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MOBILE DATABASE · REPORT

MHEALTH PERU

Author / organisation	Walter Curioso
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Improving Global Public Health Through Devices, Sensors and Mobility

Kristin M. Tolle
Director, Intuitive Interactions Team, Microsoft External Research
Microsoft Research



Healthcare Challenges and Investments

ACCESS
Only 1.6B people have adequate coverage

DEMOGRAPHICS
Aging populations, growing middle class

COSTS
<20% of government outlays in many nations, rising fast

Growing Stressors on Global Healthcare

LABOR SHORTAGES
Dearth of qualified healthcare workers

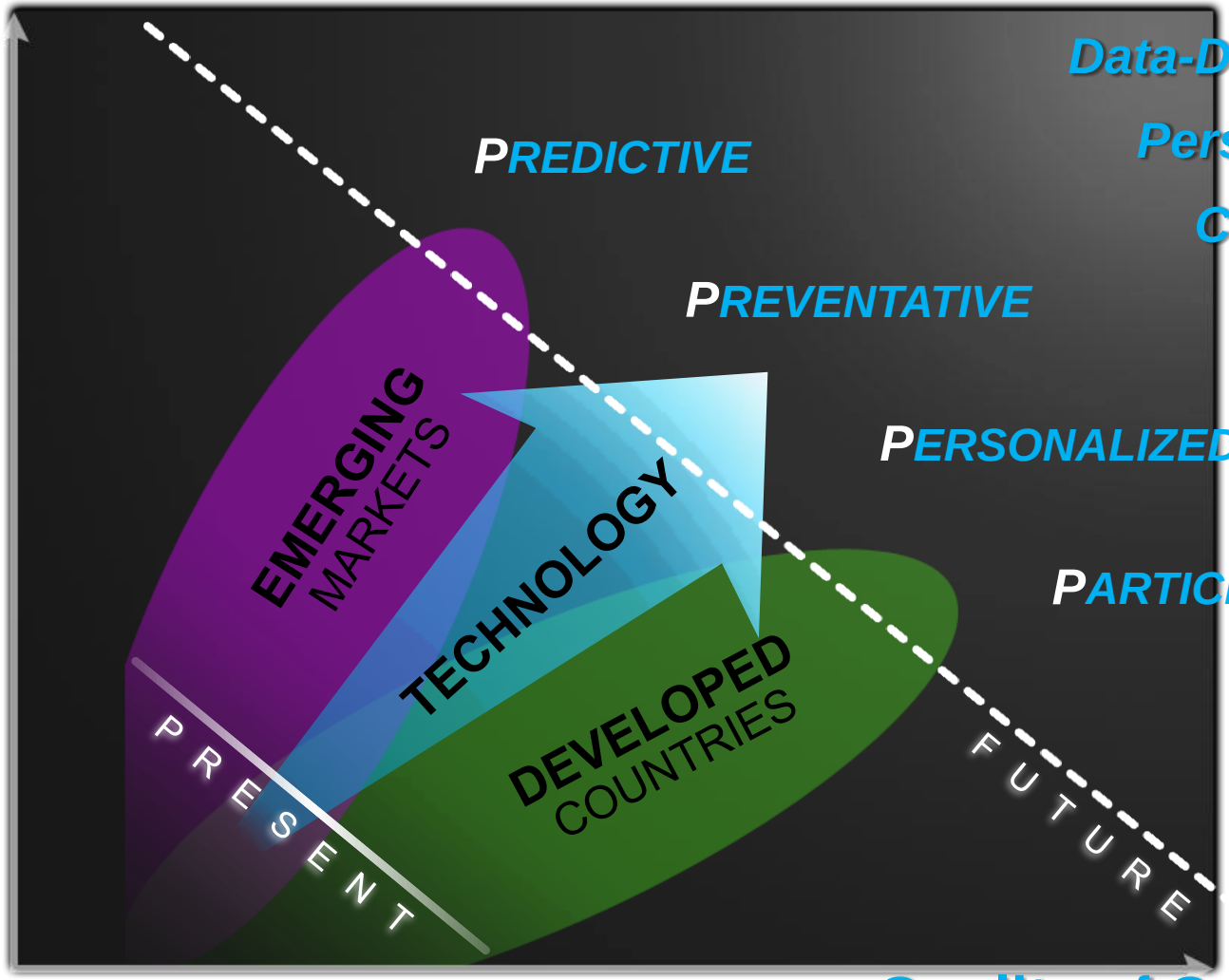
QUALITY
Healthcare systems fragmented and siloed

CONSUMERISM
Growing expectations at every level

Technology Scaling Healthcare

Number of People Served Per Doctor





Data-Driven Medicine

Personal Wellness

Connected Care

Quality of Care

Anticipating the Future: **Rural Environments**

Low-cost, Automated Diagnosis



Solutions in Clients + Cloud



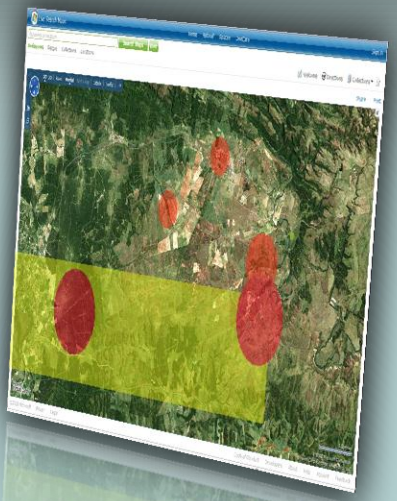
Global Resources, Local Care



Personalized Drug Delivery



Geo-Spatial View of Health



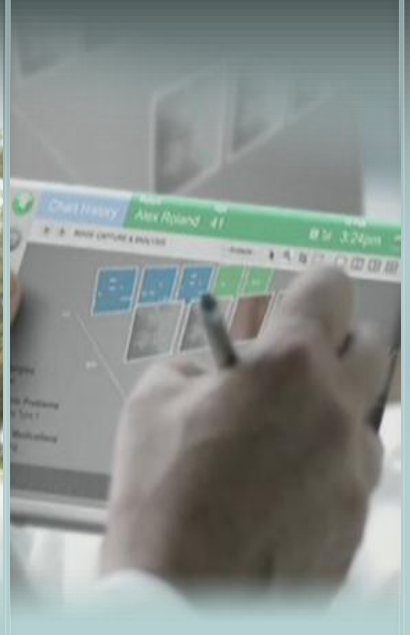
D A T A - D R I V E N M E D I C I N E

Anticipating the Future: **Urban Environments**

Personal Monitoring



Advanced Analytics



Smart Medication



Personal Health Management



Connected Data, Connected Care



Anticipatory Medicine



PERSONAL WELLNESS

Goals:



