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Mobile Health Innovations for Low-Resource Settings: Using Implementation Science to Get the Right Intervention for the Right Place at the Right Time

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Presentation Overview



- **State of the mHealth state**
- **Two-way texting (2wT) background**
- **2wT for VMMC**
 - Zimbabwe RCT
 - Zimbabwe scale-up
 - RSA RCT+ scale-up
- **2wT for antiretroviral therapy (ART) retention**
 - Lighthouse Trust Malawi
 - ZIM-PAAC Zimbabwe
- **Lessons learned from IS-guided mHealth**
- **Challenges in moving digital health forward**

Where is mHealth at the Moment?



- **As soon as this is written it is outdated!**
- **Dozens of mHealth interventions/innovations:**
 - Patient focused:
 - 1wT/2wT for adherence, retention, linkage to care
 - Patient follow-up / tracing support
 - System focused:
 - Data quality
 - Cost reduction / efficiencies
- Scattered exciting results, but few with consistent success in routine settings
- Few link/sync with DHIS2/HMIS for improved reporting/streamlining

2wT as “Innovation”



2wT, itself, is not innovative

...but, developing, testing and integrating a low-cost 2wT in routine, public healthcare settings is!

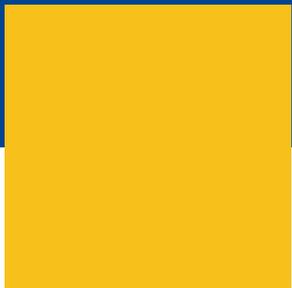
- 2wT in public settings improves relevance and potential scale
- 2wT dual advantage: engagement (retention) + data quality
- Quantify 2wT gains in efficiency (\$ and time)
- Robust implementation science to assess effectiveness
 - Why does it work? Or not? Where? For who? When?

Improvements over previous 2wT



1. 2wT designed and optimized by users
2. Hybrid 2wT: mix of automated and human-to-human messaging optimizes staff efficiency
3. Real-time client data improves reporting
4. Pilot/early stage lessons learned in workflow and usability guide 2WT integration and optimization
5. Medic Mobile's community health toolkit (CHT) is open-source software to aid efforts to adapt, maintain, and sustain the system

2wT for Voluntary Medical Male Circumcision Follow Up



Background: VMMC



- **Voluntary Medical Male Circumcision (VMMC) in Sub-Saharan Africa is safe and effective**
 - ~0.8% have adverse events (AEs)
 - ~99% of men heal without incident.
 - **In Zimbabwe and South Africa:**
 - Surgical VMMC has 3 in-person follow-ups: Days 2, 7 and 21/42
 - Most reviews for no complications
 - Severe healthcare worker shortages and few resources
- **1 million more VMMCs = 1-3 million unnecessary follow-up visits!**

