Title

Lessons Learned From the Implementation of Seek, Test, Treat, Retain Interventions Using Mobile Phones and Text Messaging to Improve Engagement in HIV Care for Vulnerable Populations in the United States

Journal

AIDS and Behavior, 21(11)

ISSN

1090-7165

Authors

Christopoulos, Katerina A
Cunningham, William E
Beckwith, Curt G
et al.

Publication Date

2017-11-01

DOI

10.1007/s10461-017-1804-8

Peer reviewed

HHS Public Access

Author manuscript

AIDS Behav. Author manuscript; available in PMC 2018 November 01.

Published in final edited form as:

AIDS Behav. 2017 November ; 21(11): 3182–3193. doi:10.1007/s10461-017-1804-8.

Implementation of Seek, Test, Treat, Retain Interventions Using Mobile Phones and Text Messaging to Improve Engagement in HIV Care for Vulnerable Populations in the United States

Katerina A. Christopoulos[1], **William E. Cunningham**[2], **Curt G. Beckwith**[3], **Irene Kuo**[4], **Carol E. Golin**[5], **Kevin Knight**[6], **Patrick M. Flynn**[6], **Anne C. Spaulding**[7], **Lara S. Coffin**[1], **Bridget Kruszka**[8], **Ann Kurth**[9], **Jeremy D. Young**[10], **Sharon Mannheimer**[11], **Heidi M. Crane**[12], and **Shoshana Y. Kahana**[13]

[1]Division of HIV, ID, and Global Medicine, Zuckerberg San Francisco General Hospital, University of California San Francisco, San Francisco, CA

[2]Departments of Medicine and Health Policy and Management, UCLA Schools of Medicine and Public Health, Los Angeles, CA

[3]Division of Infectious Diseases, Warren Alpert School of Medicine at Brown University, Providence, RI

[4]Department of Epidemiology and Biostatistics, Milken Institute School of Public Health, George Washington University, Washington, D.C

[5]Department of Health Behavior, UNC Gillings School of Global Public Health, Chapel Hill, NC

[6]Institute of Behavioral Research, Texas Christian University, Fort Worth, TX

[7]Department of Epidemiology, Emory Rollins School of Public Health, Atlanta, GA

[8]Collaborative Health Studies Coordinating Center, University of Washington, Seattle, WA

[9]School of Nursing, Yale University, New Haven, CT

[10]Division of Infectious Disease, University of Illinois at Chicago, Chicago, IL

[11]Departments of Medicine and Epidemiology, Columbia University Mailman School of Public Health, New York, NY

[12]Division of Allergy and Infectious Diseases, University of Washington, Seattle, WA

[13]Services Research Branch, National Institute on Drug Abuse, Bethesda, MD

Abstract

In the United States, little is known about interventions that rely on mobile phones and/or text messaging to improve engagement in HIV care for vulnerable populations. Domestic studies using

Corresponding Author/Request for Reprints: Katerina A. Christopoulos, Division of HIV, ID, and Global Medicine, San Francisco General Hospital, University of California San Francisco, 995 Potrero Avenue, 4th Floor, San Francisco, CA 94110, Tel 415-476-4082 x440, Fax 415-476-6953, katerina.christopoulos@ucsf.edu.

Conflict of Interest: Dr. Christopoulos has been a scientific advisory board member for Roche and a community advisory board member for Gilead. No other conflicts reported.

these technologies as part of the National Institute on Drug Abuse “Seek, Test, Treat, Retain” research initiative were queried regarding intervention components, implementation issues, participant characteristics, and descriptive statistics of mobile phone service delivery. Across five studies with 1,135 predominantly male, minority participants, implementation challenges occurred in three categories: 1) service interruptions; 2) billing/overage issues, and; 3) the participant user experience. Response rules for automated text messages frequently frustrated participants. The inability to reload minutes/texting capacity remotely was a significant barrier to intervention delivery. No study encountered confidentiality breaches. Service interruption was common, even if studies provided mobile phones and plans. Future studies should attend to the type of mobile phone and service, the participant user experience, and human subjects concerns.

Keywords

mHealth; SMS; text messaging; retention in HIV care; engagement in HIV care

Considerable interest exists in using mobile phones, especially text messaging, as tools to support health promotion and behavior change, particularly engagement in HIV care.[1,2] Research in sub-Saharan Africa has demonstrated that text messaging is effective with regard to increasing antiretroviral therapy (ART) adherence.[3–6] To date, most studies of text messaging with HIV-infected individuals in the United States (U.S.) have focused on ART adherence and sexual risk reduction in sub-groups such as youth and men who have sex with men, especially among substance users.[7–15] A recent meta-analysis of 34 randomized controlled or pre/post intervention studies published through mid-2016 from around the world found that text messaging interventions significantly improved HIV appointment attendance, ART adherence, and biologic outcomes such as CD4 cell count or HIV viral load.[16] However, little is known about text messaging and more general mobile phone interventions with other vulnerable HIV-infected populations in the U.S., such as those with recent criminal justice involvement and those who receive care at safety-net clinics,[17] though pilot studies in two academic HIV clinics reported disconnected phones in one-quarter to one-third of participants.[18,19] Both criminal justice-involved (CJI) and safety-net clinic populations are at risk for poor HIV care outcomes. Studies have shown alarmingly low rates of ART prescriptions filled[20] and retention in care[21] among HIV-infected individuals after release from prison, often to levels lower than before incarceration.[22] HIV safety-net clinic populations have high rates of mortality,[23] and missed primary care visits in these settings are associated with virologic failure and death, making retention in care a priority.[24,25]

In recognition of the urgent need to improve HIV outcomes for CJI and other vulnerable populations, the National Institute on Drug Abuse funded a large-scale HIV research initiative in 2010 using the “Seek, Test, Treat, Retain” (STTR) paradigm. Twenty-two studies conducted some or all of the following: testing outreach to high-risk populations, ART initiation, and promotion of retention in long-term HIV care and treatment. The STTR consortium emphasized the prospective collection of harmonized data,[26] as well as functioning as a platform to assess the implementation of similar interventions in different settings. Herein we describe a cross-site assessment of the lessons learned in using mobile

phones and text messaging to support HIV treatment and retention in care, which constitutes a unique opportunity to advance the scientific knowledge of the field.

