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Implementation Science and mHealth: Insights at the Intersection?

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Motivating Example

- Patients testing HIV + often don't come back to pick up CD4 results in Swaziland

- Mobile phone penetration is high – 80%

- SMS messages are inexpensive, but still cost money.

- Free intervention: at time of blood draw for CD4 testing, the counselor puts a number with name "Go Back to Clinic"

- Receive a "buzz" before appointment

- No difference in follow-up before and after the intervention (80.1% versus 83.3%, p = 0.401)

Questions addressed in mHealth

- Why do some mHealth interventions work while others do not?

- What kinds of interventions have robust effects across diverse implementing settings?

- For interventions that work, what are the determinants of scalability and sustainability?

- What is the mechanisms of effects?

Overview: Perspectives from Implementation Science?

- *Can conceptualizing mHealth interventions within an implementation science framework enhance effectiveness and relevance?*

- Describe emerging perspectives from implementation science
  - Motivation for a "science of implementation"
  - "Roadmap" for approaching an implementation problem scientifically
    - Quantifying the gap between evidence and practice
    - Analysis of the reasons for the gap between evidence and practice
    - Conceptualization of implementation strategies

- Apply these emerging perspectives can inform research using mHealth
  - Match right intervention to the right problem

Global Implementation Gap: HIV Treatment

Clinical Advancement and Investments

Billions of dollars

$1.6 $2.0 $3.6 $4.3 $5.6 $6.6 $8.7 $8.7 $8.7 $8.8 $8.3 $8.1

1990   2000
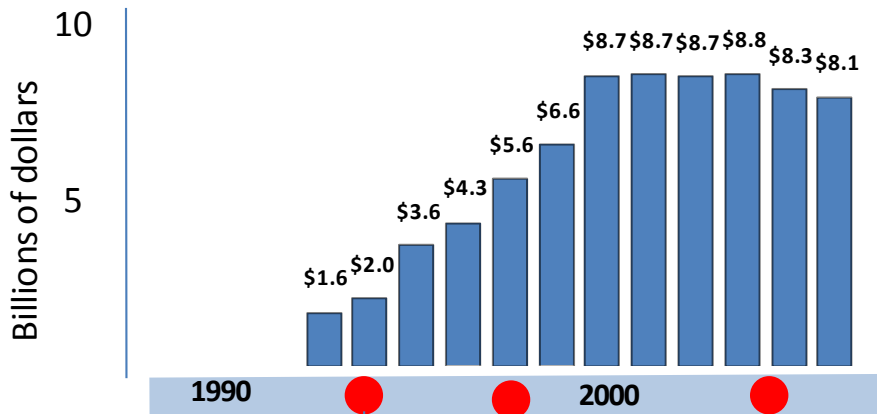
94%
Of normal lifespan expected with ART
Helleberg CID 2013 Mar;56(5):727-34.

96%
Transmission reduction with ART
Cohen NEJM2011; 365:493-505

95% Reduction in vertical
Mofeson MMWR 2013 Mar;56(5):727-34.

The Global HIV Treatment Cascade

	Living with HIV	Diagnosed	Treated	Suppressed
	36.9	19.8	15	11.6
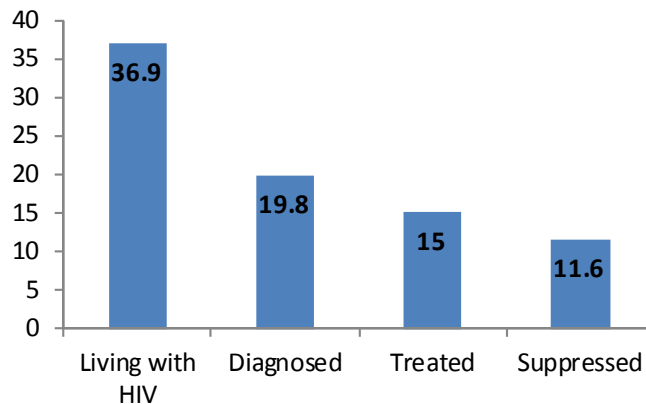
- **53%** of persons living with HIV are aware
- **41%** have accessed treatment
- **31%** are suppressed

Science to Address the Gap

- "The NIH has recognized that closing the gap between research discovery and clinical and community practice through scientific inquiry is… an absolute necessity"

- "Implementation Research is the scientific study of methods to promote the integration of research findings and evidence-based interventions into healthcare practice and policy."

