

Toward a Systems Science Approach to Eliminating Health Disparities in Indigenous Populations

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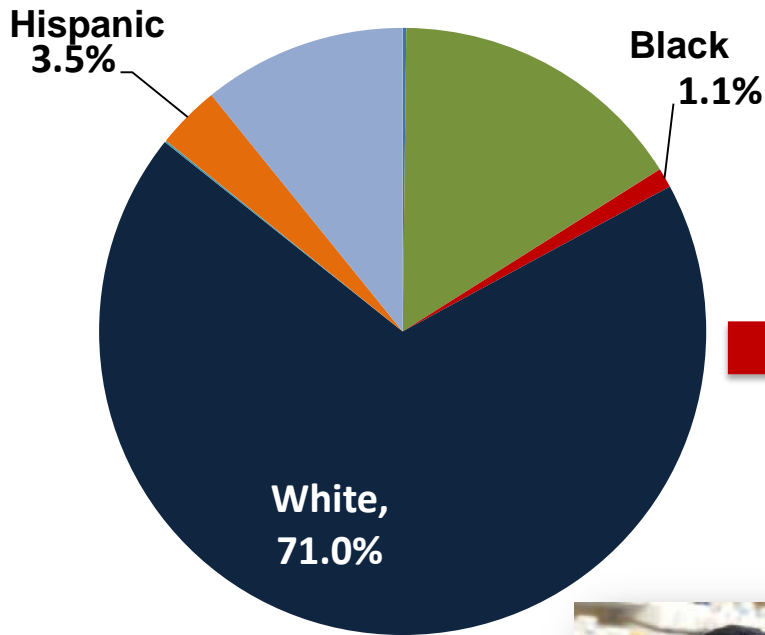
International Indigenous Health Symposium

October 14, 2016

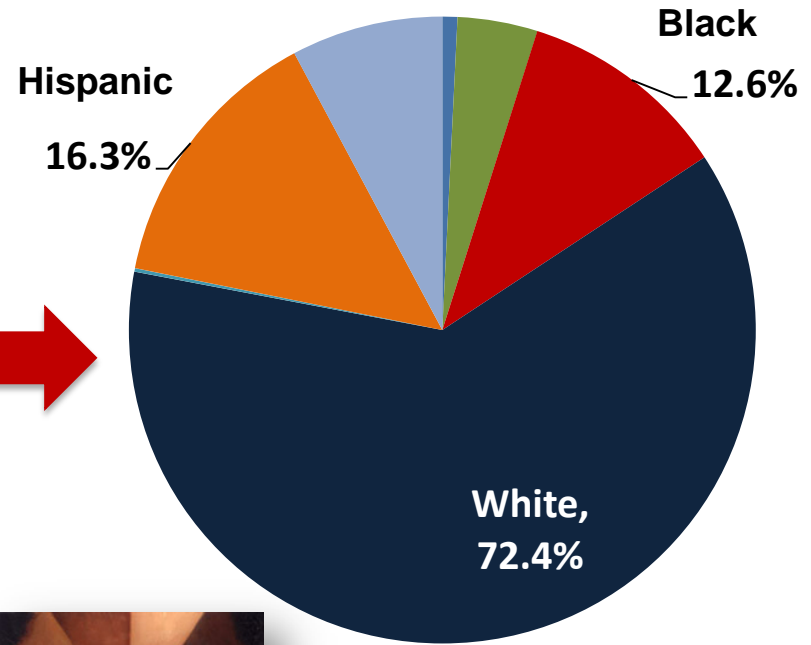


Imagine the NIH in 2025 - Diversity – Source of Our Excellence: **What If?** Diversity of NIH Grantees Reflected a Diverse Nation

NIH PI Grantees



US Population



Toward a Systems Science Approach to Eliminating Health Disparities



- Diverse, Global, Networked Scientific Community
- **Health Inequities and Mission-driven Public Health Impact**
- Seizing Unprecedented Opportunities

The Health Inequity Challenge: “Unfinished Business” in Public Health Impact

FOR THE SAKE OF ALL A report on the health and well-being of African Americans in St. Louis

Washington University in St. Louis

Chronic Disease in St. Louis: PROGRESS FOR BETTER HEALTH

By Bertina F. Drake, PhD, MPH and Keith Elder

This fifth and final brief in the For the Sake of All series focuses on chronic disease in the St. Louis area. This brief will examine our progress to date and will discuss how where we live influences our health.

Locally,

OPEN ACCESS Freely available online

Eight Americas: Investigating Mortality Disparities across Races, Counties, and Race-Counties in the United States

Christopher J. L. Murray^{1,2,3}, Sandeep C. Kulkarni^{2,4}, Catherine Terrell J. Iandiorio³, Majid Ezzati^{1,2*}

ABSTRACT

Background

The gap between the highest and lowest mortality rates in the United States is over 35 y. We divided the United States into eight distinct groups, representing different racial and ethnic groups, to identify disparities that can inform our public health strategies to reduce mortality.

Nationally,

PLOS MEDICINE

Original Article

Temporal Trends in Ischemic Heart Disease Mortality in 21 World Regions, 1980-2010: The Global Burden of Disease 2010 Study

Andrew E. Moran^{1*}; Mohammad H. Forouzanfar²; Gregory Roth²; George Mensah³; Majid Ezzati⁴; Christopher J. L. Murray²; Mohsen Naghavi²

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Abstract

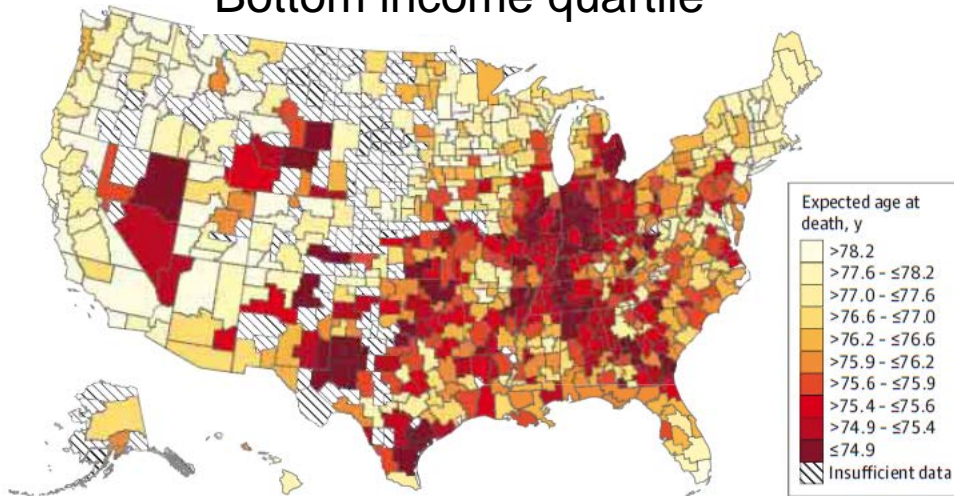
Background—Ischemic Heart Disease (IHD) is the leading cause of death worldwide. The Global Burden of Diseases, Risk Factors and Injuries (GBD) 2010 Study estimated global and regional IHD mortality from 1980 to 2010.