Methods

The principal investigators (PIs) of each STTR study included in this analysis and the STTR data coordinating center (DCC) at the University of Washington conferred to discuss implementation facilitators and challenges across studies. Based on this discussion, the first author developed a questionnaire on implementation issues and circulated it to study PIs. The first author then held follow up phone calls with each PI and project staff to define and clarify the details of each study's experience. The DCC assembled baseline demographic characteristics on study participants, including age, race/ethnicity, gender, education level, and HIV viral load. Most studies also collected data on sexual orientation, housing status, drug use, depression, and time since HIV diagnosis.

Description of Studies

There were five domestic STTR studies whose interventions relied on mobile phones and, more specifically, text messaging, to support retention in care and treatment among HIV-infected individuals in different geographic regions of the U.S. (Table I).[17,27–29] Four of the studies focused on CJI populations recently released from custody settings while the fifth focused on viremic patients at an urban safety-net clinic who were either new to clinic or poorly retained in HIV care. The primary outcome for all studies was viral suppression at either 6 or 12 months following study enrollment. All studies ensured participants were able to read and comprehend a sample text message (Table II). Below we describe each of the studies in turn.

The Link LA study was a randomized controlled trial (RCT) of routine transitional case management compared to a peer navigation intervention upon release from the Los Angeles County jail. All participants received either a Samsung Smiley T359, T-Mobile Prism II, or Kyocera Rally S1370 phone and a T-Mobile plan (at first with limited minutes but shifted to unlimited minutes early in the study), unlimited texting, and no data. Peer navigators used study-issued mobile phones to conduct "care calls" to the intervention arm and utilized a structured list to discuss issues that related to HIV care engagement and medication adherence. Navigators also used calls and texts to remind intervention arm patients of upcoming clinic appointments and to set up accompaniment to appointments. Phones were used to arrange study visits for both arms.

Project imPACT sought to maintain viral suppression among prisoners post-release in the Southeastern and Southwestern U.S. Participants were randomized either to an intervention that consisted of in-person motivational interviewing in prison and by phone post-release, linkage by a care coordinator, daily texted ART reminders, and clinic appointment reminders or to the care-as-usual condition of release with an ART prescription and referral to community care. Participants in both study arms were provided mobile phones after prison release with unlimited calls/text messages to study staff, however, intervention participants also received 600 minutes/month to ten friends and family. Phones were also used to conduct

unannounced pill counts in both arms to measure adherence. The medication reminders were sent from an automated platform at the University of North Carolina.

The CARE+ Corrections study was a RCT focused on HIV-infected residents of Washington, D.C., who had been recently released from any type of correctional facility and consisted of a one-time computerized interactive motivational interviewing session as well as text message medication reminders, clinic appointment reminders, motivational messaging, and risk behavior prevention messages. The control arm viewed a one-time educational video on overdose prevention and did not receive mobile phones. For intervention participants, the study provided Android smartphones with a cellular data plan or reimbursed $25/month for any texting costs incurred if the participant chose to use their own mobile phones. For study phones, the study utilized the university's corporate cellular plan and set up a pooled minutes arrangement consisting of 400 anytime minutes, unlimited data, and unlimited texts per line per month. Under the pooled minutes arrangement, participants who exceeded the 400 minute limit were counterbalanced by participants who used less than the 400 minute limit. Texting was automated through a commercial platform (Dimagi).

The Preparing for SUCCESS Study intervention was a feasibility study testing an intervention that consisted of six strengths-based case management sessions followed by text message check-ins and reminders after individuals were released from the Fulton County Jail in Atlanta while the comparison arm received standard jail-based case management and a $10 gift card. Intervention arm participants were given mobile phones loaded with $25 worth of minutes if they had no phones, otherwise they received a $25 gift card or minutes only. Automated messages using a commercial platform (Dimagi) were sent to participants after jail release to assess housing status, medication adherence, and medical care. Participants and interventionists could also text as needed.

The Connect4Care study (C4C) was an RCT designed to improve virologic suppression in safety-net HIV clinic patients in San Francisco with detectable viral loads who were at high risk for loss to follow up. Possession of a cell phone and willingness to send/receive up to 25 text messages per month were eligibility criteria for the study, however, if patients did not own a phone they were referred to the government Lifeline Assistance, or, "Obama Phone" program, which provides free cell phones and basic plans that include text messaging to all low-income individuals (http://www.obamaphone.com). All participants received texted reminders about their HIV primary care appointments and intervention arm participants received supportive, informational, and motivational text messages thrice-weekly. Intervention arm participants were asked to respond to these messages at least once weekly and all participants were asked to respond to a check-in text message once a month confirming participation in the study. Text messages were sent from an automated platform (Mobile Commons by Upland Software).

Results

Description of Participants

There were 1,135 participants across the five studies (Table III). The median age was 42 (range 19–74) years and 14% were women; 7% were transgender. Roughly one-half (51%) of the participants were black and 17% were Latino. About one-third (32%) had less than a high school education. Of those participants with available data, 43% were heterosexual (n=398), 52% were stably housed (n=398), and the median time since HIV diagnosis was 8.2 years, with 13% of participants diagnosed in the past year (n=698). Just over one-third (38%) had a history of injection drug use (n=342) and 63% (n=754) reported recent stimulant use.

