

Texting and Infectious Disease

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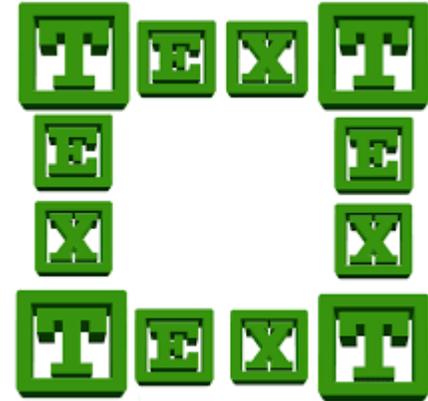
AZDHS Infectious Disease Training July 27, 2016



Mel & Enid Zuckerman
College of Public Health

Overview

- ▶ Why text?
- ▶ And why for infectious diseases?
- ▶ Relevance for tuberculosis
- ▶ The TXT4MED project
- ▶ Future avenues



Texting



- ▶ By end of 2013, 97 mobile phone subscriptions per 100 people worldwide.
- ▶ 83% of American adults own cell phones and three-quarters of them (73%) send and receive text messages.
- ▶ Cell owners between the ages of 18 and 24 exchange an average of 109.5 messages on a normal day.
- ▶ African American and Hispanic cell users are more intense and frequent users of phone capabilities than whites.
- ▶ Minorities send more text messages and make more calls on average than their white counterparts.

Source: Pew Research Center's Internet & American Life Project

Under what circumstances (in the disease prevention context) might texting be useful?

- ▶ Many conditions require long term and life-long medication--potential for poor adherence to medication and care
- ▶ Conditions which affect a considerably large portion of the population and thus merit concern as a public health problem
- ▶ Conditions where there is a strong behavioral component regarding prevention
- ▶ Considerable amount of social support to sustain effective home-based-care

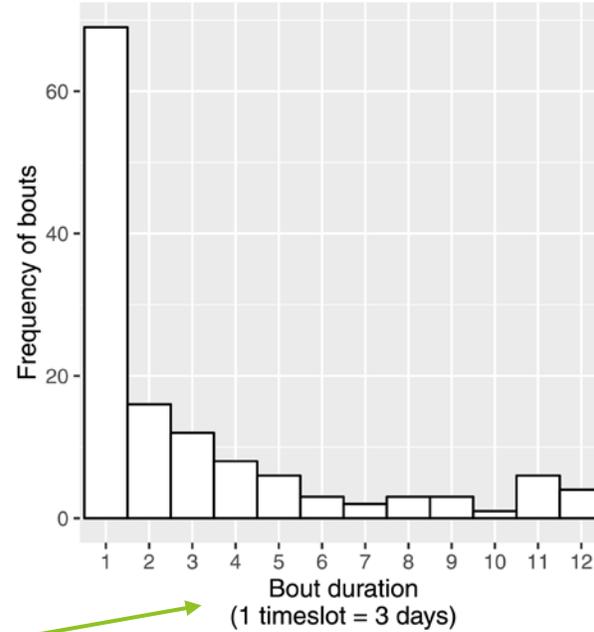
Texting applications in the context of infectious diseases

- ▶ Sentinel/syndromic surveillance
- ▶ Disease monitoring
- ▶ Early alerts
- ▶ Mass drug administration (MDA)
- ▶ Test result notification
- ▶ Medication reminders and motivation
- ▶ Information dissemination

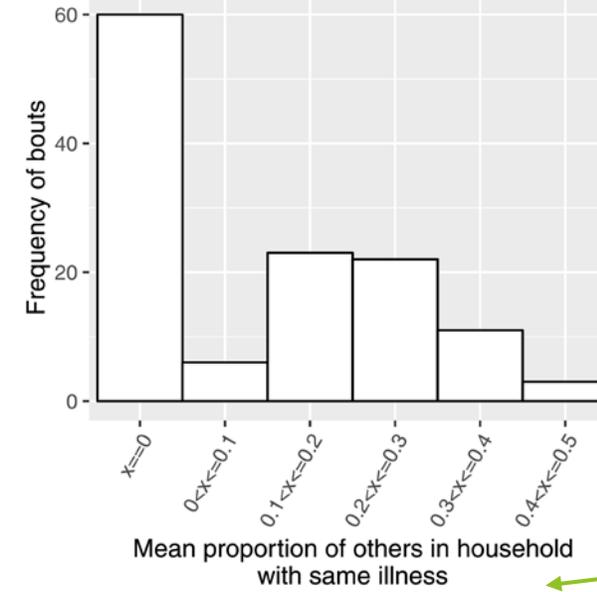
(Published)
Trials mostly in
Africa

Participatory Syndromic Surveillance

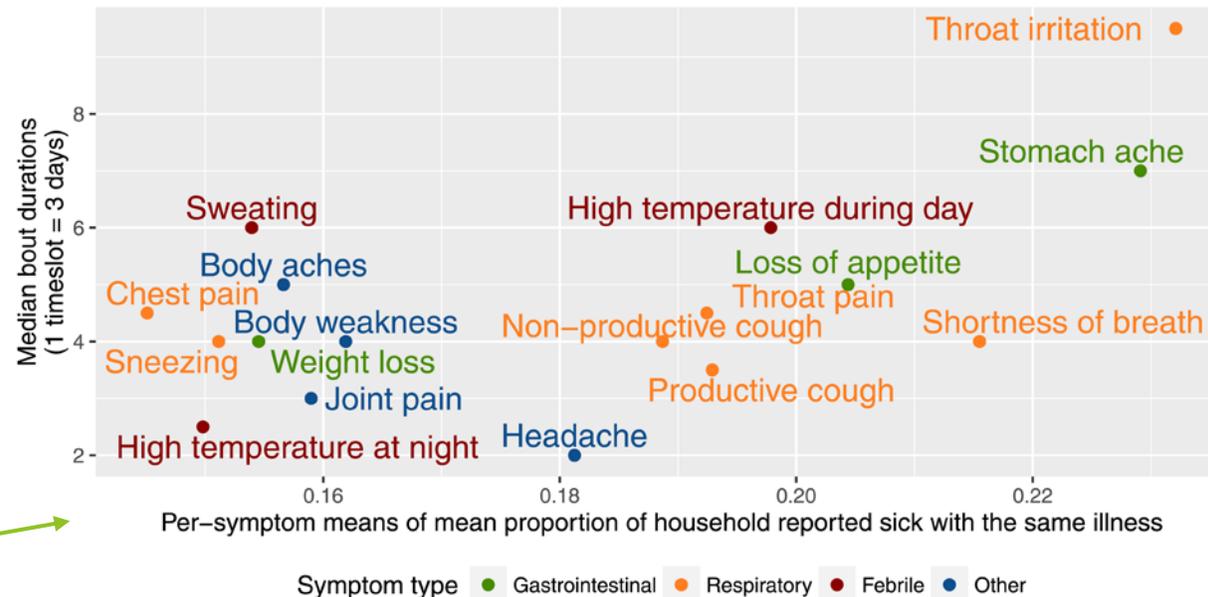
7a. Distribution of individual-level bout duration



