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Author manuscript

*AIDS Care*. Author manuscript; available in PMC 2021 August 01.

Published in final edited form as:

*AIDS Care*. 2020 August ; 32(8): 959–964. doi:10.1080/09540121.2020.1737639.

## Beyond mobile phones: exploring using technology to support sustained engagement in care for HIV-infected women on antiretroviral therapy

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### Abstract

Disengagement from HIV care has emerged as a challenge to the success of universal test and treat strategies for HIV-infected women. Technology may enhance efforts to monitor and support engagement in HIV care, but implementation barriers and facilitators need to be evaluated. We conducted a mixed-method study among HIV-infected, pregnant women and healthcare workers (HCWs) in Malawi to evaluate barriers and facilitators to three technologies to support monitoring HIV care: 1) text messaging, 2) SIM card scanning and 3) biometric fingerprint scanning. We included 123 HIV-infected, pregnant women and 85 HCWs in a survey, 8 focus group discussions and 5 in-depth interviews. Biometric fingerprint scanning emerged as the preferred strategy to monitor engagement in HIV care. Among HCWs, 70% felt biometrics were very feasible, while 48% thought text messaging and SIM card scanning were feasible. Nearly three quarters (72%) of surveyed women reported they would be very comfortable using biometrics to monitor HIV appointments. Barriers to using text messaging and SIM card scanning included low phone ownership (35%), illiteracy concerns, and frequent selling or changing of mobile phones. Future work is needed to explore the feasibility of implementing biometric fingerprint scanning or other technologies to monitor engagement in HIV care.

### Keywords

HIV; pregnancy; technology; engagement in HIV care; mobile phones; biometrics

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**Declaration of interest:** The authors report no conflicts of interest.

**Presentation:** A version of this work was presented at the 22nd International AIDS Conference in Amsterdam, Netherlands, July 23–27, 2018.

**Data availability statement:** The data that support the findings of this study are available from the corresponding author, AMB, upon reasonable request.

## Introduction

Since its introduction in 2013, the WHO's policy of universal test and treat for all pregnant and breastfeeding women with HIV, known as Option B+, has contributed to significant progress in lowering HIV incidence and improving access to antiretroviral therapy (ART) (Organization, 2017; UNAIDS, 2016; WHO, 2013). Despite these gains, disengagement from HIV care, high rates of mobility, and transferring between clinics have all emerged as challenges (Clouse et al., 2017; Knettel et al., 2018; Tweya et al., 2014). For Option B+ to be successful, supporting women's ongoing engagement in HIV care is essential.

Sustained engagement in HIV care requires the ability to monitor transfers between clinics (Bengtson, Go, et al., 2019; Rice et al., 2018). In Malawi and South Africa, up to 30% of women who default from Option B+ programs have self-transferred and are receiving care elsewhere (Clouse, et al., 2017; Tweya, et al., 2014). Technologies, such as mobile phones and biometric fingerprint scanning could provide a simple and reliable way to identify women transferring HIV clinics (Bengtson, Kumwenda, et al., 2019; Catalani, Philbrick, Fraser, Mechael, & Israelski, 2013; McNairy et al., 2017; Odei-Lartey et al., 2016; van der Kop et al., 2018; Wall et al., 2015). However, barriers and facilitators to implementing these technologies to monitor engagement in HIV care have not been evaluated. To fill this gap, we conducted a mixed-method study evaluating barriers and facilitators towards using three different types of technology to monitor engagement in care for HIV-infected women in Option B+.

## Methods

### Study design and sample

We conducted a formative mixed-methods study among HIV-infected pregnant women initiating ART through Option B+ and healthcare workers (HCWs) at two large urban ART clinics in Lilongwe, Malawi. We included HIV-infected women initiating or re-initiating ART through Option B+ and HCWs from a range of roles. All participants had to be at least 18 years of age and reside in Lilongwe District to participate. HCWs included were nurses, tracers responsible for locating patients defaulting from HIV care, and a range of other healthcare support positions.