Key Challenges Related to the Implementation of Mobile Phone-Based Aspects of the Interventions

Key implementation challenges occurred in three categories: service interruptions, billing/overage issues, and the participant user experience (Table IV).

Service Interruptions

Interruptions in mobile phone service were common across studies. Interruptions were usually due to phones being lost or stolen, or, in the case of the C4C study, which had participants use their own phones, inability to pay for service. Other reasons for service interruption included re-incarceration, entry into residential treatment programs, and hospitalization. In LINK LA, about 75% of the study population had a disconnection in service at some point during the study because phones were lost, stolen, or a non-study participant answered the phone, in which case service was turned off until the study could confirm the participant was in possession of the phone. Of the 230 participants in the C4C study, only 52% had the same phone number for the 12-month duration of the study. In the imPACT study, 18% of participants given phones lost their phone at least once and in CARE + Corrections, 58% of participants given study smartphones required a replacement due to loss or theft.

Indeed, for the four studies that provided phones, the type of phone appeared to influence phone retention rates. In the SUCCESS study, 100% of participants discarded the inexpensive phone that the study gave them, citing the availability of comparable free phones from the Obama Phone program. However, in CARE+ Corrections >90% of participants receiving the Android smartphone did not turn it in at study end, suggesting that the phone was desirable. It is worth highlighting that due to the frequency of service interruption, all studies employed extensive locator forms for participants, including contact information for friends, family, counselors, and case managers as well as email and social media addresses. C4C participants also used Google Voice™ to continue to receive text messages (via email) if their cell phone service was turned off.

Billing/Overage Issues

Three of the CJI studies worked with large mobile phone companies to provide plans to participants. All of these studies experienced problems with overage fees related to

international calls, 411 calls, billing errors, and toll-free numbers, and some participants also discovered how to unlock phones to access data and games or call additional contacts, incurring additional charges. Restrictions on use had to be constantly widened in scope during the course of each study, which often necessitated a fair amount of study staff time. In addition, it was difficult, if not impossible, to sync billing cycles with study participation. One strategy employed by CARE+ Corrections and eventually by Project imPACT that helped address overage issues was to use a pooled minutes set-up, in which participants who used more minutes were offset by those who used fewer minutes. The SUCCESS study, which used an allotment of minutes rather than an ongoing plan, found that the inability to reload minutes on a participant's phone remotely, as has been done in sub-Saharan Africa, was a tremendous obstacle to consistent mobile phone use. When the initial allotment of minutes ran out, participants tended to simply discard the phone and replace it, hindering follow-up efforts.

Participant User Experience

All of the studies had a relatively large proportion of older individuals (34% of participants were aged 47 years or older), which meant that some of these individuals, particularly those who had been incarcerated for a long period of time, had to be trained on mobile phone use and text messaging, including how to read, type, and send a message. C4C study staff also had to familiarize participants with short code (5 digit number), which was used due to lower costs, and learned to check at enrollment whether a participant's plan could accept a text message from a short code. Although many low-cost plans did not, the text messaging vendor was able to switch these participants to a long code (standard 10 digit number).

Several studies used automated platforms that asked for a response, which raised an important set of decisions with regard to: 1) what the system considered a "Yes" or "No" response and programming these equivalents; 2) setting response windows (reply outside of a response window would result in a generic study message as opposed to one related to the initial question, and; 3) setting rules for how the system would respond to a response not in the format requested. The rules regarding response windows and formats at times resulted in participants becoming frustrated with the system. Below is one example shared by the SUCCESS study.

> *Study*: How are you? Have you had SUCCESS in getting a doctor's appointment yet? 1: Yes, 2: No.
>
> *Respondent*: 1
>
> *Study*: Great, when are you going? (Enter date as yyyymmdd)
>
> *Respondent*: March 13, 2015
>
> *Study*: Invalid date format: expected YYYYMMDD. Great, when are you going? (Enter date as yyyymmdd)
>
> *Respondent*: 3 13 2015
>
> *Study*: Invalid date format: expected YYYYMMDD. Great, when are you going? (Enter date as yyyymmdd)

Respondent: WHAT THE HELL

If participants received text messages that they liked, however, they frequently responded "Thank you," even if they knew it was an automated message. However, at times participants did not remember or were confused about who was texting them. Below is an example shared by staff from the C4C study that illustrates this challenge.

Study: The wise person understands that his own happiness must include the happiness of others. –Dennis Weaver Please reply YES if you received this text.

Participant: Yes

Study: Thanks for the feedback. We appreciate your participation.

Participant: Who this?

Study: I'm sorry I did not understand. Please reply YES or NO.

Participant: Who is 69866 that I am talking to? Is this a machine? Is this a scene that I'm in?

Finally, C4C study staff found that several participants accidentally opted out of receiving text messages after typing STOP, which many automated texting platforms recognize as a signal to stop sending messages. Periodically monitoring for accidental opt-outs required staff time.

Human Subjects Concerns

Importantly, no study reported any privacy breaches around HIV status disclosure. No text messages created by studies mentioned the word "HIV," an *a priori* decision made by study investigators. There were several unusual occurrences in the C4C study that were reported to the institutional review board. In one case, a participant developed paranoid psychosis and believed study text messages were coming from government representatives who were tracking his movements. In another case it became clear that a participant receiving a follow-up assessment was not the original participant, but rather had assumed the original participant's Obama Phone telephone number. The new owner had the same first name as the original participant and a date of birth that was off by one digit; moreover, he seemed to recognize and welcome the study's call. While an extreme case, it highlights the potential for turnover in telephone numbers, particularly with phones provided by Obama Phone vendors, and the need for careful identity confirmation.

