CW PHS
CENTER FOR WIRELESS & POPULATION HEALTH SYSTEMS

Overview of Center for Wireless and Population Health Systems

Professor of Family Medicine and Public Health
Director, Center for Wireless and Population Health Systems
The Qualcomm Institute/Calit2
University of California, San Diego

Defense Health Board
February 10, 2016

UC San Diego

QUALCOMM INSTITUTE

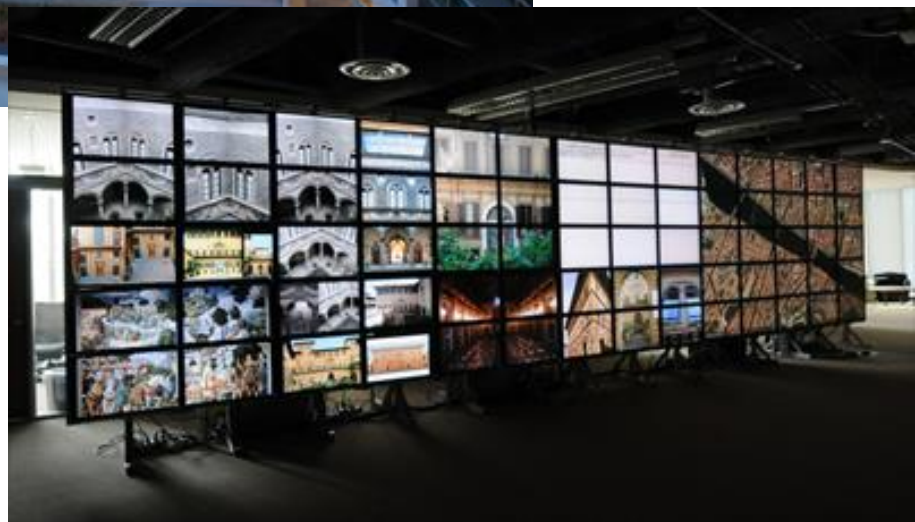
Calit2

QUALCOMM INSTITUTE

Calit2

California Institute for Telecommunications and Information Technology

University of California San Diego



Collaborating Investigators & Partners

CW PHS
CENTER FOR WIRELESS & POPULATION HEALTH SYSTEMS

UCSD School of Medicine
Family & Preventive Medicine, Pediatrics, Medicine, Psychiatry & Emergency Medicine

Kevin Patrick, MD, MS, Fred Raab, Linda Hill, MD, MPH, Jacqueline Kerr, PhD
Jeannie Huang, MD, MPH, Cheryl Rock, PhD, James Sallis, PhD, James Fowler, PhD,
Lucila Ohno-Machado, MD, PhD, Richard Garfein, PhD, Ted Chan, MD, Cinnamon Bloss, PhD

UCSD Jacobs School of Engineering & The Qualcomm Institute
Bill Griswold, PhD, Ingolf Krueger, PhD, Tajana Rosing, PhD, Sanjoy Dasgupta, PhD,
Yannis Papakonstantinau, PhD, Emilia Farcas, PhD, Nadir Weibel, PhD, Jessica Block, MS
Deborah Forster, PhD

San Diego Supercomputer Center
Chaitan Baru, PhD, Natasha Balac, PhD

SDSU School of Public Health
Elva Arredondo, PhD, Gregory Talavera, MD, MPH

PhD students and Post-doctoral Fellows (current)
Laura Pina, Ernesto Ramirez, Gina Merchant, Maggie Crawford, Marta Jankowska, PhD
Yannis Katsis, PhD, Max Menarino, PhD, Job Godino, PhD,

Funded by:

Robert Wood Johnson Foundation
NSF
National Heart Lung and Blood Institute
NIH OBSSR
NATIONAL CANCER INSTITUTE

Center for Wireless and Population Health Systems

CW PHS
CENTER FOR WIRELESS & POPULATION HEALTH SYSTEMS

Research on systems of wireless, clinical, and home technologies to measure and improve health-related exposures and behaviors in:

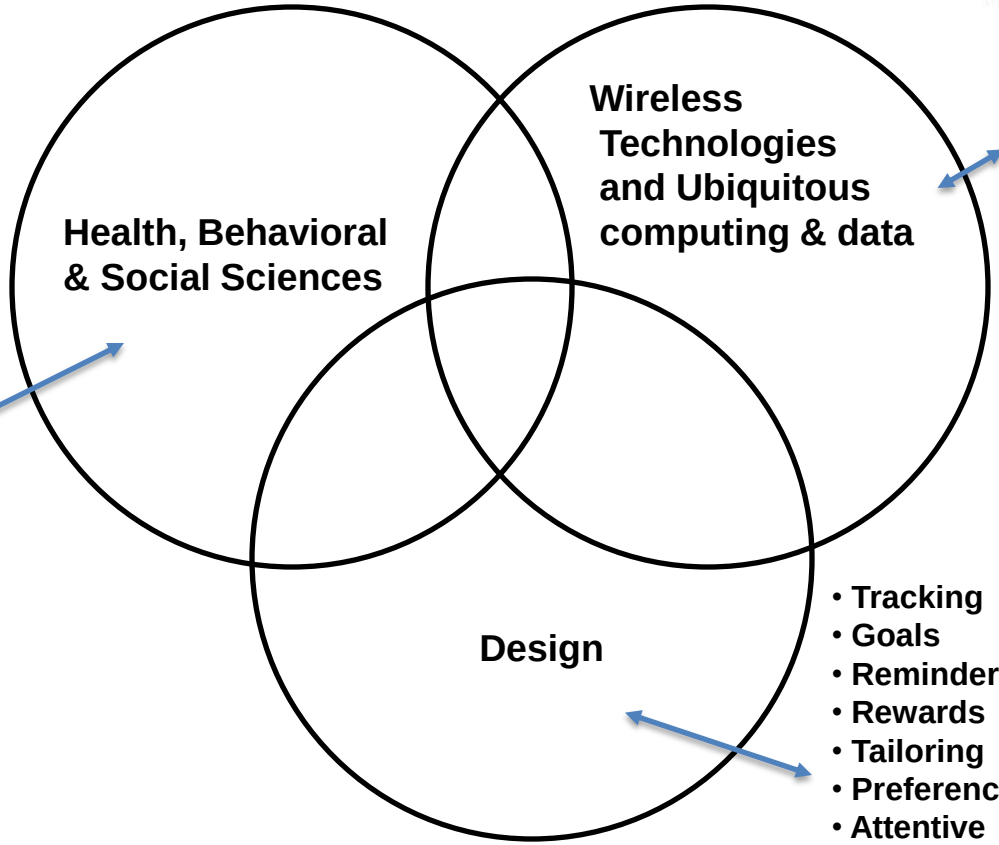
- -- Healthy adolescents
- -- Overweight and obese children and adults
- -- Depressed adults
- -- Adolescents risk for type 2 diabetes
- -- Adolescents with chronic disease (e.g. cystic fibrosis or IBD)
- -- Older adults to promote successful aging
- -- Adolescents recovering from leukemia
- -- Young adults to prevent weight gain
- -- Adults with schizophrenia
- -- Exposure biology & environmental health research
- -- Cancer comparative effectiveness research
- -- Individuals with TB in need of directly observed Rx

UC San Diego

it² Calit2

Areas of research

CENTER FOR WIRELESS & POPULATION HEALTH SYSTEMS



- Medical care
- Public health
- Personal health
- Social Networks

- Mobile phone apps
- SMS/MMS
- Mobile video
- Body area networks
- Wearable sensors
- Ecosystem of external sensors (home, work, etc.)
- Cloud computing
- Social networks
- Server analytics, data mining

- Tracking
- Goals
- Reminders
- Rewards
- Tailoring
- Preference-based
- Attentive
- Ecological
- Context Aware
- Gamified
- Cybernetic

- Cog Sci
- Media/Comm
- Beh Sci
- Soc Sci
- Hum/Comp Interaction

The New York Times

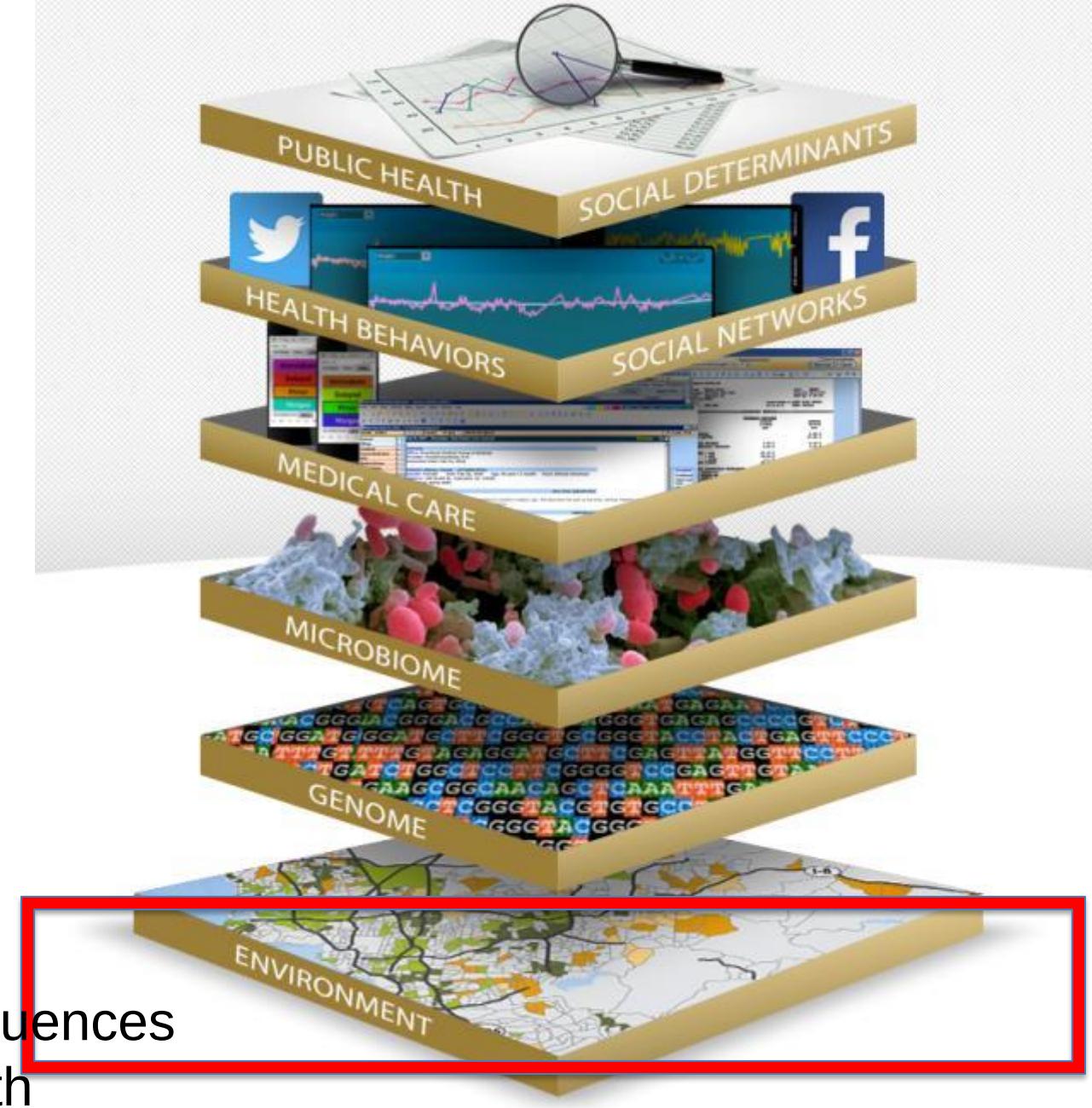
Technology

Farhad Manjoo, Jan 21, 2016

STUART GOLDENBERG

Tech's 'Frightful 5' Will Dominate Digital Life for Foreseeable Future

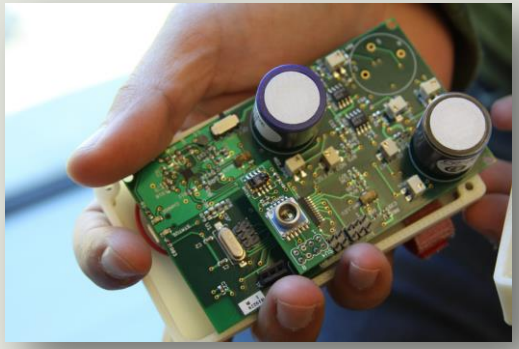
By just about every metric, Amazon, Apple, Facebook, Google and Microsoft are getting larger, more entrenched in their own sectors, more powerful in new sectors and better protected from competition.



Major influences on health

CitiSense

Always-on Participatory Sensing for Air Quality

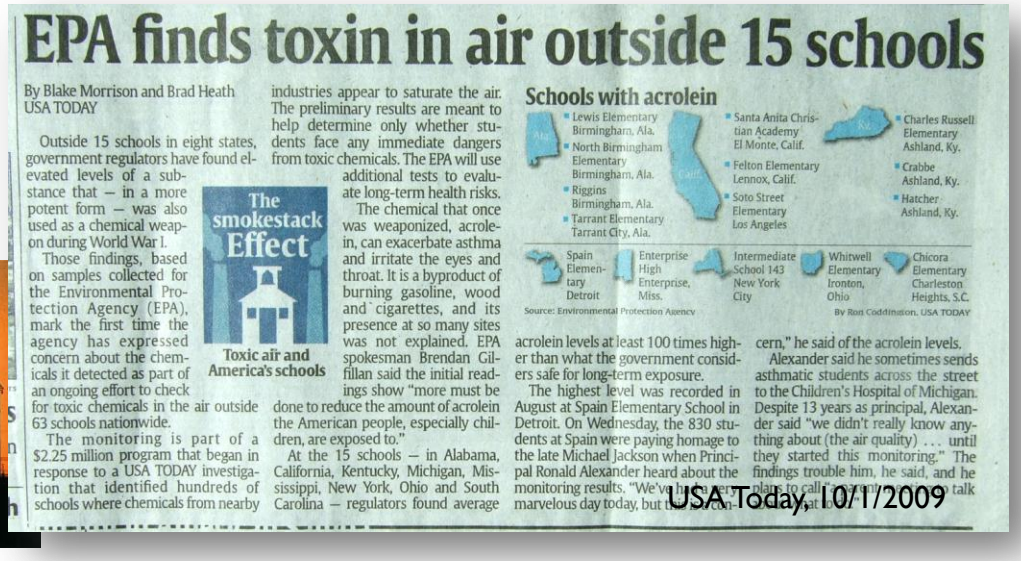


PI: UCSD, CSE
Five Co-PIs

Cyber-Physical Systems Program, NSF, 0932403

UCSDCSE UCSD

Impact of Environmental Exposure



EPA finds toxin in air outside 15 schools

By Blake Morrison and Brad Heath
USA TODAY

Outside 15 schools in eight states, government regulators have found elevated levels of a substance that — in a more potent form — was also used as a chemical weapon during World War I.

Those findings, based on samples collected for the Environmental Protection Agency (EPA), mark the first time the agency has expressed concern about the chemicals it detected as part of an ongoing effort to check for toxic chemicals in the air outside 63 schools nationwide.

The monitoring is part of a $2.25 million program that began in response to a USA TODAY investigation that identified hundreds of schools where chemicals from nearby industries appear to saturate the air. The preliminary results are meant to help determine only whether students face any immediate dangers from toxic chemicals. The EPA will use additional tests to evaluate long-term health risks.