For the survey, a convenience sample of HCWs and HIV-infected women presenting for antenatal who met inclusion criteria were asked to participate. A separate convenience sample of HCWs and women were recruited for FGDs. Women and HCWs eligible for inclusion were sensitized to the aims of study; those who consented to participate filled out a survey or were contacted by a research assistant to schedule their participation in a FGD or IDI. All participants provided written informed consent to participate and ethical approval was provided by The University of [removed for peer review] and the National Health Science Research Committee in Malawi.

### Data collection and analysis

We conducted a quantitative survey, eight focus group discussions (FGDs; four among women and four among HCWs), and five in-depth interviews (IDIs; all among HCWs). The

survey and FGDs were designed to assess barriers and facilitators to using technology to monitor engagement in HIV. IDIs were conducted among HCWs only to understand current practices to support engagement in HIV care. Survey and FGD questions explored three potential technologies to monitor HIV visits: 1) mobile phone text messaging, 2) mobile phone SIM card scanning, and 3) biometric fingerprint scanning.

Data collection tools were prepared in English and translated into Chichewa. Survey data were analyzed descriptively using Stata version 15 (StataCorp, College Station, TX). Qualitative interviews were audio recorded in Chichewa, transcribed and translated into English by a research assistant, and entered into Nvivo v.11 (Nvivo qualitative data analysis Software; QSR International Pty Ltd.). Transcripts were read for content and coded using first deductive and then inductive coding and key themes were identified (Bernard, 1995).

## Results

We included 104 HIV-infected women initiating ART in Option B+ and 50 HCWs in the survey. Among surveyed women, the median age was 25 (IQR 25, 30), 80% lived in an urban area, 68% were married, 48% had completed secondary school or higher (Table 1) and 35% reported owning their own mobile phone (Table 3). Among HCWs surveyed, 54% were providers and 22% were administrative staff, tracers, or HIV testing counselors (Table 2). An additional 19 HIV-infected women participated in FGDs and 30 HCWs participated in FGDs and IDIs.

### Attitudes toward using technology to monitor engagement in HIV care

In both quantitative and qualitative data, there was strong support among women and HCWs for using technology to monitor engagement in HIV care. Women expressed few concerns about sharing their mobile phone or fingerprint information with clinic staff. Nearly half (45%) of all surveyed HCWs reported that it was difficult or very difficult to know when a patient had transferred to another clinic and that technology could help to identify transfers.

*[Using technology to monitor engagement in HIV care across clinics] would be very helpful because it would reduce defaulting and movements across clinics because the people at [one HIV clinic] would know that if a client did not collect drugs from there then she collected them at [a different HIV clinic]. - FGD, mentor mother*

In the survey, nearly 80% of HCWs felt biometric fingerprint scanning would be very useful and 70% felt it was very feasible, compared to 48% for both text messaging and SIM card scanning (Figure 1). Among women, 72% reported they would be very comfortable using biometrics to register at HIV clinics, compared to 52% for SIM card scanning and 55% for text messaging.

### Barriers and facilitators to mobile phone-based strategies

Familiarity and the availability of mobile phones were important facilitators to using mobile phone-based strategies to monitor engagement in HIV care (Figure 2). However, participants also identified several important barriers. Only 35% of surveyed women owned their own

phone and 72% reported running out of airtime credit within the last day (Table 3). In addition, nearly a quarter of HCWs surveyed raised concerns about text messages going to the wrong recipient due to women providing incorrect phone numbers or human error.

In qualitative interviews, patient privacy emerged as an important concern when using mobile phone-based strategies to monitor engagement in care. Particularly for text messages, both HCWs and women raised concerns about the potential for inadvertent disclosure of one's HIV status or raising concerns with partners. As one woman shared "My husband always checks the missed calls and the received calls on my phone, even [text] messages."