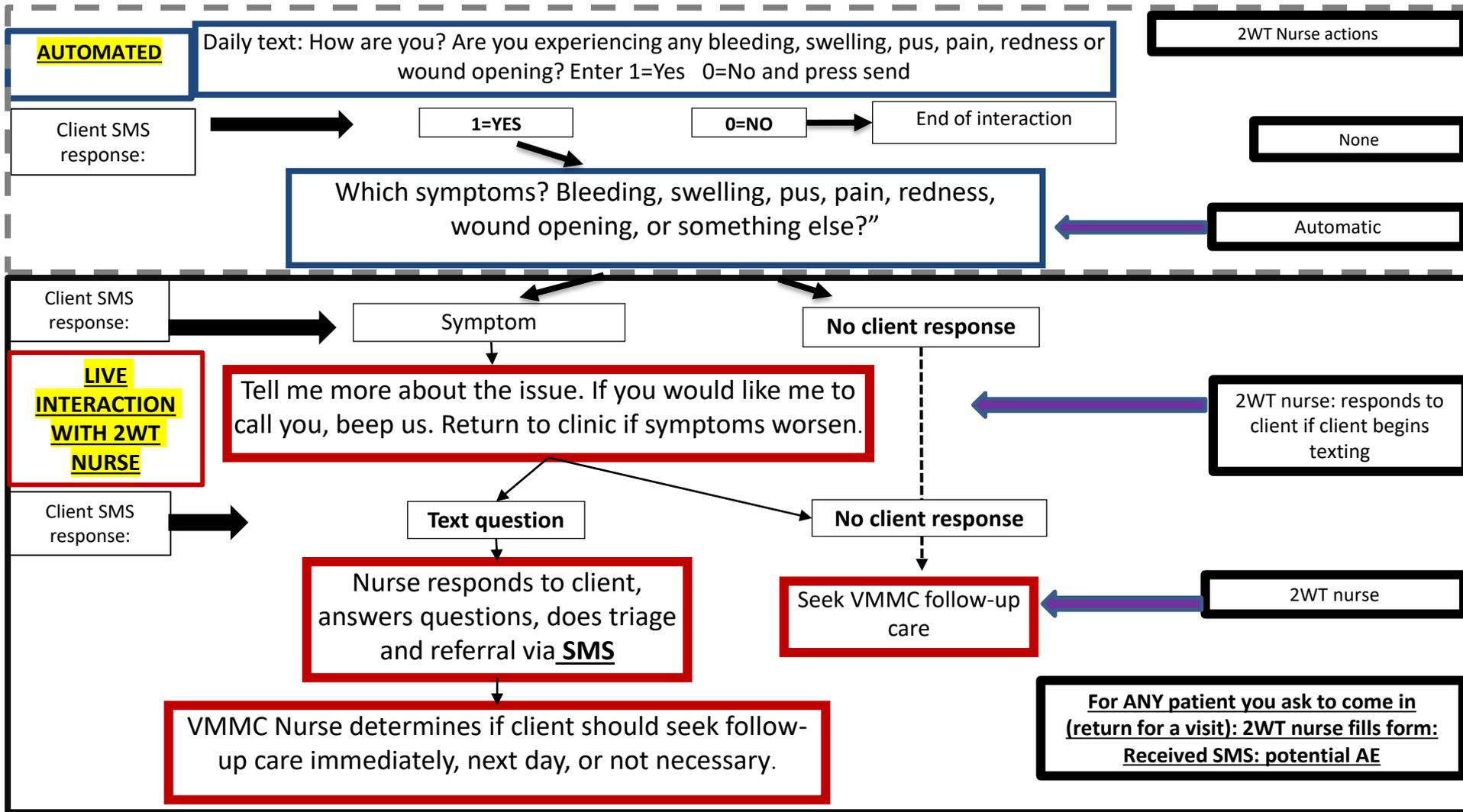


2wT not for traditional retention, but for active engagement in care. 2wT *reduces* visits to healthcare providers while retaining patients in follow-up. Heightened relevance with COVID.

2wT Intervention for Zimbabwe VMMC

- **Medic Mobile's Community Health Toolkit (CHT) app for 2wT supports direct provider to patient messaging *instead* of in-person reviews in ZAZIC routine VMMC program**
 - Open source software – no subscriptions or fees
- **2wT identifies men with desire/need for follow up**
- **Text-based, post-op VMMC care reduces unnecessary visits:**
 - Benefits for client: cost and convenience
 - Benefits for healthcare workers: Perform other duties or VMMC
 - **Increases men's engagement in care and self-efficacy to monitor healing independently**
- **2wT is stand-alone using computers, tablets, or phones**

2wT Nurse/Patient Interaction Flow Diagram



2wT for VMMC Demo



DEV INSTANCE
MEDIC MOBILE™

Messages Tasks Reports (19) People

All form types All places Any date Any status Search everything

- HCA's Area** 18 days ago
Enroll New Person
Testing Health Facility
- Test Felix** a month ago
Received SMS: potential AE
Testing Health Facility
- Test Binod Texting** a month ago
VMMC Client Visit
HCA's Area • Testing Health Facility
- HCB** a month ago
Confirm Clinic Visit Following SMS Referral
HCB's Area • Testing Health Facility
- Test Felix** a month ago
Received SMS: potential AE
Testing Health Facility
- HCA** a month ago
Received SMS: potential AE
HCA's Area • Testing Health Facility
- Test Felix** a month ago
VMMC Client Visit
Testing Health Facility

No report selected

Analytics dashboard: individual widgets



Browser address bar: <https://analytics.medicmobile.org/dashboard#tab-6f9a362ed2f5bacde585d3133bdf44a4>

Navigation: Apps, X-Drive I-TECH HQ, Google Scholar

Page Header: MEDIC MOBILE, My Dashboards, Caryl

Section: VMMC Clients Data

Clients in Texting category

364

SMS response to Day 2 and Day 7

Study No	Phone	Day 2	Day 7
00001556	+263776516238	Same Day	After 2 Day(s)
00002557	+263772420712	Same Day	Same Day
00003558	+263779000629	Same Day	Same Day
00006559	+263773538675	Same Day	Same Day
00008561	+263785696221	Same Day	Same Day
00017565	+263783415605	Same Day	Same Day
00018566	+263715857746	Same Day	Same Day
00019567	+263778868833	Same Day	After 3 Day(s)