The smokestack Effect
Toxic air and America's schools

The chemical that once was weaponized, acrolein, can exacerbate asthma and irritate the eyes and throat. It is a byproduct of burning gasoline, wood and cigarettes, and its presence at so many sites was not explained. EPA spokesman Brendan Gillan said the initial readings show "more must be done to reduce the amount of acrolein the American people, especially children, are exposed to."

At the 15 schools — in Alabama, California, Kentucky, Michigan, Mississippi, New York, Ohio and South Carolina — regulators found average acrolein levels at least 100 times higher than what the government considers safe for long-term exposure.

The highest level was recorded in August at Spain Elementary School in Detroit. On Wednesday, the 830 students at Spain were paying homage to the late Michael Jackson when Principal Ronald Alexander heard about the monitoring results. "We've had a marvelous day today, but t[illegible]

cern," he said of the acrolein levels.

Alexander said he sometimes sends asthmatic students across the street to the Children's Hospital of Michigan. Despite 13 years as principal, Alexander said "we didn't really know anything about (the air quality) . . . until they started this monitoring." The findings trouble him, he said, and he plan[illegible]

Schools with acrolein

- Lewis Elementary Birmingham, Ala.
- North Birmingham Elementary Birmingham, Ala.
- Riggins Birmingham, Ala.
- Tarrant Elementary Tarrant City, Ala.
- Santa Anita Christian Academy El Monte, Calif.
- Felton Elementary Lennox, Calif.
- Soto Street Elementary Los Angeles
- Charles Russell Elementary Ashland, Ky.
- Crabbe Ashland, Ky.
- Hatcher Ashland, Ky.
- Spain Elementary Detroit
- Enterprise High Enterprise, Miss.
- Intermediate School 143 New York City
- Whitwell Elementary Ironton, Ohio
- Chicora Elementary Charleston Heights, S.C.

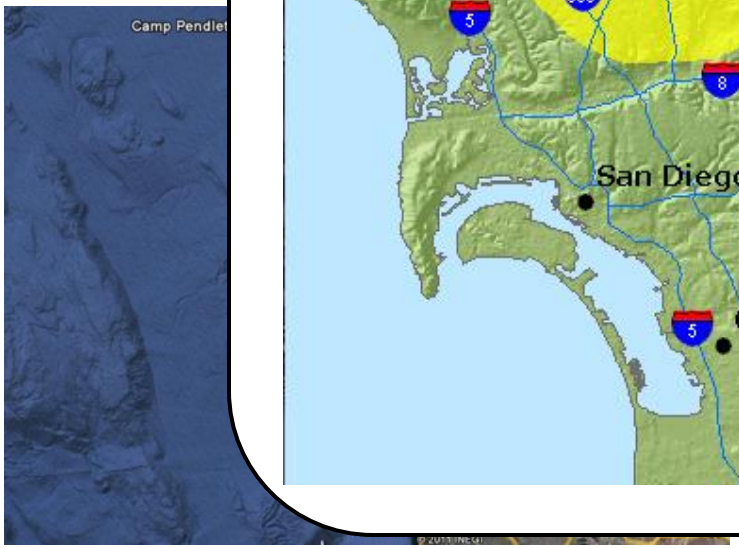
Source: Environmental Protection Agency
By Ron Coddington, USA TODAY

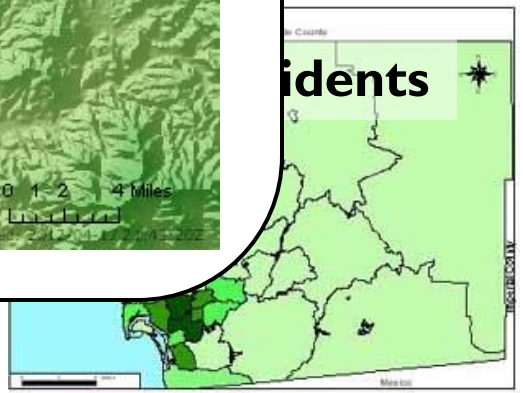
USA Today, 10/1/2009

- Asthma events are 50% higher near highways
  - 30% of public schools are near highways
  - 350,000 – 1,300,000 respiratory events in children annually
- Diesel exhaust → Carcinogen (WHO/IARC, 2012)
- Peak exposure→ Cardiac events, increased hospitalizations

Current State of Air Quality Monitoring

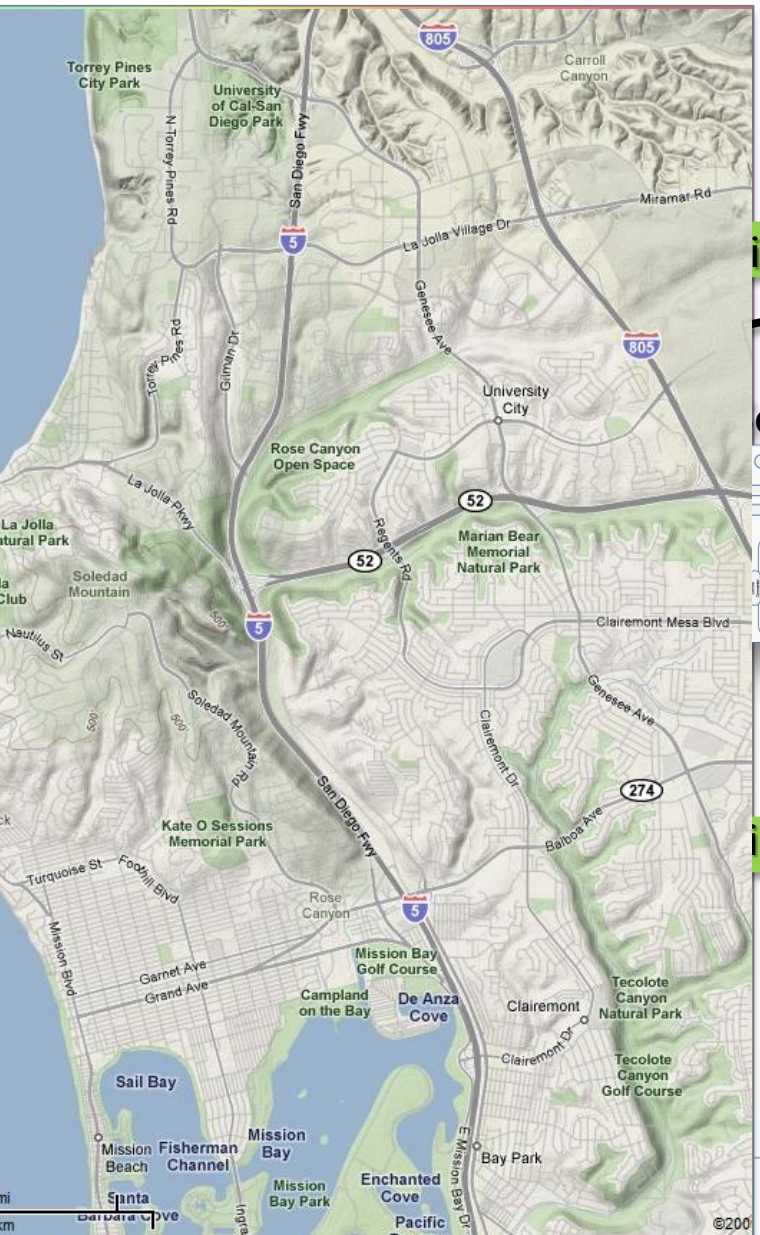
- EPA requires local agencies to monitor air quality for their region
  - Required number of sensors, monitored pollutants are based on region size, population, regional issues

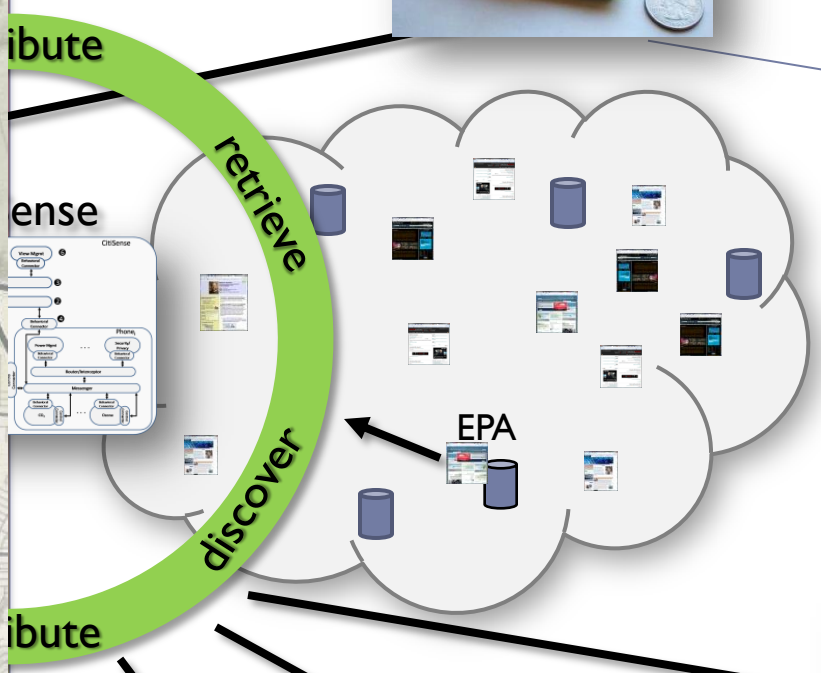


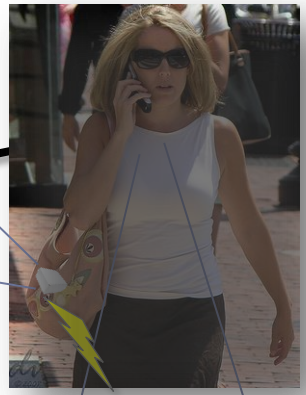


10 monitoring sites for San Diego County

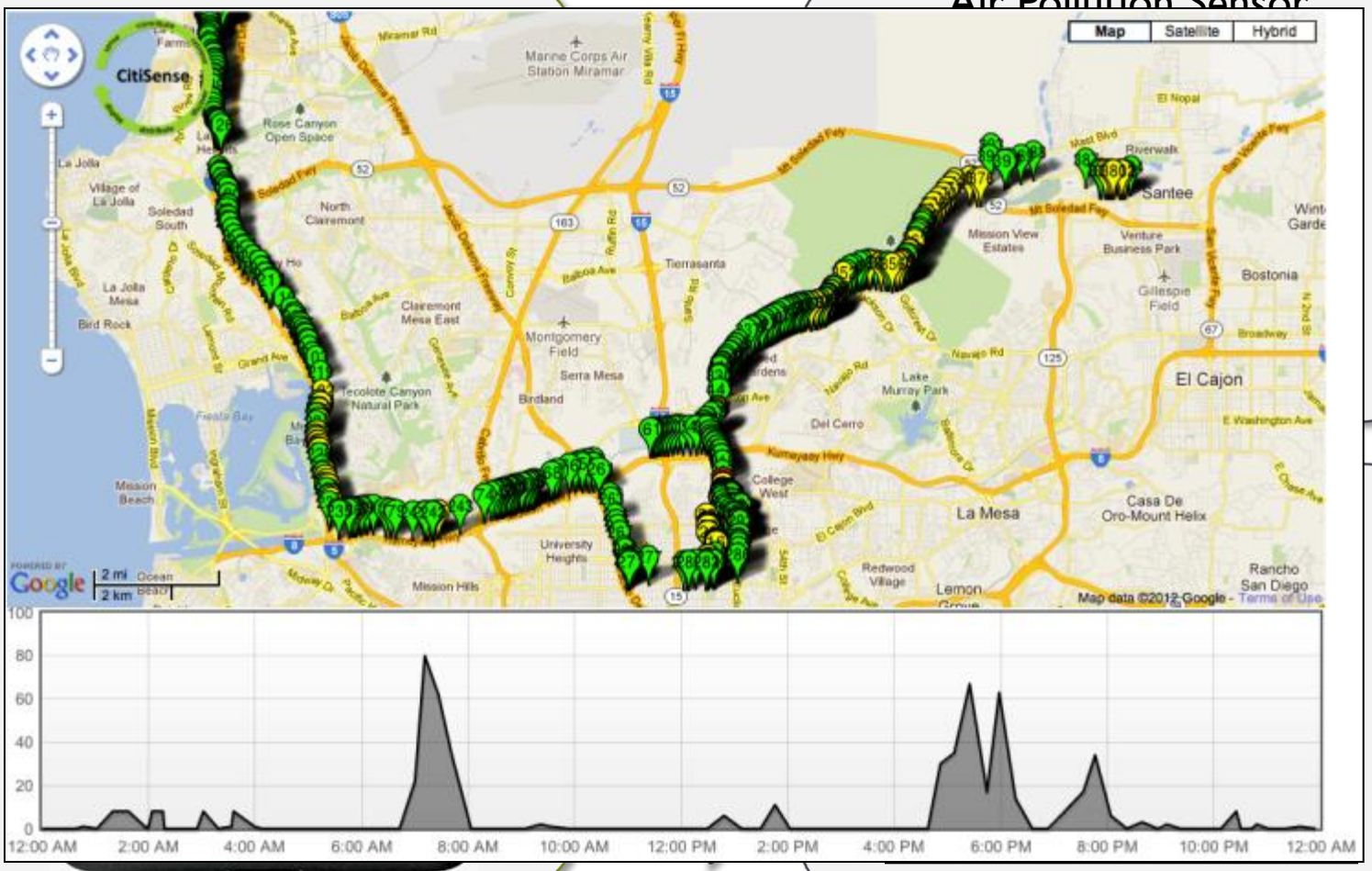
Participatory Sensing of the Environment