### Barriers and Facilitators to Biometric Fingerprint Scanning

Women and HCWs reported few concerns about patient privacy or HIV status disclosure related to biometric fingerprint scanning. In fact, for some biometric fingerprint scanning was seen as providing improved privacy (Figure 2).

*I would prefer the fingerprint scanning to the SIM card scanning because the SIM card would be seen by everyone but no one would know whose finger it is. It's private.* – FGD, woman re-initiating ART

Other important facilitators to using biometric fingerprint scanning included the ability to reliably and uniquely identify women. As one new ART initiator said, "I think the fingerprint scanning is better. You may lose your phone and the SIM card goes with it, but you can't lose your finger." For HCWs, the potential to uniquely identify patients and access their health information across a network of clinics was an important facilitator of improved clinical care.

*Implementing this [biometric] system would be helpful ... because it would help us to link up with our clients to know if they have been coming to make sure that they are still on treatment. Even if they do not come to our clinic... we know that they have collected their ARVS. We won't include such clients among the defaulters or the list of missed appointments.* - FGD, health services associate

To successfully implement biometric fingerprint scanning at HIV clinics, participants identified sensitization among patients, providers, and community members as essential. Barriers to implementing biometric fingerprint scanning included: 44% of surveyed HCWs identified the need for additional financial resources, 32% for training, and 12% the need for additional staff.

### Discussion

In this mixed methods study of HIV-infected women initiating ART and HCWs in Lilongwe, Malawi we evaluated barriers and facilitators towards using technology to monitor engagement in HIV care. Compared to mobile phone-based strategies, biometric fingerprint scanning emerged as the preferred strategy among both women and HCWs. Barriers to using mobile phone-based strategies included low phone ownership, illiteracy concerns, frequent selling or changing of phones, and concerns about privacy and confidentiality (Figure 2). Facilitators to using biometric fingerprint scanning included minimal privacy concerns among women or HCWs and the perceived improved ability by HCWs to identify when

patients transferred clinics. Investments in training, community sensitization, and infrastructure were noted as essential to support successful implementation of biometrics across HIV clinics.

As universal test and treat for HIV-infected pregnant women and adults rapidly becomes standard of care, reliable and comprehensive monitoring of engagement in HIV care is essential. In our study of women and HCWs in Option B+ programs, use of technology in general to support monitoring engagement in HIV care was highly acceptable, with biometric fingerprint scanning considered the most feasible strategy. Future work is needed to explore the feasibility of implementing biometric fingerprint scanning, alone or in combination with other technologies, to monitor women's engagement in HIV care across HIV clinics.

## Acknowledgements:

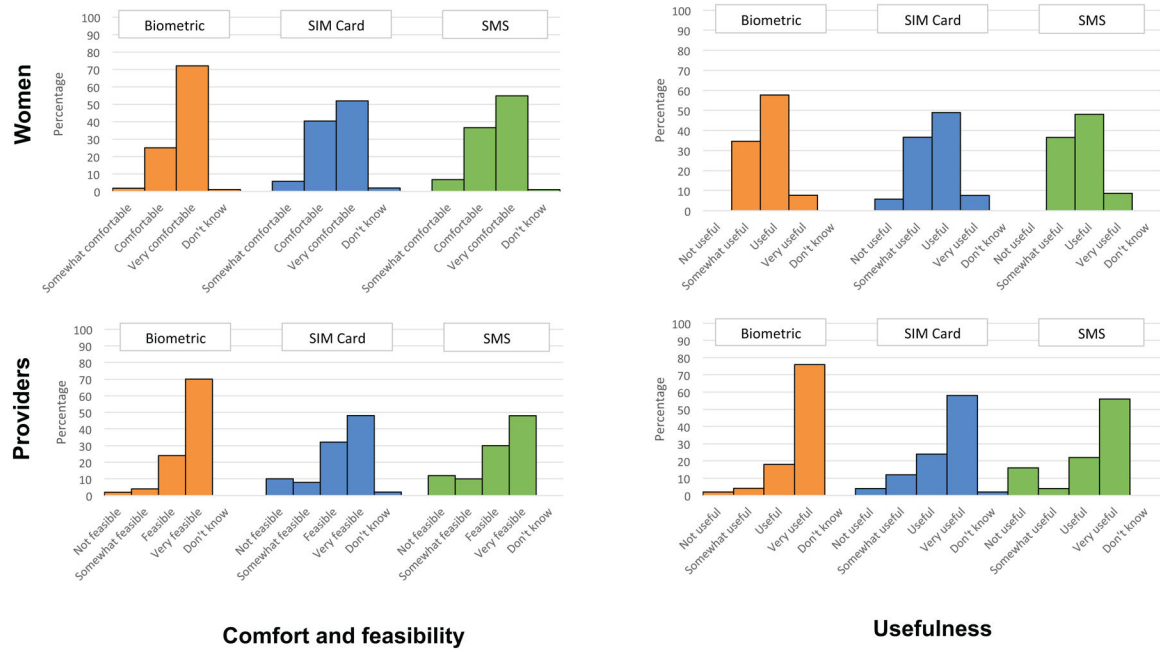
We thank the women and healthcare workers who participated in this study. We also thank the National Institute of Mental Health and University of North Carolina Center for AIDS Research for funding support.