Devices, Sensors and Mobility for Healthcare

- Invest in High-impact and socially relevant healthcare research
- Improve global public health through the reach of ubiquitous technologies (e.g., cell phones)
- Encourage the development of low-cost mobile devices
- Improve the quality of care where it is needed most
- Scalable and Interoperable

Definition of Projects that Scale

What I'd like to see is a "scale score" for projects

- **Scale Up**: The ability for a project to scale from 10 to 100 to 1000 to 1 million+ users.
- **Scale Out**: How much is a project tied to a macrocosm? Can I take the same concept and reuse it in Botswana? In Argentina, in Alaska?
  - Overcoming barriers: language, interface, customs
- **Scale In**: How does this work for individuals—does it cover just children? Adults? What about variations within groups?
  - Personalization, individualization
- **Scale Across**: How well does a system that is tested for one disease accommodate others?
  - Interoperability

Historical Investment Strategy in Healthcare

- **2005-2007** : Digital Inclusion Projects
- **2008-2009** : Global Cell Phone as a Platform for Healthcare
- **2010-2011** : African Cell Phone as a Platform for Healthcare
- **Future** : Investments Appropriate to the Region – Focus on Ubiquitous Computing Solutions

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Mobile Health: The opportunity of mobile technologies to support public health in Peru

Walter H. Curioso, MD, MPH
Research Professor
Universidad Peruana Cayetano Heredia (Lima, Peru)
Affiliate Assistant Professor
University of Washington (Seattle, Washington)

mHealth can be defined as mobile computing, medical sensors, and communications technologies for health care*

Cell phones



PDAs





Ebook readers





Smart phones



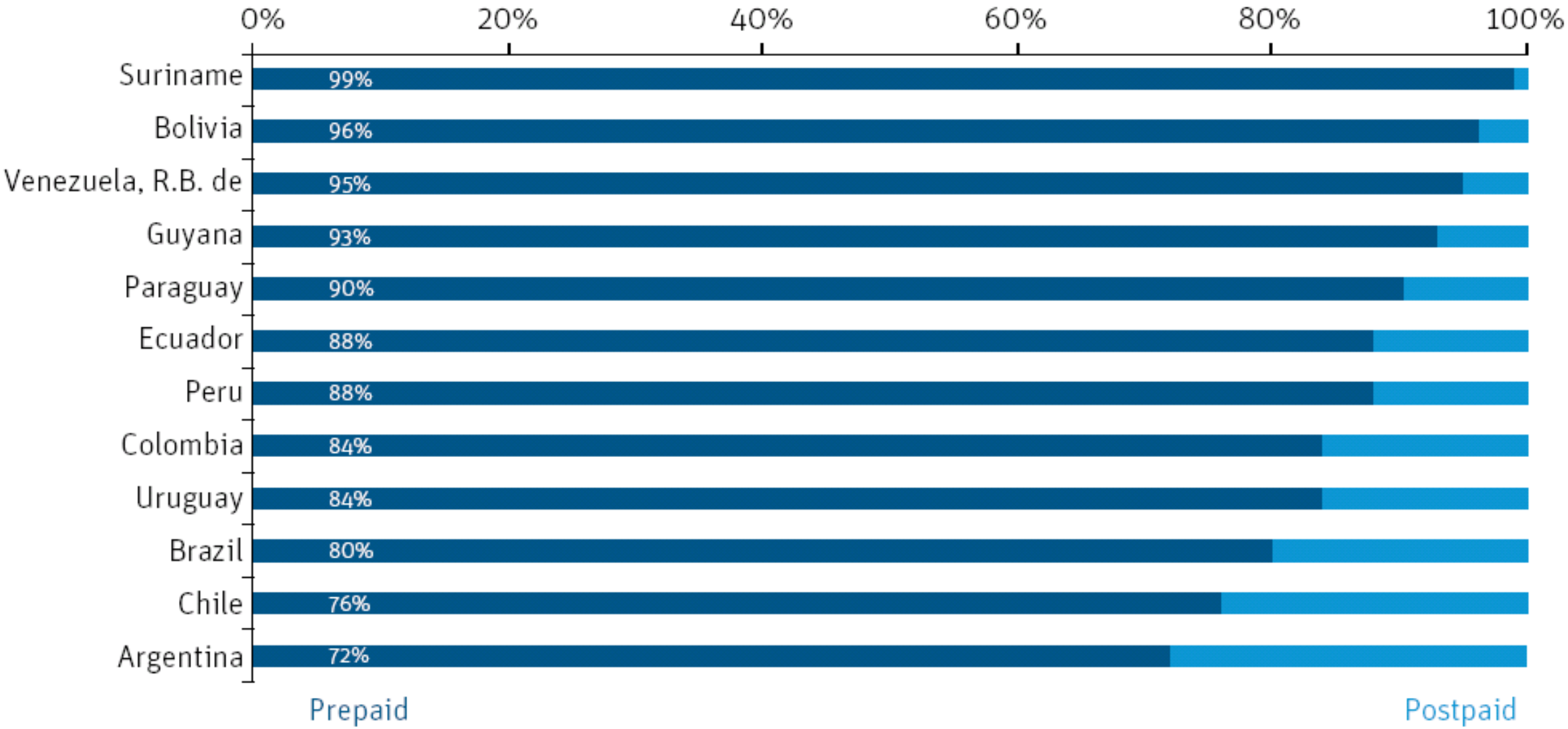
Monitoring Devices (mobile EKG)



MP3 players (iPods for mLearning)