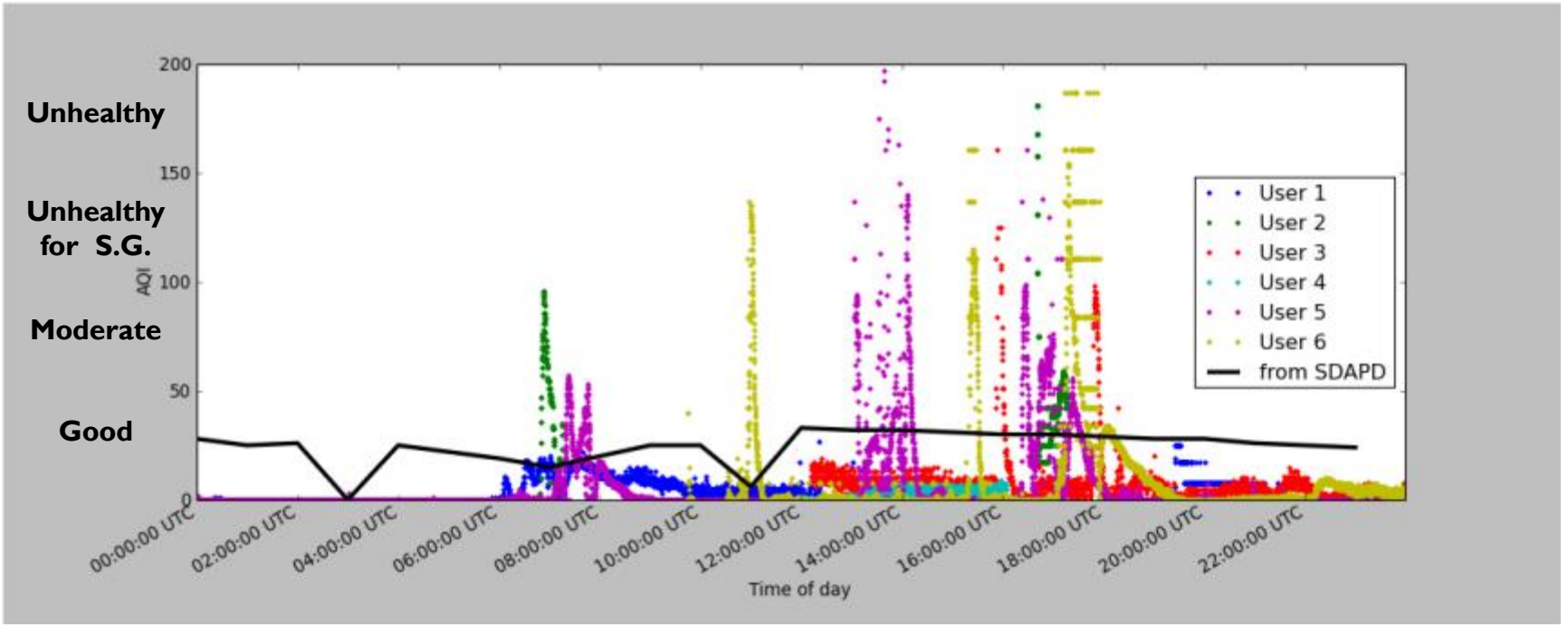
CitiSense: System Overview



User Study of Individual Exposure

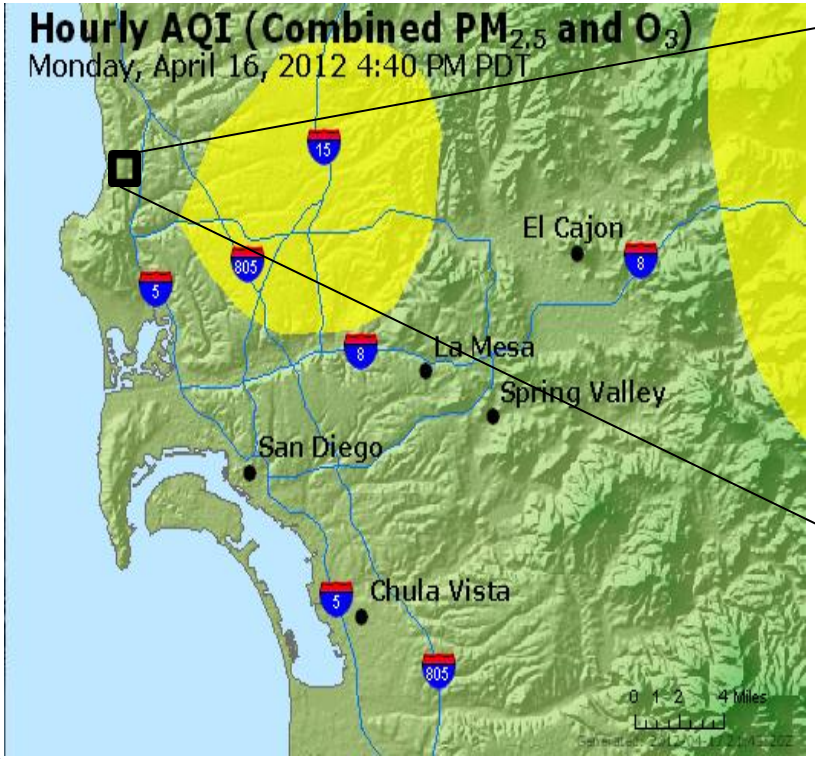
- Conducted a month-long user study (Spring 2012)
  - 16 users (two groups of eight users each)
- Recruited from the UCSD community
  - Students, faculty, and staff
  - Variety of commuting methods: car, bus, bicycle, motorized scooter, trolley, and train
  - Commute at least 20 minutes each direction
- Each user was asked to carry a provided smartphone and CitiSense sensor everyday
  - Compensated $75 for time, travel costs at conclusion

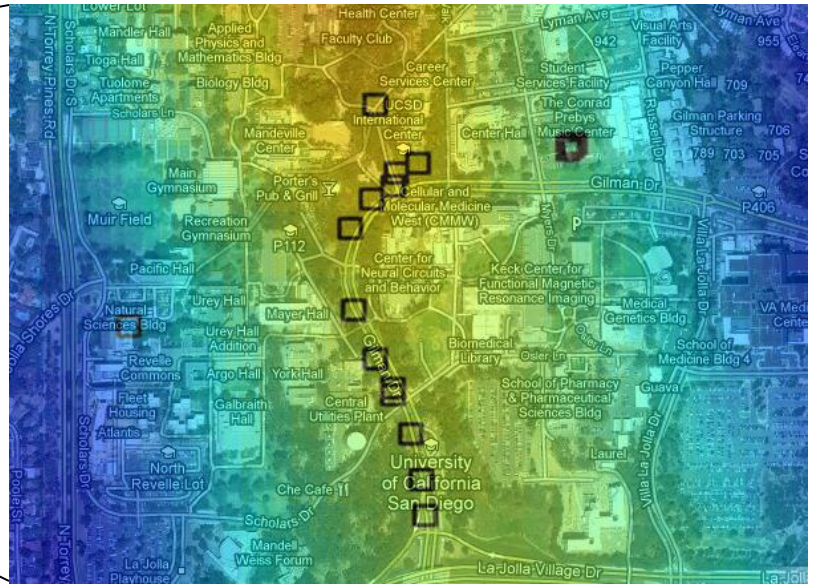
Individual Exposure vs. Regional Summary



March 15th, 2012

Data Enables Finer Grained Maps





Simple interpolation
(using standard geostatistical kriging techniques)

CitiSense: Improving Geospatial Environmental Assessment of Air Quality Using a Wireless Personal Exposure Monitoring System

Nima Nikzad, Nakul Verma, Celal Ziftci, Elizabeth Bales, Nichole Quick†, Piero Zappi, Kevin Patrick†, Sanjoy Dasgupta, Ingolf Krueger, Tajana Šimunić Rosing, William G. Griswold
Department of Computer Science and Engineering, †School of Medicine
University of California, San Diego
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ABSTRACT

Environmental exposures are a critical component in the development of chronic conditions such as asthma and cancer. Yet, medical and public health practitioners typically must depend on sparse regional measurements of the environment that provide macro-scale summaries. Recent projects have begun to measure an individual's exposure to these factors, often utilizing body-worn sensors and mobile phones to visualize the data. Such data, collected from many individuals and analyzed across an entire geographic region, holds the potential to revolutionize the practice of public health.

We present CitiSense, a participatory air quality sensing system that bridges the gap between personal sensing and regional measurement to provide micro-level detail at a regional scale. In a user study of 16 commuters using CitiSense, measurements were found to vary significantly from those provided by official regional pollution monitoring stations. Moreover, applying geostatistical kriging echniques to our data allows CitiSense to infer a regional map that contains considerably greater detail than official regional summaries. These results suggest that the cumulative impact of many individuals using personal sensing devices may have an important role to play in the future of environmental measurement for public health.

Categories and Subject Descriptors

J.3 [Life and Medical Sciences]: Health

General Terms

Measurement, Experimentation, Human Factors.

Keywords

Air quality, exposure monitoring, public health.

1. INTRODUCTION

Understanding the cause of common disorders such as asthma and cancer is necessary in order to lessen the incidence and burden of such diseases. While genotyping techniques have improved drastically in recent years, studying environmental exposures has lagged behind. For many diseases, such as colon and breast cancer, causes are unknown and are likely due to environmental factors [12]. In fact, it is estimated that only about 10-15% of disease etiology can be accounted for by genetic factors, with environmental factors playing a significant role in the pathogenesis of many diseases [13, 14]. Exposure to air pollution is associated with numerous adverse health outcomes including increased cardiopulmonary mortality and hospital admissions, worsening of asthma symptoms and accelerated cognitive decline in older women [10, 19-26]. In 2005, Wild proposed the idea of an "exposome", which encompasses life-style factors as well as environmental exposures during one's life-time [11]. When studied along with the genome, understanding the exposome can yield a more complete picture of disease etiology. However, studying long-term exposure to environmental risks has historically been very difficult. While a large-scale and long term study of a population may help identify locations where

Figure 6. EPA provided AQI map of the San Diego County region April 16th, 2012 at 4:40 PM PDT, with a box added to mark the location of the UCSD campus.

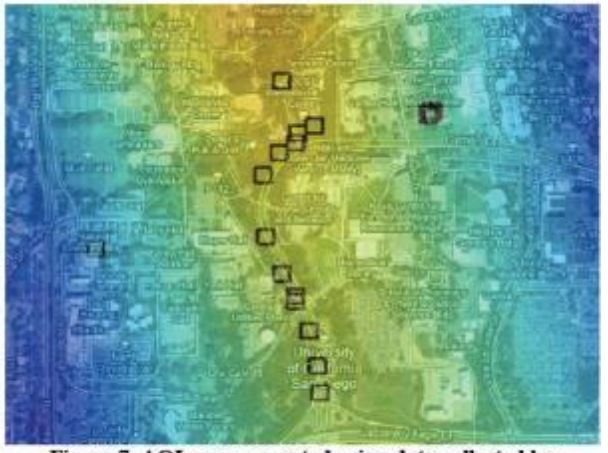
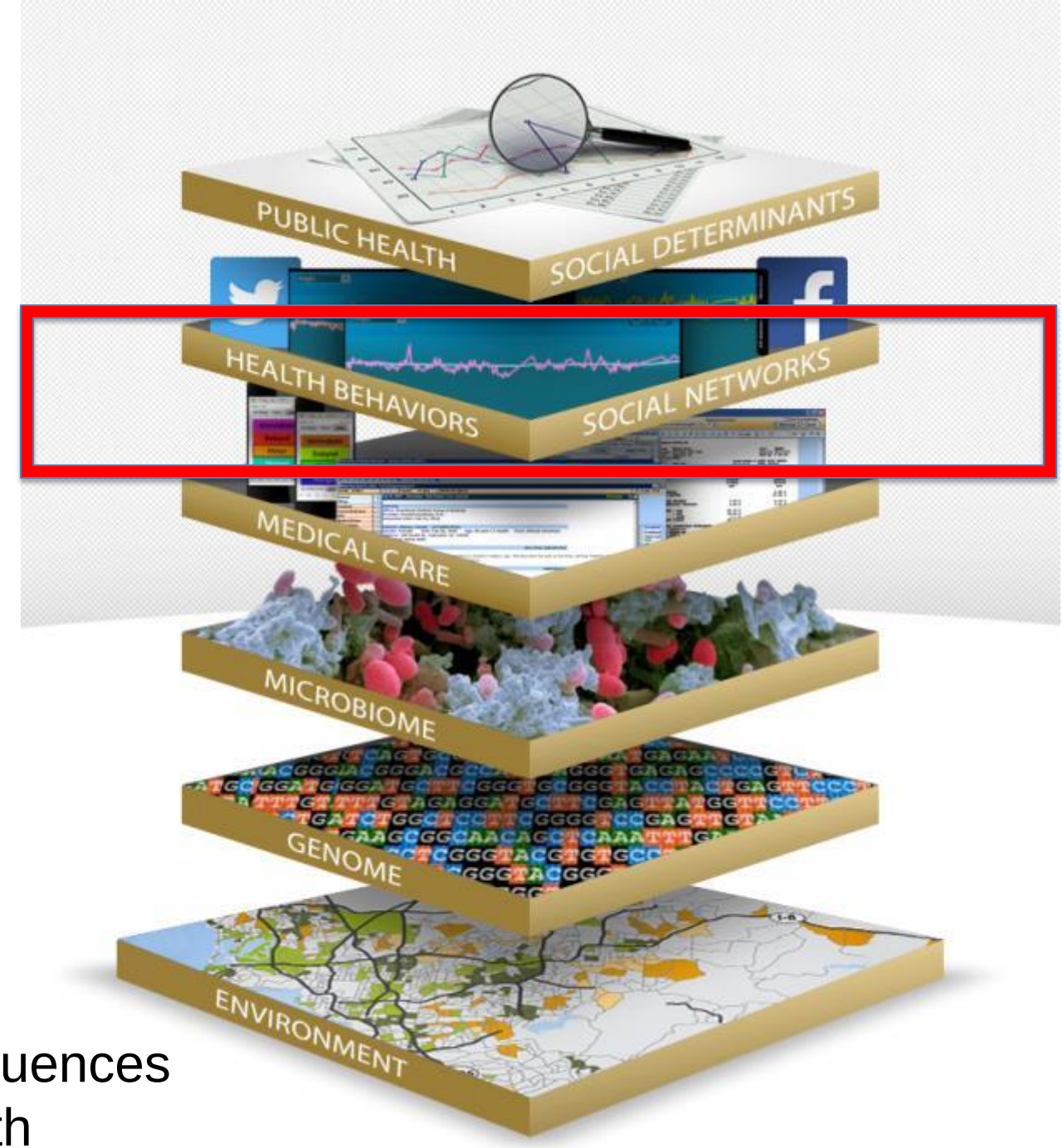


Figure 7. AQI map generated using data collected by CitiSense for the UCSD campus area during a five minute window on April 16th, 2012 at 4:27 PM PST. The boxes represent pollution reading locations during that window.

CitiSense findings varied considerably from those provided by official EPA estimates (via EPA website)

Applying geostistical krieging techniques allows CitiSense to infer a regional map with greater detail than official summaries

(Best Paper, Wireless Health, 2012)



Major influences on health

Health Data Exploration Project

Project Director: [redacted]
Professor, Family and Preventive Medicine, UCSD
Director, Center for Wireless and Population Health Systems, Calit2

Project Co-Director [redacted]
Chief of Staff, Calit2

Investigators

[redacted] PhD, Project Scientist, UC Irvine
[redacted] PhD, Adjunct Professor, UC Irvine
[redacted] PhD, Project Scientist, UC Irvine
[redacted] PhD, Director, Calit2/UCSD

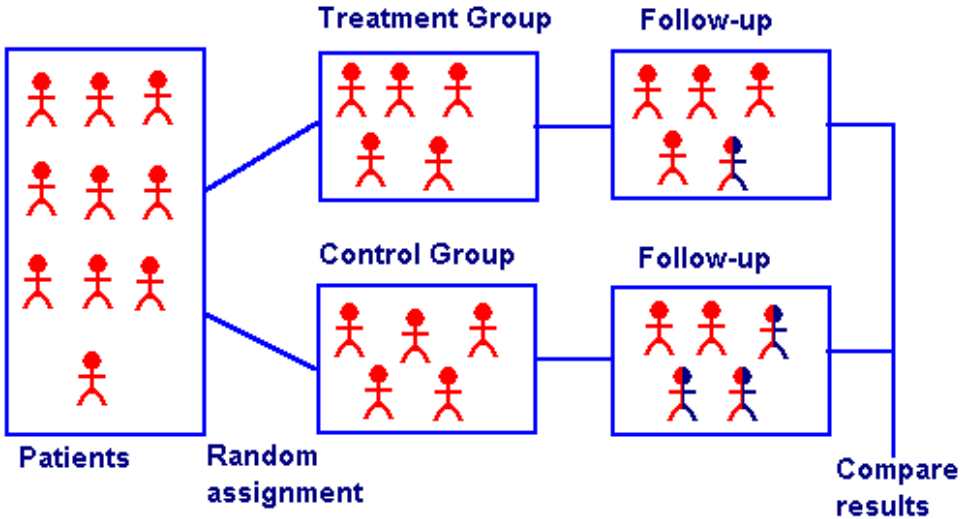
PI: 1 individual
Co-Is: 2 individuals
2013-2017

Robert Wood Johnson Foundation

“Health happens where we live, learn, work and play.”

