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of PUBLIC HEALTH

What is m-Possible ?
Leveraging mobile technology for global health

Alain B. Labrique, PhD, MHS, MS

Director
JHU Global mHealth Initiative

Associate Professor
Dept. of International Health
Johns Hopkins Bloomberg School of Public Health
Dept. of Health Informatics, School of Medicine
Dept. of Community Medicine School of Nursing

Chair
WHO mHealth Technical Evidence Review Group
WHO Digital Health Guidelines Development Group

Visiting Professor, Xiamen University, Fujian, China

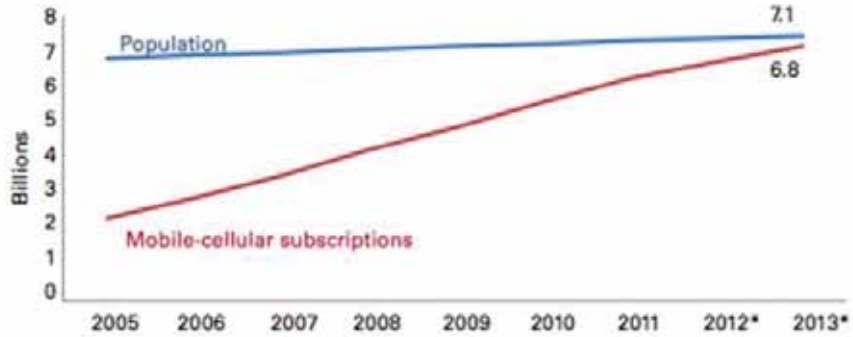
#ICT4SDG

The World in 2013

ICT FACTS AND FIGURES

6.8 BILLION MOBILE-CELLULAR SUBSCRIPTIONS

As the number of subscriptions approaches global population figures mobile-cellular growth slows



Source: ITU World Telecommunication /ICT Indicators database
Note: * Estimate

In 2013, there are almost as many mobile-cellular subscriptions as people in the world, with more than half in the Asia-Pacific region (3.5 billion out of 6.8 billion total subscriptions).

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The Mobile Phone "Revolution" - 2000-2017

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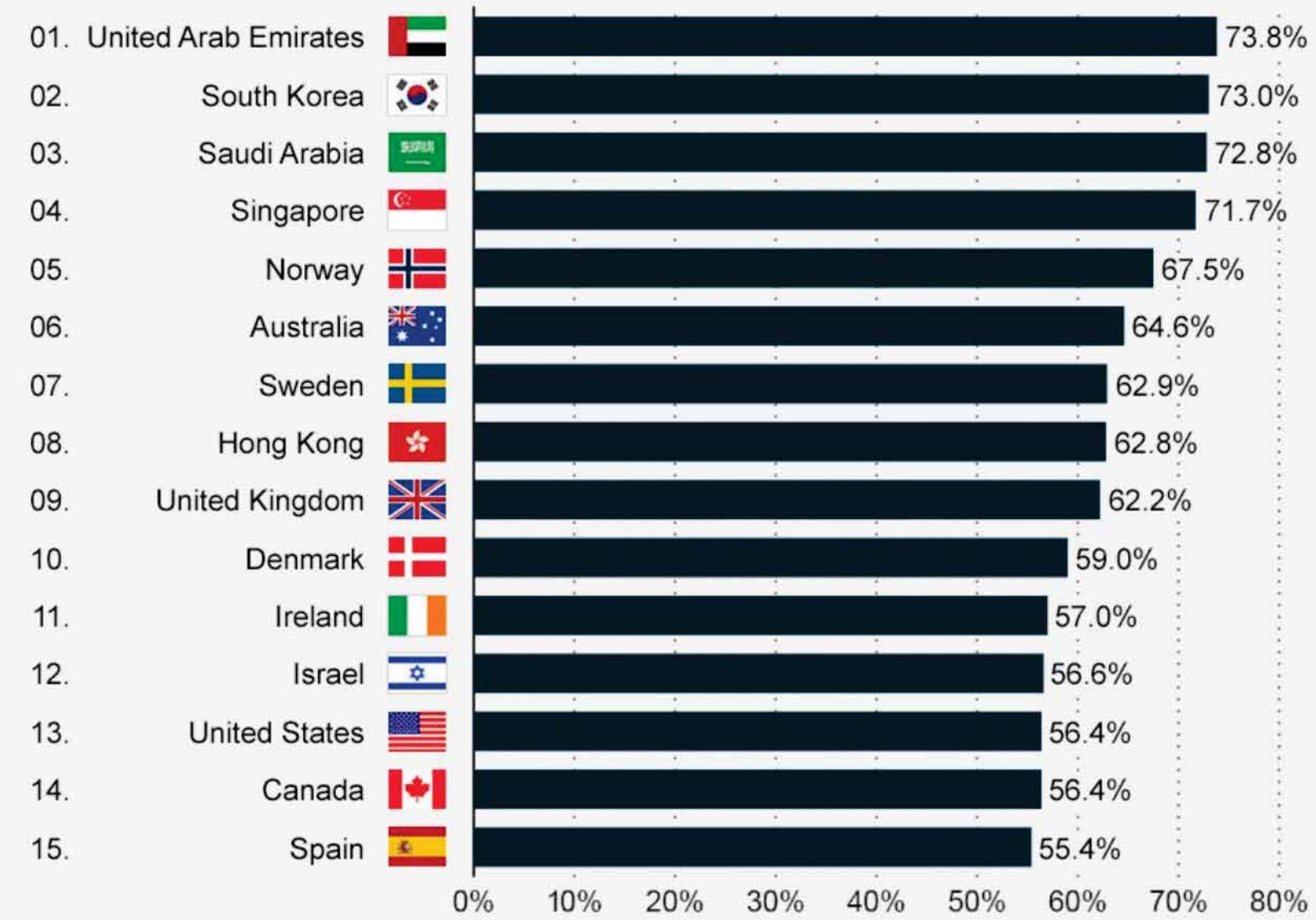
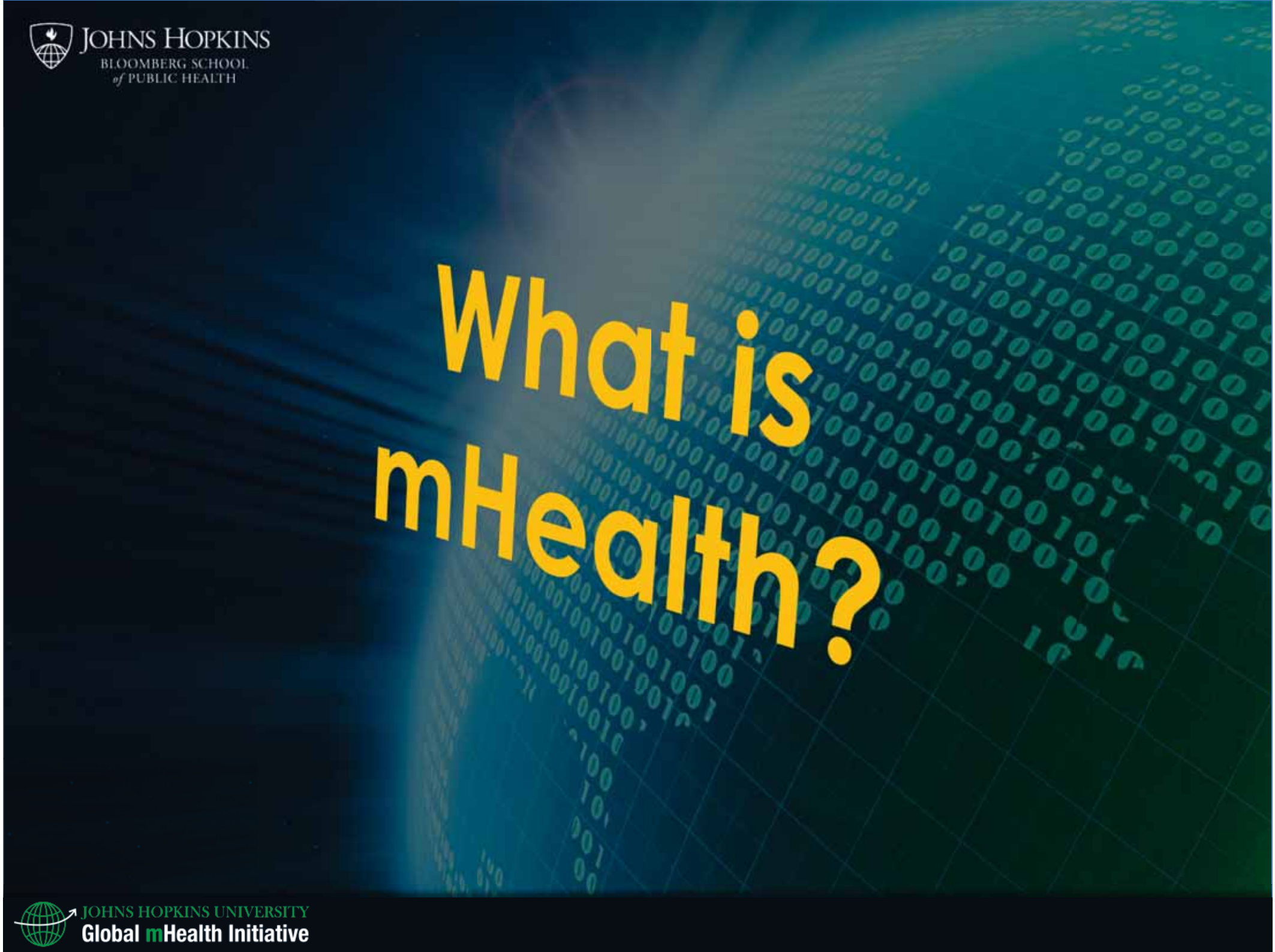
The World is Changing Rapidly

Euclidean map of 10 million of the 850 million Facebook users friend networks
© Paul Butler, FB

Top 15 countries with the highest smartphone penetration in Q1 2013



* sample sizes were 1,000 for all countries except Ireland at 900 and Saudi Arabia and UAE at 500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What is mHealth?
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m

Unte
Diverse
techno
health re

and health outcomes

mHealth 5c's

- Connect People
- Compress Time
- Capture Information
- Competence & Confidence

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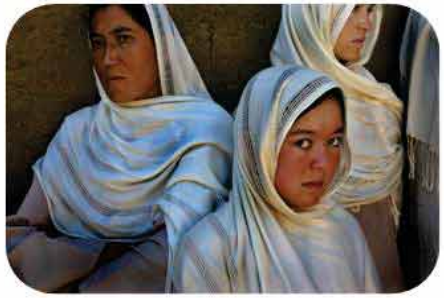
mHealth is not a single THING.
Mobile tools can be used to strengthen different parts of the health system.



Education and Awareness
Messaging in support of public health and behavioral change campaigns.

Diagnostic and Treatment Support
Mobile phones to support provider decisions and as a point-of-care device.

Disease and Epidemic Outbreak Tracking
Sending and receiving data on disease incidence, outbreaks and public health emergencies.

Supply Chain Management
Using mobile solution to improve stock-outs and combat counterfeiting.

Remote Data Collection
Collecting real-time patient data with mobile applications.

Remote Monitoring
Maintaining care giver appointments or ensuring medication regime adherence.

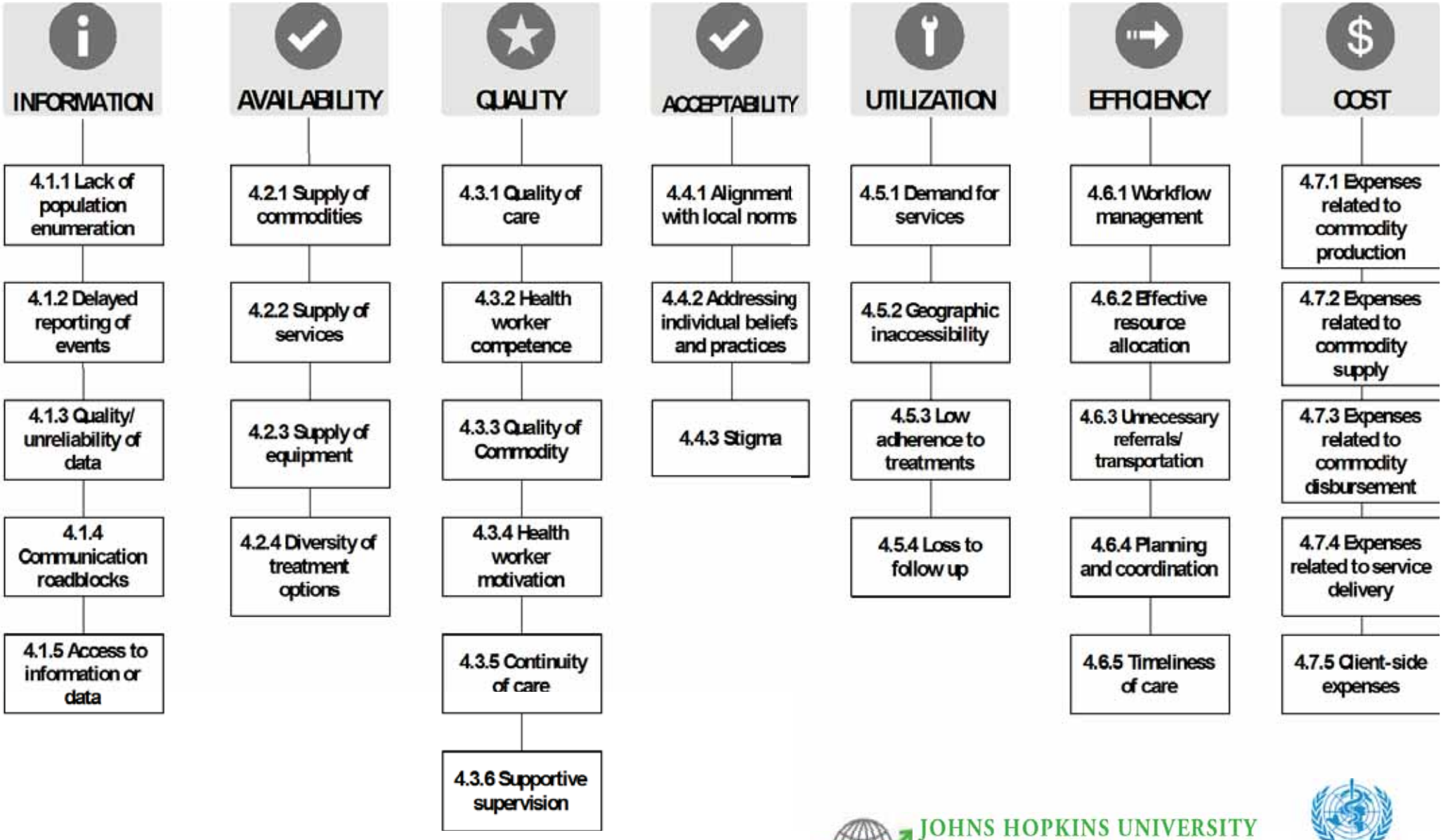
Healthcare Worker Communication and Training
Connecting health workers with sources of information.

12 Common Applications of mHealth

1. Client education & behaviour change communication (BCC)
2. Sensors & point-of-care diagnostics
3. Registries / vital events tracking
4. Data collection and reporting
5. Electronic health records
6. Electronic decision support
   Information, protocols, algorithms, checklists
7. Provider-to-provider communication
   User groups, consultation
8. Provider workplanning & scheduling
9. Provider training & education
10. Human resource management
11. Supply chain management
12. Financial transactions & incentives

Labrique et al. GHSP 2013

What problem(s) are you trying to solve?



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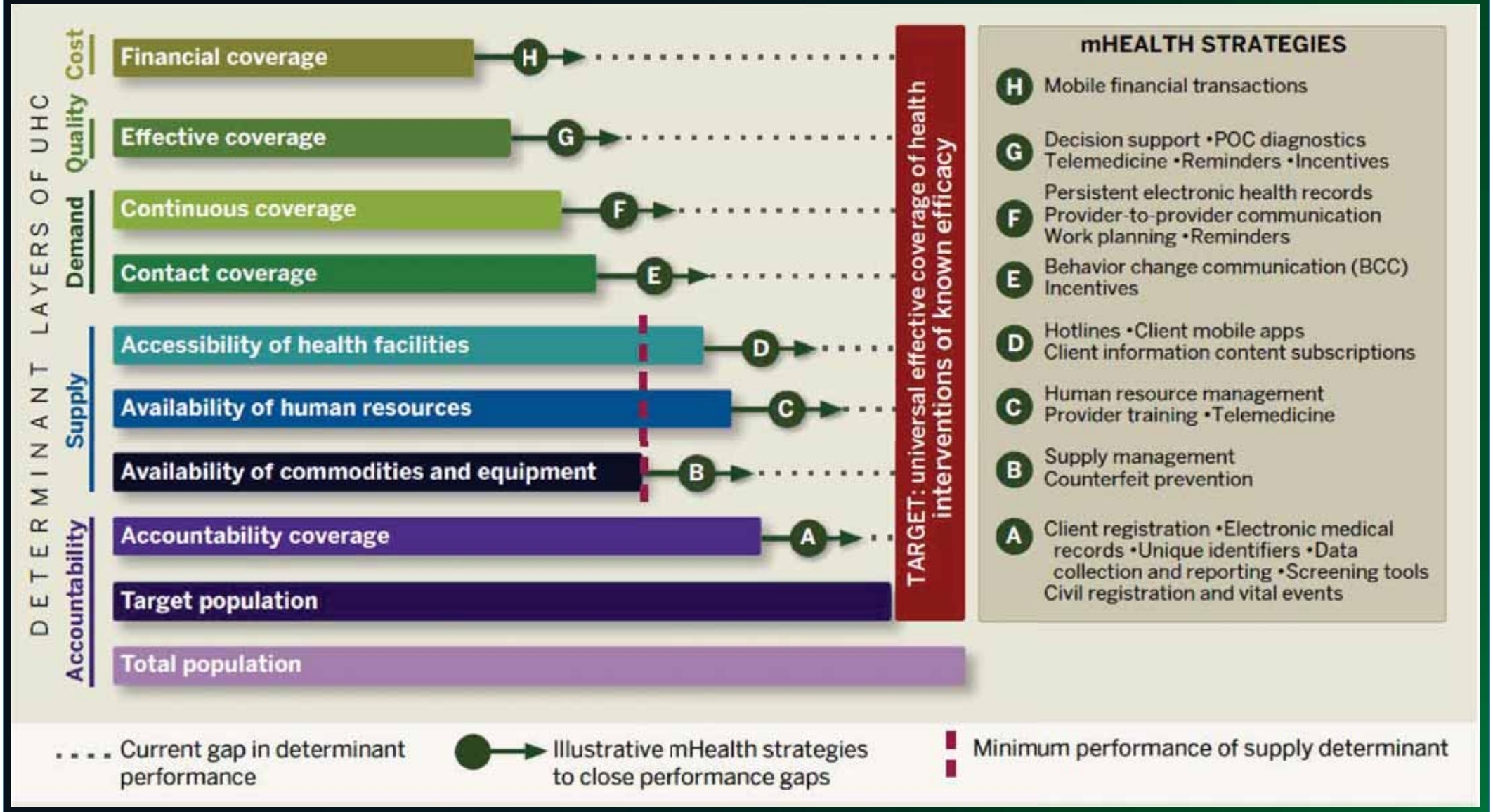
World Health Organizatior

Science
AAAS

Prioritizing integrated mHealth strategies for universal health coverage

Garrett Mehl and Alain Labrique

Science **345**, 1284 (2014);
DOI: 10.1126/science.1258926



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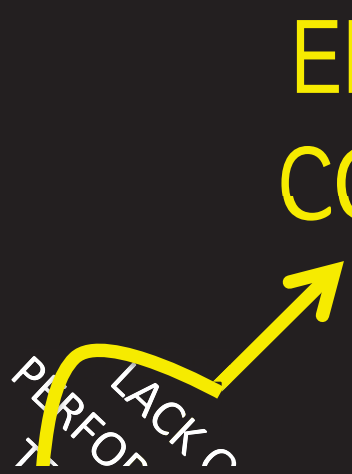
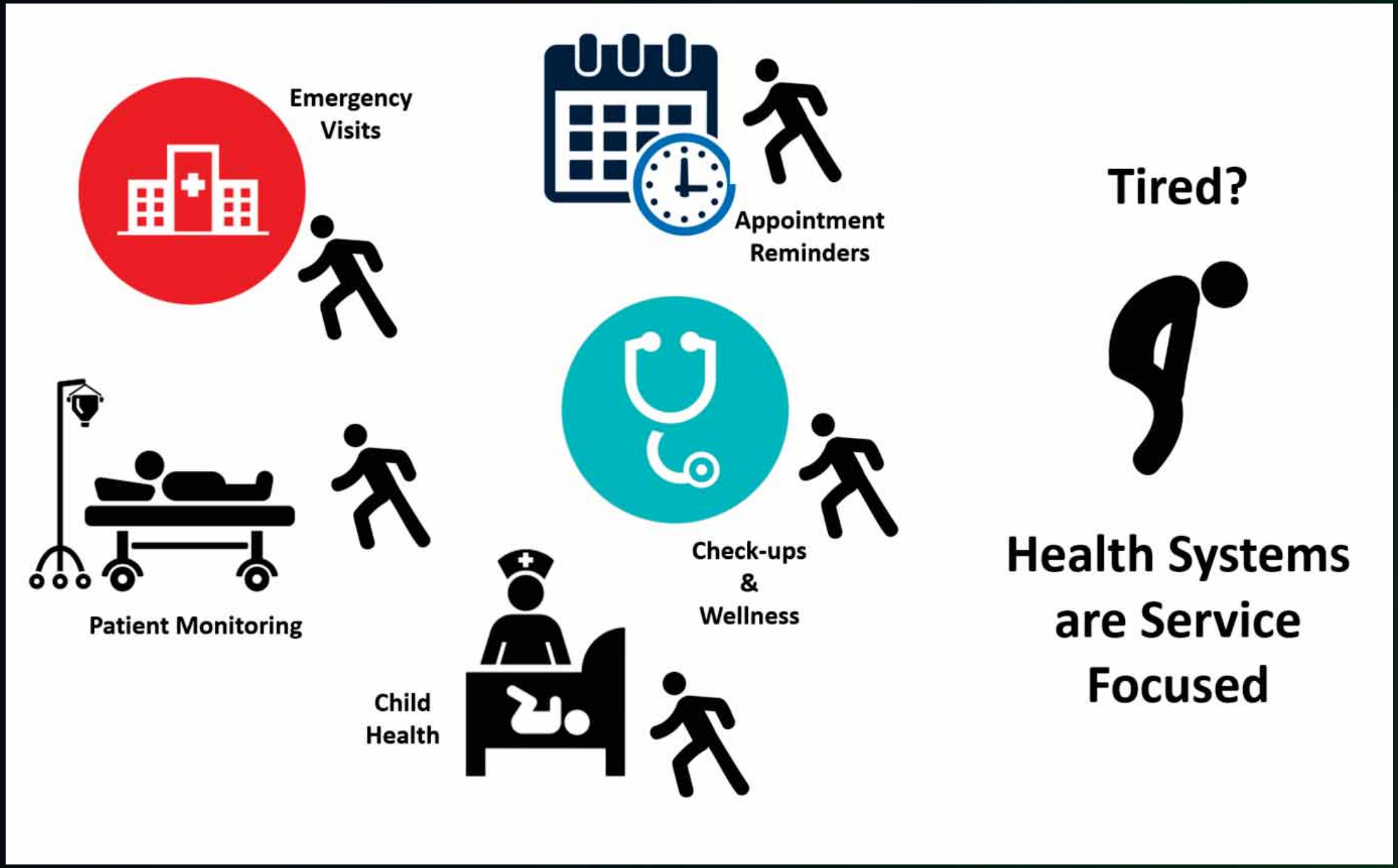
mHealth should not be about the technology. Its a Health Systems Catalyst.



