



Scripps Translational
Science Institute



mHealth: Enabling the Re-engineering of Healthcare

Steven R. Steinhubl, MD December 1, 2015



What is mHealth?

“mHealth (or mobile health) is the use of mobile or wireless devices to improve health outcomes, healthcare services and health research.”

-NIH Consensus group



mHealth: Enabling the Re-Engineering of Healthcare

- 1. Technology progress, in perspective.**
- 2. Where can mHealth make a difference?**
- 3. The changing landscape of healthcare.**
- 4. Challenges to adoption.**

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ASCI Red



- World's fastest super-computer in 1996 – *1.8 teraflops/sec* (1.8 trillion operations /sec)
- \$55 million to develop.
- Occupied 1,600 square feet of floor space.
- Used 800 KW/hr (~800 homes)



- 2006 – 1.8 teraflops/ sec
- \$500
- 200 watts
- 64 million units sold



Deep Blue



May, 1997
IBM's Deep Blue beat World Chess Champion Garry Kasparov.

Stockfish Chess

By Tord Romstad

Open iTunes to buy and download apps.

[View More by This Developer](#)



Description

Strong free chess program.

Features:

[Tord Romstad Web Site](#) [Stockfish Chess Support](#)

[...More](#)

What's New in Version 2.7.0

NOTE: Unfortunately, there's an annoying bug in this version. Every game you look at in the nifty new game preview widget will cause the performance to degrade somewhat, until you exit and restart the program. A new version that corrects this bug will be available soon.

[...More](#)

[View in iTunes](#)

This app is designed for both iPhone and iPad

Free

Category: Games
Updated: Sep 26, 2013
Version: 2.7.0
Size: 17.1 MB
Language: English
Seller: Tord Romstad
© 2009–2013 Tord Romstad, Marco Costalba, Joona Kiiski
[Rated 4+](#)

Compatibility: Requires iOS 7.0 or later. Compatible with iPhone, iPad, and iPod touch.

Screenshots





2012

OCTOBER 30, 2012, 7:11 PM | 11 Comments

I.B.M.'s Watson Goes to Medical School

By STEVE LOHR

FACEBOOK

TWITTER

GOOGLE+

E-MAIL

SHARE

PRINT

Next up for Watson, I.B.M.'s clever [question-answering computer](#)? A stint as a medical student at the [Cleveland Clinic Lerner College of Medicine of Case Western Reserve University](#).



I.B.M., via Agence France-Presse — Getty Images

Watson, I.B.M.'s question-answering computer.

The collaboration, announced on Tuesday, includes a bit of controlled crowdsourcing, with the Cleveland clinicians and medical school students answering Watson's questions and correcting its mistakes.

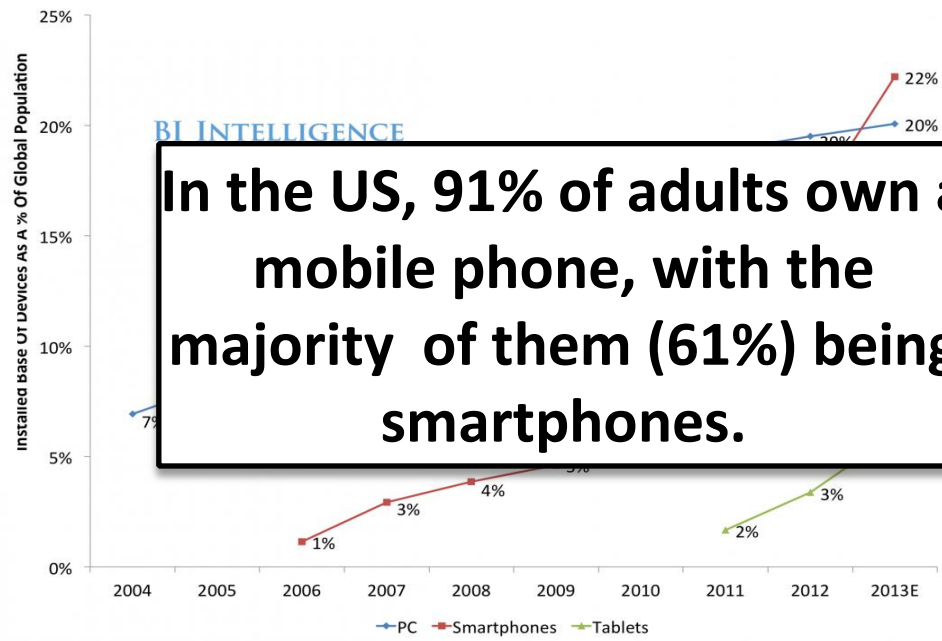
Watson is now "...the size of three pizza boxes stacked up. It's also 24 times faster and has seen a 2,400 percent improvement in performance."

Mobile phone subscriptions per capita





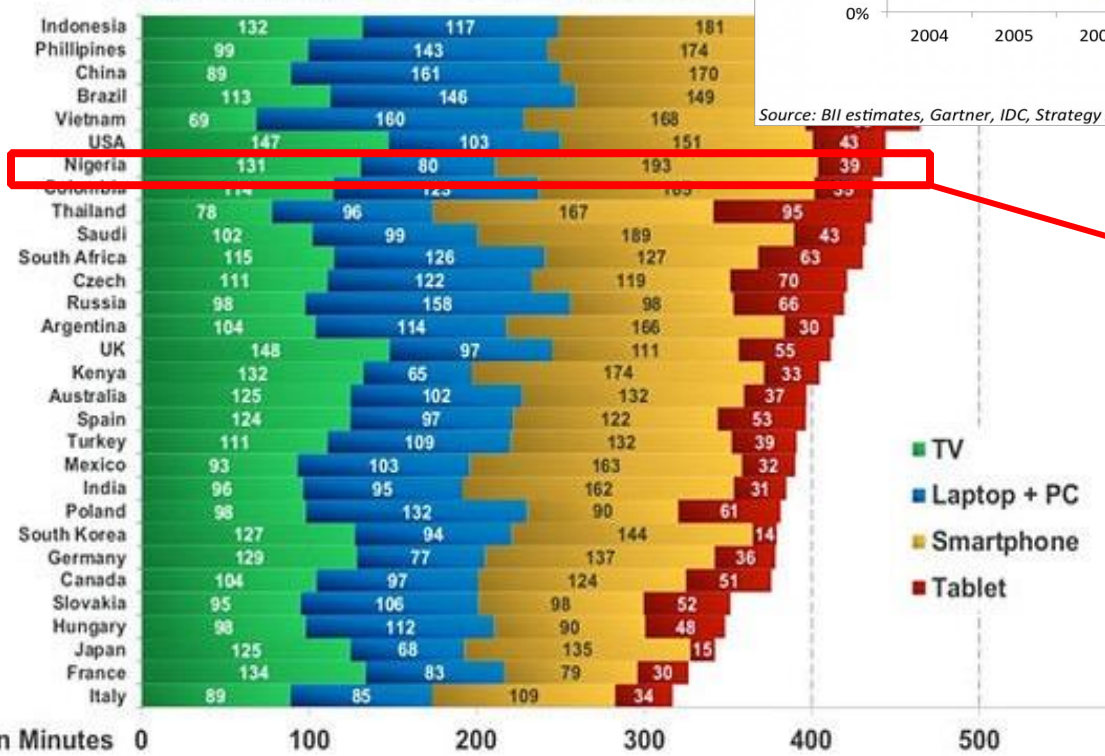
Global Device Penetration Per Capita



BI INTELLIGENCE

In the US, 91% of adults own a mobile phone, with the majority of them (61%) being smartphones.