- "Implementation research seeks to understand the behavior of healthcare professionals and support staff, healthcare organizations, healthcare consumers and family members, and policymakers in context… in the adoption, implementation and sustainability of evidence-based interventions."

http://grants.nih.gov/grants/guide/pa-files/PAR-13-056.html

Quantifying the Gap between Evidence and Practice

"Evidence"

"Knowledge"

"Research findings"

⟷

"Use"

"Delivery"

"Practice"

"Uptake"
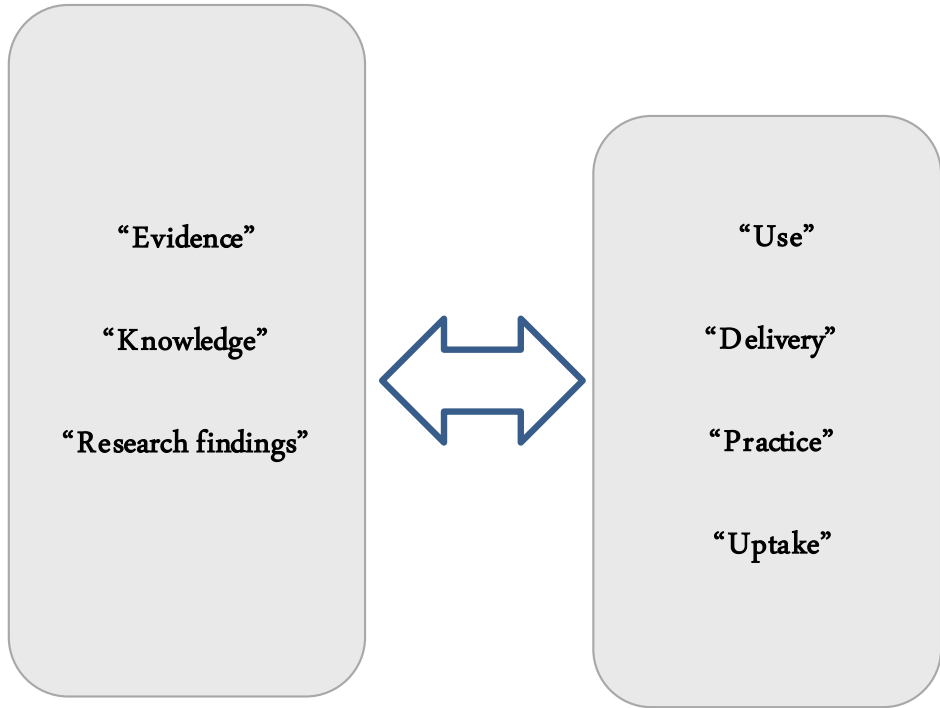
- Understanding the evidence for a particular problem
  - Randomized trials
  - Meta-analyses and systematic reviews
  - Professional guidelines
- Quantify the practice gap
  - Fraction of eligible patients receiving the treatment? Potential practice settings?
- Consequences of the fact this intervention is not being used
  - Morbidity, mortality, patient-reported outcomes

Quantifying the Gap: Isoniazid Preventative Therapy in Persons Living with HIV

- TB is top killer of persons with HIV – 200,000 deaths a year

- Isoniazid preventative therapy in reduces TB by 50%
  - Established by multiple randomized trails in Africa

- IPT is used in less than 10% of persons eligible in LMIC

- Even fewer are fully adherence to 9 months of therapy

Why do these Gap Exist?
Framework, Models, Theories in Implementation Science

- Understand the drivers and causes of the gap *systematically (through use of previous work)*
  - "Map the gap"
    - Make sure you've considered the problem comprehensively and deeply
  - Explain the gap
    - General explanations that can be applied to understand the reasons for the gap

- Change the gap *scientifically*
  - Formulate an understanding of mechanisms of change
  - Inform intervention development / selection

"Why do these Gaps Exist?" Trial and Error Approach

"Why is there a gap between evidence and practice?"

Apply your personal experience and contextual knowledge

Call your friend who you think is smart – review content literature

Try something – write a proposal

Find that it has sub-optimal impact or score

Propose formative research – some interviews

Good case scenario: reviewers raise something you didn't think of.

Worse case scenario: you finish the formative research and realize that there were factors you should have considered finding out more about

Realize need to systematically assess what others have said about how to approach the behavioral problem

"Why do these Gaps Exist?" Theory-Based Approach

Why is there a gap between evidence and practice?