7b. Distribution of reported others in household with the same illness at time of reporting (individual-level bouts)



7c. Comparison of average durations and self-reported number of individuals in household experiencing the same illness within individual-level bouts (n > 10 only)



Sentinel Surveillance



- ▶ Since 2014, phone-based system for timely integrated disease surveillance and response in Rwanda has collected information on 23 infectious diseases from more than 50% of health facilities nationwide [TRACnet] (Kizito, 2013)
- ▶ Madagascar launched first nationwide sentinel surveillance system for influenza-like illness (ILI) based on use of mobile phones (Rajatorinina, 2012)
 - ▶ **Daily** syndromic surveillance using SMS can effectively enhance traditional public health surveillance systems already in place.
 - ▶ **Combined** biological surveillance and syndromic surveillance using SMS makes it possible to rapidly detect the circulation of the influenza virus in areas under surveillance.

Disease Monitoring

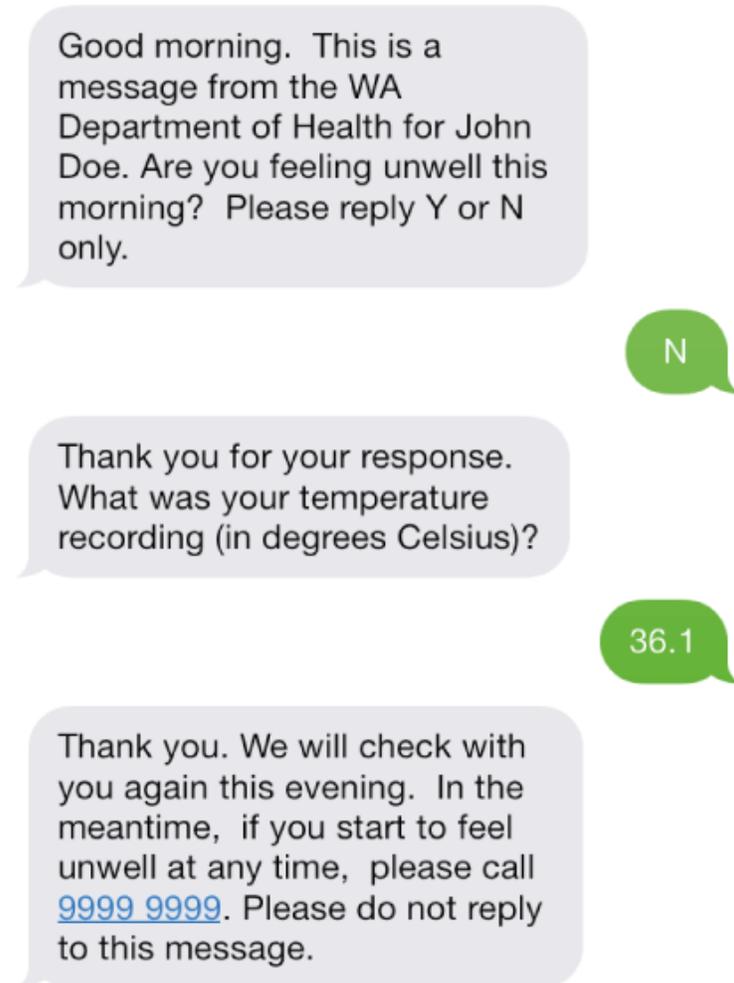
- ▶ In Uganda, feasibility and benefits of a short message service (SMS) text messaging-based reporting system have been demonstrated to help program managers monitor malaria in real time (Assimwe 2011)
- ▶ When completed, each section of a form presents the data in a format that is readily transferable into a simple text message composed of a header, numbers, and spaces.

TEST	112	47	32	17	0000	06	11	
	Total OPD attendance	Suspected malaria cases	RDT tested cases	RDT positive cases	Microscopy tested cases	Microscopy positive cases	Positive cases under 5 years	Positive cases 5+ years

Disease Alerts--EbolaTracks

FIGURE

An example of the text messages sent from EbolaTracks each morning with responses from a fictitious participant



“For any participants who report feeling unwell or a temperature $\geq 37.5^{\circ}\text{C}$, **EbolaTracks automatically sends both an SMS and an email alert to an on-call medical officer**, who then telephones the individual to assess their condition and determine appropriate management. In addition, **if an individual does not respond within an hour, EbolaTracks generates an SMS and email alert to the on-call officer**, who then contacts the person to check their condition and to ensure that they are monitoring their temperature. Any SMS responses that cannot be interpreted by the programme are considered non-responses during automated processing and the on-call officer is notified. The on-call officer can review these responses, interpret and manipulate them manually, or may contact the participant if further clarification is needed.”

Tracey, 2015

Mass Drug Administration

- ▶ Liverpool mHealth Suite (LMS): MeasureSMS-MDA tool to improve drug supplies and MDA coverage rates in real-time (currently being trialed in urban Tanzania)

MeasureSMS-MDA: Flow of information for community-based MDA



CDDs distribute tablets, and record the age group and sex of each individual, plus whether or they have lymphoedema or hydrocoele