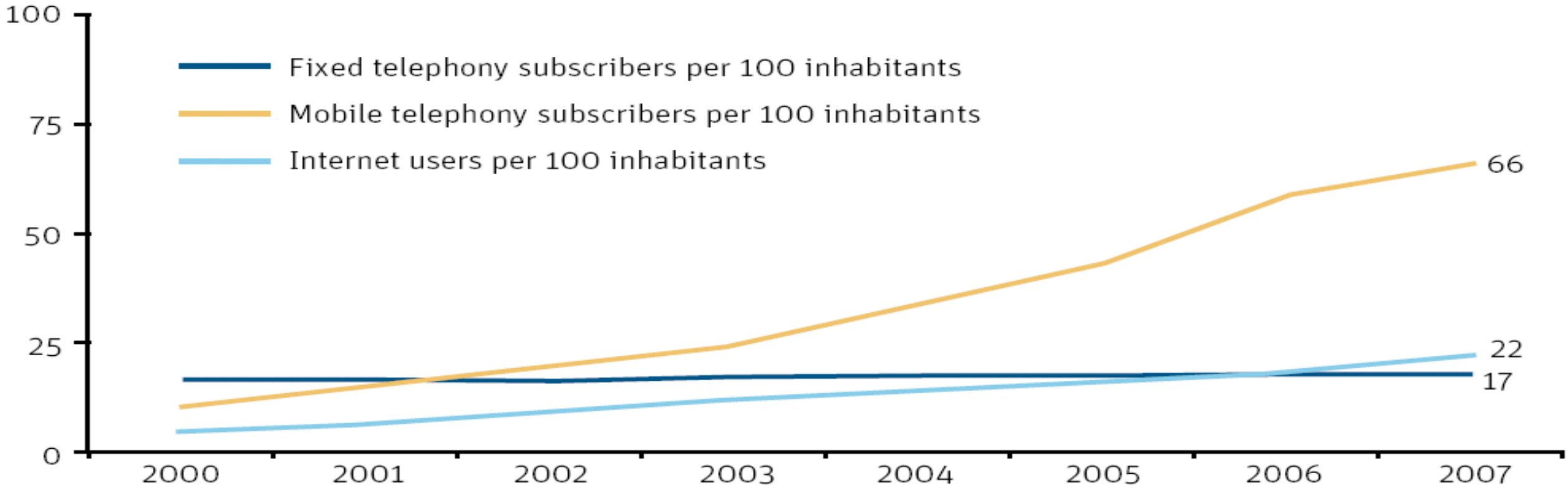
*Istepanian, R. Introduction to the Special Section on M-Health: Beyond Seamless Mobility and Global Wireless Health-care Connectivity. IEEE Transactions on Information Technology in Biomedicine: 2004. 8(4), 405-413.

More than 383 million cell phones in Latin America



Source: ITU 2007.

Cell phones in Latin America

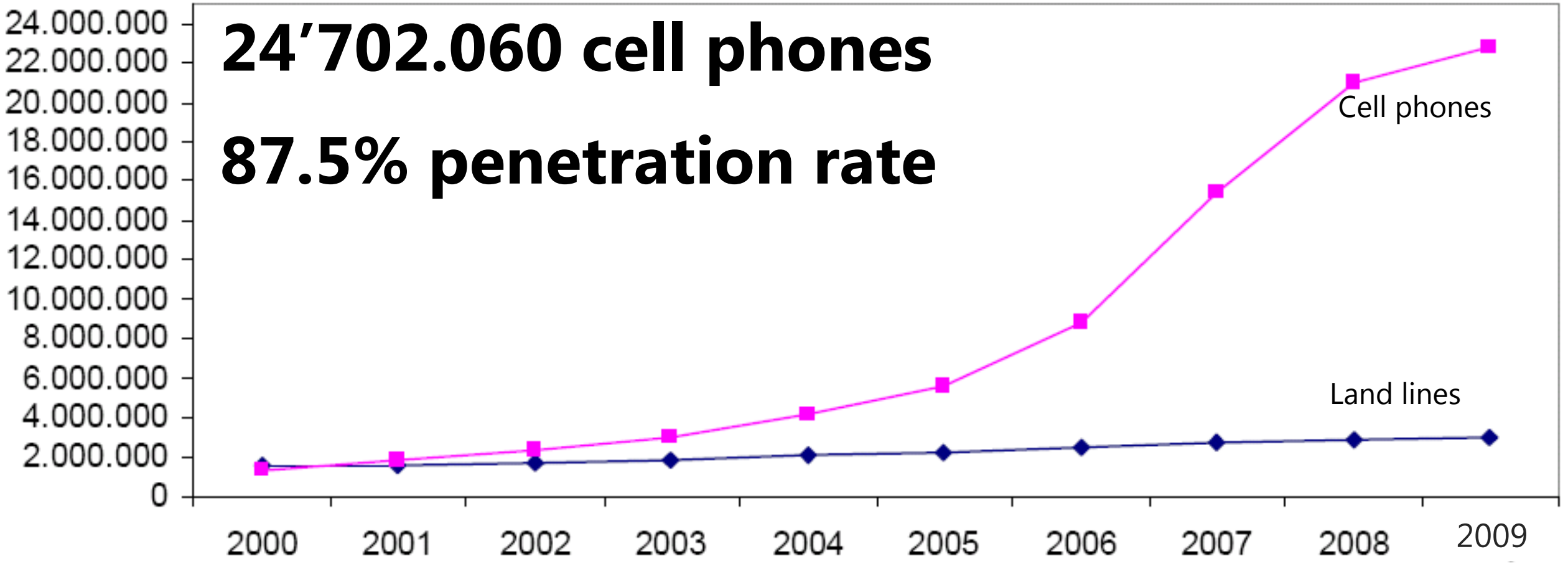


Source: International Telecommunications Union (ITU). 2007.