Consult frameworks and theories in implementation science

Apply your own contextual knowledge, local network, consult stakeholders to further shape your "diagnosis"

Invest in a formulation of a diagnosis

Consult relevant frameworks and theories in a particular area of social science or psychology

Peruse primary literature to sharpen your understanding of the problem

Propose research which is embedded in existing discourse; builds on what is known; adds to body of knowledge

Quantifying the Gap: Rogers' Diffusion of Innovations

Innovators 2.5 %　Early Adopters 13.5 %　Early Majority 34 %　Late Majority 34 %　Laggards 16 %

Market share %
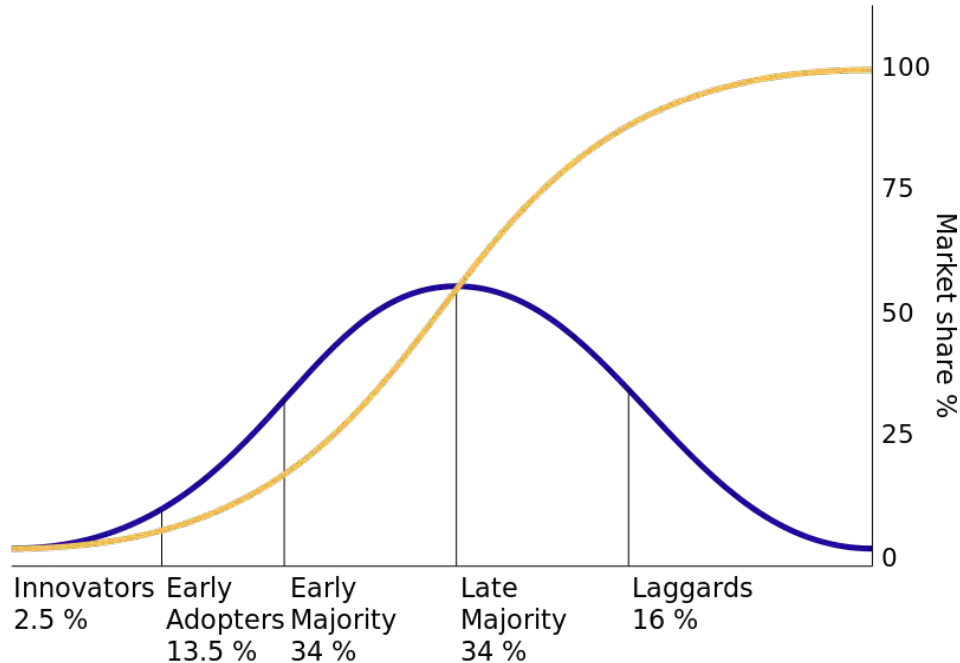
- Quantify the gap *socio-behaviorally*
  - Innovators
  - Early adopters
  - Early majority
  - Late majority
  - Laggards

- Characteristics of the intervention that drive spread
  - Observability
  - Trial-ability
  - Relative advantage…

Public Health Impact: REAIM

RE-AIM ELEMENT	Definition	Example -ART adherence	Assessment
REACH	Reach is an individual-level measure (e.g., patient or employee) of participation.	Can SMS technologies reach patients taking ART?	+++
EFFECTIVENESS	Magnitude of effect among those offered treatment	Can SMS messages change medication taking behavior?	++
ADOPTION	The proportion and representativeness of settings that adopt a given policy or program.	Can mHealth be taken up at the facility, province, etc. levels?	+
IMPLEMENTATION	The extent to which a program is delivered as intended.	Can an SMS intervention be delivered as intended?	++
MAINTENANCE	Sustainability in a given governance, policy, economic and funding context	Can and SMS intervention for X problem be incorporated into government policy?	+