Summary of Clients

Study No	Enrollment D...	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10	Day 11	Day 12	Day 13
00415053	Jun 18, 2018	NO AE	NO AE	NO AE	NO AE	NO AE	NO AE	NO AE	NO AE	NO AE	NO AE	NO AE	NO AE	NO AE
00420054	Jun 20, 2018	NO AE	NO AE	NO AE	NO AE	NO AE	NO AE	NO AE	NO AE	NO AE	NO AE	NO SMS	NO AE	NO SMS
00501081	Jul 5, 2018	NO AE	Potentia...	NO SMS	NO AE									
00600030	Jul 5, 2018	NO AE	NO AE	NO SMS										

VMMC 2wT Main Results



- **Three main findings:**

- 2wT was safe: AE ascertainment **doubled** (proxy for active surveillance) while overall AE rate $\leq 2\%$
 - Workload reduced by 85%
- 2wT was highly usable for clients and providers: 93% responded within the critical 14-day healing period
- 2wT was cost effective: 2wT-based follow-up saved \$2.1 (R35) per client over routine in-person visits

- **Now scaling:**

- Zimbabwe routine care – phone and laptop
 - Users paying for SMS; uptake is good!
- RSA: NIH-RO1 for RCT and scale – tablet and laptop
 - Revised aims for how AE reporting increases; IS-guided scale-up and costing from MoH perspective

Why 2wT Holds Promise for VMMC at Scale

- **Right Intervention**

- User-centered design: HCWs should drive technology, not be subject to it
- Reduced overstressed providers workload
- Safe, cost-effective, user-approved!

- **Right Place**

- Routine setting with close proximity to research team
- ZAZIC VMMC services integrated with routine MoHCC care – seen as MoH-led/partnered

- **Right Time**

- Aimed to overcome a known/recognized inefficiency during scale-up
- Untapped desire: Clients willing to pay; uptake nears 40% of those eligible
- Reduced visits = COVID19-related advantages (pandemic silver lining!)

➤ Still 2wT not for everyone

Why 2wT Holds Promise for VMMC at Scale

- **Implementation science-led process from research to routine:**
 - 2wT tasks streamlined, removing RCT redundancies and cross-checks
 - Technology: SMS aggregator; design adaptation, simplification.
 - A central hub (daily 2wT, global indicator reporting, QA) and site spoke (LTFU, reviews) model
 - Shortened training: MC providers receive a two-hour training and WhatsApp-based supervision.
- **Value-added of *THIS* 2wT intervention:**
 - Referral loops ensure potential AE reviews
 - Clients receive reviews when requested
 - Tasks/reminders to ensure nurse-led client management for quality care
 - Routine reporting supported; DHIS2/EMR linkage potential***

Why Might 2wT for VMMC Still Fail?



- Despite evidence, alternative approaches considered
 - Global reluctance to alter in-person visit guidance
 - Promotion of un-tested alternative technologies
Competition versus collaboration across IPs
 - MoH ownership and interoperability concerns
- Lack of coherence and cooperation between Ministries, donors and grantees remains a major challenge for digital health to deliver maximum benefits to vulnerable communities



2wT for ART Retention

Background: ART Retention



- ART retention is sub-optimal: ~50% by 5 years are lost to follow-up (LTFU)
 - In Malawi, Zimbabwe, and elsewhere in SSA, poor data quality compounds problems
 - True LTFU (needs tracing) are combined with silent transfers + data quality (wasted tracing)
- Poor retention + poor data quality = wasted human and financial resources

2wT for ART Concept



- **CHT app for 2wT sends:**
 - 1) Weekly motivational adherence messages (blast)
 - 2) Specific visit-date reminders (2wT); response requested
 - 3) If needed, missed visit alerts (2wT); response requested
- **2wT proactive contact *before* missed visits**
- **2WT responses automatically record transfers:**
 - Improved outcome data + ID of true LTFU= reduced tracing workload
- **2wT free for clients and open source**
- **Data exchange before EMR linkage**

2wT for ART Aims



Malawi:

