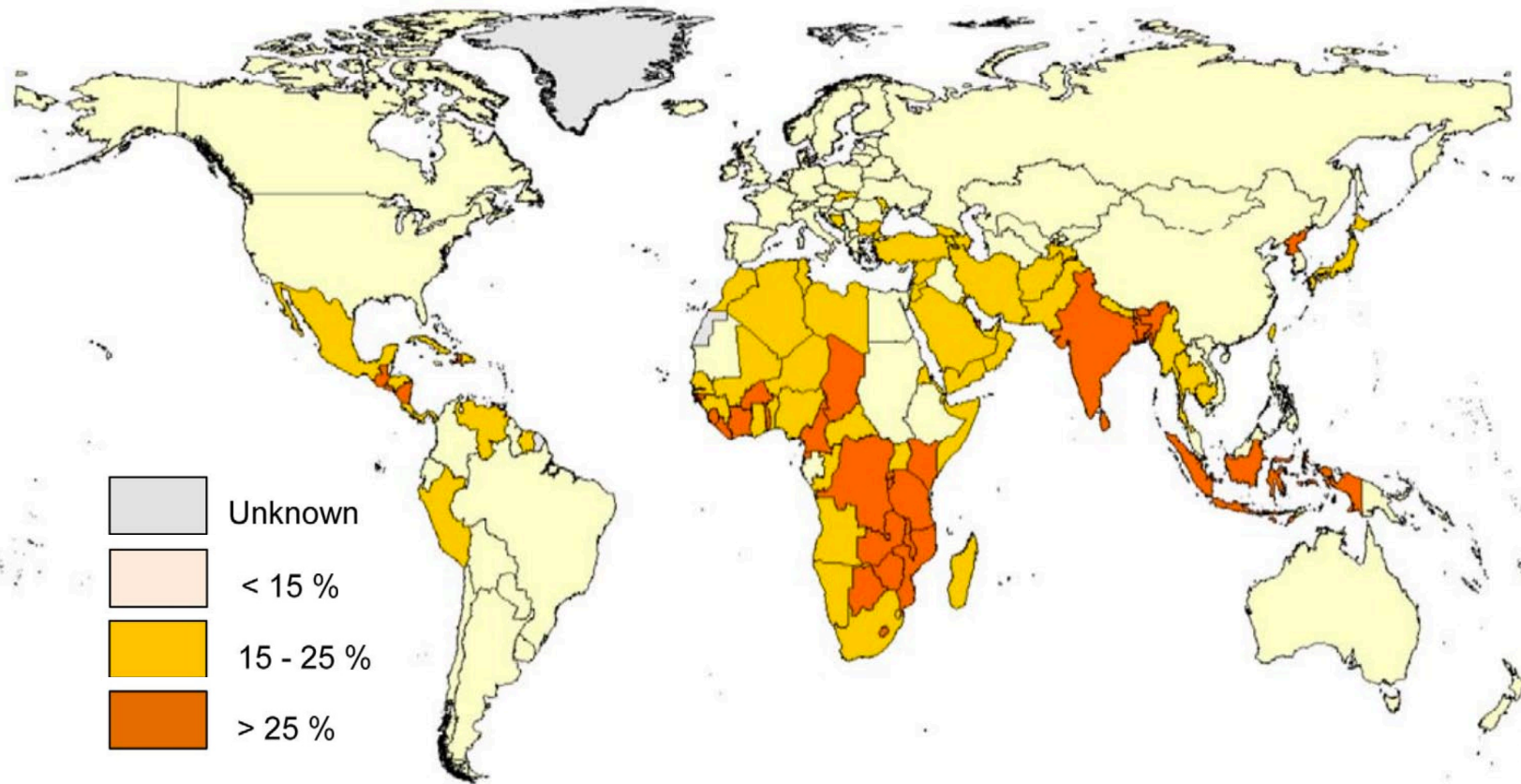
Visible readouts in an hour



Low costs

Our original motivator: vitamin & mineral deficiencies in the developing world

Estimated percentage of people with inadequate zinc intake

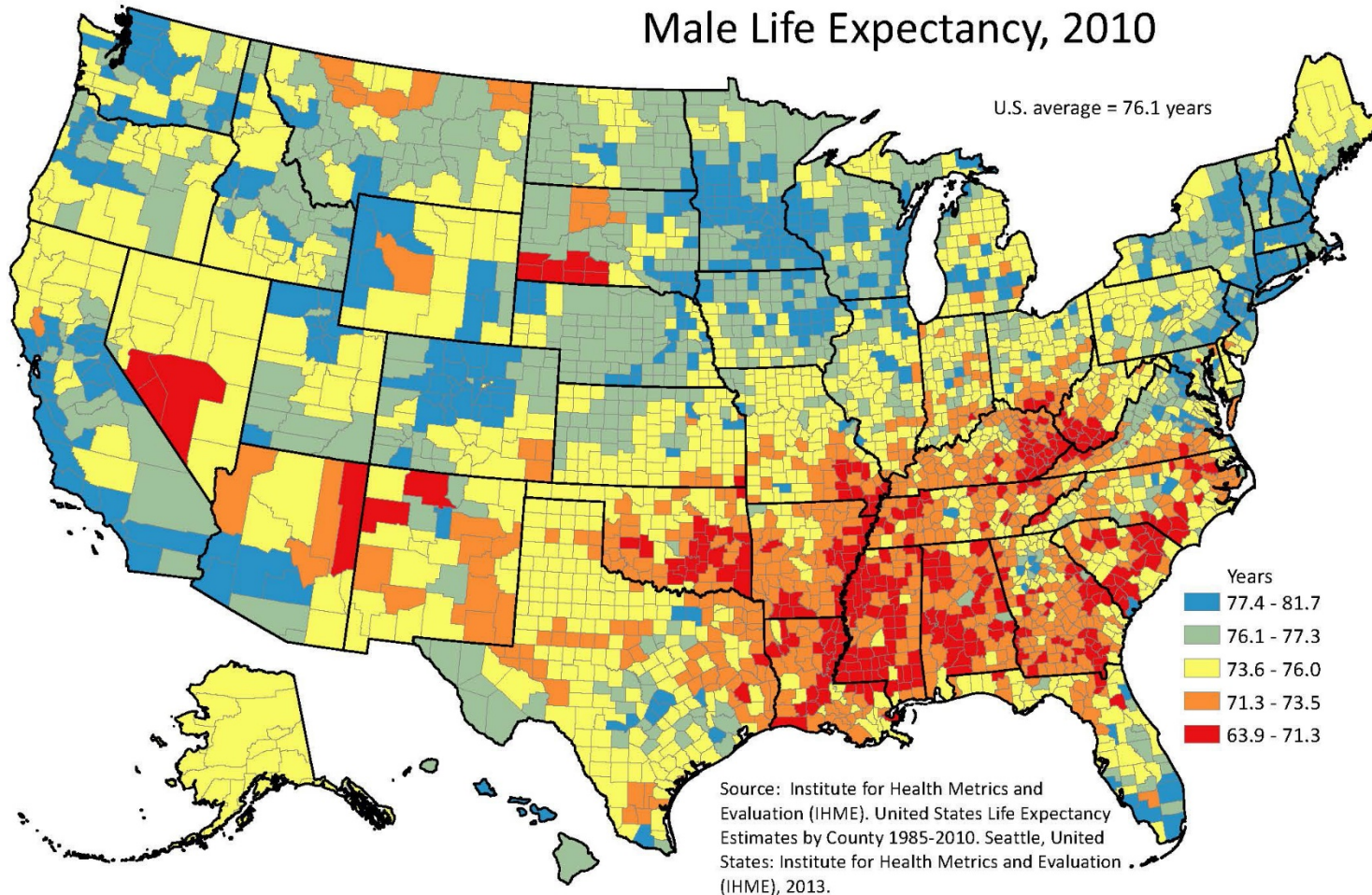


Directly responsible for over 100,000 deaths of children under 5 annually

Lack of data on specific areas affected limits efficient supplementation programs

Diagnostic tests are too expensive and logistically challenging for monitoring resource-poor areas

But health disparities exist at home, too...