Peru

24’702.060 cell phones

87.5% penetration rate













Aplication areas in mHealth

Low

High

Complexity of applications in mHealth

Education

Monitoring/ Adherence

Data collection

Emergencies

Information Systems

Diagnosis and Consultations

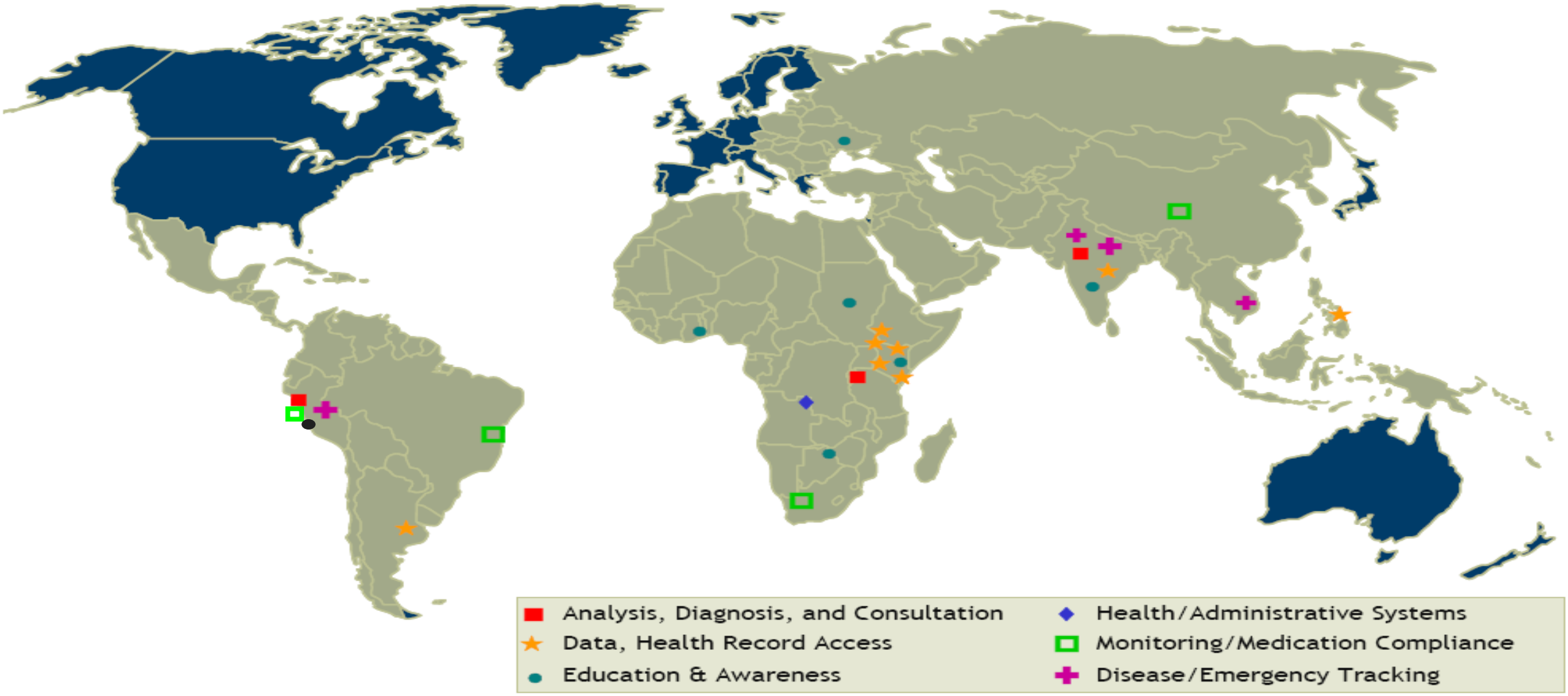






Adapted from: “mHealth in the Global South: Landscape Analysis” Vital Wave Consulting 2008.

mHealth in the developing world



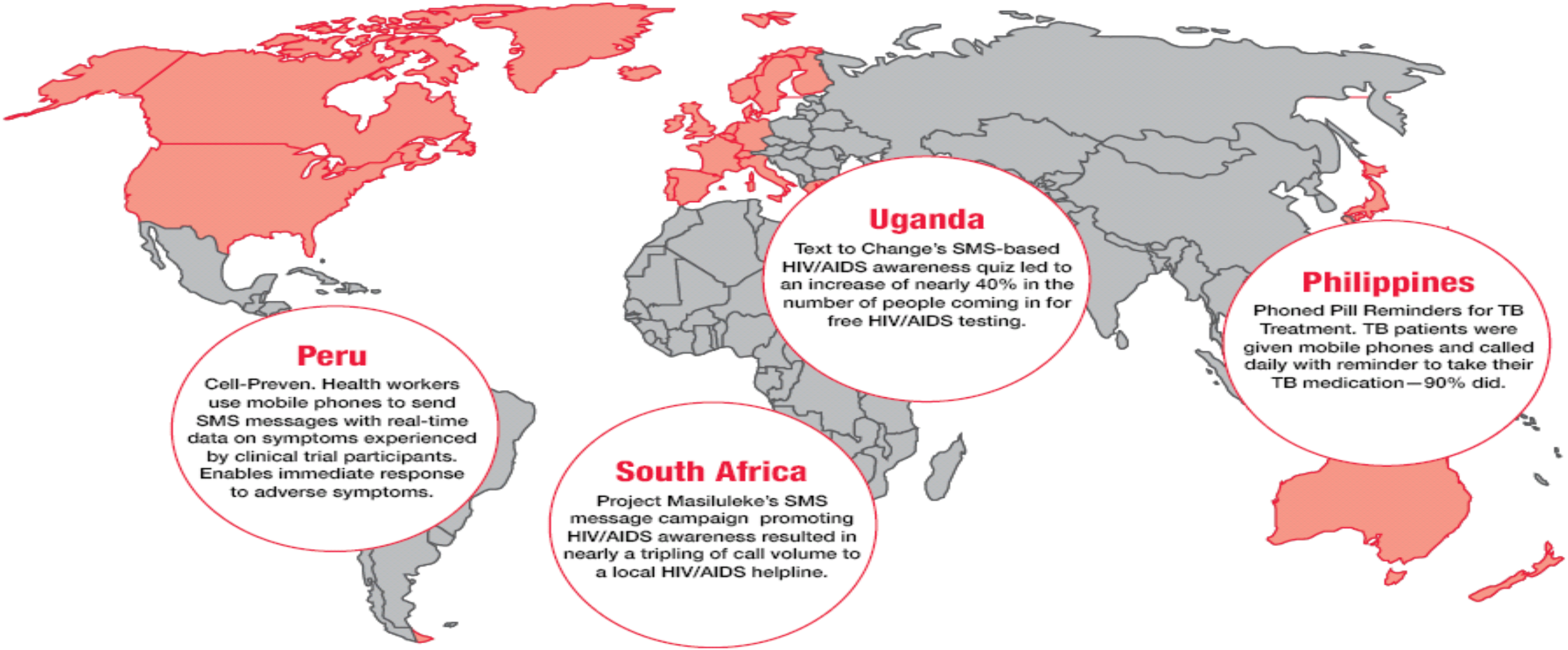
Adapted from: Vital Wave Consulting. mHealth for development: the opportunity of mobile technology for healthcare in the developing world. Washington (DC) and Berkshire (UK): UN Foundation–Vodafone Foundation Partnership; 2009.

mHealth for development

This report details 51 mHealth programs, either currently operating or slated for implementation in the near future, that are taking place in 26 different developing countries. mHealth programs are more prevalent in some countries than others for reasons that have not yet been assessed by the academic literature. In particular, India, South Africa, Uganda, Peru, and Rwanda stand out for their level of mHealth activity.