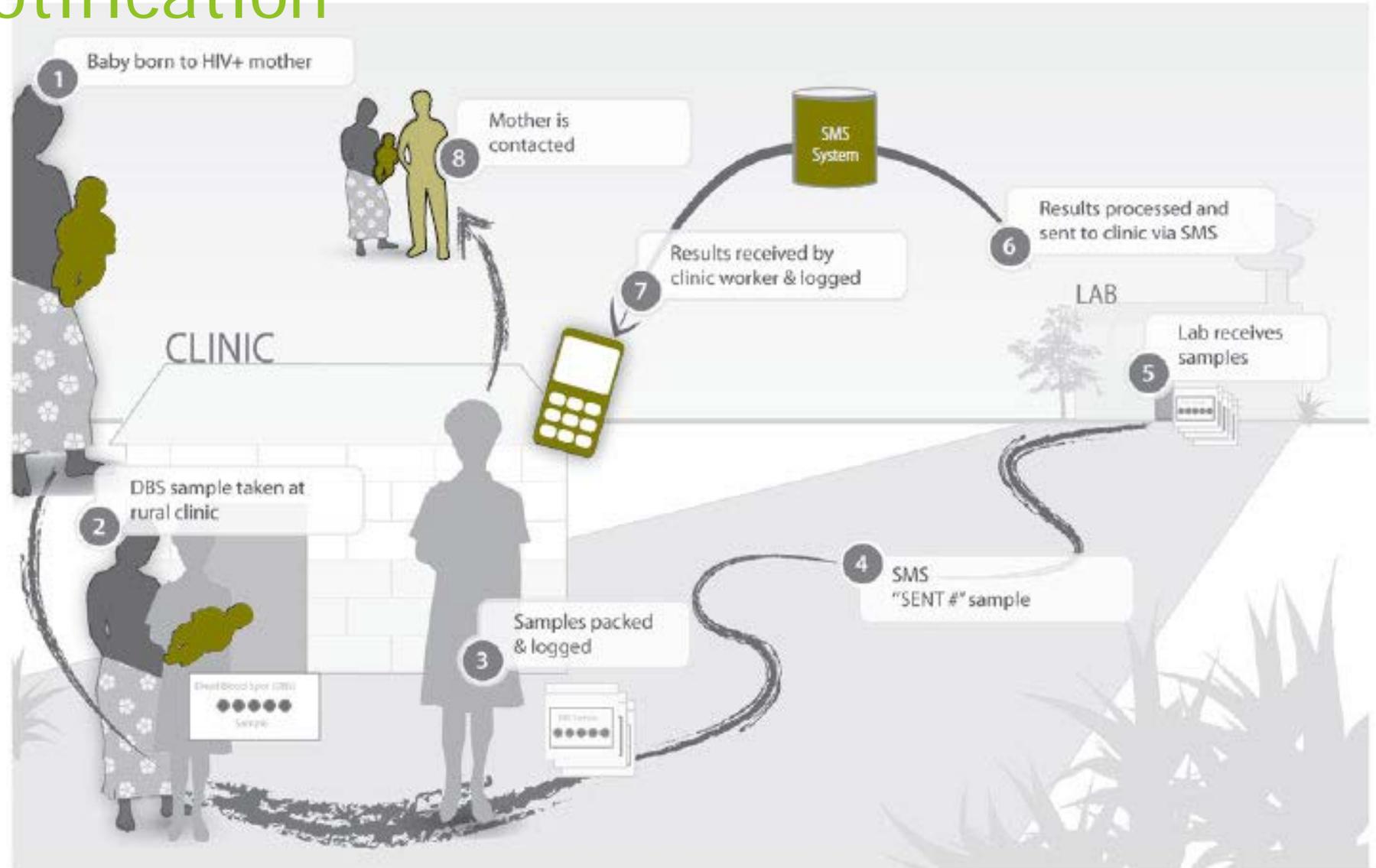
Health centre supervisors collate CDD records daily, and record cumulative number of tablets distributed and morbidity cases recorded per community

Community summaries are submitted by the supervisor via SMS at the end of each day

Supervisors receive daily coverage summaries at community/health centre/district level by SMS. District coordinators access the daily data for all reporting levels via a webpage

Fig. 1. Mobile-phone-based system for infant HIV test result notification, Zambia, 2008–2011

Test Result Notification



Seidenberg, 2012

DBS, dried blood spot; HIV+, positive for human immunodeficiency virus; SMS, short message service. Image reproduced with permission from Frog Design (San Francisco, USA) for the United Nations Children's Fund.

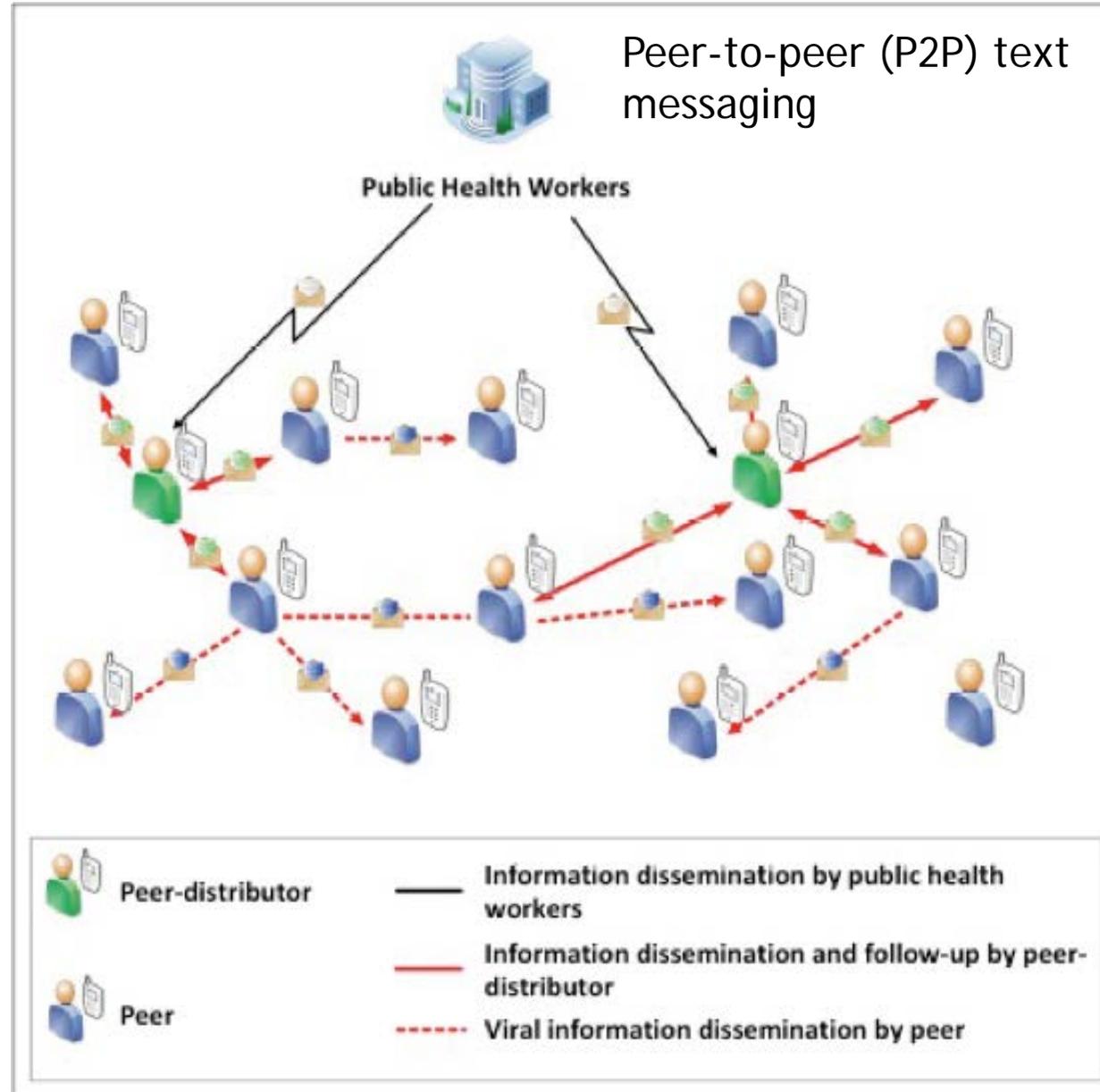
Reminder Systems

- ▶ Whether text message, mobile phone call, or concomitant text message and mobile phone call increase attendance at medical appointments for HIV care in a population of children infected with or exposed to HIV in Cameroon (Bigna, 2014)

