




Digital Health – Designing Behavioral Change

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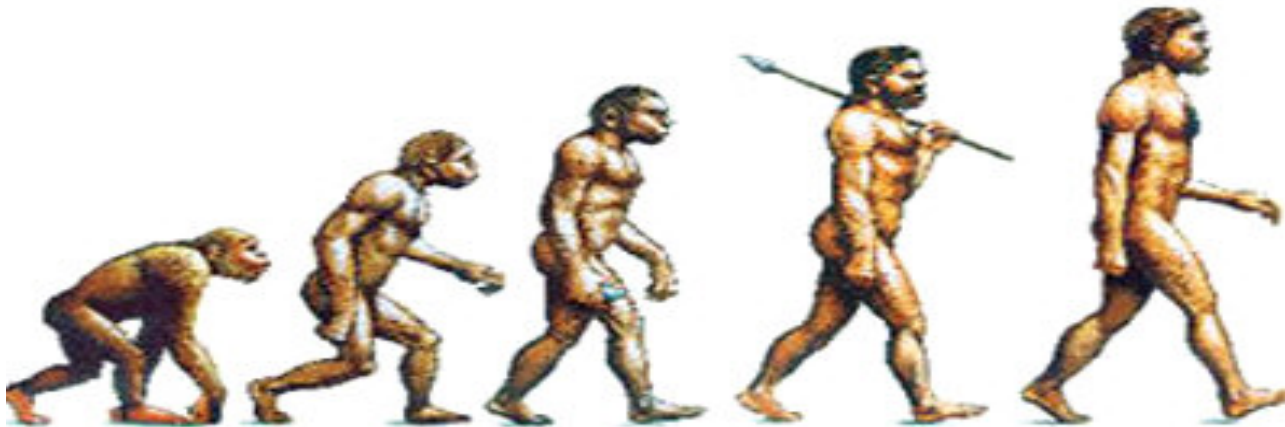
@SanjeevBhavnani 



Disclosure

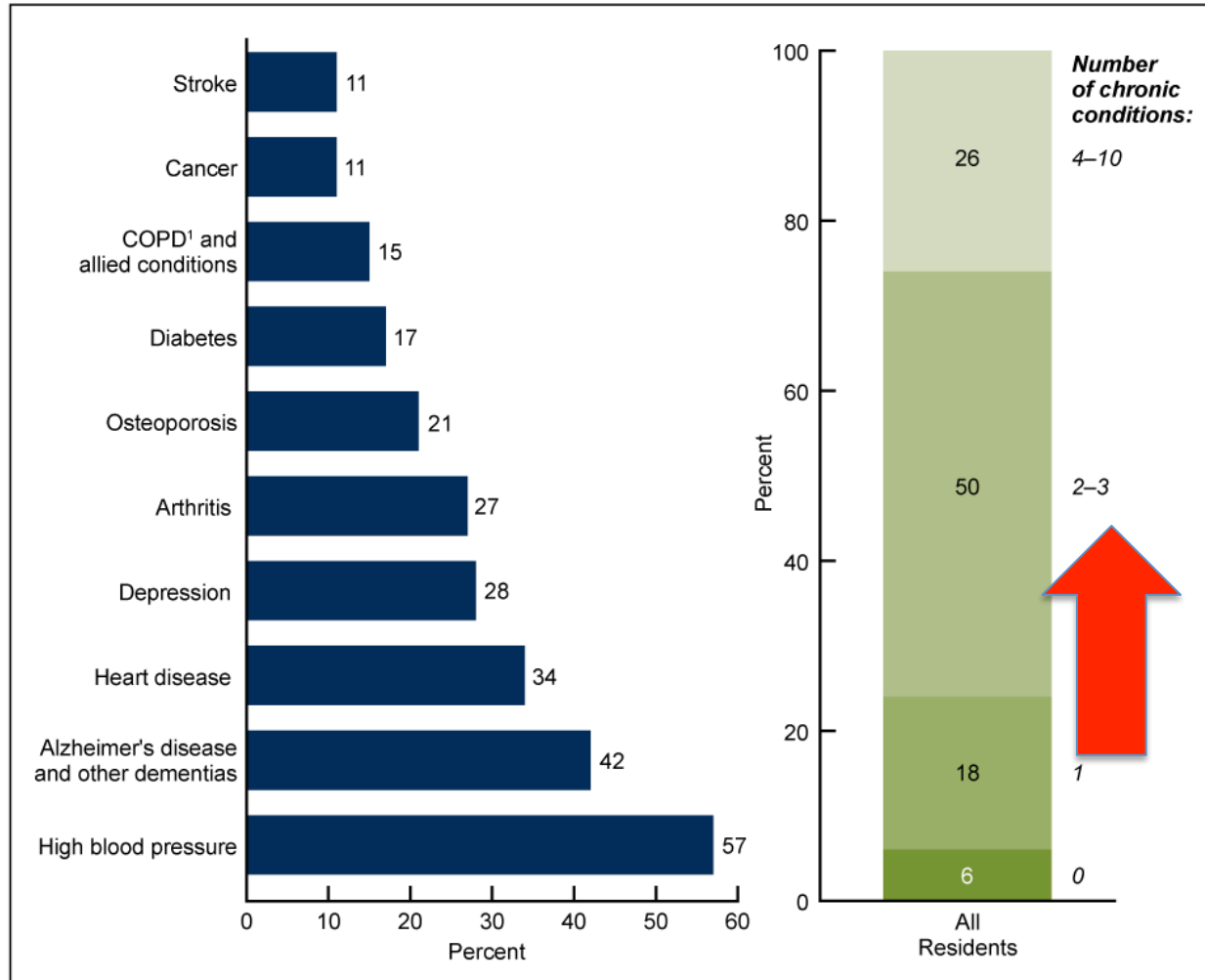
Recipient of an unrestricted educational and research grant from the Qualcomm Foundation 2013-2015

Why Mobile Health?



The Problems

- ❑ The average North American above the age of 50 has **2-3** chronic medical conditions
- ❑ Major contributor to mental health diseases
- ❑ This population will rise to **100 million** by 2030
- ❑ Cost of > **4 trillion** dollars per year