From: Vital Wave Consulting. mHealth for development: the opportunity of mobile technology for healthcare in the developing world. Washington (DC) and Berkshire (UK): UN Foundation–Vodafone Foundation Partnership; 2009.

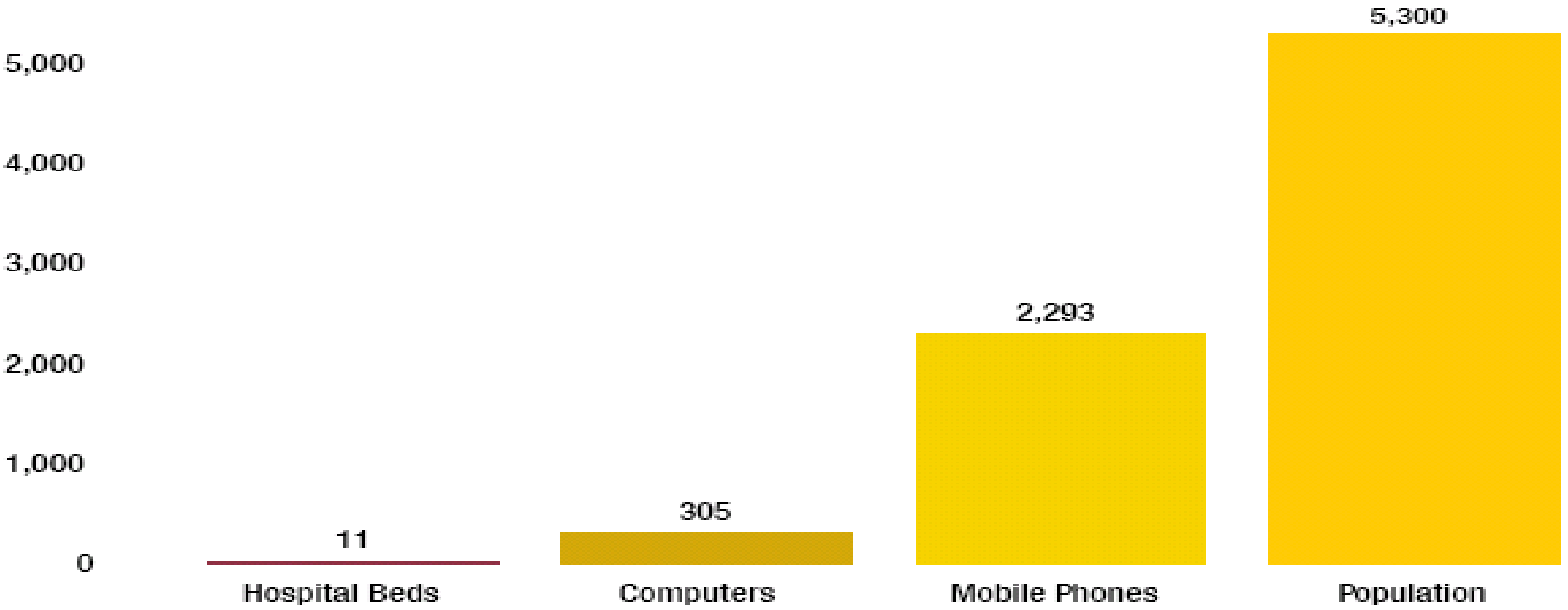
Impact of mHealth applications



Impact of mHealth applications across the developing world.

From: Vital Wave Consulting. mHealth for development: the opportunity of mobile technology for healthcare in the developing world. Washington (DC) and Berkshire (UK): UN Foundation–Vodafone Foundation Partnership; 2009.

Mobile phones reach further into developing countries than other technology and health infrastructures



Technology and health-related statistics for developing countries (millions).[4]

Vital Wave Consulting, Business Monitor International (BMI), International Telecommunications Union, World Bank's World Development Indicators, and the United Nations.

Universidad Peruana Cayetano Heredia (Lima)



Research Health Informatics UPCH

Cell-POS (www.cellpos.org)



SMS reminders and educational text-messages for PLWHA

Via-Net



Feasibility of internet data collection

SOMOS



Encouraging HIV testing through online videos

WaWaNet (Mobile Citizen)



Supporting maternal and child care with mobile devices in Callao

Colecta-PALM



Risk assessment for PLWHA

Cell-PREVEN (www.prevenperu.org)



Real-time surveillance system for adverse events

Net-Lab



Internet lab access for PLWHA

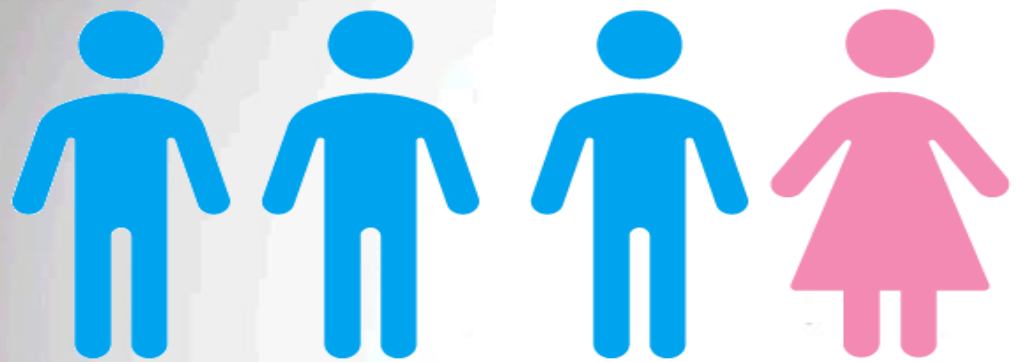
PDA-PREVEN



Electronic data collection through PDAs

HIV in Peru

20-93,000 **HIV (+)**



National ART Program

up to 88% don't take their antiretroviral medicines as the doctor prescribed



simply forgetting
inconvenience

side effects
financial constraints
being away from home
fear of disclosure/stigma
too busy

Mills E. PLoS Med 2006;3(11):e438

People living with HIV in Peru are using tools such as cell phones, and the Internet (via E-mail, chat, list-serv) to support their HIV care and to make social and sexual connections



Curioso WH, Kurth AE. Access, use and perceptions regarding Internet, cell phones and PDAs as a means for health promotion for people living with HIV in Peru. BMC Medical Informatics and Decision Making 2007; 7:24.