**Funding:** This work was supported by the National Institute of Mental Health [grant number R00MH112413] and the University of North Carolina Center for AIDS Research [grant number P30 AI50410].

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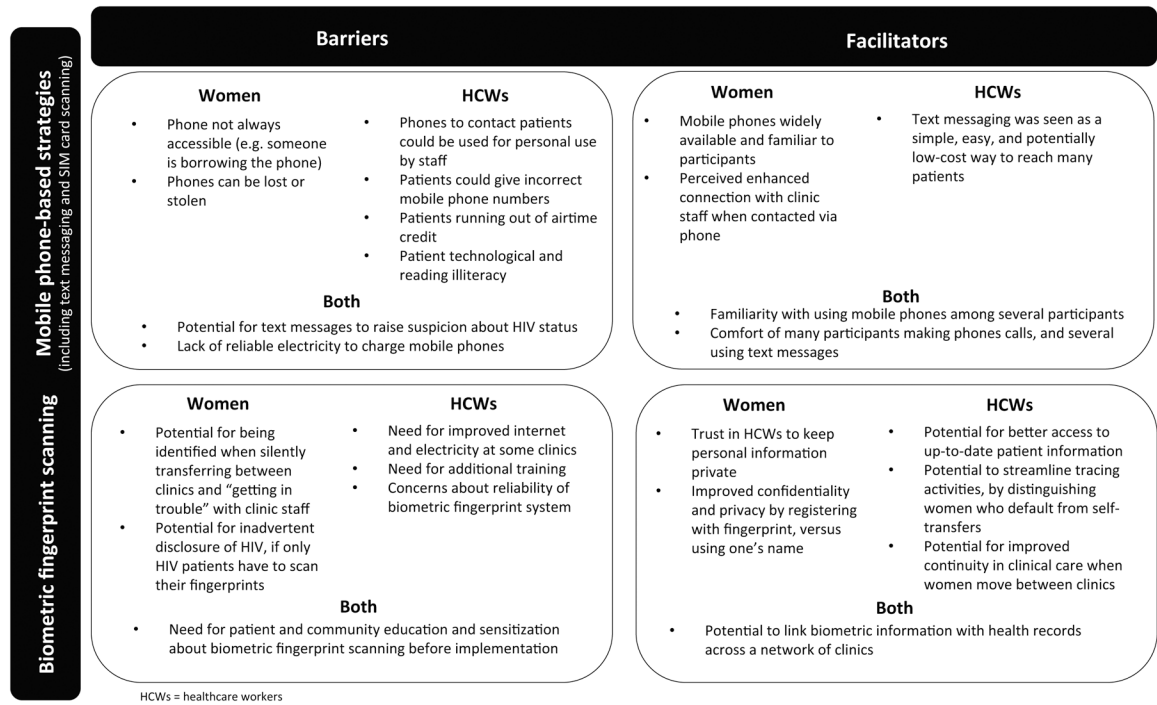
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**Figure 1.** Attitudes towards using technology to monitor engagement in HIV care for HIV-infected women initiating antiretroviral therapy.