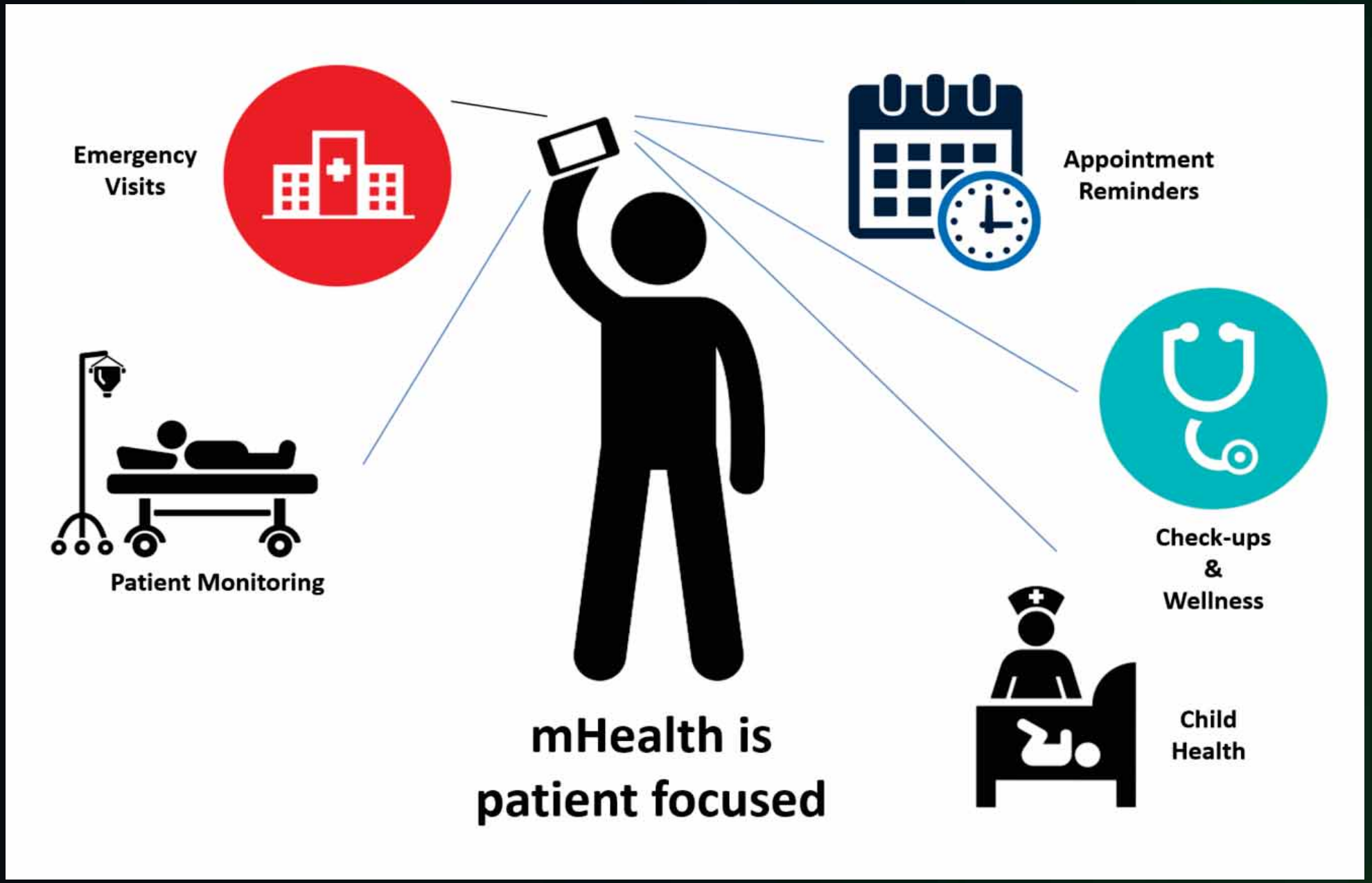
Shift focus from “Does mHealth work?” to “Does mHealth *optimize* what we know works ?”

INTERVENTION OF KNOWN EFFICACY

Jo Y, Labrique AB et al. PLOS One *2013*



A Clinical Perspective



A Clinical Perspective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JOHNS HOPKINS
SCHOOL of MEDICINE
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INSTITUTE
OF
BIOETHICS
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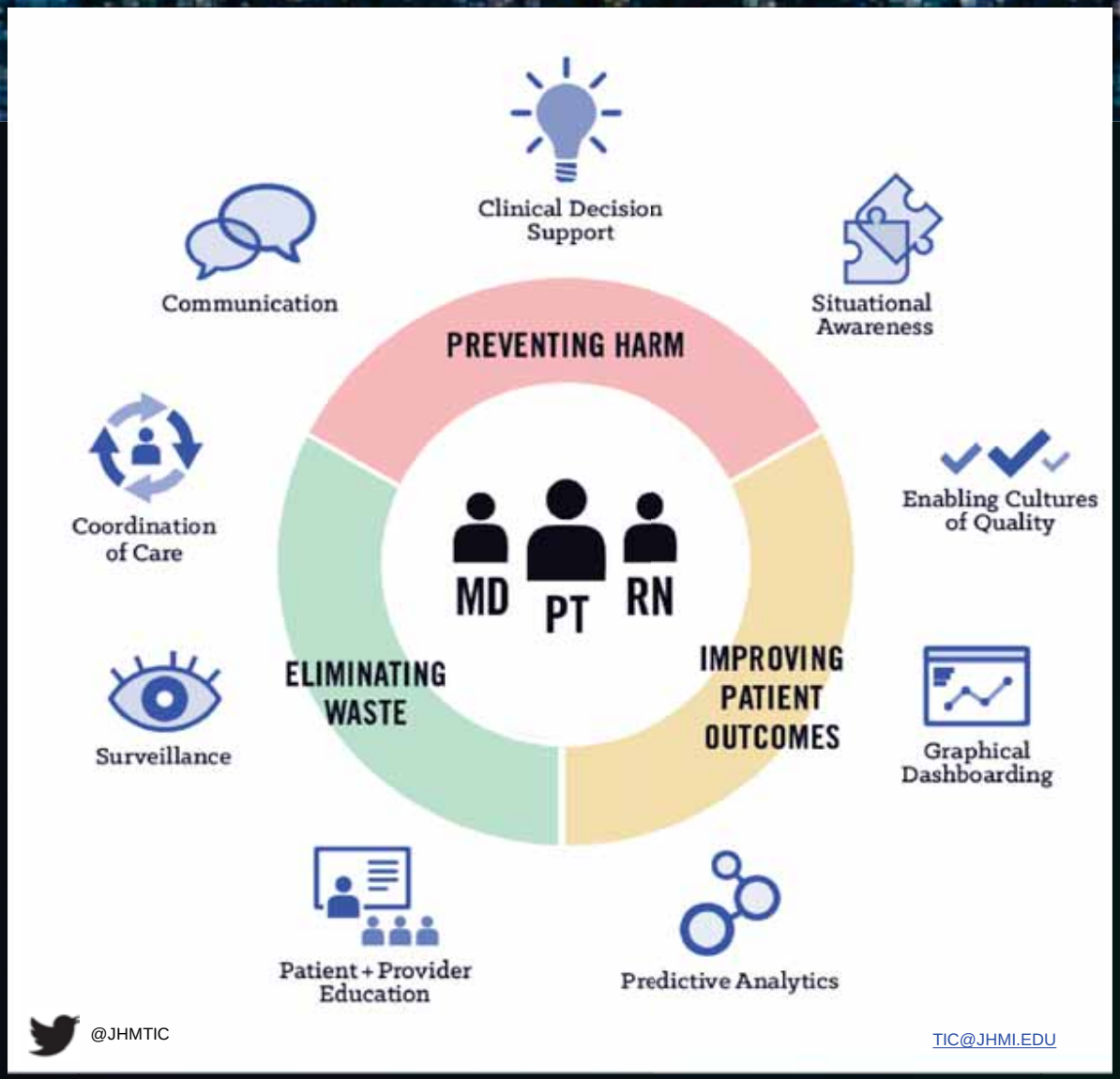
APL
The Johns Hopkins University
APPLIED PHYSICS LABORATORY
unicef
World Health Organization
mHealth
working group
mHealth Alliance

JHUTechnology Innovation Center



The Technology Innovation Center brings together clinicians, Health IT, and researchers to create patient-centered medical solutions.

October 2016: WHO Launches "Evidence-based Guidelines for Digital Health Strategies" Process.

World Health Organization

human reproduction programme hrp

research for impact

UNDP-UNFPA-UNICEF-WHO-WORLD BANK

LAYERS OF mHEALTH STRATEGIES

Patient Knowledge and Self-Efficacy

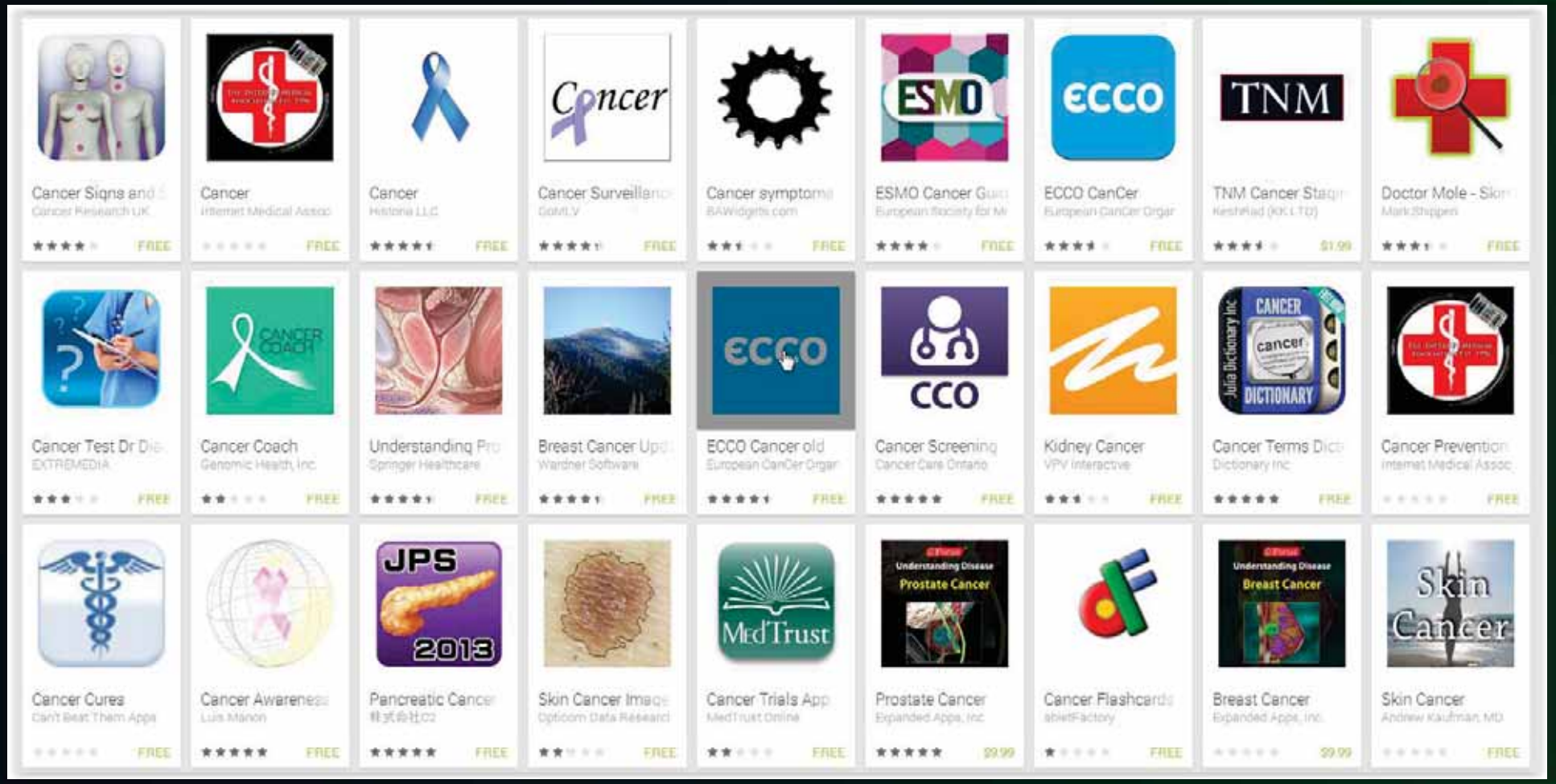
Provider Competence and Accountability

- DECISION SUPPORT
- ENUMERATION
- SURVEILLANCE

Health System Adequacy

- SUPPLY CHAIN
- STAFF AND FACILITY PERFORMANCE MONITORING
- REFERRAL SUPPORT

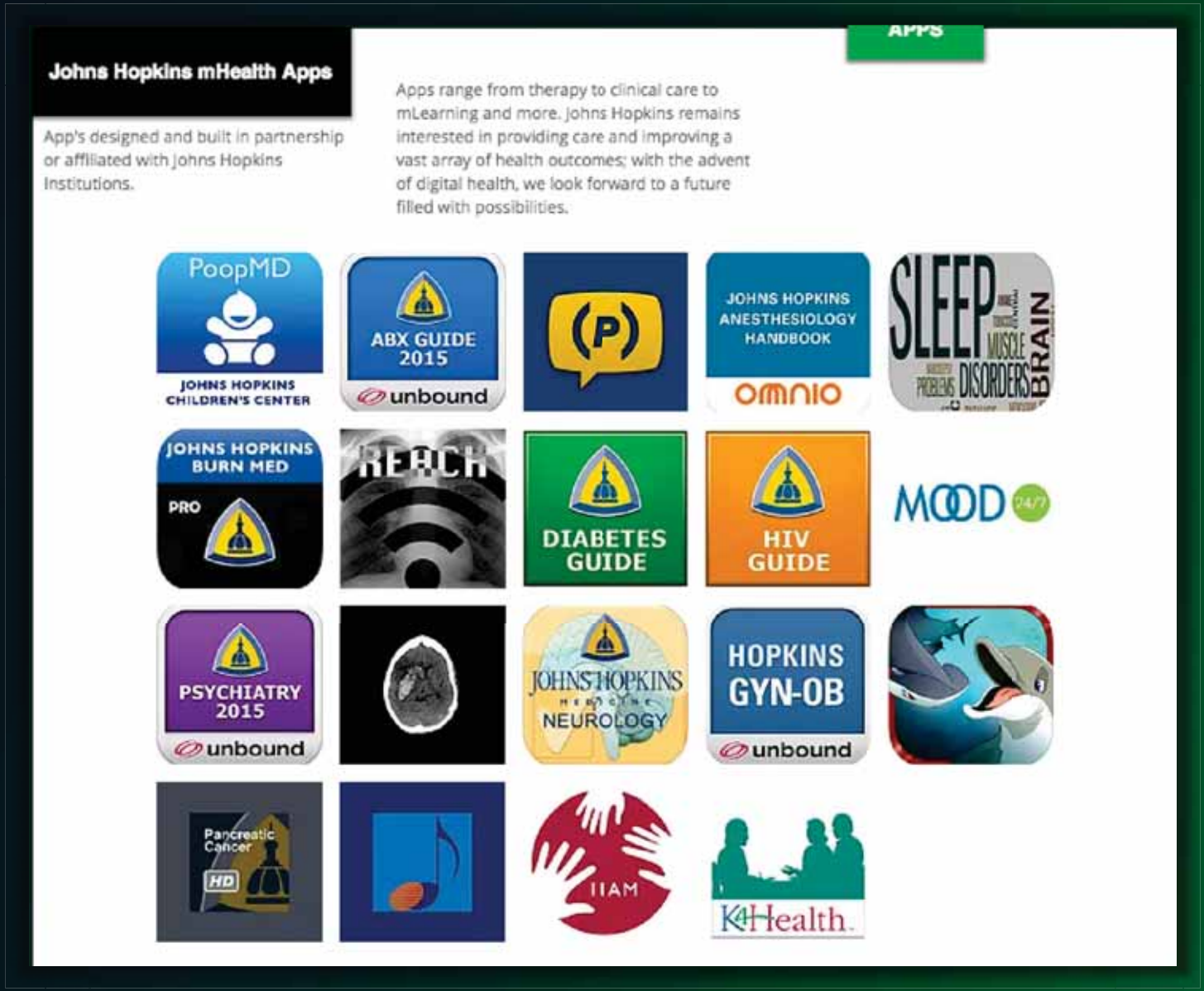
Apps apps everywhere…



... including at Hopkins

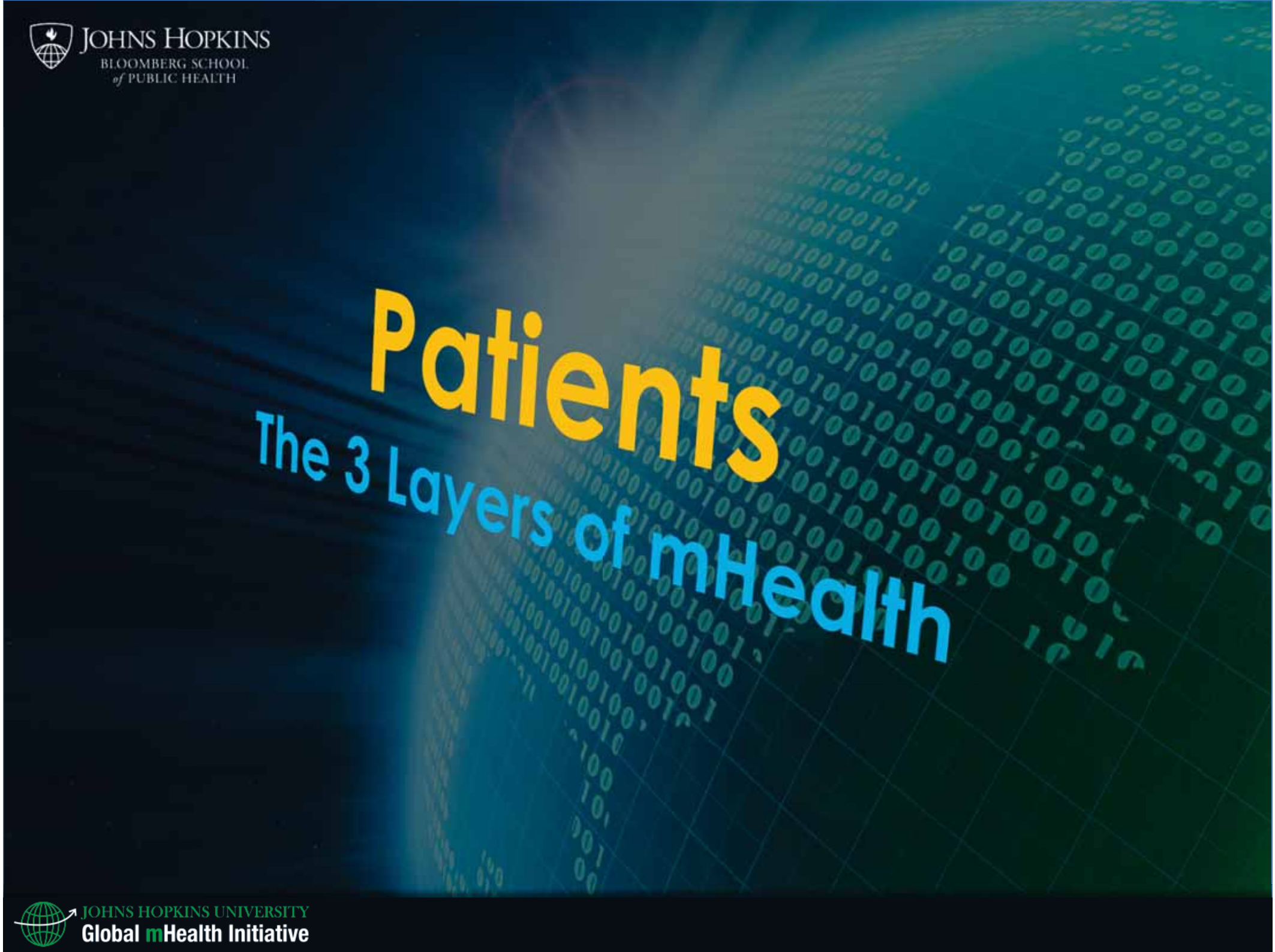
We even have a review site!

iMedicalApps.com
The most widely read of all medical app review sites, receiving over 400,000 page views per month. Content is written by a team of doctors and medical students.