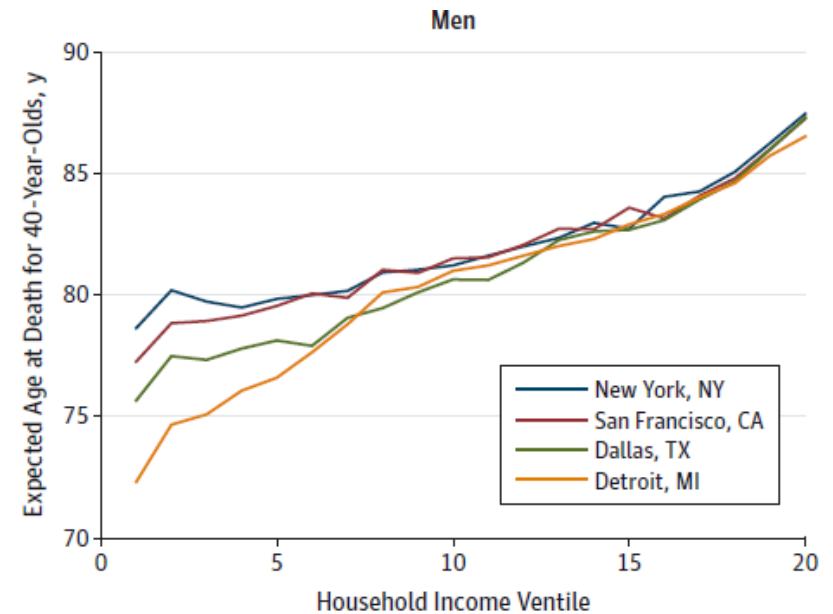
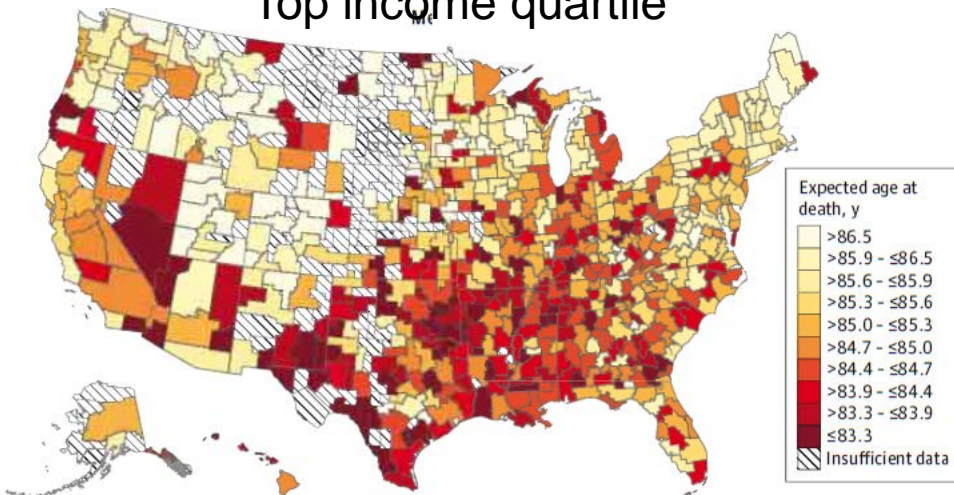
Globally.

Variation in Life Expectancy and Health Inequities: Place Matters – Effects of Income and Geographic Region: Men

Bottom income quartile



Top income quartile



- Higher income was associated with greater longevity.
- Association between LE and income varied substantially across areas.
- Differences in LE were correlated with health behaviors and local area characteristics.

Health Inequities – A Complex, Multi-level Problem

Systems Science & the Socio-ecological Model

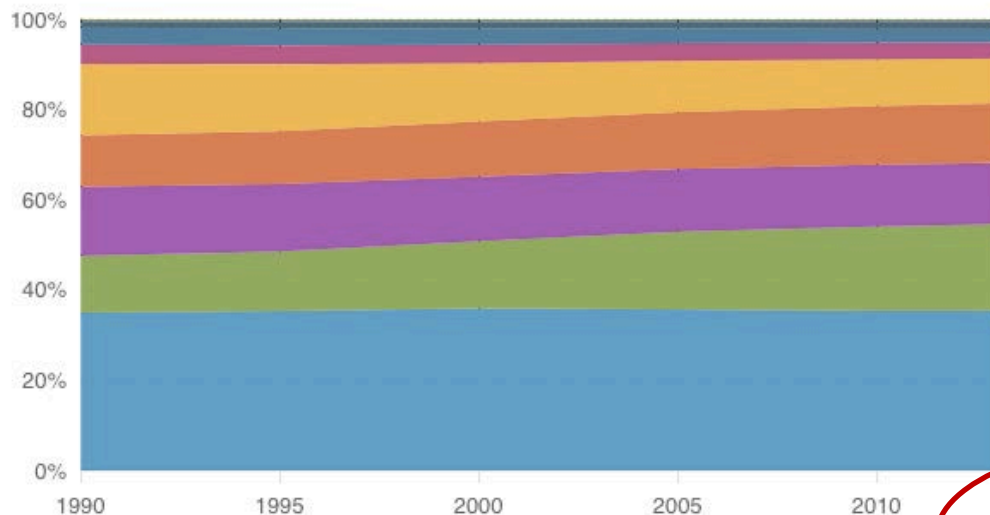
Classic Approach	Systems Approach
Reductionist	Holistic; Integrated Systems
Uni-dimension data	Multi-dimensional data
Single-discipline lab	Multidiscipline teams
Individual molecules	Pathways & networks
Descriptive models	Predictive modeling
Molecular assays	High-output assays
Molecules <u>OR</u> Cells	Molecules <u>AND</u> Cells
<u>OR</u> Tissues <u>OR</u> Populations	<u>AND</u> Tissues <u>AND</u> Populations
<u>OR</u> Social Context	<u>AND</u> Social Context



CVD, Diabetes & Lung Diseases - Greatest Causes of Mortality; Yet Modifiable Risk Factors Greatest Contributors in Oceania