Rand Corporation 2014



June 19, 2000



November 1, 2007



August 10, 2009

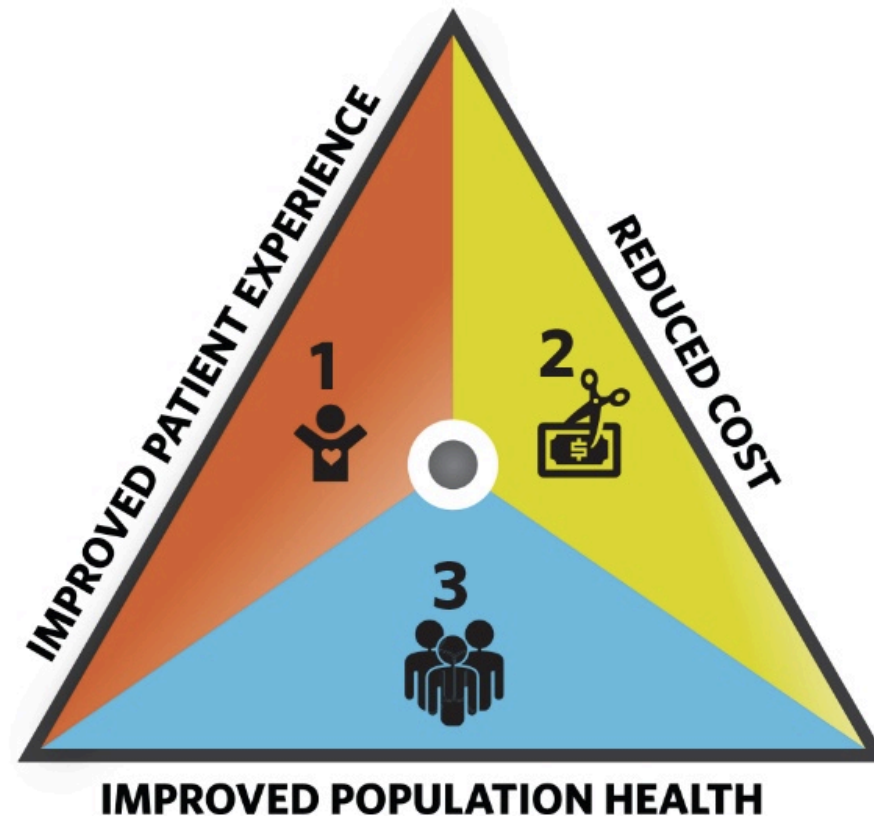


September 11, 2014

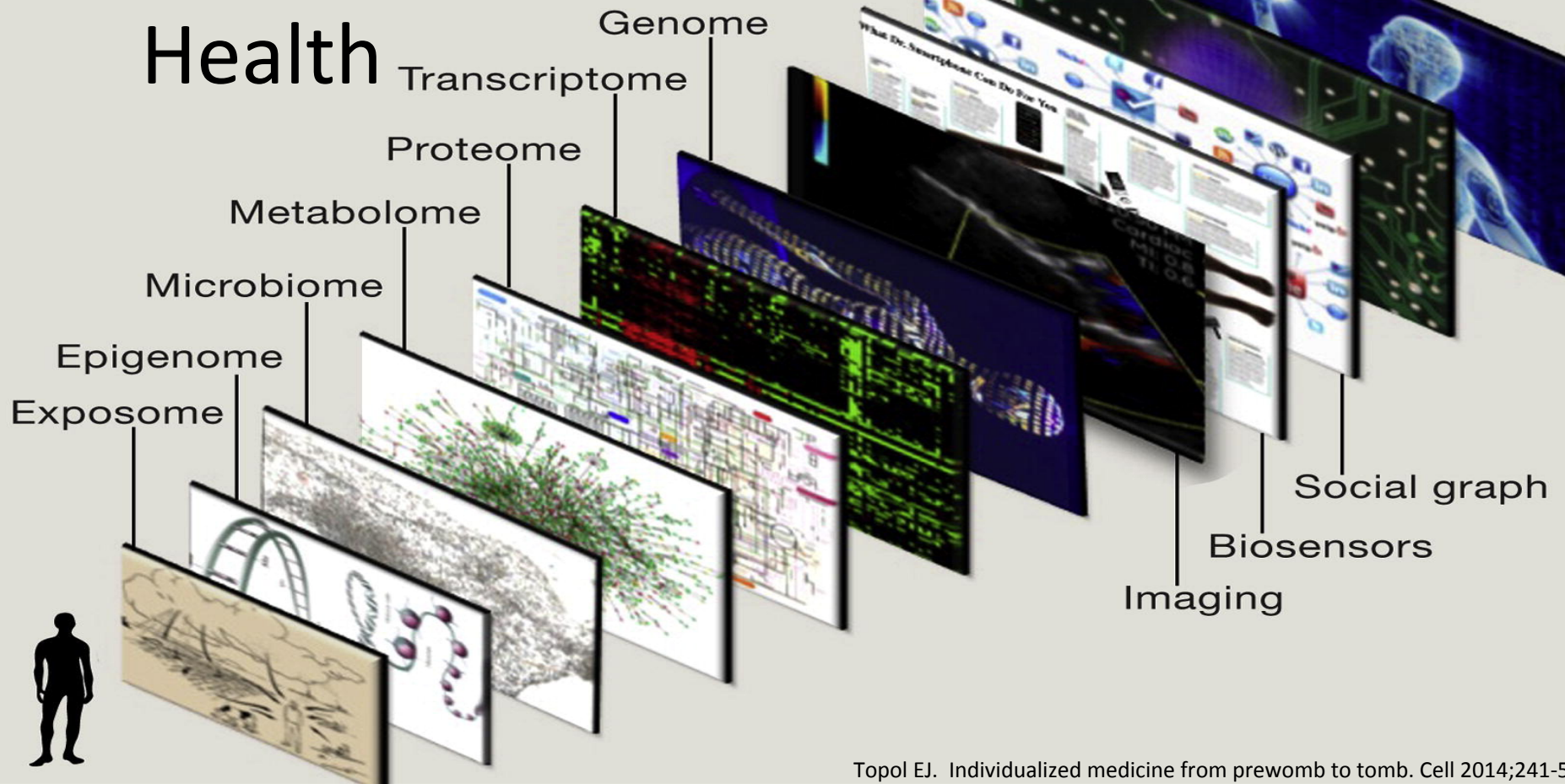


February 23, 2015

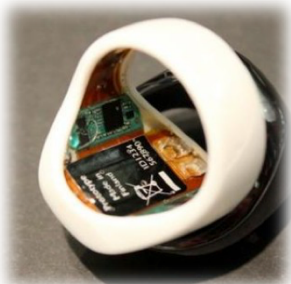
Triple Aim in Healthcare



Digital Health



Topol EJ. Individualized medicine from prewomb to tomb. Cell 2014;241-53



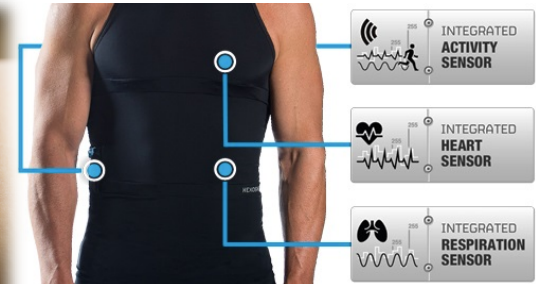
Smart Ring



Smart Tablet



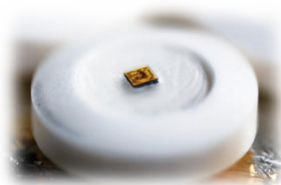
Smart Skin



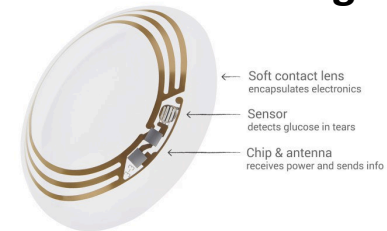
Smart Clothing



Smartphone Exam



Smart Pills



Smart Contact Lens



Smart Necklace

**Smartphone
Lab Testing**



**Smartphone
Ultrasound**

Smart Genome Sequencing



Smart Watch

Seizure

Glucose

VIEWPOINT

Wearable Devices as Facilitators, Not Drivers, of Health Behavior Change

Mitesh S. Patel, MD, MBA, MS
Philadelphia VA Medical Center, University of Pennsylvania, Philadelphia.

David A. Asch, MD, MBA
Philadelphia VA Medical Center, University of Pennsylvania, Philadelphia.

Kevin G. Volpp, MD, PhD
Philadelphia VA Medical Center, University of Pennsylvania, Philadelphia.



Author Reading at
jama.com

Several large technology companies including Apple, Google, and Samsung are entering the expanding market of population health with the introduction of wearable devices. This technology, worn in clothing or accessories, is part of a larger movement often referred to as the “quantified self.” The notion is that by recording and reporting information about behaviors such as physical activity or sleep patterns, these devices can educate and motivate individuals toward better habits and better health. The gap between recording information and changing behavior is substantial, however, and while these devices are increasing in popularity, little evidence suggests that they are bridging that gap.

Only 1% to 2% of individuals in the United States have used a wearable device, but annual sales are projected to increase to more than \$50 billion by 2018.¹ Some of these devices aim at individuals already motivated to change their health behaviors. Others are being considered by health care organizations, employers, insurers, and clinicians who see promise in using these devices to better engage less motivated individuals. Some of these devices may justify that promise, but less because of their technology and more because of the behavioral change strategies that can be designed around them.

Medical News & Perspectives

Is There an App to Solve App Overload?

Bridget M. Kuehn, MSJ

Like many physicians, Suzanne Clough, MD, struggled to meet her patients’ needs regarding their type 2 diabetes in a few 12-minute visits each year. But too often, patients’ concerns about day-to-day condition management weren’t fully addressed. Many were frustrated, and some didn’t follow her guidance because they weren’t seeing results.

The recommendations, she said, “didn’t have value [for them].”

Clough wondered whether real-time, 24/7 diabetes management support would help. That question led her on a 10-year journey to develop the WellDoc BlueStar mobile app for patients with type 2 diabetes. It analyzes trends in patient-entered data on blood glucose level, carbohydrate consumption, medication use, and other information to provide real-time coaching for the patient. Patients can then securely share the data with their physician through a web portal.

The WellDoc BlueStar app is part of an exploding medical app market, with an estimated 660 million downloads of health-related apps in 2013 alone, according to a report by the IMS Institute for Healthcare

thebmj

Research ▾

Education ▾


News & Views ▾

Head To Head

Can healthy people benefit from health apps?

BMJ 2015 ; 350 doi: <http://dx.doi.org/10.1136/bmj.h1887> (Published 14 Apr

Cite this as: BMJ 2015;350:h1887



thebmj

BMJ talk medicine
Health apps for well people - problematic

Cookie policy

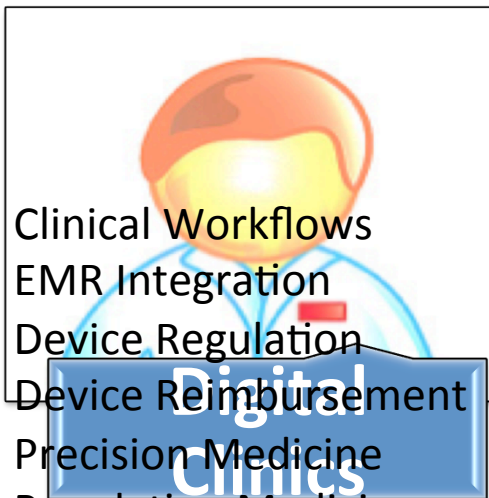
Article

Related content

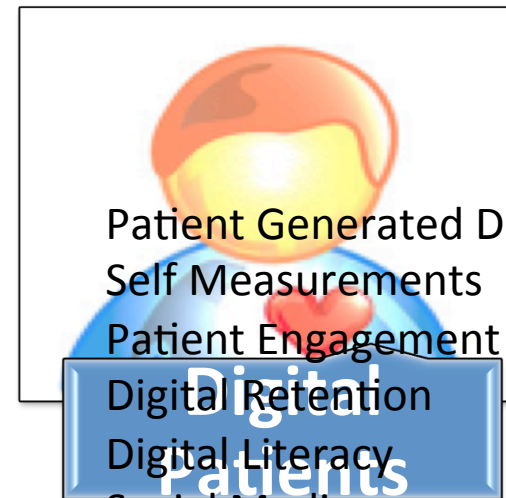
Metrics

Responses

Digital Health



Big Data
Cost Reduction
Outcomes



Incentives






Finlandia
HEALTH CENTRE


Name Marty Adelman Date _____

Please prescribe 1
Digital health 'app'

Refill X _____ Signature S. Bhavnani MD
unlimited ND - Licence # _____

G104 - 2480 Spruce Street (at Broadway), Vancouver, BC, Canada V6H 2P6
Tel: (604) 734-7760 Fax: (604) 558-2480