- DON'T

- DO – think about *digital strategies* to resolve clinical + population health constraints / bottlenecks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Patients
The 3 Layers of mHealth
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Empower patients to verify quality

FRONTLINESMS

RapidPro

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Leveraging the "Internet" of Things

AdhereTech

Zero Patient Setup

Immediately and automatically sends data from anywhere in the world

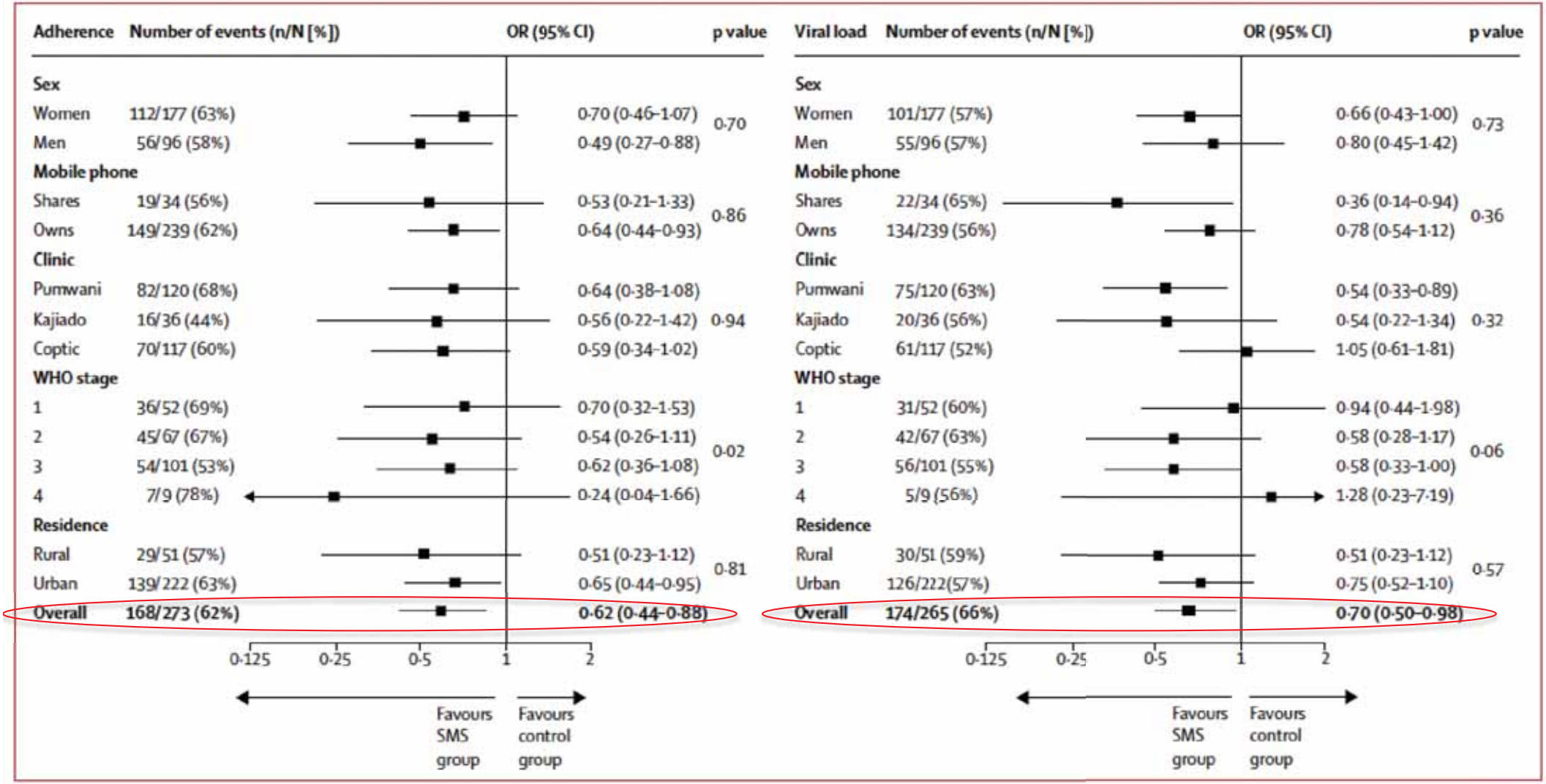
Reliable & Scalable

Built by one of the largest high-tech medical device manufacturers in the USA

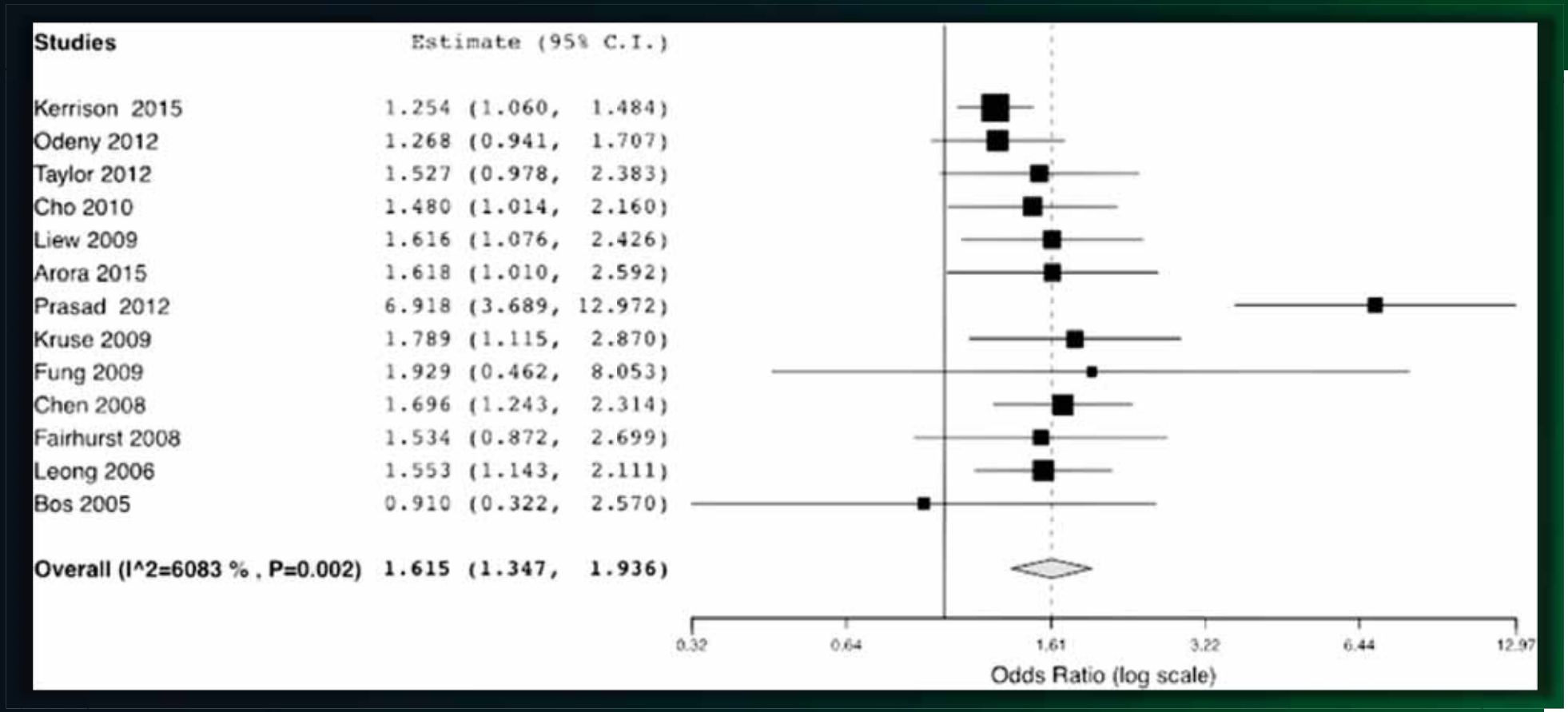
Customizable Interventions

Bottle settings (automated phone calls, text messages, lights, chimes, etc.) can be adjusted and personalized

Text message reminders improve adherence by 62%

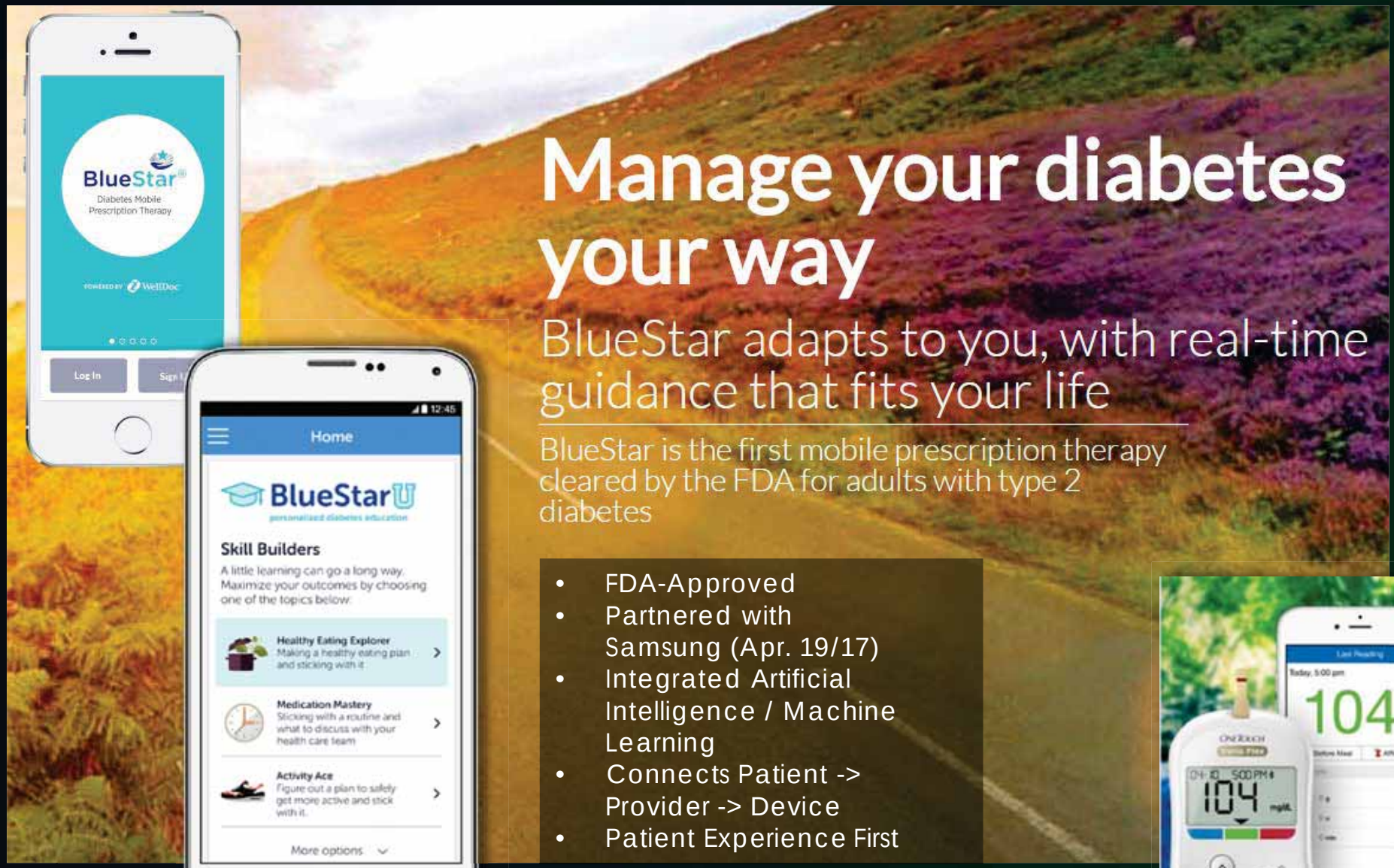


Text message reminders reduce missed appointments by 61%



Boksmati, N., Butler-Henderson, K., Anderson, K. et al. The Effectiveness of SM Reminders on Appointment Attendance: a Meta-Analysis. J Med Syst (2016) 40: 90. doi:10.1007/s10916-016-0452-2

Take two apps and call me in the morning.



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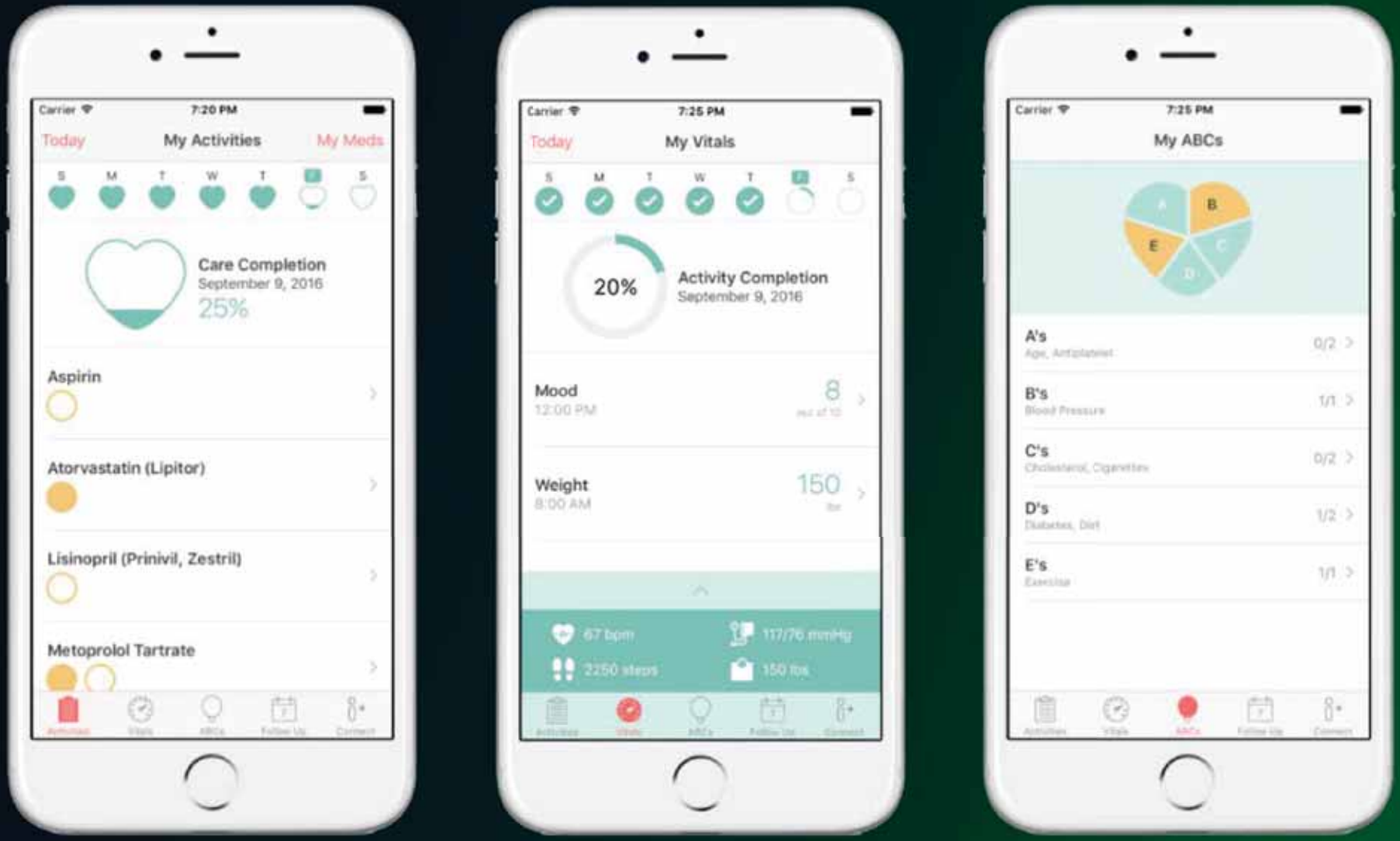
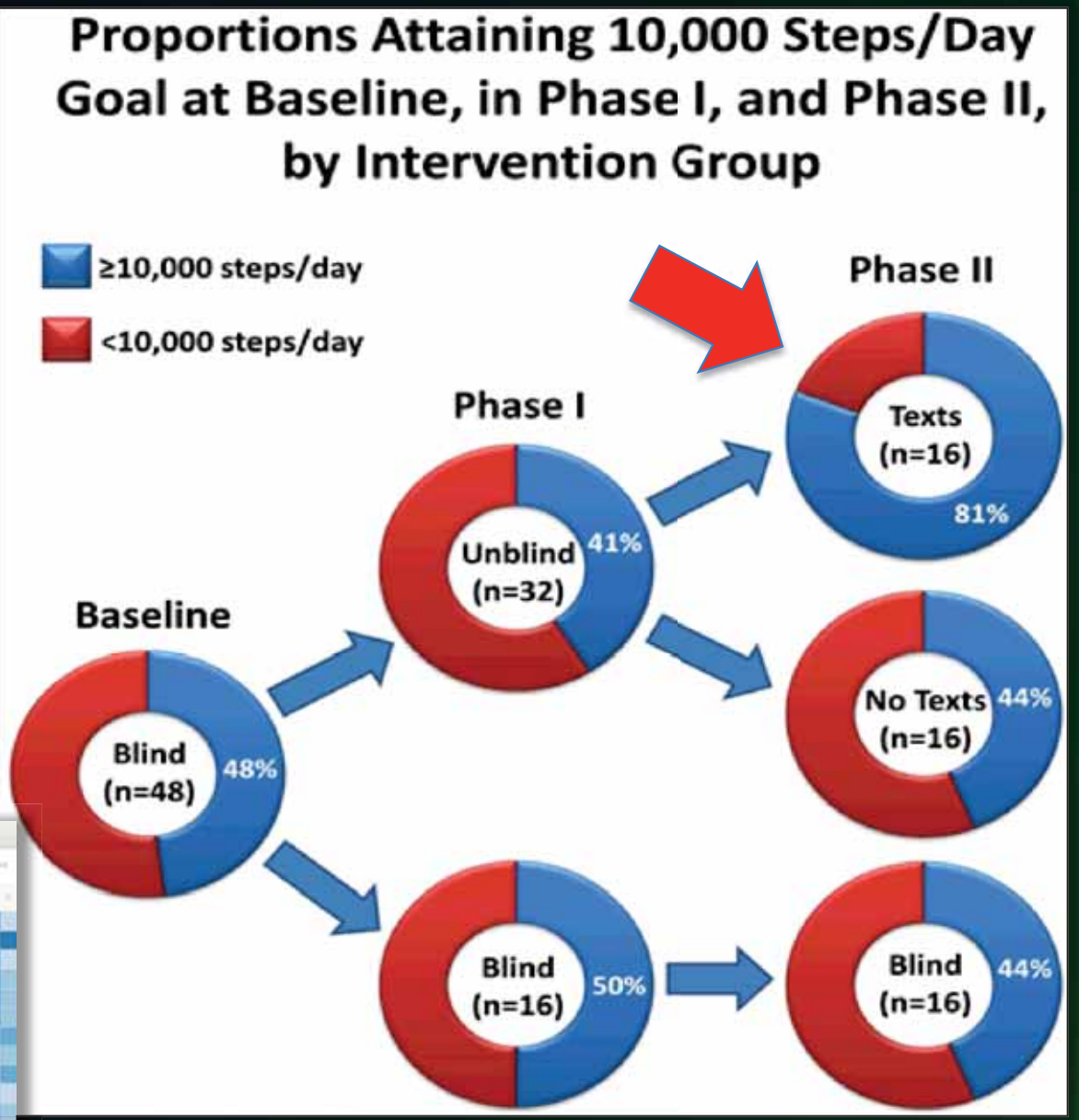
CorrieHealth: A model to improve patient self-efficacy



corriehealth.com

Examples like mActive, extend the continuity of the clinical visit, by allowing patient engagement with their own post-discharge activity and 'continued' oversight by the clinical care team.