Cell POS: Evaluation of a Computer-Based System using Cell Phones for HIV positive people in Peru

Focus groups

Pilot evaluation

Randomized controlled trial

Curioso WH. Evaluation of a Computer-Based System using Cell Phones for HIV people in Peru. Grant: FIC/NIH. 1R01TW007896-01. NIH RePORTER 2010

Cell POS: Evaluation of a Computer-Based System using Cell Phones for HIV positive people in Peru

Focus groups

Pilot evaluation

Randomized controlled trial

Four focus groups

- 26 HIV (+) participants (37 years, SD: 8.5)
- Community-based clinic (Via Libre)
- Focus group guide
- 1.5 – 2 hours
- Two researchers coded transcripts independently
- Content analysis approach
- IRB approvals:
  - Univ. Washington
  - Via Libre
  - UPCH
- Informed consent



Curioso WH, Quistberg DA, Cabello R, Gozzer E, Garcia PJ, Holmes KK, Kurth AE. "It´s time for your life": How should we remind patients to take medicines using short text messages? AMIA Annu Symp Proc 2009;:129-133.

Participants preferred receiving a readable message rather than a phone call or a pre-recorded voice message



Less intrusive



Less interrupting than receiving a phone call

SMS over a recorded voice messages or a phone call as reminder alerts because they are **easier**, **more confidential**, and **more readily available**

People are interested in not only receiving a reminder, but also in something that lifts their self-esteem and gives them encouragement

"*It's **time for your life***"

Automated,
telephone-based interventions
emphasizing
social cognitive concepts
(e.g. **motivation**, **self-efficacy**)
have demonstrated
short and
longer-term efficacy



Marcus B. Contemp Clin Trials 2007; 28(1): 90-104.
Pinto B. Am J Prev Med 2002; 23(2): 113-120.

Confidentiality issues are very important in any strategy that uses cell phones in healthcare (1)

Avoid sensitive words ("having HIV", "antiretroviral pills")

The fears they shared with us about confidentiality are likely related to social issues such as empowerment, **stigma** towards those with HIV/AIDS, and **discrimination** (2)



(1) Lester R. AIDS 2006; 20(17): 2242-2244.
(2) Curioso W. THPE0793. 17th Int. AIDS Conf. 2008; Mexico.

Cell phone reminder system as a friend

The participants often anthropomorphized the system with human characteristics such as thinking of it as a "friend," a "guide" or even an "angel."



The portability of "always ready" devices in combination with the messaging interventions can create a **synergistic feedback loop** between **patient** and **device** as evidenced by Milch's finding:

"several of the patients allowed that the pager became a trusted friend"(1)

(1) Milch RA. Am J Hosp Palliat Care 1996;13:46–8.

Long-term relationship

Successful mobile interaction through messages
should promote an intensive, **positive relationship**
between the user and the mobile application,
like a **longstanding** and **comfortable friendship**



Fogg BJ. Increasing persuasion through mobility.
In: Fogg BJ, Eckles D. Mobile Persuasion –
20 Perspectives on the Future of Behaviour Change.
Stanford Captology Media, Special First Printing, Stanford University, 2007.

Focus groups: Conclusion

- Results have created a basis to develop a dynamic, personalized and confidential messaging system

- These results indicate that the characteristics of the reminder (notification modality, the message, and the context) could play an important role in interventions to improve patient adherence to antiretroviral therapy

Cell POS: Evaluation of a Computer-Based System using Cell Phones for HIV positive people in Peru

Focus groups

Pilot evaluation

Randomized controlled trial

Cell-POS: Enhancing adherence to antiretrovirals and supporting HIV transmission

http://www.cellpos.org/cellpos/cellpos.htm





SMS



Antiretroviral therapy reminders

It's the time for your life

Appointment reminders

Your appoinment with Dr. X is scheduled on Monday 9am

Prevention messages and supportive health information

Hepatitis B is much more contagious than HIV. Get more info and protect yourself

Curioso WH. Evaluation of a Computer-Based System using Cell Phones for HIV people in Peru. Grant: FIC/NIH. 1R01TW007896-01. NIH RePORTER 2010

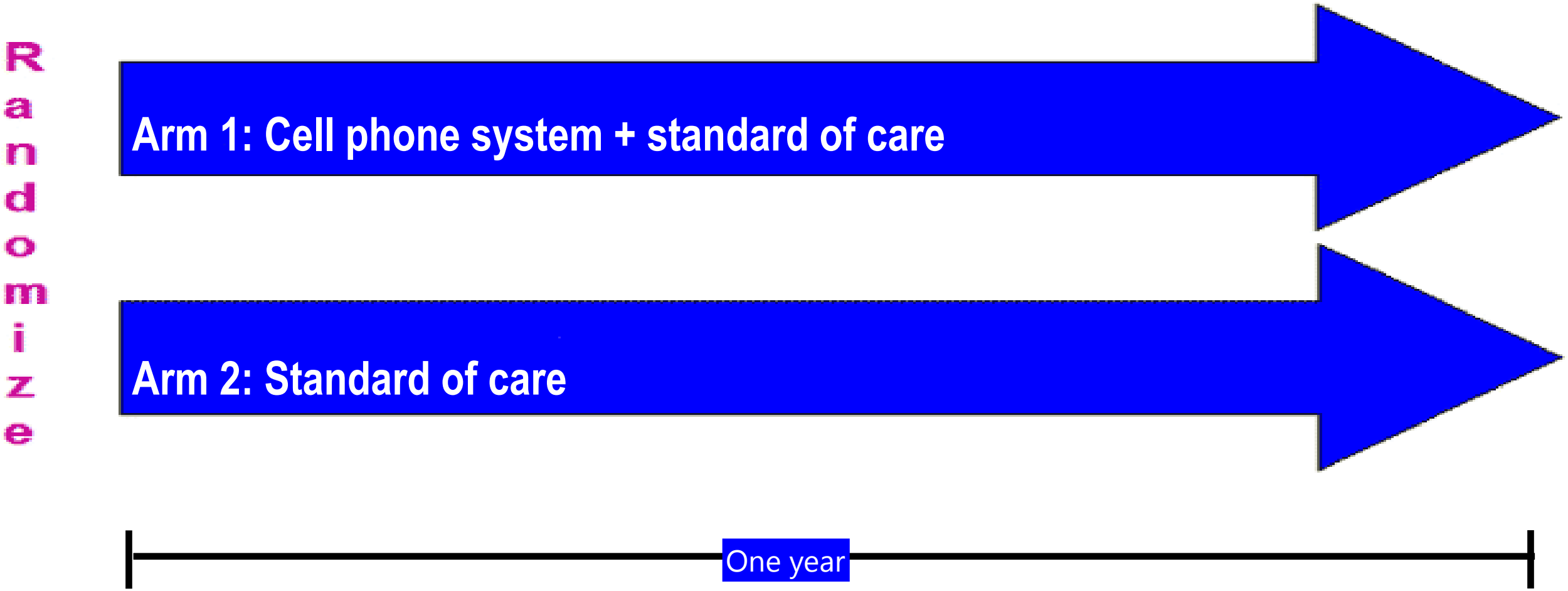
Cell POS: Evaluation of a Computer-Based System using Cell Phones for HIV positive people in Peru