Robert Wood Johnson Foundation

Traditional Health Research



Randomized controlled trials

Surveillance

nhanes

BRFSS

Biomarkers

EMRs

NATIONAL HEALTH INTERVIEW SURVEY

Since 1957

The Economist

FEBRUARY 28TH–MARCH 6TH 2015 Economist.com

Brazil's economic quagmire

The theology of jihad

America's oversold manufacturing boom

Venezuela's slow-motion coup

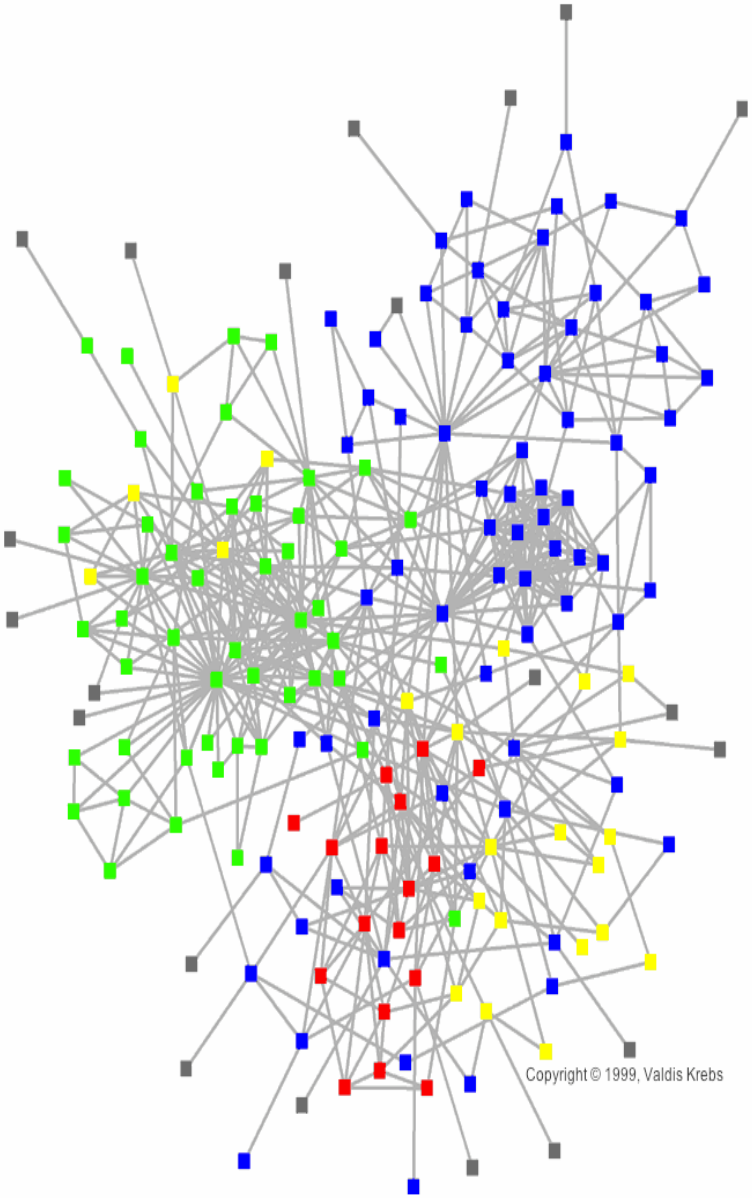
Mosquito sex and malaria

Planet of the phones

By 2020
80% of adults will
have a supercomputer
in their pocket

Wearable devices for tracking health-related states

Social Networks



Facebook:
156 Million Daily Users in US
1.55 Billion worldwide
(Q3, 2015)

The Internet of Things

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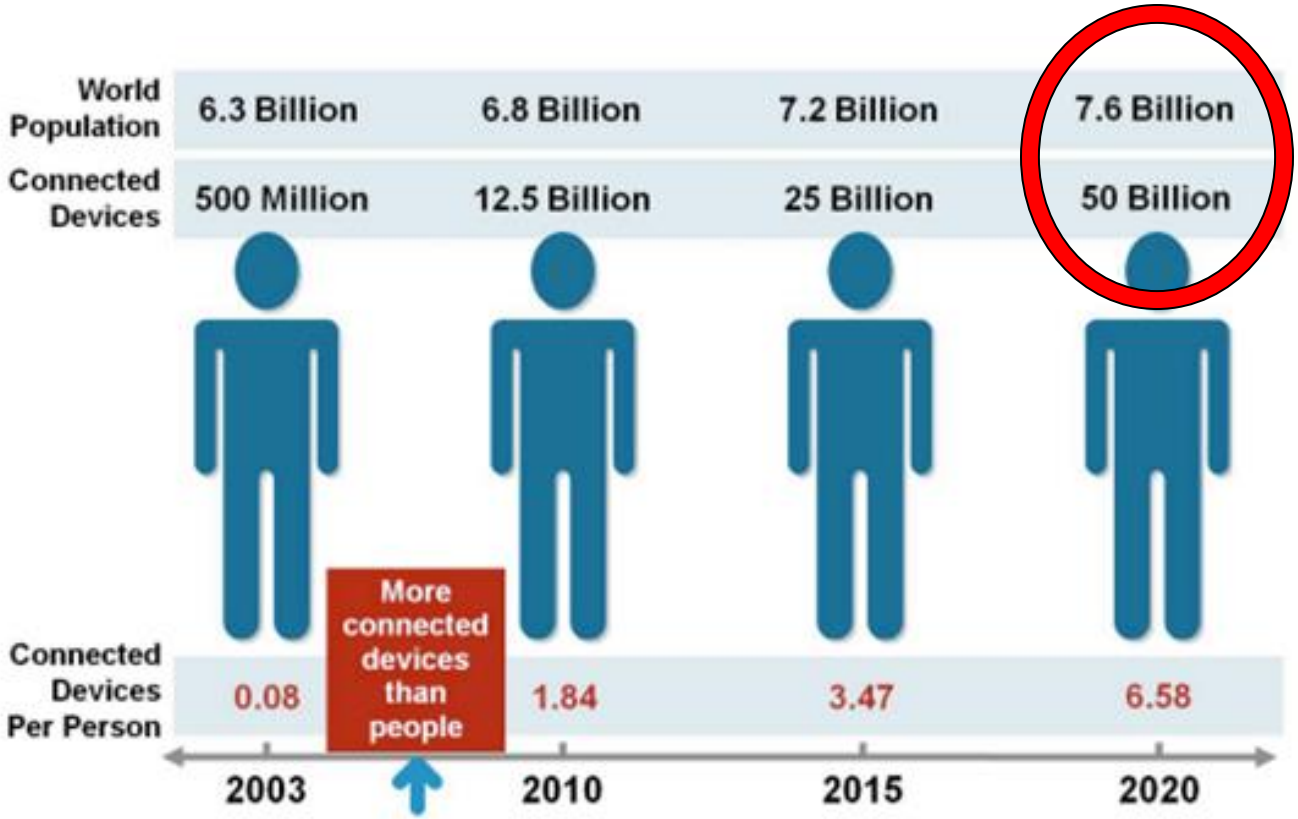


Source: Cisco IBSG, April 2011

An increasingly diverse & expanding ecosystem of devices, apps, and services generating vast amounts of data…

myfitnesspal
Calorie Counter & Diet Tracker

RunKeeper

mood

CVSHealth

Ralphs rewards

Google Microsoft IBM amazon.com

Personal Data and Health

- New paths for reflection and self-improvement
  - Healthy behaviors and lifestyles
- New connections with clinical care
  - Mobile health applications
  - Monitoring & intervening on chronic disease
- New health knowledge from aggregate data
  - Public health surveillance
  - Health research

Issues (some)

- Research Methods (design, data, scale, etc.)
- Data Quality (validity, reliability)
- Representativeness of Data
- Data ownership & Terms of Use
- Privacy
- Ethics & Informed Consent
- Cultural differences (.com, .edu, .gov, .org)
- Dynamic nature of personal health data environment

Health Research Data Comparison

Clinical Data		Personal Data
Clinical Research Study	Context of Collection	Everyday Life
Expensive	Cost per Observation	Cheap
Validated	Measurement Trueness	Unvalidated
Tuned to Research Qs	Data Specificity	General Purpose
Standardized	Comparability	Unstandardized
Comprehensive	Completeness	Erratic
Personal, Clear	Informed Consent	Mediated, Questionable
Definable	Ethical Issues	Ambiguous
Highly Regulated	Confidentiality	Varies Widely
Low Risk of Identification	Anonymity	Larger Risk of Identification
Contrived	Ecological Validity	Lived Experience
Periodic	Pace of Observation	Continuous
Self-report	Behavior, Mood, Exposome	Sensed

Health Data Exploration Project

Project Director: [redacted]
Professor, Family and Preventive Medicine, UCSD
Director, Center for Wireless and Population Health Systems, Calit2

Project Co-Director [redacted]
Chief of Staff, Calit2

Investigators

[redacted] PhD, Project Scientist, UC Irvine
[redacted] PhD, Adjunct Professor, UC Irvine
[redacted] PhD, Project Scientist, UC Irvine
[redacted] PhD, Director, Calit2/UCSD

Report Available at:
hdexplore.calit2.net

Robert Wood Johnson Foundation

Building a Network

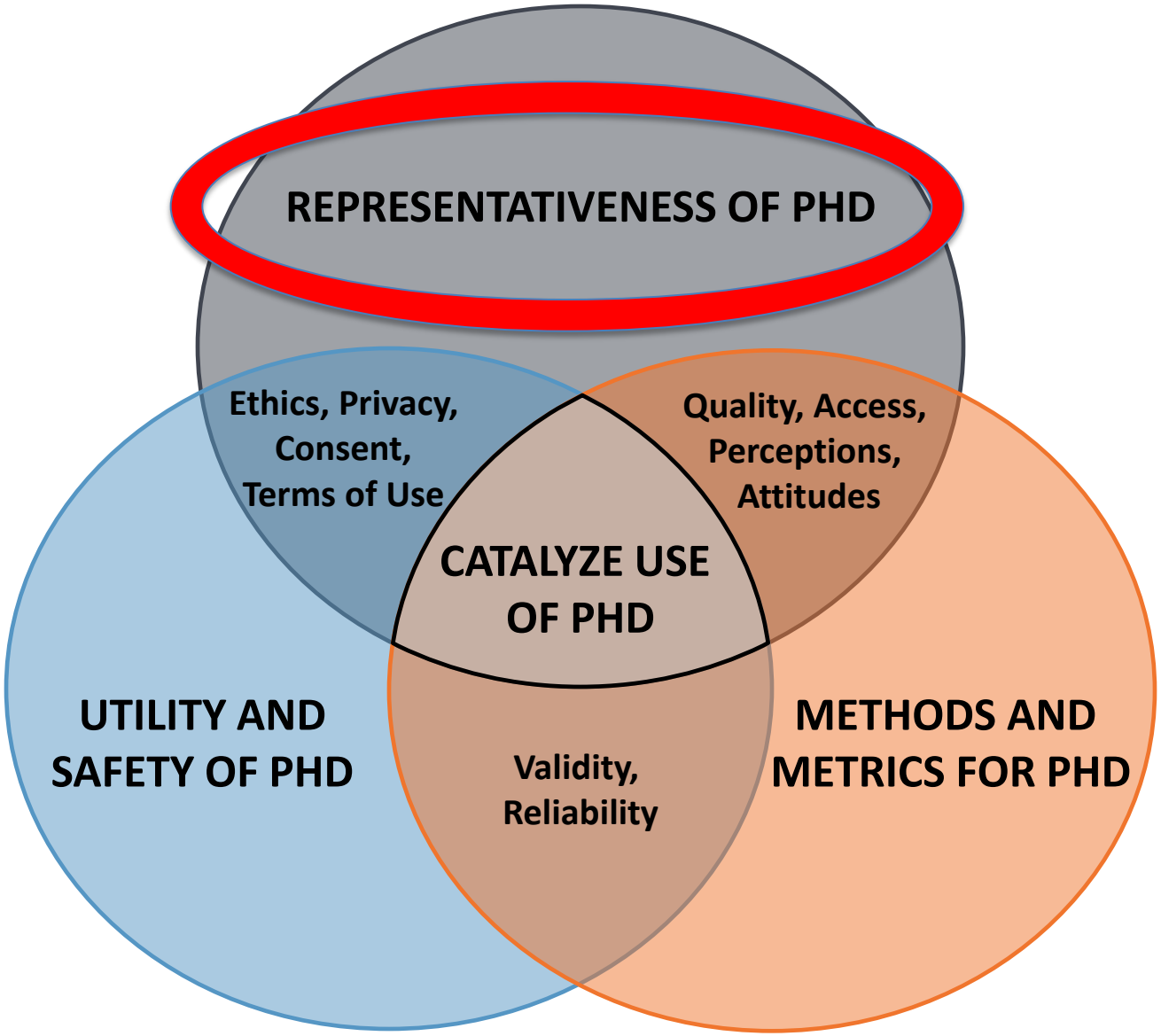
- Funded by Robert Wood Johnson Foundation in Fall, 2014
- Network of innovators in PHD to catalyze the use of personal data for the public good
  - Companies, researchers, and strategic partners
- Annual meetings, webinars, workshops, etc.

Info at: hdexplore.calit2.net

Health Data Exploration Network

Key Advisors & Steering Committee, 2015-2017

Program Office Core Research Areas

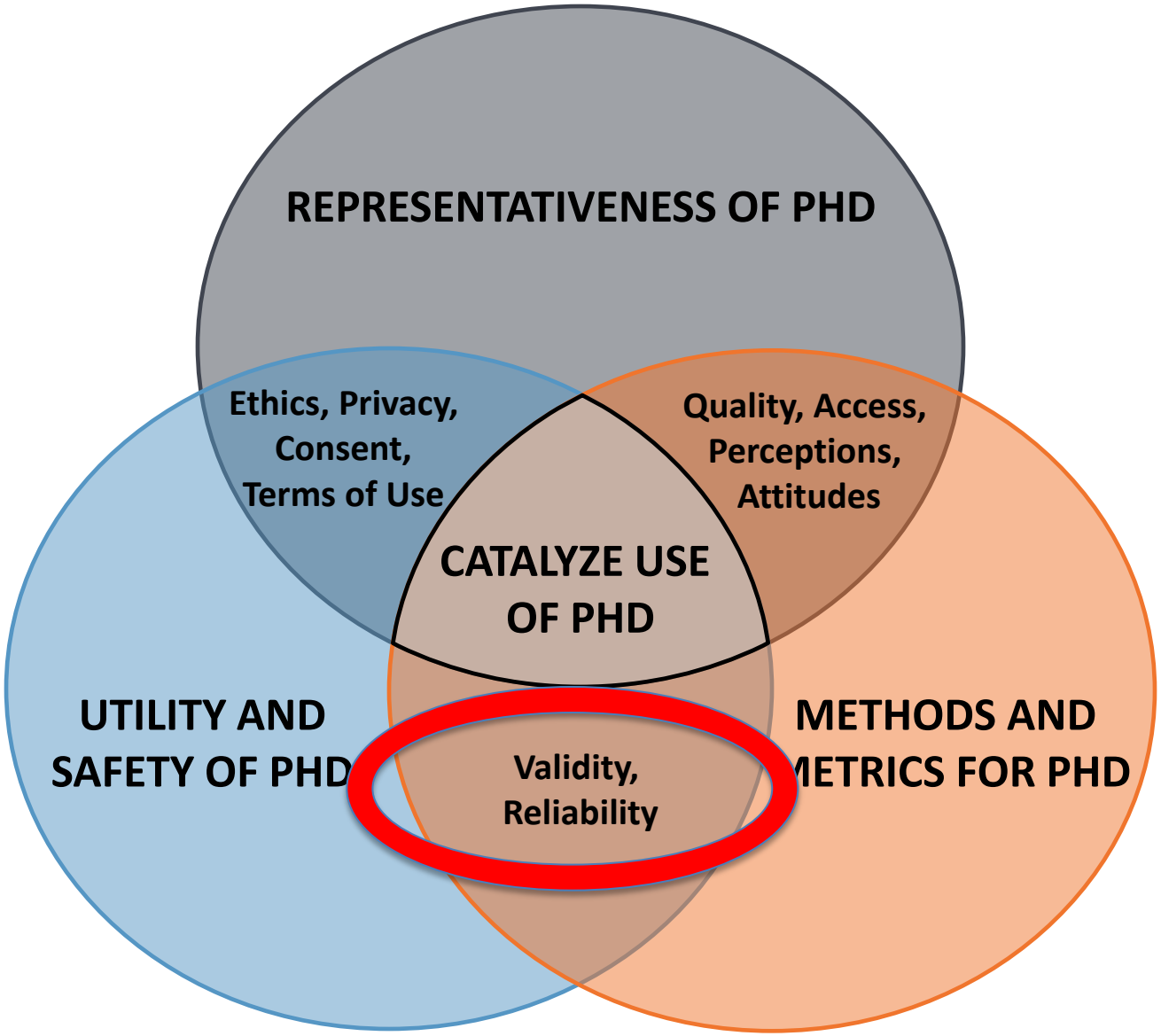


Technology Adoption

- Tends to be unevenly distributed in society
- Different communities will have different patterns of use
  - Access, usefulness, and usability
  - Perceptions of risks and benefits
  - Personal and collective motivations
- Influenced by a variety of social, economic, technological, and cultural factors