Comparisons between groups for attendance

	Odds ratio (95% CI)	p value
<i>Intention-to-treat analysis</i>		
Text message plus call vs control	7·5 (2·9–19·0)	<0·0001
Call vs control	5·5 (2·3–13·1)	0·0002
Text message vs control	2·9 (1·3–6·3)	0·012
Text message plus call vs text message	2·6 (0·96–6·9)	0·08
Call vs text message	1·9 (0·75–4·7)	0·21
Text message plus call vs call	1·4 (0·47–3·9)	0·57

Information Dissemination



Beck, 2014

Why use a texting intervention?



- ▶ Quick, direct communication on all types of mobile phones
- ▶ Used with other initiatives to establish and maintain contact between patient and provider over course of treatment
- ▶ Efficient, considerably less invasive to daily lives compared to phone calls
- ▶ Mobility, instantaneous access, and direct communication likely to enhance efficiency of service delivery
- ▶ Cost savings include direct costs defrayed to health system as well as opportunity costs of missed appointments and lengthy treatment duration

TXT4MED—A little about LTBI

- ▶ Tuberculosis (TB) the leading cause of death from an infectious disease worldwide.
- ▶ Two billion people, one-third of the world's population, infected with *Mycobacterium tuberculosis* (LTBI), resulting in approximately 1.4 million deaths annually [Ten million individuals in the US estimated to have LTBI]
- ▶ Patients developing LTBI asymptomatic and non-contagious but overall lifetime risk of LTBI progression to active TB estimated at approximately 5-10%. Risk greatly increased among immunosuppressed individuals (e.g. HIV, diabetes and heavy steroid use)



WHO, 2006

TXT4MED—Issues of treatment adherence

- ▶ Patient adherence to LTBI therapy is low--LTBI is asymptomatic, patients may not understand risk of developing active TB, LTBI therapy has potential side effects, and LTBI therapy is of long duration (usually 9 months)
- ▶ Proportion of persons who complete LTBI treatment in the U.S. ranges between 39% and 65%. Low adherence rates undermine potential benefits of preventing TB progression in individuals with LTBI and maximizing TB control from a public health standpoint (Horsburgh, 2010).
- ▶ Low adherence increases burden of active TB disease within the community and can increase rate of drug-resistant TB strains.

TXT4MED Study Objectives

A commonly used practice for LTBI is a phone call to remind patients to visit the clinic for a check-in and monthly refill. We examine the feasibility of a pilot randomized controlled trial using text messages to improve LTBI treatment adherence (in a public health context).

Specific objectives of the current study are to:

- 1) Assess the feasibility of the intervention as indicated by participant recruitment and retention
- 2) Evaluate the acceptability of the intervention, as indicated by intervention adherence, outcome measurement rates, and feedback from participants.

Eligibility

- ▶ LTBI patients identified by PCHD clinic staff
- ▶ Research staff are notified of initial visit appointment
- ▶ At initial visit, patient is approached to conduct eligibility screen
 - ▶ Inclusion
 - ▶ 18+ years old
 - ▶ cell phone available
 - ▶ understands how to receive/send text messages
 - ▶ LTBI patient agreeing to start self-administered therapy
 - ▶ Rifampin or INH

Enrollment

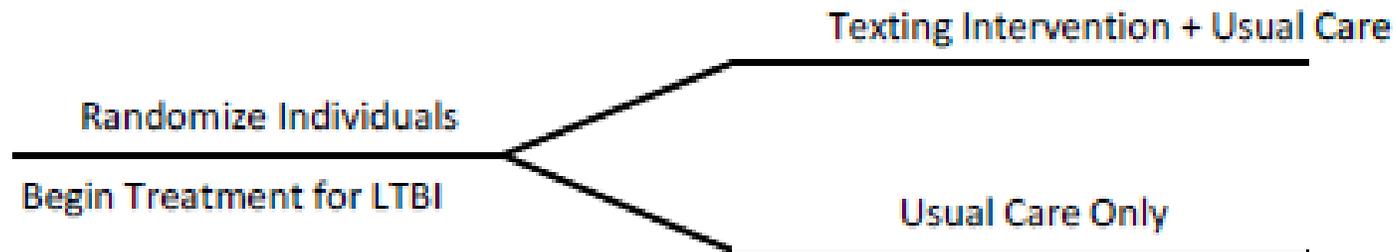
- ▶ LTBI patients come back for a follow-up appointment to pick up medication monthly
- ▶ Enrollment happens at their first medication pickup
- ▶ Forms are completed utilizing a Language Line as needed
 - ▶ Informed Consent
 - ▶ HIPAA Release
 - ▶ Entry Survey