Daily Distribution of Screen Minutes Across

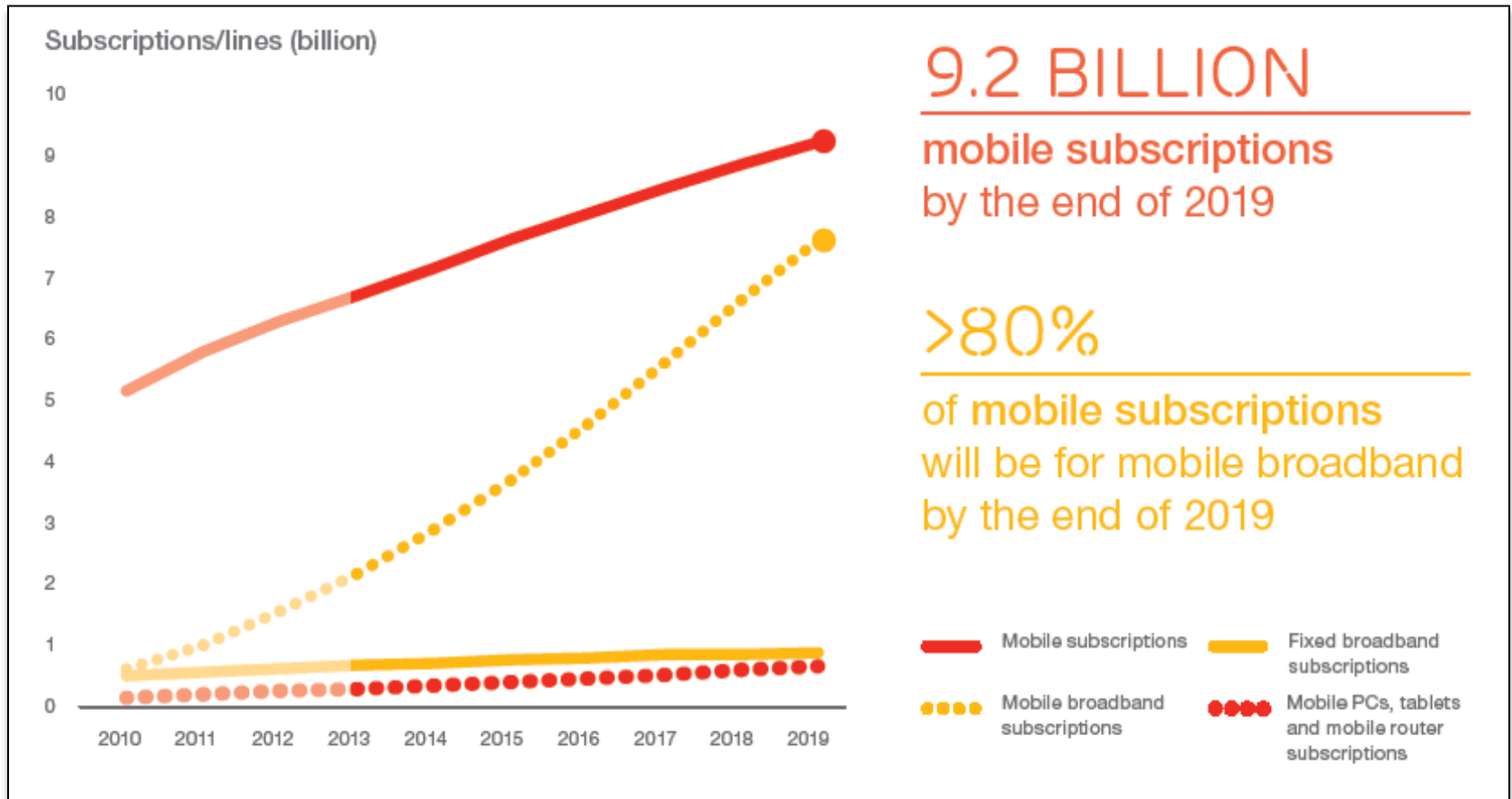


Source: BII estimates, Gartner, IDC, Strategy Analytics, company filings, World Bank 2013

194 minutes a day looking at smartphone or tablet screen. 147 looking at TV, 103 at laptop or PC.

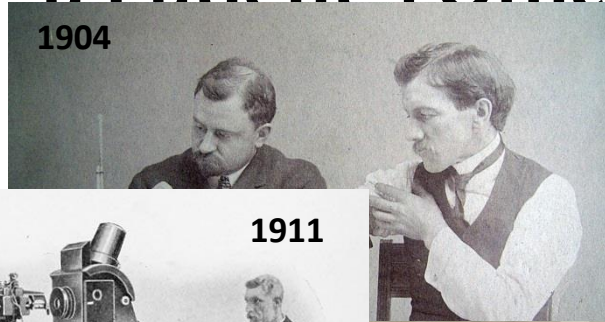
<http://www.nydailynews.com/news/world/chuck-contrasting-pics-st-peter-square-article-1.1288700#ixzz2ePFO9300>

Projected Worldwide Growth in Mobile & Smartphones



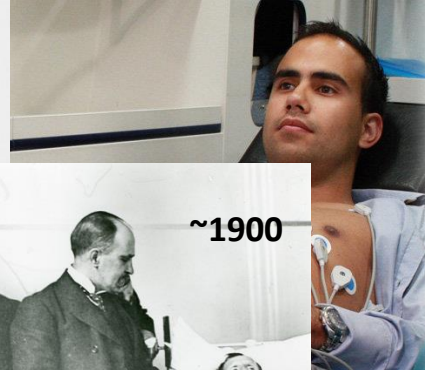
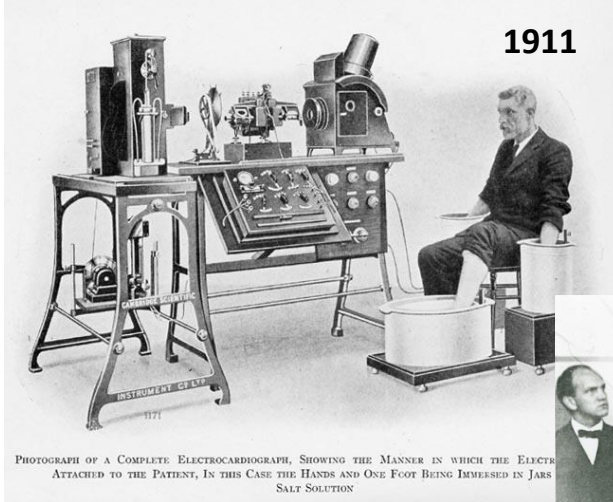
A Historical (and Present Day) Look at Our Tools for a Patient's Office Visit

Blood Pressure



- Sphygmomanometer invented 1881.
- Popularized by Harvey Cushing 1901

ECG



- Willem Einthoven 1901.
- Precordial leads introduced 1944

Physical Exam/Auscultation



- Laënnec 1816.
- Binaural stethoscope 1851

House Calls

- In 1930's ~40% of all patient encounters were in their home.

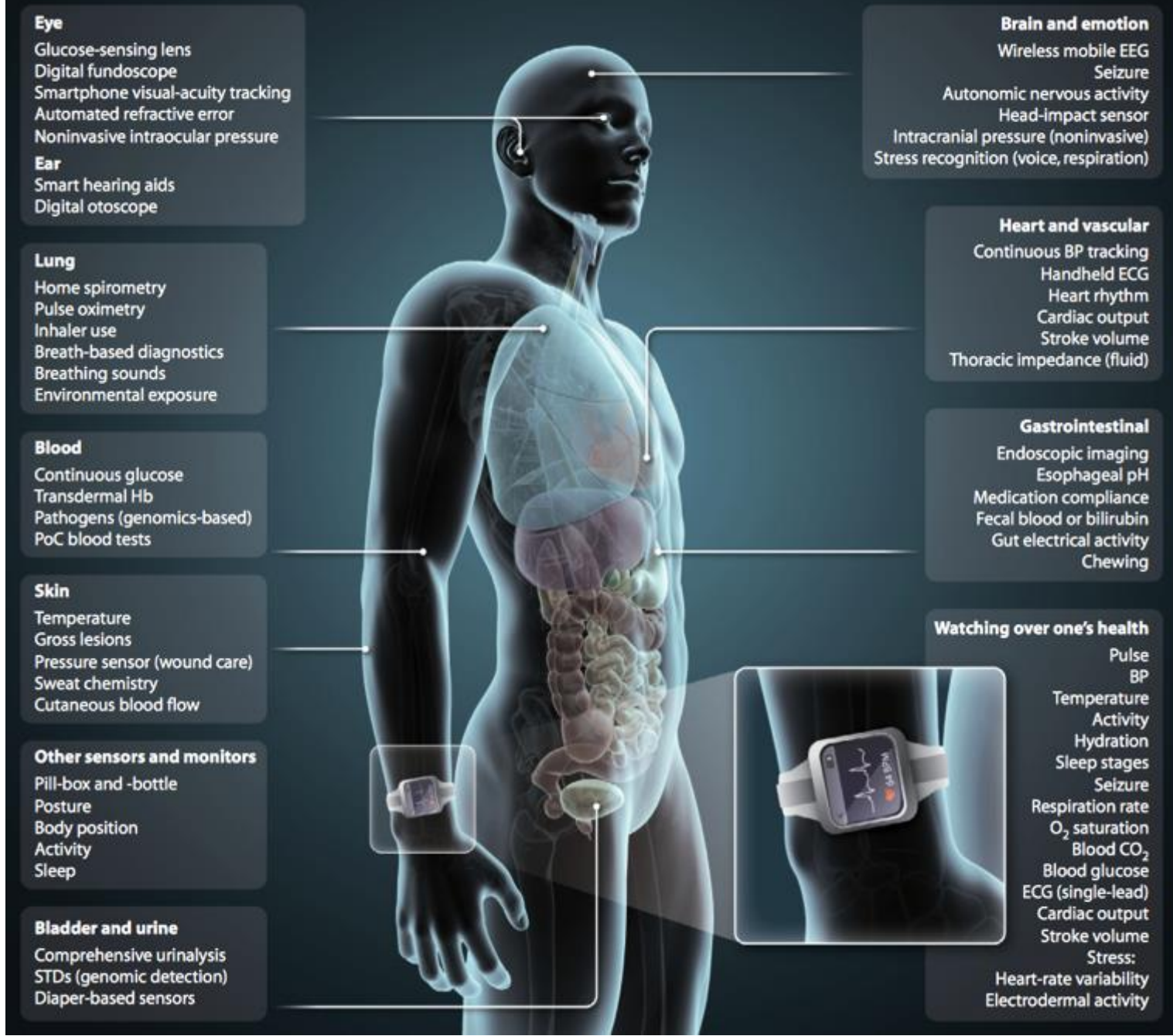
"You're like part of the family, Doctor!"