Elucidate and Explain: COM-B
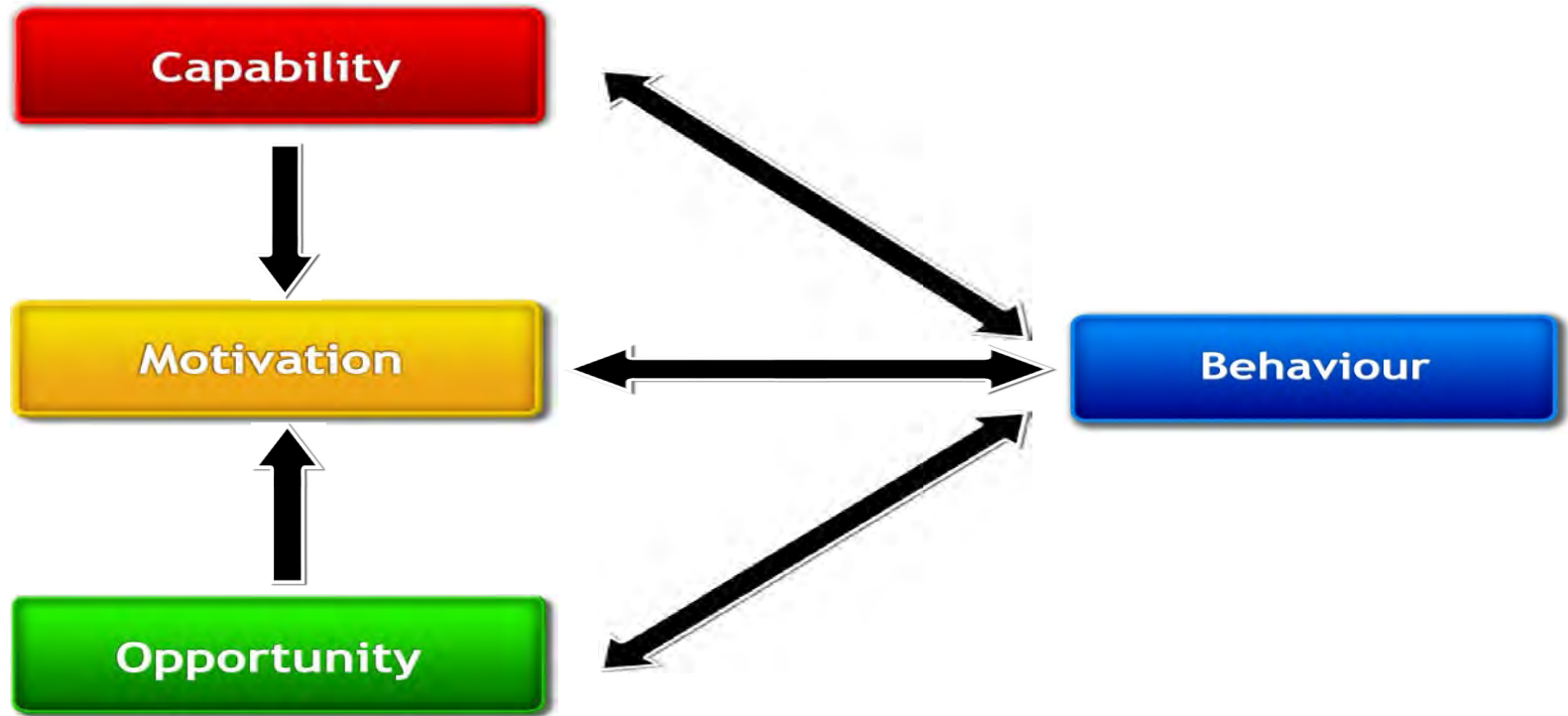
CFIR: Mapping Drivers of Implementation

- Consolidated Framework of Implementation Research (Damschroeder 2009)

- Organizing topology of ways to think about implementation – a "meta-theory"

- The CFIR comprises five major domains
  - Intervention characteristics
  - Outer setting: policy, economic, political and social context
  - Inner setting: organizational characteristics
  - Individuals: actors in the system
  - Process: behavior change blueprint
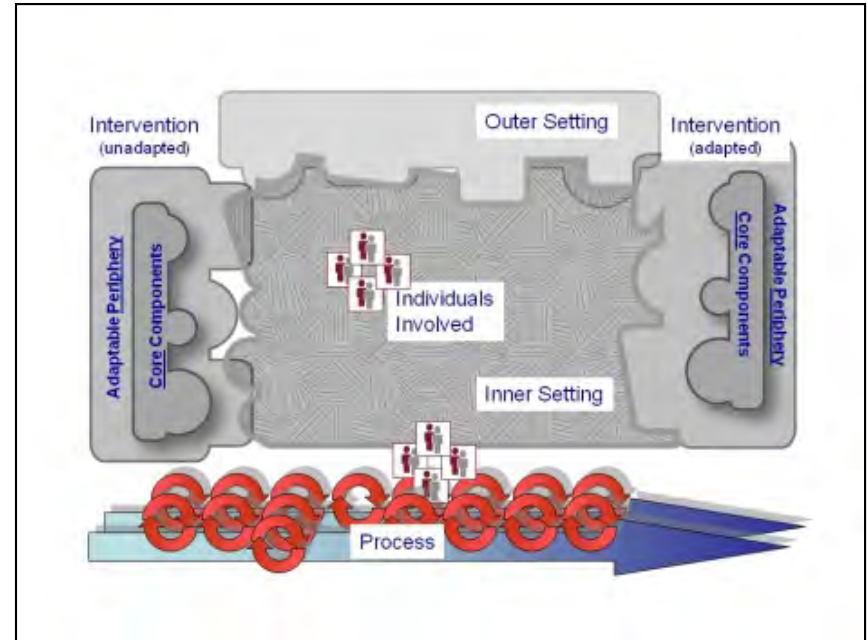
Frameworks + Content Knowledge about a Particular Problem = Strong Gap Analysis