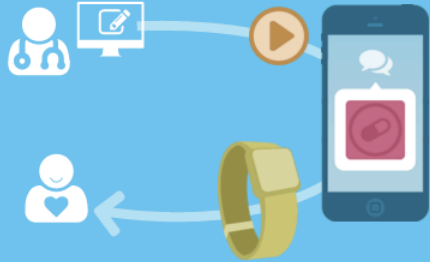









HAPPIER, HEALTHIER PATIENTS

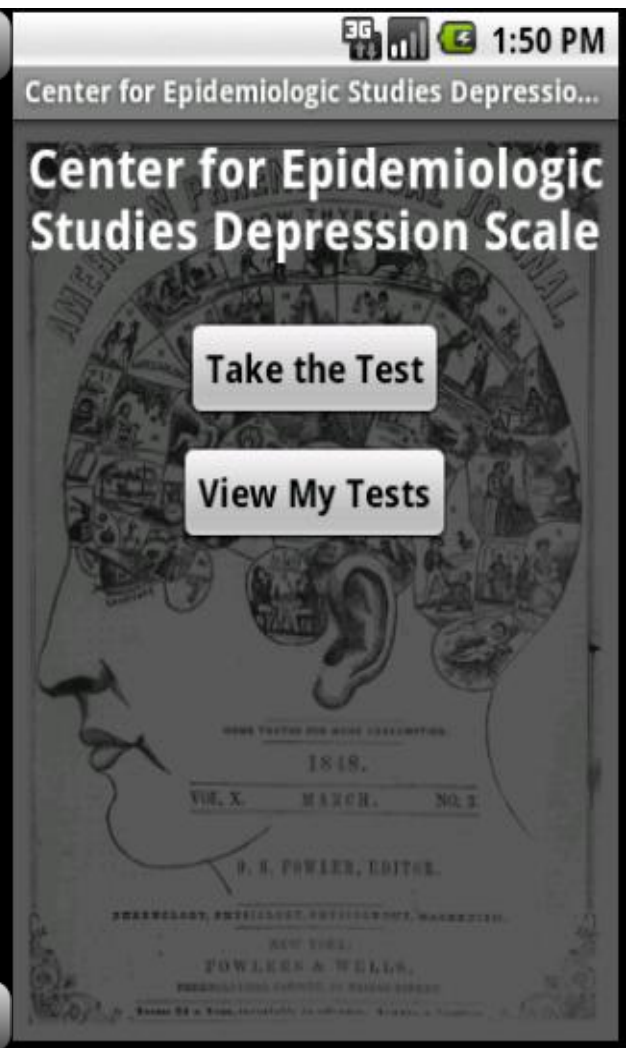
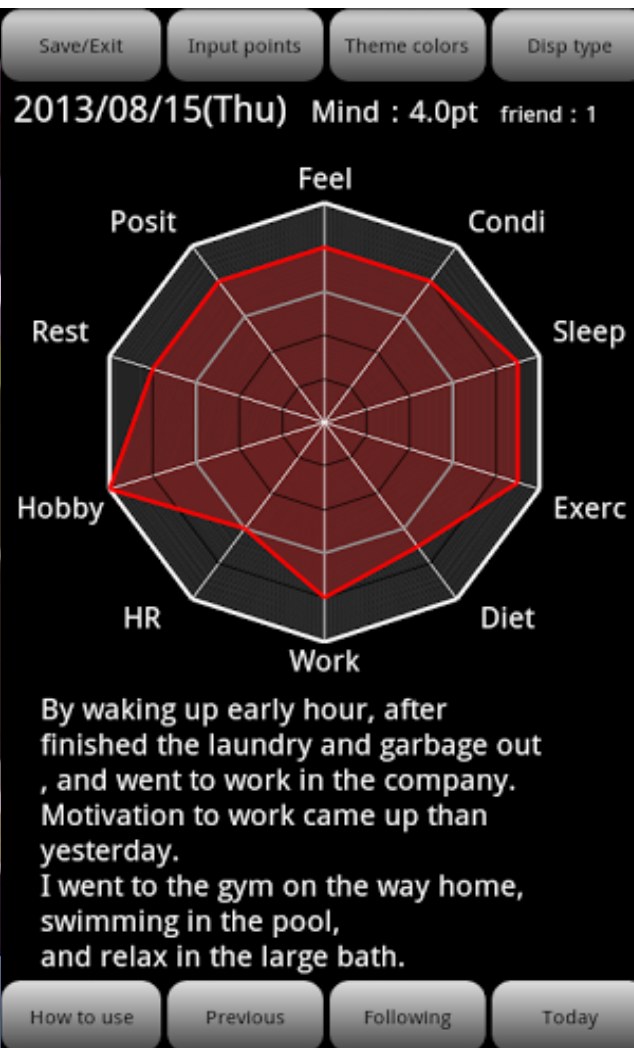
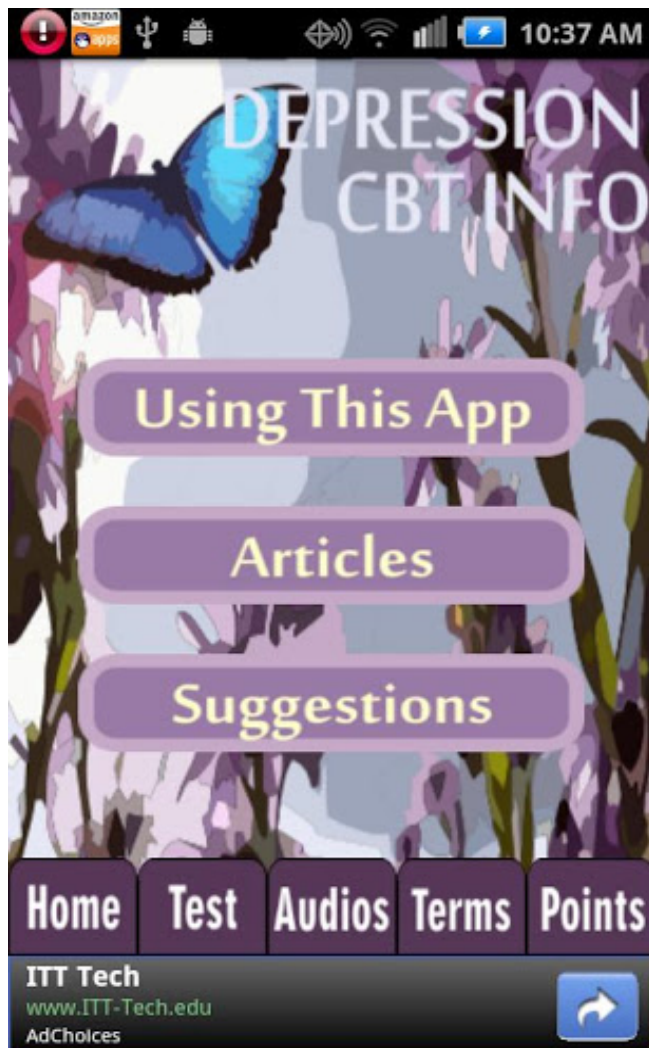
AppScript™ is the leading discovery and distribution platform for mobile health technologies. Improve patient satisfaction by prescribing mobile health apps, connected devices and content.

Try it Now!



Start Prescribing Today





Artificial Intelligence

Specifications

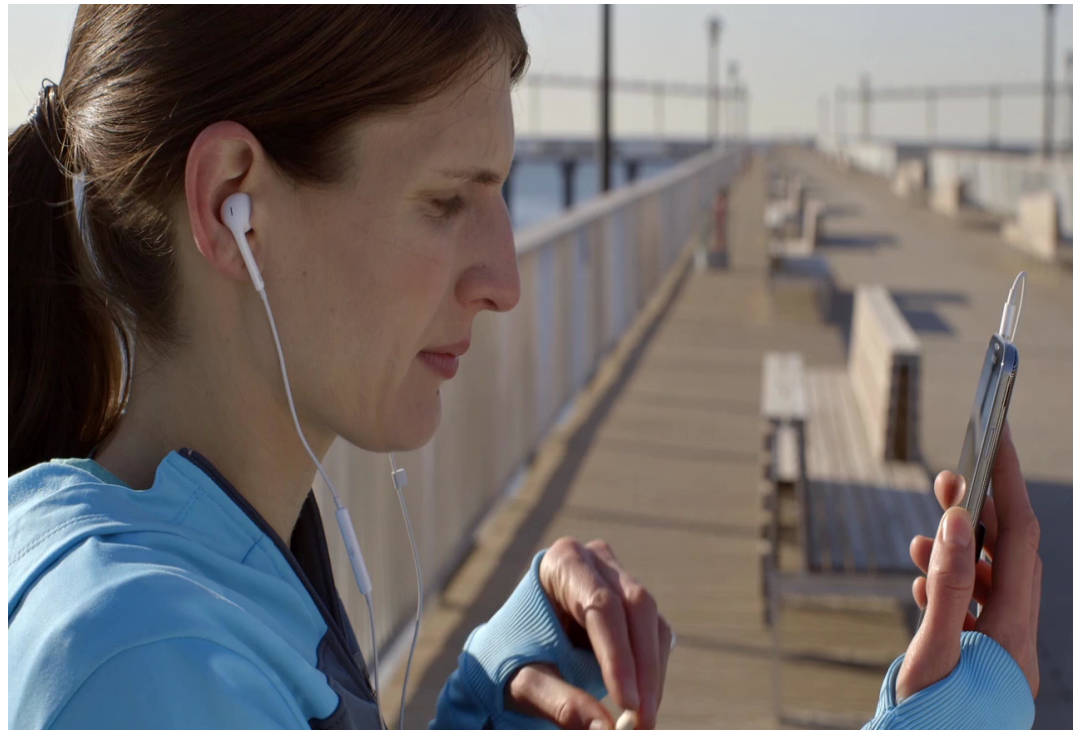
- Facial recognition
- Motion sensing
- Automated pill identification