**Figure 2.** Barriers and facilitators of using technology to monitor engagement in care for HIV-infected women initiating antiretroviral therapy.



**Table 1.**

Demographic and clinical characteristics of 104 HIV-infected, pregnant women initiating antiretroviral therapy in Lilongwe, Malawi.

Characteristic	Women N=104
	<i>Median (IQR)</i>
Age (median, IQR)	25 (22, 30)
Age at first marriage	19 (18, 21)
Number of weeks pregnant	24 (20, 26)
Number of living children	1 (0,2)
Religion	<i>N (%)</i>
Christian	91 (88%)
Muslim	12 (11%)
None	1 (1%)
Residence	
Urban	82 (80%)
Rural	19 (18%)
Don't know	2 (2%)
Occupation	
Peasant farmer	4 (4%)
Housewife/caretaker	58 (56%)
Small business owner	33 (31%)
Casual laborer	5 (5%)
Other	4 (4%)
Education	
None	4 (4%)
Standard 1–7	27 (26%)
Standard 8	21 (20%)
Secondary or more	50 (48%)
Don't know	2 (2%)
Marital Status	
Single or never married	32 (31%)
Married	71 (68%)
Separated	1 (1%)
Living arrangement	
Alone	26 (25%)
With husband	65 (62%)
With family or friends	13 (13%)
Is this your first pregnancy?	
No	78 (75%)
Yes	26 (25%)
<b>Among women living with a partner</b>	<b>N=65</b>

Characteristic	Women N=104
Is your partner HIV-infected	
No	27 (42%)
Yes	10 (15%)
Don't know	28 (43%)
Have you disclosed your status to your partner?	
No	49 (77%)
Yes	13 (20%)
Don't know	2 (3%)

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**Table 2.**

Characteristics of 50 HIV Healthcare Workers (HCWs) in Lilongwe, Malawi.

	<b>HCWs N=50</b>
	<i>Median (IQR)</i>
Age (median, IQR)	36.5 (33, 38)
Years in position (median, IQR)	5 (2, 11)
Position	<i>N (%)</i>
Administrative	3 (6%)
Data clerk/coordinator	2 (4%)
Health services associate	8 (16%)
Mentor mother	4 (8%)
Nurse/Matron	23 (46%)
Clinical Officer	4 (8%)
Tracer	2 (4%)
HIV testing counsellor	4 (8%)
Frequency of patients transfer to another HIV clinic without letting this clinic know they are transferring	
Not very frequently	16 (32%)
Somewhat frequently	16 (32%)
Frequently	4 (8%)
Very frequently	10 (20%)
Don't know	4 (8%)
Difficulty of finding patients who transfer clinics using the current EMR system	
Not very difficult	12 (25%)
Somewhat difficult	14 (29%)
Difficult	11 (22%)
Very difficult	11 (22%)
Don't know	1 (2%)

**Table 3.**

Characteristic of mobile phone use among 104 HIV-infected women initiating antiretroviral therapy.

	<b>Women (n, %)</b>
	<b>N=104</b>
Mobile phone ownership	
Does not own her own phone	68 (65%)
Does own her own phone	36 (35%)
<b>Among with women a mobile phone</b>	<b>N=36</b>
Primary mobile phone use	
Phone calls	28 (78%)
Text messages	4 (11%)
Other	4 (11%)
Hours per day the phone is charged	
All day	28 (78%)
About half the day	6 (17%)
Less than half the day	2 (5%)
Last time you ran out of phone credit	
Yesterday or today	26 (72%)
Sometime last week	7 (19%)
Sometime last month	2 (6%)
Don't know	1 (3%)