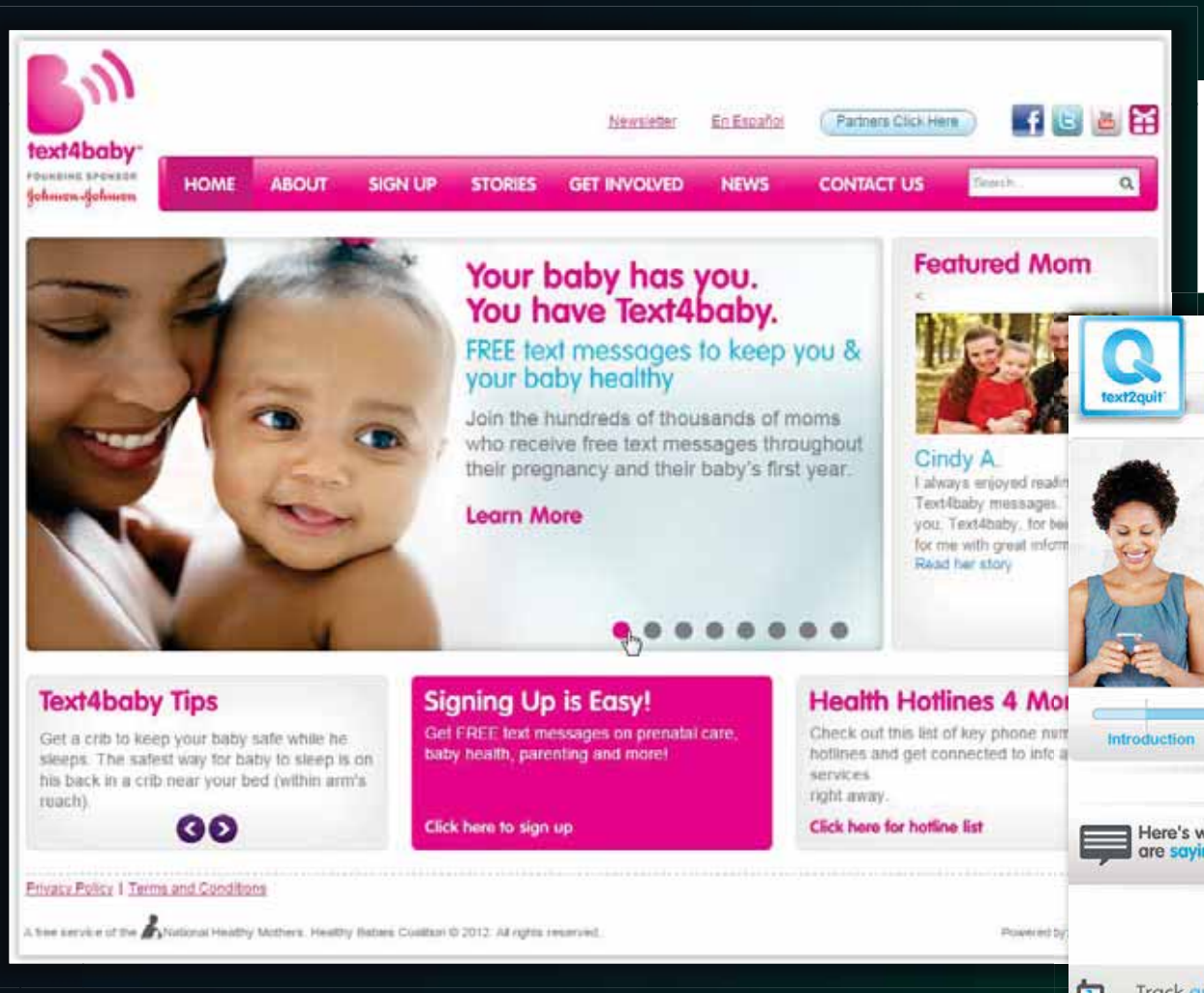


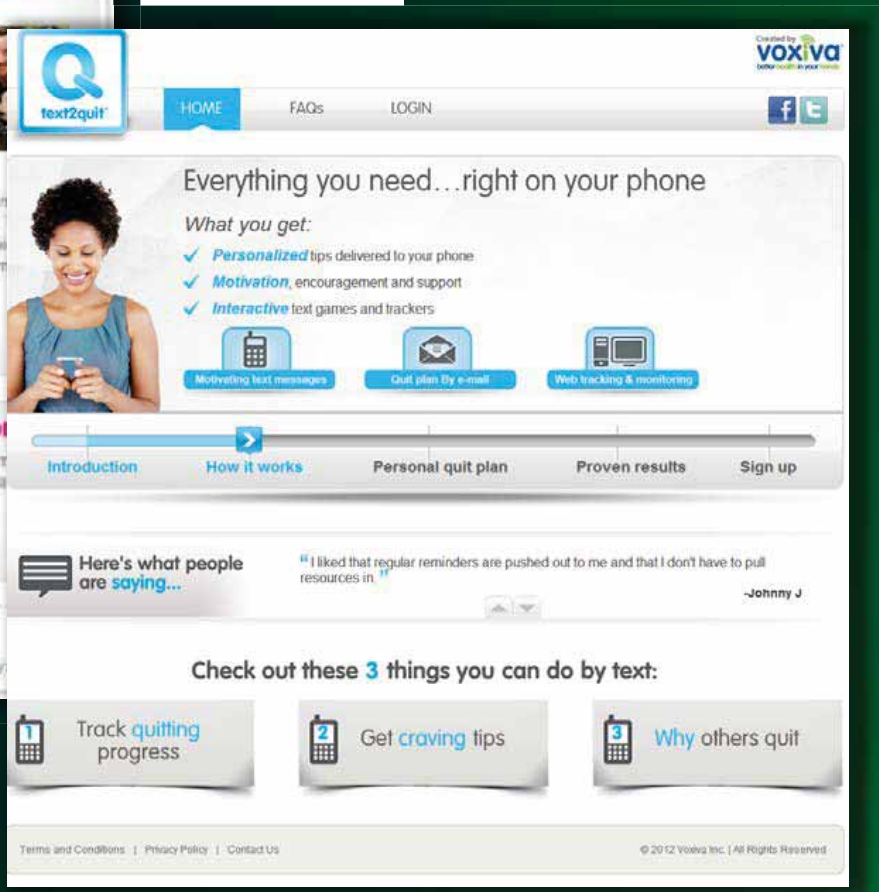
Patient Education (mLearning)

Text Messaging for Patient "Groups"

Examples:

nancy
king





momconnect

with MAMA

ect builds on the success of MAMA and
e mHealth messaging services to create
s among pregnant women and their
out available health services. This in turn
nge improved access and usage, which
help improve health status and MDG
Development Goals) target indicators.

Our Goals

Register each pregnancy at a Government Health Facility.
To send stage-based, personalized SMSs to each mom in the registry.
Allow women to engage further with the health system, through a set of help desk tools and services available to her.

health
Department:
Health
REPUBLIC OF SOUTH AFRICA

MAMA
Mobile Alliance for Maternal Action

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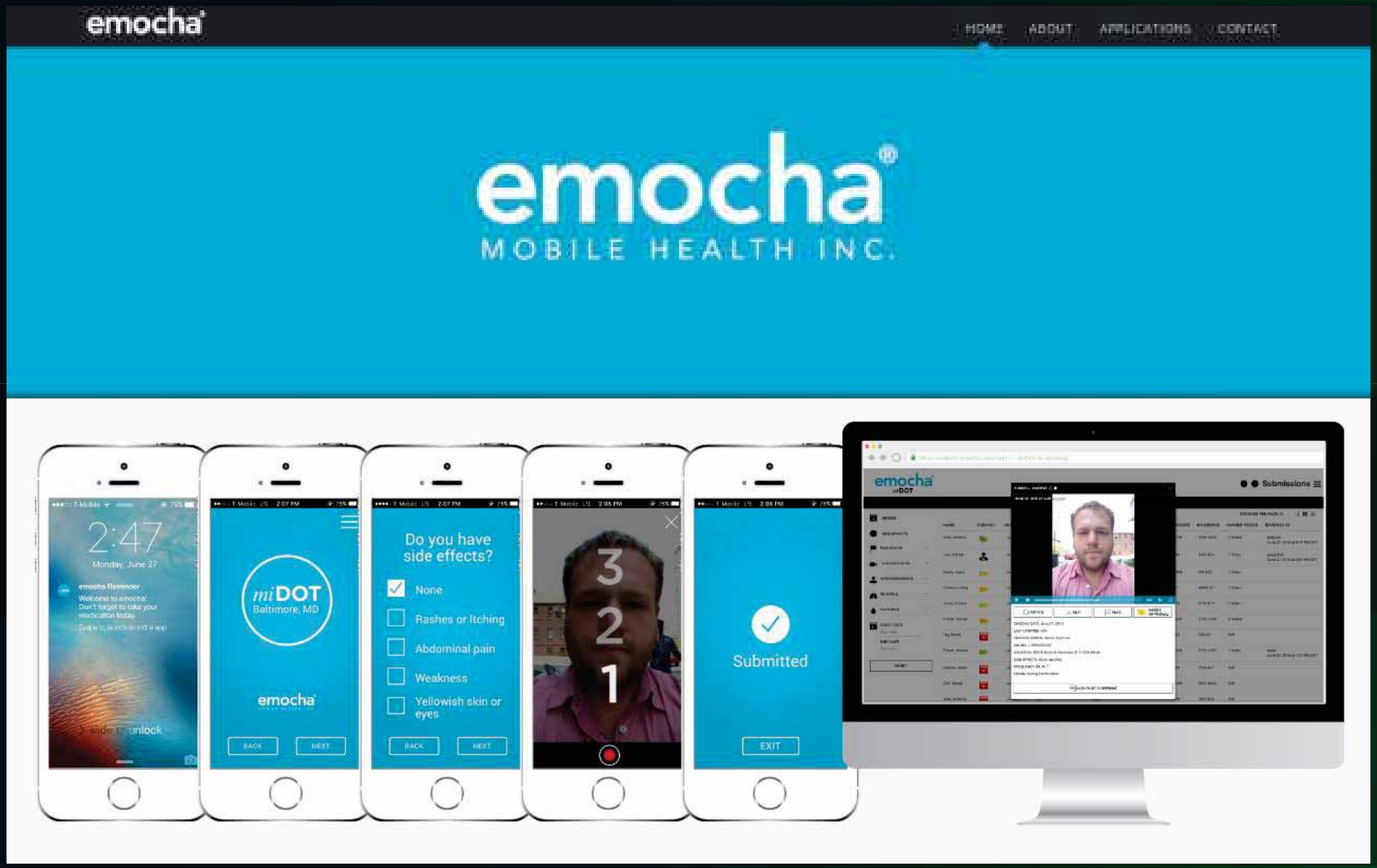
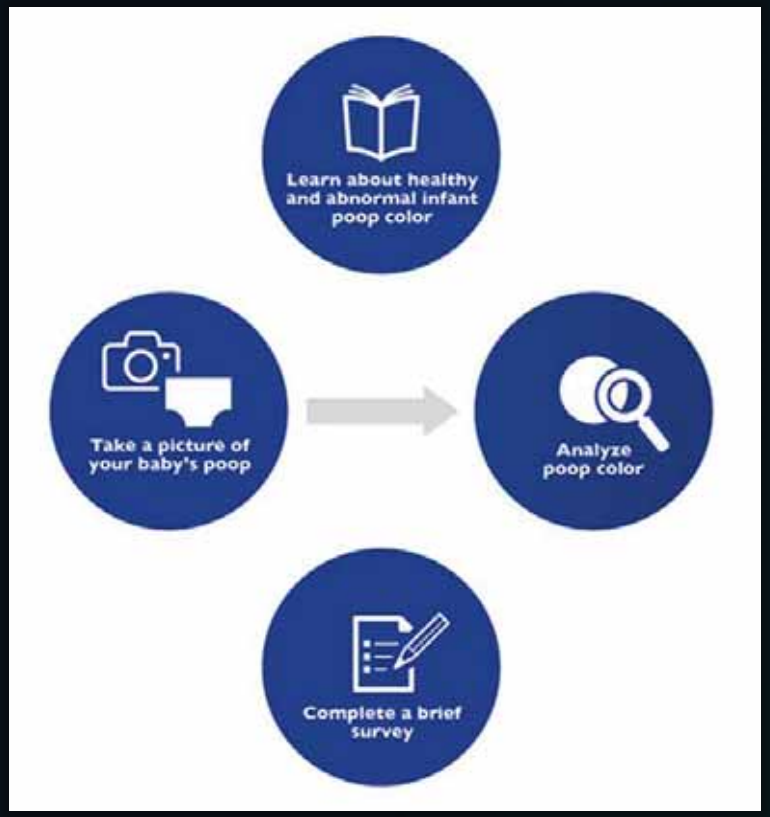
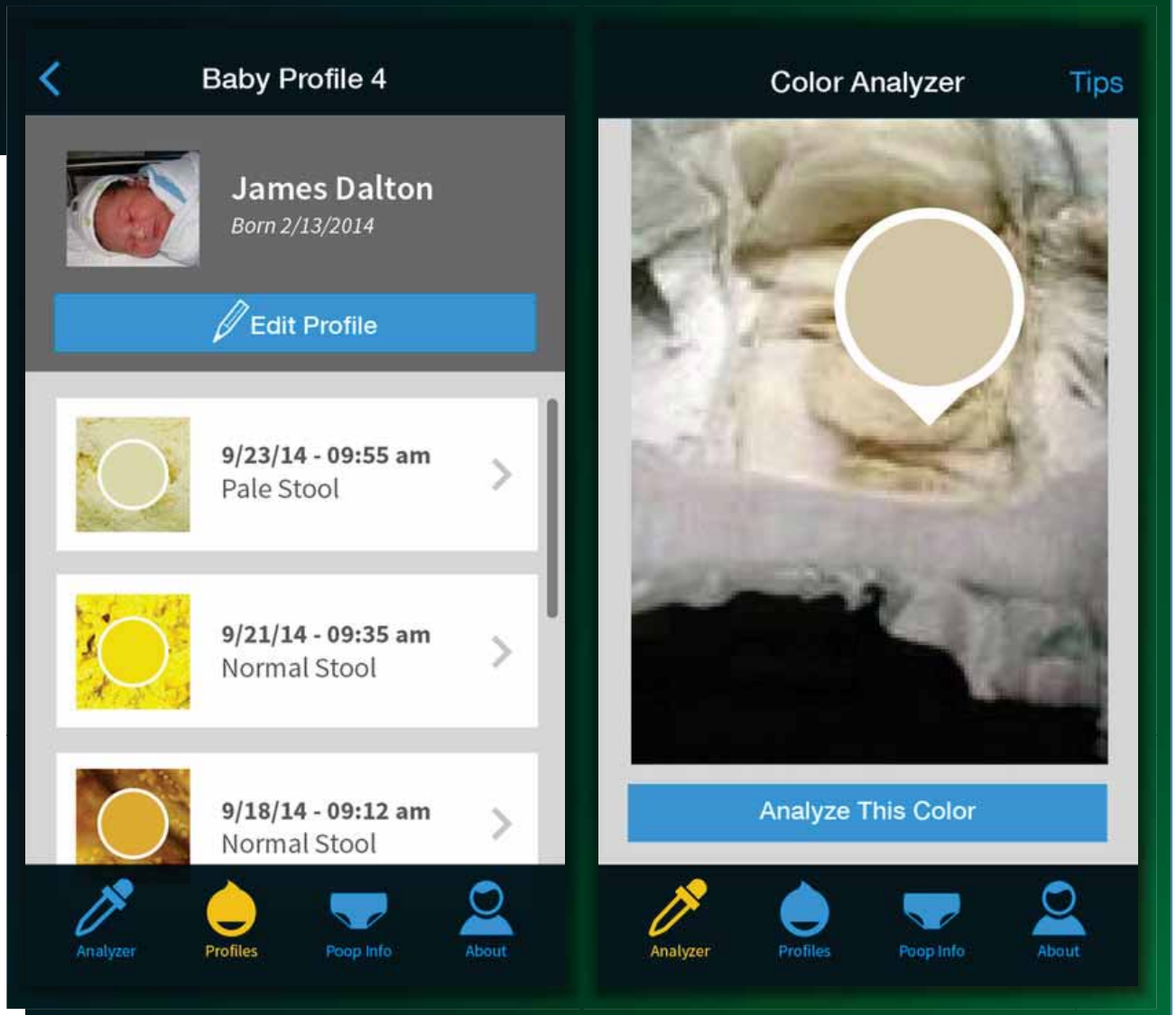
Mobile Video Directly Observed Therapy

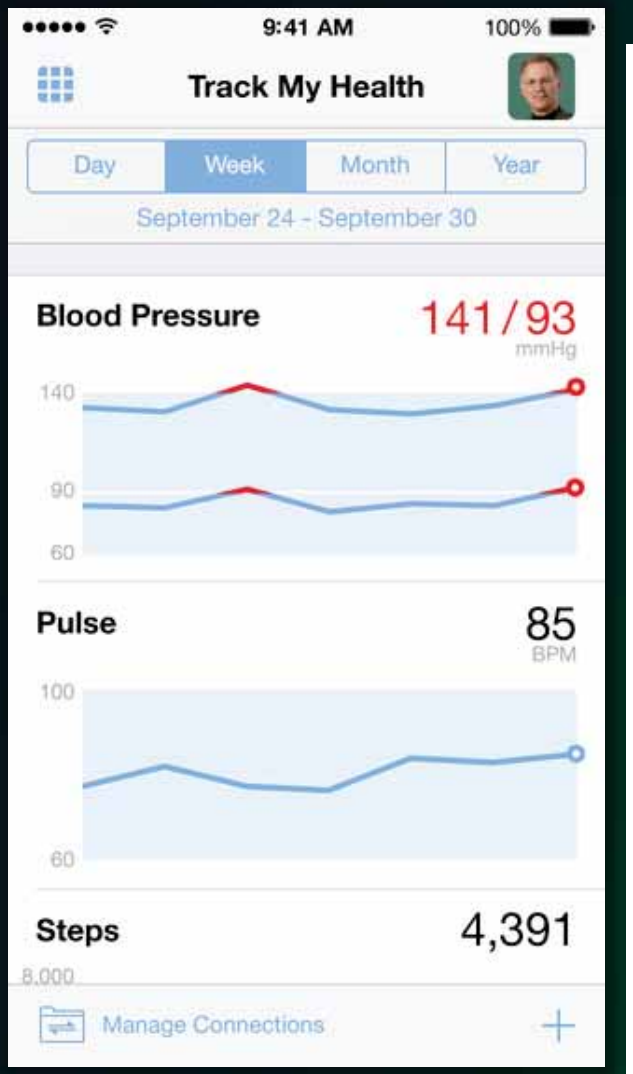


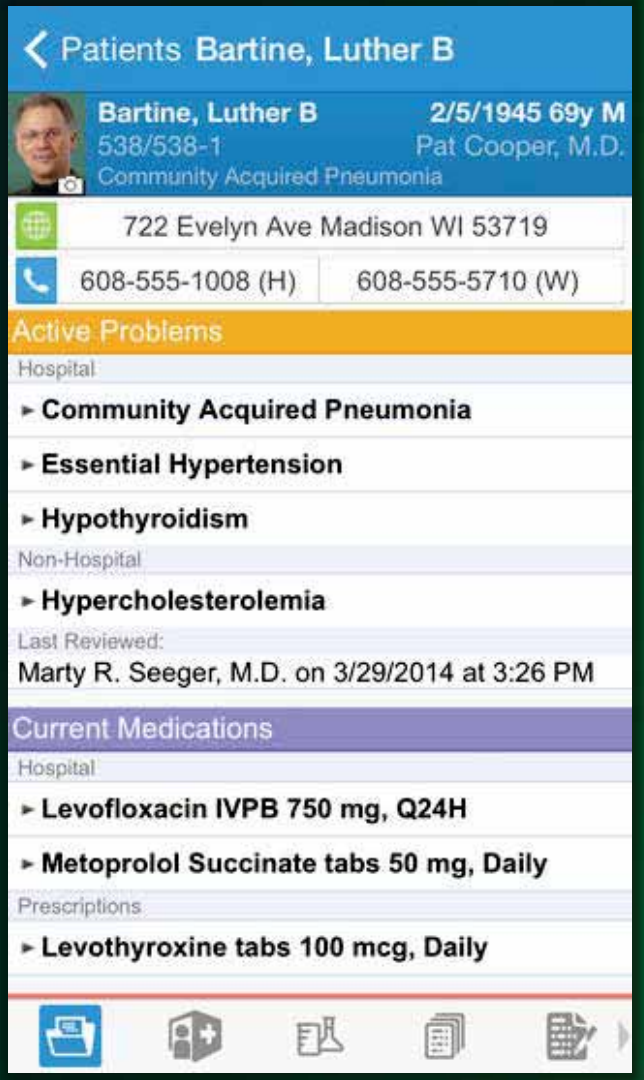
PoopMD+ for Biliary Atresia





EPIC EMR Patient View App





The Wired [redacted]

sensor -

a device that detects or measures a physical property and records, or otherwise responds to it.

[redacted], Fitbit

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Published in final edited form as:

J Prev Alzheimers Dis. 2016 March ; 3(1): 8–12. doi:10.14283/jpad.2015.78.