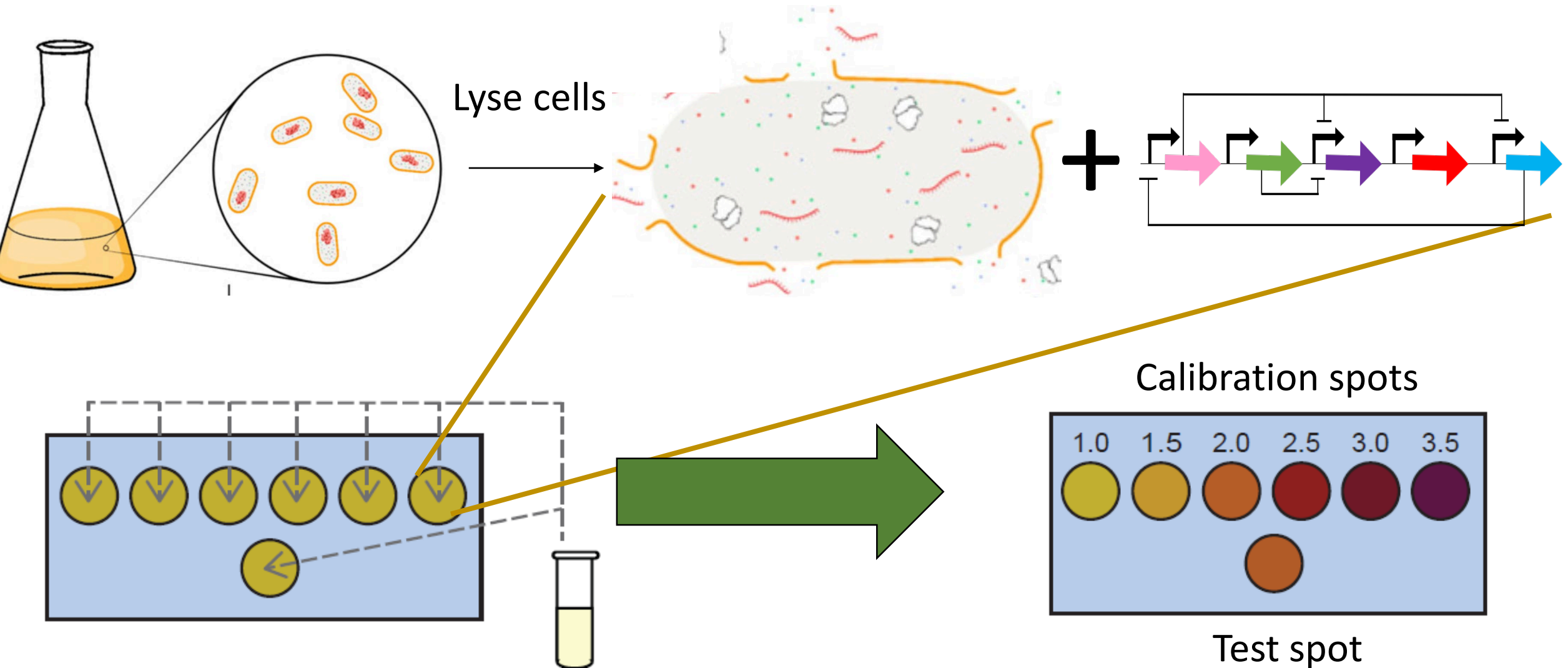


Unequal access to healthcare

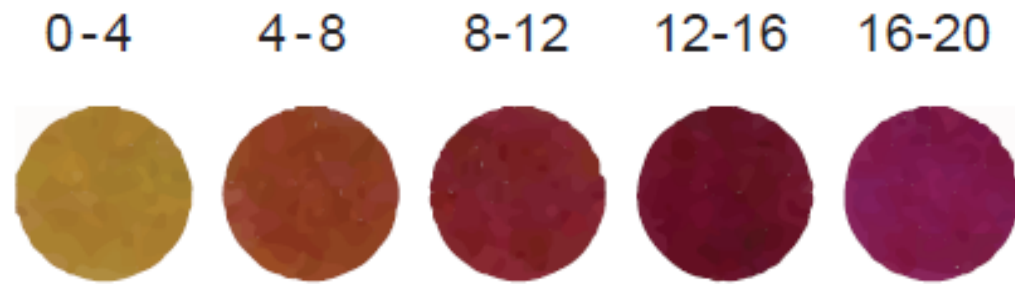
Uneven quality of healthcare when access is available?
(resource and cost limitations)

If we had more diagnostic data, could we do a better job in the at-risk areas?

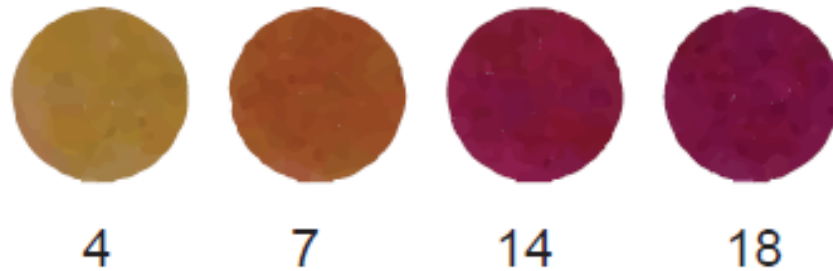
Our vision: cheap, easy, equipment-free biosensor tests



We have developed a completely equipment-free test for zinc, a key nutrient, using microliter volumes of blood...

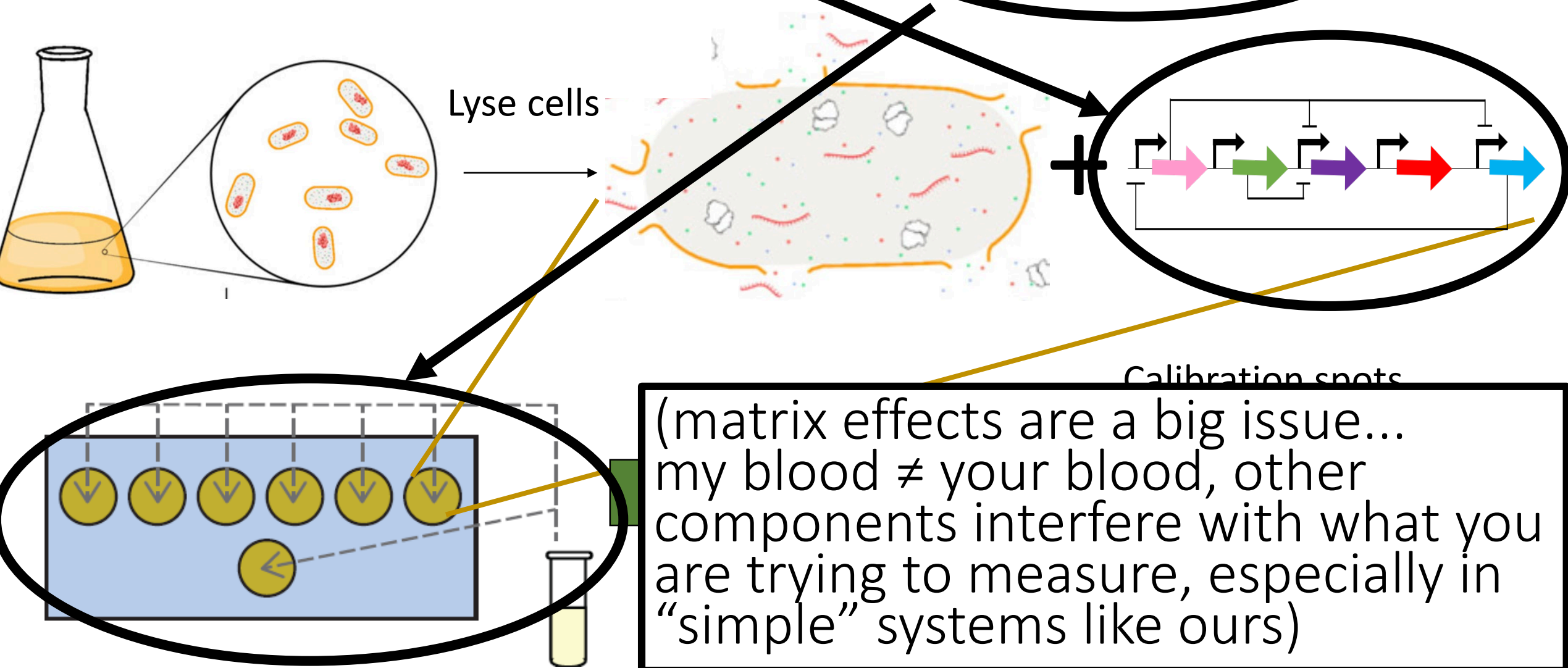


Calibration spots

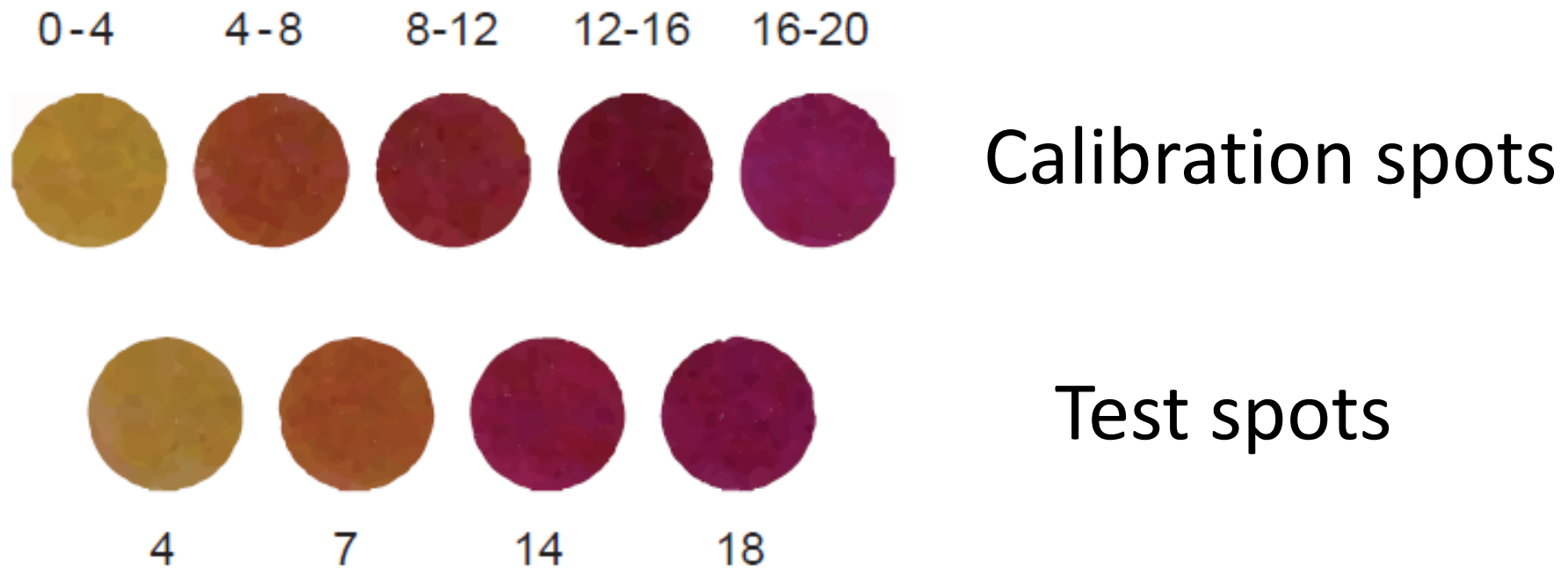


Test spots

... and a generalizable approach to equipment-free semi-quantitation that compensates for **matrix effects!**



This yields a platform for low-cost, equipment-free, low-volume, quantitative diagnostic blood tests



Thank you to the people who do all of the work!