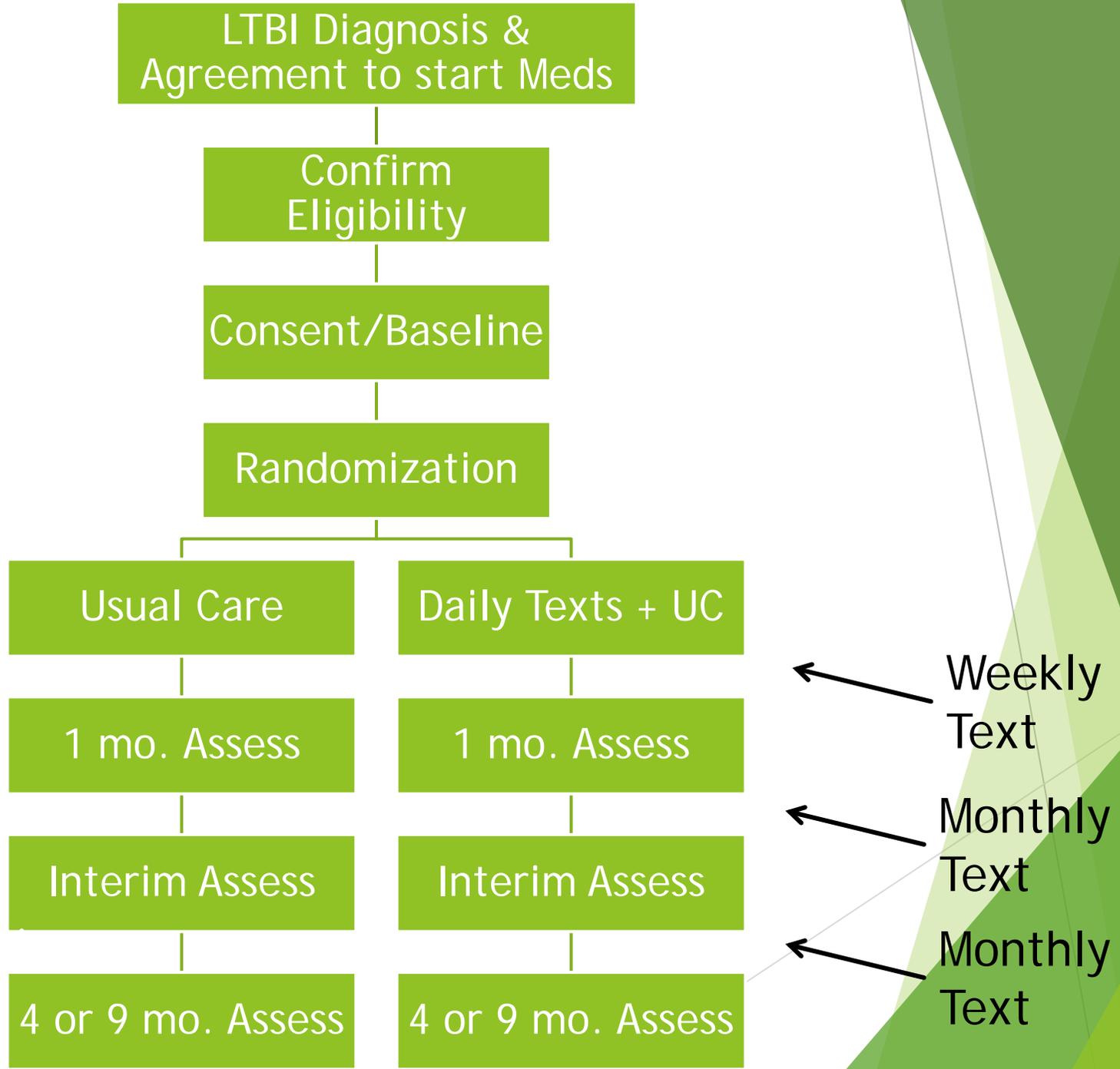


Standard Phone Interpreting Call Flow

Intervention Arms

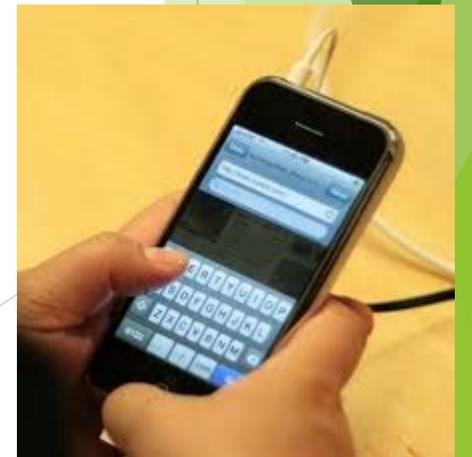
- ▶ Patient is randomized into one of two intervention arms (research staff are blinded)
- ▶ If they are in the texting intervention arm, they are entered into the online texting platform





Texting Intervention

- ▶ Daily: Message timed to medication ingestion
- ▶ “Please take your medication” in language of choice [reminder]
- ▶ Monthly: variable day/week for motivational message (e.g. “keep it up”)
- ▶ Protecting privacy



TXT4MED Website

txt4med.arl.arizona.edu



About This Study

As Tuberculosis (TB) treatment regimens can be many months long, adherence to TB medication may be difficult for some to complete. The TXT4MED study enrolls patients from the Pima County Health Department Tuberculosis Clinic into a clinical trial. The purpose of the study is to determine whether text message reminders to take TB medication are a low cost, effective means of improving adherence to TB treatment regimens.



Our Research Group

The TXT4MED study group is led by Principal Investigator, Eyal Oren PhD. Dr. Oren is an epidemiologist at the University of Arizona with many years of experience studying respiratory infections. Dr. Oren is working in conjunction with the Pima County TB Clinic (Tucson, AZ) to recruit study participants and provide ongoing care for enrolled patients.



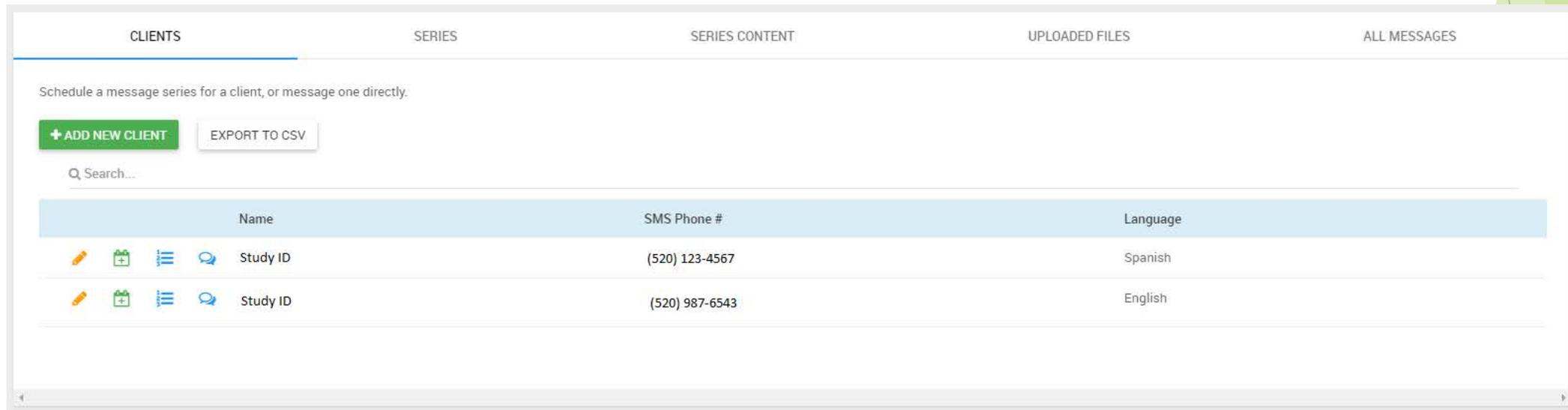
Questions and Comments

If you have any questions or concerns regarding this study please email txt4med@email.arizona.edu.