Confirmation

- Patient
- Prescribed dose
- Date/Time/Place

Communication

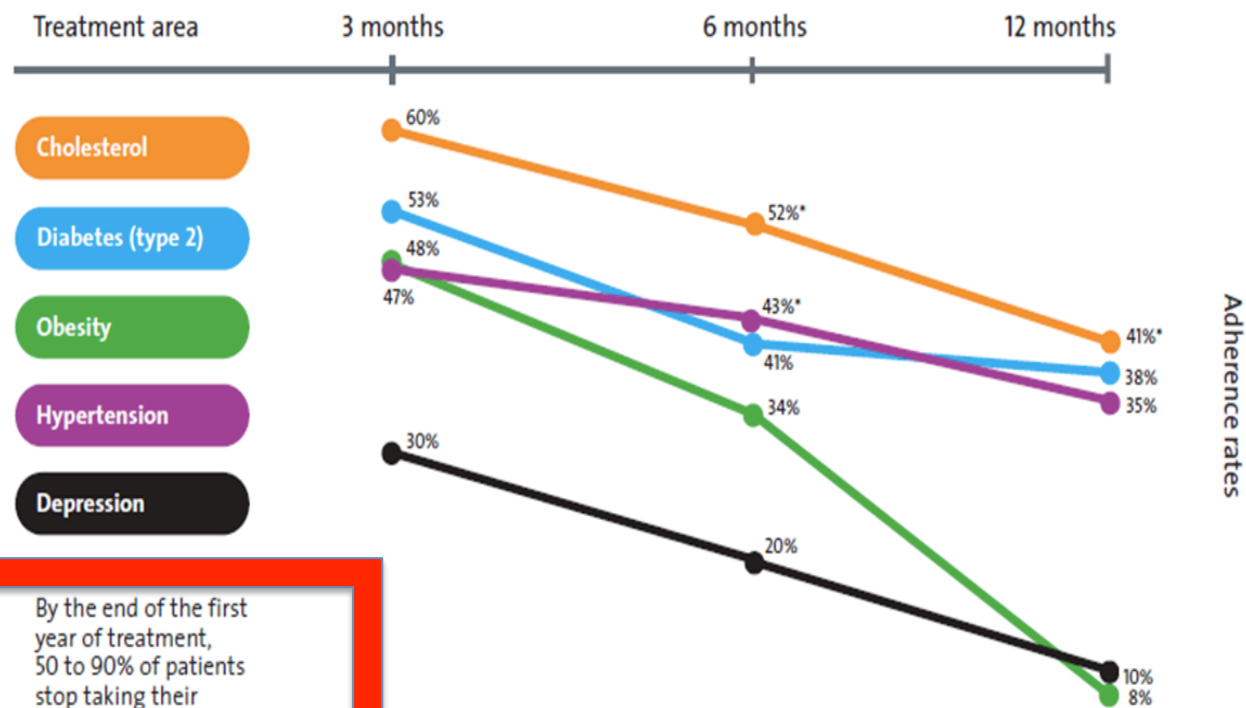
- Patient ↔ Provider



The Problem

Many patients stop taking their medications

Adherence rates plummet in just a few months



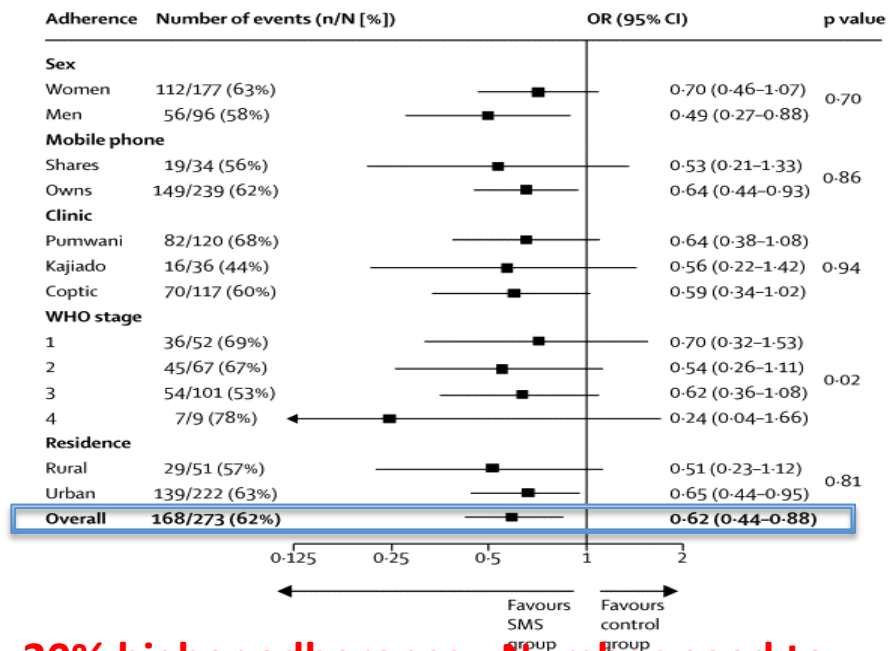
American Society of Family Practice Healthcare Statistics 2015

- **High chronic disease burden - depression**
- 60% can not identify their medications
- 30-50% do not follow prescription instructions
- Directly responsible for >10% of healthcare costs (~\$15 Billion)
- >2 Million serious adverse drug reactions

Texting – Powerful Intervention for Behavioral Change

WelTel

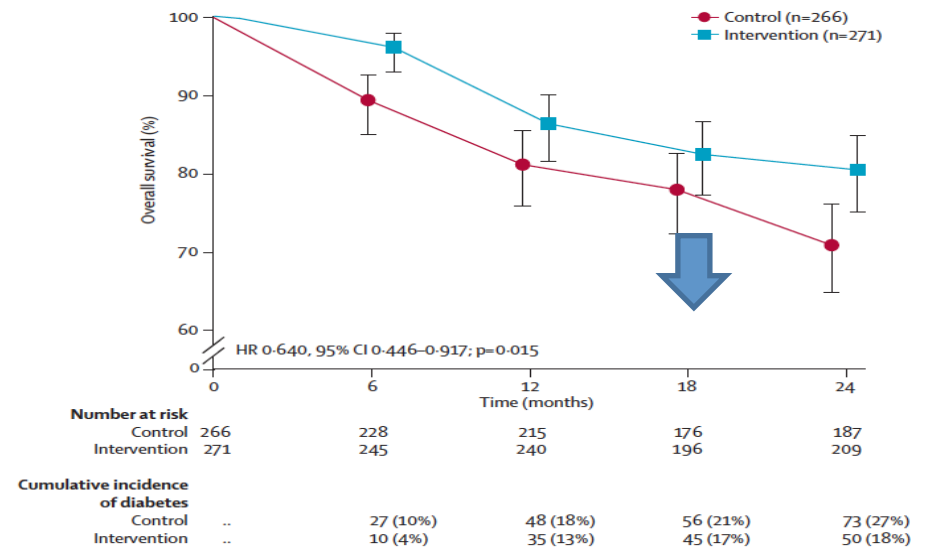
HIV Medication Adherence Trial



20% higher adherence – Number need to treat of 11 to achieve viral load suppression

Diabetes

Texting to Prevent Diabetes



35% reduction in diabetes at 2-years

Smart Bottles

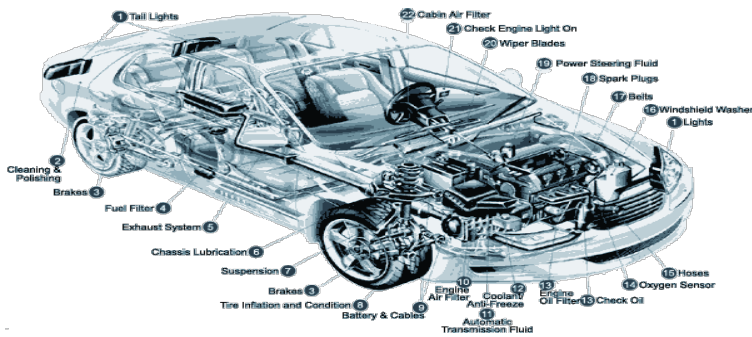


- Reminders
 - Text messages
 - Alarms
- Tamper proof
 - Time release
 - Compliance record once pill is dispensed
- Shares information with clinic and pharmacy

www.clevercap.org

Nanosensors

Car



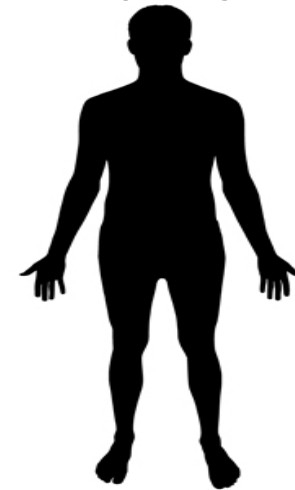
> 400 sensors

Smartphone



10 sensors

Human



0 sensors

Edible Sensors

Wireless Observed Therapy



DiCarlo L. A digital health solution for using and managing medications: wirelessly observed therapy. IEEE Pulse. 2012. FDA Approved 2012



Docs Willing to Share Medical Practice with Patients? *Sort of*

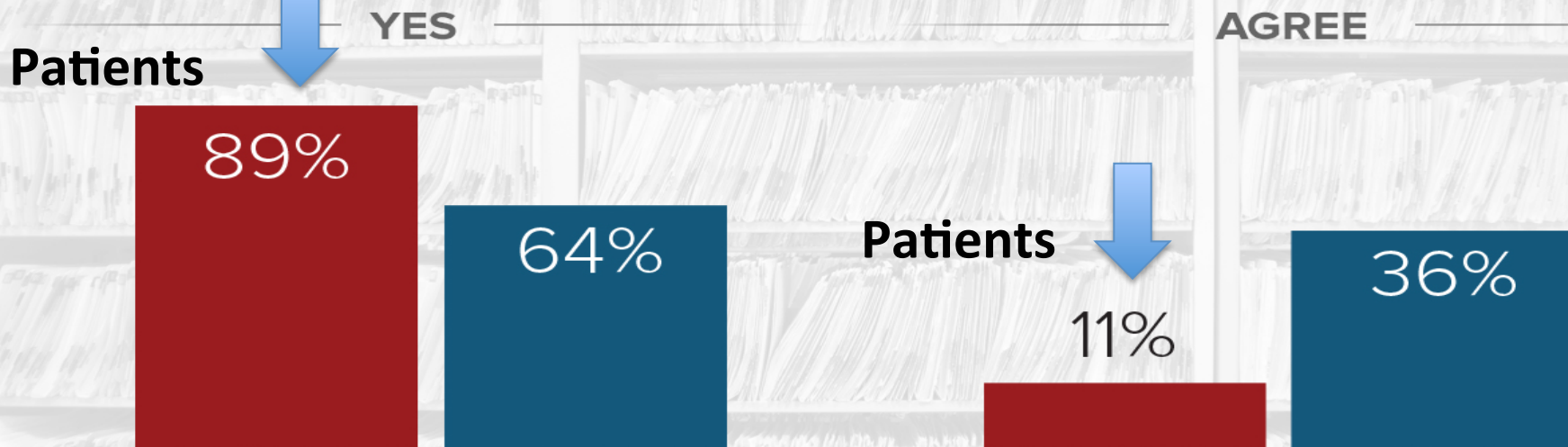
A WebMD/Medscape Patient-Clinician Report



PHYSICIAN NOTES

Do patients have the right to see all of the notes taken by their physicians during an office visit?

Doctors should share only the notes they deem appropriate.



LEGEND: PATIENTS PHYSICIANS

PATIENTS' USE OF TECHNOLOGY

Should technology be used by patients to assist in the diagnostic process?