Robert Dromms

Justin Lee

Monica McNerney

April Miguez

Sugantha Moorthy

Maren Smith

McKenzie Smith

Amy Su

Yan Tang

Katie Vermeersch

Daniel Watstein

Jason Ye

Weiwei Yin

Yan Zhang

Our cell-free “connections”:

Mike Jewett

Julius Lucks

Current/recent undergrads:

Cirstyn Michel

Caroline Sane

Manav Sevak

Madelyn Shelby

Adam Silverman

Paige Steppe

Kelsey Tjen

Bryan Wijaya

Funding:

NIH

Bill & Melinda Gates Foundation

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Poster Session Break

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Moving from Sick-care to Healthcare & the Proactive Innovations Moving Healthcare Forward

Panel Discussion

Moderator



Tabia Henry Akintobi, PhD, MPH

Professor, Department of Community
Health and Preventive Medicine

Associate Dean, Community Engagement

Director, Prevention Research Center

Director, Evaluation and Institutional Assessment

Department of Community Health and
Preventive Medicine

Morehouse School of Medicine

Panelists



Bridget Hurley
Evidation Health
VP of Clinical and Regulatory



J. Patrick O'Neal, M.D.
Georgia Department of
Public Health (DPH)
Commissioner & Director of
Health Protection



Jim McClelland
State of Indiana
Executive Director for Drug
Prevention, Treatment, and
Enforcement



Vivian Singletary, JM, MBA
Public Health Informatics
Institute (PHII), Task Force for
Global Health, Director

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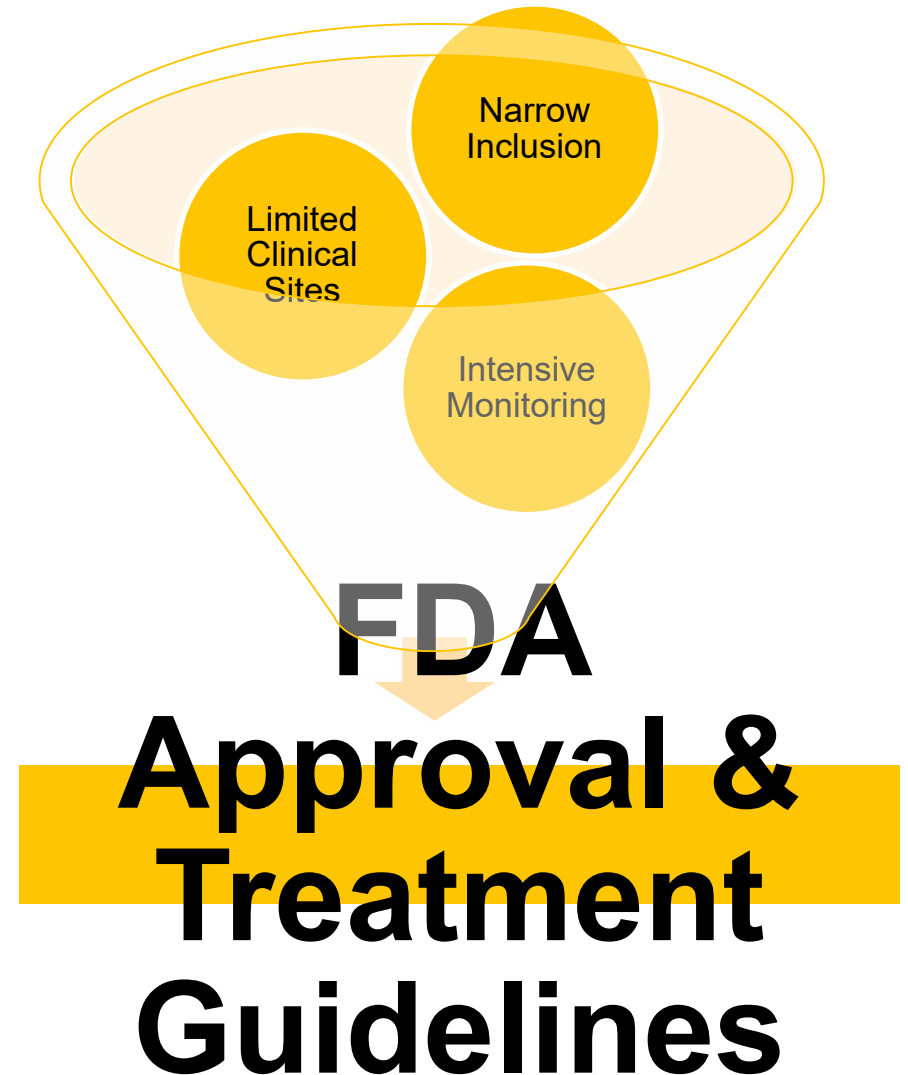
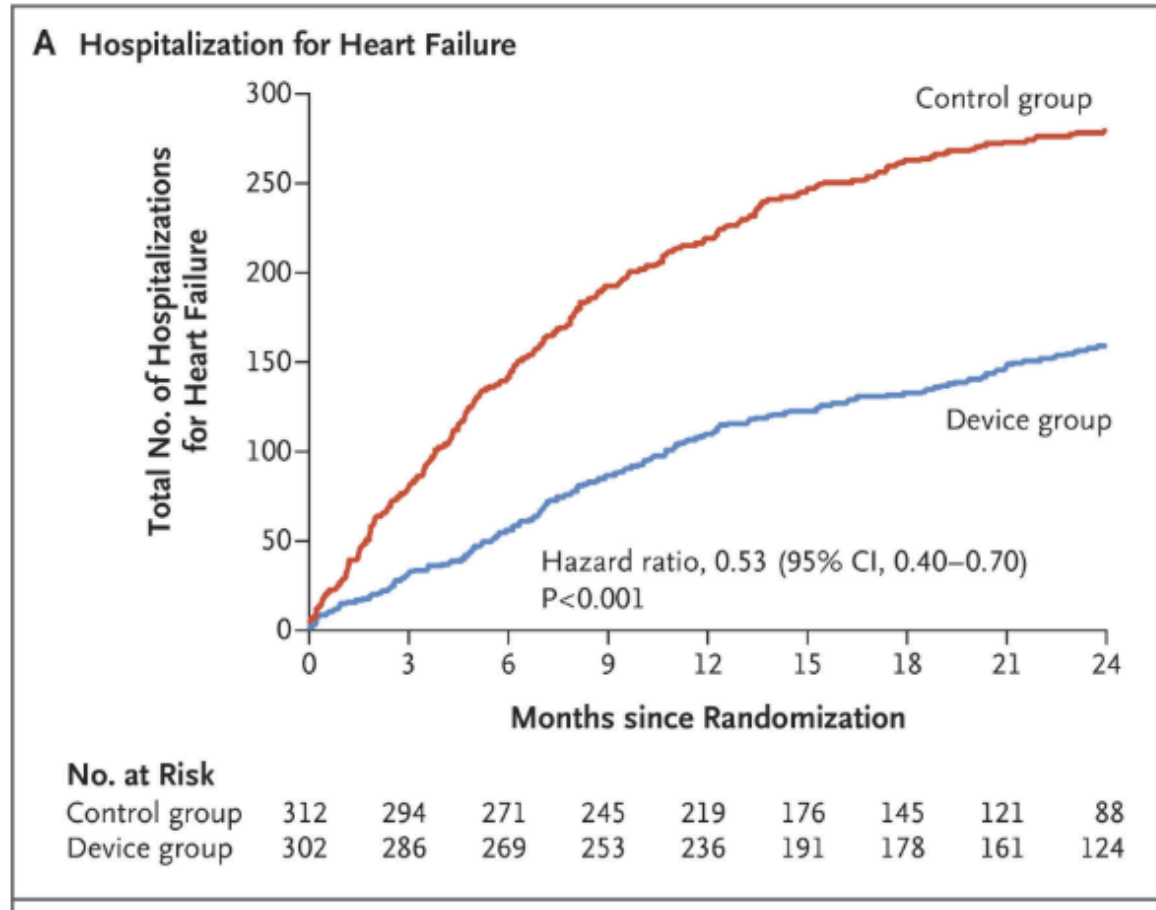


EVIDATION HEALTH:
EMPOWERING PATIENTS TO DRIVE HEALTHCARE THROUGH REAL WORLD
DATA

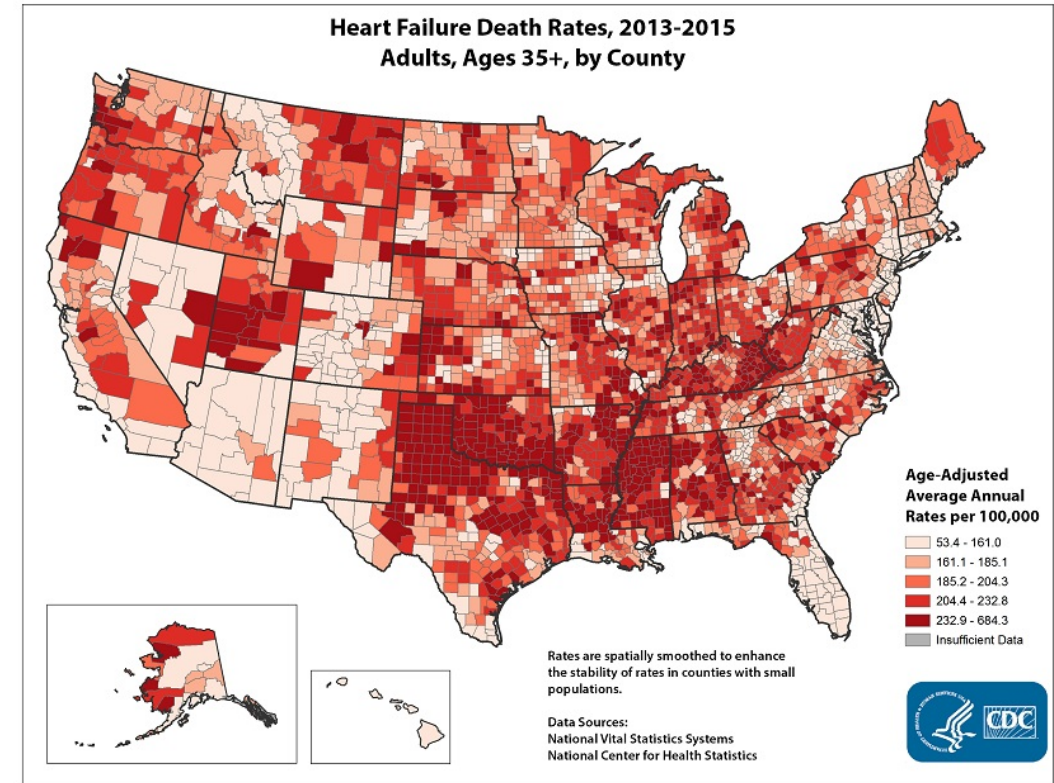
NOVEMBER 2018

Bridget Hurley
VP, Clinical & Regulatory
@evidation

The Gold Standard: *Randomized Clinical Trials for Safety / Efficacy*

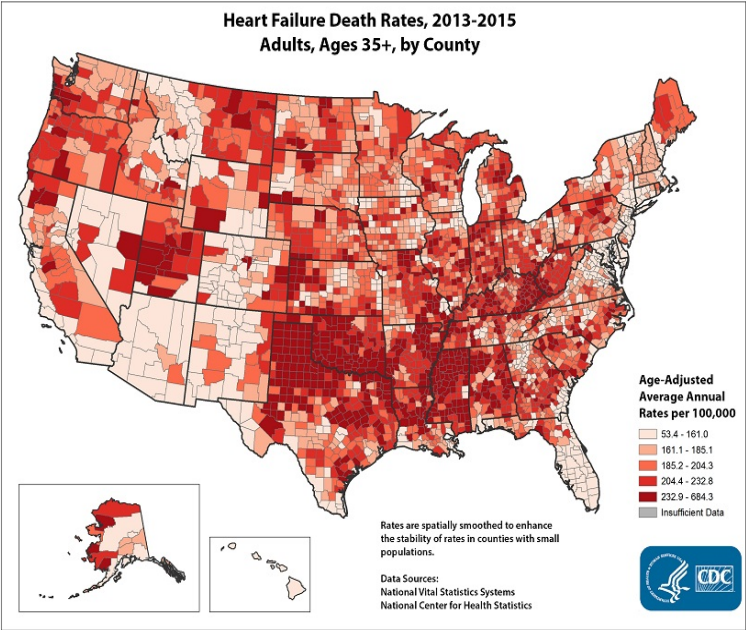
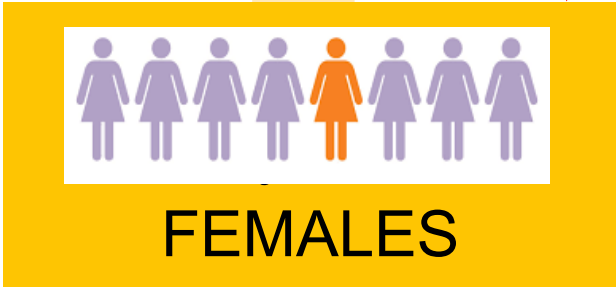