Mortality Over Time as Percentage of Overall Harm from Non-Communicable Diseases

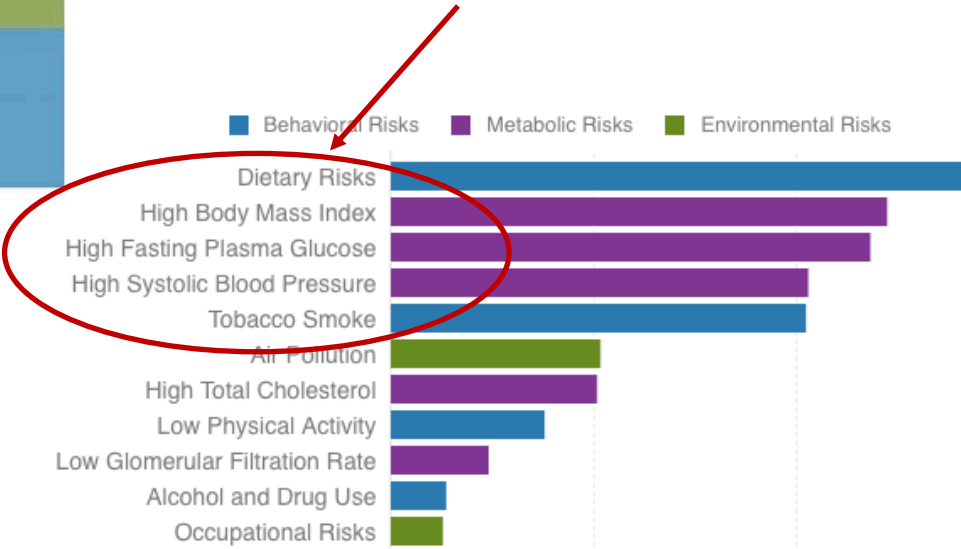
Annual Mortality



- Cardiovascular Diseases
- Diabetes, Urogenital, Blood, and Endocrine Diseases
- Chronic Respiratory Diseases
- Cancer
- Digestive Diseases
- Other Non-Communicable Diseases
- Cirrhosis
- Neurological Disorders
- Mental and Substance Use Disorders
- Musculoskeletal Disorders

Risk Factors Contributing to Non-Communicable Disease Mortality

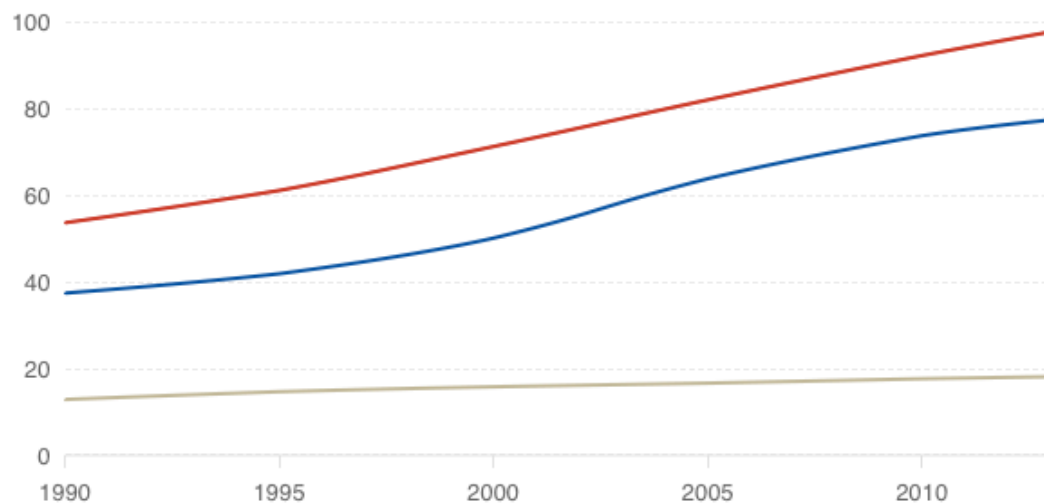
Modifiable Risks



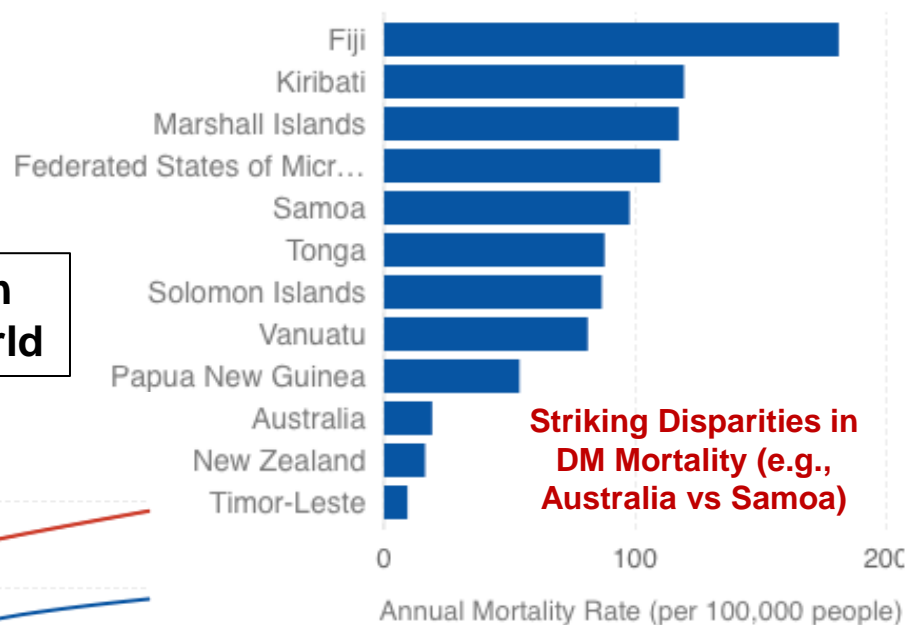
Mortality from Diabetes in Oceania Highlights Differences and Disparities Across the Region

Mortality Rate from DM Higher Over Time in Samoa as Compared to Oceania and the World

Annual Mortality Rate (per 100,000 people)



■ Samoa ■ Oceania ■ The World



Striking Disparities in DM Mortality (e.g., Australia vs Samoa)

Differences and Disparities in Mortality Rate from DM

Heart Disease in Native Hawaiians & Pacific Islanders: Surfacing the Issues with Limited Data

Native Hawaiians/Pacific Islanders

- 70% more likely to die from heart disease than whites.
- 70% more likely to be diagnosed with heart disease than whites.
- More prevalent risk factors for heart disease than whites.