• Doctor, yes—doctor of the science of medicine and surgery, with all the knowledge and skill that his years of training and experience provide.
But your doctor is more than that:
He is a wise counselor to old and young. He is a loyal and understanding friend to all.
He is, indeed, "like part of the family."



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The Near Future of Wearable Sensor Data

1. Activity



11. Temperature

12. Hydration

13. Glucose (?)

Oura Ring



Measures:

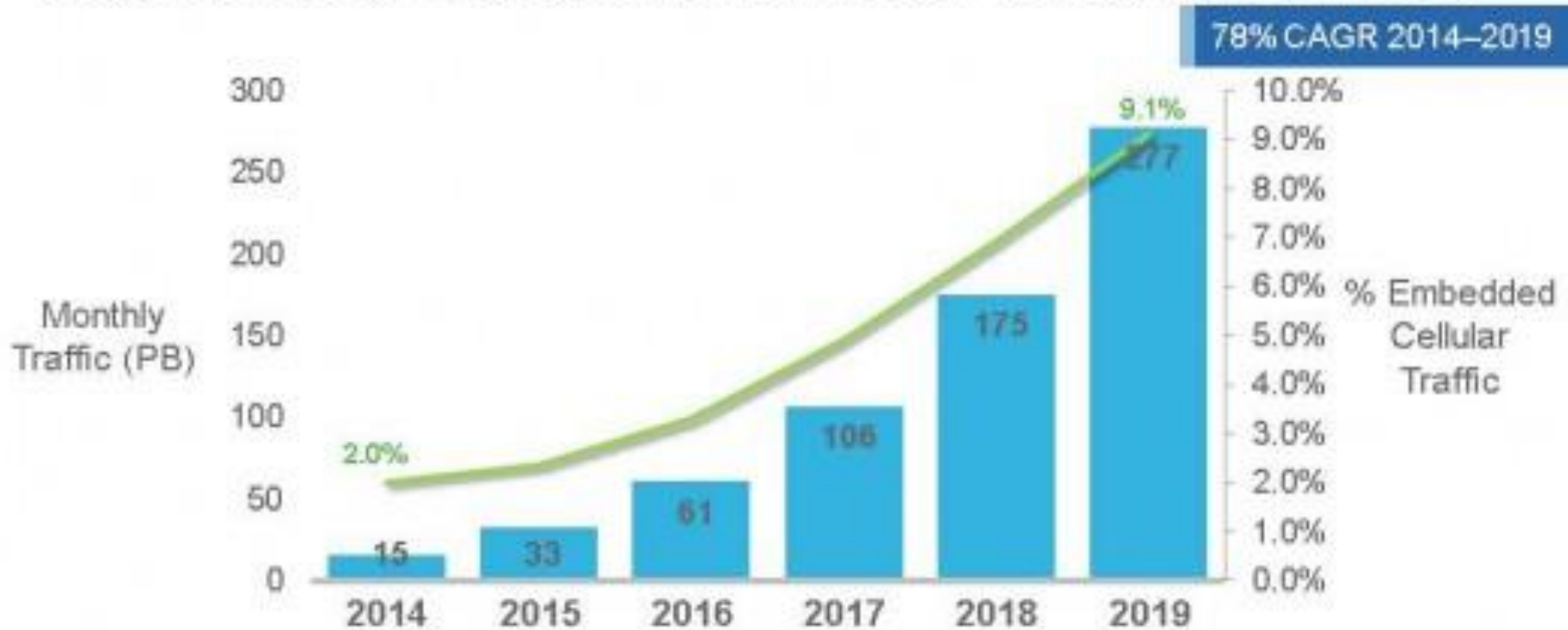
- Heart rate
- Respiration rate
- Body temperature
- Movement.

Algorithms interpreting sleep cycles closely match analysis done at sleep laboratories.

Predicted Growth in Wearables

Global Connected Wearable Devices Traffic

Global Connected Wearables Traffic will Grow 18-Fold from 2014-2019



Source: Cisco VNI Global Mobile Data Traffic Forecast, 2014–2019

Gartner's 2014 Hype Cycle for All Emerging Technologies



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By NEIL VER

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Permanente Medical Group CEO: Video, big data are the future. Wearables, not so much.

By: [Jonah Comstock](#) | Oct 29, 2015

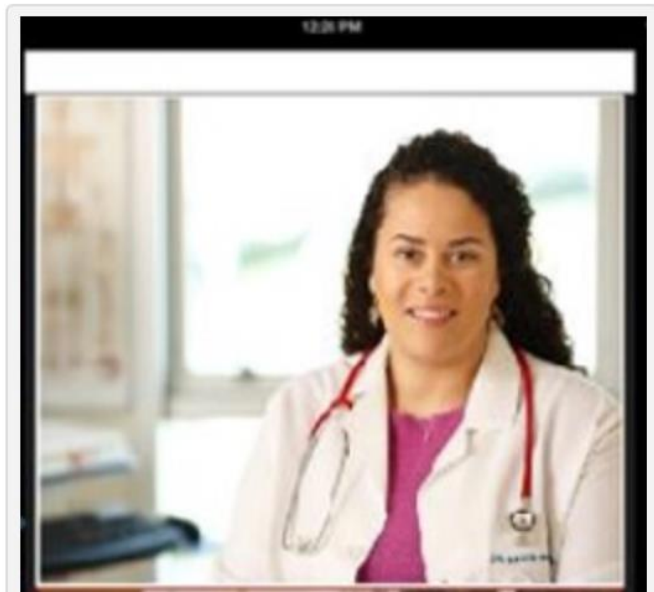
Tweet 74

Share 12

Share 15

Tags: [big data](#) | [Kaiser Permanente](#) | [Partners Connected Health Symposium](#) | [Partners Connected Health Symposium 2015](#) | [Partners Healthcare](#) | [video visits](#) | [wearables](#) |

Doctors, technologists, and entrepreneurs have a lot of different visions of the future of medicine, and they don't always line up. Dr. Robert Pearl, the Executive Director and CEO of The Permanente Medical Group, part of Kaiser Permanente, thinks some digital health offerings — like video visits — will revolutionize medicine. Others — like health monitoring wearables — are going nowhere, he told the crowd at Partners HealthCare Connected Health Symposium.



Dr. Ezeki

"I don't think very many of us want to have a thousand continuous traces of the patient's heart rhythm, and the last place we want it is inside the