Cost

The costs associated with mobile phones, service plans, and automated texting platforms varied widely, in part because of the different approaches employed by studies, e.g., using phones included with service plans vs. purchasing them separately, simple vs. more complicated texting logic (Table V). A considerable amount of staff time was required to track service interruptions, oversee the implementation of automated texting, and, for the studies that provided plans, monitor overage charges. It was difficult to estimate a precise amount of time for each task because study staff were responsible for multiple duties with regard to participants.

Conclusion

The pragmatic and procedural issues encountered by these five studies (Table 4) highlight the potential challenges in using mobile phone technology with vulnerable populations living with HIV in the U.S. From an implementation standpoint, service interruption was common, even with studies that provided cell phones and paid for unlimited minutes/texts to participants. As a result, per-protocol analyses that consider only those individuals who maintained consistent phone service may be warranted in addition to the “real world” intent to treat analysis. Studies providing phones also encountered difficulties related to overage charges that required staff time to monitor and correct. The inability to reload minutes remotely, as has been done in sub-Saharan Africa, posed a significant barrier in the study that allotted participants minutes rather than an unlimited plan. Another key lesson learned regarding the provision of phones was the influence of type of phone on phone retention – older flip-phones were often discarded, while smartphones were valued, though they were also occasionally sold. To maximize success, future studies that provide phones might consider criteria of “nice, but not too nice” or partnering with local efforts to distribute phones through the Obama Phone program. The costs associated with maintaining mobile phone connections and using text messaging platforms in real world settings merit further investigation.

The use of Google Voice™ by several participants in the C4C study raises an interesting issue with regard to intervention delivery. Google Voice™ allows participants to receive text messages when connected to wireless internet. Interventions are generally designed with the assumption that text messages are being sent and received at a particular time, e.g. prior to a participant’s daily dose of ART. However, the use of Google Voice™ raises the possibility that participants may receive no messages for several days or weeks and then many messages at once, since message delivery depends on internet connection, which may be intermittent. The lack of a consistent “dose” may undermine intervention efforts. In addition, though the C4C study did not text confidential information, Google Voice™ is not considered Health Information Portability and Accountability (HIPAA) compliant, which can raise a difficult ethical challenge: although studies may require individuals to have a mobile phone with a wireless carrier for enrollment, they cannot know when participants are using Google Voice™ to bridge the gap of a cellular service interruption.

An important consideration in designing interventions using text messages is the participant user experience, since levels of comfort and ease with texting may vary. Texting may not be easy for older individuals, especially with flip phones. Participants recently released from prison needed to be educated on how to text and short codes. An important benefit of short codes is that they can send 30 messages per second, facilitating the “one-to-many” text message transmission used by many automated platforms; moreover, because carriers vet and approve short codes, they are not subject to suspension for heavy traffic. However, certain low-cost carriers cannot accept short code. In addition, the programmed responses that are sent via automated platforms may result in participant frustration, especially when a “loop” is triggered in which the platform gives the same response repeatedly. One interesting observation is that many participants replied with “Thank you” despite knowing that the text message was automated. Study participation was not associated with any inadvertent

disclosure of HIV status, in part because the studies decided *a priori* not to include the word HIV in any study-created text messages. Appointment and medication reminders were often purposely written in generalized terms to protect confidentiality, but at times this coding led to confusion among participants as to who was texting them. While these studies accepted this cost of privacy protection, future work should explore the acceptability of more specific messages.

Indeed, best research practices for mobile phone use include reviewing issues specific to text messaging in study consent forms, emphasizing: 1) that text messaging is not a secure technology and that messages stored on a device are the participant's responsibility; 2) that automated systems have the potential for glitches, such as sending a message at the wrong time or repeating a message, and; 3) describing whether and how texting data are being stored, who has access to it, and when it may be accessed.[30] The choice of texting platforms for intervention studies is a critical decision but represents an area that has received relatively little attention; a recently published review has begun the important process of identifying available platforms, proposing criteria for evaluating their functionality, and documenting their use in the peer-reviewed literature.[31] In addition, although a study consent form may function as an opt-in, it is worth making explicit that participants can stop receiving messages at any time. The Telephone Consumer Protection Act of 1991 requires prior express consent for non-emergency, auto-dialed, pre-recorded, or artificial voice calls to wireless phone numbers, and in 2015 the Federal Communications Commission affirmed this consent applies to text messages and can be revoked at any time. Finally, if protected health information is involved, researchers must ensure HIPAA compliance.

The outstanding question with regard to interventions using mobile phones and text messaging to promote engagement in HIV care for vulnerable HIV-infected populations in the U.S. is whether or not they are effective at improving care and treatment outcomes. Evidence to date suggests that features of texting interventions associated with successful adherence outcomes are messages sent less frequently than daily, bidirectional communication, and personalized message content.[32,33] STTR study results will add to this evidence base. Only one study described here (imPACT) has published results so far. Although the imPACT intervention (of which mobile phone distribution and texted ART reminders comprised only one component) was not successful at maintaining virologic suppression in those released from prison, it did significantly improve attendance at an outpatient clinic appointment.[34] These results highlight the likely role and potential challenge of multiple contextual factors that are known to disrupt virologic suppression after incarceration, including environments with high rates of substance use, poverty, homelessness, discrimination, lack of employment, and lack of health insurance.[35–38]

Even if the other STTR studies described here report negative findings with regard to interventions using mobile phones and text messaging, attending to issues in implementation will become that much more important. The literature reviewed in this paper suggests that text messaging to improve HIV care and treatment is generally efficacious. The scientific community will then need to focus on how to make it effective for the hardest to treat. For example, bidirectional texting with an automated platform may not be as effective as texting in real time with a live person. Including mobile phone or text messaging interventions as

part of a larger package of services and supports is another approach. If findings are positive, questions regarding cost-effectiveness, scale-up and sustainability will be germane. Regardless**,** we believe this assessment offers valuable lessons for researchers interested in designing engagement in care interventions for vulnerable populations that rely on mobile phone use and text messaging. These lessons include careful attention to the type of mobile phone and service, the participant user experience, and human subjects concerns.

