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Improving adoption and acceptability of digital health interventions for HIV disease management: a qualitative study

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Abstract

Disease management remains a challenge for many people living with HIV (PLWH). Digital health interventions (DHIs) may assist with overcoming these challenges and reducing burdens on clinical staff; however, there is limited data regarding methods to improve uptake and acceptability of DHIs among PLWH. This qualitative study aimed to assess patient and provider perspectives on the use of DHIs and strategies to promote uptake among PLWH. Eight focus groups with patients ($k = 5$ groups; $n = 24$) and providers ($k = 3$ groups; $n = 12$) were conducted May through October of 2014. Focus groups (~90 min) followed a semi-structured interview guide. Data were analyzed using thematic analysis on three main themes: (a) perspectives towards the adoption and use of DHIs for HIV management; (b) perceptions of barriers and facilitators to patient usage; and (c) preferences regarding content, structure, and delivery. Analyses highlighted barriers and facilitators to DHI adoption. Patients and providers agreed that DHIs feel "impersonal" and "lack empathy," may be more effective for certain subpopulations, should be administered in the clinic setting, and should use multimodal delivery methods. Emergent themes among the providers included development of DHIs for providers as the target market and the need for culturally adapted DHIs for patient subpopulations. DHIs have potential to improve HIV management and health outcomes. DHIs should be developed in conjunction with anticipated consumers, including patients, providers, and other key stakeholders. DHIs tailored for specific HIV subpopulations are needed. Future studies should evaluate dissemination methods and marketing strategies to promote uptake.

Keywords

mHealth, HIV/AIDS, Qualitative methods, Treatment, Adherence

Implications

Practice: Adoption of DHIs hinges on the ability of the tool to solve a problem for the providers such as improving care coordination or reducing practitioner's time providing support services for patient self-management, and improving patient outcomes including medication adherence, appointment attendance, and credible disease-specific education.

Policy: DHIs demonstrated to be effective in promoting medical management of HIV should be identified and made available to providers, insurers, and patients.

Research: Research needs to develop and test digital applications and tools that are designed to solve known problems for this patient population and test their effectiveness.

INTRODUCTION

Digital health technologies (digital health interventions [DHIs]) are increasingly used to disseminate health information to patients across the health care system. Patients can access medical records online, communicate with treatment providers via email or chat, and receive patient education electronically [1]. There has been significant interest in the development and testing of behavioral interventions delivered through digital platforms [2]. Uptake of these platforms may increase access to effective behavioral interventions among underserved populations, which may lead to improved health outcomes and reduced health care expenditures.

Many people living with HIV (PLWH) experience comorbid medical and psychiatric complications [3, 4], creating increased disease burden and decreased financial and social resources in the HIV treatment setting. Inadequate treatment adherence and retention remains a significant concern among PLWH [5, 6]. HIV requires lifelong adherence to medication, regular attendance at clinic appointments, and frequent completion of labs and blood work [7–10]. Management of HIV is further complicated among patients who experience treatment regimen fatigue, which is characterized by lapses in motivation to maintain adherence and continue with the prescribed treatment protocol [11]. Novel approaches to prevention and treatment are needed to address the syndemic of medical and psychiatric complications among PLWH.

DHIs are unique in their potential to assuage treatment burden by assisting patients and providers with management of HIV and other medical and psychiatric comorbidities. DHIs are cost-effective [12], flexible, and can be delivered by computer [13], short message services (SMS) text-messaging [14–16], or smartphone applications [17, 18]. They have been used to re-engage patients in care, provide real-time adherence monitoring, increase motivation to promote health behavior change, and provide education and support [19–21]. Additionally, DHIs may allow patients to receive behavior change interventions who are unable to access intervention services due to lack of insurance coverage or transportation challenges.

As DHIs continue to be developed and tested, it is imperative that research highlights the limitations of uptake among this population to better inform implementation approaches. Barriers to adoption and implementation of DHIs among PLWH have not been identified in the extant literature. While the evidence for DHIs' efficacy in research trials is positive overall and research in the area is growing rapidly, relatively little is known regarding patient and provider perspectives on the barriers to and use of these technologies. Baranoski and colleagues [22] compared patient and provider perspectives on the use of text messaging for HIV medication adherence. Both providers and patients reported text-messaging interventions as acceptable for promoting adherence, with alarms and reminders for medication compliance described as most helpful for patients. The primary barriers to use of text messaging interventions identified were patient apathy and additional burden on providers. Providers and patients can provide crucial insights to guide design, dissemination, and eventual adoption of DHIs into the health care context.