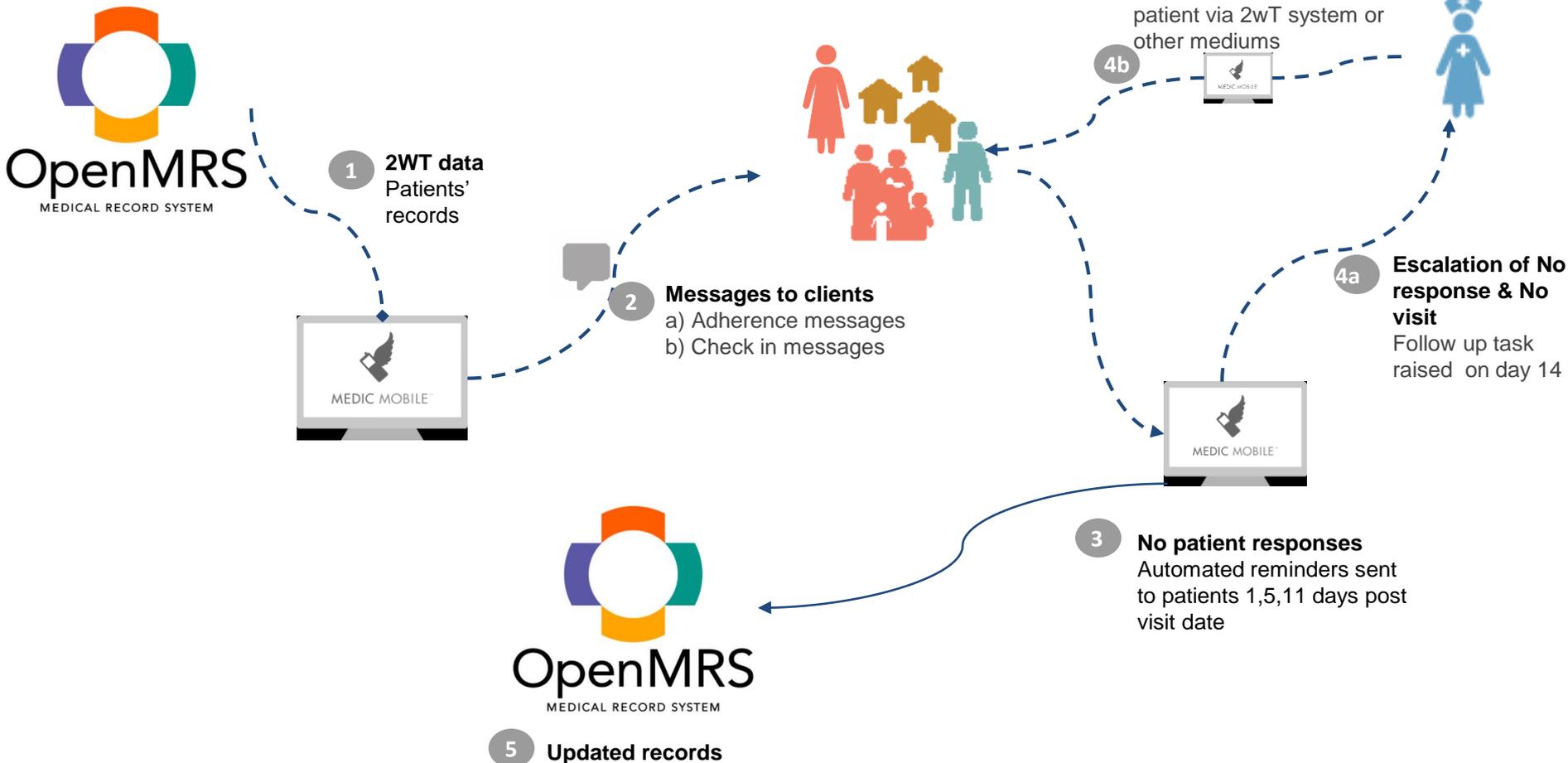
- NIH-funded R21/R33 Lighthouse EMR model
 - New initiates only (faster study outcomes)
- **Q1: Determine if 2wT can increase client retention**
- **Q2: Estimate the cost savings associated with 2wT**
- **Q3: Integrate 2WT into routine EMRS and assess via RE-AIM***
 - Reach: LH and MPC clients enrolled in 2WT
 - Effectiveness: Retention and B2C referrals at both LH and MPC
 - Adoption: Mixed-methods for 2WT acceptability, usability, costs
 - Implementation: Describe 2WT and B2C facilitators, barriers, work
 - Maintenance: >80% target clients receive 2WT from routine HCWs

Zimbabwe:

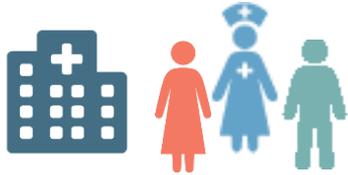
- CDC-funded: ~stand-alone +visit verification + EMR linkage

*RE-AIM framework: Glasgow, R. E., Vogt, T. M. & Boles, S. M. Evaluating the public health impact of health promotion interventions: the RE-AIM framework, . American journal of public health 89, 1322-1327 (1999).