But how does this translate to medical practice in the Real World?



Real World Example:

Congestive Heart Failure: 5.7 Million Patients in the US



Masoudi et al, Most hospitalized older persons do not meet the enrollment criteria for clinical trials in heart failure. Am Heart J, 2003 Aug;146(2)250-7.



DIET

SOCIAL

LOCATION

GLUCOSE

STRESS

SLEEP

At Evidation, we see patients like this in the digital era of medicine.

EXERCISE

ROUTINES

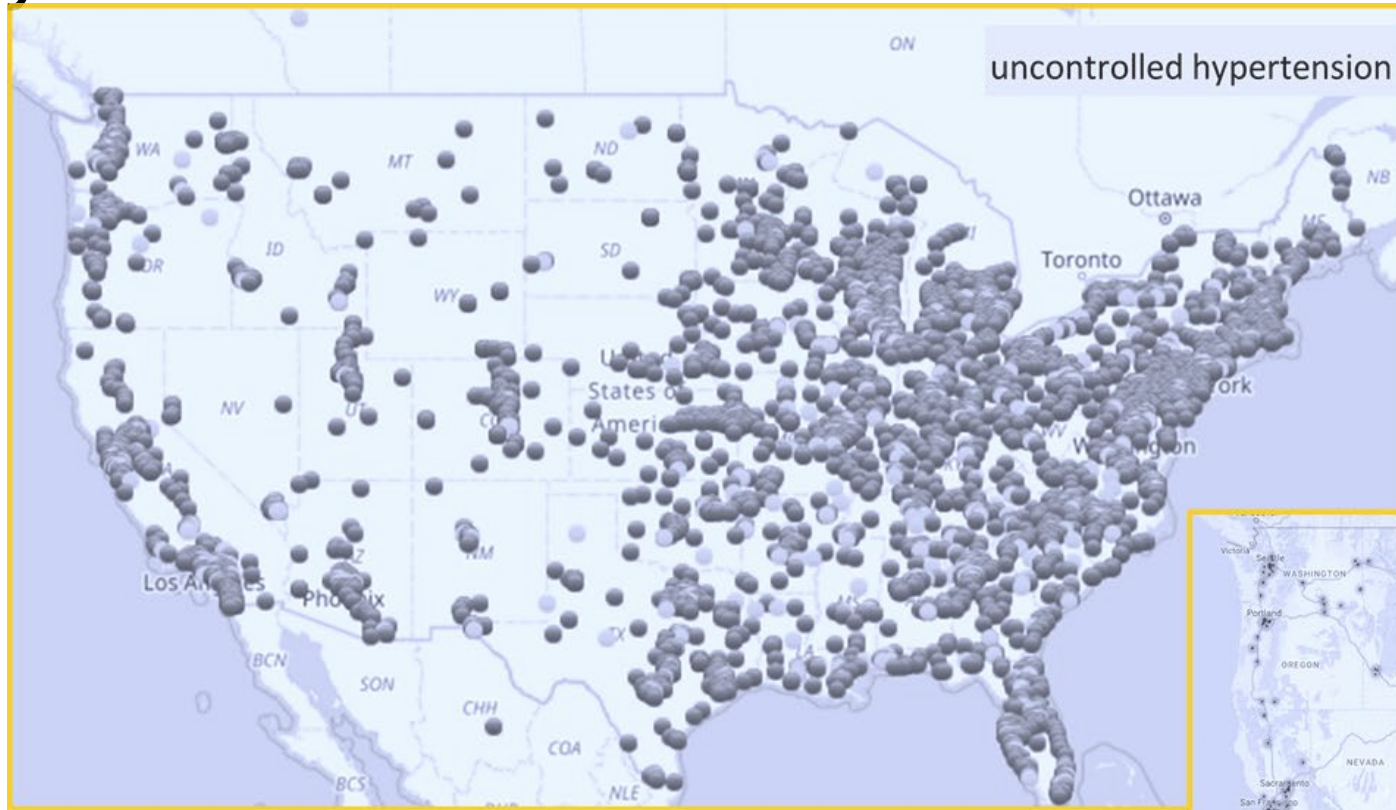
SPEECH AND VOICE

MOVEMENT

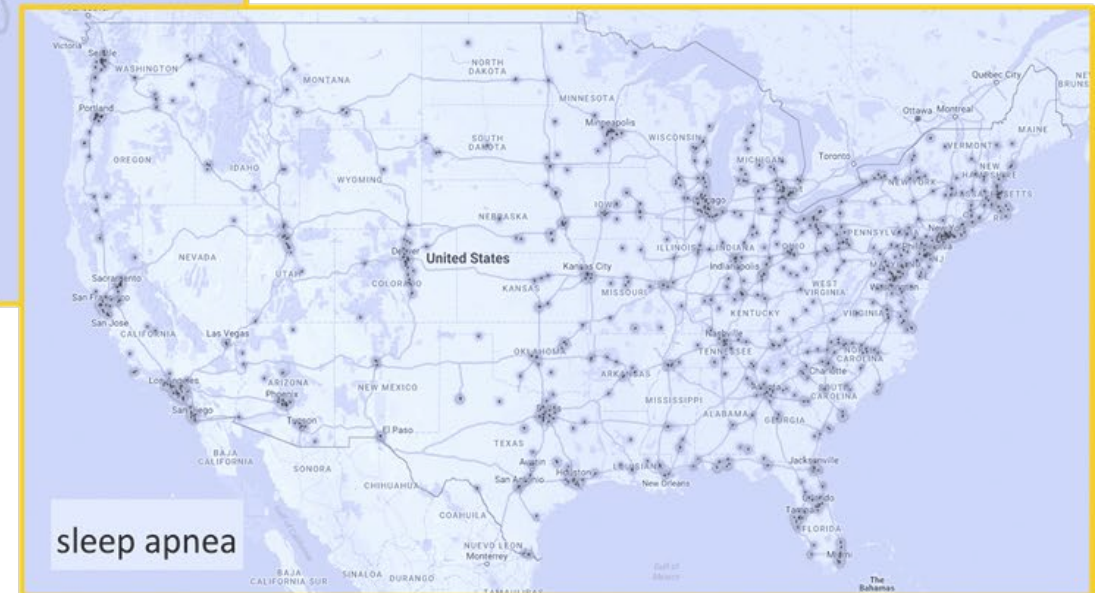
HEART RATE

APP INTERACTIONS

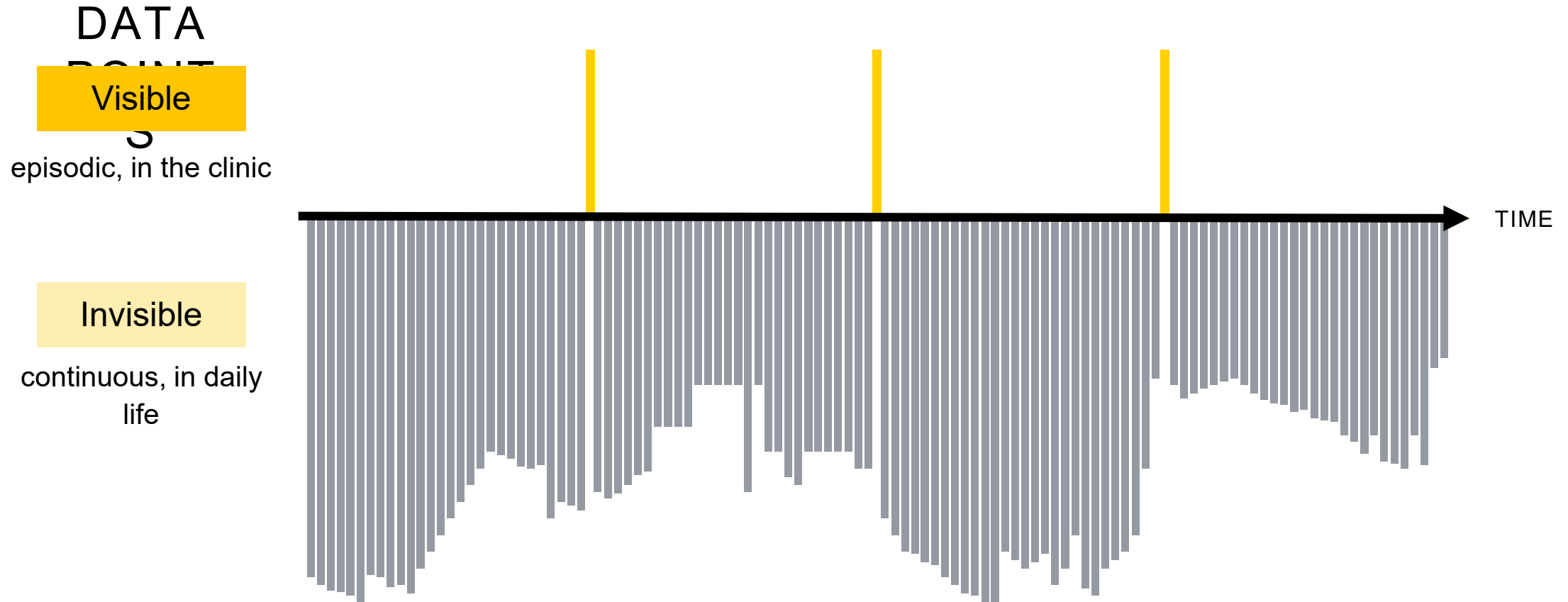
Digital “virtual” studies allow patients to participate—*anywhere, anytime.*



**ENROLLMENT
FOOTPRINTS IN RECENT
PROSPECTIVE STUDIES**

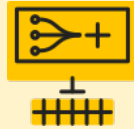


PATIENT OUTCOMES HAVE BEEN HISTORICALLY MEASURED USING LIMITED DATA FROM WITHIN THE SYSTEM—*NOT FROM DAILY LIFE.*



Harnessing this new data source allows us to ask and answer different questions about human health ***in the real world...***

Can quantifying everyday life better stratify chronic pain patients?