Better understanding of patient and provider preferences for design and delivery of DHIs is necessary for consumer uptake of evidence-based DHIs. Assessment of provider perspectives towards patient usage of DHIs may inform channels of dissemination and barriers to adoption. The current study extends previous research by examining patient and provider perspectives on DHIs to manage HIV disease. The aim of this qualitative study was to assess patient and provider: (a) perspectives towards the adoption of DHIs to assist patients in the management of HIV; (b) perceptions of barriers and facilitators to patient uptake of DHIs; and (c) preferences regarding content, structure, and delivery of DHIs for HIV disease management.

METHODS

Target population

This qualitative study recruited PLWH engaged in care and healthcare providers working within the HIV community to participate in focus groups examining perspectives on the use of DHIs in the clinic setting. The patients were recruited from an academic immunology center in the Midwest during Spring 2014. Patients were eligible for the study if they were (a) infected with HIV, (b) over the age of 18 years, (c) currently prescribed antiretroviral therapy (ART), and (d) fluent in English. Adults who were unable to consent and current clinic employees were not eligible to participate in the patient focus groups.

Healthcare providers were recruited from an academic immunology center and local HIV/AIDS service organizations in the Fall of 2014. Providers were eligible to participate if they (a) were over age 18 years, (b) were employed full-time at a local HIV treatment setting, and (c) had more than 1 year of experience working with PLWH. Providers were not excluded based on their HIV status. We aimed to conduct the number of focus groups necessary for saturation of key themes.

Procedure

This study was conducted in accordance with procedures approved by the university's Institutional Review Board.

Patient focus groups

Potential participants were screened for eligibility based on their electronic medical records (i.e., currently prescribed ART). After initial screening, they were contacted in-person during their scheduled clinic appointments. They were approached in the waiting room and led by a trained research assistant to a private area, where the research assistant provided him/her with information about the study. Eligible participants were scheduled to attend a focus group. All participants were offered transportation assistance for their scheduled appointment.

Upon arriving for their scheduled focus group appointment, participants were escorted to a clinic conference room, where they met with the other focus group participants and research investigators. Prior to each discussion, participants reviewed study risks, benefits, and procedures with research staff and provided written informed consent. Focus group discussions lasted approximately 90 min, with an additional 30 min allocated for completion of questionnaires. A trained research assistant took notes during the groups to ensure the integrity of transcription. Following the group discussion, participants completed a brief set of questionnaires regarding demographic and treatment characteristics. Each participant received a $20 gift card for their participation and refreshments during the focus group.

Provider focus groups

Healthcare providers at each recruitment site received a recruitment flyer and an email with details about the study. Providers interested in participating contacted the study staff, were screened for eligibility, and were scheduled for a time to attend a focus group. General procedures for provider focus groups were identical to those used in the patient groups. Providers were compensated $40 for participation in the focus group.

Discussion guide

A semi-structured interview was used to guide both patient and provider focus group discussions. The interview guides for patients and providers differed, in that (a) the patient guide included a section assessing technology knowledge, skills, and usage patterns and (b) the provider guide included a section assessing barriers to delivering adherence interventions within the existing organizational structure. The guides were structured to assess participants' initial perspectives of DHIs broadly, and then we provided a sample of intervention content (Table 3) to promote understanding and visualization of a program that could be delivered within the clinical setting. Open-ended questions were used to assess participants' usage patterns of technology, barriers and facilitators in use of technology to facilitate treatment adherence, preferences for digital health tools, and perceived utility of these tools. Participants in this study had not previously used a DHI, which is a product of limited access to DHIs in Ryan White funded HIV clinical settings. Thus, participants were provided a sample intervention with a list of proposed content (Table 3) to be included in a DHI designed for PLWH to facilitate understanding of DHIs.