Design mapping: 2wT for ART tracing



Workflow Mapping: 2wT Registration Design



1 Registration

Patient's demographic information is captured electronically and on paper based tools. Patient is assigned ARV number and a patient ID. A barcode sticker is printed and pestered on patient's file, health passport book, CD₄ lab request and ART Mastercard

Introduce the 2wT study, obtain consent & register in 2wT system?



2 CD₄ Count check

Test requisition is logged in EMR, sample collected, analysed and results recorded on CD₄ lab request form and logged in EMR



3 Counselling

Positive living and adherence education is delivered. Collection of locator information is done on paper.

Introduce the 2wT study, obtain consent & register in 2wT system?



4 Checking vital signs

Patient's vitals are measured and recorded in EMR, health passport and patient file



5 Clinician review

Conducts clinical assessment, enters results in EMR and completes the clinical assessment form. Discusses and prescribes ART and other prophylactic medication.



6 Pharmacy

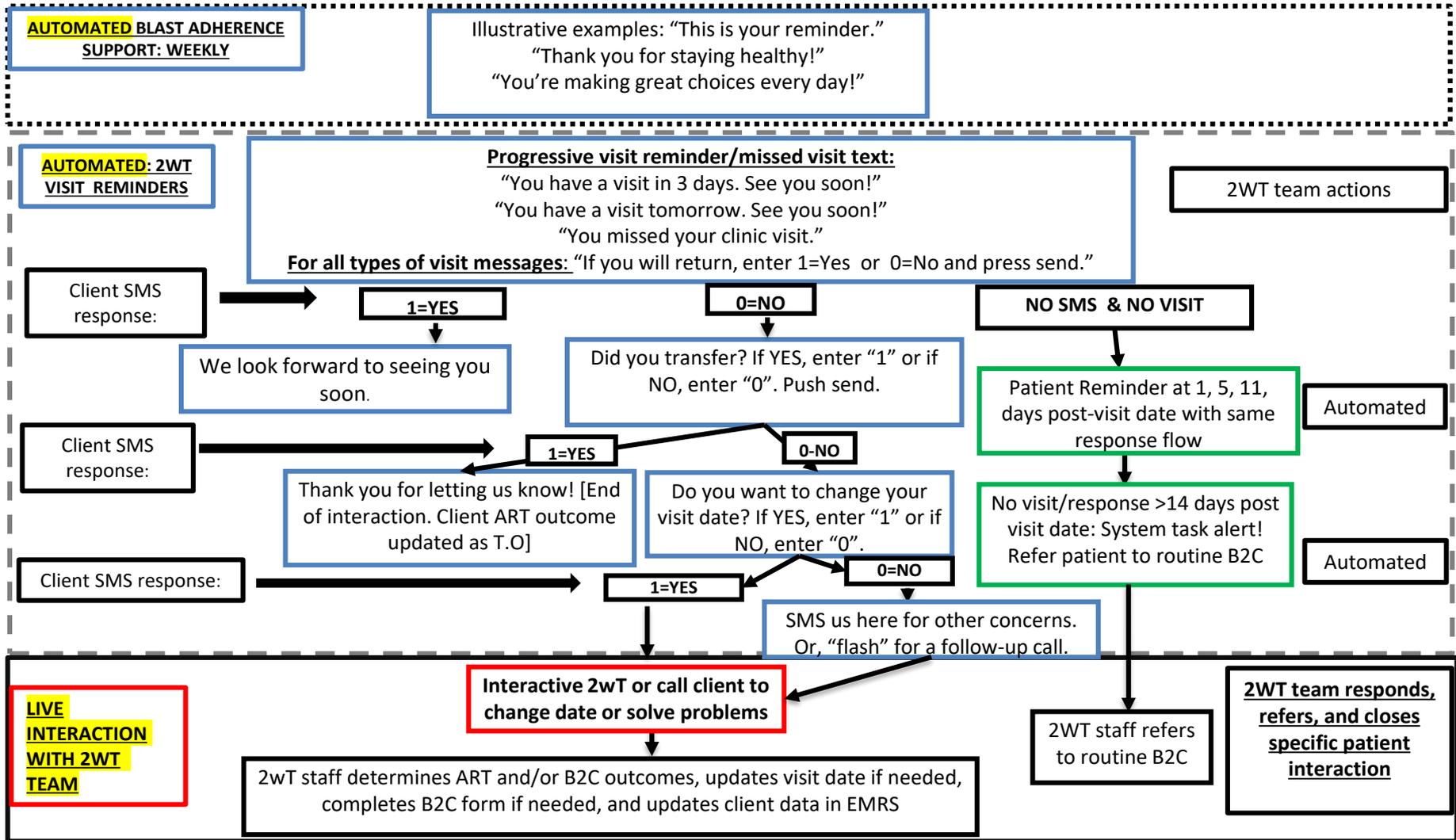
EMR calculates and assigns next appointment dated based on the number of drugs dispensed. Two stickers are printed and pestered on patient's health passport and on the Mastercard.