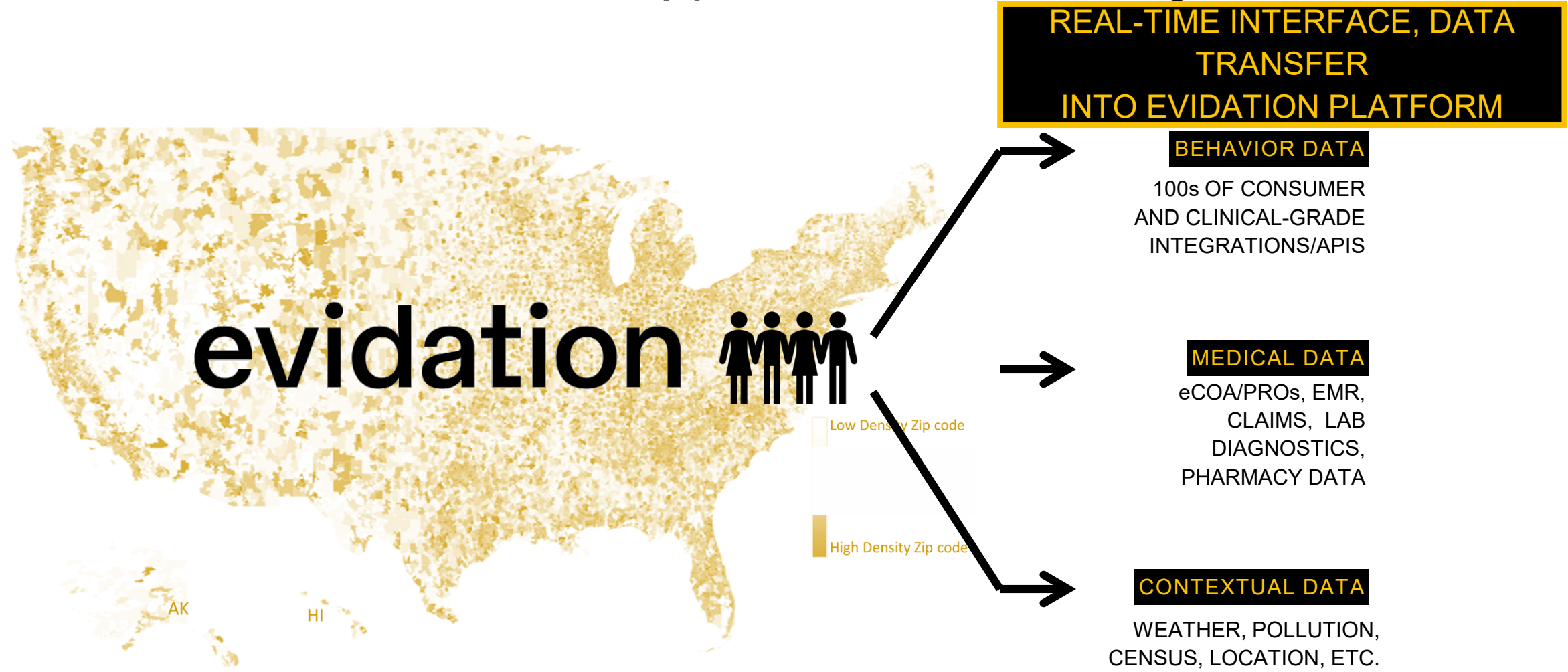
Is a patient's daily movement pattern a better measure of surgical recovery?



How can we measure impact of digital interventions entirely outside clinic walls, *at any scale?*



Today we have >2M connected individuals permissioning their data for use in a whole new approach to measuring outcomes.



Real World Clinical Data – *outside the clinic walls.*

The Medication adherence Improvement Support App For Engagement—Blood Pressure (MedISAFE-BP) trial

- First prospective trial to rigorously evaluate an mhealth application's effect on blood pressure and medication adherence in the U.S.
- Table 1 illustrates diversity that is straightforward to obtain in virtual, site-less clinical research
 - 57% female
 - 29% African American or Hispanic
 - 47% without a college degree
 - The above were not a requirement of study design



BRIGHAM AND
WOMEN'S HOSPITAL



Table 1. Baseline Characteristics by Treatment Group

Characteristic	Intervention (n = 209)	Control (n = 202)	P Value
Age, mean (SD), y	51.7 (10.5)	52.4 (10.1)	.51
Female, No. (%)	120 (57.4)	127 (62.9)	.26
Race/ethnicity n (%)			.03
Black	43 (20.6)	60 (29.7)	
White	149 (71.3)	119 (58.9)	
Other	17 (8.1)	23 (11.4)	
BMI, mean (SD)	35.38 (7.9)	35.59 (8.6)	.79
Physical activity, No. (%)			.49
≤2 h/wk	127 (60.8)	116 (57.4)	
>2 h/wk	82 (39.2)	86 (42.6)	
Education, No. (%)			.49
Did not finish high school	3 (1.4)	5 (2.5)	
High school graduate	31 (14.8)	20 (9.9)	
Some college	46 (22.0)	56 (27.7)	
College graduate	73 (34.9)	68 (33.7)	
Vocational degree	19 (9.1)	22 (10.9)	
Graduate degree	37 (17.7)	31 (15.4)	

Morawski et al, Rationale and design of the Medication adherence Improvement Support App For Engagement—Blood Pressure (MedISAFE-BP) Trial. Am Heart J;186:40-47, 2017.

Morawski et al, The accuracy of self-reported blood pressure in the MedISAFE-BP Trial. AHA QCOR Scientific Sessions, Quality Care and Outcomes Research, 2017.

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Toward Better Lives and Stronger, Healthier Communities

A presentation by Jim McClelland

November 2018

Executive Director for Drug Prevention, Treatment and Enforcement, State of Indiana