Acknowledgments

Funding: Funded by National Institutes of Health R01 DA032057, R01 DA030781, R01 DA030747, R01 DA030793, R34 DA035728.

The authors would like to acknowledge Terence Johnson for assistance in assembling the cost data.

References

1. Reynolds NR, Testa MA, Su M, et al. Telephone support to improve antiretroviral medication adherence: a multisite, randomized controlled trial. J Acquir Immune Defic Syndr. 2008; 47:62–8. [PubMed: 17891043]
2. Horvath T, Azman H, Kennedy GE, Rutherford GW. Mobile phone text messaging for promoting adherence to antiretroviral therapy in patients with HIV infection. Cochrane Database Syst Rev. 2012:CD009756. [PubMed: 22419345]
3. Lester RT, Ritvo P, Mills EJ, et al. Effects of a mobile phone short message service on antiretroviral treatment adherence in Kenya (WelTel Kenya1): a randomised trial. Lancet. 2010; 376:1838–45. [PubMed: 21071074]
4. Pop-Eleches C, Thirumurthy H, Habyarimana JP, et al. Mobile phone technologies improve adherence to antiretroviral treatment in a resource-limited setting: a randomized controlled trial of text message reminders. AIDS. 2011; 25:825–34. [PubMed: 21252632]
5. Mbuagbaw L, van der Kop ML, Lester RT, et al. Mobile phone text messages for improving adherence to antiretroviral therapy (ART): an individual patient data meta-analysis of randomised trials. BMJ Open. 2013; 3:e003950.
6. Haberer JE, Musiimenta A, Atukunda EC, et al. Short message service (SMS) reminders and real-time adherence monitoring improve antiretroviral therapy adherence in rural Uganda. Aids. 2016; 30:1295–300. [PubMed: 26760452]
7. Garofalo R, Kuhns LM, Hotton A, Johnson A, Muldoon A, Rice D. A Randomized Controlled Trial of Personalized Text Message Reminders to Promote Medication Adherence Among HIV-Positive Adolescents and Young Adults. AIDS Behav. 2016; 20:1049–59. [PubMed: 26362167]
8. Belzer ME, Kolmodin MacDonell K, Clark LF, et al. Acceptability and Feasibility of a Cell Phone Support Intervention for Youth Living with HIV with Nonadherence to Antiretroviral Therapy. AIDS Patient Care STDS. 2015; 29:338–45. [PubMed: 25928772]
9. Belzer ME, Naar-King S, Olson J, et al. The use of cell phone support for non-adherent HIV-infected youth and young adults: an initial randomized and controlled intervention trial. AIDS Behav. 2014; 18:686–96. [PubMed: 24271347]
10. Dowshen N, Kuhns LM, Gray C, Lee S, Garofalo R. Feasibility of interactive text message response (ITR) as a novel, real-time measure of adherence to antiretroviral therapy for HIV+ youth. AIDS and behavior. 2013; 17:2237–43. [PubMed: 23546844]
11. Lewis MA, Uhrig JD, Bann CM, et al. Tailored text messaging intervention for HIV adherence: a proof-of-concept study. Health Psychol. 2013; 32:248–53. [PubMed: 22545972]
12. Reback CJ, Ling D, Shoptaw S, Rohde J. Developing a Text Messaging Risk Reduction Intervention for Methamphetamine-Using MSM: Research Note. Open AIDS J. 2010; 4:116–22. [PubMed: 20657827]