- Frameworks for understanding a problem are no substitute for content knowledge about the problem
- Give you bins – you need to fill in the blanks

Example of Gap Analysis: Isoniazid Preventative Therapy

Evidence to support practice

Policy and guidelines at national level

Knowledge of and support of by middle managers in health systems

Supply chain

Setting priorities

Management of front line health care worker behavior

Identification and prescription

Acceptability and adherence
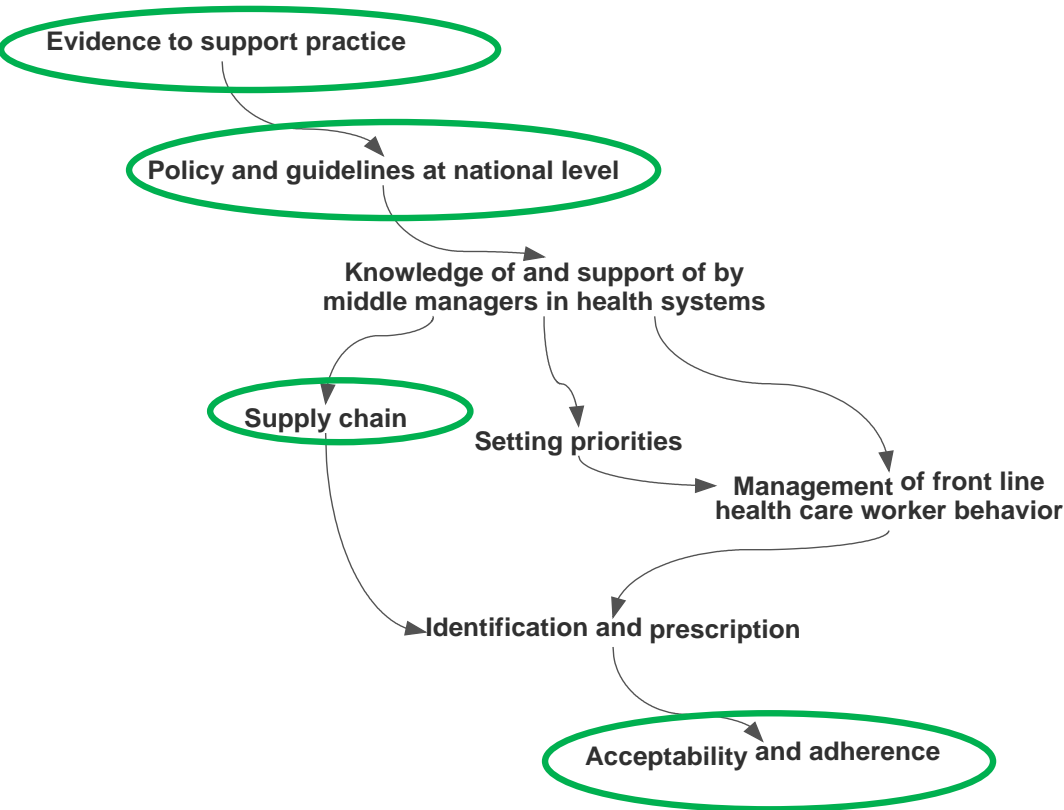
CFIR and socio-ecological analysis:

- Not policy makers, not front line health workers nor patients
- *Middle managers (district health officers)*

COM-B

- Knowledge, beliefs, attitudes
- No consensus about prioritization of
- Managerial capabilities

Diffusion of innovations

- Low "observability" of intervention effect

From Gap, to Gap Analysis, to Implementation Intervention

We have identified a gap and analyzed the reasons for it...

You want to change the behavior of the health system, organization, health care worker, patient or community to close that gap