Eric Fischer / Mapbox

Program Office Core Research Areas



Program Office Core Research Areas

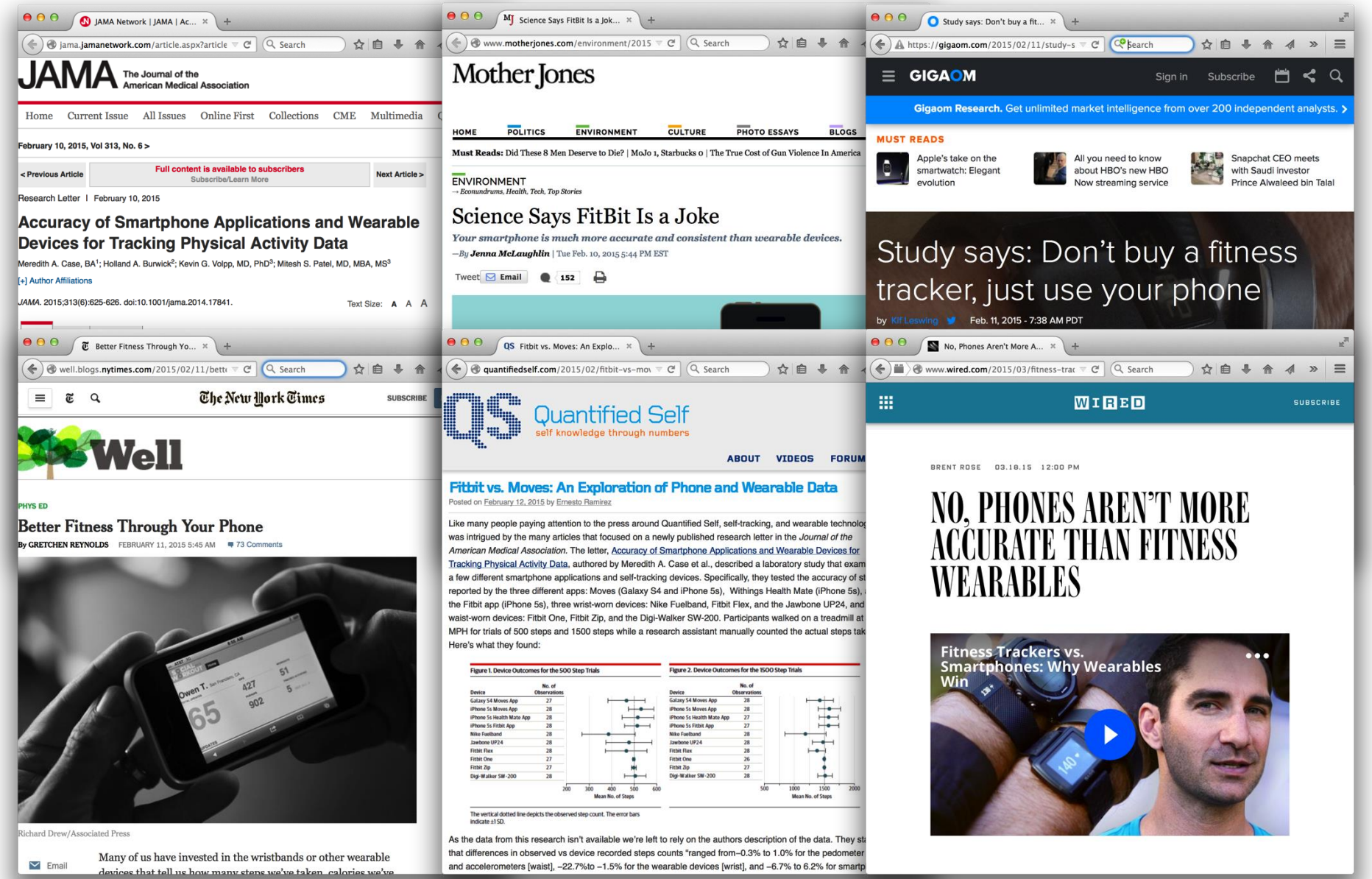
Validity & Reliability of Personal Health Data Derived from Consumer-level Wearable Devices: A Scoping Review

Project Leader: PhD

Research Associate, UC San Diego

Member HDE Core Team

Background


JAMA Network | JAMA | Ac...
jama.jamanetwork.com/article.aspx?article
JAMA
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February 10, 2015, Vol 313, No. 6 >
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Research Letter | February 10, 2015
Accuracy of Smartphone Applications and Wearable Devices for Tracking Physical Activity Data
Meredith A. Case, BA[1]; Holland A. Burwick[2]; Kevin G. Volpp, MD, PhD[3]; Mitesh S. Patel, MD, MBA, MS[3]
[+] Author Affiliations
JAMA. 2015;313(6):625-626. doi:10.1001/jama.2014.17841.
Text Size: A A A
Science Says FitBit Is a Jok...
www.motherjones.com/environment/2015
Mother Jones
HOME POLITICS ENVIRONMENT CULTURE PHOTO ESSAYS BLOGS
Must Reads: Did These 8 Men Deserve to Die? | MoJo 1, Starbucks 0 | The True Cost of Gun Violence In America
ENVIRONMENT
→ Econundrums, Health, Tech, Top Stories
Science Says FitBit Is a Joke
Your smartphone is much more accurate and consistent than wearable devices.
—By Jenna McLaughlin | Tue Feb. 10, 2015 5:44 PM EST
Tweet Email 152
Study says: Don't buy a fit...
https://gigaom.com/2015/02/11/study-s
GIGAOM
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Gigaom Research. Get unlimited market intelligence from over 200 independent analysts. >
MUST READS
Apple's take on the smartwatch: Elegant evolution
All you need to know about HBO's new HBO Now streaming service
Snapchat CEO meets with Saudi investor Prince Alwaleed bin Talal
Study says: Don't buy a fitness tracker, just use your phone
by Kif Leswing Feb. 11, 2015 - 7:38 AM PDT
Better Fitness Through Yo...
well.blogs.nytimes.com/2015/02/11/bett
The New York Times
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Well
PHYS ED
Better Fitness Through Your Phone
By GRETCHEN REYNOLDS FEBRUARY 11, 2015 5:45 AM 73 Comments
Richard Drew/Associated Press
Email
Many of us have invested in the wristbands or other wearable
Fitbit vs. Moves: An Explo...
quantifiedself.com/2015/02/fitbit-vs-mo
Quantified Self
self knowledge through numbers
ABOUT VIDEOS FORUM
Fitbit vs. Moves: An Exploration of Phone and Wearable Data
Posted on February 12, 2015 by Ernesto Ramirez
Like many people paying attention to the press around Quantified Self, self-tracking, and wearable technolo
was intrigued by the many articles that focused on a newly published research letter in the Journal of the
American Medical Association. The letter, Accuracy of Smartphone Applications and Wearable Devices for
Tracking Physical Activity Data, authored by Meredith A. Case et al., described a laboratory study that exam
a few different smartphone applications and self-tracking devices. Specifically, they tested the accuracy of st
reported by the three different apps: Moves (Galaxy S4 and iPhone 5s), Withings Health Mate (iPhone 5s),
the Fitbit app (iPhone 5s), three wrist-worn devices: Nike Fuelband, Fitbit Flex, and the Jawbone UP24, and
waist-worn devices: Fitbit One, Fitbit Zip, and the Digi-Walker SW-200. Participants walked on a treadmill at
MPH for trials of 500 steps and 1500 steps while a research assistant manually counted the actual steps tak
Here's what they found:
Figure 1. Device Outcomes for the 500 Step Trials
Figure 2. Device Outcomes for the 1500 Step Trials
Device
No. of Observations
Galaxy S4 Moves App 27
iPhone 5s Moves App 28
iPhone 5s Health Mate App 28
iPhone 5s Fitbit App 28
Nike Fuelband 28
Jawbone UP24 28
Fitbit Flex 28
Fitbit One 27
Fitbit Zip 27
Digi-Walker SW-200 28
Mean No. of Steps
The vertical dotted line depicts the observed step count. The error bars indicate ±1 SD.
As the data from this research isn't available we're left to rely on the authors description of the data. They st
that differences in observed vs device recorded steps counts "ranged from−0.3% to 1.0% for the pedometer
and accelerometers [waist], −22.7%to −1.5% for the wearable devices [wrist], and −6.7% to 6.2% for smartp
No, Phones Aren't More A...
www.wired.com/2015/03/fitness-trac
WIRED
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BRENT ROSE 03.18.15 12:00 PM
NO, PHONES AREN'T MORE ACCURATE THAN FITNESS WEARABLES
Fitness Trackers vs. Smartphones: Why Wearables Win

Challenge to Assess Validity

- Engineering specifications of sensors are difficult to find
- How sensors are utilized is often proprietary and secretive
- Extent to which design and materials influence measurement is unknown
- Process of bringing new models to market is outpacing independent evaluation
- No universal criteria for judging methodological rigor of studies

HDE Network
Agile Research Projects

- Small proof-of-concept, demonstration, or pilot projects: $25k-$75k, < 6 months
- Advance use of PHD for Research
- Leverage two or more network members
- Research teams will communicate regularly
- Results presented at Network Webinars
- Outcomes shared as openly as possible

Agile Research Project #1

When Am I At My Best? – Passive Sensing of Circadian Rhythms for Individualized Models of Cognitive Performance

PhD, U. of Washington
Tanzeem Choudhury, PhD, Cornell

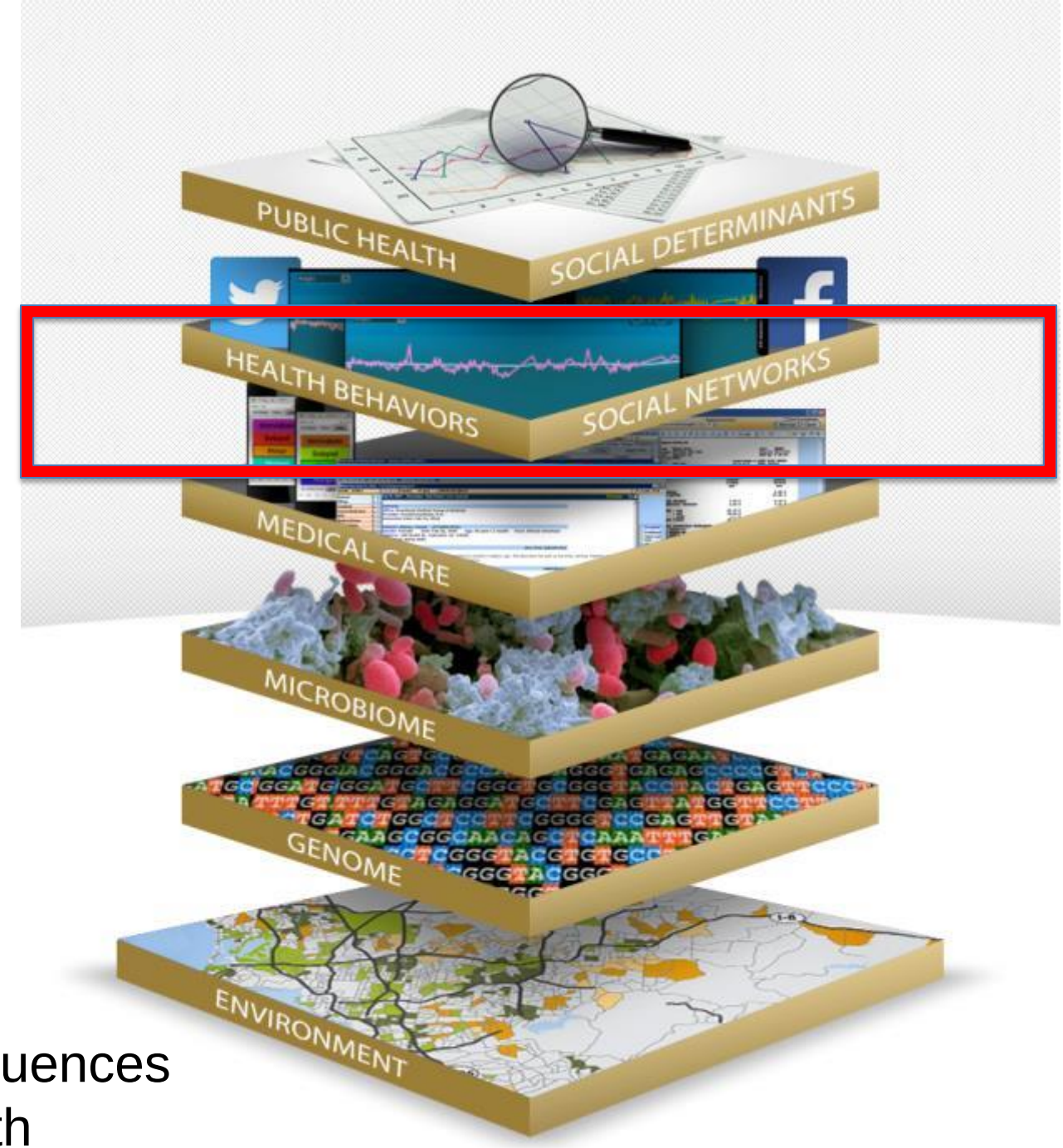
Use smartphone data to capture interaction patterns, web use & sleeping behaviors
Conduct a 3-week feasibility study
Model trends in reports of cognitive performance & measured reaction times

Agile Research Project #2

From Self-monitoring to Self-experimentation: Behavior Change in Patients With Multiple Sclerosis

PhD, PatientsLikeMe
PhD, Arizona State University
PatientsLikeMe

Determine current status of using wearable devices for managing Multiple Sclerosis with emphasis on self-customization
Develop a “Wearables 101” course for MS patients
Pilot test the course among a group of patients & refine as needed