13. Reback CJ, Grant DL, Fletcher JB, et al. Text messaging reduces HIV risk behaviors among methamphetamine-using men who have sex with men. AIDS Behav. 2012; 16:1993–2002. [PubMed: 22610370]
14. Ingersoll K, Dillingham R, Reynolds G, et al. Development of a personalized bidirectional text messaging tool for HIV adherence assessment and intervention among substance abusers. Journal of substance abuse treatment. 2014; 46:66–73. [PubMed: 24029625]
15. Ingersoll KS, Dillingham RA, Hettema JE, et al. Pilot RCT of bidirectional text messaging for ART adherence among nonurban substance users with HIV. Health Psychol. 2015; 34S:1305–15. [PubMed: 26651472]
16. Mayer JE, Fontelo P. Meta-analysis on the effect of text message reminders for HIV-related compliance. AIDS Care. 2017; 29:409–17. [PubMed: 27477580]
17. Christopoulos KA, Riley ED, Tulsky J, et al. A text messaging intervention to improve retention in care and virologic suppression in a U.S. urban safety-net HIV clinic: study protocol for the Connect4Care (C4C) randomized controlled trial. BMC Infect Dis. 2014; 14:718. [PubMed: 25551175]
18. Norton BL, Person AK, Castillo C, Pastrana C, Subramanian M, Stout JE. Barriers to using text message appointment reminders in an HIV clinic. Telemed J E Health. 2014; 20:86–9. [PubMed: 24160900]
19. Rana AI, van den Berg JJ, Lamy E, Beckwith CG. Using a Mobile Health Intervention to Support HIV Treatment Adherence and Retention Among Patients at Risk for Disengaging with Care. AIDS Patient Care STDS. 2016; 30:178–84. [PubMed: 27028183]
20. Baillargeon J, Giordano TP, Rich JD, et al. Accessing antiretroviral therapy following release from prison. JAMA. 2009; 301:848–57. [PubMed: 19244192]
21. Althoff AL, Zelenev A, Meyer JP, et al. Correlates of retention in HIV care after release from jail: results from a multi-site study. AIDS and behavior. 2013; 17(Suppl 2):S156–70. [PubMed: 23161210]
22. Iroh PA, Mayo H, Nijhawan AE. The HIV Care Cascade Before, During, and After Incarceration: A Systematic Review and Data Synthesis. American journal of public health. 2015; 105:e5–16.
23. Dowdy DW, Geng EH, Christopoulos KA, et al. Mortality among antiretroviral-eligible patients in an urban public clinic. Journal of acquired immune deficiency syndromes. 2011; 57:297–300. [PubMed: 21602697]
24. Mugavero MJ, Lin HY, Allison JJ, et al. Racial disparities in HIV virologic failure: do missed visits matter? J Acquir Immune Defic Syndr. 2009; 50:100–8. [PubMed: 19295340]
25. Mugavero MJ, Westfall AO, Cole SR, et al. Beyond core indicators of retention in HIV care: missed clinic visits are independently associated with all-cause mortality. Clin Infect Dis. 2014; 59:1471–9. [PubMed: 25091306]
26. Chandler RK, Kahana SY, Fletcher B, et al. Data Collection and Harmonization in HIV Research: The Seek, Test, Treat, and Retain Initiative at the National Institute on Drug Abuse. American journal of public health. 2015; 105:2416–22. [PubMed: 26469642]
27. Kurth A, Kuo I, Peterson J, et al. Information and Communication Technology to Link Criminal Justice Reentrants to HIV Care in the Community. AIDS Res Treat. 2013; 2013:547381. [PubMed: 23984054]
28. Peterson J, Cota M, Gray H, et al. Technology use in linking criminal justice reentrants to HIV care in the community: a qualitative formative research study. Journal of health communication. 2015; 20:245–51. [PubMed: 25529057]
29. Golin CE, Knight K, Carda-Auten J, et al. Individuals motivated to participate in adherence, care and treatment (imPACT): development of a multi-component intervention to help HIV-infected recently incarcerated individuals link and adhere to HIV care. BMC Public Health. 2016; 16:935. [PubMed: 27596559]
30. Abroms LC, Whittaker R, Free C, Mendel Van Alstyne J, Schindler-Ruwisch JM. Developing and Pretesting a Text Messaging Program for Health Behavior Change: Recommended Steps. JMIR Mhealth Uhealth. 2015; 3:e107. [PubMed: 26690917]

31. Iribarren SJ, Brown W 3rd, Giguere R, et al. Scoping review and evaluation of SMS/text messaging platforms for mHealth projects or clinical interventions. Int J Med Inform. 2017; 101:28–40. [PubMed: 28347445]

32. Kalichman SC, Kalichman MO, Cherry C, Eaton LA, Cruess D, Schinazi RF. Randomized Factorial Trial of Phone-Delivered Support Counseling and Daily Text Message Reminders for HIV Treatment Adherence. J Acquir Immune Defic Syndr. 2016; 73:47–54. [PubMed: 27105048]

33. Finitsis DJ, Pellowski JA, Johnson BT. Text Message Intervention Designs to Promote Adherence to Antiretroviral Therapy (ART): A Meta-Analysis of Randomized Controlled Trials. PLoS One. 2014; 9:e88166. [PubMed: 24505411]

34. Wohl DA, Golin CE, Knight K, et al. Randomized Controlled Trial of an Intervention to Maintain Suppression of HIV Viremia After Prison Release: The imPACT Trial. J Acquir Immune Defic Syndr. 2017; 75:81–90. [PubMed: 28277487]

35. Freudenberg N, Daniels J, Crum M, Perkins T, Richie BE. Coming home from jail: the social and health consequences of community reentry for women, male adolescents, and their families and communities. Am J Public Health. 2005; 95:1725–36. [PubMed: 16186451]

36. Conklin TJ, Lincoln T, Tuthill RW. Self-reported health and prior health behaviors of newly admitted correctional inmates. Am J Public Health. 2000; 90:1939–41. [PubMed: 11111273]

37. Haley DF, Golin CE, Farel CE, et al. Multilevel challenges to engagement in HIV care after prison release: a theory-informed qualitative study comparing prisoners' perspectives before and after community reentry. BMC Public Health. 2014; 14:1253. [PubMed: 25491946]

38. Binswanger IA, Nowels C, Corsi KF, et al. "From the prison door right to the sidewalk, everything went downhill," a qualitative study of the health experiences of recently released inmates. Int J Law Psychiatry. 2011; 34:249–55. [PubMed: 21802731]

AIDS Behav. Author manuscript; available in PMC 2018 November 01.

Table I

Description, Design Characteristics and Eligibility Criteria for US STTR Studies Using Mobile Phone Interventions