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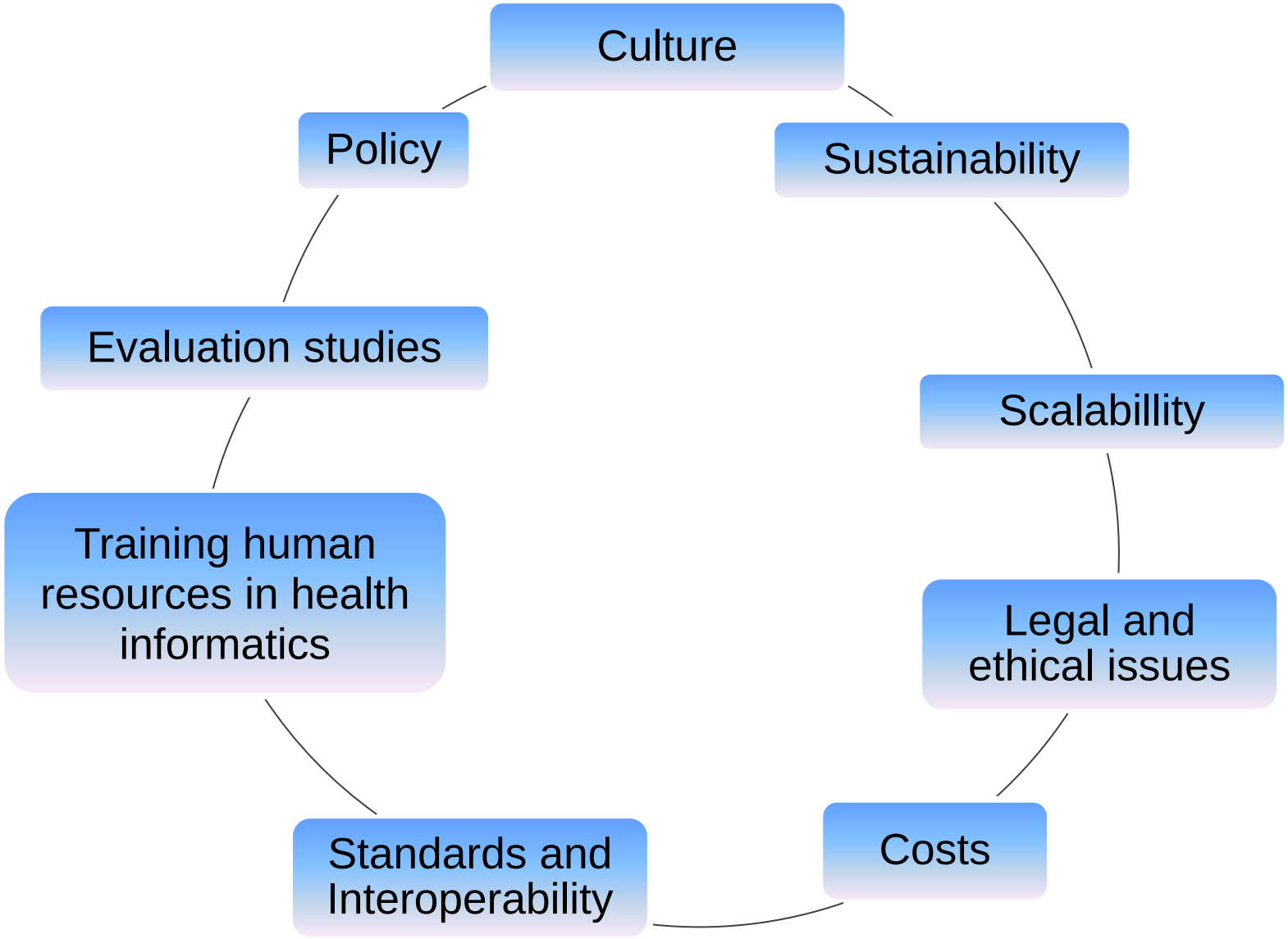
Pilot evaluation

Randomized controlled trial

Randomized controlled trial



mHealth Challenges



CELL PHONES & M-HEALTH

By Walter H. Curioso and Patricia N. Mechael

Enhancing 'M-Health' With South-To-South Collaborations

doi: 10.1377/hlthaff.2009.1057
HEALTH AFFAIRS 29,
NO. 2 (2010): 264–267
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The People-to-People Health
Foundation, Inc.

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Patricia N. Mechael is mHealth and Telemedicine Advisor for the Millennium Villages Project at Columbia University in New York City.

QUIPU

Andean Global Health Informatics Research and Training Center

http://www.andeanquipu.org

Curioso WH, Mechael PN. Enhancing 'M-Health' With South-To-South Collaborations. Health Affairs (Millwood) 2010;29(2):264-7.

Thanks!