7 Counselling Session 2

Discussion on how and time to take the drugs given ensues. Emphasis on drug adherence

2wT Text ART Retention Flow Diagram



B2C=Back to care tracing program; EMRS=Electronic medical records system

Interactive Texting Demos



- Mock up 1
 - Patient confirms they will return to clinic.
- Mock up 2
 - Patient transferred clinic
 - For the pilot, no request of transfer clinic name
- Mock up 3
 - Patient would like to change the visit date

People's/Patient's Tab Mockup



The screenshot displays the 'People' tab in the Medic Mobile app. The top navigation bar includes 'Messages', 'Tasks', 'Reports', 'People', and 'Targets'. A search bar is located below the navigation bar. The left sidebar lists several patients, with 'Beatrice Bass' highlighted. The main content area shows the details for Beatrice Bass, including her Patient ID (A65421D), ARV number (20000), phone number (+256123456789), and the hospital she belongs to (MPC district hospital, Lilongwe district). Below the patient details are sections for 'Tasks' and 'Reports'. The 'Tasks' section shows 'NO tasks in the next week'. The 'Reports' section shows two reports: 'No response follow up' (6 days ago) and 'Patient Registration' (3 months ago). At the bottom, there is a floating action bar with icons for 'New action', 'Send message', 'Edit', and 'Delete'. A red circle highlights the 'Add' icon (a person with a plus sign) in the bottom left corner, with an arrow pointing to it from the text 'Register new patients'.

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Messages Tasks Reports **People** Targets

Search

MPC Clinic
Contact: Amanda

Amanda Allen
Contact: Amanda Allen

Beatrice Bass
Contact: Beatrice Bass

Caroline Cooney
Contact: Caroline Cooney

Dana Dearborn
Contact: Dana Dearborn

Ellen Eisenberg
Contact: Ellen Eisenberg

Francine Fanshaw
Contact: Francine Fanshaw

Garnet Geil
Contact: Garnet Geil

Houston Horn
Contact: Houston Horn

Beatrice Bass
★ Primary Contact

Patient ID
A65421D

ARV number
20000

Phone
[+256123456789](tel:+256123456789)

Belongs to
[MPC district hospital. Lilongwe district](#)

Tasks I week | 2 weeks | View all

NO tasks in the next week

Reports I week | 2 weeks | View all

Beatrice Bass
No response follow up 6 days ago

Beatrice Bass
Patient Registration 3 months ago

+ Send message Edit Delete

Register new patients

Task/Alert Tab Mockup



- Messages ¹
- Tasks**
- Reports ²
- People
- Targets

Beatrice Bass No response follow up	Due today
Dana Dearborn Stop messages	1 day left
Ellen Eisenberg Change visit date	2 days left
Amanda Allen No response follow up	3 days left
Carver Cooney Change visit date	3 days left
Gina Gorman Stop messages	
No more tasks	

No response follow up

Task description: Patient has not responded to the visit reminders or attended the visit. Please contact them.

Patient Name: Beatrice Bass
Client ID: A23456B
Health facility: MPC
Client's phone number: +2561234567

Cancel

Click to complete form



Task Tab Mockups



MEDIC MOBILE™

Messages **1** **Tasks** Reports **2** People Targets

	Beatrice Bass No response follow up	Due today
	Dana Dearborn Stop messages	1 day left
	Ellen Eisenberg Change visit date	2 days left
	Amanda Allen No response follow up	3 days left
	Carver Cooney Change visit date	3 days left
	Gina Gorman Stop messages	
No more tasks		

No response follow up

Why has patient not been responding to SMS or attending visits?
Select all that apply

- Patient says the messages are too many
- Patient does not wish to continue participating in the study
- Patient has raised confidentiality concerns
- Patient no longer has access to a phone
- Patient has moved to another location/district
- Patient died
- Unable to contact or find patient
- Other

[Cancel](#) [< Prev](#) [Next >](#)

Example 2wT Messaging Interface



The interface features a dark top navigation bar with the MEDIC MOBILE logo and icons for Messages (with a red notification badge), Tasks, Reports (with a red notification badge), People, and Targets. A hamburger menu icon is on the right.