	LINK-LA	imPACT	CARE+ Corrections	SUCCESS	Connect4Care
Geographic Location	Los Angeles	Southeast/Southwest US	Washington, D.C.	Atlanta, GA	San Francisco
Study Design	RCT	RCT	RCT	Feasibility study with comparison group	RCT
Number of Participants	356	381	112	56 participants 45 non-participants in comparison group	230
Eligibility Criteria	-HIV-infected -Jail inmate -Aged 18+ -English fluency -Referred for transitional case management -Male or transgender individuals -Expected release in next 2 months -Residing in Los Angeles County, CA upon release	-HIV-infected -Prison inmate - Aged 18+ -English fluency -On ART -Viral load <400 -Expected release within 3 months	-HIV-infected -Jail inmate or released from any correctional facility or halfway house within the past 6 months -English fluency -Washington, D.C. resident	-HIV-infected -Detained or sentenced in jail -Aged 18+ -English fluency -Likely to be released in the Atlanta area within 6 weeks	-HIV clinic patient new to clinic or poorly retained in care -Aged 18+ -English fluency -Have a cell phone and willing to send/receive up to 25 messages/month -Viral load >200 -New to clinic (no more than 2 primary care visits) or a history of poor retention
Intervention Components	Peer navigation intervention. -Mobile phones used for 14 “care calls,” which employed a structured list of potential barriers to engaging in care. -Medical appointments and reminders also provided through calls and texts.	1) Motivational interviewing face to face in prison and by phone post release 2) Care coordination with needs assessment 3) SMS medication reminders	1) One-time computerized interactive motivational interviewing/counseling session 2) Text message appointment reminders plus medication and prevention reminders either daily or weekly	Up to six strengths-based in-person case management sessions supplemented by texting (if possible, in-person sessions were initiated pre-release)	Supportive, informational, and motivational messages three times a week, plus texted reminders 48 hours prior to upcoming primary care appointments
Control Condition	Routine transitional case management	ART prescription provision by prison and referral to community care	Educational video on overdose prevention and resource guide	Standard jail discharge process	Texted medical appointment reminders
Study Visit Schedule	3, 6, and 12 months	2, 6, 14, and 24 weeks	3 and 6 months with monthly check-in calls	3 and 12 months post-release	6 and 12 months, with check in calls at 3 and 9 months
Primary Outcome	At one year: Linkage and retention ART adherence Virologic suppression	Virologic suppression 24 weeks post release (secondary outcomes include linkage, retention and ART adherence)	Virologic suppression at 24 weeks	Proportion with: -At least 1 post-release viral load -2 viral loads separated by 90 days -Undetectable viral load at 1 year	Virologic suppression at 1 year
Qualitative Evaluation	No	Yes	Yes	No	Yes
Cost Analysis	Yes	Yes	Yes	No	Yes

Table II

Mobile Phone Features Across 5 US STTR Studies

	Link-LA	imPACT	CARE+Corrections	SUCCESS	Connect4Care
Cell Phone Provided?	Yes	Yes	Intervention arm only; reimbursed $25/month if using own phone	Intervention arm only	No
Type of Phone Provided	Samsung Smiley T-Mobile Prism Kyocera Rally	Samsung Convoy and Gusto	Android smartphone	TracFone	N/A
Type of Plan Provided	Unlimited minutes/texting	Intervention: 600 min/month (unlimited to study) plus unlimited texting Control: Unlimited texting	400 anytime minutes, unlimited night/wknd, unlimited data and texts	No plan provided, $25 worth of minutes given at enrollment	N/A
Allowed to Keep Phone At Study End?	Yes	Yes	No, but nearly 90% did not turn in phone	Yes (but none did)	N/A
Screened for Ability to Read SMS?	Yes	Yes	Yes	Yes	Yes
Use of Text Messages:					
To Coordinate Study Visits	Yes	Yes	Yes	Yes	No
As Clinic Appointment Reminders	Yes	Yes	Yes	Yes	Yes
As Medication Reminders	No	Yes	Yes	Yes	Yes
Other Behavioral Messages	No	No	Yes	Yes	Yes
Type of Texting Platform	Manual	Automated medication reminders and manual medical appointment reminders	Automated and ad hoc with study staff	Automated medication reminders and ad hoc with study staff	Automated
Short Code (5 digits) vs. Long Code (standard 10 digit telephone number)	Long code	Long code	Long code	Long code	Short code unless carrier did not accept it; then long code used

AIDS Behav. Author manuscript; available in PMC 2018 November 01.

Table III

Demographic characteristics for participants of 5 US STTR studies that implemented mobile phone interventions

		Studies					
		Total	**Link LA**	**Impact**	**Care + Corrections**	**SUCCESS**	**C4C**
N	N	1,135	356	381	112	56[1]	230
Age	1,135						
Median (IQR)		42 (16)	40 (17)	44 (14)	41.5 (18.5)	37.5 (11)	45 (15)
Range		19–74	21–69	20–64	19–63	21–58	21–74
18–35		371 (33)	146 (41)	105 (28)	42 (38)	22 (39)	56 (24)
36–46		375 (33)	100 (28)	144 (38)	36 (32)	24 (43)	71 (31)
47+		389 (34)	110 (31)	132 (35)	34 (30)	10 (18)	103 (45)
Race/ethnicity	1,135						
Black or African American		584 (51)	123 (35)	252 (66)	98 (88)	39 (70)	72 (31)
White		243 (21)	78 (22)	75 (20)	4 (3)	5 (9)	81 (35)
Hispanic or Latino		193 (17)	111 (31)	31 (8)	1 (1)	2 (3)	48 (21)
Other/Two or more races		109 (10)	44 (12)	23 (6)	9 (8)	4 (7)	29 (13)
Refused/DK/Missing		6 (1)	0	0	0	6 (11)	0
Gender	1,135						
Female		163 (14)	13 (4)	84 (22)	32 (29)	4 (7)	30 (13)
Male		895 (79)	304 (85)	287 (75)	64 (57)	50 (89)	190 (83)
Transgender		74 (7)	39 (11)	9 (3)	14 (12)	2 (4)	10 (4)
Refused/Unknown		3 (<1)	0	1 (<1)	2 (2)	0	0
Sexual Orientation	398						
Heterosexual/Straight		172 (43)	--	--	84 (75)	11 (19)	77 (34)
Homosexual/Gay/Lesbian		157 (40)	--	--	18 (16)	24 (43)	115 (50)
Bi-sexual/Other		65 (16)	--	--	8 (7)	20 (36)	37 (16)
Refused/Unknown		4 (1)	--	--	2 (2)	1 (2)	1 (<1)
US Education	1,135						
< High School		364 (32)	131 (37)	156 (41)	29 (26)	13 (23)	35 (15)