An approach to conceptualize the interventions or strategies to close this gap?
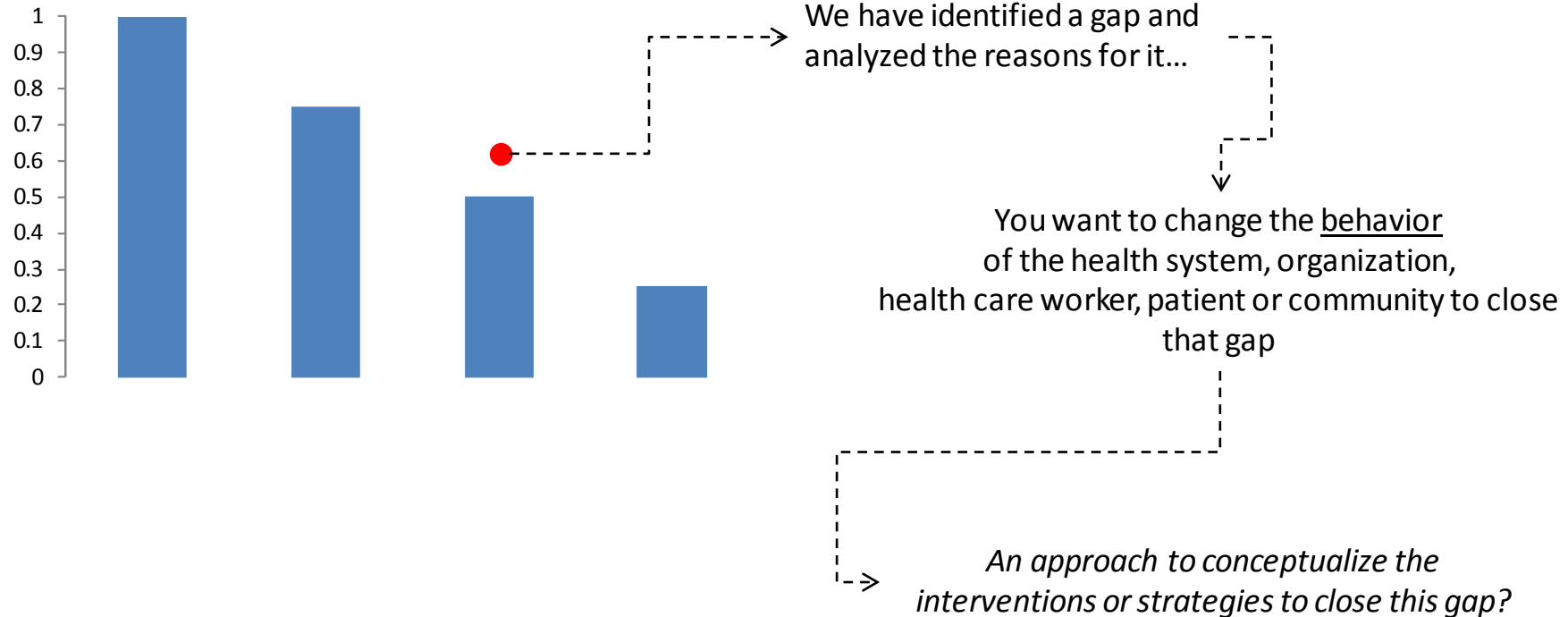
Conceptualizing and specifying implementation interventions

Actor → People (or organization, etc) carrying out the designated intervention action

Action → The specific activities of the intervention

Dose, temporality

Action target → Conceptual target; capability, opportunity or motivation; includes unit of analysis

Behavioral target → Behavior you want to change - a necessary but usually insufficient cause of closing cascade step

Cascade step (Or gap)

Proctor et al. Implémentation Science 2013, 8:139

Actor

Generalizable characterization of "actor"
- Socio-demographics
- Training, education (e.g., nurse)
- Position (e.g., middle manager)
- Identity (e.g., peer)
- Sociometrically (e.g., opinion leader)
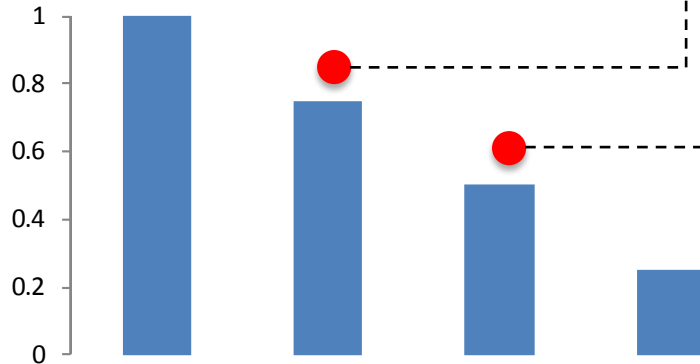
Knowledge / motivation gap: middle managers in the Ugandan health system might not know or care about IPT – **"actor" might be an opinion leader or advocacy organization who would influence middle managers**

Technical gap: middle managements wants to implement IPT but doesn't know how to get it done – **"actor" could be a professional with X training who occupies a new "seconded" position in the ministry**

Who is the actor in an mHealth intervention?