Major influences on health

Smart Health Study

UC San Diego Calit2

CW PHS

CENTER FOR WIRELESS & POPULATION HEALTH SYSTEMS

Social Mobile Approach to Reduce Weight

NIH/NHLBI U01 HL096715; PI

MD, MS and PhD

Protocol

Contents lists available at ScienceDirect

Contemporary Clinical Trials

journal homepage: www.elsevier.com/locate/conclintrial

Design and implementation of a randomized controlled social and mobile weight loss trial for young adults (project SMART)

K. Patrick [a,b,*], S.J. Marshall [a,b], E.P. Davila [a,b], J.K. Kolodziejczyk [a,b,c], J.H. Fowler [b,d], K.J. Calfas [b], J.S. Huang [a,e,f], C.L. Rock [b], W.G. Griswold [g], A. Gupta [a], G. Merchant [a,b,c], G.J. Norman [a,b], F. Raab [a,b], M.C. Donohue [b], B.J. Fogg [h], T.N. Robinson [i]

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ARTICLE INFO

Article history:

ABSTRACT

Purpose: To describe the theoretical rationale, intervention design, and clinical trial of a two-year

“User-centered” Intervention

SMART HEALTH Study

Website

Smart-phone Apps

Facebook

Email

Text Messages

Health Coach + Virtual Facetime

Via phone & online chat

Other Tools

Bathroom Scale & Pedometer

“State of the Science” Theory

Core Behavior Strategies
Intention Formation
Goal Setting
Goal Review
Feedback on Performance
Self-monitoring

Michie et al., 2009, 2011

Theoretical Principles
Social Cognitive Theory
Ecological Theory
Social Network Theory
Theories of Operant Learning
Theories of Tailored Health Communications
Self Regulation Theory
Behavioral Choice Theory

Suite of Apps

Mobile Apps

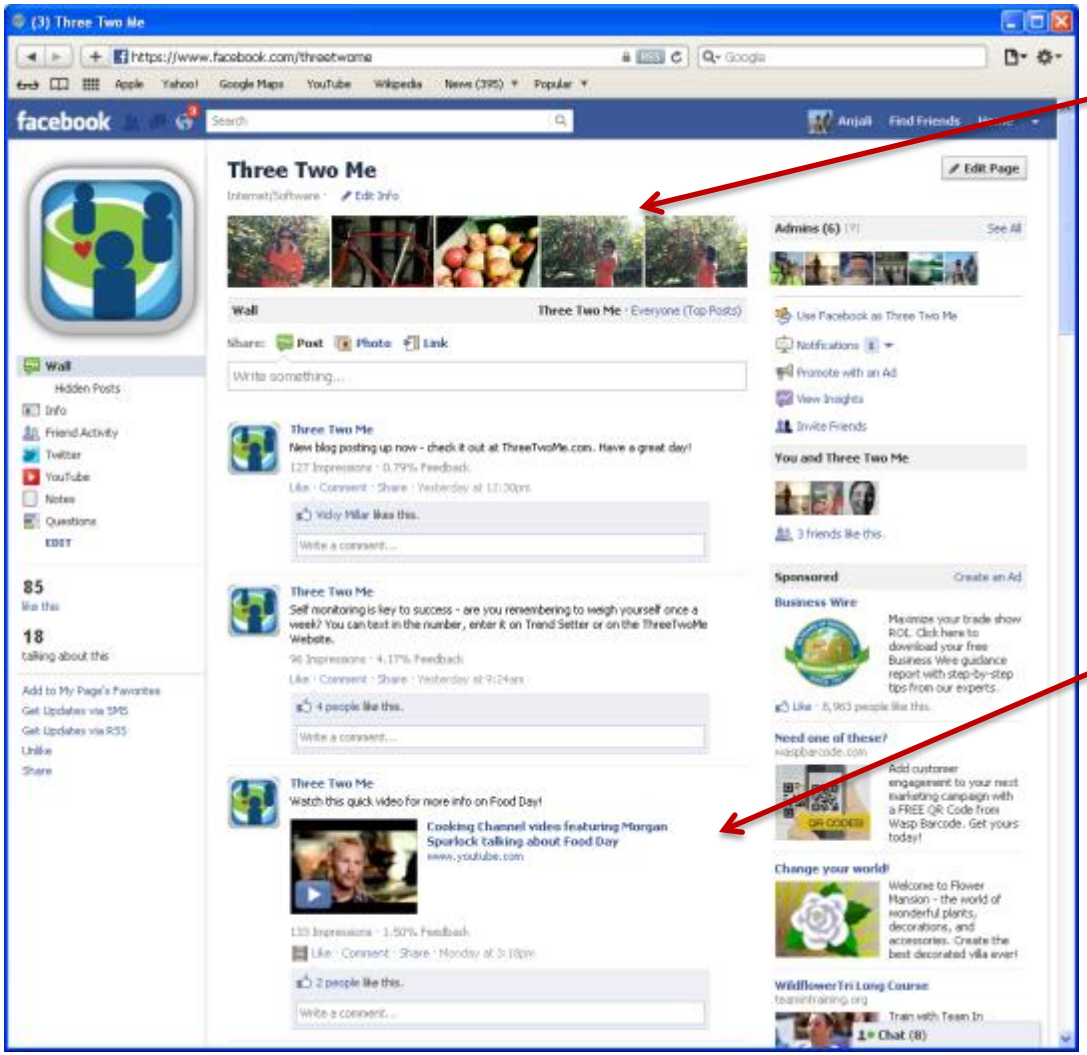
APP	TARGET BEHAVIORS & STRATEGIES					
	Self-Monitoring	Intention Formation	Goal-Setting	Goal Review	Feedback	Knowledge
Be Healthy		X	X	X		
TrendSetter	X	X			X	X
Goal Getter			X	X	X	
Facts & Quizzes					X	X

All apps accessible via

- ✓ **Mobile**
- ✓ **Website**
- ✓ **Facebook**

three two me Enabled

Facebook Page



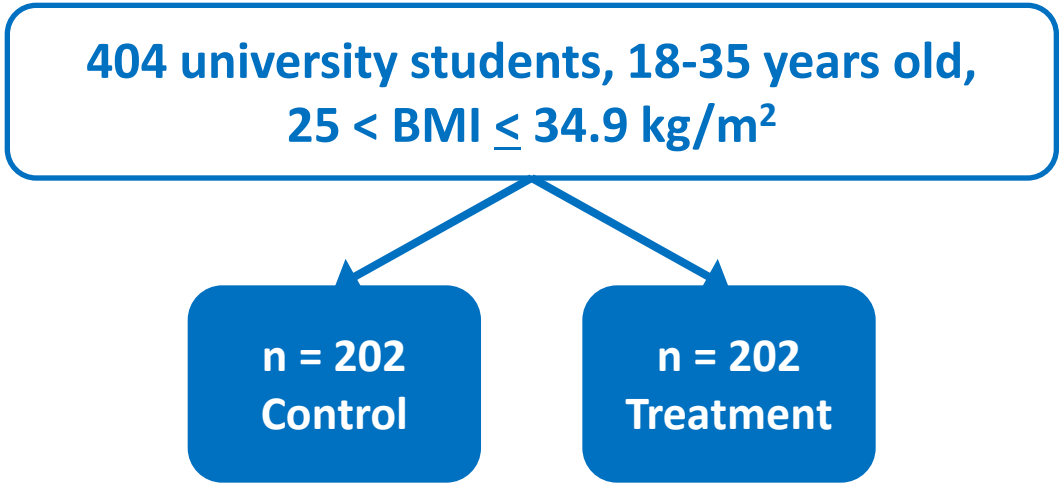
- Christina – "The Health Coach"
- # of "Likes" overall
- # of "Likes" per post
- # of Impressions
- % feedback on the post
- Video on National Food Day

Design

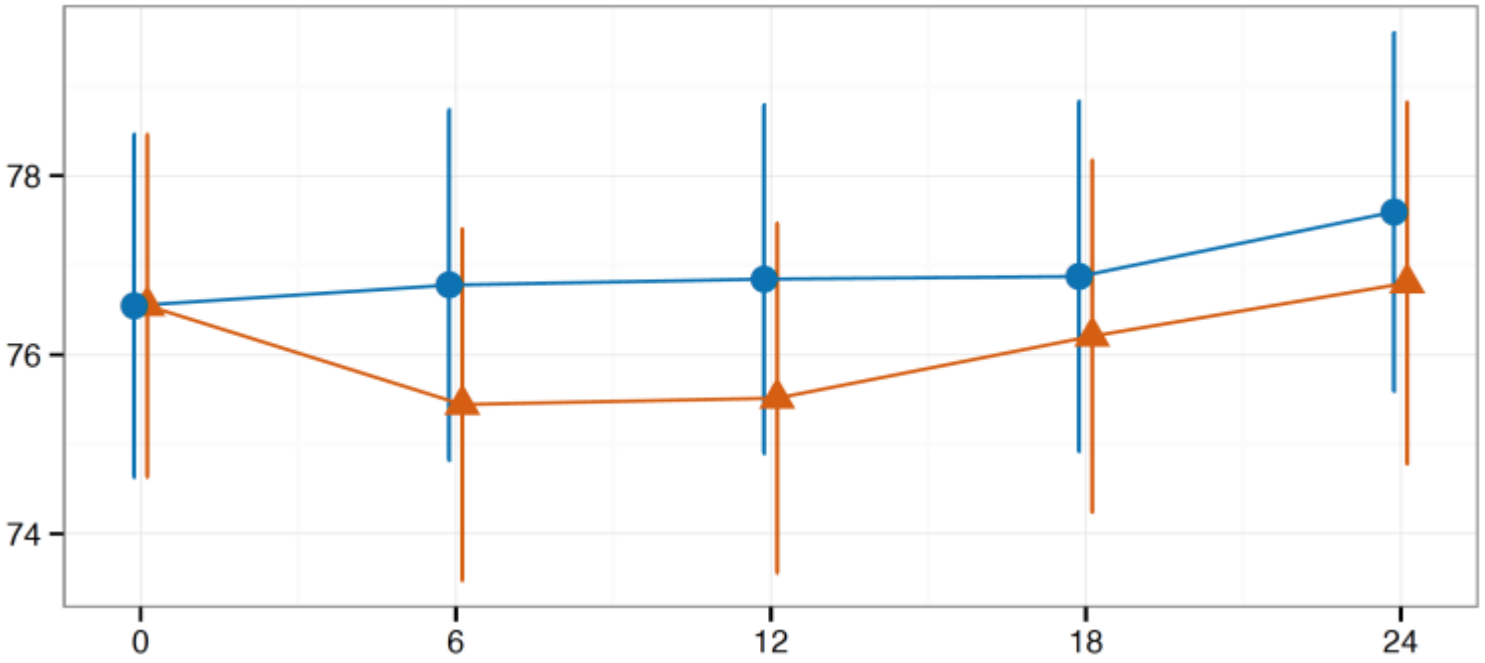
Inclusion Criteria

- ✓ Owns a personal computer
- ✓ Owns a mobile phone and uses text messaging
- ✓ Facebook user or willing to start using Facebook

Campus	n
SDSU	182
UCSD	164
CSUSM	58
Total	**404**



Results: weight (kg)



Control	n	202	196	193	183	179
	Mean	76.5	76.8	76.8	76.9	77.6
	95% CI	74.6, 78.5	74.8, 78.7	74.9, 78.8	74.9, 78.8	75.6, 79.6
Intervention	n	202	185	184	164	162
	Mean	76.5	75.4	75.5	76.2	76.8
	95% CI	74.6, 78.5	73.5, 77.4	73.6, 77.5	74.2, 78.2	74.8, 78.5

Additional Analyses

Subgroups
- Sex
- Age
- Ethnicity
- Engagement

Weight-related
- % change in weight
- % who lost at least 5%
- % who lost at least 3%
- % who did not gain weight
- % who did not gain more than 3%

Metabolic and Anthropometric
- Blood pressure
- Heart rate
- Waist Circumference
- Arm Circumference

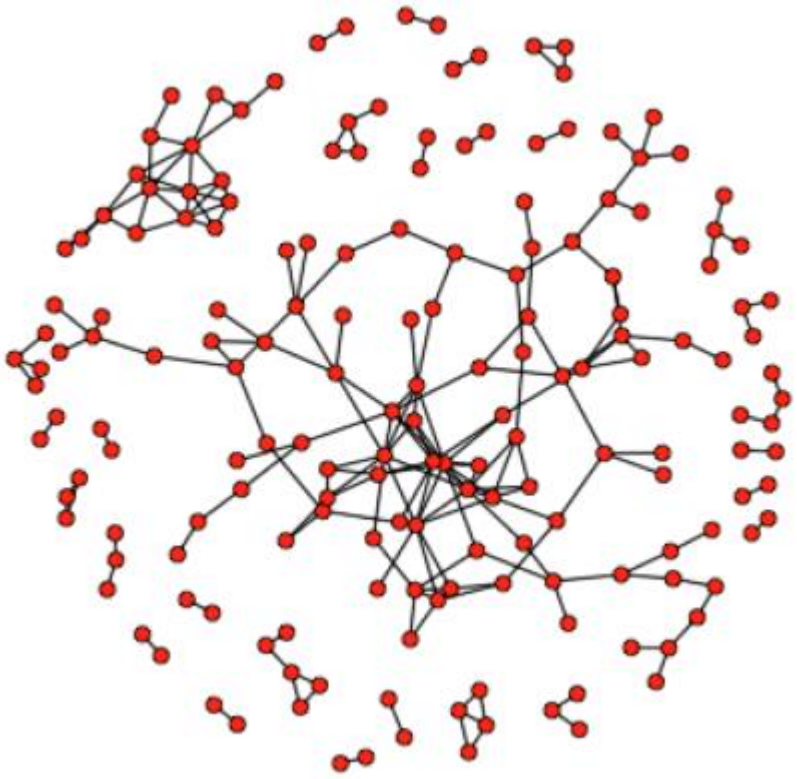
Behavioral
- Physical activity
- Sedentary behavior
- Diet
- Sleep

Psychological
- Quality of life
- Depression
- Body image
- Self-esteem

Psychosocial
- Intentions
- Self-efficacy
- Social support
- etc…

Facebook and Social Networks

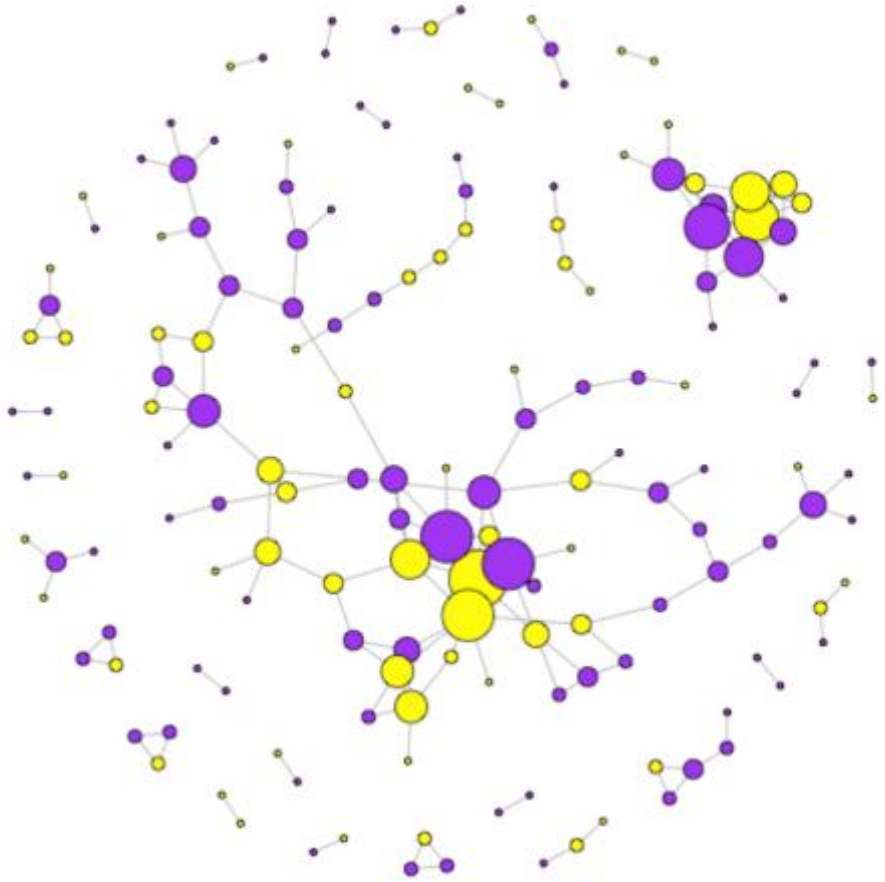
Facebook and Social Networks



Basic Network Picture

- We have friendship data on 315 participants
- 114 (36%) participants are friends with at least one other participant
- There are 214 friendships between study participants (179 friendships when lost to follow-up are excluded)
- Degree summary statistics (# of other participants each participant is connected to):
  - Mean = 2.4
  - Median = 2
  - Range = 1 - 11

Facebook and Social Networks



Network Picture by Condition
Yellow = Control | Purple = Intervention

Facebook and Social Networks

Does being in a weight-loss trial affect how much you talk about healthy living with your online social network?