Age-adjusted percentages of coronary heart disease among persons 18 years of age and over, 2012

Native Hawaiian/Pacific Islander	Non-Hispanic White	Native Hawaiian/Pacific Islander / Non-Hispanic White Ratio
10.3*	6.2	1.7

Age-adjusted percentage of persons 18 years of age and over who have high blood pressure, 2012

Native Hawaiian/Pacific Islander	Non-Hispanic White	Native Hawaiian/Pacific Islander / Non-Hispanic White Ratio
36.5	23.4	1.6

Indigenous Leaders Engaged in Transformational Change: Eliminating Health Disparities in Native Hawaiians & Pacific Islanders

CVD Risk -- Diabetes in Hawaii by Race/Ethnicity, BRFSS 2014

DOH Race-Ethnicity	Diabetes			Estimated Population
	#	%	C.I. (95%)	#
Caucasian	17,000	5.0	4.0 - 5.9	342,500
Native Hawaiian	17,000	12.8	10.0 - 15.7	132,800
Chinese	5,988	10.8	8.0 - 13.9	59,700
Filipino	24,500	13.0	9.7 - 16.2	188,600
Japanese	30,700	13.6	11.1 - 16.1	226,000
Black	n/r	n/r	n/r	30,200
Native Alaskan/ American Indian	n/r	n/r	n/r	6,900
Other Asian	n/r	n/r	n/r	26,200
Other Pacific Islander	3,800	14.8	6.3 - 23.2	25,900
Other	2,400	9.0	4.3 - 13.6	26,700

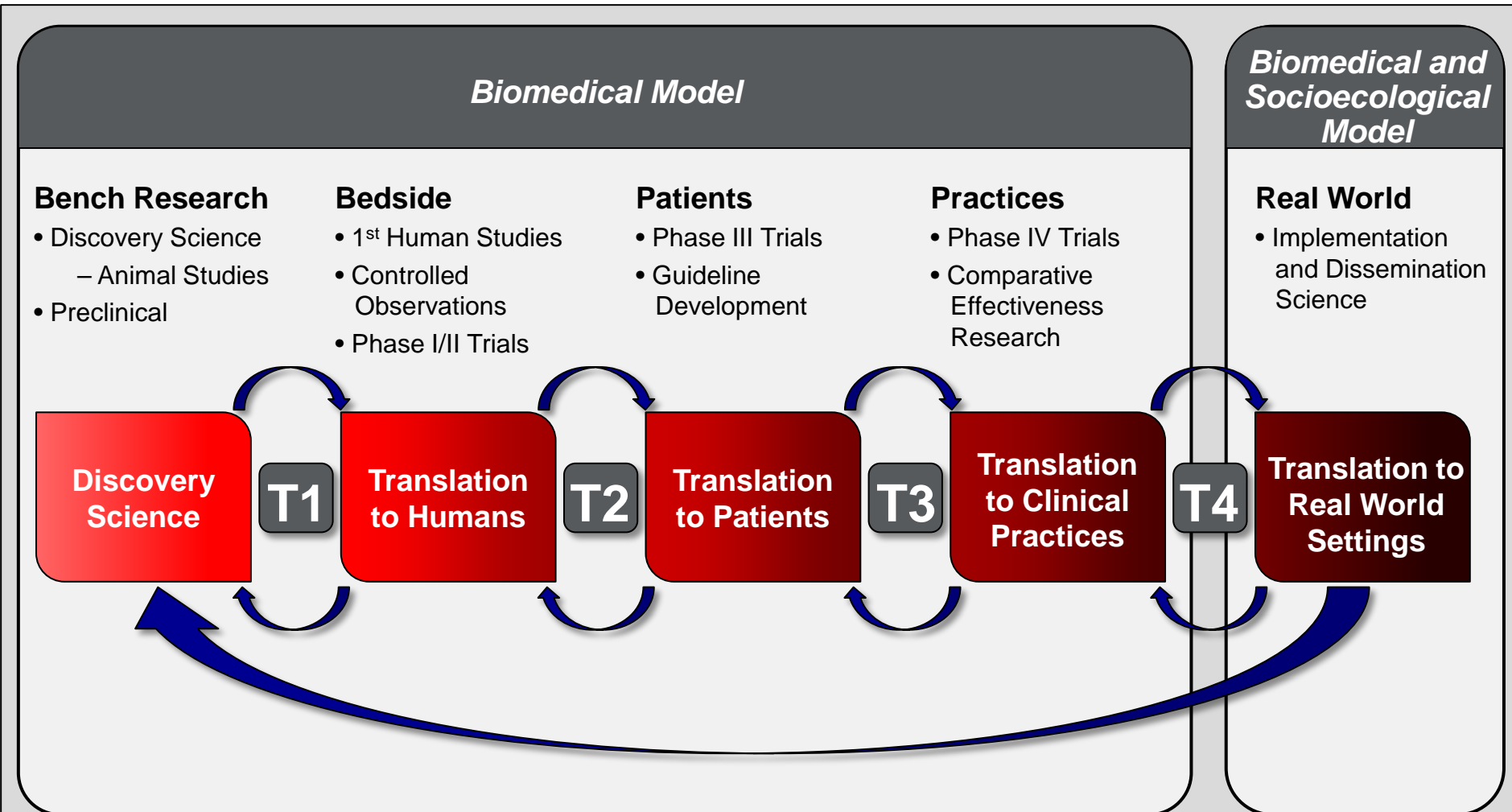


Native Hawaiians & Pacific Islanders are one of the highest risk populations for cardiometabolic diseases in the US.



Mau MK et al. Epidemiol Rev. 2009;31:113-29

Translating Discovery Science into Public Health Impact: From 'Nucleotides-to-Neighborhoods'



A Systems Approach to Health Inequities:

What if we systematically leveraged a network of community partners and resources in knowledge-exchange to reduce health inequities?