Client Management

- ▶ Clients are added into the platform to receive messages
- ▶ Messages are customized by time of day, and start the day after enrollment
- ▶ 5+ languages available

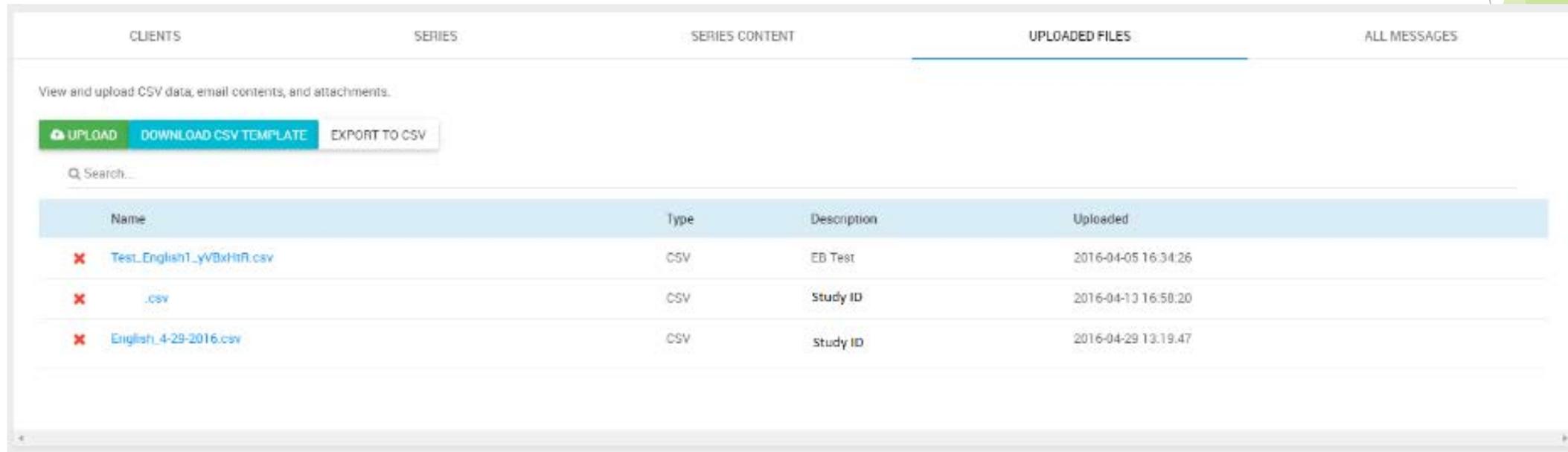


The screenshot displays a web application interface for client management. At the top, there are five tabs: CLIENTS, SERIES, SERIES CONTENT, UPLOADED FILES, and ALL MESSAGES. The CLIENTS tab is active. Below the tabs, there is a heading: "Schedule a message series for a client, or message one directly." Below this heading are two buttons: "+ ADD NEW CLIENT" (green) and "EXPORT TO CSV" (white). Below the buttons is a search bar with the text "Q Search...". Below the search bar is a table with three columns: Name, SMS Phone #, and Language. The table contains two rows of client data.

Name	SMS Phone #	Language
    Study ID	(520) 123-4567	Spanish
    Study ID	(520) 987-6543	English

Message Management

- ▶ Messages are uploaded into the platform specific to the client
- ▶ Messages can then be modified as needed (e.g. extra follow-up messages, encouragement, etc.)



View and upload CSV data, email contents, and attachments.

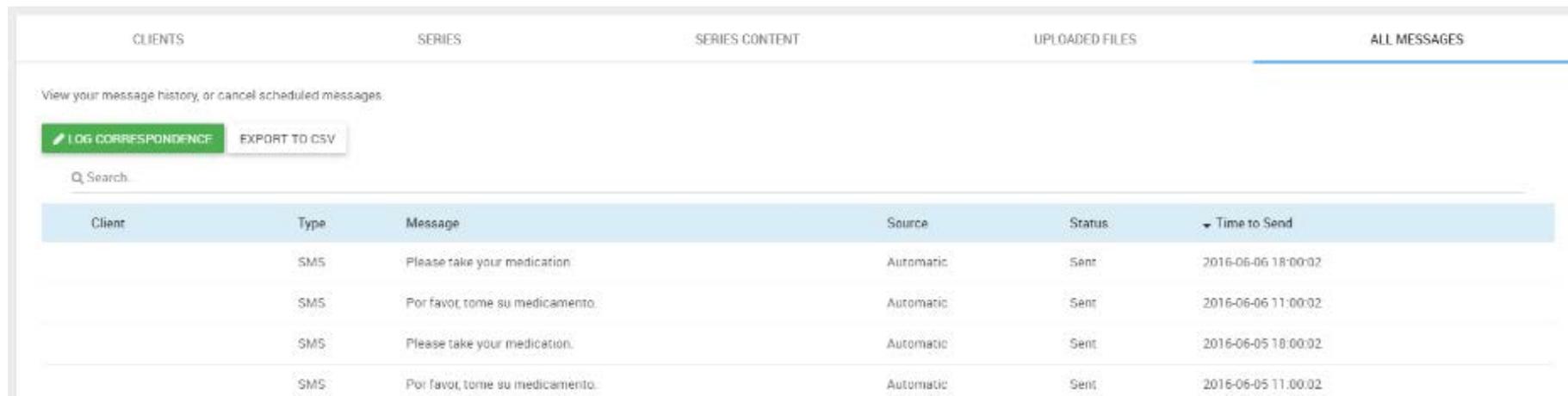
UPLOAD DOWNLOAD CSV TEMPLATE EXPORT TO CSV

Q Search...

Name	Type	Description	Uploaded
 Test_English1_yvBxHtfl.csv	CSV	EB Test	2016-04-05 16:34:26
 .csv	CSV	Study ID	2016-04-13 16:50:20
 English_4-29-2016.csv	CSV	Study ID	2016-04-29 13:19:47

Sample Message Delivery

- ▶ Messages are checked periodically to make sure the platform is sending appropriately
- ▶ If patients respond back they receive an automated message
 - ▶ “Please contact the clinic for any questions or concerns.”



View your message history, or cancel scheduled messages.