Public Sector

EDUCATION

SOCIAL
SERVICES

CRIMINAL
JUSTICE

WORKFORCE
DEVELOPMENT

HOUSING

Education

Social
Services

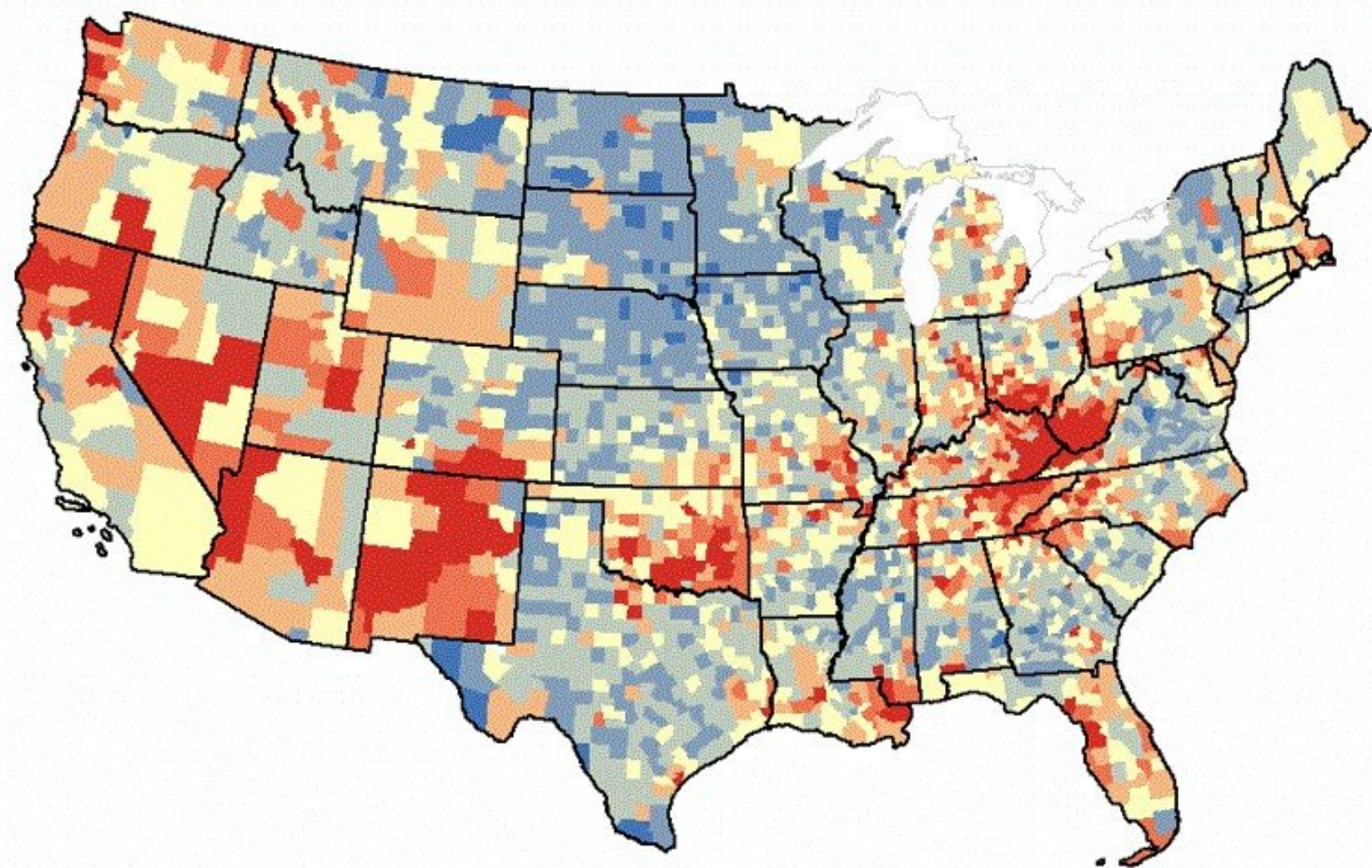
Criminal
Justice

Workforce
Development

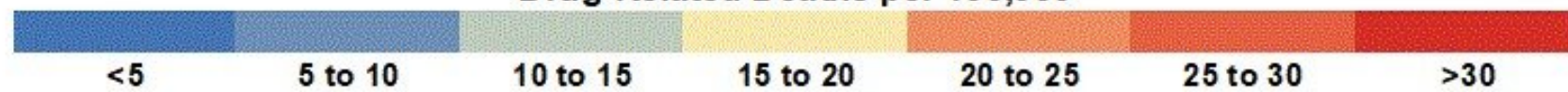
Housing

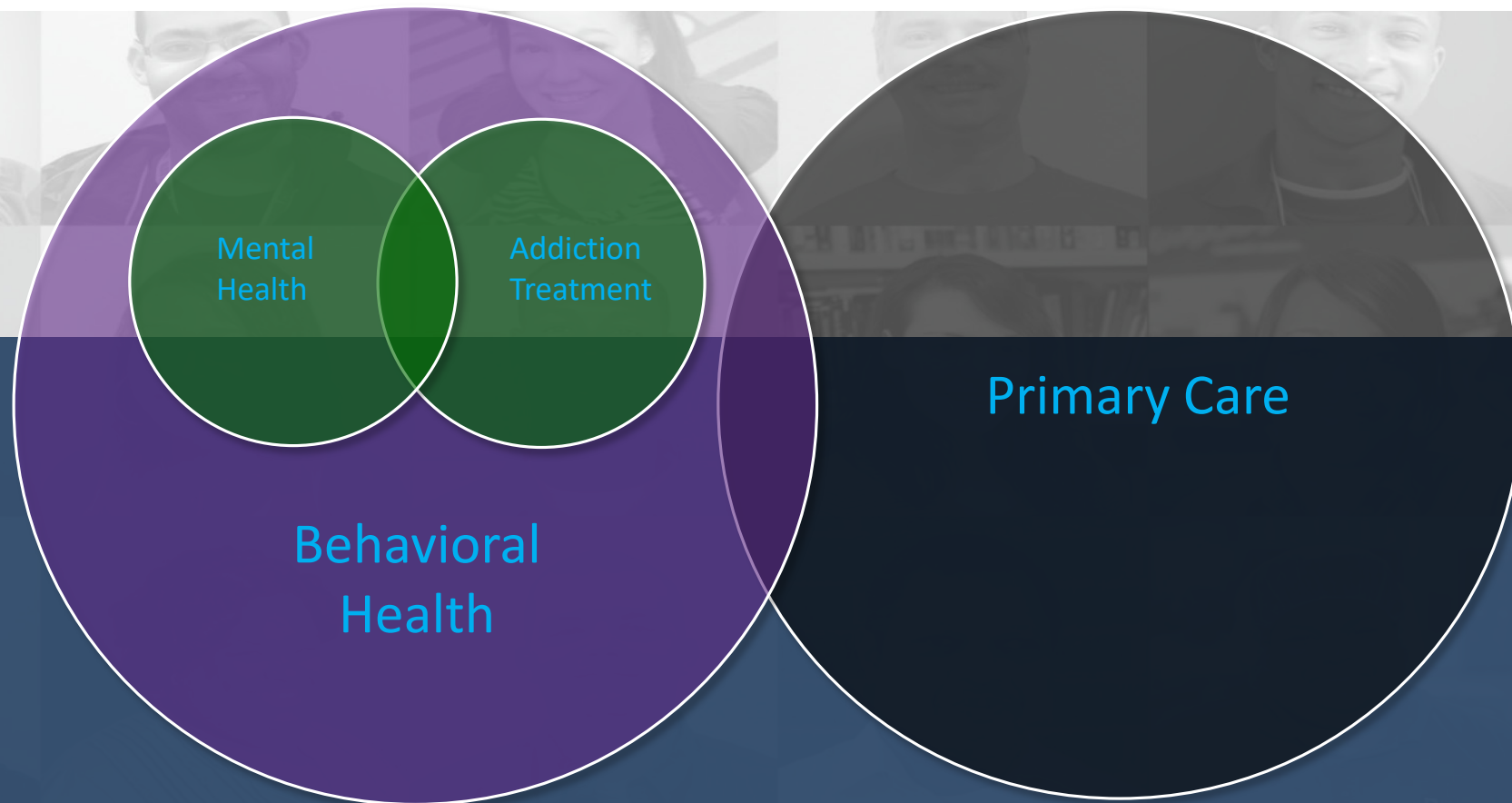
Not-for-profit Sector





Drug-Related Deaths per 100,000



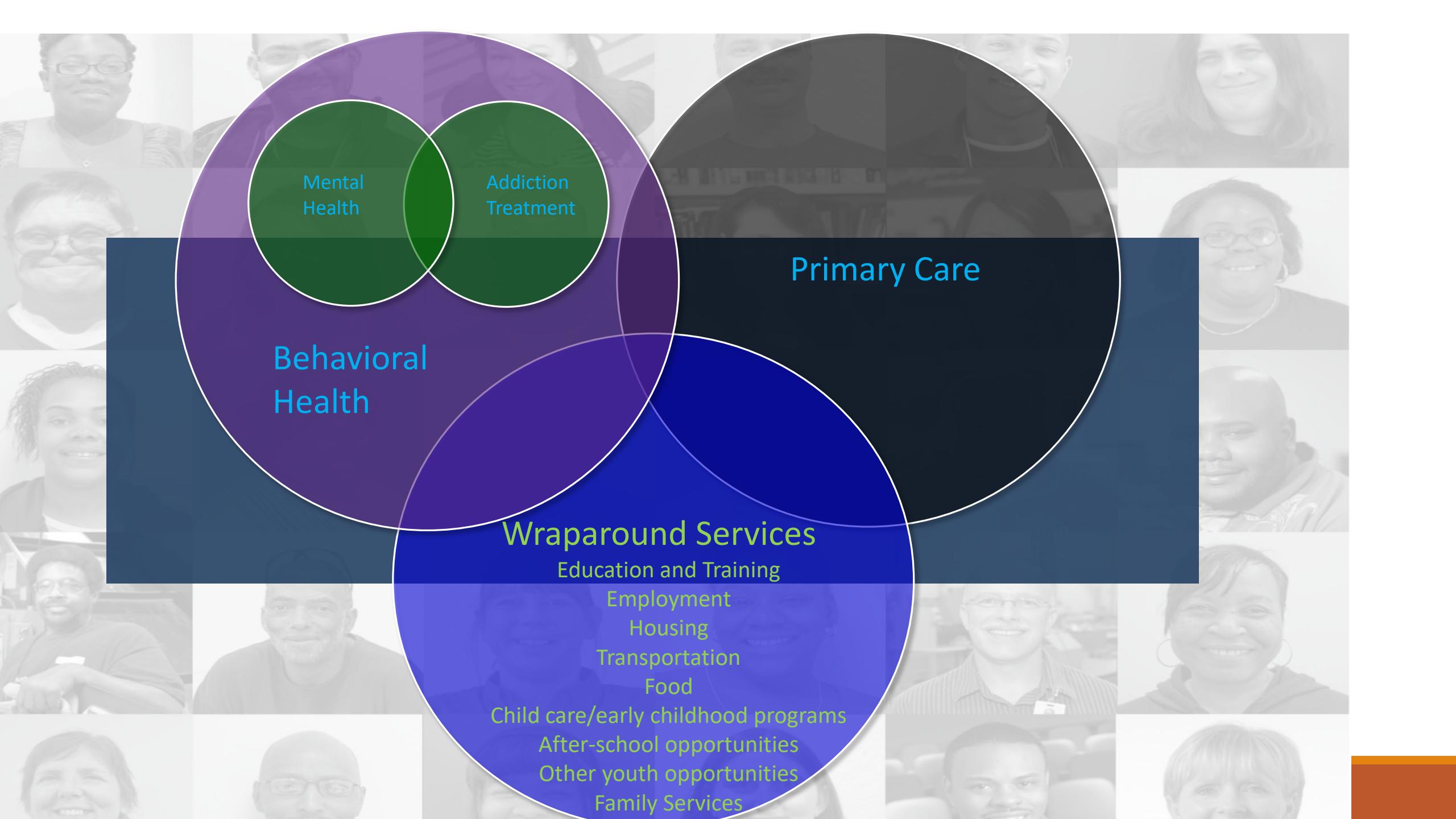


Mental
Health

Addiction
Treatment

Behavioral
Health

Primary Care



Mental
Health

Addiction
Treatment

Behavioral