YES

Patients

84%

69%

LEGEND:

PATIENTS

PHYSICIANS

conditions, symptoms, treatments...



Live better, together!™

Making healthcare better for everyone through sharing, support, and research

Join now

(it's free!)



Learn from others

Compare treatments, symptoms and experiences with people like you and take control of your health



Connect with people like you

Share your experience, give and get support to improve your life and the lives of others



Track your health


Chart your health over time and contribute to research that can advance medicine for all




350,000 members

2,500+ conditions

60+ published research studies

28 million data points about disease





See more

View

Last 3

Showing Aug 1

InstantMe

InstantMe

Temperature (F)



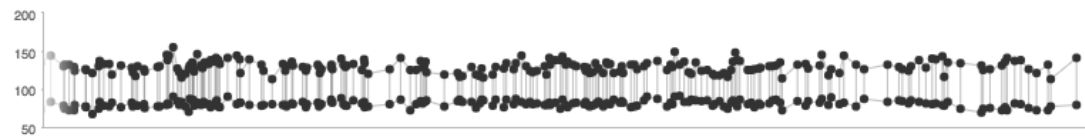
Latest result:
97.7 Fahrenheit
Nov 16, 2015

Glucose, blood



Latest result:
144 mg/dL / 2
Nov 16, 2015

BP



Latest result:
141 mmHg / 79
mmHg
Nov 16, 2015

Pulse Rate



Latest result:
65 beats/min / 1 / 0
Nov 16, 2015

Hemoglobin A1C, %



Latest result:

New approach for analyzing self-reporting of insomnia symptoms reveals a high rate of comorbid insomnia across a wide spectrum of chronic diseases

Bozena Katic, James Heywood, Fred Turek, Emil Chiauzzi, Timothy E. Vaughan, Kristina Simacek, Paul Wicks, Sachin Jain, Christopher Winrow, John J. Renger

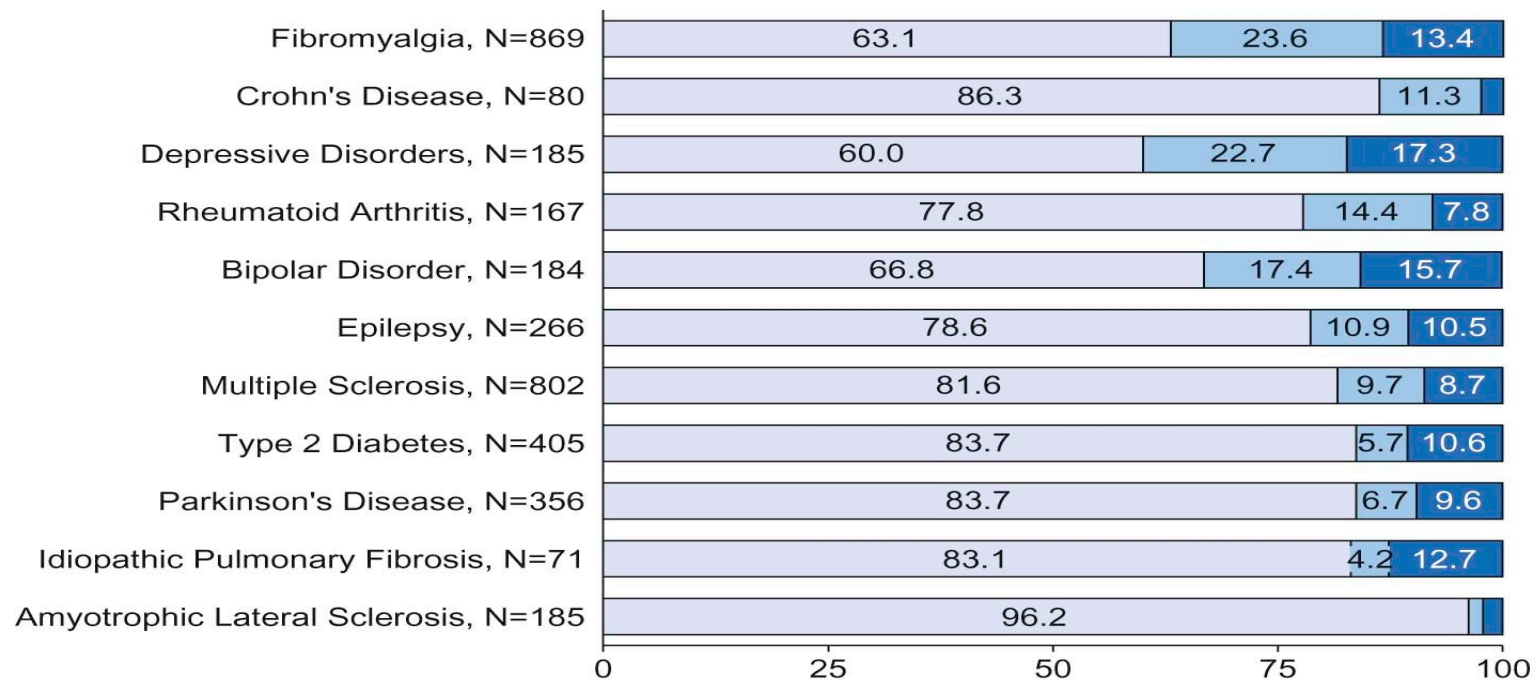
Sleep Medicine

Volume 16, Issue 11, Pages 1332-1341 (November 2015)

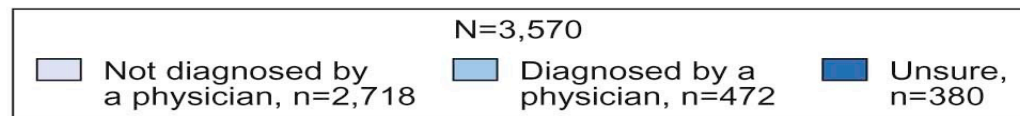
DOI: 10.1016/j.sleep.2015.07.024



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Insomnia Diagnosis by Primary Condition, %





Headache

It's a Brain Tumor!

Google Search

I'm Feeling Lucky

Do High Healthcare Utilizers Engage with Digital Health?

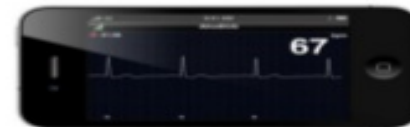
**Smartphone
Glucometer**



**Smartphone
Blood Pressure
Wired for Health**



**Smartphone
iECG**



Randomized clinical study that will evaluate the impact of remote wireless monitoring for patients with diabetes, hypertension, and arrhythmias. This study will test whether wireless monitoring can reduce health care costs and increase health self-management for patients with chronic health conditions.

The 100 patient, 6 month study will look at the patients' health care insurance claims and compare them to the insurance claims of the 100-person Control Group

QUALCOMMLIFE
A NORTHEAST COAST GROUP

 **Scripps Translational
Science Institute**

Bloss CS. bioRxiv online October 28, 2015; doi: <http://dx.doi.org/10.1101/029983>

Do High Healthcare Utilizers Engage with Digital Health?

	Baseline		Follow-up		Mean Difference	
	<i>Control</i> <i>N</i> = 85	<i>Monitoring</i> <i>N</i> = 75	<i>Control</i> <i>N</i> = 65	<i>Monitoring</i> <i>N</i> = 65	<i>Control</i> <i>N</i> = 85	<i>Monitoring</i> <i>N</i> = 75
Total Claims (\$)	4,265 (10,190) 961 (3,166)	7,159 (25,251) 990 (2,340)	5,596 (22,187) 807 (2,734)	6,026 (21,426) 845 (2,273)	1,331 (21,042) 0 (2,372)	-1,133 (31,465) 0 (1,780)
Condition Claims (\$)	1,512 (6,868) 163 (375)	2,434 (14,296) 117 (387)	6,165 (37,153) 111 (379)	630 (21,43) 179 (516)	4,653 (36,165) 0 (200)	1,317 (14,400) 0 (200)
Pharmacy Claims (\$)	1,519 (2,687) 325 (1,590)	1,859 (5,315) 345 (1,164)	1,667 (2,780) 611 (1,603)	2,188 (6,340) 340 (1,458)	147 (1,057) 11 (531)	329 (1,860) 0 (321)
Total Visits (#)	4.49 (5.01) 3 (6)	4.92 (6.51) 3 (4)	4.17 (4.21) 2 (7)	4.77 (5.35) 3 (5)	0.28 (0.75) 0 (2)	0.45 (0.85) 0 (3)
Office Visits (#)	4.11 (4.41) 3 (5)	4.05 (4.09) 3 (4)	3.95 (3.92) 2 (5)	4.32 (4.48) 3 (4)	-0.15 (3.30) 0 (2)	0.28 (3.60) 0 (2)
ER Visits (#)*	0.17 (0.60)	0.03 (0.17)	0.05 (0.37)	0.06 (0.30)	-0.12 (0.72)	0.03 (0.35)
Inpatient Stays (#)*	0.22 (0.94)	0.85 (4.27)	0.17 (0.89)	0.38 (1.88)	-0.05 (1.16)	-0.46 (4.30)

Digital Engagement

Know Your Patients Technology Needs



Improving Digital Engagement

Behavioral science factors for long-term engagement

Habit Formation

Social Motivation

Goal Reinforcement

Device related factors

- Design, aesthetics, out-of-the box experience
- Fit and form factor
- User experience and lifestyle compatibility