Community Health Workers



Primary Care Physicians



Home Health Setting



**Schools /
Community Resources**



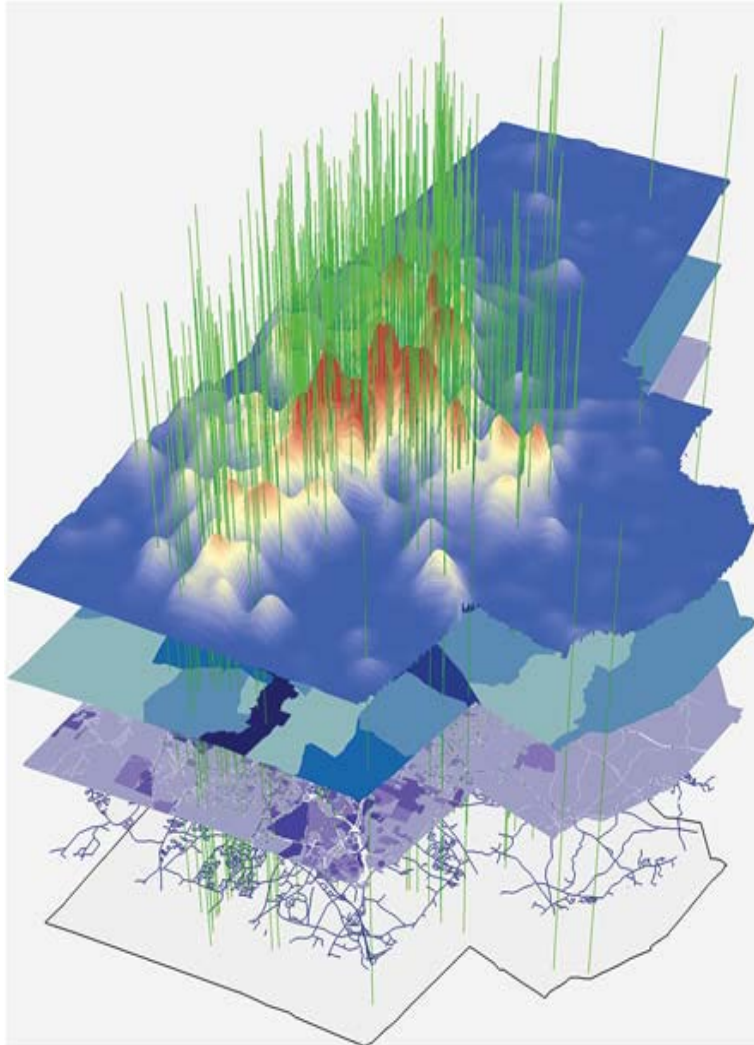
Pharmacies & Clinics



mHealth/Wearable Sensors



Converting Data-2-Knowledge for Community Health Impact: Duke Health System Maps/Targets Diabetes 'Hot Spots'



- **Integrative, multi-component systems analysis**
 - EMR-linked data warehouse
 - Geographic Information Systems
 - Socio-economic (female head-households)
 - Environmental factors (food access)
- **Health System Platform**
 - **Innovative** strategies to target fundamental **change interventions**
 - Patient-centered, value-added community-level healthcare

He Huliau -- Indigenous Transformational Leaders: A Turning Point in Inequities – From Description-to-Action

TBM

Translating the Diabetes Prevention Program in Native Hawaiian and Pacific Islander communities: the PILI 'Ohana Project

DPP-like intervention improves weight loss, BP, exercise capacity, physical activity frequency, and Fat in Diet Score across all groups.

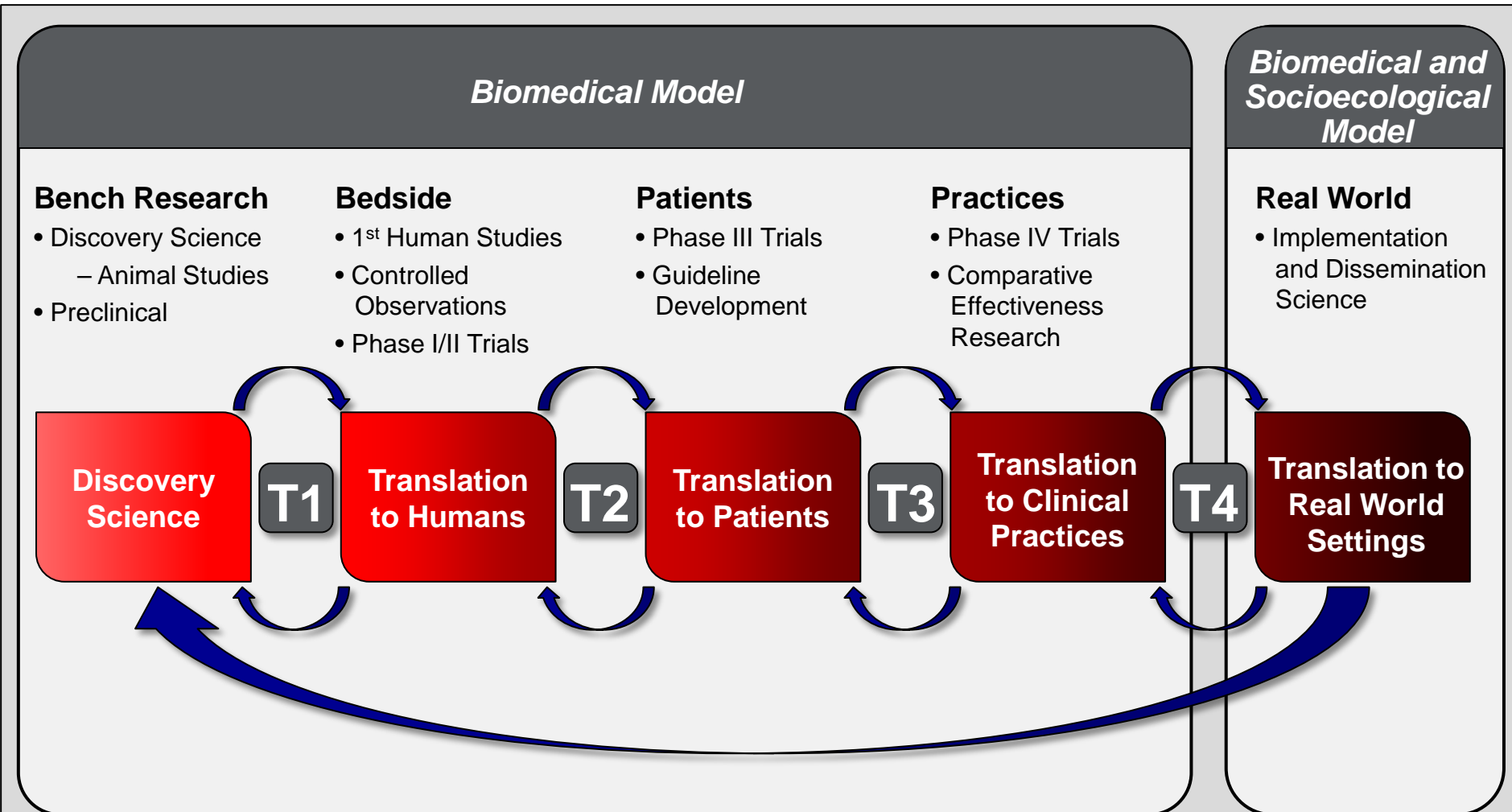
Table 3 | Pre- to post-intervention changes in clinical and behavioral measures across community sites and in combined sample