[LOG CORRESPONDENCE](#) [EXPORT TO CSV](#)

Search

Client	Type	Message	Source	Status	Time to Send
	SMS	Please take your medication.	Automatic	Sent	2016-06-06 18:00:02
	SMS	Por favor, tome su medicamento.	Automatic	Sent	2016-06-06 11:00:02
	SMS	Please take your medication.	Automatic	Sent	2016-06-05 18:00:02
	SMS	Por favor, tome su medicamento.	Automatic	Sent	2016-06-05 11:00:02

RedCap Form Management

- ▶ RedCap is a secure (HIPAA-compliant) form management program to allow for tracking of patient forms
- ▶ Forms are submitted after patient visit for all enrolled participants into RedCap
- ▶ Electronic, secure, and easy to use and track

The screenshot displays the RedCap user interface. At the top, the RedCap logo is visible, along with the user's login information: "Logged in as barrette | Log out". Below this, there are navigation links for "My Projects", "Project Home", and "Project Setup", and a "Project status: Production" indicator.

The main form is titled "TB Abstraction" and contains the following fields:

- Date TB skin test placed:** A date input field with a calendar icon and a "Today" button.
- Date TB skin test read:** A date input field with a calendar icon and a "Today" button.
- TB Skin Test:** Radio buttons for "Positive", "Negative", "Not Done", and "Unknown".
- Induration:** A text input field with a unit "mm" below it.
- Interferon Gamma Release Assay date drawn:** A date input field with a calendar icon and a "Today" button.
- Interferon Gamma Release Assay:** Radio buttons for "Positive", "Negative", "Not Done", and "Unknown".
- Primary Reason for LTBI evaluation:** A text input field.
- Date of LTBI Diagnosis:** A date input field with a calendar icon and a "Today" button.
- LTBI Treatment Start Date:** A date input field with a calendar icon and a "Today" button.
- LTBI Treatment Drug Regimen:** A text input field with a placeholder "Drug, Dose, Frequency".
- Incomplete LTBI therapy in past:** Radio buttons for "Yes", "No", and "Unknown".

At the bottom of the form, there is a "Form Status" section with a "Complete?" dropdown menu set to "Incomplete" and a "Save Record" button.

RedCap Dashboard



Logged in as **barrette** | Log out

My Projects

Project Home

Project Setup

Project status: **Production**

Data Collection

Record Status Dashboard

Add / Edit Records

Data Collection Instruments:

- Eligibility Screen
- Consent Form
- Entry Survey
- Exit Survey
- Patient Satisfaction Survey
- MR Abstraction Baseline
- Side Effects Form
- Side Effects Form 2
- Side Effects Form 3
- Adherence Form Month 1
- Adherence Form Month 2

TXT4MED

Record Status Dashboard (all records)

Displayed below is a table listing all existing records/responses and their status for every data collection instrument (and if longitudinal, for every event). You may click any of the colored buttons in the table to open a new tab/window in your browser to view that record on that particular data collection instrument. Please note that if your form-level user privileges are restricted for certain data collection instruments, you will only be able to view those instruments, and if you belong to a Data Access Group, you will only be able to view records that belong to your group.

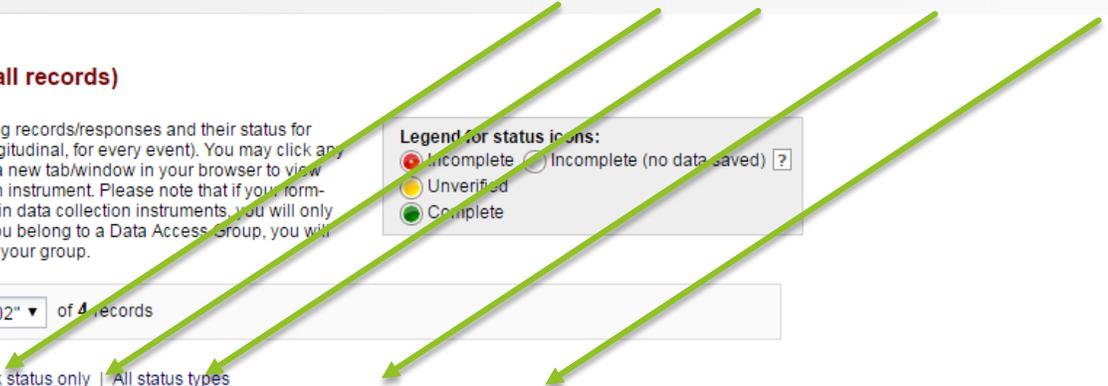
Displaying record "001" through "SIL02" of 4 records

Displaying: Instrument status only | [Lock status only](#) | [All status types](#)

Study ID	Eligibility Screen	Consent Form	Entry Survey	Exit Survey	Patient Satisfaction Survey	MR Abstraction Baseline	Side Effects Form	Side Effects Form 2	Side Effects Form 3	Adherence Form Month 1	Adherence Form Month 2	Adherence Form Month 3	Adherence Form Month 4	Adherence Form Month 5	Adherence Form Month 6	Adherence Form Month 7	Adherence Form Month 8	Adherence Form Month 9

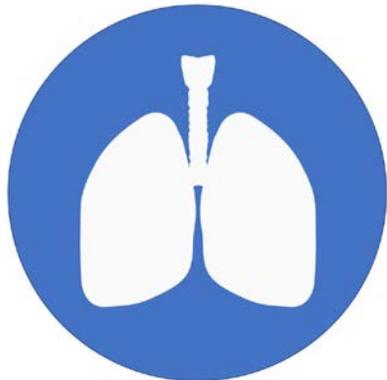
Legend for status icons:

- Incomplete
- Incomplete (no data saved) ?
- Unverified
- Complete



TXT4MED Study Progress and Key Points

- ▶ Enrollment Begun—large study team to meet eligible patients
- ▶ Monthly data assessments
- ▶ Qualitative information collected at baseline (and eventually end)
- ▶ Study costs
- ▶ Variation in text formatting and content to assess effectiveness of delivery (see next slide)



Key characteristics of text messaging interventions

“Dosing”

- Frequency (e.g. Daily, once per week)
- Timing (tied to a particular event?)
- Duration (3 months, 1 year)
- Personalization
- Condition-specific?
- Length

“Other”

- Automation
- Language

“Content”

- Message type (e.g. Advice, support and distraction delivered in non-formal language)
- Interactivity (response? What type?)

Intervention Characteristic	OR (95% CI)	k
Daily Messaging		
Yes	1.25 (0.46, 1.68)	5
No	1.46 (1.20, 1.79)	4
Bidirectional Communication		
Yes	1.57 (1.22, 2.01)	5
No	1.26 (1.00, 1.58)	4
Personalized Message Content		
Yes	1.69 (1.03, 2.77)	3
No	1.36 (1.14, 1.62)	6
Messages Matched to Dose Schedule		
Yes	1.72 (1.08, 2.75)	4
No	1.35 (1.13, 1.61)	5

Note. Odds ratios (OR) gauge the success of the interventions at increasing adherence as represented by its average across available measures for each study, where larger values indicate better success. Each moderator listed was evaluated individually without controlling for other listed moderators; that is, analyses are bivariate.

doi:10.1371/journal.pone.0088166.t003

Texting is about communication

- ▶ Understand your audience
- ▶ Content Development
- ▶ Cultural Competency
- ▶ Audience Reach
- ▶ Disseminate

Audience Insights

Communicating to Moms (with Kids at Home)



There are approximately 83 million moms in the United States today.¹ Moms are the primary gatekeepers to household decisions and finances, controlling more than \$1.6 trillion a year in spending.² This report will help you understand the subtle nuances that exist among different generations of moms (i.e., baby boomers, Generation X, and Generation Y) and how you can capture their attention more effectively.