The Feasibility of At-Home iPad Cognitive Testing For Use in Clinical Trials

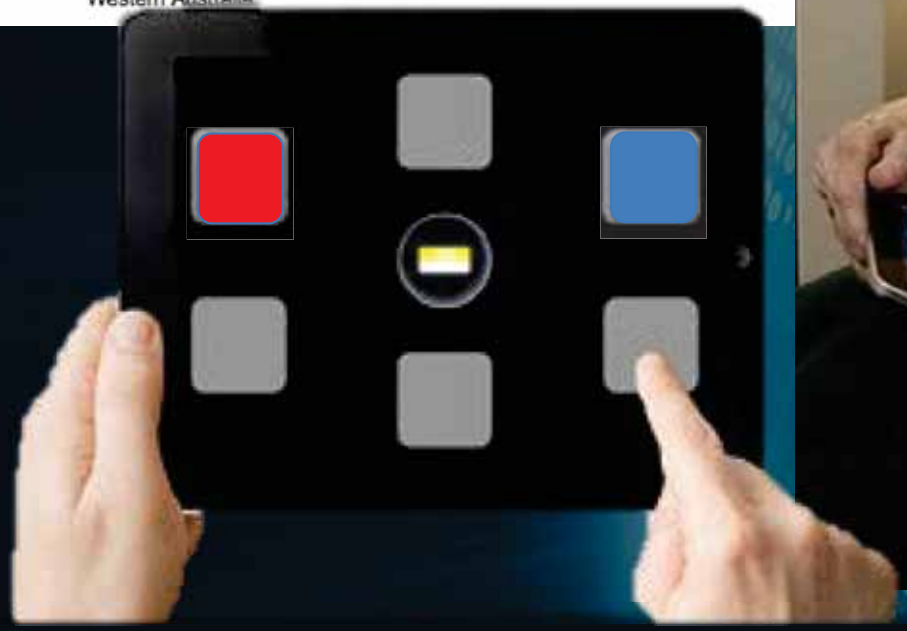
Dorene M. Rentz, PsyD[1,6], **Maria Dekhtyar**[2], **Julia Sherman**[3], **Samantha**
Deborah Blacker, MD, ScD[5], **Sarah L. Aghjayan, BA**[6], **Kathryn V. Papp,**
Amariglio, PhD[1,6], **Adrian Schembri, DPsych**[7], **Tanya Chenhall, MA**[7], **P**
Paul Aisen, MD[8], **Bradley T. Hyman, MD, PhD**[1], and **Reisa A. Sperling, M**

[1]Department of Neurology, Massachusetts General Hospital, Harvard Medic
MA USA

[2]Boston University, Boston, MA USA

[3]University of Chicago, Chicago, IL USA

[4]Commonwealth Scientific and Industrial Research Organization (CSIRO), e
Western Australia



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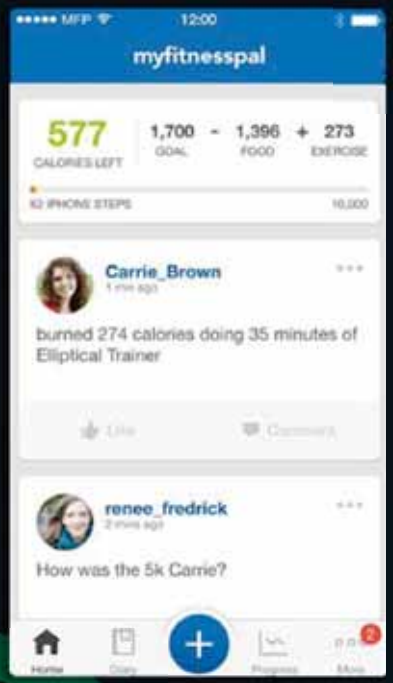
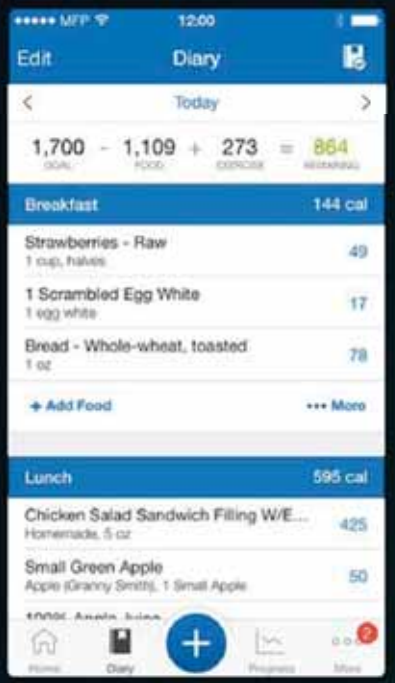
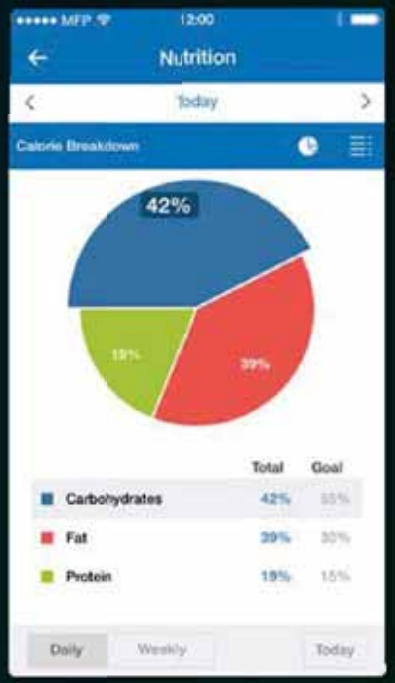
Monitor changes in patterns, or respond to alerts

myfitnesspal







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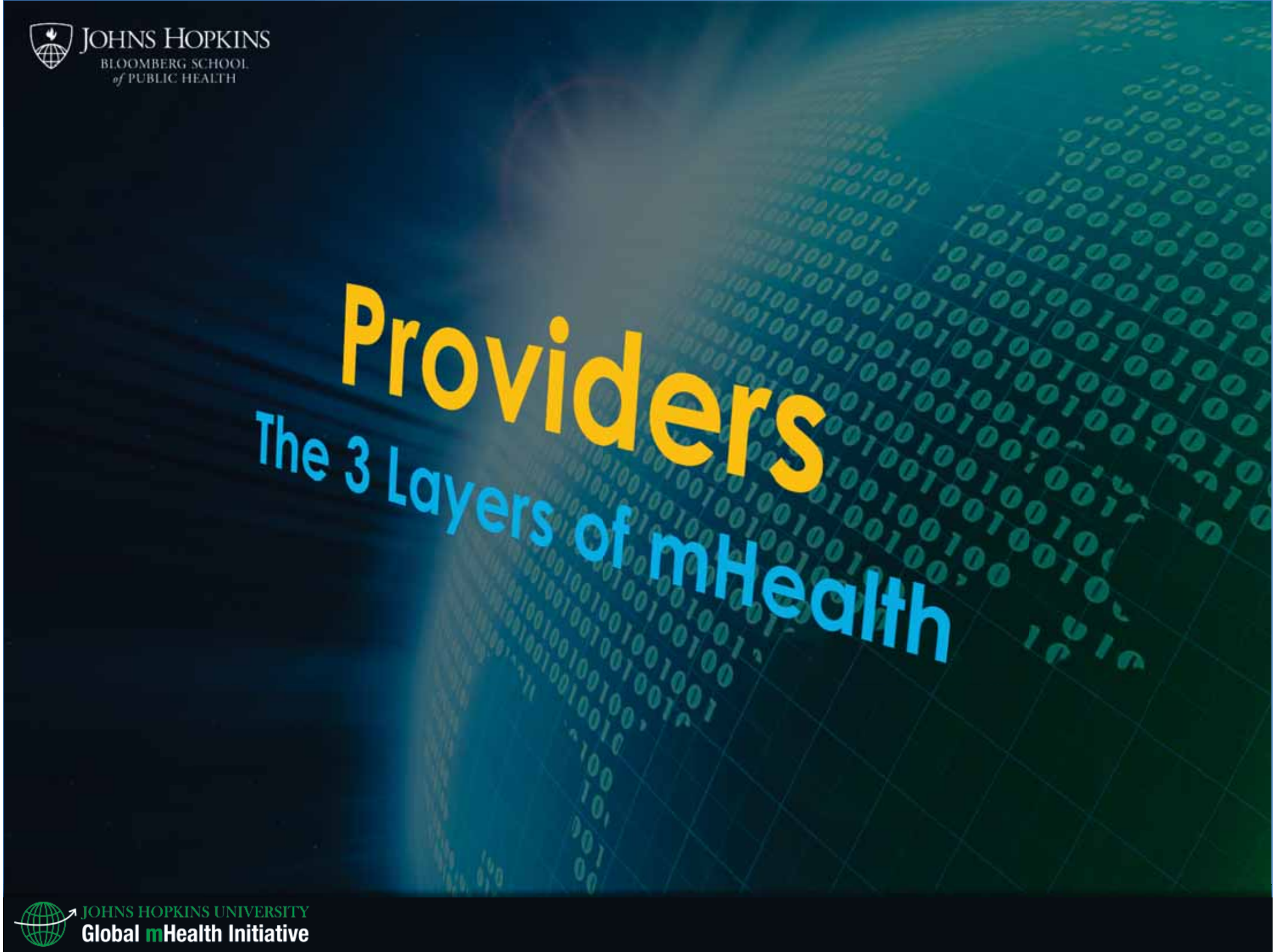
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Providers
The 3 Layers of mHealth
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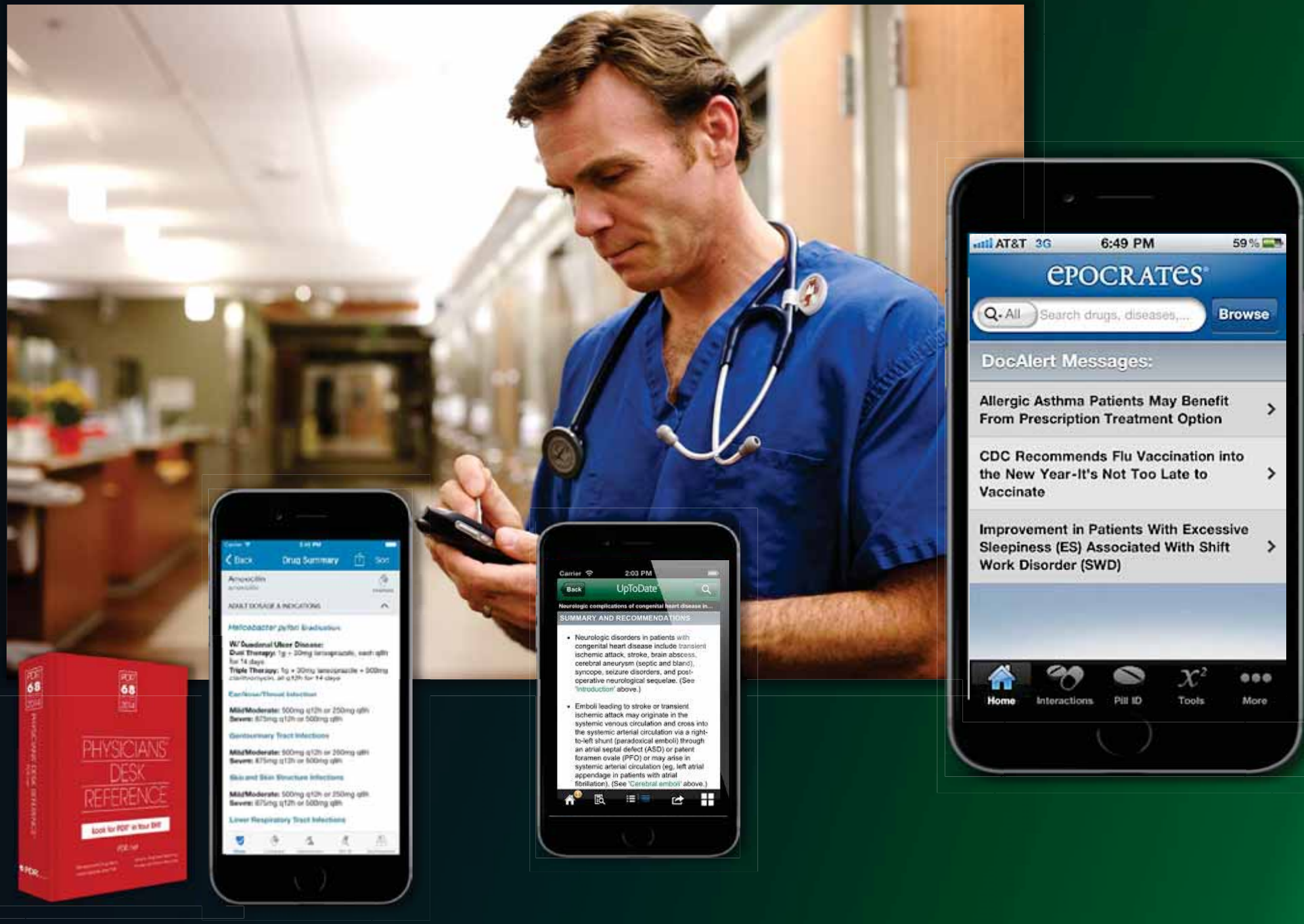

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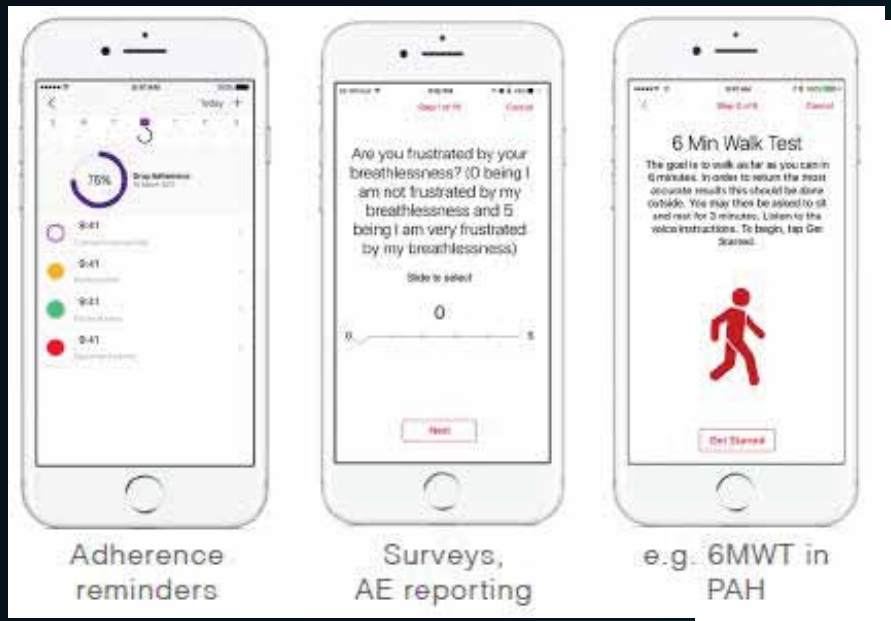
New paradigms linking patients & clinicians

"Medical charts, vitals, clinical images, scans and other critical information - all in one place and easily accessible at a touch of a finger."



Patient Solutions ⟷ **Provider Solutions**

WORKFLOW INTEGRATION

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medopad
empowering mobile health

Promising early data suggests impact

Patient monitoring solutions savings carefully documented in numerous controlled randomised health economics studies:

Case Report *Provider Organisation*	Technology	Outcome measures	Number of patients	Outcome
CHF patients *Brockton Hospital/Signature Healthcare*	Blood pressure cuff and scale both linked via Bluetooth to an iPad	Hospital readmission medical expenses	25-30 per month	No readmissions $216k in cost savings
Asthma patients *Multiple sites/studies (12 studies)*	Bluetooth enabled inhaler sensor	Hospital admissions, ER visits, pharmaceutical costs	96,631 across all 12 studies	$2,101 less per year per patient in total costs. 79% reduction in rescue inhaler use
Chronic Heart Failure *Germany*	Daily measures weight, blood pressure, ECG, thorax impedance and breathing rate, oxygen saturation	Patients measurement self-management. Reduce morbidity and mortality	7,220 patients being monitored across 7 projects	20% ⇩ mortality, 66% ⇩hospital stays, 21% ⇩ readmissions

Source: Goldman Sachs (5-Feb-2016)

medopad

MeraDoctor

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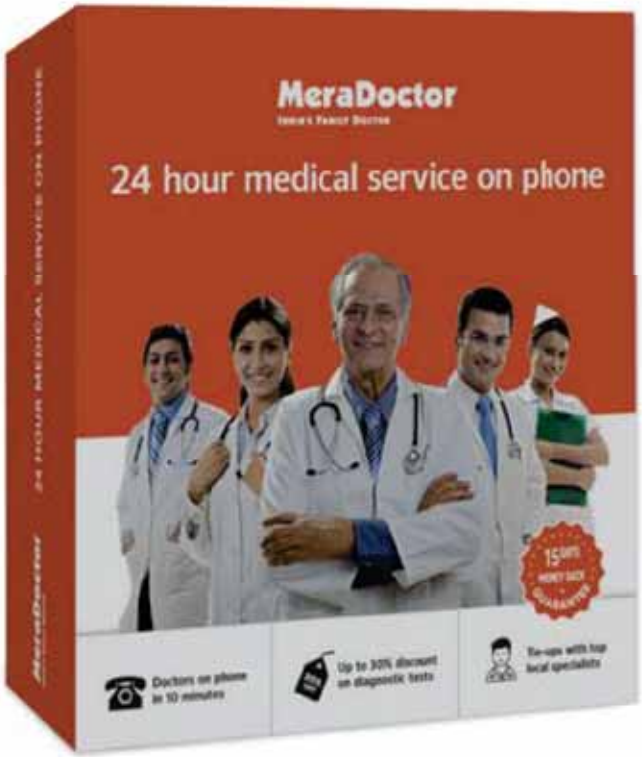
(Pay only ₹ 200 from your prepaid or postpaid bill!)



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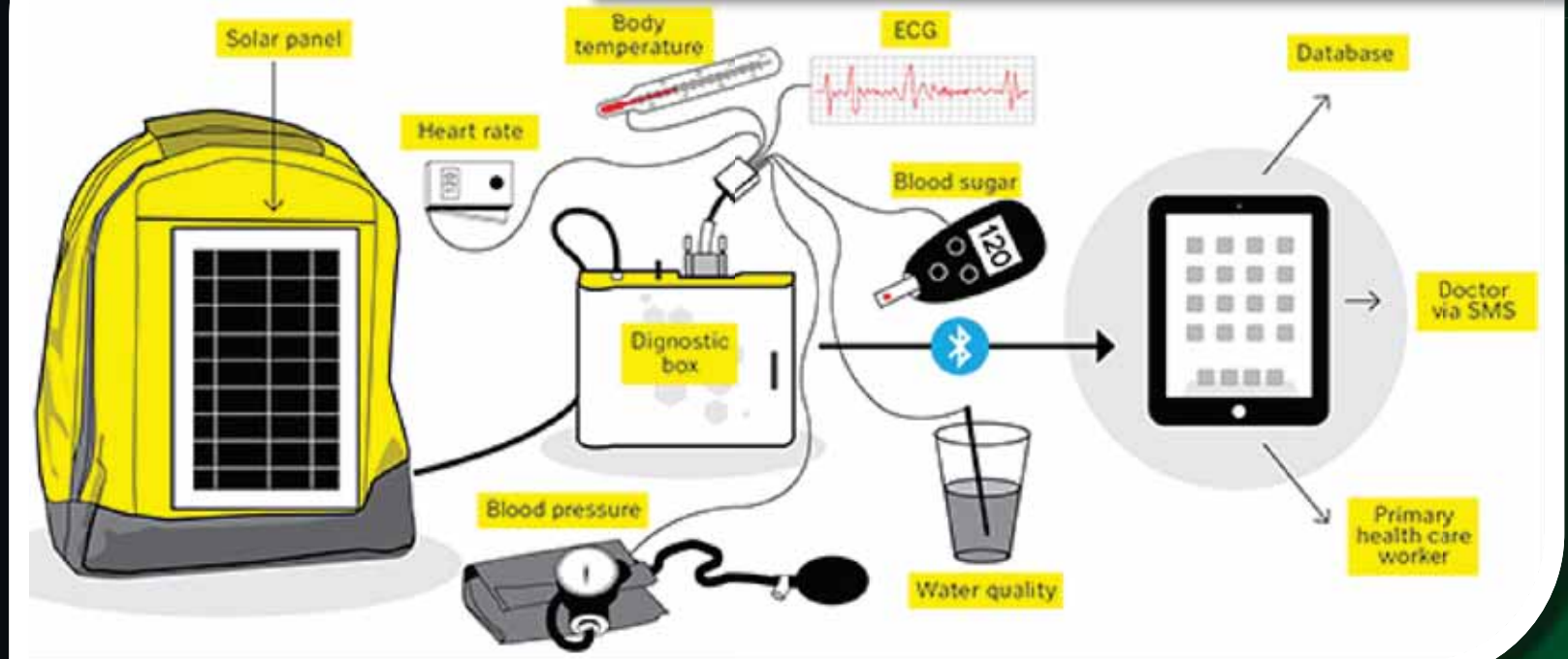

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NCBI Resources How To alabriq

PubMed.gov
US National Library of Medicine
National Institutes of Health

PubMed

Advanced

Abstract

Send to:

Int J Nurs Stud. 2015 May;52(5):963-9. doi: 10.1016/j.ijnurstu.2015.01.016. Epub 2015 Feb 8.

Can simple mobile phone applications provide reliable counts of respiratory rates in sick infants and children? A applications.

Black J[1], Gerdtz M[2], Nicholson P[3], Crellin D[4], Brown

Author information

Abstract

BACKGROUND: Respira
incorrectly. Mobile phone
may improve the accurac

OBJECTIVES: The study
respiratory timer approac

The touch screen is tapped each time the child inhales.

Once enough consistent taps have been made an animation of a baby breathing is displayed.

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Mobile Academy for Frontline Health Workers

Sulekha Devi, shows her Mobile Academy Certificate

Use IVR technology that is handset independent, audio based and accessed via a simple voice call to train Bihar's 200,000 community health workers to deliver life-saving information to millions of families

- Mobile Academy is a training course on maternal and child health
- Covers 33 months - from pregnancy until the child is 2 years of age
- Designed to expand CHWs' knowledge of life saving preventative health and enhance their communication skills
- Divided into chapters, lessons and quizzes
- Accumulative pass/fail score
- Printed certificate for all those who pass

BBC MEDIA ACTION

TRANSFORMING LIVES THROUGH MEDIA AROUND THE WORLD

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Extending Reach of Clinical Care to Populations: Screening, Post-discharge Follow-up, Home Visits

Challenges

- Community-based enrolment & counseling
- Population denominator
- Scheduling & reminders
- Protocol adherence
- Linkages to care → Referrals and Follow-up

Open Smart Register Platform (OpenSRP)

mPOWERING FRONTLINE HEALTH WORKERS

World Health Organization

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OpenMRS

unicef

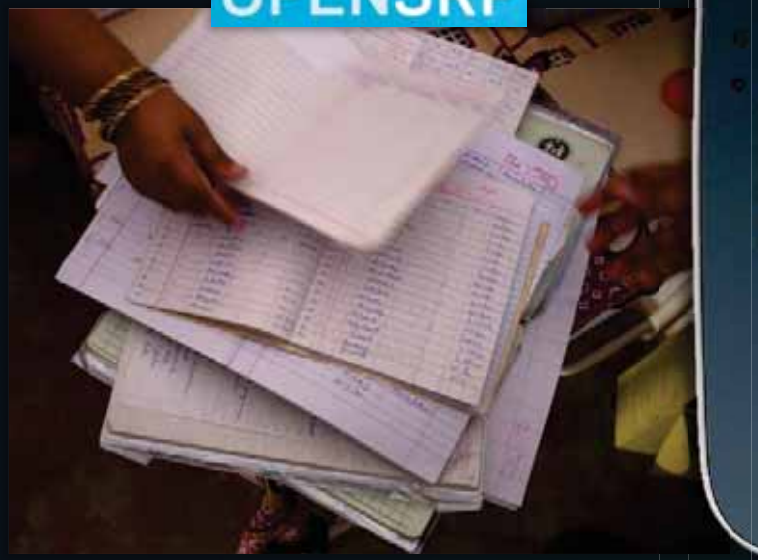
THE EARTH INSTITUTE COLUMBIA UNIVERSITY

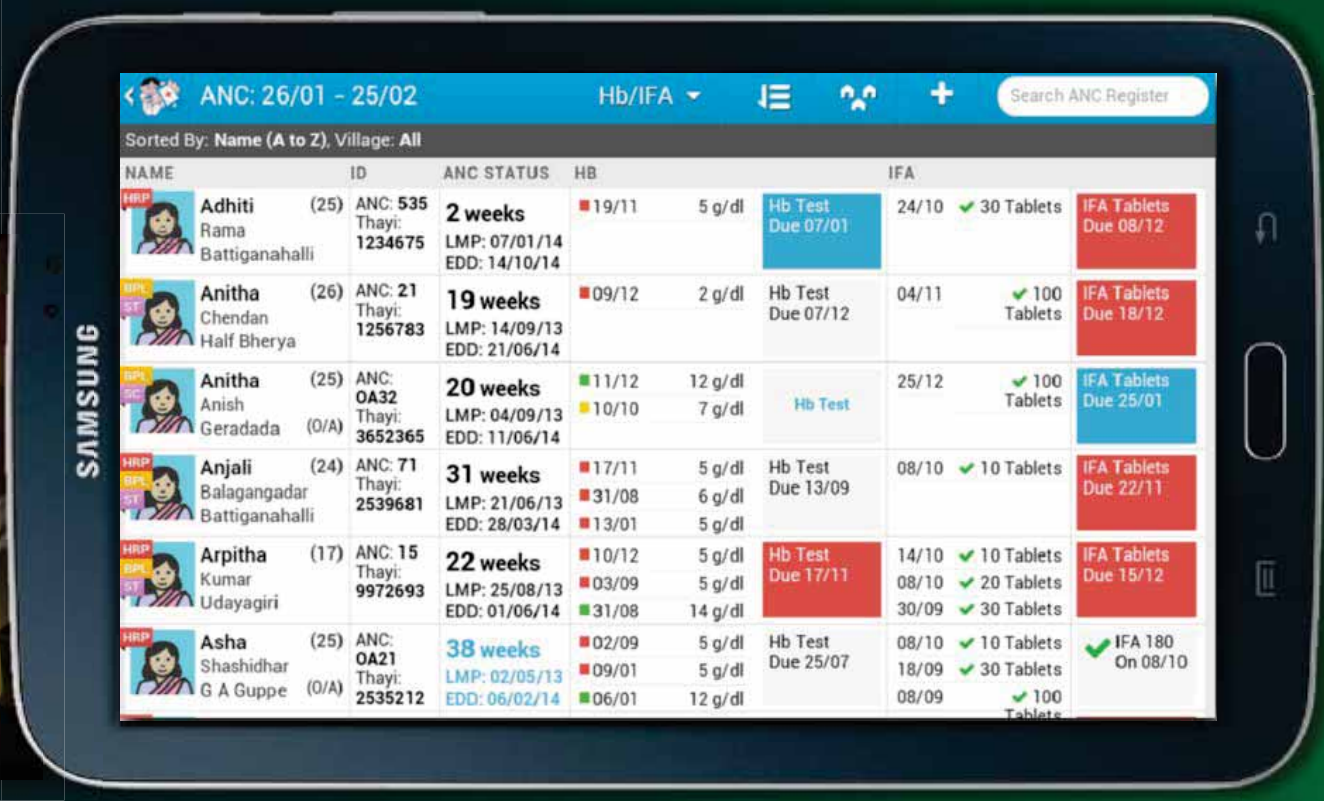
ThoughtWorks

wellcome trust

OpenSmartRegister mimics standard patient line-listings used by Community Outreach Workers around the globe, with "smart" digital features...