		Studies					
		Total	**Link LA**	**Impact**	**Care + Corrections**	**SUCCESS**	**C4C**
High School		363 (32)	74 (21)	134 (35)	65 (58)	27 (48)	63 (27)
> High School		407 (36)	150 (42)	91 (24)	18 (16)	16 (29)	132 (58)
Refused/Unknown		1 (<1)	1 (<1)	0	0	0	0
Housing Stability	398						
Stable		209 (52)	--	--	68 (61)	26 (46)	115 (50)
Unstable		47 (12)	--	--	21 (19)	10 (18)	16 (7)
Homeless		56 (14)	--	--	22 (20)	20 (36)	14 (6)
Refused/Unknown		86 (22)	--	--	1 (1)	0	85 (37)
Supervision Status	793						
Prison or Jail		--	Jail	Prison	--	Jail	--
Substance use severity (TCU Score, 0–9)							
1 year reference period: Mean ± sd (range)	168	3.8 ± 3.2 (0–9)	--	--	4.3 ± 3.1 (0–9)	3.0 ± 3.3 (0–9)	--
6 month reference period: Mean ± sd (range)	230	2.4 ± 2.8 (0–9)	--	--	--	--	2.4 ± 2.8 (0–9)
Injection Drug Use							
Ever Use	342	129 (38)	--	--	16 (14)	--	113 (49)
Recent Use[2]	398	62 (16)	--	--	5 (6)	6 (11)	51 (22)
Recent Stimulant Use[2]	754	473 (63)	245 (69)	--	43 (38)	32 (57)	153 (67)
Depression score (CES-D)							
CES-D 10 score >=10	112	57 (51)	--	--	57 (50.9)	--	--
CES-D 20 score >=16	286	193 (67)	--	--	--	37 (66.1)	156 (67.8)
Viral Load (Study Baseline)	1,135						
% VL < 200		670 (59)	222 (63)	364 (95)	71 (63)	13 (23)	0 (0.0)
% VL >= 200		455 (40)	129 (36)	17 (5)	37 (33)	42 (75)	230 (100)
% VL missing		10 (1)	5 (1)	0	4 (4)	1 (2)	0
Years Since HIV Diagnosis							
Median (Range)[3]	586	8.2 (0.003–33.5)	6.6 (0.003–28.9)	--	--	--	11.4 (0.01–33.5)
< 1 Year	698	90 (13)	51 (14)	--	13 (12)	--	26 (11)
1–4 Years		145 (21)	98 (28)	--	14 (12)	--	33(14)

		Studies					
		Total	**Link LA**	**Impact**	**Care + Corrections**	**SUCCESS**	**C4C**
5–9 Years		137 (20)	69 (19)	--	26 (23)	--	42 (18)
10+ Years		324 (46)	138 (39)	--	59 (53)	--	127 (56)
Refused/Unknown		2 (<1)	0	--	0	--	2 (1)

[1] SUCCESS had a total of 101 people, 45 matched pairs and 11 not matched in total. Data was only collected on intervention arm (n=56).

[2] Recent injection drug use and stimulant drug use timeframes: C4C, 6 months; CARE + Corrections, 3 months; Link LA, 30 days; and Success, 30 days

[3] CARE + Corrections collected years since HIV diagnosis using a categorical time intervals only, therefore we did not report a median or range.

TCU: Texas Christian University Drug Screen, CES-D: Center for Epidemiologic Studies Depression Scale

Table IV

Key Implementation Issues

- Service interruptions due to lost/stolen phones, inability to pay bill, inability to remotely load minutes
- Staff time required to provide replacement phones, correct overages, monitor opt-outs
- Use of Google Voice (text messages may not be delivered as study intends)
- Billing cycles out of sync with study participation
- Overage charges related to international and 411 calls, toll-free numbers, unlocking of mobile phone games/data
- Need for training on how to read and send text messages
- With automated systems
  - Programming yes/no equivalents
  - Programming response windows
  - Participant frustration with 2 way texting when using automated responses
  - Accidental opt-outs
- Privacy/Confidentiality

Table V

Costs Associated with Aspects of U.S. Mobile Phone-Based STTR Interventions

	LINK-LA	imPACT	CARE+ Corrections	SUCCESS	Connect4Care
Total Time in Field	36 months	Site 1: 32 months Site 2: 30 months	24 months	25 months	40 months
Cost of Mobile Phones	$7,186.91	Site 1 Staff -$179.97 Participants -Included with service plan (see below) Site 2 Staff -$597 Participants -Included with service plan (see below)	Using promotional programs, Android smartphones were free or $0.99/month	$10/phone × 7 phones = $70	N/A
Service Plan	Staff -Monthly average per line: $18.81 -Monthly average lines: 12 -Total Cost: $5,416 Participants -Monthly average per line: $12.71 -Monthly average lines: 70 -Total Cost: $51,336	Site 1 Staff -$3,905.50 Participants -Standard: $28,363.80 -Overage: $6,772.81 Total Cost: $35,136.61 Site 2 Staff -Total Cost: $18,690 -Monthly average per line: $203 Participants -Standard: $47,250 -Overage: $4,282 Total Cost: $51,532	br1>$65/month per participant Total Cost $24,054.85	br1>$25 increments of minutes × 30 = $750	N/A
Automated Texting Platform	N/A (texting between staff and participants was included in the service plan)	$5,275.38 for platform development $6,705.64 for maintenance and sending text messages	$16,000 for platform development, start-up & maintenance $7,000 in messaging fees	$3,000 for training & services $1,110 in fees	$2500 start-up $1250/month maintenance and messaging costs

AIDS Behav. Author manuscript; available in PMC 2018 November 01.