Measure ^a	KULA (n=59)		HM (n=58)		KOM (n=70)	
	Post-intervention	$\mu_{\text{pair-diff}}^b$	Post-intervention	$\mu_{\text{pair-diff}}^b$	Post-intervention	$\mu_{\text{pair-diff}}^b$
Weight (kg) [†]	97.7±22.5	-2.2±3.1 [‡]	92.6±20.4	-2.3±3.6 [‡]	103.7±22.5	-2.0±3.8 [‡]
BMI (kg/m ²) [†]	37.2±6.6	-0.8±1.2 [‡]	34.0±6.1	-0.9±1.4 [‡]	37.9±7.7	-0.7±1.4 [‡]
Systolic BP (mmHg)*	127.3±21.2	-9.3±22.4 [†]	129.4±20.7	-2.6±16.1	125.9±16.1	-1.2±17.3
Diastolic BP (mmHg) [†]	79.6±12.7	-9.5±14.2*	82.5±12.6	-1.7±10.5	78.8±11.9	-1.9±11.4
6MWT (ft) [‡]	1,408.5±290.1	183.7±207.4 [‡]	1,497.3±369.5	169.8±237.6 [‡]	1,176.9±324.0	23.1±243.5
Physical Activity Fq	2.9±1.1	-0.6±1.4 [†]	2.9±1.1	-0.5±1.1 [‡]	2.7±0.9	-0.3±1.1*
Fat in Diet Score ^d	2.7±0.3	-0.3±0.3 [‡]	2.7±0.3	-0.2±0.4 [‡]	2.6±0.4	-0.3±0.4 [‡]

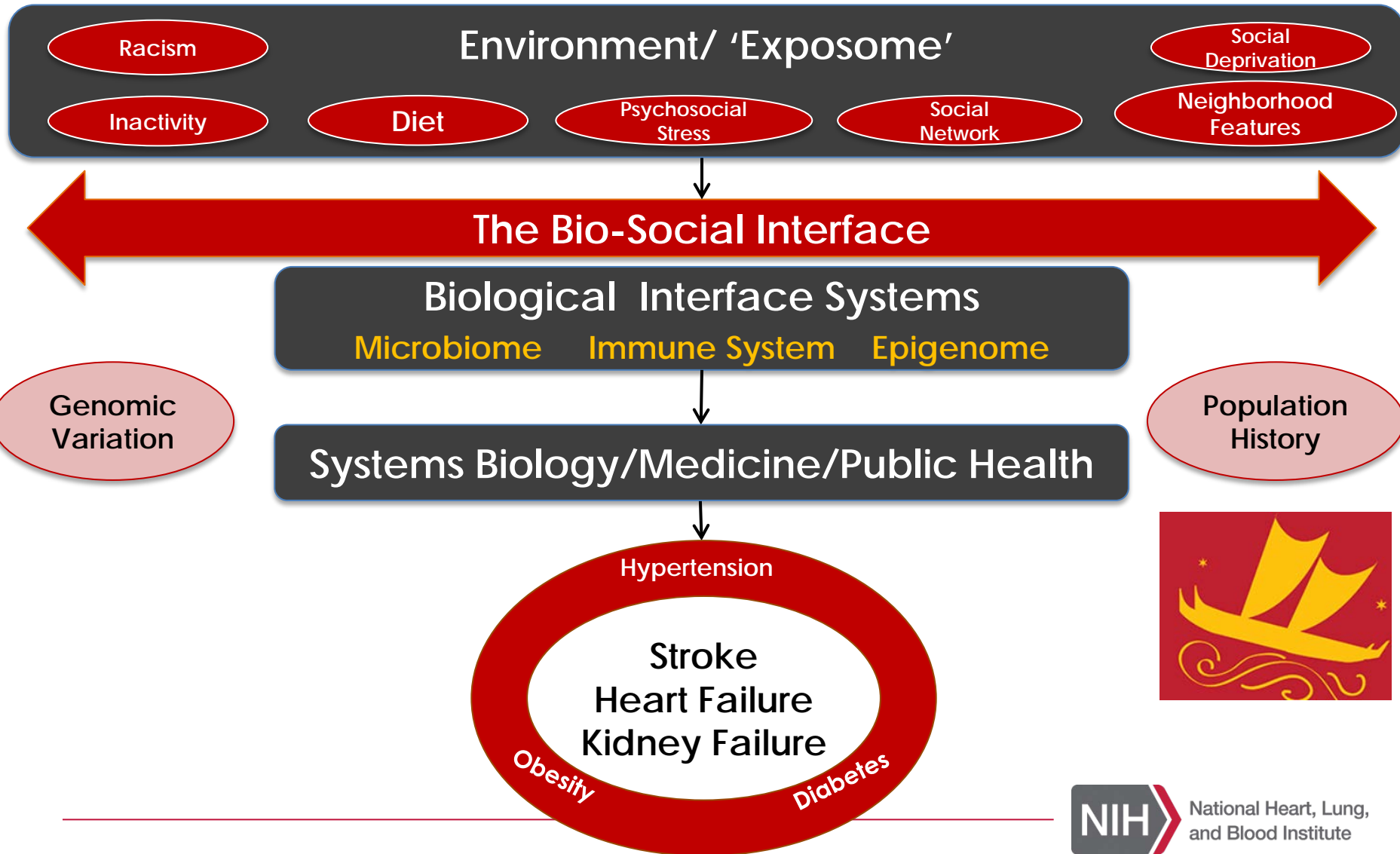
Measure ^a	KKV (n=52)		Combined Total (n=239)	
	Post-intervention	$\mu_{\text{pair-diff}}^b$	Post-intervention	$\mu_{\text{pair-diff}}^b$
Weight (kg) [†]	110.8±34.8	-0.2±3.2	101.1±25.9	-1.7±3.5 [‡]
BMI (kg/m ²) [†]	41.6±11.9	-0.1±1.2	37.6±8.6	-0.6±1.3 [‡]
Systolic BP (mmHg)*	123.8±20.2	-0.3±16.9	126.6±19.5	-3.3±18.6 [†]
Diastolic BP (mmHg) [†]	76.0±11.9	-0.5±11.7	79.3±12.3	-3.4±12.5 [‡]
6MWT (ft) [‡]	1,397.7±323.3	62.2±223.6	1,359.9±349.1	106.6±238.4 [‡]
Physical Activity Fq	3.3±1.1	-0.6±1.3 [†]	3.0±1.1	-0.5±1.2 [†]
Fat in Diet Score ^d	2.7±0.4	-0.3±0.5 [‡]	2.7±0.4	-0.3±0.4 [‡]



Translating Discovery Science into Public Health Impact: From 'Nucleotides-to-Neighborhoods'