- Create a Healthy-Active-Lifestyle (HAL) dictionary to flag posts as reflecting purposeful exercise and/or healthy eating
- Restricted to outgoing posts made by participant
- Quantify the # of HAL posts / total # of posts over study period
- Test whether treatment group has more HAL than control and whether engagement with study tools increases HAL

Facebook and Social Networks

Does HAL Facebook activity predict weight loss? Does being connected to another participant who lost weight predict weight loss?

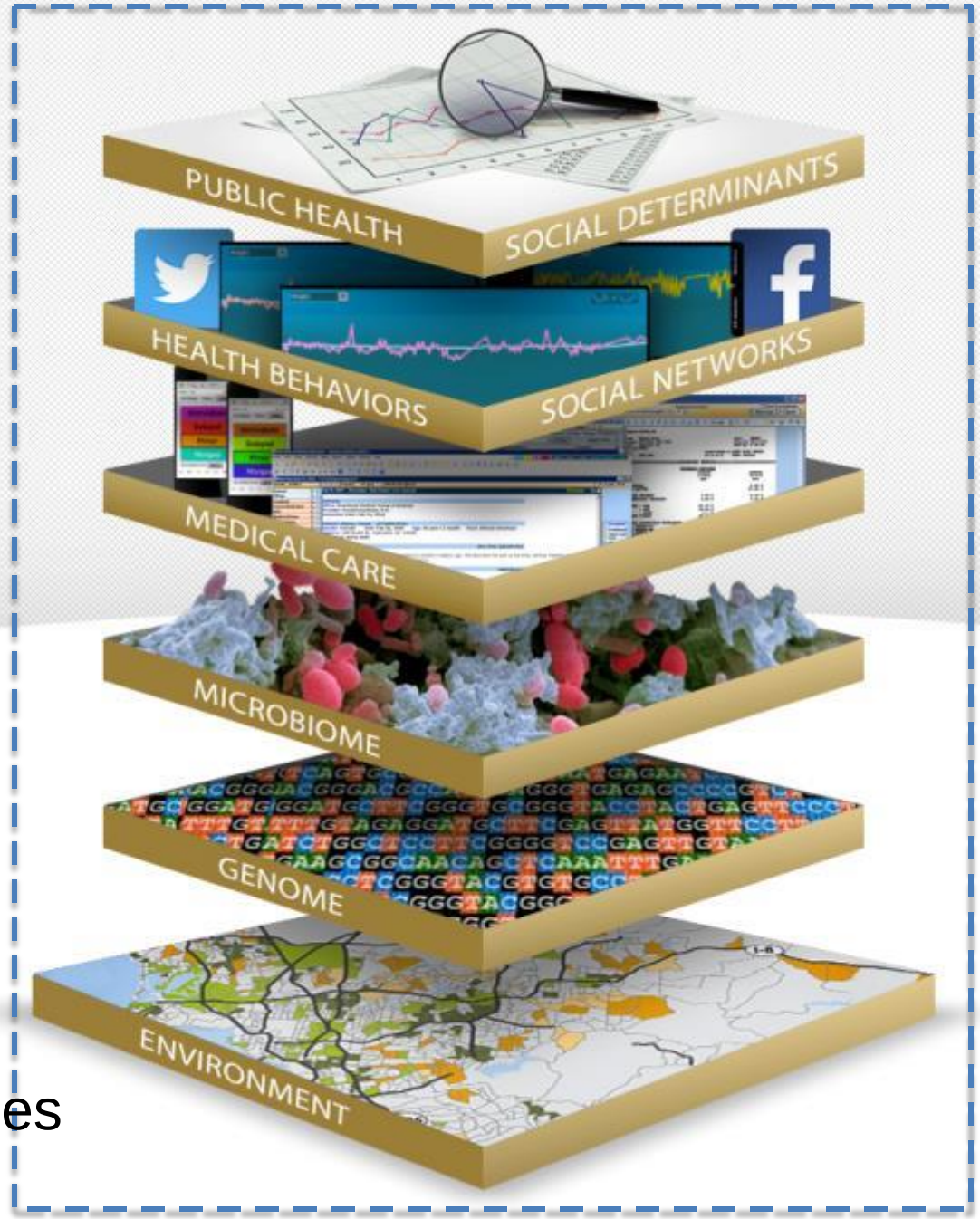
- Quantify the amount of social support for HAL on Facebook:
  1. Likes, comments to HAL posts made by participants
  2. HAL posts from friends
- Quantify engagement with the ThreeTwoMe Facebook page
- Quantify # of study friends who lost weight
- Test whether engagement with the ThreeTwoMe page and receiving online social support for HAL predicts weight loss after adjusting for other tool use

Facebook and Social Networks

How does social network position, connectedness, and network structure affect weight loss efforts?

- Use individual (e.g., centrality) and network level (e.g., density) variables to describe the SMART network
- Test how individual and network variables are related to weight-related outcomes and behaviors

Connecting the dots….



Major influences on health

DELPHI

Data e-Platform to Leverage Multilevel Personal Health Information

PI
Co-PIs and Investigators

NSF 1237174, Information & Intelligent Systems

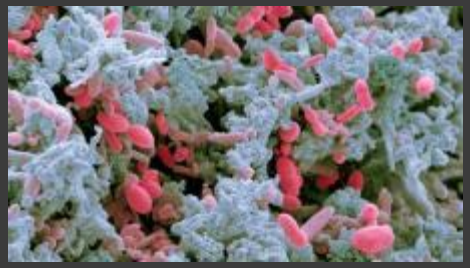
Multiple sources of health-relevant data

Medical Records

Personal Health Data
(weigh-ins, run info, …)

Environmental Data
(pollution, noise, greenspace, …)

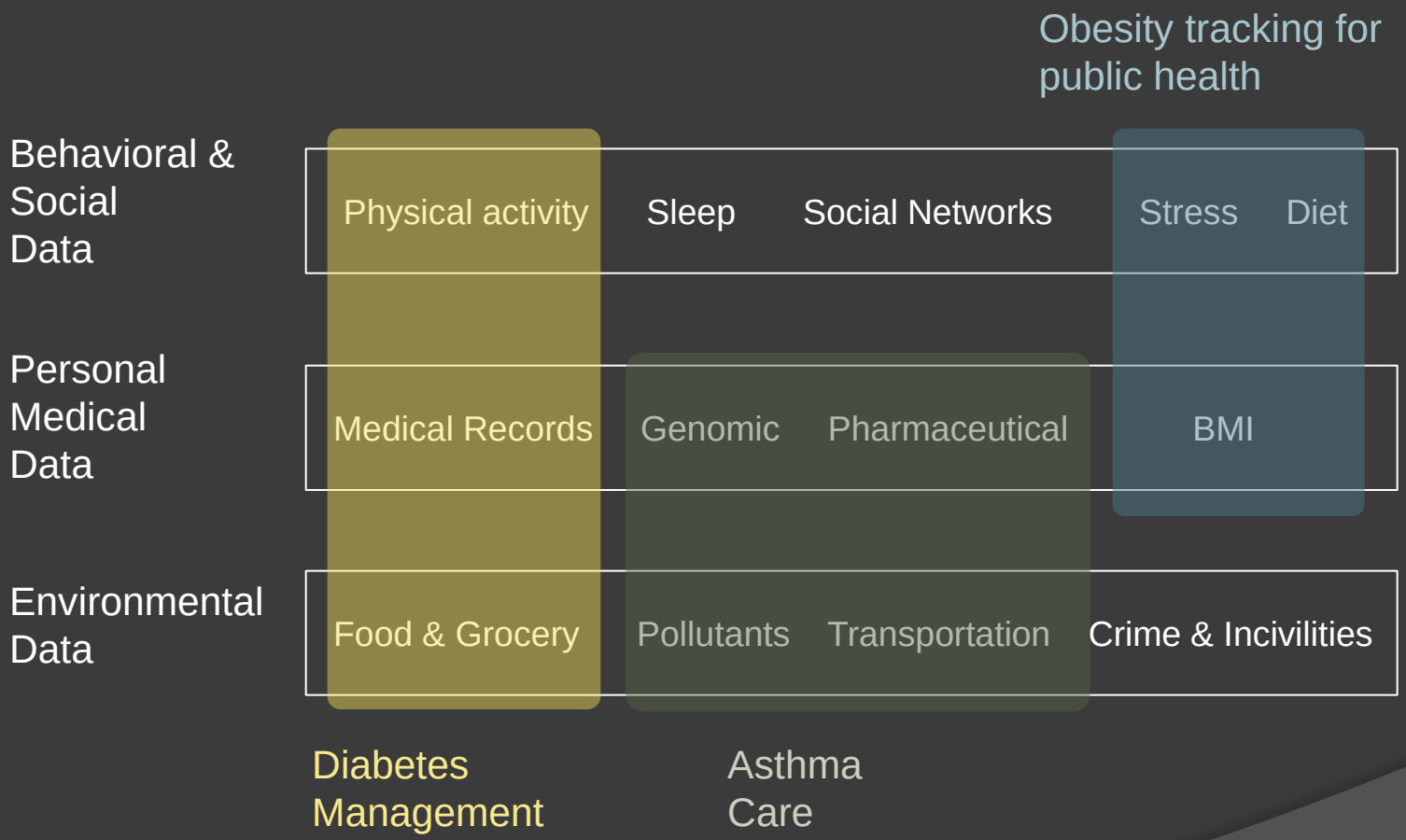
Genomic Data



Microbiome Data

Public Health &
Social Determinants Data

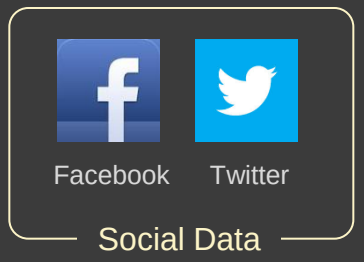
Providing health care & population health requires reasoning across these layers

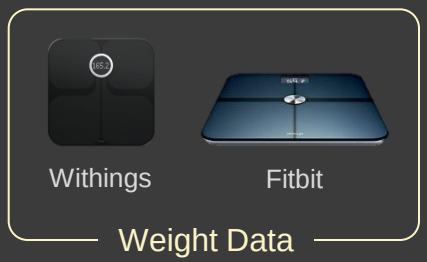


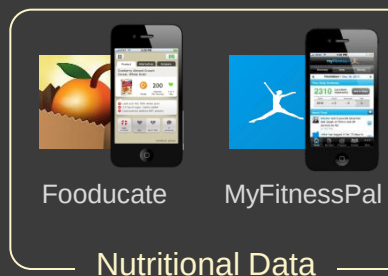
Today: Most health data are either ignored or are functionally unavailable

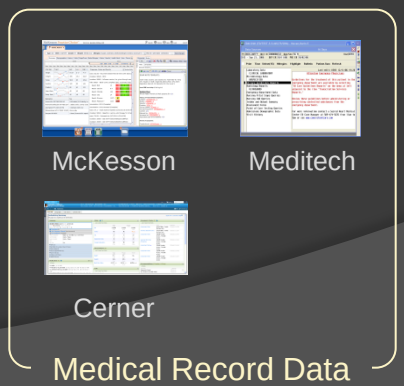
Reasons:

- Data are collected and maintained by different entities
  - Making it hard to find and access them
- Data have different data types
  - Making it hard to combine them









DELPHI: The Goal

- Integrate heterogeneous data into a “single” uniform database
  - By taking into account the geospatial context
- Implement an analytics and visualization layer on top
- Open data and analytics to 3rd-party developers of apps & services

Enable personalized population health through the creation of a “Whole Health Information Platform” that takes into account everything from the genome to the exposome – essentially *all* health-relevant data

Partners

QUALCOMM

SAN DIEGO HEALTH CONNECT
Better Information • Better Care

COUNTY OF SAN DIEGO
HHSA
HEALTH AND HUMAN SERVICES AGENCY

SANDAG

CONNECT

DELPHI System Architecture

Medical Records*

BEACON Health Info Exchange

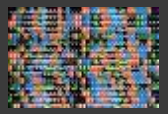
Personal Sensor Data*

Qualcomm Life

Location Data*

Smartphone

Environmental Data



Genomic Data

3rd party web-services

ANALYTICS LAYER: Allows developers to run common analytics efficiently

INTERFACE

DELPHI

WHOLE HEALTH INFORMATION MODEL (WHIM)