OPENSRP





- SMSs alert the respective Health Workers with an Application Notification to their Tablet.

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of PUBLIC HEALTH
Systems
The 3 Layers of mHealth
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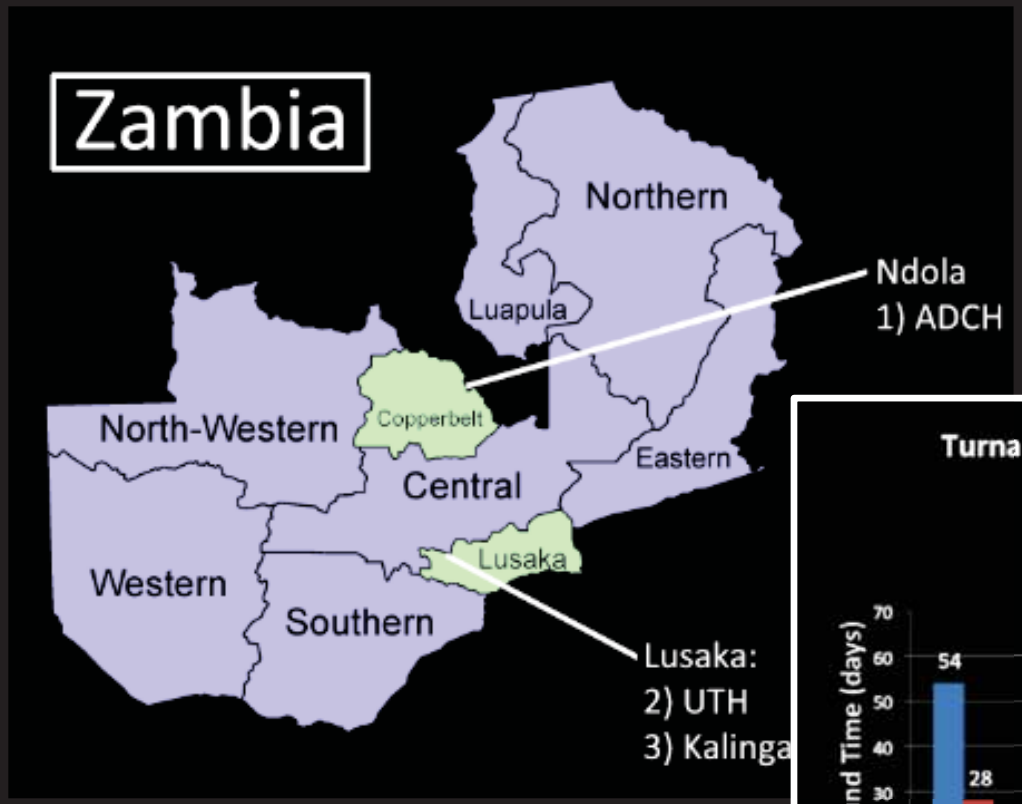
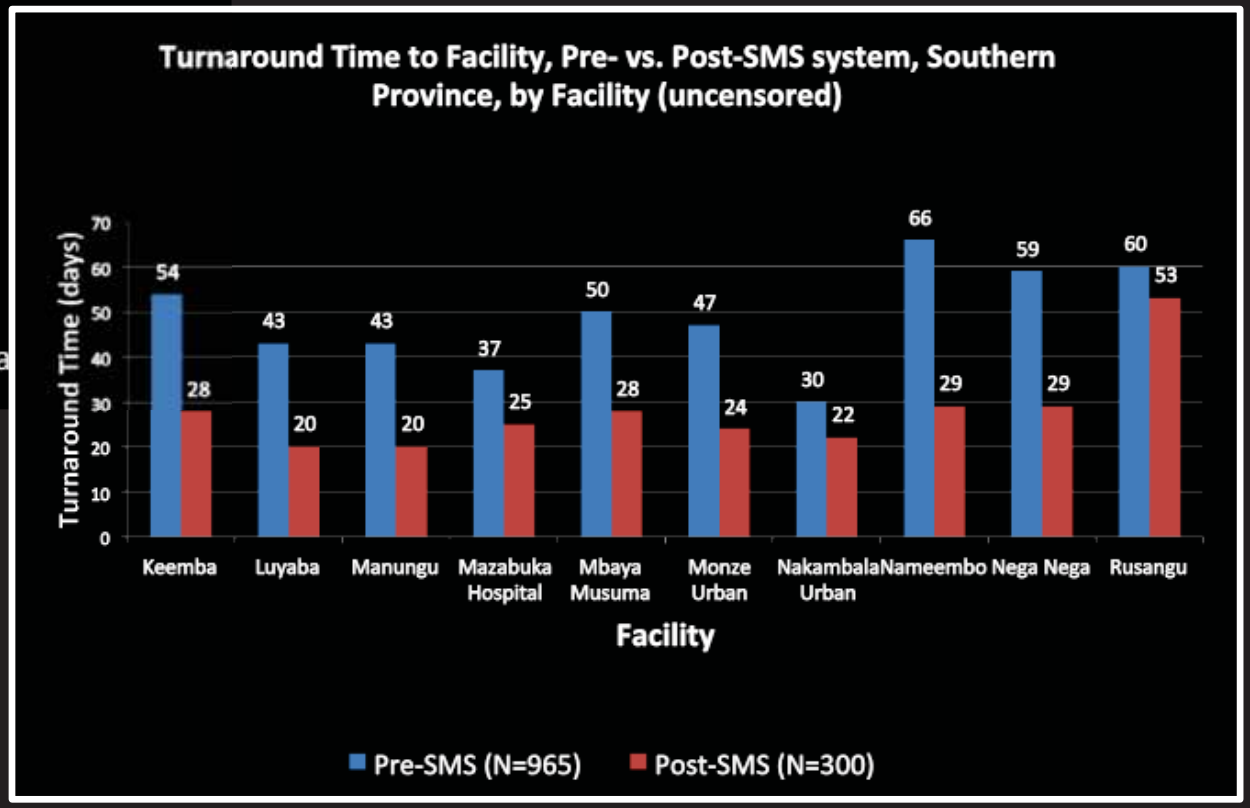
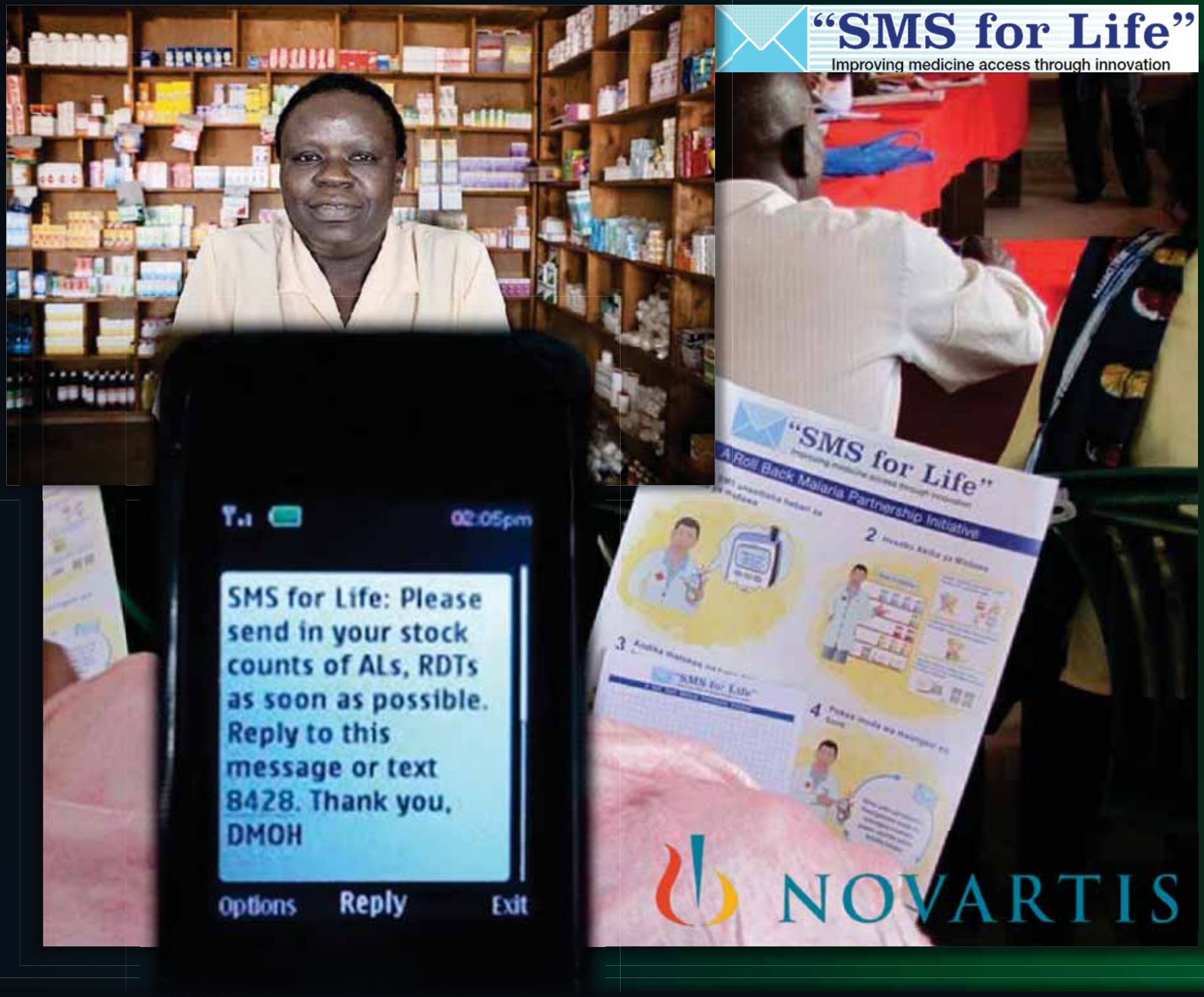
Program Mwana:

SMS to reduce Infant HIV PCR Turnaround Time

(*Median 46% Reduction in DAYS*)







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Simple interventions = Significant Impact !

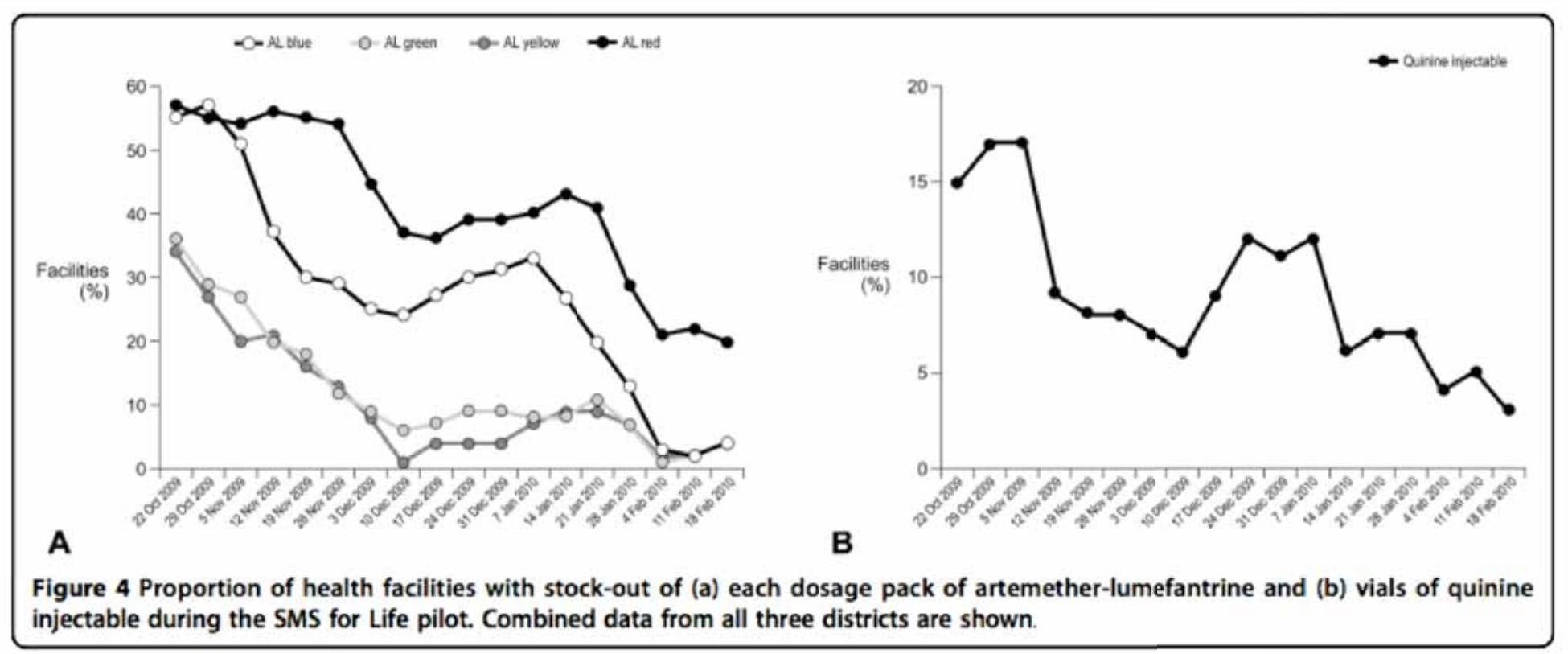


Figure 4 Proportion of health facilities with stock-out of (a) each dosage pack of artemether-lumefantrine and (b) vials of quinine injectable during the SMS for Life pilot. Combined data from all three districts are shown.

Barrington et al. Malaria Journal 2010, 9:298
http://www.malariajournal.com/content/9/1/298

Tools to Monitor Population Health

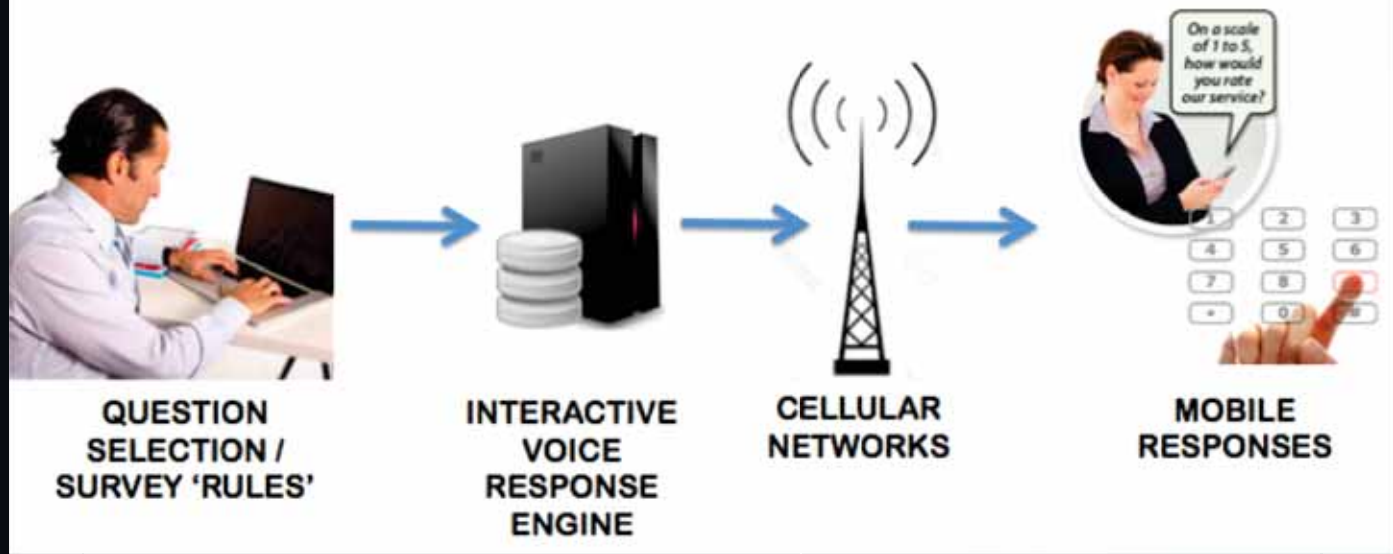
SAGES provides national-grade biosurveillance and outbreak detection, using sophisticated tracking and predictive analytics to identify unusual patterns of disease.