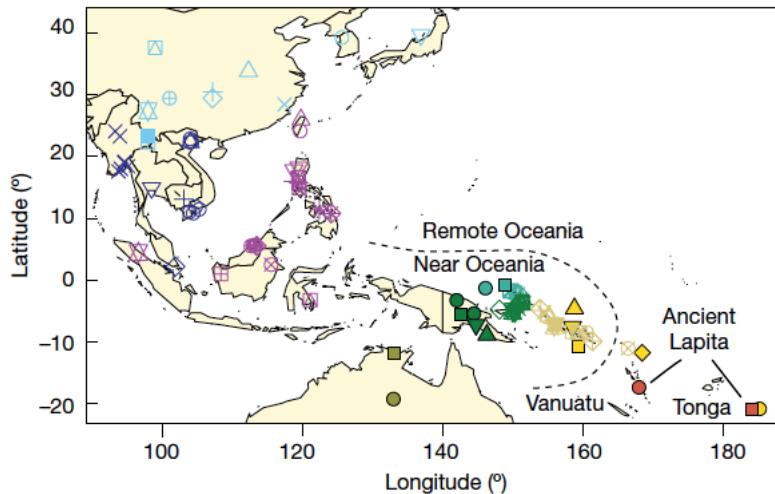
The Ecosystems of Cardiovascular Health Inequities: Multi-Level, Bio- Social Determinants



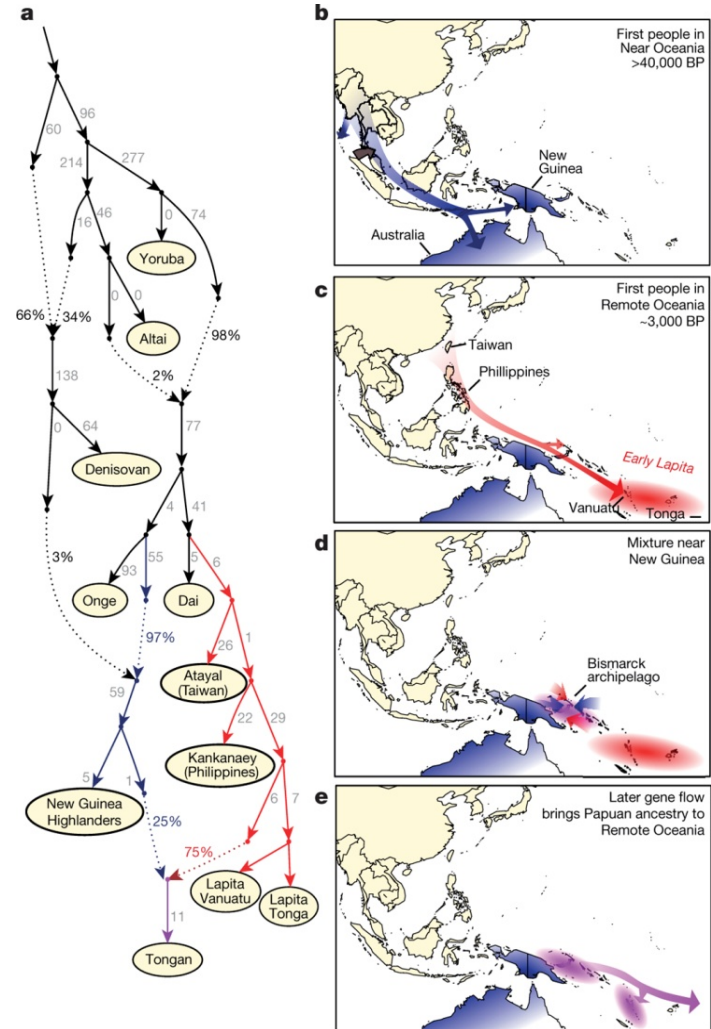
Understanding Ancestral Population History: Cultural-Genetic Influences on Health

nature International weekly journal of science

Genomic insights into the peopling of the Southwest Pacific



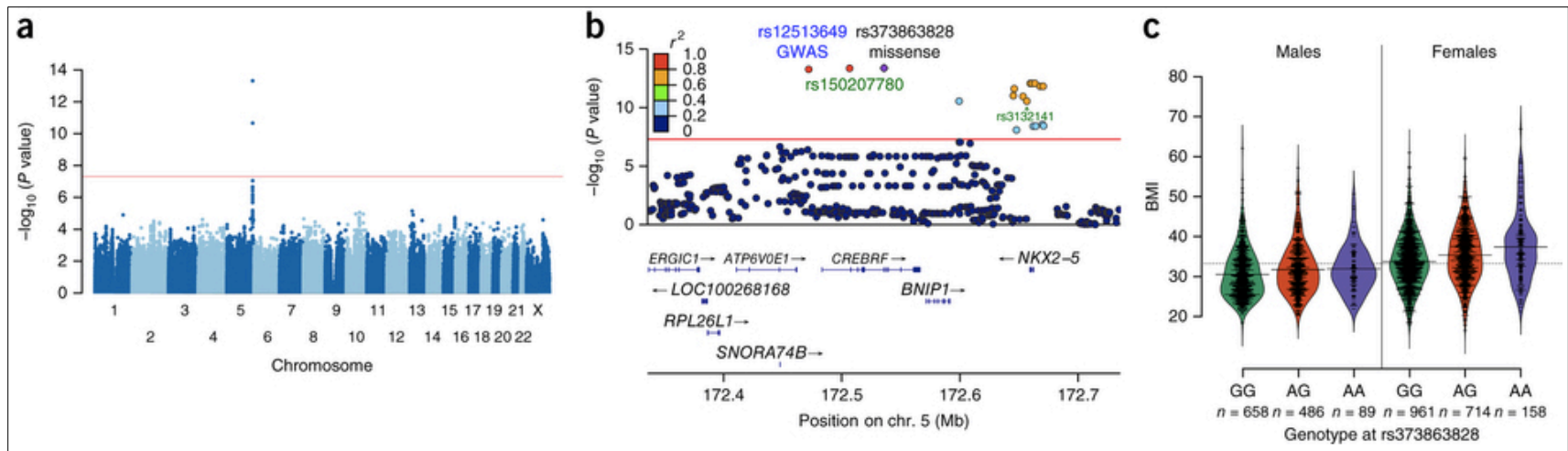
- Pacific Islands populated from waves of migration from SE Asia.
- First people to Near Oceania >40,000 BP
- Early waves (3000 BP) of migrants populated Remote Oceania
- Subsequent waves of Papuan ancestry.