Insights into Moms

1. Baby boomer moms who waited to have kids behave more like Gen X moms who have kids the same age as theirs.³ A 48-year-old boomer mom and a 35-year-old Gen X mom who take their toddlers to the same preschool have more in common than the boomer mom has with her boomer peers who have older kids.
2. Most moms go online daily, and more than half go online more than 20 times per week.⁴ The explosion of social networking sites and blogs for moms allow women to connect with and learn from each other.
3. One of the most effective ways to reach moms is through their peers. Moms are much more likely to follow unsolicited advice from their friends and family than anything they see, hear, or read via mass media channels.⁴
4. Moms put a great deal of time and effort into choosing what is best for themselves and their families, and they want to feel like they have accomplished something meaningful when they've made a decision.⁵
5. The average age of first-time moms was 25.2 in 2005,⁶ up from 21.4 in 1970.
6. Sixty-five percent of moms with preschool-aged children worked in 2006,⁴ up from 30% in 1970.
7. The number of single moms has increased 300% over the last 30 years, from 3.4 million to 10.4 million.⁷
8. In 2007, 40% of births were from unmarried women, up from 34% in 2002.⁷
9. The average stay-at-home mom spends 91.6 hours a week doing mom-related jobs (cooking, cleaning, laundry, driving, etc.). If paid the going rate for each of these tasks, her annual salary would be approximately \$122,732.⁸

Audience Insights can help you to communicate more effectively with your audience in order to influence their behavior. CDC's Marketing and Communication Strategy Branch (MCSB) divides audiences into segments with similar needs, preferences, and characteristics and provides CDC programs with audience-specific information, marketing expertise, and communication planning. To develop **Audience Insights**, secondary data is collected and analyzed from CDC-licensed consumer databases, books, articles, and the Internet. For more information, email MCSEHealthMktg@cdc.gov or contact Lynn Solder, Chief, MCSB, at LSolder@cdc.gov.

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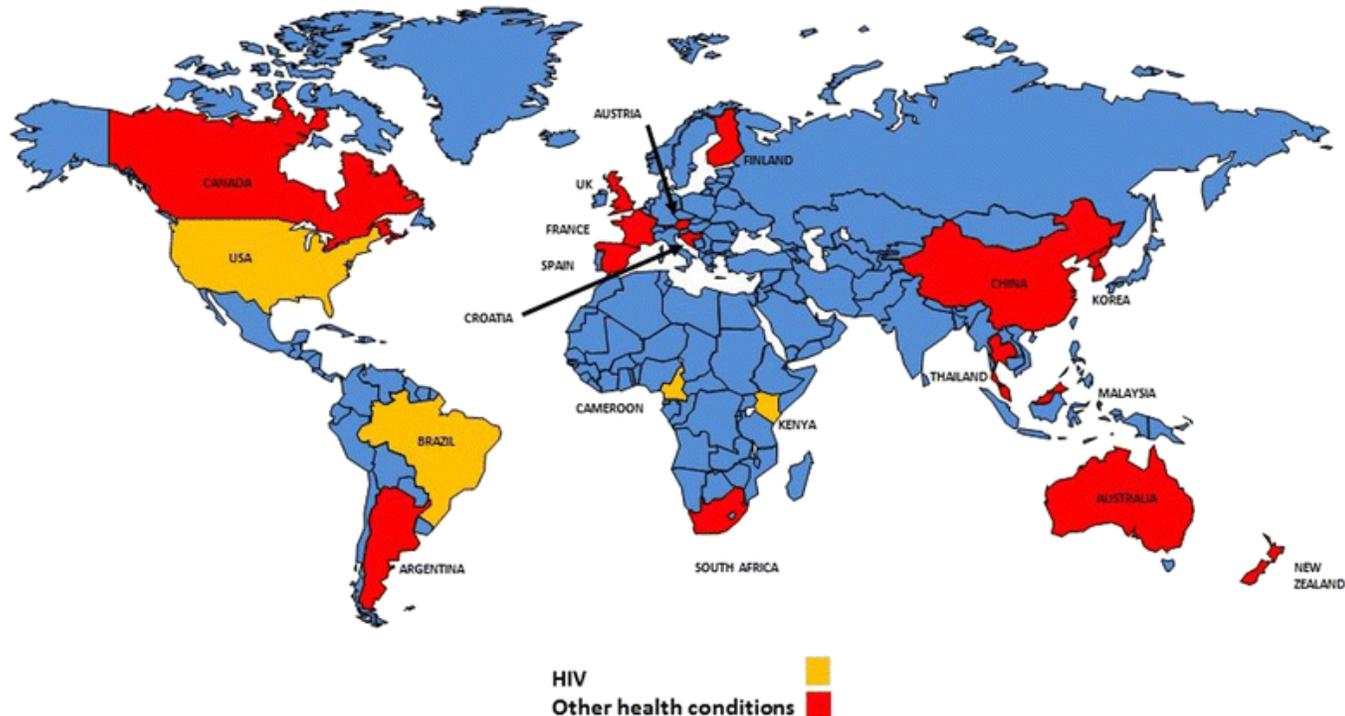


U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
Marketing and Communication Strategy Branch



Future Needs in ID

- ▶ Recent review of systematic reviews of texting (Mbuagbaw 2015)
 - ▶ Only 2 text messaging interventions in HIV, 1 TB



“The only behaviour change intervention targeted in people living with HIV was **adherence to medication**. The effects on behaviour change and health promotion are inconsistent, and almost null for self- management of illness, communicating results of medical investigations and adherence to TB medication.”

Knowledge gaps



- ▶ Need for higher quality studies (Cole-Lewis, 2010; Gurol-Urganci 2012)
- ▶ Investigation of long-term effects (de Jongh 2012; Militello 2012)
- ▶ Importance of delving further into text message characteristics in order to optimize outcomes (Horvath 2012)
- ▶ Characterization of risks and harms (Vodopivec-Jamsek 2012), user satisfaction and acceptability (Gurol-Urganci 2012), cost effectiveness (de Jongh, 2012), and dose response (Militello, 2012).

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Questions?