NEWS? SEND

Zapatilla Azul Livingston Pullar
\$ 1,089

COMPRÁ

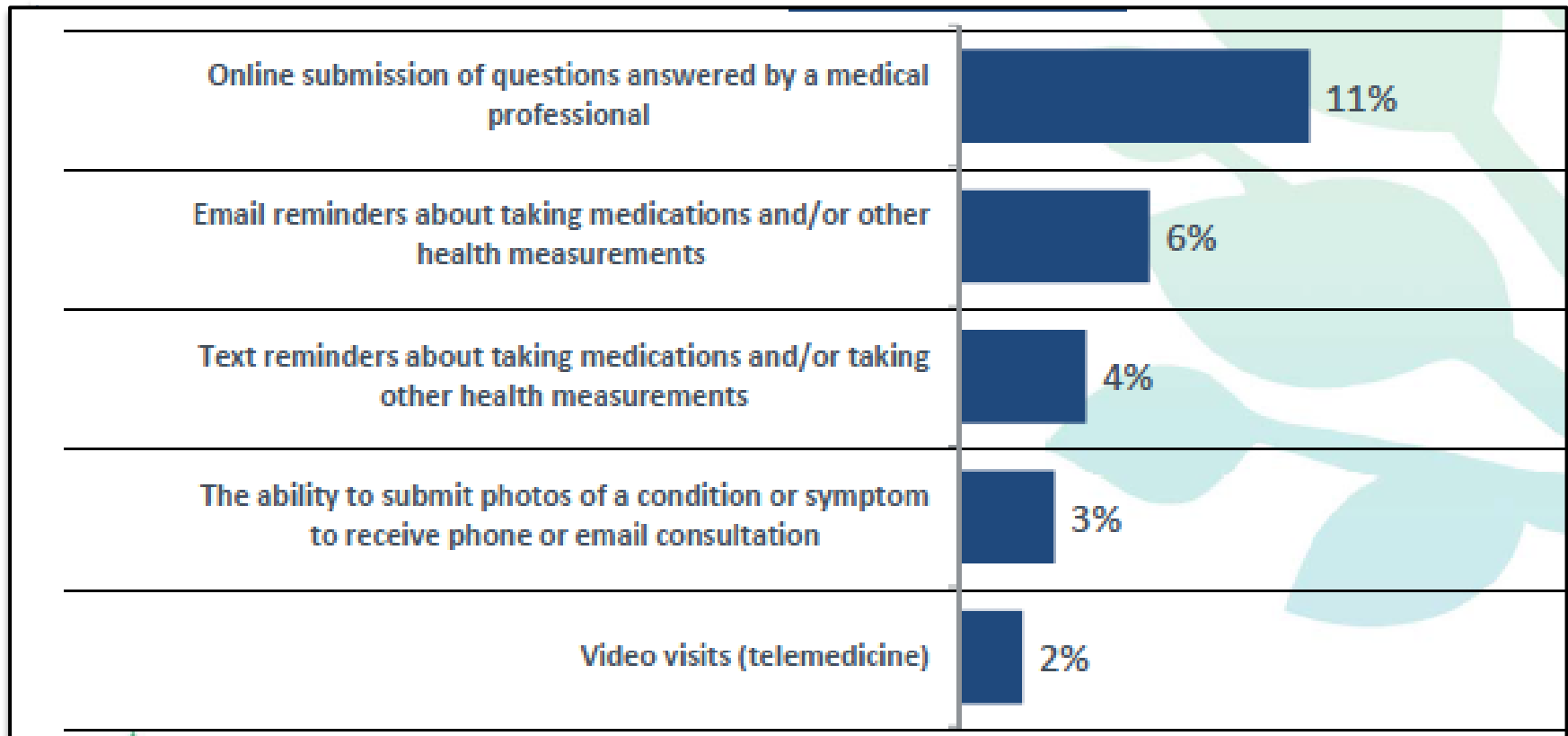
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anslational

There Remain Huge Gaps in People-Centered Care Availability

Online survey of 5,014 US adults

Access to Interactions with Primary Care



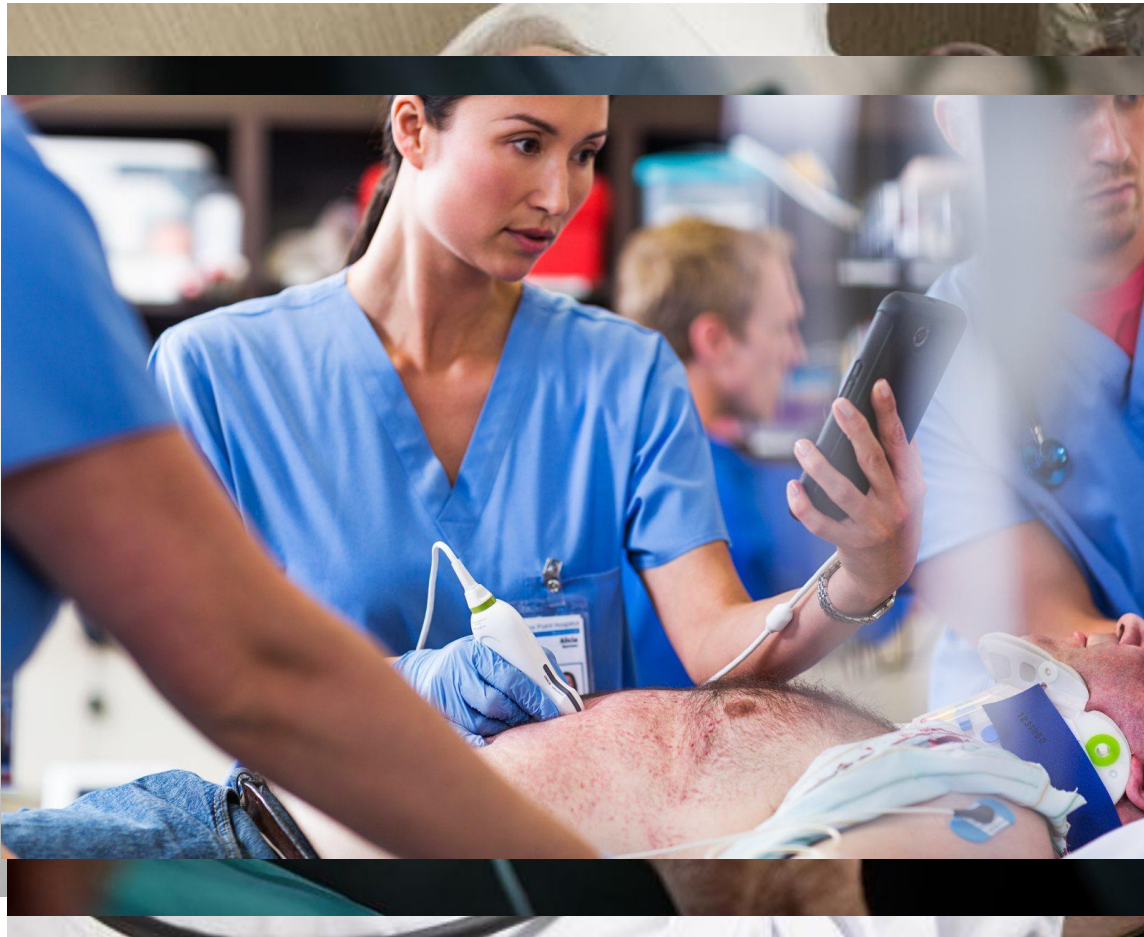
Acute Diagnostics, When and Where They are Needed

More than a million people are searching on Google for information on ear infection at 4:30 a.m. every morning