Health

Primary Care

Wraparound Services

Education and Training

Employment

Housing

Transportation

Food

Child care/early childhood programs

After-school opportunities

Other youth opportunities

Family Services

Local Coalitions

Cross Sector

Public, Private, Not-for-Profit

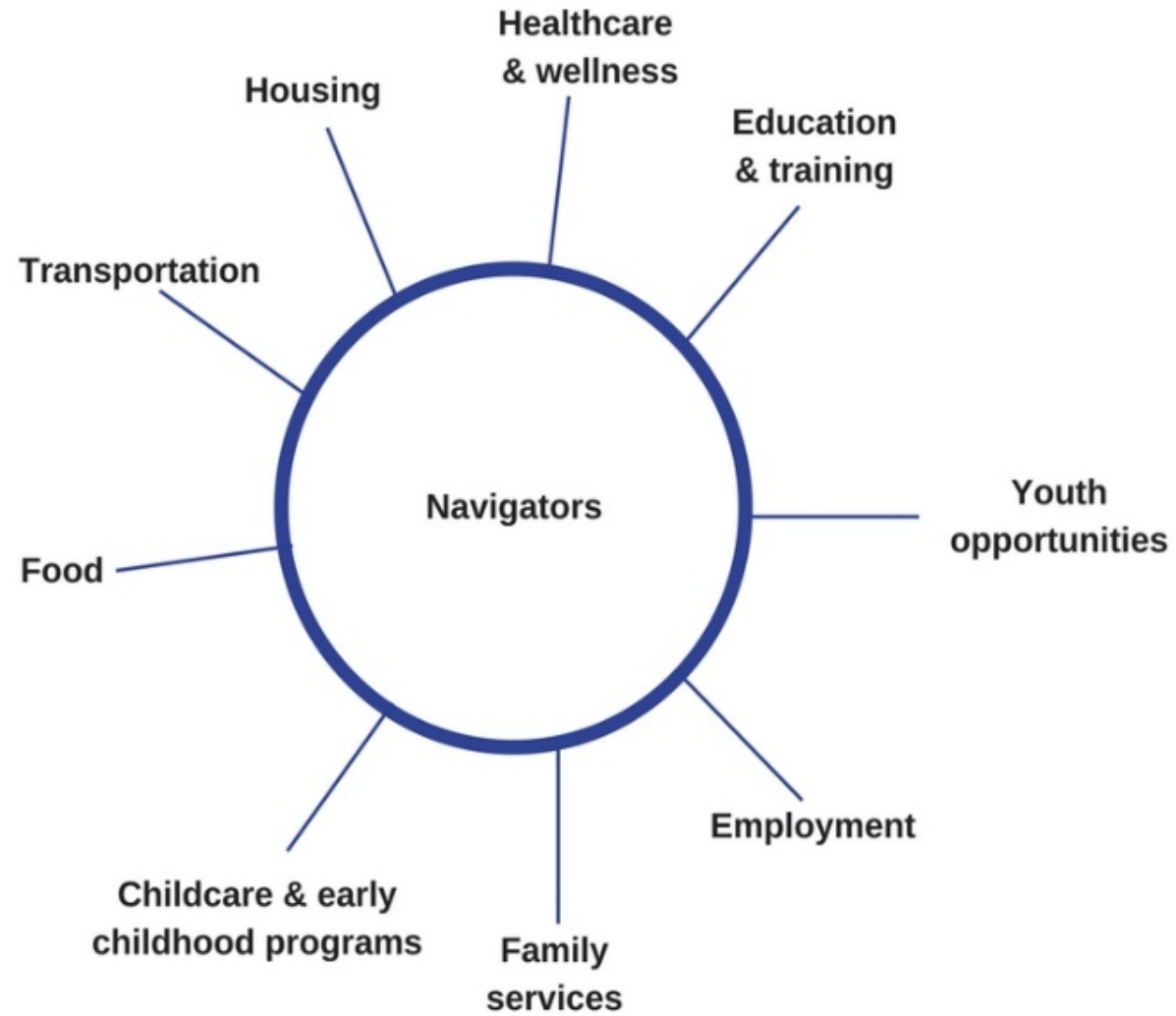
Businesses, Educational Institutions, Health Care Entities

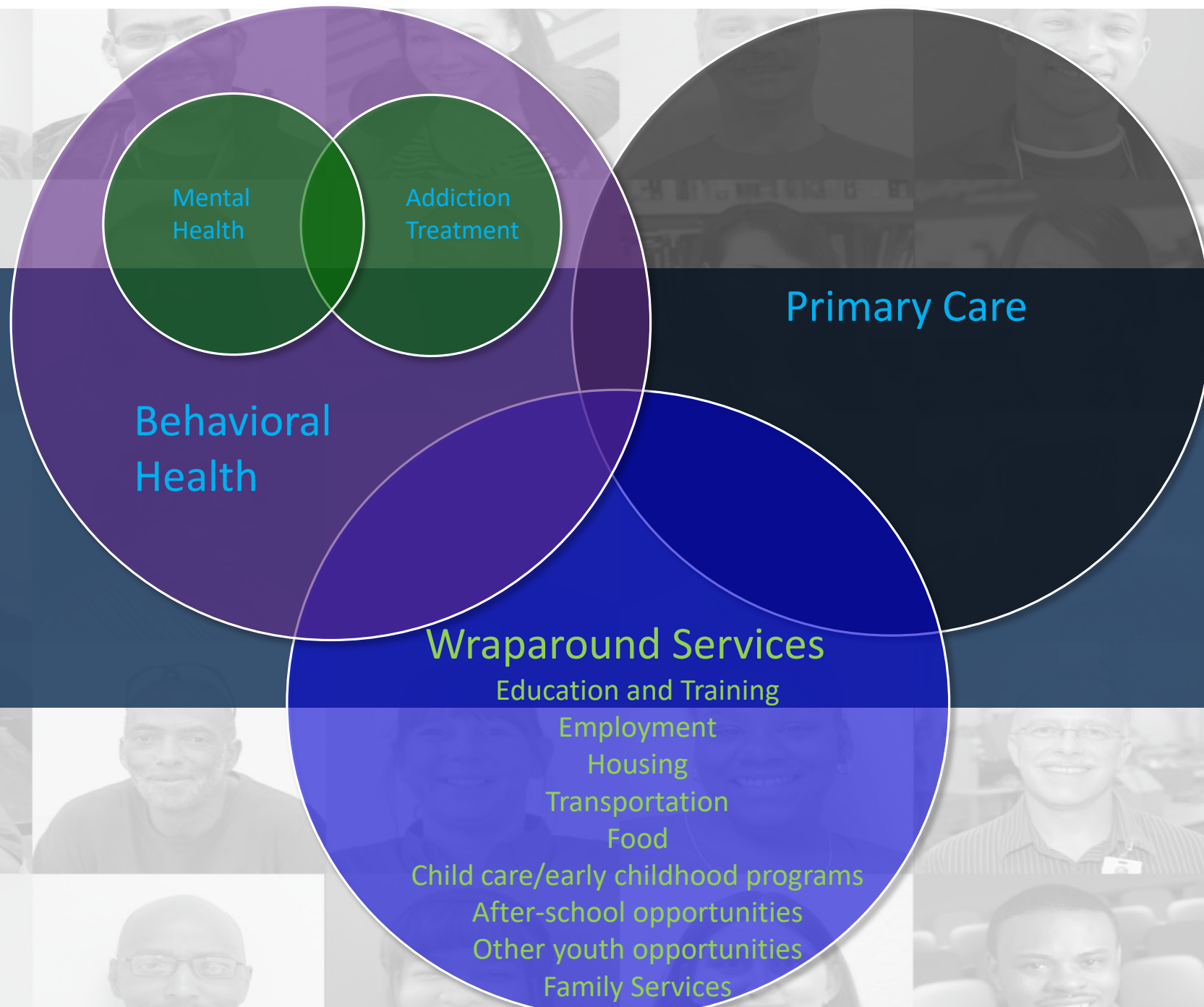
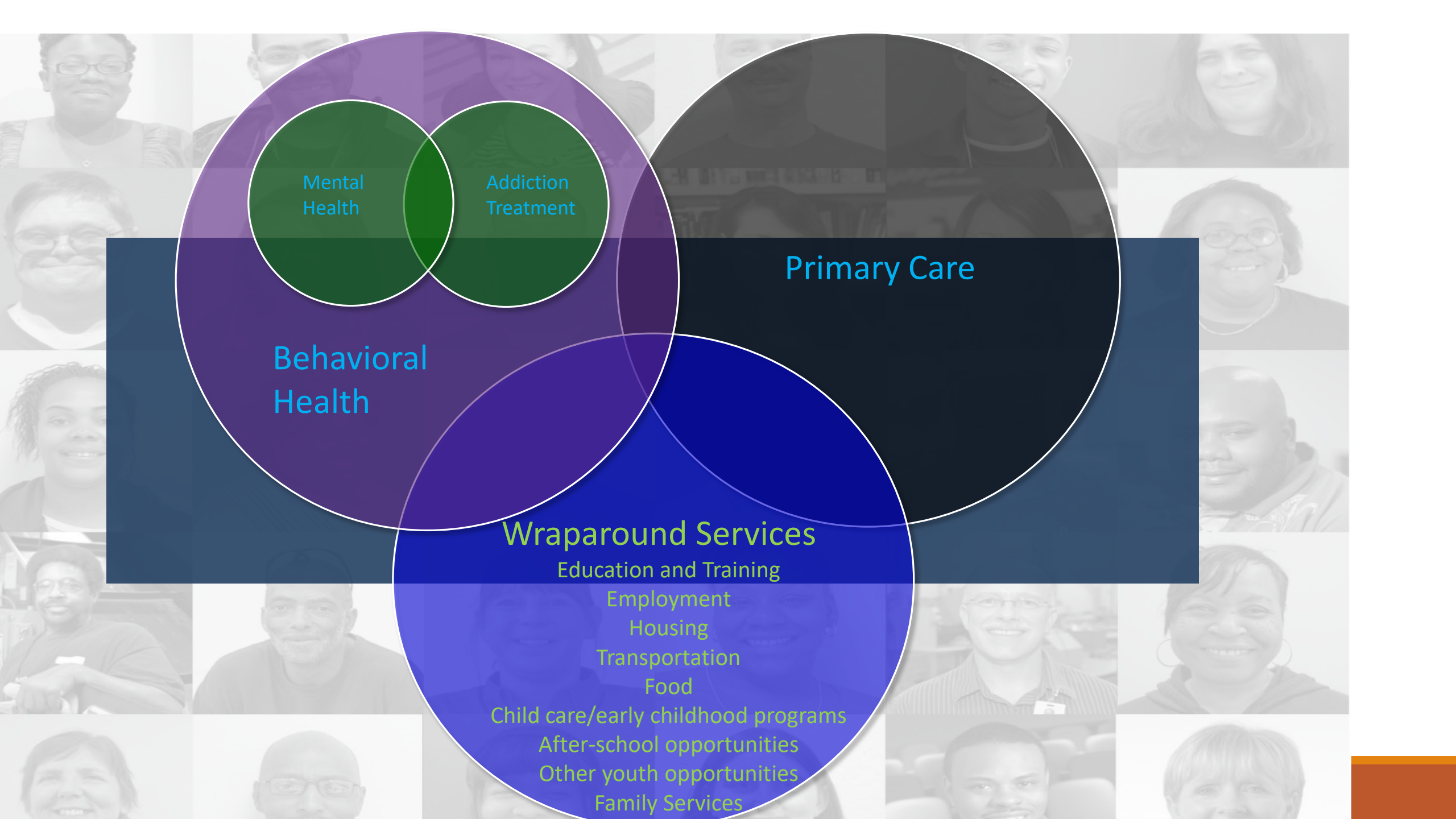
Local Governments, Law Enforcement Agencies, Courts