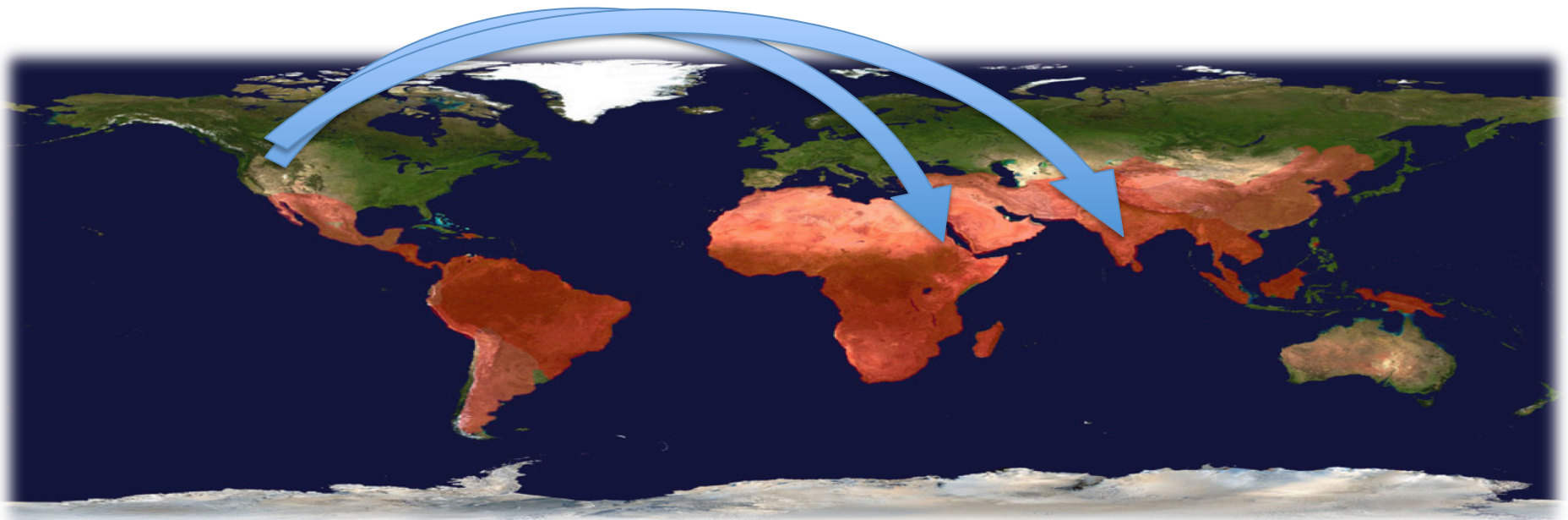
Digital Engagement Patient Participation



Cho MJ. Healthc Inform Res 2014

Bhavnani S. Mobile Health Revolution in Cardiovascular Medicine (2015)