Population-level text message / "robocall" surveys to estimate risk factors

10 Countries

Bloomberg Data For Health Initiative

Noncommunicable Disease Risk Factor Surveillance



World Health Organization

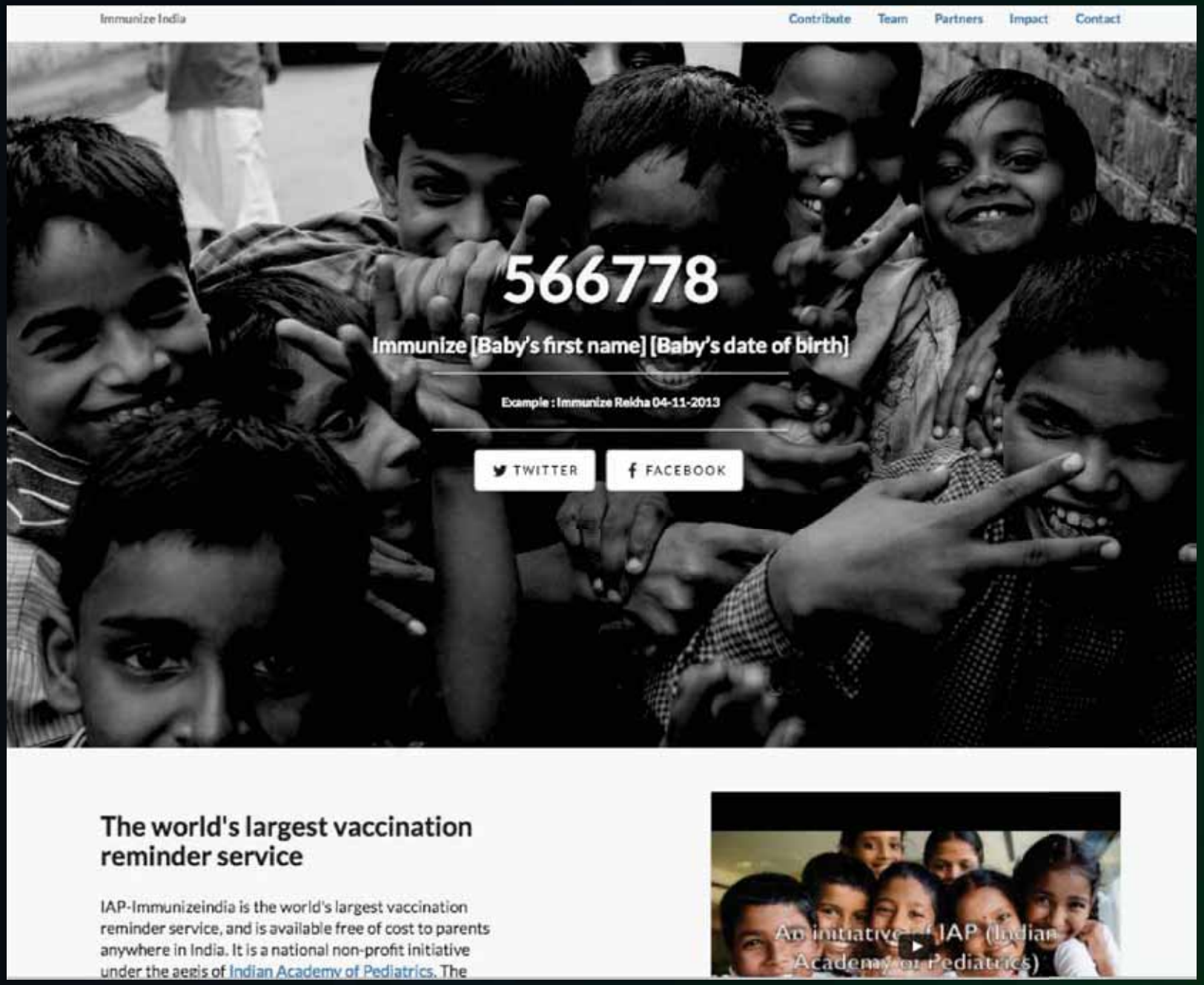
Johns Hopkins Bloomberg School of Public Health

CDC Foundation — Helping CDC Do More, Faster

Department of Health & Human Services USA

CDC Centers for Disease Control and Prevention

Johns Hopkins University Global mHealth Initiative


Immunize India
Contribute
Team
Partners
Impact
Contact
566778
Immunize [Baby's first name] [Baby's date of birth]
Example : Immunize Rekha 04-11-2013
TWITTER
FACEBOOK
The world's largest vaccination reminder service
IAP-Immunizeindia is the world's largest vaccination reminder service, and is available free of cost to parents anywhere in India. It is a national non-profit initiative under the aegis of Indian Academy of Pediatrics. The

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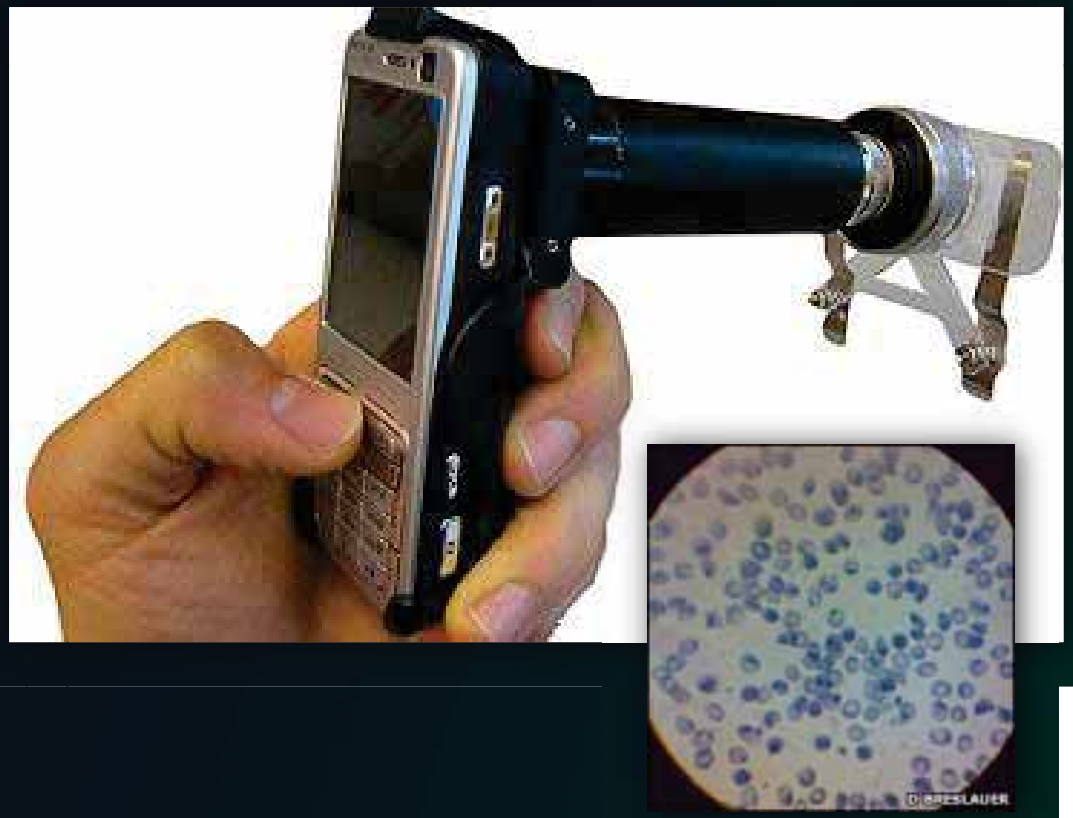
Faster Networks, Cheaper "Tech"

New frontiers!

Remote, Point-of-care Diagnostic tools



Breslauer D., et al. 2009 Mobile Phone Ba

OScan

Screening tool for oral lesions

PraKash Lab. Stanford University

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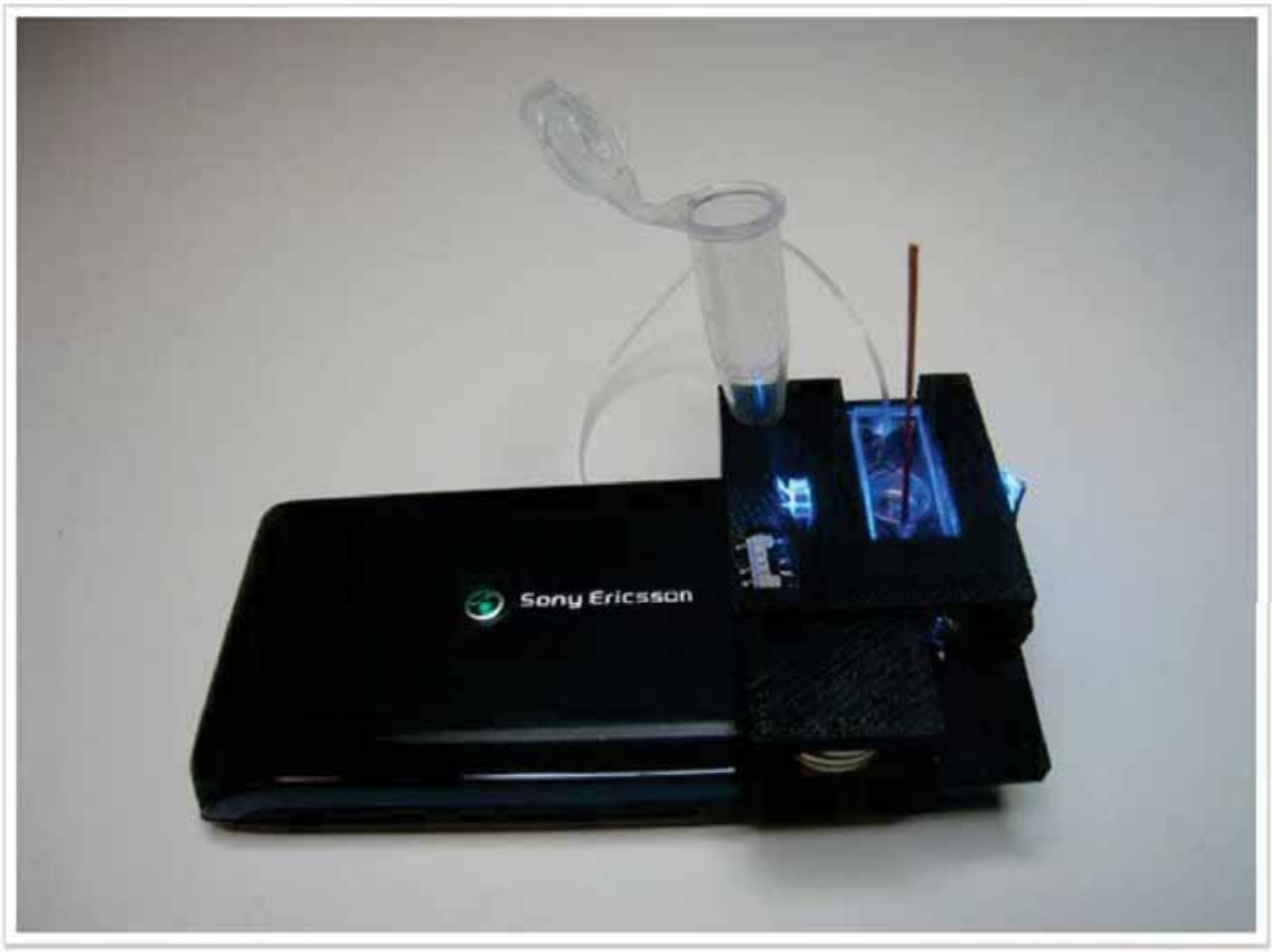
FDA is approving numerous "mobile" alternatives to clinical devices...

A .com
Q ttp://mobihealthnews.com/9459/west-wireless-health-announces-sense4baby-prototyp

Mobile-based Flow Cytometry



Opto-fluidic Fluorescent Imaging Flow Cytometer on a Cellphone

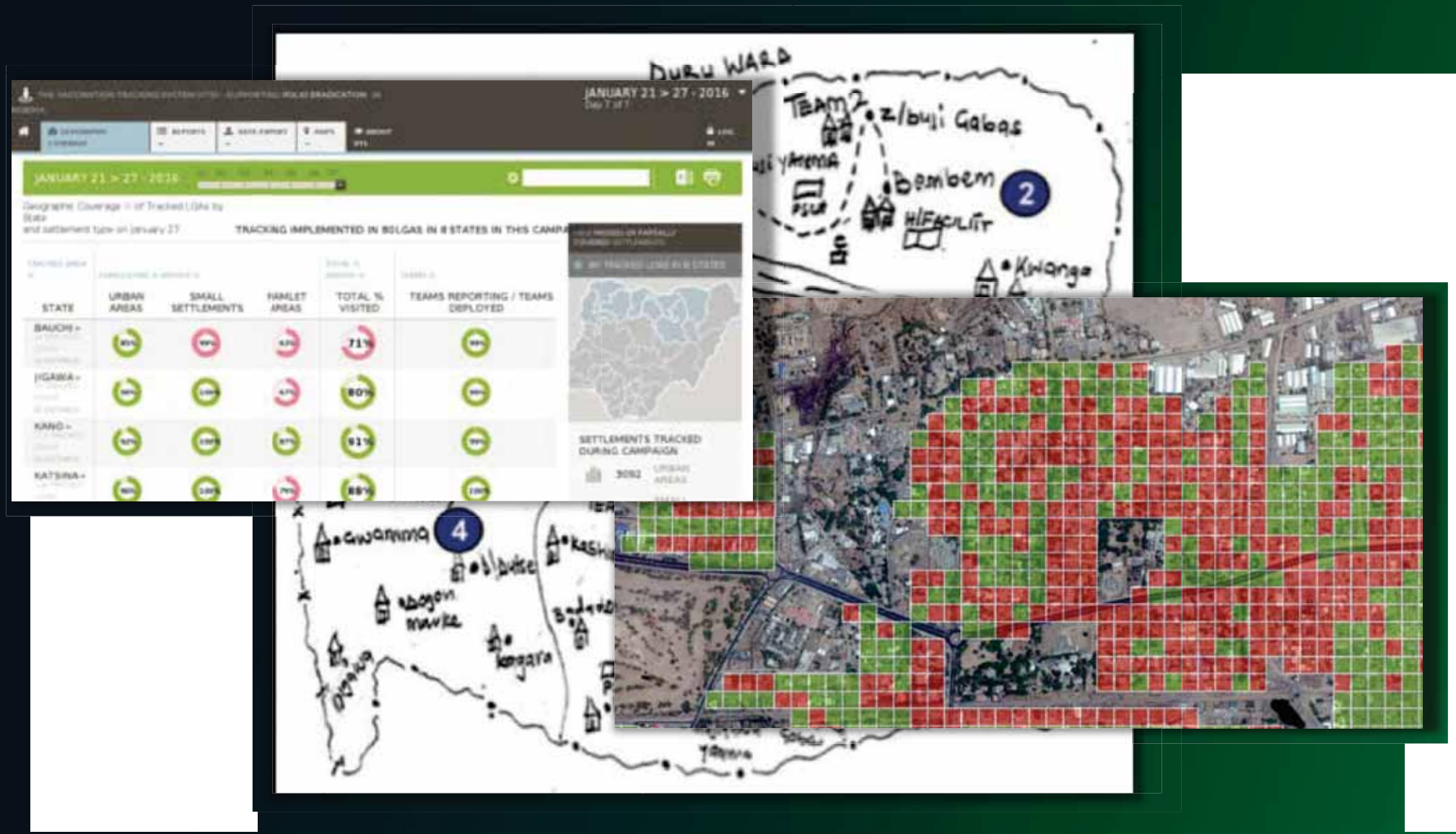
Even larger sample volumes are possible with this device. It images cells dynamically as they flow through a microfluidic channel past the image sensor. A "movie' is captured as the cells flow and processed mathematically to derive cell count and density. Sample volume is limited only by how much time can be allocated for the test. An important application for this type of testing might be for monitoring HIV+patients. It is expected that this model will play significant role in global health and environmental monitoring.

HOLOMIC LLC

Mobile microscopy wherever you need it

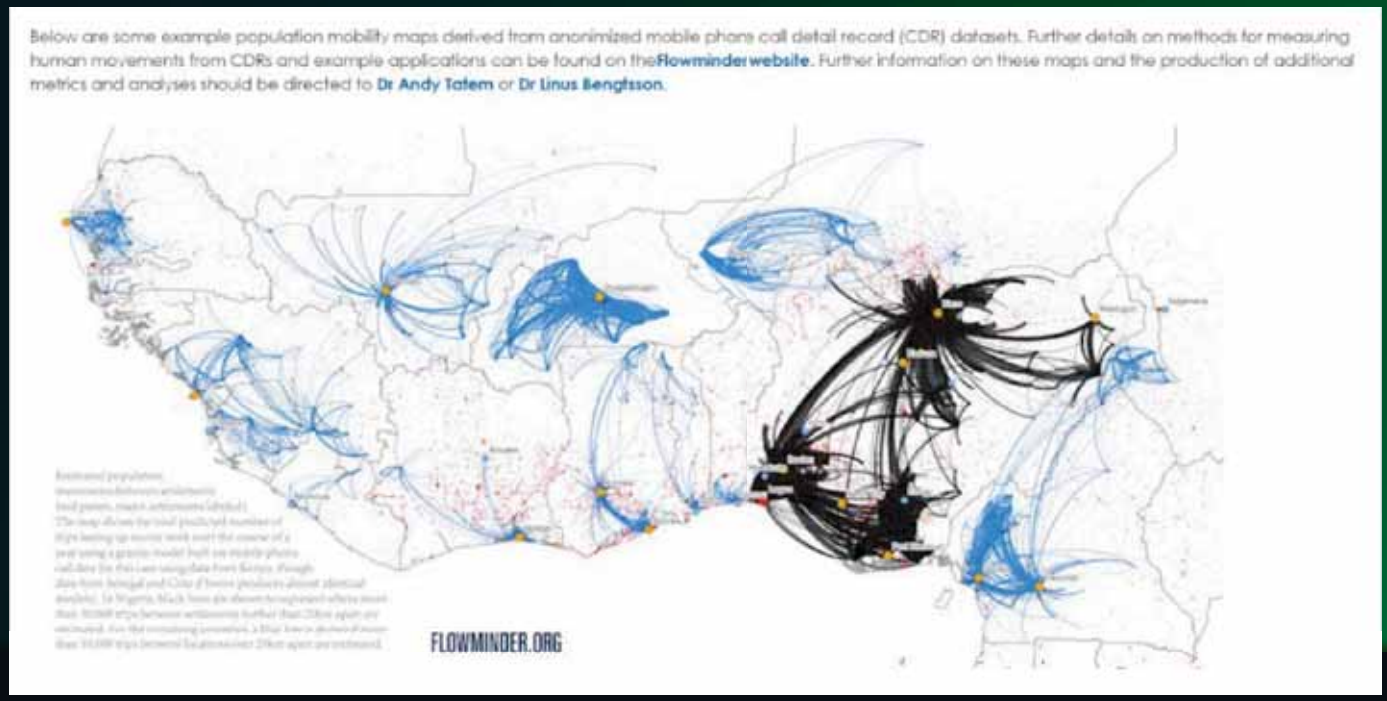
Ozcan Research Group (Nano-Bio Photonics / UCLA): Optical imaging techniques for point of-care diagnostics Hongying Zhu , Serhan O. Isikman , Onur Mudanyali , Alon Greenbaum and Aydogan Ozcan Lab Chip, 2012, Advance Article

Real-time geospatial data use for program optimization



Machine learning and AI : Field potential of "big data"

- Dynamic, Learning Systems which:
  - Refine risk models as new outcomes are added
  - Task shift burden of data interpretation
  - Can be used for system optimization AND health outcome tracking
  - Leverage META-DATA captured by devices

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Take-Home
Messages
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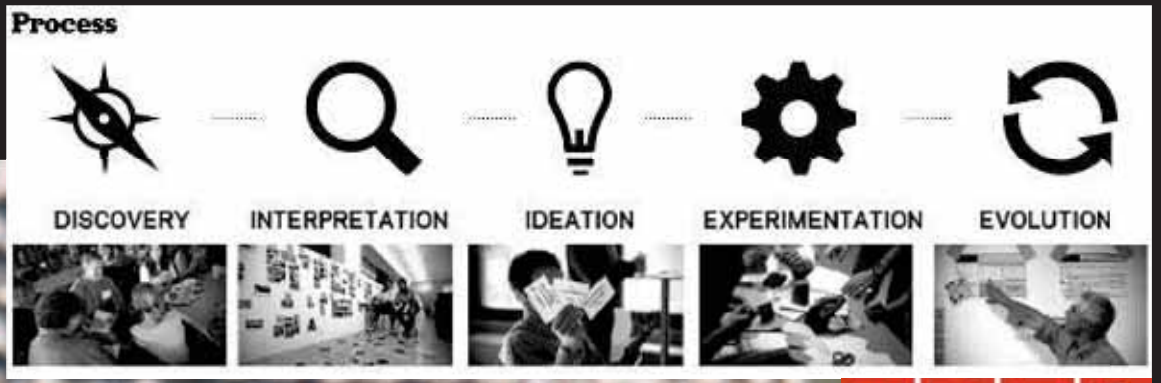
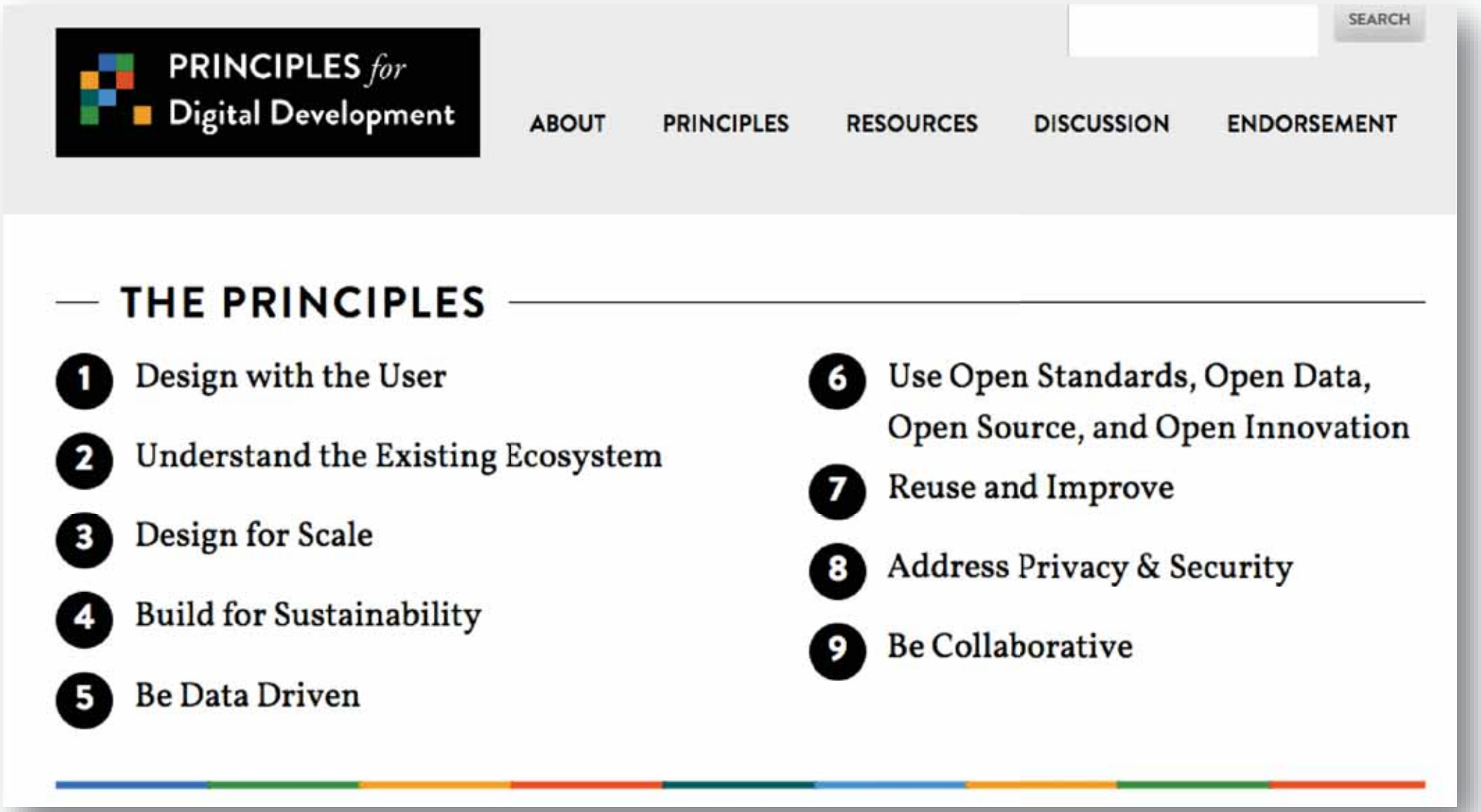
Human-Centered Design



"...Human-centered design is about listening.... When we better understand the realities of people's lives, we are able to design and deliver solutions that are useful to them."