Action

"An active verb statements to specify the specific actions, steps, or processes that need to be enacted" (e.g., train, educate, persuade, motivate) (BCW)
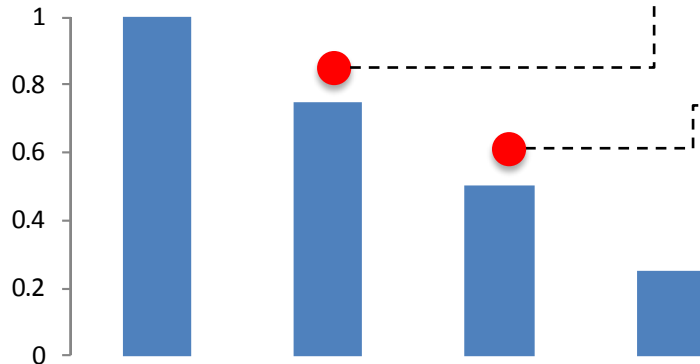
Knowledge / motivation gap: Leadership does not know or care about ACE – "actor" an advocacy organization might **persuade through petition letters and reputational incentive.**

Technical gap: Leadership wants it but doesn't know how to get it done – "actor" could be an opinion leader who occupies a new "seconded" position which **seeks to engage, motivate and train colleagues in middle management positions**

What types of actions are best suited for mHealth technologies? (Counsel vs. inform? Deep vs. rapid? Push vs. nudge?)

Action Target: Transportability

- Action target is a determinant of behavior
 - One schema for action targets: capability, opportunity, motivation (COMB)
- Understanding action target (s) enables inference about results in one setting in another
- Mechanism informs generalizability
  - Direct anti-plasmodium effect → can expect the same effect in low prevalence areas
  - Boosting coartem → not transportable to low prevalence settings

How can mHealth interventions influence capabilities, opportunities, motivation?

First episode of malaria

Recurrent malaria

Achan NEJM 2012;367:2110-8.
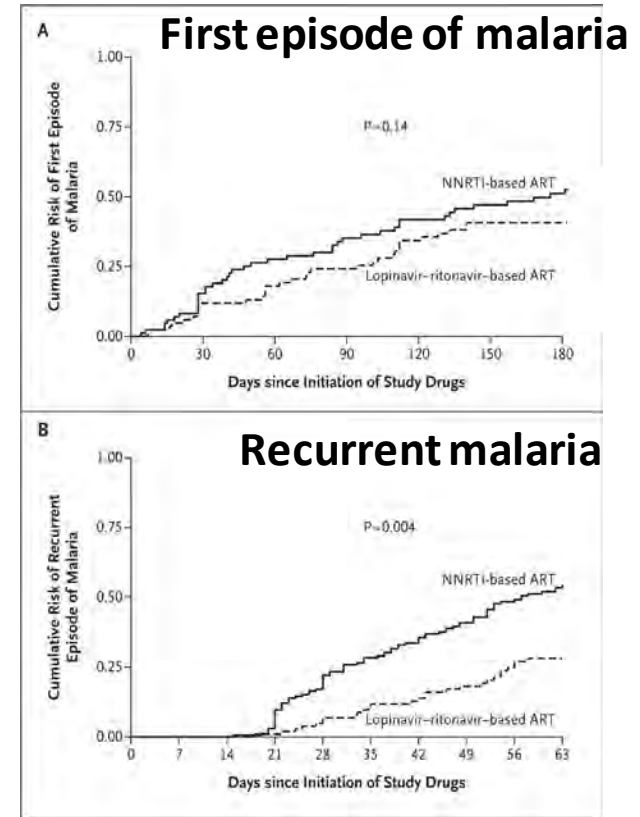
Return to Motivating Examples...

al. Infectious Diseases of poverty 2013, **2**:12
http://www.idpjournal.com/content/2/1/12

INFECTIOUS DISEASES OF POVERTY

RESEARCH ARTICLE   **Open Access**

Using no-cost mobile phone reminders to improve attendance for HIV test results: a pilot study in rural Swaziland

Merav Kliner[1]*, Abigail Knight[2], Canaan Mamvura[2], John Wright[3] and John Walley[1]

Abstract

Background: Mobile technology has great potential to improve adherence and treatment outcomes in healthcare settings. However, text messaging and phone calls are unaffordable in many resource-limited areas. This study investigates the use of a no-cost alternative mobile phone technology using missed calls ('buzzing') to act as a patient reminder. The use of missed calls as a patient reminder was evaluated for feasibility and effectiveness as an appointment reminder in the follow-up of newly-diagnosed human immunodeficiency virus (HIV) positive patients in an HIV testing and counselling department in rural Swaziland.