Improving Healthcare Access with mHealth



Point-of-Care mHealth Devices



Smartphone connected
Blood Pressure Monitor*



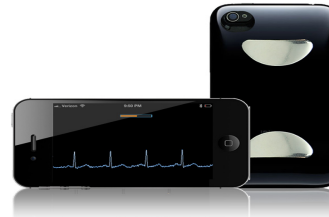
Smartphone connected
Oxygen Monitor



Smartphone connected
Glucometer*



Handheld Pocket
Mobile Ultrasound*



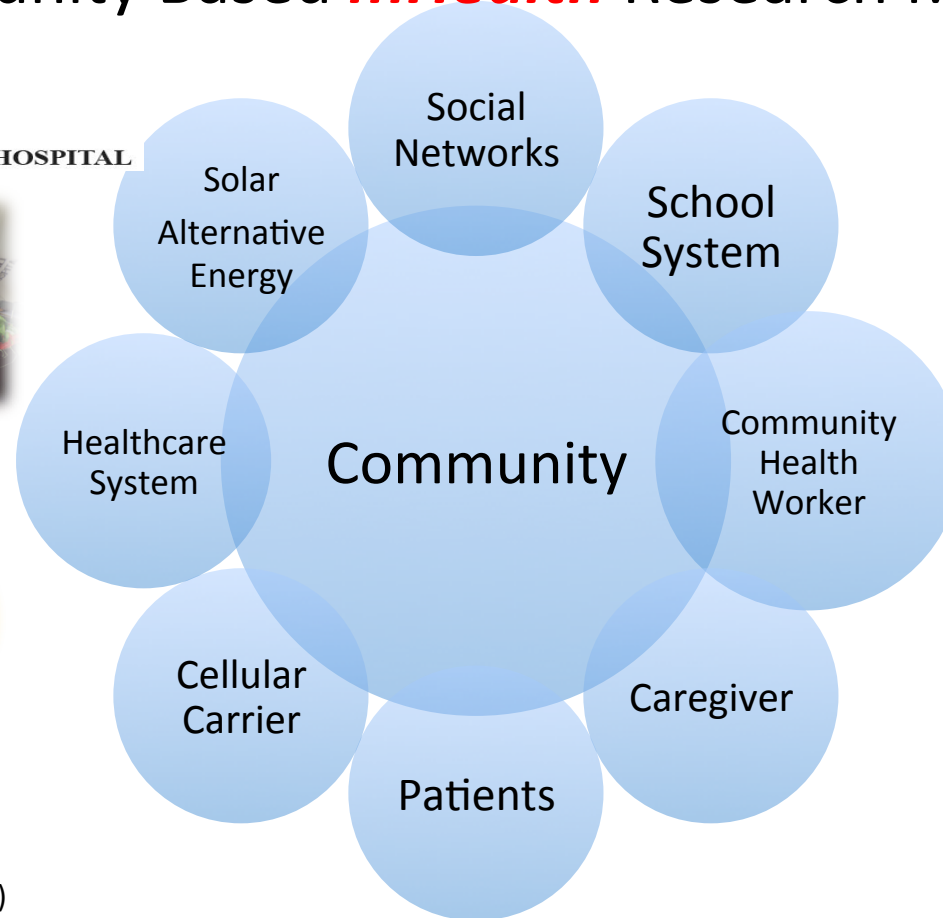
Smartphone Heart Rhythm
iECG*



iOS Devices

Community Based *mHealth* Research Model


KABALE REGIONAL REFERRAL HOSPITAL

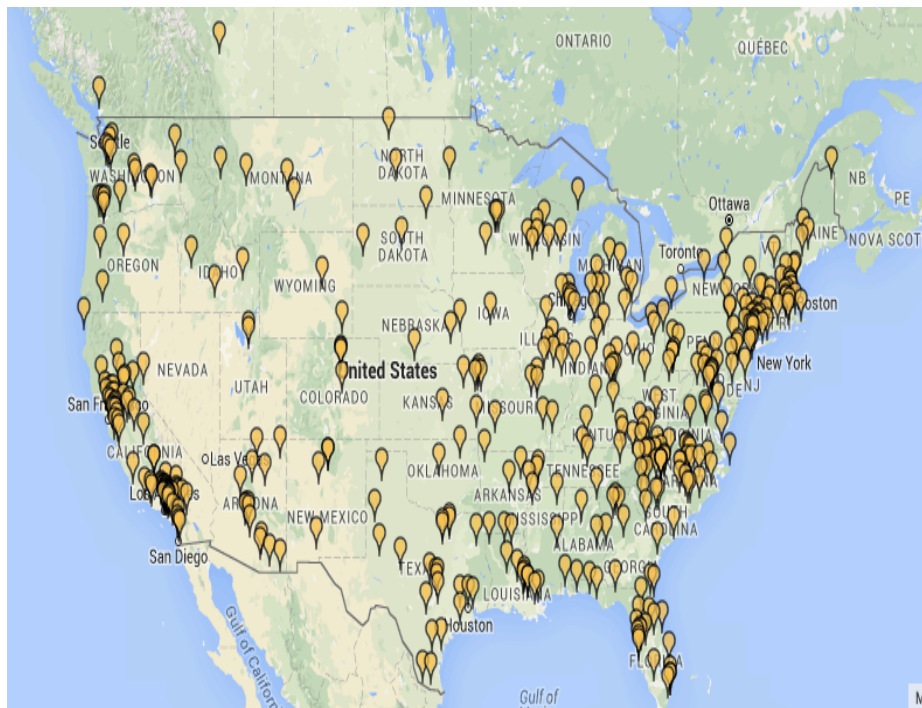


Community Based mHealth Participatory Model

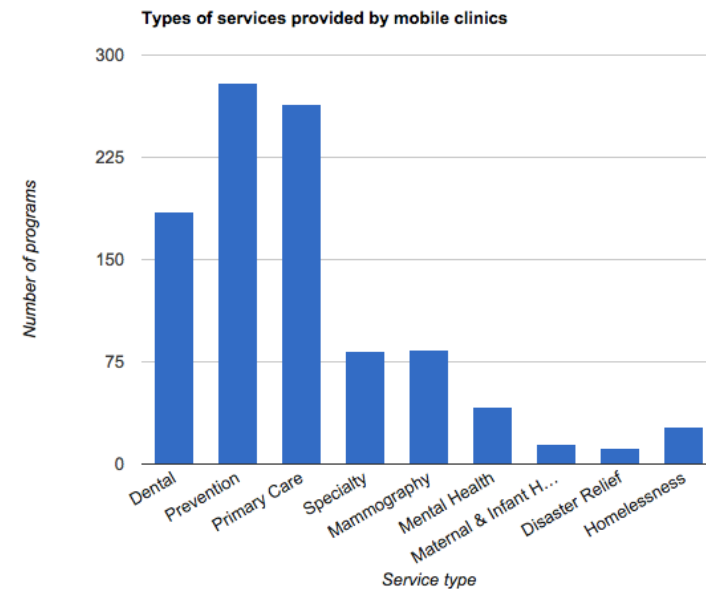
mHealth Clinics



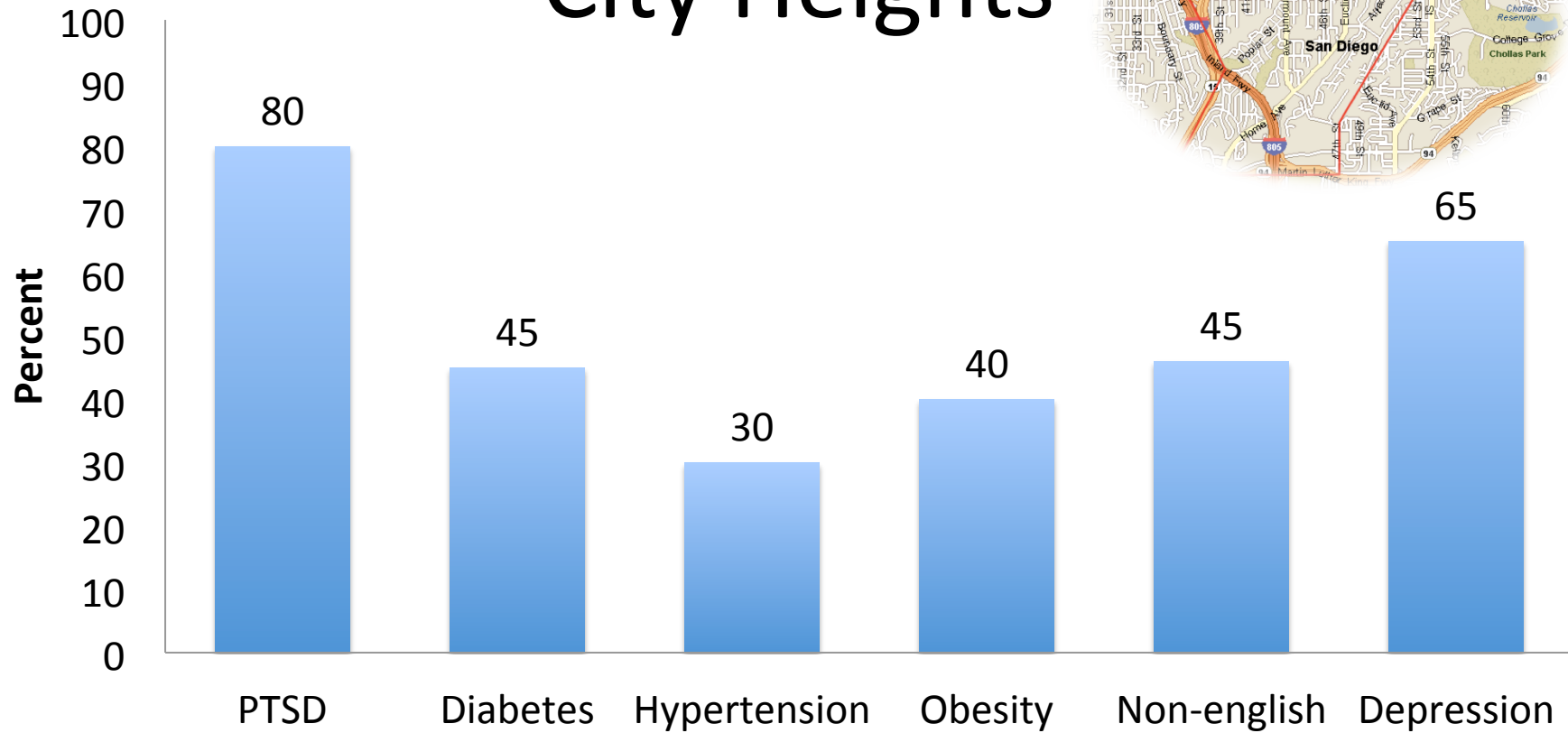
Mobile Health Map – United States



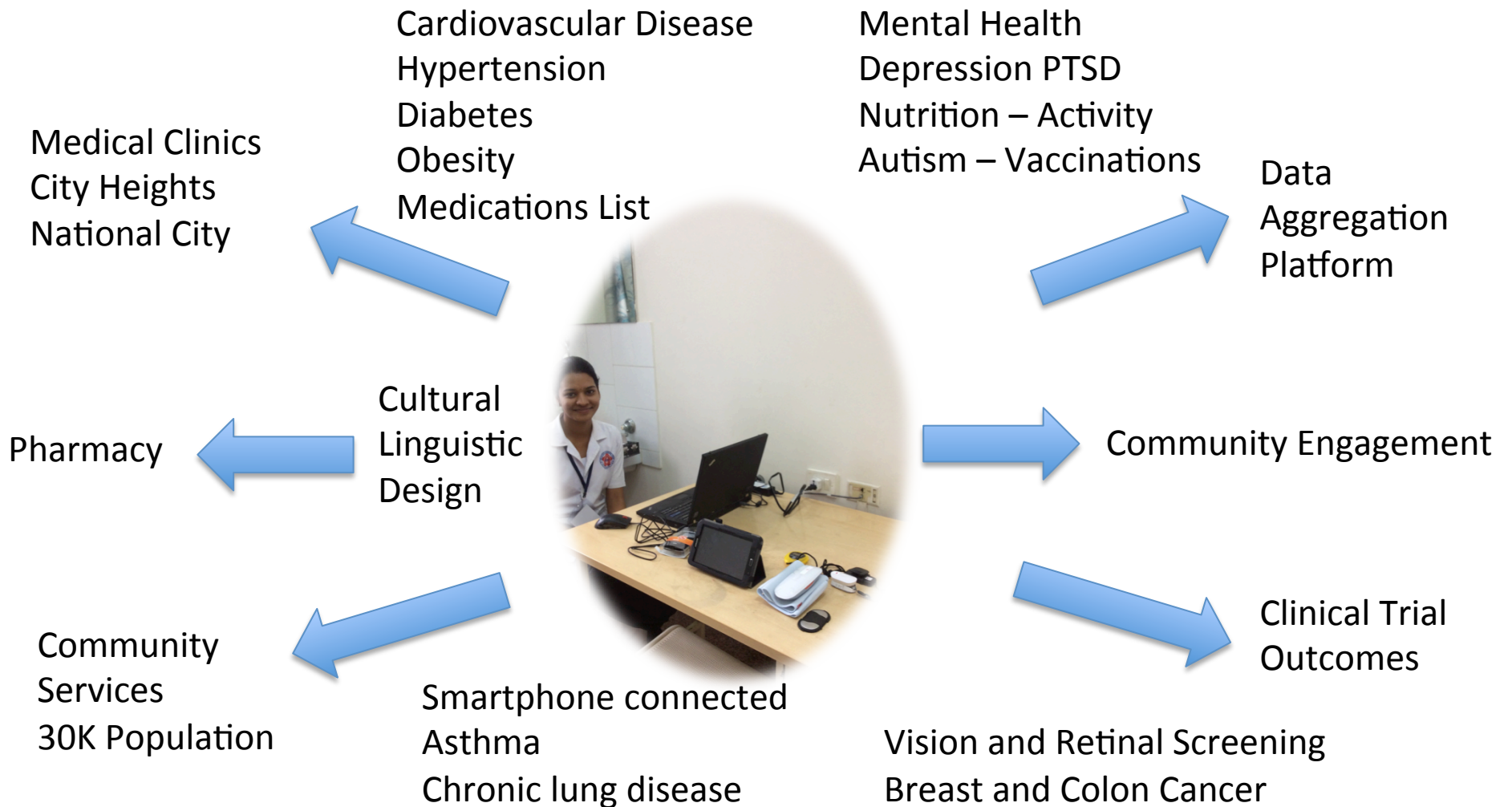
**Number of Mobile Health Clinics >1500
>5 Million visits annually**



City Heights



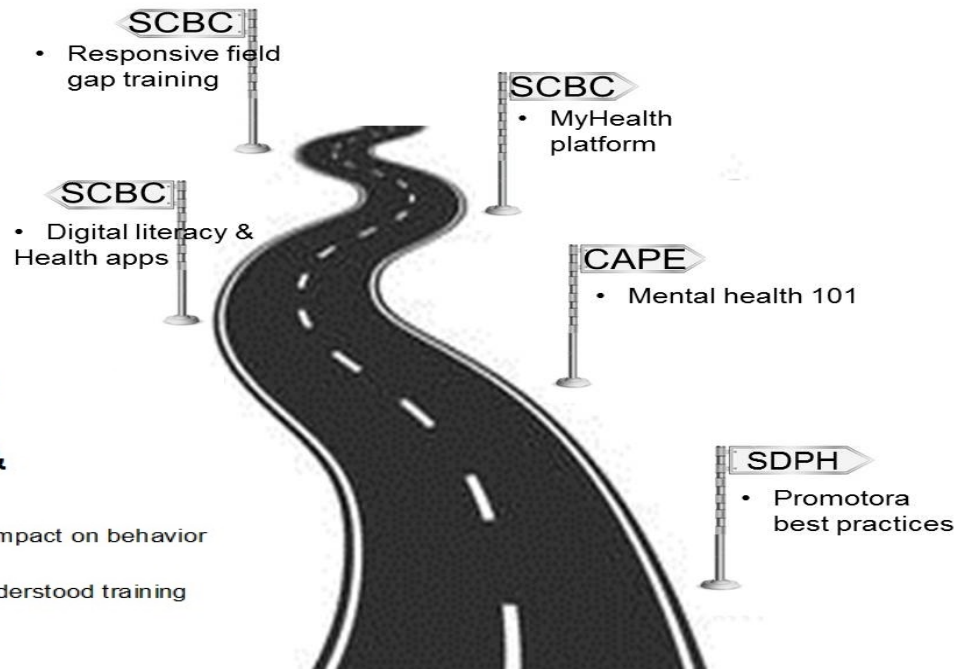
Somali Family Services (n=1,200 participants)