Philanthropies, Community-based Organizations, Faith-based Organizations

With strong local leadership







Health Systems: The Next Generation 2018

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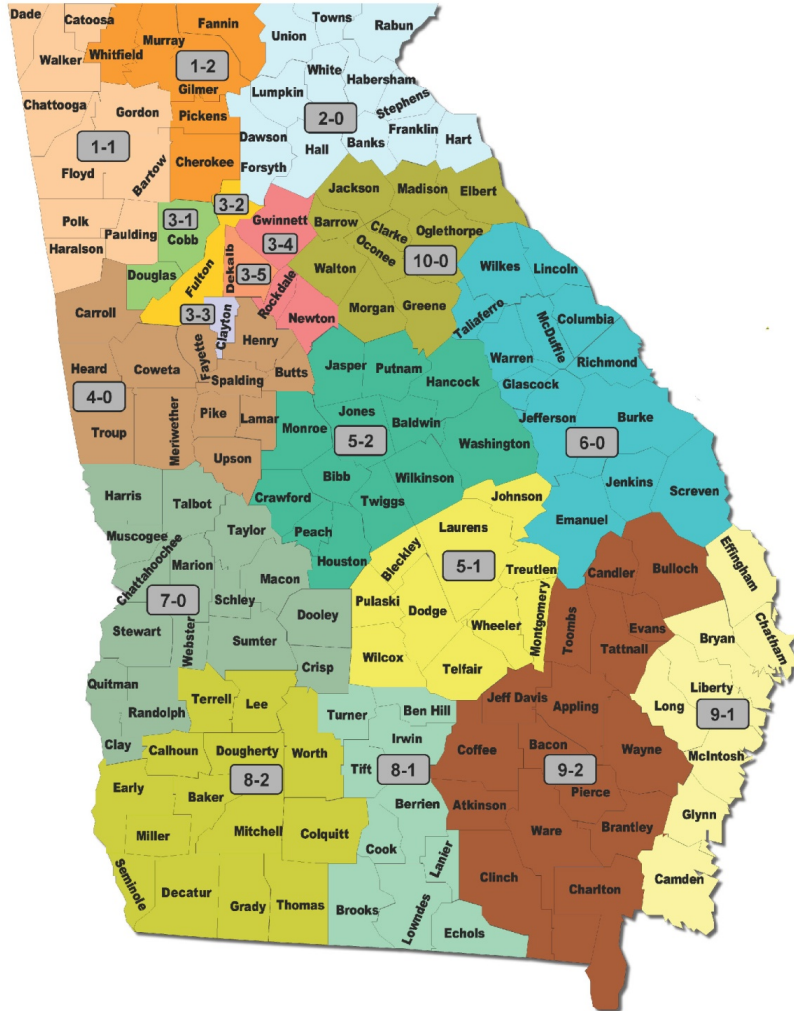


State of Public Health

UPDATE from DPH

November 9, 2018/J. Patrick O'Neal, M.D., Commissioner

Georgia Department of Public Health



159 County Health Departments

159 County Boards of Health

18 Public Health Districts

18 District Health Directors

1 Commissioner

1 State Board of Public Health

Mission Statement



- Prevent disease, injury and disability
- Promote health and well-being
- Prepare for and respond to disasters

Our Priorities

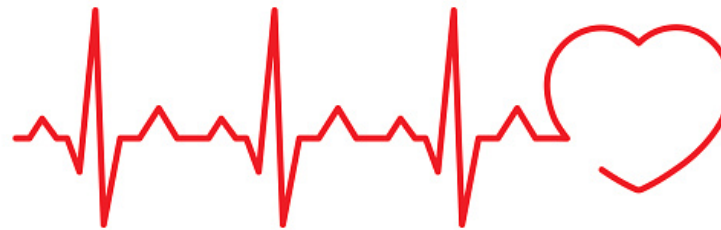
Early Brain Development



Opioid Epidemic



Cardiac Care



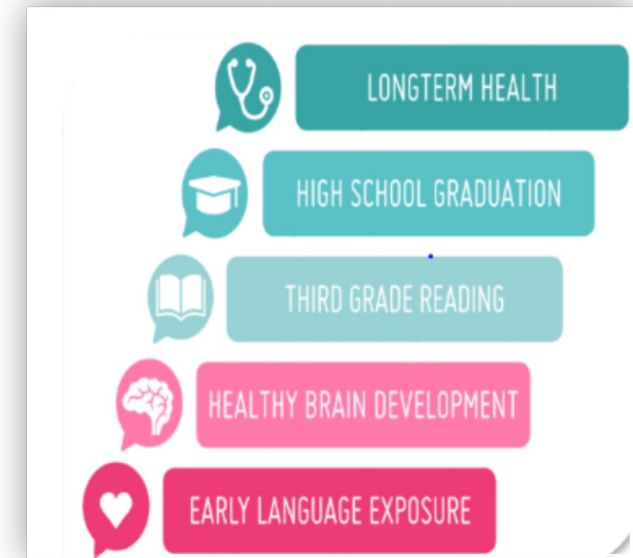
EARLY BRAIN DEVELOPMENT

- Created Brain Trust for Babies
- Newborn Screening for 31 disorders
- Early Hearing Detection and Intervention 1-3-6 month benchmarks to screen, diagnose, intervene
- Babies Can't Wait increased autism screening and treatment
- Talk with Me Baby (TWMB)—one of four nationally-recognized initiatives to increase language nutrition
- TWMB partnered with Scholastic to develop the *TWMB BOARD BOOK*
- Children 1st identifies developmental delays and links to interventions
- Home Visiting program promotes early language literacy
- Oral Health promotes oral health literacy
- Centering Pregnancy Programs to reduce preterm births
- Safe to Sleep campaign

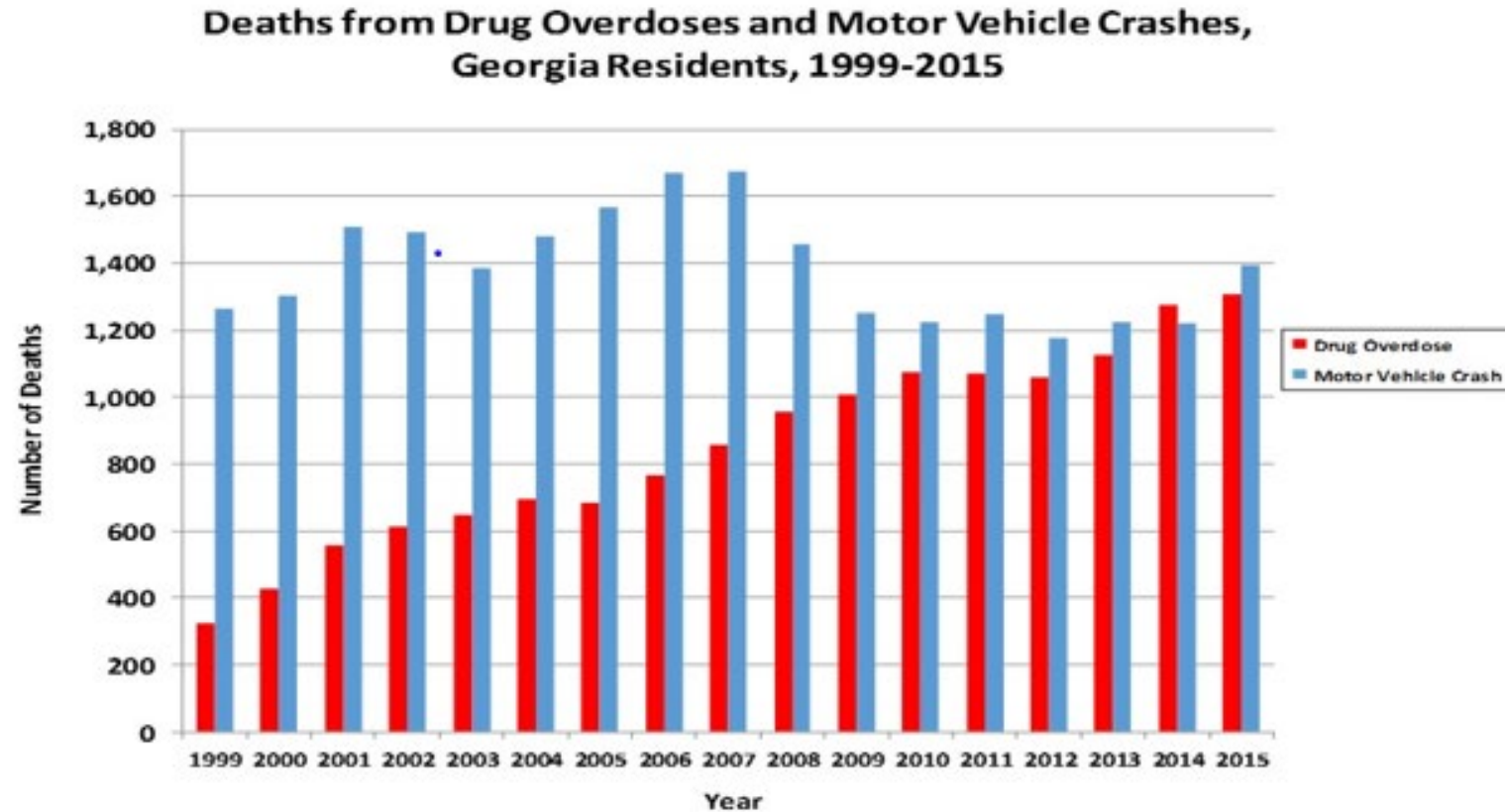


TALK WITH ME BABY

- A population-based initiative to ensure every child, beginning in utero, receives essential “language nutrition”
- The quantity and quality of nourishing language are critical to healthy brain development
- Abundant language nutrition ensures a strong foundation for
 - Social-emotional, cognitive development
 - Language and literacy
 - Pathway to third grade reading proficiency, high school graduation, lifelong success



Opioids In Georgia



Drug Overdose uses underlying cause ICD-10 Codes X40-X44, X60-X64, Y10-Y14, X85, F11-F16, F18 and F19;
Motor Vehicle Crashes uses V02-V04, V09.0, V09.2, V12-V14, V19.0-V19.2, V19.4-V19.6, V20-V79, V80.3-V80.5, V81.0-V81.1, V82.0-V82.1, V83-V86, V87.0-V87.8, V88.0-V88.8, V89.0, V89.2 (E810-E825).
Source: Georgia Department of Public Health, Office of Health Indicators for Planning (OHIP), OASIS <https://oasis.state.ga.us>

REGIONALIZED CARE

Level I—Open Heart/LVAD

Level II—PCI

Level III—Front line facilities

EMS Goal—right
patient, right place, right
time!

Thank You

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Vivian Singletary, JM, MBA

Director of the Public Health Informatics Institute



**“An ounce of prevention is
worth a pound of cure.”**

-Ben Franklin



Photo courtesy of CDC Public Health Image Library/Brian Judd



Photo courtesy of CDC Public Health Image Library/Holly Patrick



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Morehouse School of Medicine



Closing Remarks

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Thank you

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