ANALYTICS

VISUALIZATION

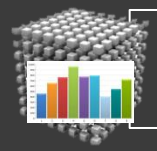
WHAPI

Feedback, alert & advice

Patient/Parent App

Integrated view of patient + feedback

Medical Personnel Individual's Dashboard



Population statistics & analytics

Medical Personnel Population Dashboard

Other New Applications

VISUALIZATION LAYER: Allows developers to create common visualizations efficiently

integrated health data and write apps that use them

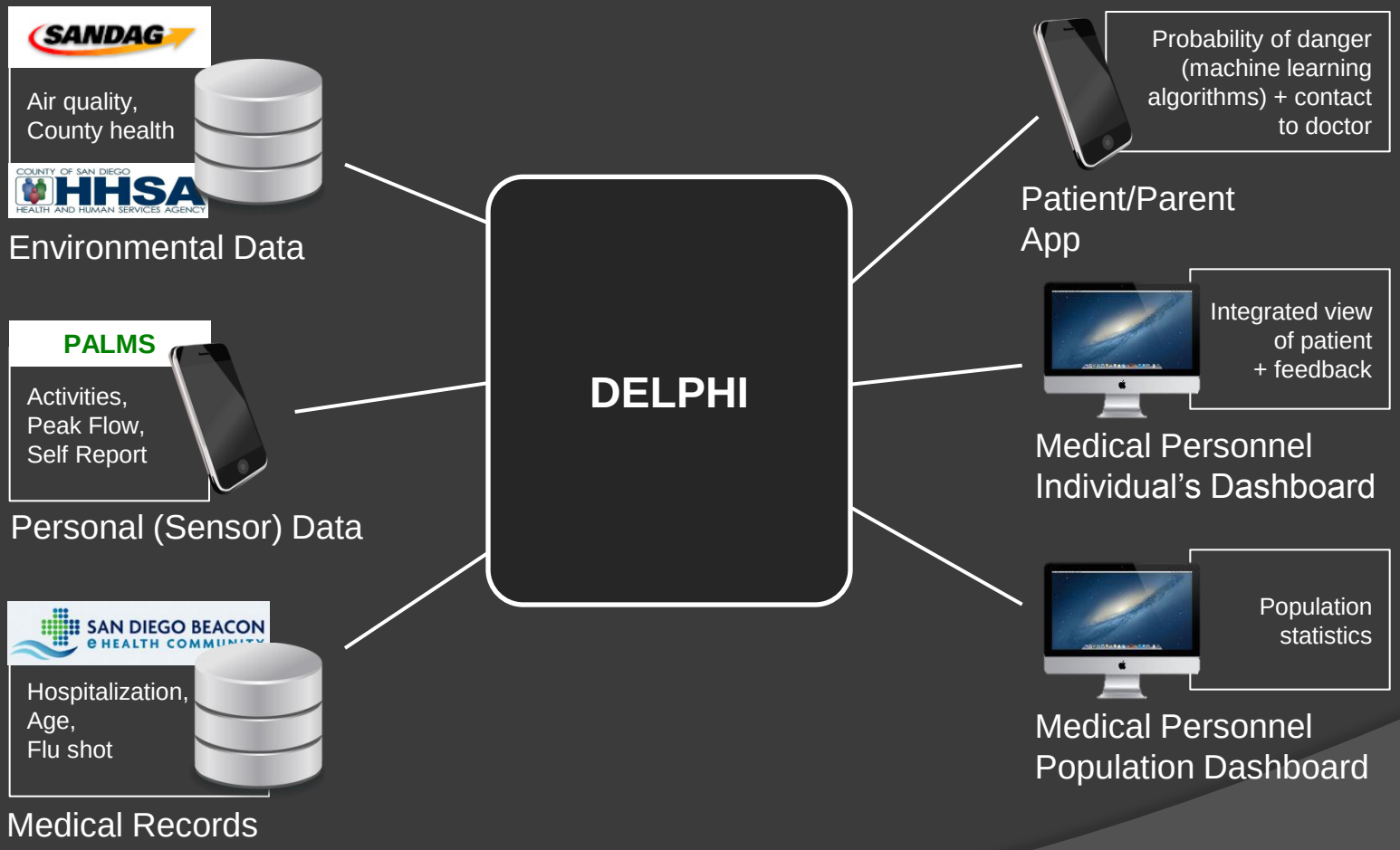
Goal: Create ecosystem for developers to create the next generation of health applications

Sources

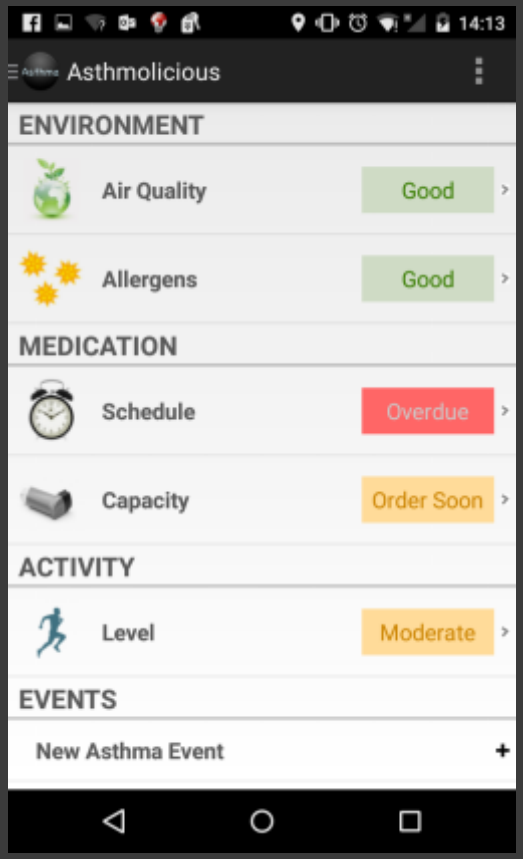
DELPHI

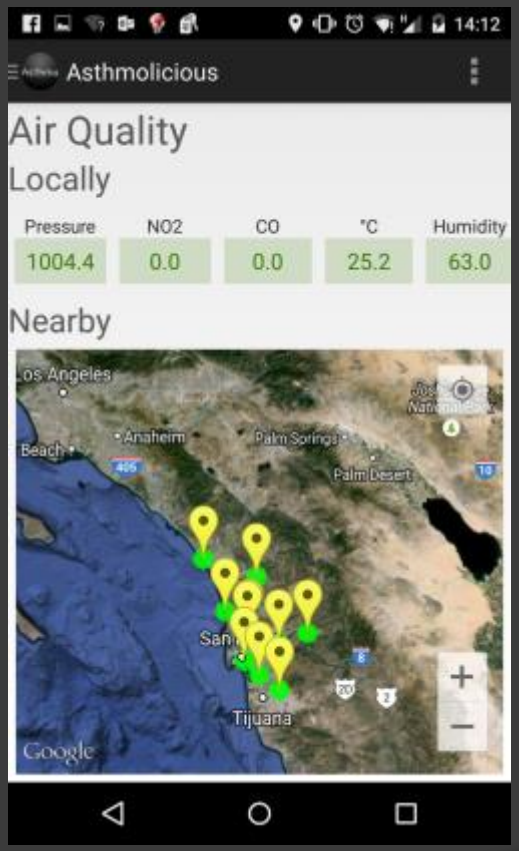
Applications

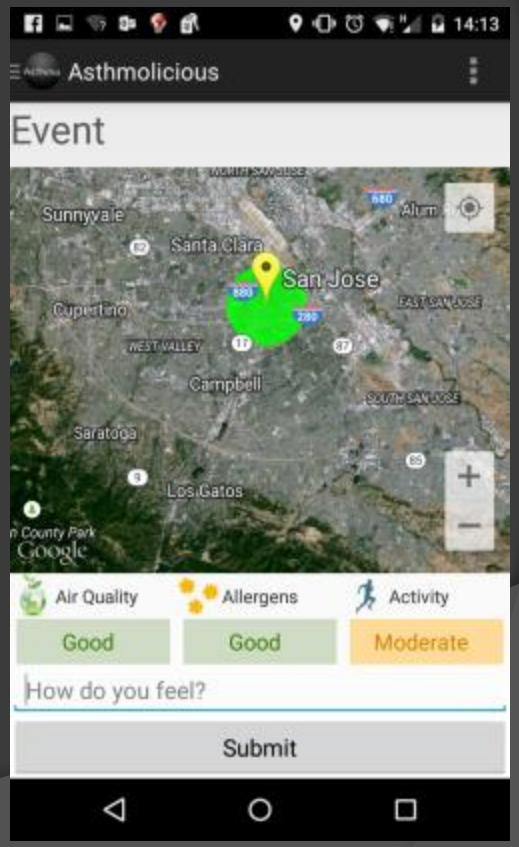
Use Case: Asthma



Use Case: Asthma App



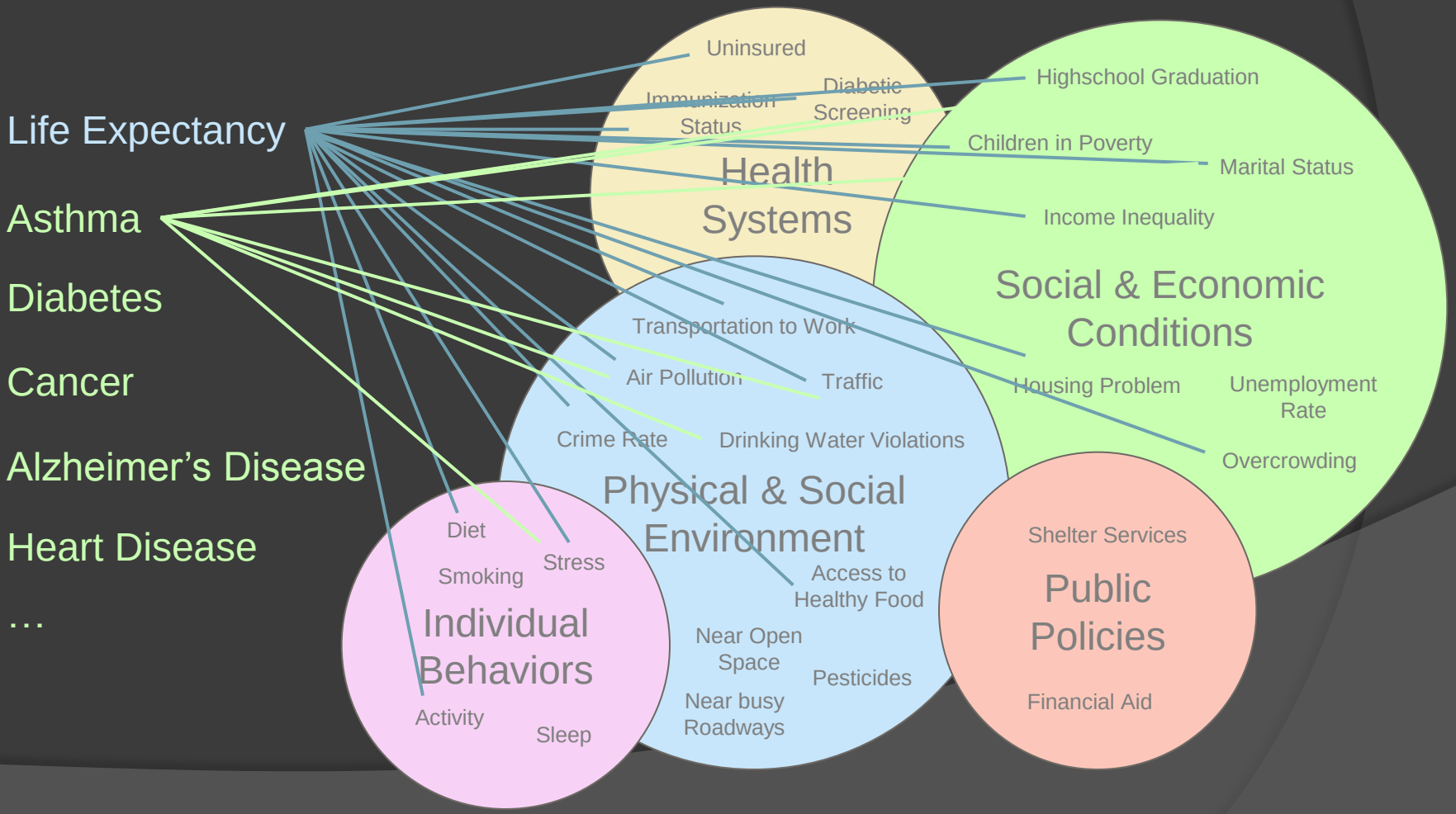




Big Data & A Culture of Health

SDHHSA, VCU & UCSD; supported by the Robert Wood Johnson Foundation

Use Case: Find correlations (and new causal relationships?) between and among different health-related variables using machine learning and other big data analytic strategies



Big Data & A Culture of Health

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Use Case: Find correlations (and new causal relationships?) between and among different health-related variables using machine learning and other big data analytic strategies

Community Design Team
Data Visualization mtg 9/30/15
Calit2/QI

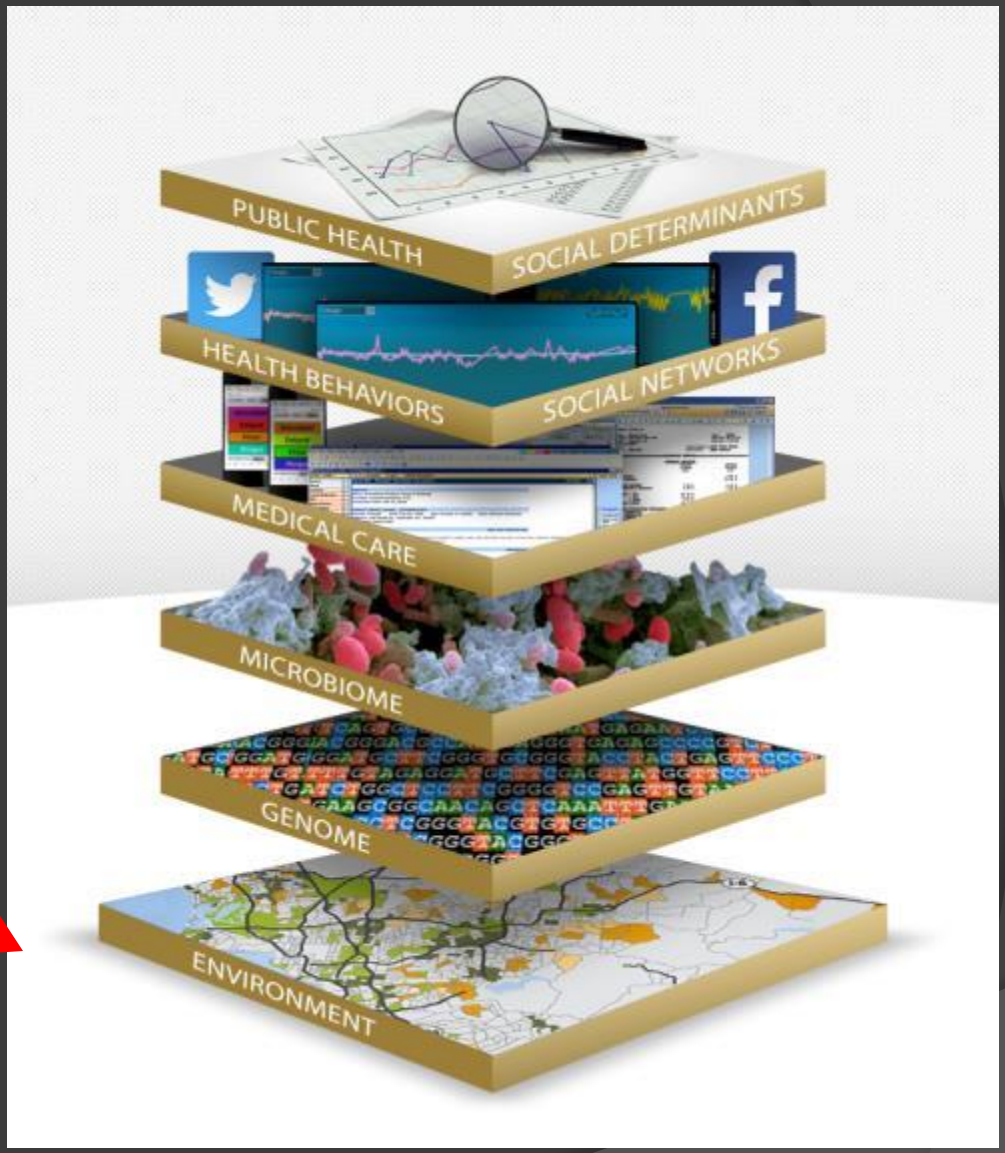
Research Challenges Addressed in the DELPHI Project

- Data Integration & Analytics in Novel Settings:
  - New data types
    - e.g. spatiotemporal data, genomic data
  - Dynamic environments
    - e.g. new sources & new applications join the system
  - Modeling this process in a defined geographical area
    - Use cases relevant to personal and population health

DELPHI

Research Challenges:
In Novel Settings

modeling in defined location



Our approach is to model access to as much health-related information as we can gather in San Diego County, Calif. Population 3.2 Million, 4000 Sq Miles

Thank You!

cwphs.ucsd.edu