Technology Training

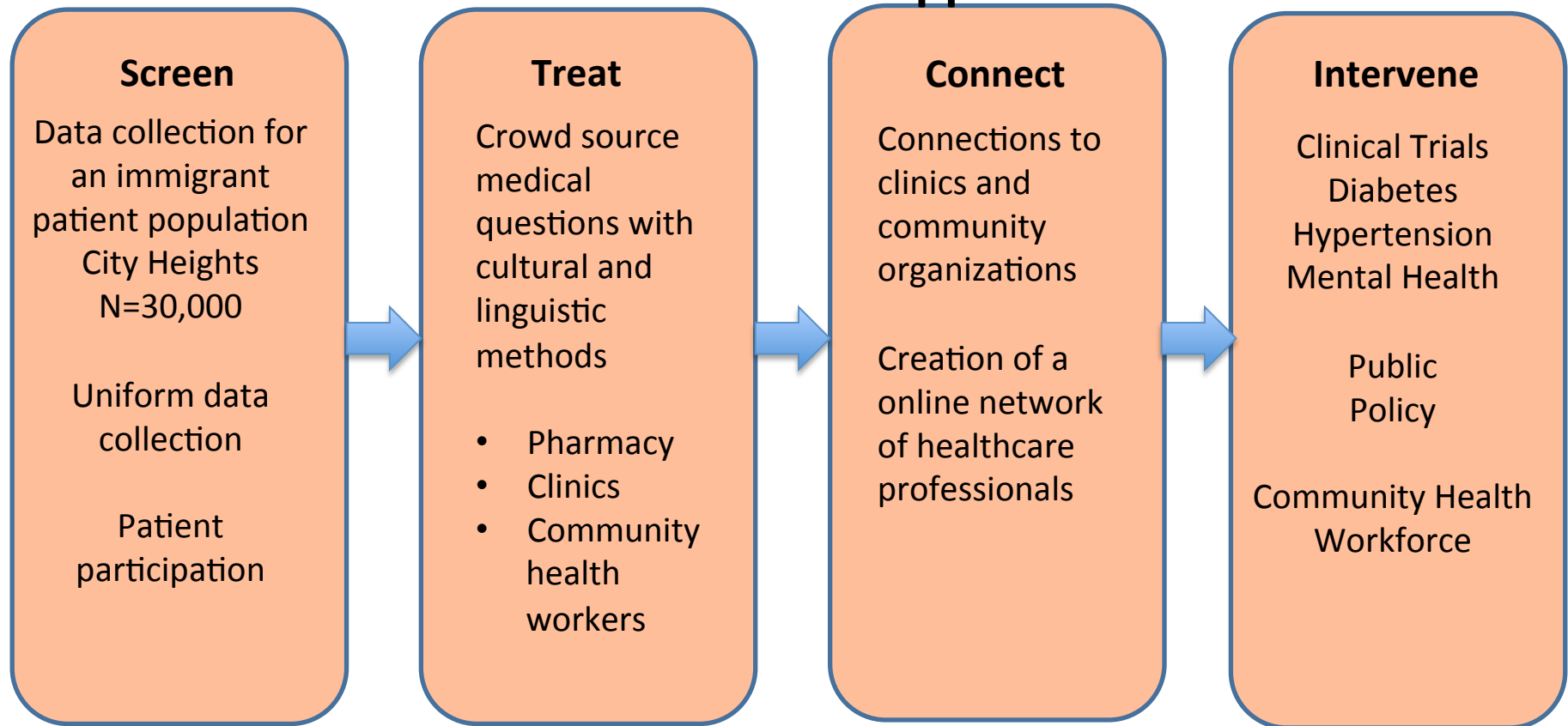


Field-tested dHealth Training Model for Community Health Workers:
60% increase in client's comprehension & positive behavior impact



Community Health Worker Training

Digital Health & Underserved Populations Multidimensional Approach






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Scripps Clinic & Research Institute

@SanjeevBhavnani 



Backup Slides

#SoMe (Social Media)








 P S
@the


My Chantix is givin me really bad rashes on my legs, and it itches so bad. #fml

 Reply  Retweet  Favorite  More

8:02 PM - 7 Feb 13

 →  **pruritus**
MedDRA
10037087

visual snow dont want to eat cross vision lost my appetite
apetite surpressed googley eyed no appetitey doublevision
blind appetite is nonexistent blurry vision miss feeling hung
inorexic double vision #notevenhungry blindness cant eat
uldn't see making me eat like a mouse vision change blurry
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can't eat killed my apetite googly eyed lost teh appetite
lost apetite crosseved killed my appetite seeing weird cou
cross eved seeing weird colour stomach small changes in vis
lack of apetite never want to eat seeing weird color never h

Typos

visual snow dont want to eat cross vision lost my appetite
apetite surpressed googley eyed no appetitey doublevision
blind appetite is nonexistent blurry vision miss feeling hung
inorexic double vision #notevenhungry blindness cant eat
uldn't see making me eat like a mouse vision change blurry
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can't eat killed my apetite googly eyed lost teh appetite
lost apetite crosseyed killed my appetite seeing weird cou
cross eyed seeing weird colour stomach small changes in vis
lack of apetite never want to eat seeing weird color never h

Visual Impairment

MedDRA 10047571

Visual impairment

SNOMED 397540003

Decreased appetite

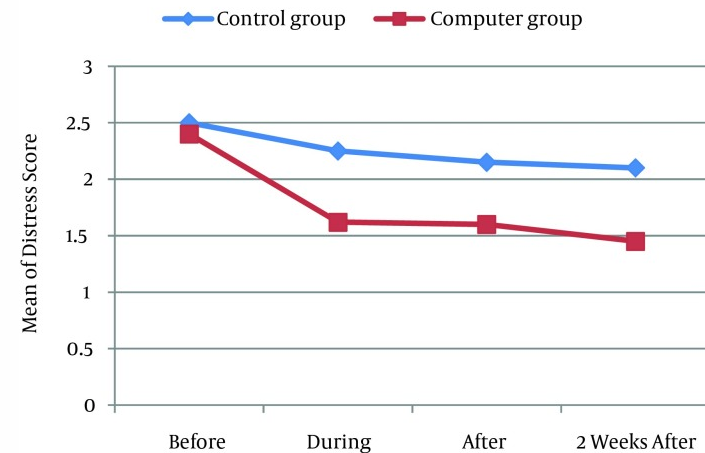
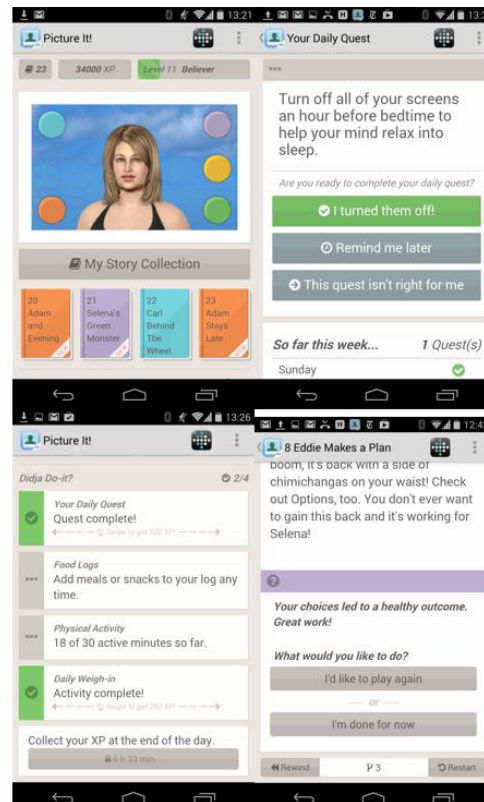
MedDRA 10061428

Loss of appetite

SNOMED 79890006

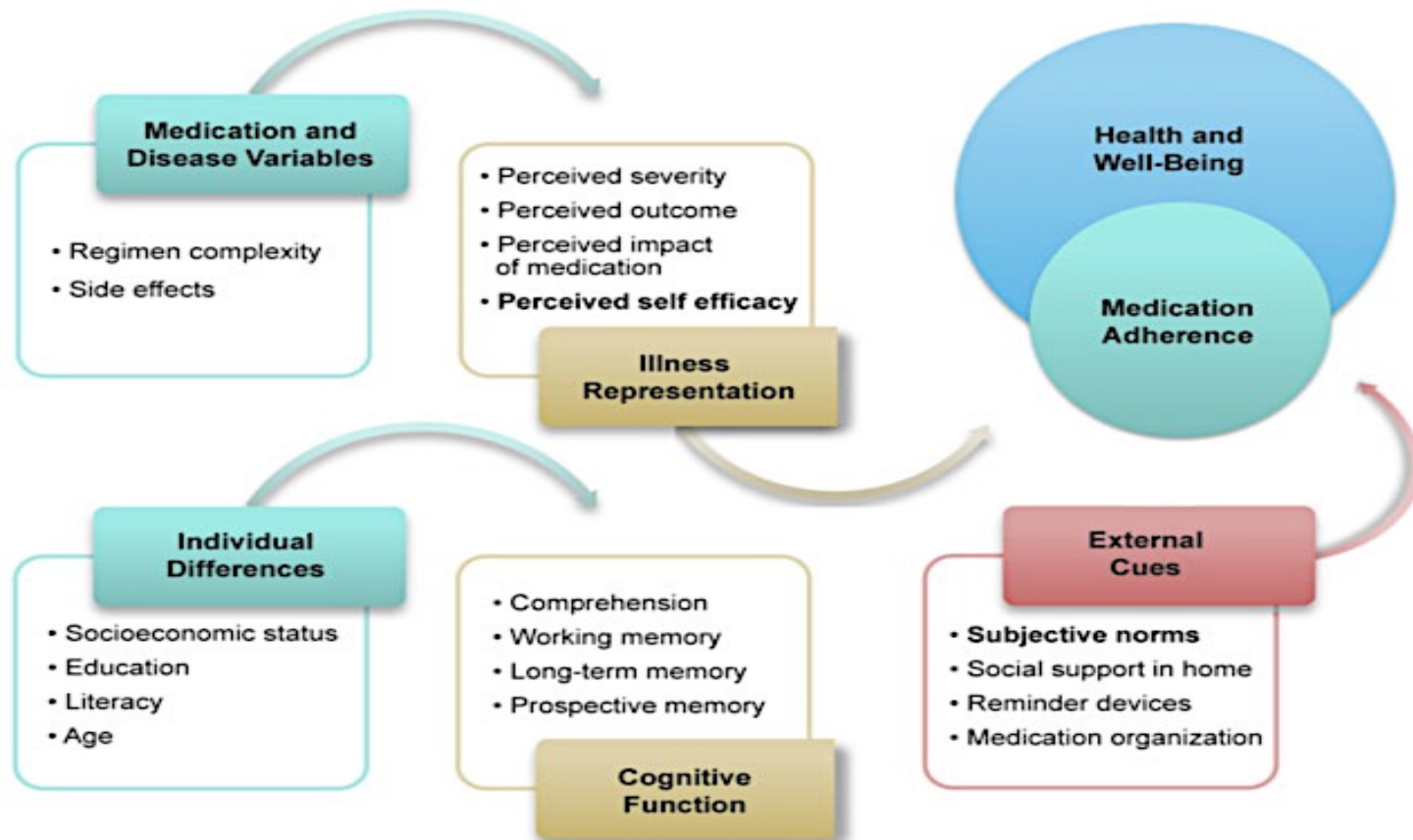
Interactive Patient Participation

Gamification



Kamel Boulos MN, Digital games for type 1 and type 2 diabetes: underpinning theory with three illustrative examples. JMIR Serious Games. 2015

Digital Health for Behavioral Change



Conceptual Framework of Medication Adherence Derived from the Health Belief Model