Methods: This pilot study uses a before-and-after operational research study design, with all patients with mobile phones being offered the intervention. The primary outcome was the rate of attendance at the HIV testing and counselling department for collection of results in those with mobile phones before and after the introduction of the intervention.

Results: Over two-thirds, 71.8% (459/639), of patients had a mobile phone. All patients with a mobile phone consented to being buzzed. There was no difference in attendance for follow-up at the clinic before and after the intervention was implemented (80.1% versus 83.3%, p = 0.401), or after adjusting for confounding factors (OR 1.13, p = 0.662).

Conclusion: This pilot study illustrates that mobile technology may be feasible in rural, resource-poor settings as there are high rates of mobile phone ownership and the intervention had a 100% uptake rate, with positive feedback from staff and patients. In this particular setting, the intervention did not improve attendance rates. However, further research is planned to investigate the impact on adherence to appointments and medications in other settings, such as HIV chronic care follow-up and as part of an enhanced package to improve adherence.

Keywords: HIV infections, Mobile phone, Africa, Rural health, Text messaging, Buzzing, MHealth

Multilingual abstracts
Please see Additional file 1 for translation for the abstract into the six official working languages of the United Nations.

Background
Non-attendance at outpatient clinics can lead to poor health outcomes and high costs. There are healthcare- and patient-related factors that can lead to appointments

being missed. Healthcare-related factors include poor communication, duration of time between appointments and poor facilities in waiting areas, such as lack of confidentiality [1-3]. Patient-related factors include health beliefs, difficulty with transportation and forgetfulness [4-6]. Any form of reminder may, therefore, reduce the rate of missed appointments.

Mobile technology is frequently used as a tool to improve adherence and treatment outcomes in healthcare settings. It has been used to increase knowledge [7], improve health outcomes [8-11], encourage behaviour change [12] and improve collaboration between healthcare workers in resource-limited settings [13]. A

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- Patients testing HIV + often don't come back to pick up CD4 results in Swaziland

- Mobile phone penetration is high – 80%

- SMS messages are inexpensive, but still cost money.

- Free intervention: at time of blood draw for CD4 testing, the counselor puts a number with name "Go Back to Clinic"

- Receive a "buzz" before appointment

- No difference in follow-up before and after the intervention (80.1% versus 83.3%, p = 0.401)

Use of an Implementation Science Approach: Swaziland Study

Gap	Gap Analysis	Actor	Action	Dose	Action Target	Behavioral Target	Result
Patients who test positive for HIV often give blood for CD4 testing, but fail to return to get results in Swaziland	Patients "forget" to return for CD4 testing results	Counselors who register patient numbers – saves a number in client phone that says	"Buzz" that says "Go to the hospital"	Once before appointment to pick up CD4	Unstated (implied that its is a reminder)	Patient return to pick up CD4 results	82% retrieved CD4 in both before and after 417

- Assessment of the "gap analysis"
  - Is there reason to believe that "forgetfulness" drives non pick-up?
  - Structural barriers? (can't afford transport) Psychosocial ones (denial)? Facility? (Inconvenient hours?)
- Assessment of "Intervention design"
  - Suboptimal diagnosis of the problem led to testing of a strategy that has little chance of being effective
  - Motivated by technology (great opportunity) rather than a systematic approach to the implementation problem

Example: Formal "Behavioral Diagnosis"

Gap	Justification	Actor	Action	Dose	Action Target	Behavioral Target	Result
Only 28% of HIV exposed babies born to HIV infected mothers get timely HIV testing	Application of Health Belief Model found that patients wanted information, to feel cared and encouraged. Not to be reminded of HIV.	The "clinic"	Tailored Messages to deliver information, encouragement and cues to action and also care. Option for call back.	14 messages during and after pregnancy, with	Patient knowledge, self-efficacy and motivation	Bring baby for testing	172 of 187 (92.0%) infants had DBS testing, compared to 154 of 181 (85.1%) in the control group (RR 1.08, 95% CI 1.00 – 1.16, P=0.04).

- Gap analysis (qualitative interviews)
  - Perceived susceptibility, severity was high, perceived benefits were high
  - Barriers – health systems difficult to navigate
- Formulation of action and action target
  - Message as cue to action as well as information and encouragement for self efficacy
  - *"Everybody would wish to be loved"*
  - *"A positive message and a personal touch"*
  - *"Should not mention HIV"*

Odeny AIDS 2014

Implementation Science is Team Science

- Engineering
- Design
- Health
- Economics
- Computer science
- Psychology
- Sociology

Thank You

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