The main content is split into two panels. The left panel shows a list of messages:

- Humphreys Chiroto** (9:24 AM): Hello yes I am going to Kawale 18 MPC • Lighthouse Trust
- Banga Farai** (9:08 AM): I cannot make my visit. Can I change dates? LH • Lighthouse Trust
- Norman Chiweshe** (Yesterday): Zikomo kwambele! C U 18 Nov MPC • Lighthouse Trust
- Peter Hatendi** (Yesterday): I missed my visit. Traveling. help? MPC • Lighthouse Trust

Below the list is a "No more messages" indicator and a "Send message" button with a plus icon.

The right panel shows a detailed view of a message from **Humphreys Chiroto** (+123456789, MPC clinic). The message history includes:

- Outgoing (blue bubble): Hi Humphreys. Thank you for letting us know you transferred your care. Where will you be seeking care? (Sent 9:00 AM)
- Incoming (grey bubble): Hello yes I am going to Kawale 18. (Received 10:45 AM)
- Outgoing (blue bubble): Thank you. We wish you well in your care. (Sent 11:00 AM)

At the bottom of the right panel is a text input field labeled "Send a reply..."

Dashboard mockup: 2wT officer/tracer

Health Facility

Year

Month

Week

Day

Total number of clients
enrolled to the 2wT study

120

Total number of clients who
have opted out of the 2wT
study

10

Messaging Summary

Message type/Status	Sent	Delivered	Failed
Adherence	50	40	10
Check in	50	40	5

SMS reponses to check ins

Message Status	Response	No response
	40	10

Summary of patient's interactions (Y= yes, N= No, - (no interaction))

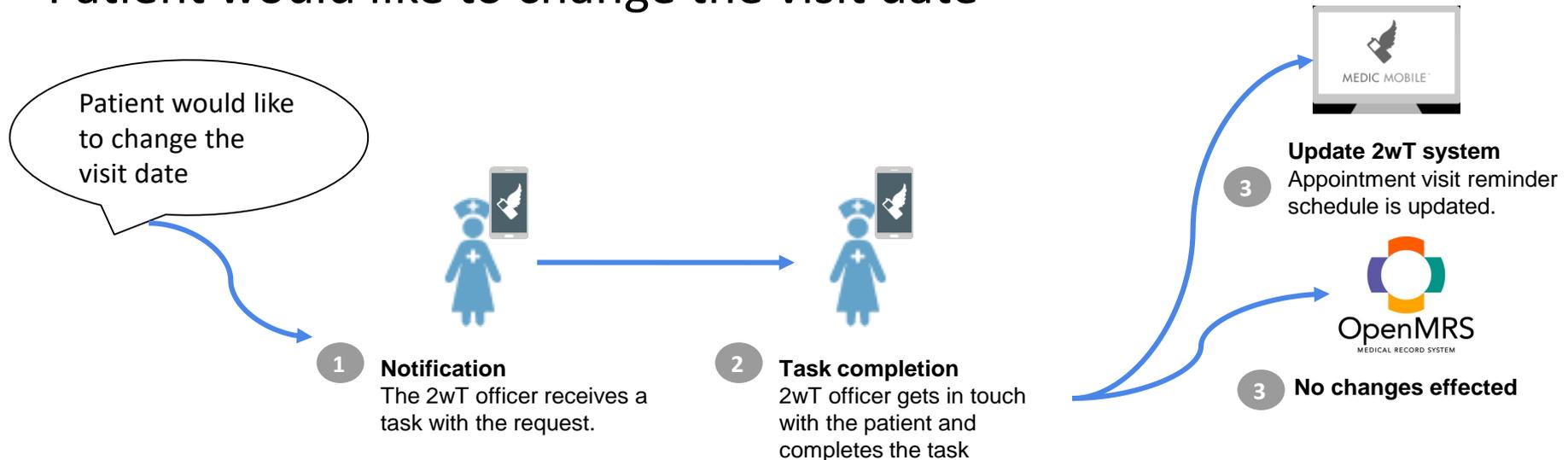
Patient ID/ Response to visit reminders	Day 3 Pre visit	Day 1 Pre visit	Visit Status	Day 1 Post visit	Day 5 Post visit	Day 11 Post visit	B2C Notified
A002	Y	Y	Attended	-	-	-	-
B005	Y	-	Transferred	-	-	-	Yes
A006	Y	Y	Visit date changed	-	-	-	Yes
A0011	N	N	Didn't attend	N	N	N	Yes
B001	N	Y	Attended	-	-	-	-
B007	Y	Y	Didn't attend	N	N	N	No
A0013	N	N	Attend	N	Y	Y	-
A0017	N	N	Didn't attend	N	Y	Y	Yes