Legacy of Ocean-Voyager Ancestors: 'Thrifty' Gene Variant Predisposes to Obesity in Samoans

nature
genetics

A thrifty variant in *CREBRF* strongly influences body mass index in Samoans

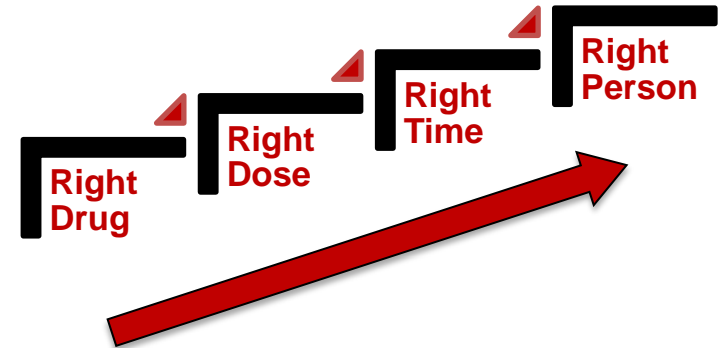
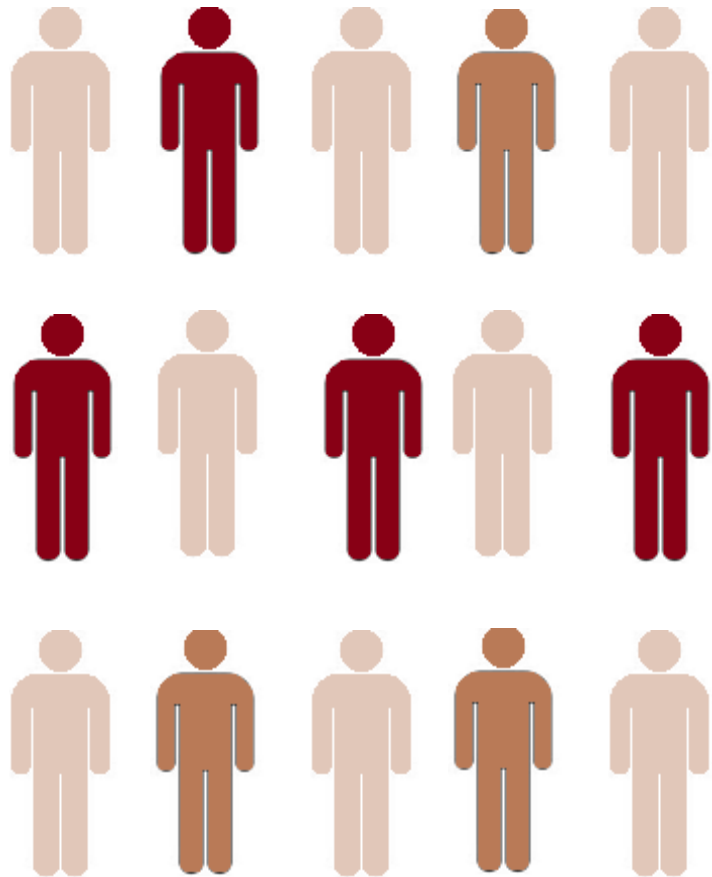


- High prevalence (>80%) of obesity in Samoans.
- Common variant (0.25) in the *CREBRF* gene strongly associated with BMI.
- *CREBRF* missense variant is rare (<0.001) in other populations.
- Positive selection for fat storage; metabolic advantage during famine.



What If? Molecular Markers and Imaging Tools Provided Better Refinement of Patient Subsets for Targeted, Tailored Interventions?

Promise of Precision Medicine

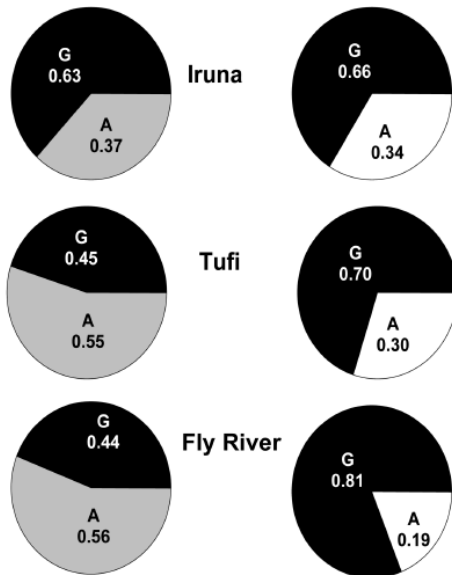


Precision Medicine – Right Drug/Right Patient: Variation in Drug Metabolism in Polynesian Population

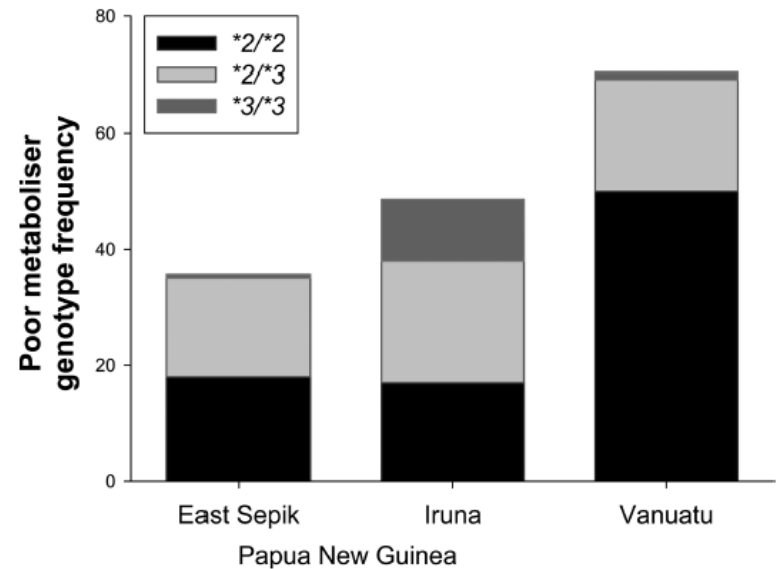
Variants of CYP2C19 in Populations in Papua New Guinea

*2 loci (c.681 G>A)

*3 loci (c.636 G>A)



Comparison of Poor Metaboliser Genotype Frequency and Pattern of CYP2C19 Variants



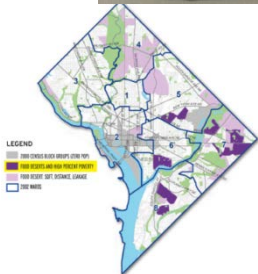
- Among Papua New Guinea, Iruna have the highest frequency (34%) of poor metabolism variants; compared with Europeans (3%).
- Poor metabolism of the anti-platelet drug – clopidogrel – to active form reduces clinical efficacy in preventing CVD events.

Holistic Systems Approach to Discovery, Prevention, and Pre-Emption of Health Disparities

What if we embedded within minority-serving health systems rich data collection of behaviors, mHealth sensor data, patient-centered outcomes, and environmental factors, into shared data commons platforms...



Built Environment
Physical Activity
Nutrition
Geospatial
Psychosocial
Genomics
Proteomics
Metabolomics



....and applied deep analytics with creative cultural insight to predict, prevent and preempt chronic disease?



National Heart, Lung,
and Blood Institute