Ryan Olohan, Industry Director, Healthcare. Google Inc.
October 2015



The Stethoscope as a Relic of the Past

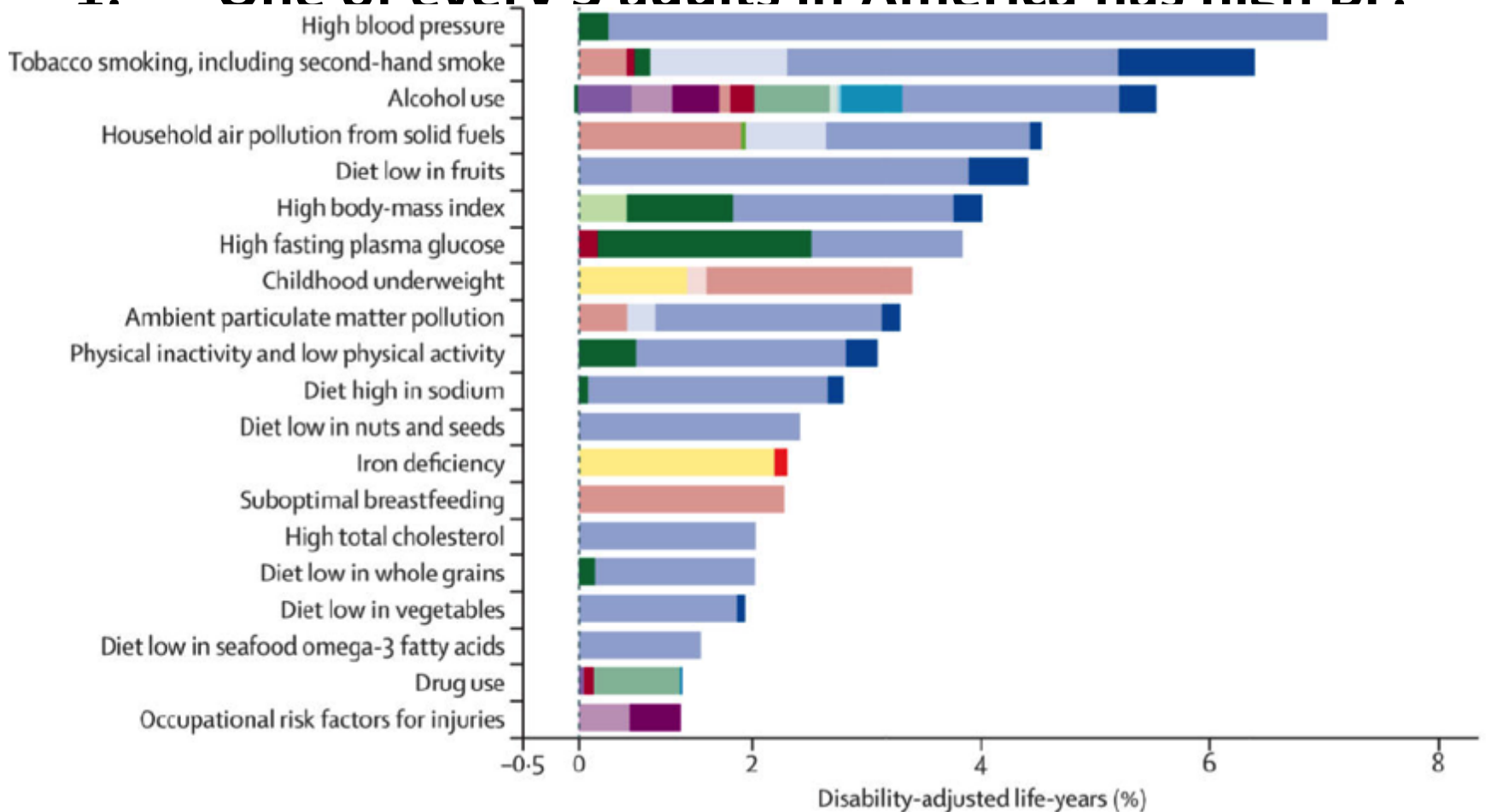


**Auscultation skills in 860 providers:
Trainees thru Faculty**

	Sensitivity	Specificity
Systolic	84%	35%
Diastolic	49%	67%

Global Burden of Disease Attributable to 20 Leading Risk Factors (2010)

1. One of every 3 adults in America has high BP.¹



1. WHO. Morbidity and mortality weekly report 2011;00(4):103-108.

2. Heidenreich PA. Circulation 2011;123(8):933-944.

3. National Ambulatory Medical Care Survey: 2010 Summary Tables.

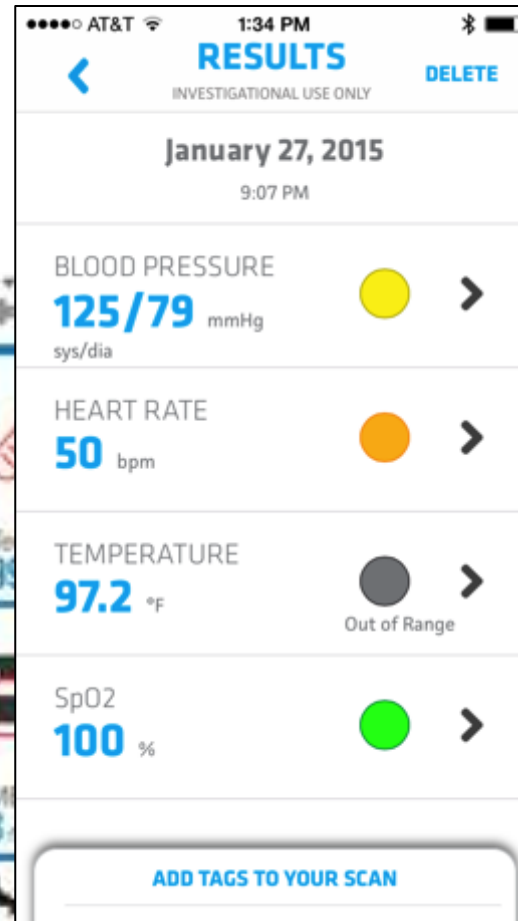


Improved Blood Pressure Control with Self-Monitoring and Self-Treatment

Blood Pressure, mm Hg

	Baseline		6 Month		12 Month		Difference ^b	
	No. of Patients	Mean (95% CI) ^a	No. of Patients	Mean (95% CI) ^a	No. of Patients	Mean (95% CI) ^a	6 Month	12 Month
Systolic Blood Pressure Complete Case								
Usual care	230	143.6 (141.9-145.4)	225 ^c	138.1 (136.0-140.3)	230	137.8 (135.4-140.3)	6.1 (2.9-9.3)	9.2 (5.7-12.7)
Intervention	220	143.1 (141.4-144.9)	215	131.8 (129.6-134.1)	220	128.2 (125.9-130.4)		
Diastolic Blood Pressure Complete Case								
Usual care	230	79.5 (78.3-80.8)	225 ^c	77.2 (75.9-78.5)	230	76.3 (75.0-77.6)	3.0 (1.4-4.7)	3.4 (1.8-5.1)
Intervention	220	80.5 (79.2-81.8)	215	75.3 (74.0-76.6)	220	73.8 (72.6-75.0)		

Simplified and Connected HTN Management

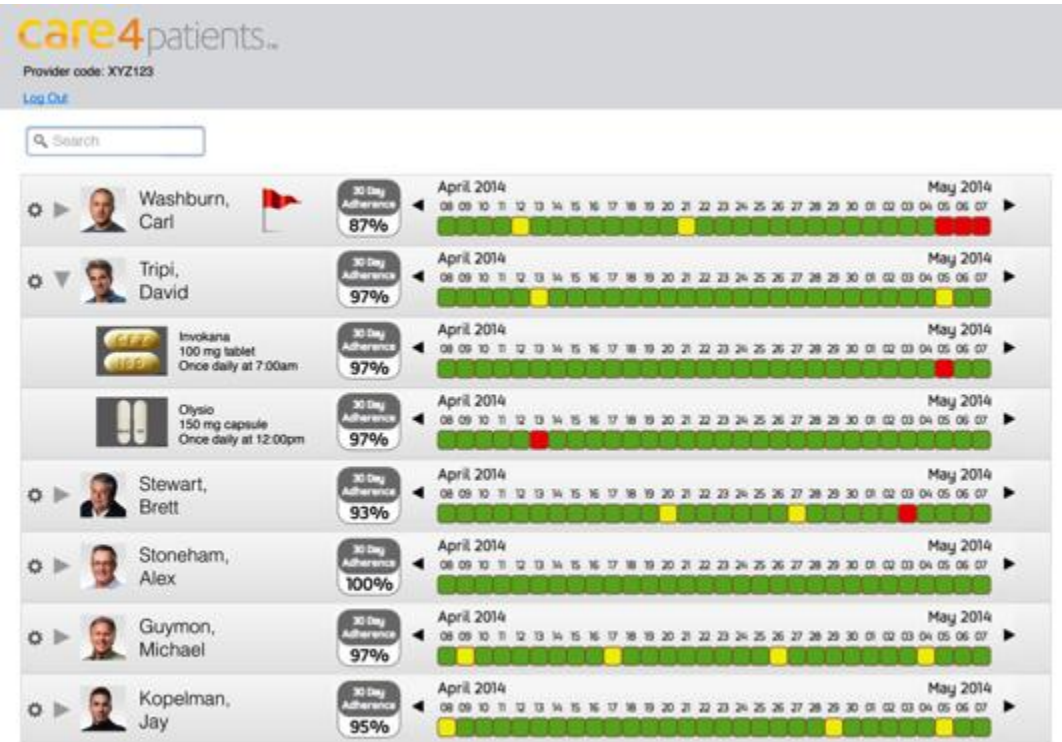




Healthcare Team



Physician, nurse,
pharmacist, dietician,
physical therapist, IT...