– Melinda Gates, May 20, 2015



http://digitalprinciples.org/

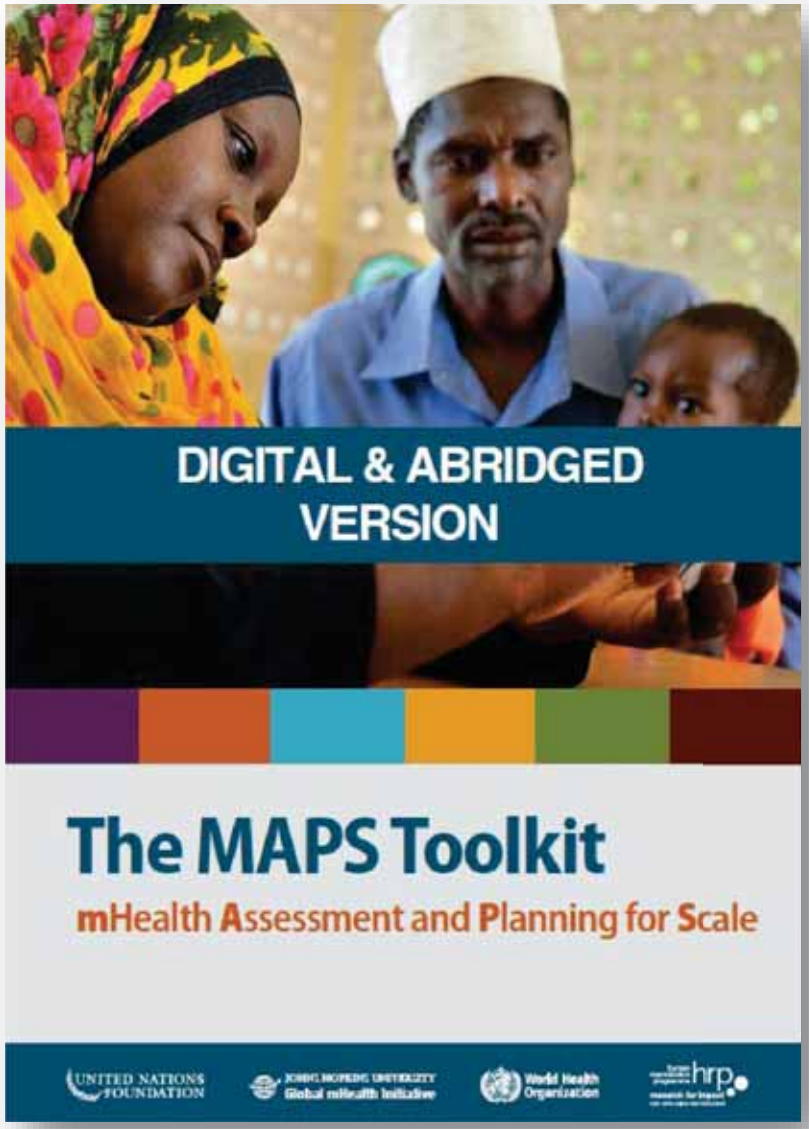
Planning an information systems project

A TOOLKIT FOR PUBLIC HEALTH MANAGERS

OPTIMIZE

World Health Organization

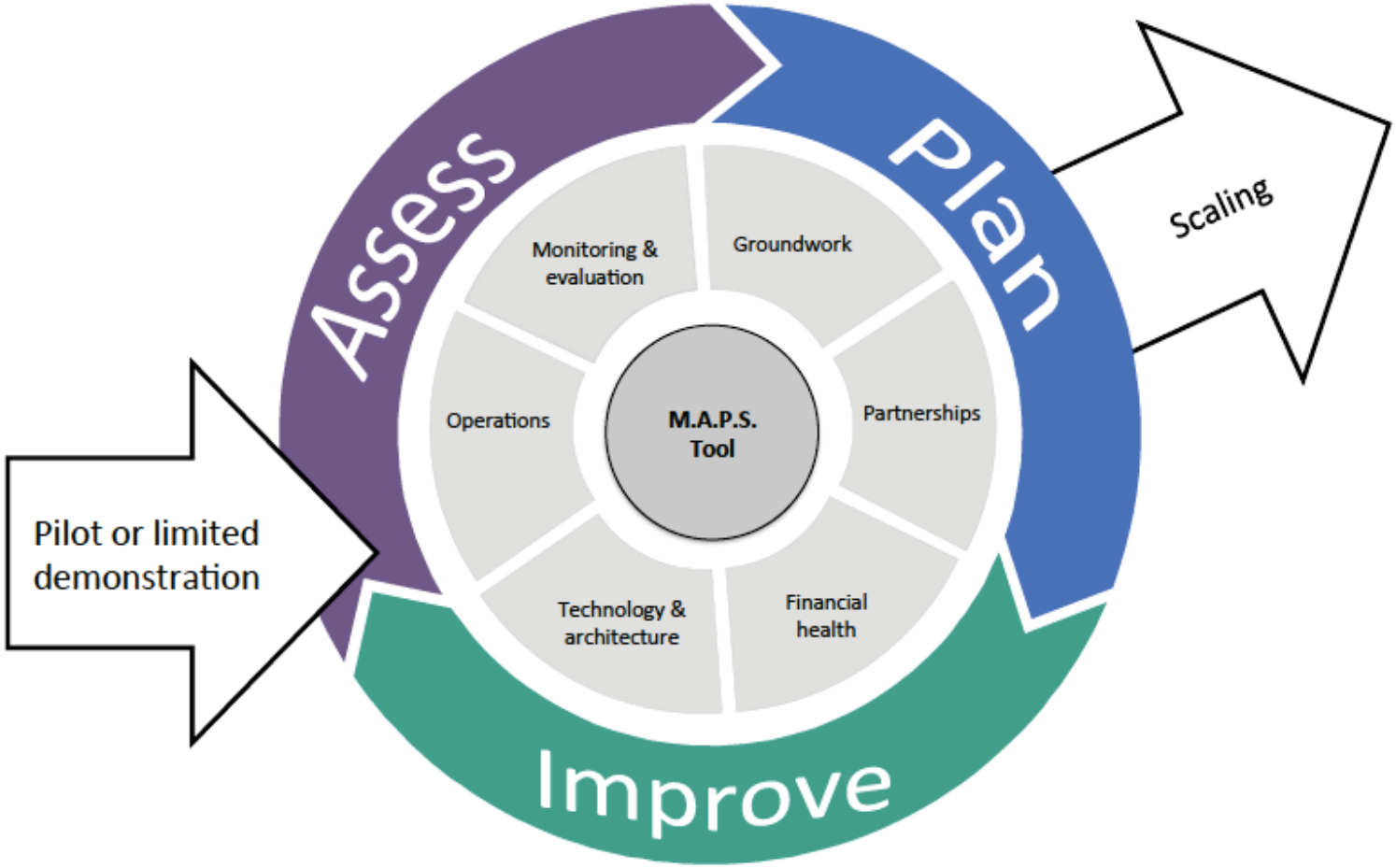
PATH



http://tinyurl.com/WHO-MAPS

The **M.A.P.S.** Tool

mHealth **A**ssessment and **P**lanning for **S**cale



- *To assess scalability by reviewing key considerations and activities*
- *To plan for future activities after identifying areas of weakness*
- *To improve on progress through scale*

World Health Organization

human reproduction programme hrp research for impact
UNDP·UNFPA·UNICEF·WHO·WORLD BANK

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CHAPTER 2

Framework for a national eHealth vision

A national eHealth vision explains why a national approach to eHealth is needed, what a national eHealth plan will achieve, and how it will be done (Figure 3). Answering these questions constitutes the major work of strategy development.

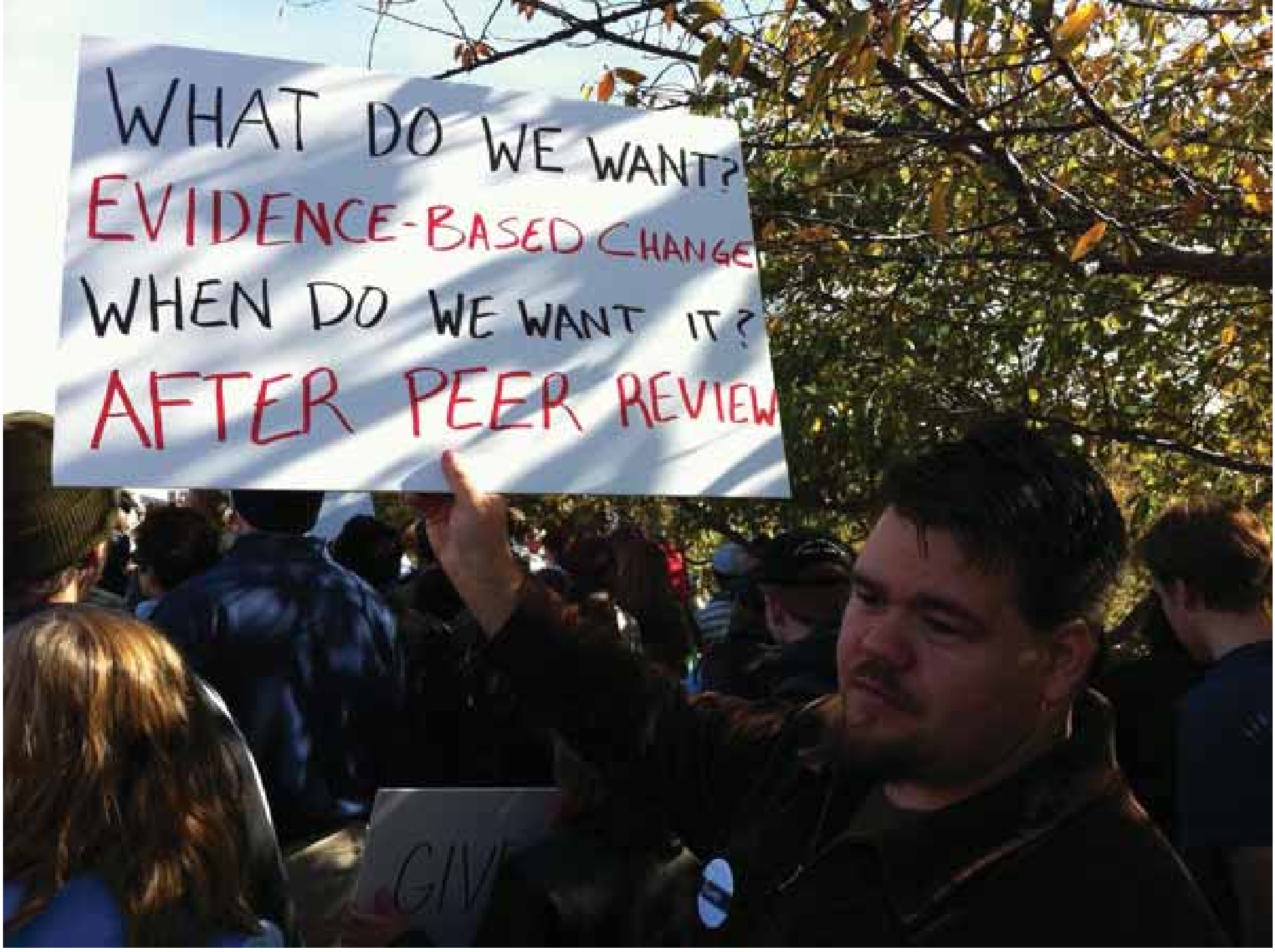
Figure 3. A framework for a national eHealth vision

2.1 Strategic context

A national eHealth vision emerges from the broader context of a country's health and development goals, providing the rationale for why eHealth is needed. Governments using this Toolkit already have a preliminary basis for undertaking a national strategy development process. This step confirms that rationale, and ensures that the broader context is also considered.

The strategic context includes:

- current and likely direction of population health, and of specific populations
- structure and status of the health system
- national health strategy, goals and priorities
- national development priorities (social and economic).


WHAT DO WE WANT?
EVIDENCE-BASED CHANGE
WHEN DO WE WANT IT?
AFTER PEER REVIEW

mHealthEvidence.org / mHealthKnowledge.org

Global Digital Health Forum

mHealthKnowledge®

by KHealth.

Advancing mHealth by connecting global health professionals to people, products, and ideas.

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Continue to grow the evidence base. Innovation can be subjected to rigorous evaluation

BMJ
British Medical Journal

mERA:

mHealth Evaluation, Reporting and Assessment Guidelines

Guidelines to complement PRISMA / CONSORT

A pragmatic approach that promotes high-quality reporting of mHealth innovation research, across varied study designs to facilitate evidence synthesis and development of guidance

- **Domain 1:** Research Methodology Reporting
- **Domain 2:** Essential mHealth (Technology, Functionality, Delivery) Reporting

Domain	Description	No.
Domain 1.1	General Reporting and Methodology Criteria	23
Domain 1.2	Quantitative Criteria	4
Domain 1.3	Qualitative Criteria	3
Domain 2	mHealth Criteria	14

World Health Organization mTERG

M&E FOR DIGITAL HEALTH

equator network

Table 1 | mHealth evidence reporting and assessment (mERA) guidelines, including mHealth essential criteria

Criteria	Item no	Notes	Page no where item is reported
Infrastructure (population level)	1		
Technologyplatform	2		
Interoperability/ Health information systems (HIS) context	3		
Intervention delivery	4		
Intervention content	5		
Usability/content testing	6		
User feedback	7		
Access of individual participants	8		
Cost assessment	9		
Adoption inputs/ programme entry	10		
Limitations for delivery at scale	11		
Contextual adaptability	12		
Replicability	13		
Data security	14		
Compliance with national guidelines or regulatory statutes	15	Mechanism used to assure that content or other guidance/information provided by the intervention is in alignment with existing national/regulatory guidelines and is described	
Fidelity of the intervention	16	Was the intervention delivered as planned? Describe the strategies employed to assess the fidelity of the intervention. This may include assessment of participant engagement, use of backend data to track message delivery and other technological challenges in the delivery of the intervention	

Criteria	Item no
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Fidelity of the intervention	16

Monitoring and Evaluating Digital Health Interventions

A practical guide to conducting research and assessment

World Health Organization
human reproduction programme hrp research for impact
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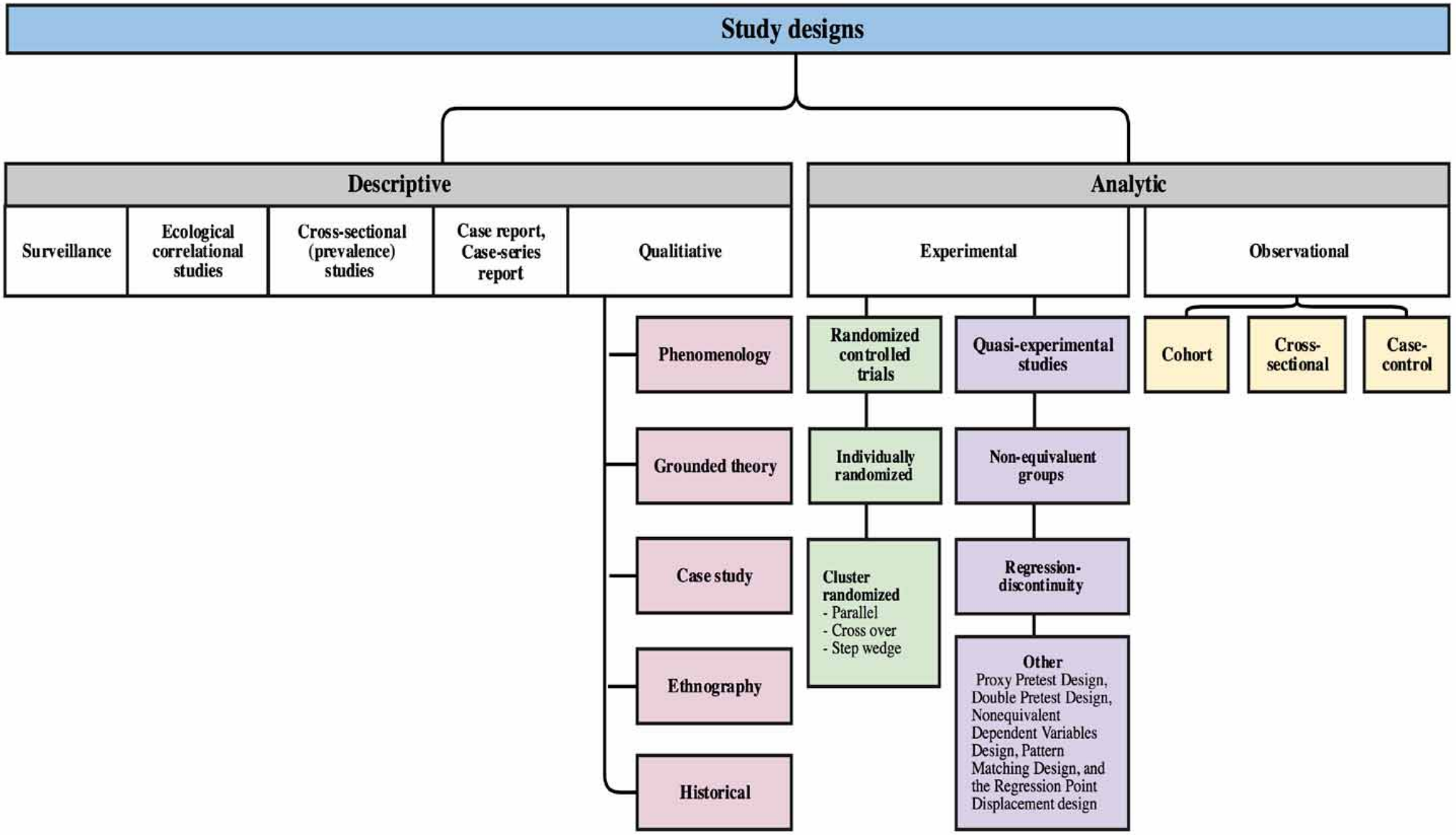
UNITED NATIONS FOUNDATION

Which Design is Appropriate for Your Project At THIS TIME ?



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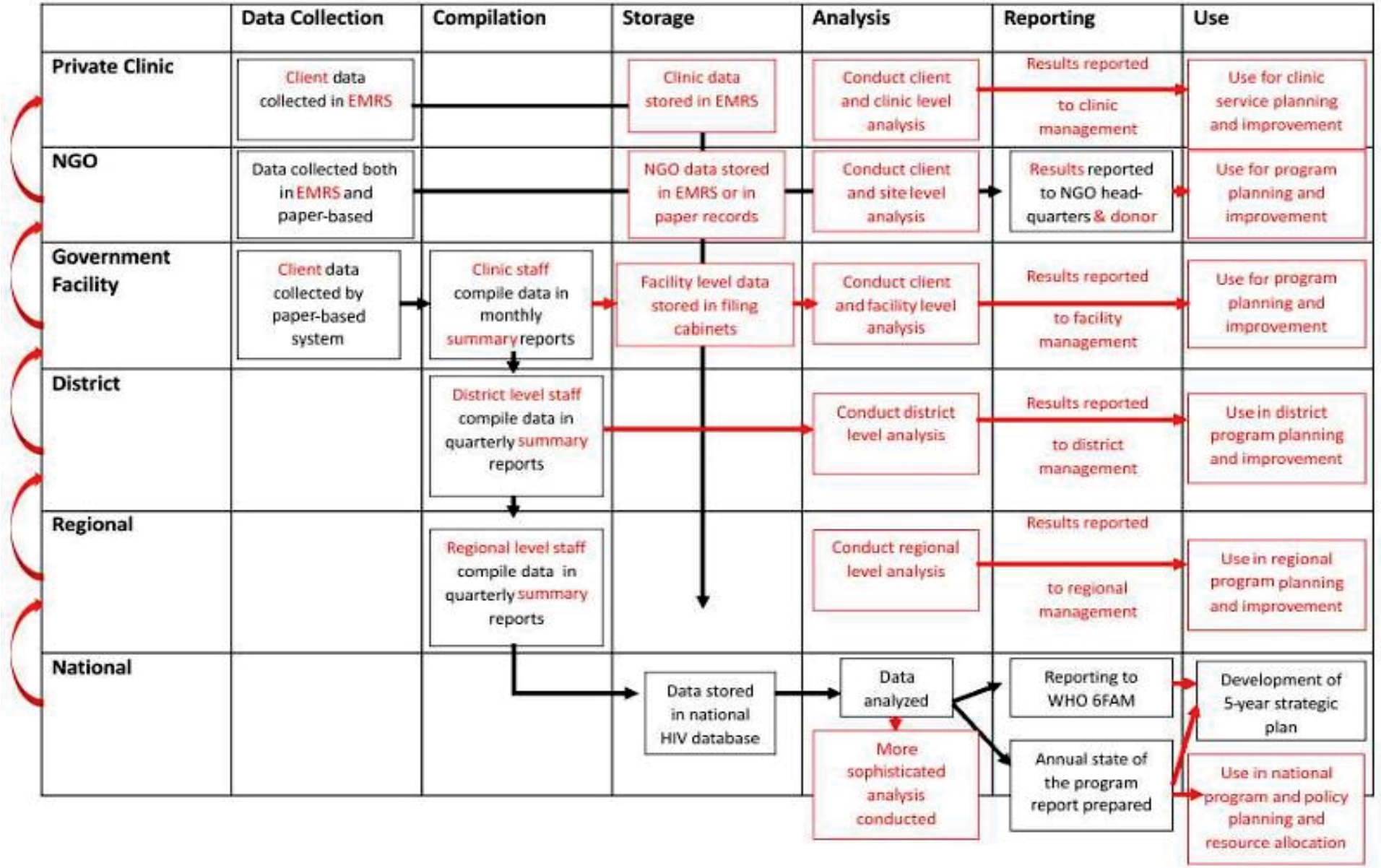
Data Quality Assessment Process



M&E FOR DIGITAL HEALTH

DIFFICULTY OF SCALING

COMPLEXITY OF ENGAGED ECOSYSTEM

INSTITUTIONAL / HEALTH SYSTEM INERTIA

THRESHOLD OF EVIDENCE

INCREMENTAL CHANGE

DISRUPTIVE INNOVATION

Degree to which the mHealth strategy changes the status quo

Draw inspiration from around the globe to understand what is “m”POSSIBLE

Thank you.

alabriqu@gmail.com Twitter: @alabriqu
@jhumhealth