Walter H. Curioso, MD, MPH
wcurioso@uw.edu



Example Projects

Giving Women and Community Voice in Sub-Saharan Africa

Promoting gender equity in Africa



John Bennett, Ravi Sterling
University of Colorado, Boulder



Project Goals:

Enabling Women in Kenya to have a community "voice" by setting up a system to record and wirelessly transmit to radio stations

Current Project Status:

- Being tested in 34 work collectives in Kenya
- Planned expansion to India

Speech Enabled Telephone Enables Healthcare Workers to Increase Medical Knowledge and Treatment Skills

Training for front-line, low-literacy health providers

Roni Rosenberg, Rahul Tongia, Jahanzeb Sherwani
Carnegie Mellon University

Project Goal:

Expand healthcare workers treatment and diagnoses knowledge without requiring literacy

Project Status:

- Tested in Pakistan (Urdu) with CHWs with pneumonia and tuberculosis
- Expanding to include hepatitis, sexually transmitted diseases and diabetes

MediNet: Mobile Health System for Diabetics and Cardio Disease

Rural monitoring of patients with heart disease and diabetes



Permanand Mohan, Salys Sultan, Ahad Deen
The University of the West Indies, Trinidad and Tobago

Project Goals:

- Data is collected from monitoring devices attached to patients and transmitted to a server using a cell phone.
- Data reasoning engine extracts all relevant information.
- Alerts are generated, when necessary, to medical officer(s) to take appropriate action (call or an onsite visit).
- The system may also make suggestions to the patient on his/her cellular phone as a result of its reasoning processes.

Long Term Goals:

- The ultimate goal is to develop a Caribbean-wide Healthcare Management System using cellular phone technology.
- The network that would integrate the medical resources of the entire region thereby promoting the sharing of medical expertise and resources in a region with very poor healthcare facilities.

Smart Phones to Promote Chronic Illness Self-Management







Treatment adherence monitoring for rural diabetics

Jiao Ma, Cynthia LaRouge,
St. Louis University
Joseph Flaherty
VA Hospital



Project Goals:

- Enable robust elderly to manage diabetes
- Enable self-monitoring and adherence proscriptive homecare plans in rural settings

Project Status:

- Focus groups and pilot complete
- Deployment plans underway in St. Louis
- Sichuan Province for next deployment

Informing At-Risk Populations About AIDS/HIV Transmission

Public Awareness Tool in at-risk populations

Henry Nyongesa, Dimane Mpoeleng
University of Botswana

Project Goal:

- Provide information to population on AIDS avoidance
- Assisting those that may suspect they have AIDS where to get diagnosis and treatment

Project Status:

- System is tested and complete
- Looking to expand the system to support non-literate users (via speech recognition)

Ultra Low Cost USB Ultrasound Probe

Portable low-cost imaging for healthcare

William Richard, David Zar
Washington University St. Louis





Project Goals:

- Reduce the cost of the ultrasound device to increase availability
- Enable ultrasound controls and images on a cell phone or Fone+ for use in rural settings

Current Project Status:

- Clinical trials study underway with Duchenne MDS patients
- Windows Mobile SDK available

CellScope: Portable Low-cost Imaging for Disease Diagnosis

Portable low-cost imaging for healthcare



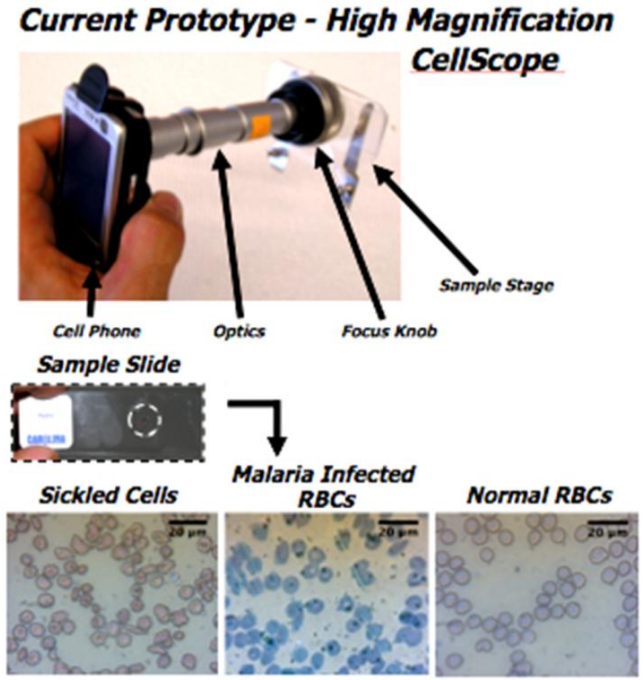
Daniel Fletcher
University of California, Berkeley

Project Goals:

- Inexpensively enable field microscopy analysis via a cell phone
- MMS images for further analysis and/or direct diagnosis

Current Project Status:

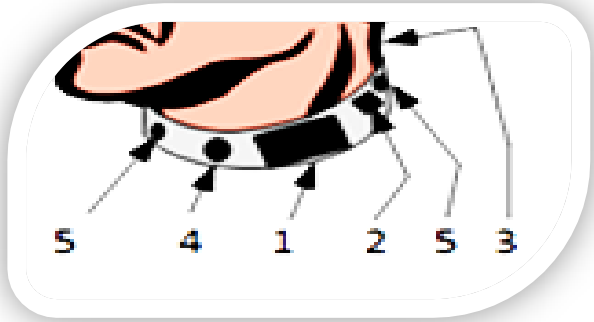
- BMGF funding to extend prototype



Monitoring Obstructive Sleep Apnea

Minimally Invasive Sleep Monitoring

Mike Sinclair, Kristin Tolle
Microsoft Research







- Neck collar sensors for in home sleep monitoring
  - Oximetry (oximeter), Head (neck) poise (3D accelerometer), Microphonics (throat microphone), Galvanic Skin Response, Heart rate
- Data captured by a cell phone and transmitted to a server
- "SmartLogger" UI for monitoring and querying the information across the different sensors and GPS/schedule information

Goals:

- Enable similar data that is collected in a sleep lab to captured in the home and over several days
- Easy to add sensor interface for cell phones
- Application to displaying information across multiple sensors in one UI

Africa: Cellphone as a Platform for Healthcare Awards

Lowering maternal mortality rates in Sierra Leone
Gary Marsden, University of Cape Town, South Africa

Use of SMS services to improve TB treatment completion in integrated tuberculosis and HIV care in resource-limited settings
Sabine Hermans, Makerere University College of Health Sciences Research, Uganda

CellChek: A cost-effective cell phone-based patient monitoring and advising system
Tamer ElBatt, Nile University, Egypt

SurgilLink: surgical guidance via mobile phones
Mohamed ElHelw, Nile University, Egypt

Mobile microscopy for automated malaria diagnosis in field conditions
John Quinn, Makerere University, Uganda

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Guarujá, Brasil | May 12 – 14 | In collaboration with FAPESP

November 8th- 10th,
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NIH 2010 mHealth Summit

Questions?



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