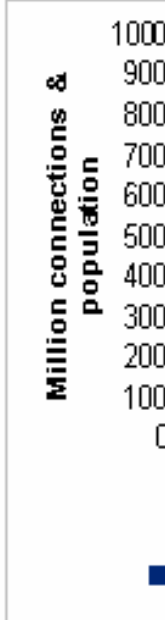


Personalized Predictive Analytics
Automated Clinical Decision Support



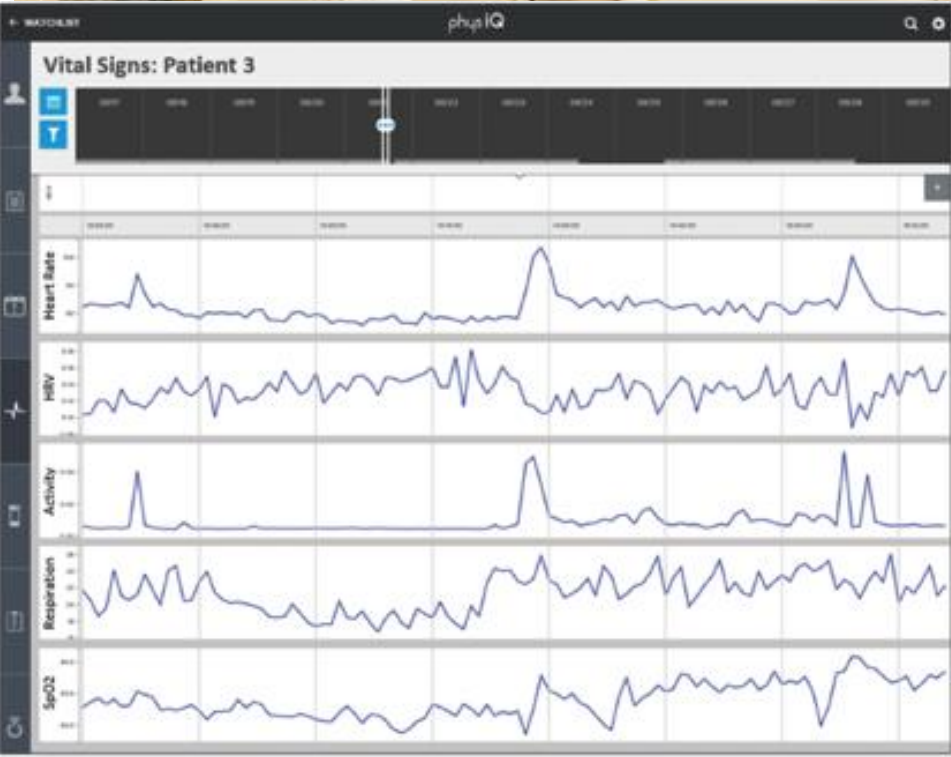
Learning Healthcare System

Mobile Phone Penetration in Sub-Saharan Africa



Source: W



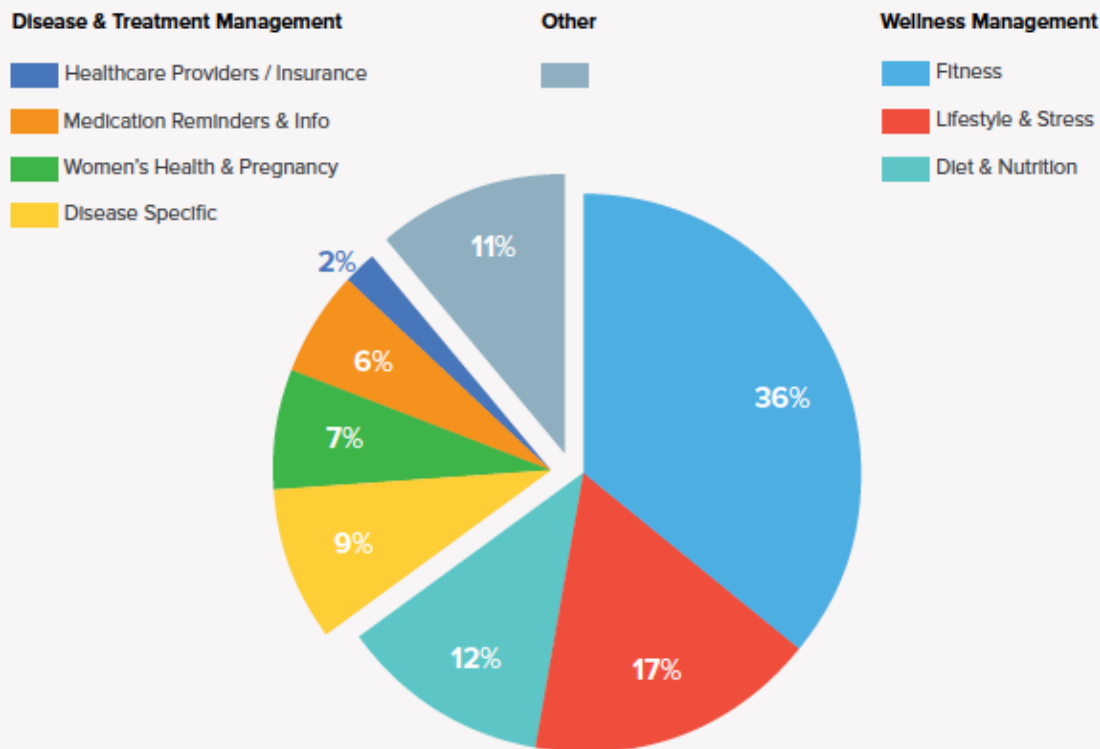


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Separating the Wheat from the Chaff When There is Mostly Chaff

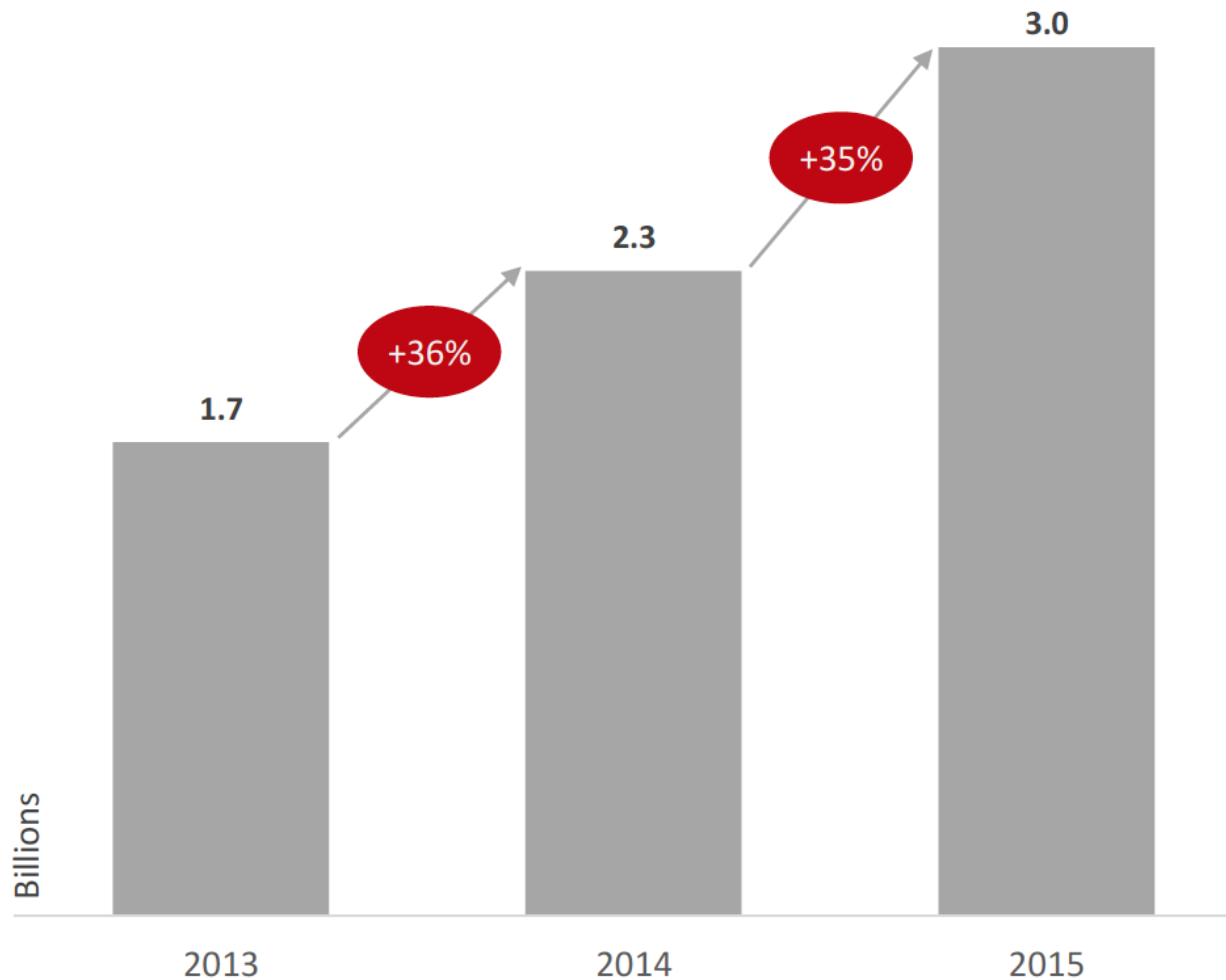
Number of Health Related Apps Now >165,000



- 100% increase in the number of iOS apps over last 2 years
- Only 0.02% (36) of all apps account for 50% of downloads.
- Only 2% provide connectivity with provider healthcare systems.