SMS responses to check ins

SMS response	% of patients with at least one response	% of patients with No response	Average response rate%
	80	10	23

Implementation Science Approach ~User-Centered Design

Patient would like to change the visit date



- Does this process align with the main operations task flow? **LH: Tracing activities for visit defaulters begin on day 14 post visit date.**
- What happens if a patient changes visit to a day that is >14 days post the visit date? Do we notify the main defaulters tracing team? How? Is this acceptable within the ART programming activities (patient will run out of drugs)? What is the user experience (the LTFU tracing team engaged) when they already indicated they will not be available? Will they continue trusting the 2wT system?)

2wT ART Expected Results



- **HCW benefits**

- 2wT fills both a workload burden and a known data quality concern
- 2wT reduced workload for tracers and M&E
- 2wT improves outcome data quality

- **Patient benefits**

- Adherence reminders engage patients in care
- Visit reminders (especially with multi-month scripts) could increase retention

- **System benefits**

- Cost effective, open source innovation that is appropriate for routine care contexts

Why 2wT Holds Promise for ART at Scale



- **Right Intervention**

- HCW should drive the technology, not be subject to it
- Reduced overstressed providers workload
- Safe (no harm), aiming for cost-effective and client/clerk user-approved

- **Right Place**

- Routine setting development, prototype, and pilot
- ART settings with routine ART providers could make/break success – REAL work context
- MoH-led/partnered – key to ownership and sustainability

- **Right Time**

- Aims to overcome a known/recognized inefficiency
- mHealth innovations in this arena show promise in research/pilot settings

Why 2wT Holds Promise for ART at Scale



- **Implementation science-led process from research to routine practice**
 - IS approach with on-site user centered design increases likelihood of local success
 - MoH site setting increases scalability, ownership, and sustainability
 - Iterate, solicit feedback, iterate, solicit feedback – know/listen/test/do cycles
- **Value-added for *THIS* 2wT innovation**
 - Silent transfers not traced
 - Client/clerk engage in retention solutions, non-clinical
 - Timely tracing lists of true LTFU
 - Higher quality ART outcome data for planning
 - Leverages the power of integration and automation

Why Might 2wT for ART Still Fail?



- **RUSH: fast tech = poor tech**
 - See: user-centered (iterative) design
 - **Data is not exciting** 
 - Data not seen as priority intervention/innovation
 - **Quality data has costs**
 - Solving data access/ownership issues are complex
 - Hope costing studies reveal true investments/advantages
 - **Linkage to EMR/other systems**
- **Lack of coherence and cooperation between Ministries, donors and grantees remains a major challenge for digital health to deliver maximum benefits to vulnerable communities**

2wT and Technology Caveats



- Ethics of access
- Confidentiality
- Outdated dinosaur tech
- Rapid pace of “innovation”
- BIPOC/class/urbanicity issues
- NGO-donor driven “centers of excellence”
- Not exciting? Not innovative? Not jazzy
 - Bring on the bells and whistles!

Where should mHealth Go?



1. Foster inter-IP collaboration over competition
2. Place user-centered (patients/HCWs) design at the helm, not donor/IPs
3. Require and promote rigorous evidence for innovation adoption
4. Resist one-size-fits-all solutions
5. Focus on appropriate tech for real world settings
 - Say no (maybe?) to power or connectivity reliance
6. Interoperability \neq panacea
 - Overcome fear of parallel systems

Thank you!



Questions? Want to see the demo? Contact me!

- [Caryl Feldacker, cfeld@uw.edu](mailto:cfeld@uw.edu)
- Medic Mobile slides credit: Maryanne Mureithi, mureithi@medicmobile.org
- For more about the Community Health Toolkit open source project, visit: <https://communityhealthtoolkit.org>
- Publications on 2wT for VMMC:
 - <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6903365/>
 - <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0233234>
 - <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0239915>
 - <https://link.springer.com/article/10.1186/s13063-019-3470-9>