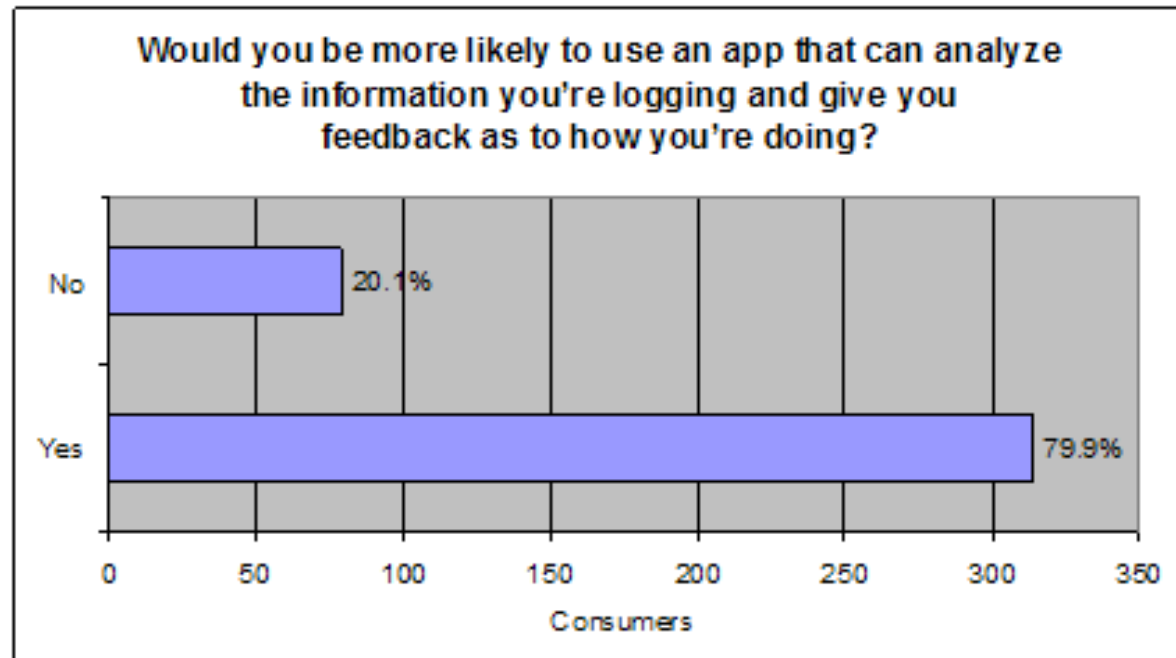
Source: Mevvy, June 2015; IMS Health, AppScript, June 2015; IMS Institute for Healthcare Informatics, August 2015

Estimated Total Downloads of mHealth Apps (billions)



Online Consumer Survey of 395 Respondents

- 26% of apps are downloaded and used only once.
- Of the people who confirm using their apps, 74% drop out by the 10th use.
- Also showed that 26% of smartphone apps retain consumer loyalty.



Digital Snake Oil

ULTIMEYES®

A simple-to-use interactive game scientifically shown to improve vision.

\$5.99 for a limited time

7.76 USERS
RATING



Acne Pwner

by: Andrew Finkel | 104



DOWNLOAD \$0.99

AcneApp

Acne therapy without risky medications.

Instructions:

Begin by choosing a light from the tab bar below. Red & Blue is the recommended option.

Rest the iPhone against your skin's acne-prone areas for 2 minutes daily to improve skin health without prescription drugs.

- Blue Light: fights bacteria



Home



Info



Blue & Red



Blue



Red

Digital Snake Oil

 **GoBe™**
The Original 100% Automatic
Body Massometer™



Measure blood pressure
using only your iPhone.

No cuff required.



ED.
AND FOR ALL YOUR HEALTH GOALS

patents pending

patents pending

Healthcare's new entrants:
Who will be the industry's
Amazon.com?

Health Research Institute
April 2014



pwc

***“The \$2.8 trillion
US healthcare
industry is being
upended by
companies
attuned to the
needs and desires
of empowered
consumers.”***



IBM **Watson**



Microsoft

♥ CVS Health

- ~1000 locations in 31 states
- Staffed by nurse practitioners and medical assistants
- Over 25 million patients



PHARMA & HEALTHCARE

10/08/2014 @ 4:48PM | 19,080 views

Walmart Announces Ambitious Goal: 'To Be The Number One Healthcare Provider In The Industry'

+ Comment Now + Follow Comments

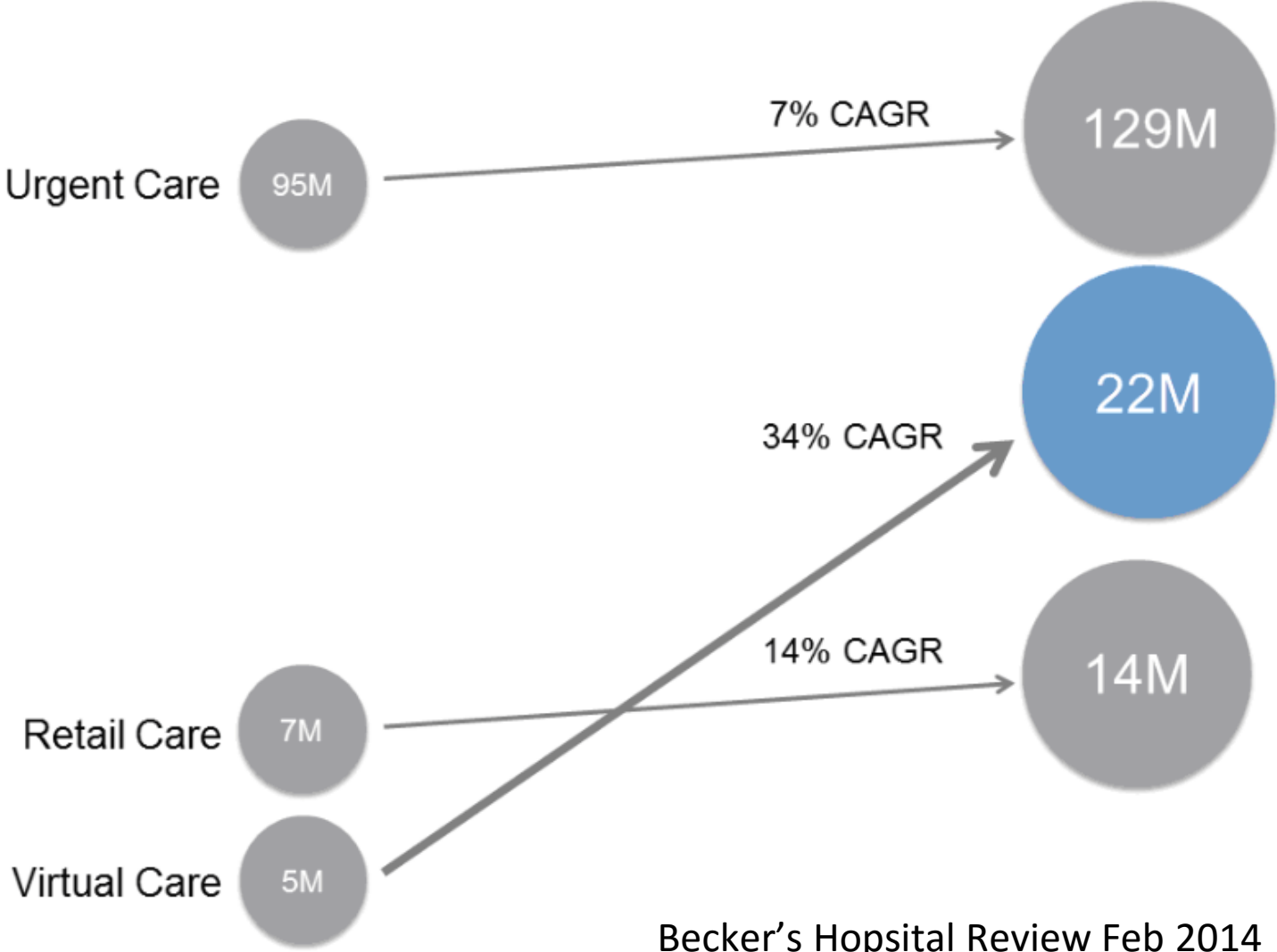


Dan Diamond
Contributor



- 40% of patients across US
- Access to health data remotely in 800,000
- 50,000 connected devices in their for
- Cards for healthy choices loyalty program.
- Largest provider of flu vaccines in the country.

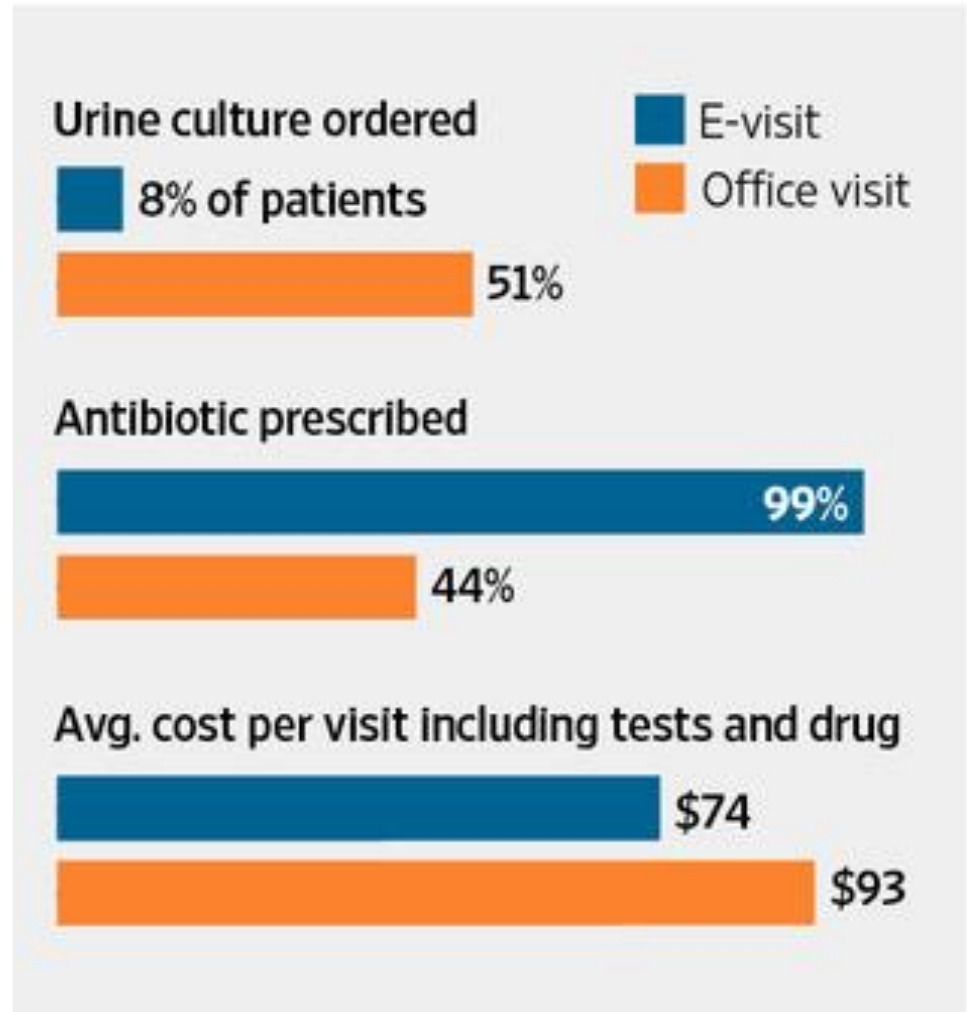
“On-Demand” Channel Growth



Becker's Hospital Review Feb 2014

Do Virtual Visits Impact Care Delivery? UTI Complaints

- No difference in the rate of f/u visits (7% for both) as a proxy for treatment failure. Compared 2855 office visits to 99 “e-visits.”
- Not examining a patient may lead to a more “conservative” treatment approach.



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The Effectiveness of Mobile-Health Technology-Based Health Behaviour Change or Disease Management Interventions for Health Care Consumers: A Systematic Review

Caroline Free^{1*}, Gemma Phillips², Leandro Galli³, Louise Watson⁴, Lambert Felix⁵, Phil Edwards¹, Vikram Patel⁴, Andy Haines⁴

“...high quality adequately powered trials of optimised interventions are required to evaluate effects on objective outcomes.”

Journal of the American Medical Informatics Association Volume 16 Number 6 November / December 2009

Review Paper ■

The Impact of Mobile Handheld Technology on Hospital Physicians' Work Practices and Patient Care: A Systematic Review

MIRELA PRGOMET, BAPPSC(HONS), ANDREW GEORGIU, PhD, JOHANNA I. WESTBROOK, PhD

“The paucity of evidence calls for much needed future research...”

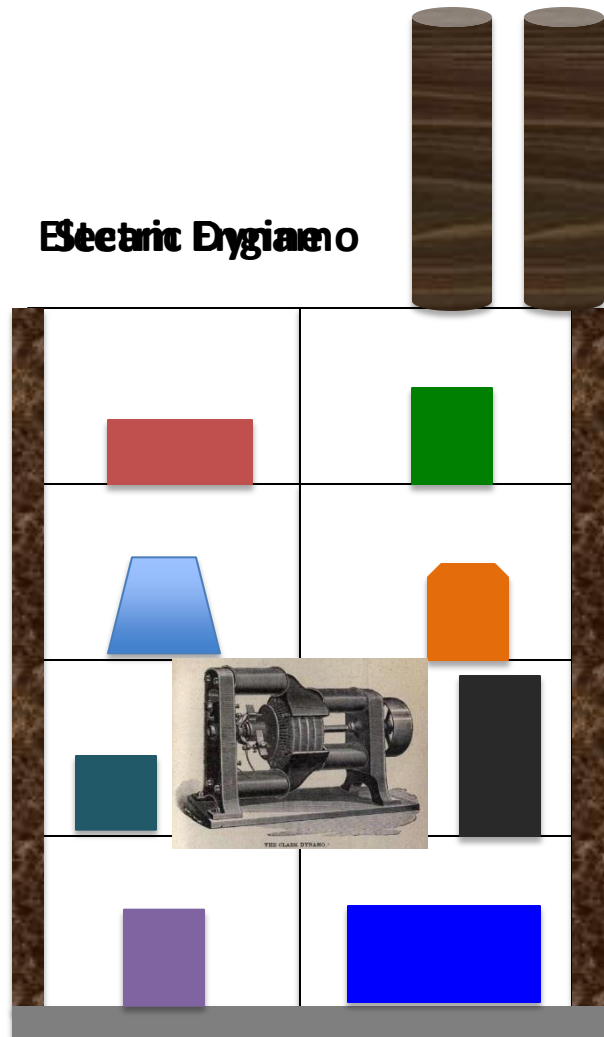
The Effectiveness of Mobile-Health Technologies to Improve Health Care Service Delivery Processes: A Systematic Review and Meta-Analysis

Caroline Free^{1*}, Gemma Phillips², Louise Watson³, Leandro Galli⁴, Lambert Felix⁵, Phil Edwards³, Vikram Patel³, Andy Haines³

“High quality trials measuring clinical outcomes are needed.”

So How Do We Show True Value?

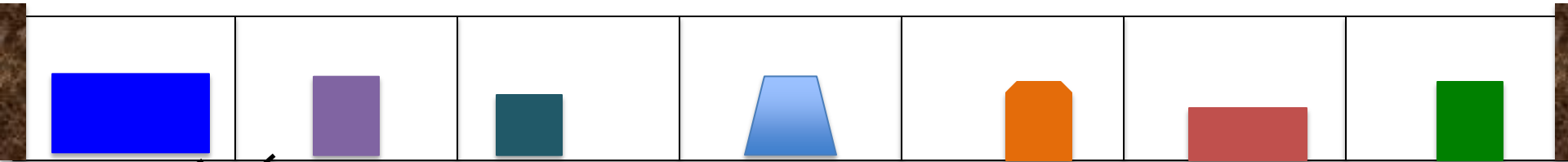
Productivity Paradox



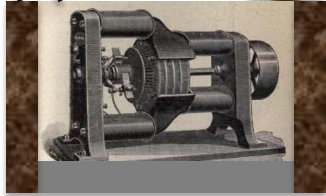
- In 1900 95% of all factory machines were still steam engine and belt driven (two decades after Edison's first electric power system started).
- It took ~ 40 years to see meaningful productivity gains as the original group drive system remained in place for much of that time.

So How Do We Show True Value?

Productivity Paradox



Just as systems of manufacturing needed to change to take advantage of transformational technology, systems of care need to be re-engineered around the capabilities that mHealth tools provide.



The mHealth: Enabling the Re-Engineering of Healthcare - Summary

- **We are well into a technology revolution of unprecedented computational power & connectivity that we are just now beginning to leverage for healthcare.**
- **The availability and variety of wearable sensors for health and wellness is rapidly increasing, although with limited clinical uptake.**
- **Consumer-facing, non-traditional providers may be in a stronger position to lead the transformation of healthcare in the US than are legacy healthcare systems.**
- **mHealth technologies can enable, but alone will not drive the complete re-engineering of the healthcare landscape.**