Coding and data analysis

Focus group discussions were audio recorded, transcribed verbatim, and reviewed for errors by trained research assistants. A preliminary coding structure was derived deductively from the interview agenda. Data were coded and analyzed using applied thematic analysis [23]. Three coders independently reviewed all transcripts and applied specific subtype coding to the coding structure inductively as themes emerged from the data. A master codebook was finalized, and trained coders reviewed and coded all transcripts independently. The coders met to review and discuss code assignments, and any discrepancies were discussed and reconciled. After consensus was reached, the final set of master codes for each transcript was entered into NVivo 10 [24]. Data analysis was iterative, using standard thematic analysis techniques, including open coding, marginal remarks, and memo-writing [23]. Themes related to the a priori research questions were extracted. Data for the patient and provider transcripts were coded separately. Authors KRC, EM, and MBM discussed and analyzed themes from patients and providers and triangulated impressions to determine the implications of the data. Analyses revealed the following themes: (a) perceived barriers to DHI adoption; (b) perceived facilitators to DHI adoption; and (c) recommendations to increase DHI uptake among PLWH.

RESULTS

Sample characteristics

A total of 24 PLWH engaged in care and 12 healthcare providers consented and participated in eight focus groups (five with patients, three with providers). See Table 1 for participant characteristics.

Patient focus groups

A total of 24 patients (83% male, mean age = 47) across five focus groups (3–8 participants per group) completed the study. Half of the participants were non-White individuals, with an average of 68 months since initiating antiretroviral medications. Most had at least a high school education (79.2%) and almost half (*n* = 10) were never married and did not identify as being in a relationship at the time. Patients reported a range of technology usage patterns with a couple of participants reporting minimal use of a computer (e.g., only for vacation planning, barely turning it on), and one participant who had received a degree in computer engineering. Participants also reported a range of cell phone usage such that some participants had Smartphone devices and reported using mobile apps frequently, while others indicated using cell phones only to make phone calls or text message.

Provider focus groups

Three provider focus groups were conducted (*n* = 4–8 participants per group) among HIV providers in the community. The groups were stratified by provider type: (a) physicians/residents/nurse practitioners; (b) nurses, counselors, social workers; and (c) case managers and outreach workers.

Perceived barriers to DHI adoption and usability

Patient-targeted DHIs

Both patients and providers noted that the usefulness of DHIs will vary as a function of the user's level of experience and comfort with technology (see Table 2). Younger patient participants reported more enthusiasm to adopt such technology into managing their healthcare; however, older patient participants who reported limited knowledge and experience with smartphone devices and computers expressed little desire to learn to incorporate such a program into their health care. For example, several older patients reported being uninterested or frustrated by computers and mobile devices—*"I deal with- and I'm there with my glasses, curser, you know, [Expletive], I hit the wrong number and I have to move it- I mean, it's just too much!"*

Participants expressed concerns regarding patient motivation and attention, literacy, and privacy. Patients and providers perceived that poor attention spans, even among motivated patients, may prove to be a barrier to program completion: *"I feel like the biggest challenge would be to keep them focused."*

Table 1 | Patient (*N* = 24) and provider (*N* = 12) demographics

Variable	Patient *N* (%)	Provider *N* (%)
Participant sex		
Male	20 (83.3)	2 (16.7)
Female	4 (16.7)	10 (83.3)
Ethnicity		
White	12 (50)	7 (58.3)
African American/Black	8 (33.3)	2 (16.7)
Hispanic/Latino	1 (4.2)	5 (41.7)
American Indian	3 (12.5)	1 (8.3)
Employment Status		
Full time	7 (29.2)	12 (100)
Part time	1 (4.2)	0
Unemployed, seeking	2 (8.3)	0
Unemployed, not seeking	2 (8.3)	0
Disabled	12 (50)	0
Education		
Some high school	5 (20.8)	—
High school/GED	7 (29.2)	
Some college	6 (25)	
College	4 (16.7)	
Master's level	2 (8.3)	
Sexual orientation		
Bisexual	4 (16.7)	—
Gay/lesbian	12 (50)	
Heterosexual	5 (20.8)	
Undecided	1 (4.2)	
Prefer not to respond	2 (8.3)	
Marital status		
Never married	10 (41.7)	—
Married	6 (25)	1 (8.3)
Divorced	2 (8.3)	5 (41.7)
Domestic Partnership	2 (8.3)	2 (16.7)
Widowed	1 (4.2)	1 (8.3)
Living with same-sex partner	2 (8.3)	1 (8.3)
Living with opposite-sex partner	1 (4.2)	2 (16.7)
Employment title	—	
Pediatric coordinator		
Case manager		
Health advocate		
Social worker		
Nurse practitioner		
Physician		
	Patient *M (SD)*	Provider *M (SD)*
Age	47 (12.98)	39 (14.28)
How long prescribed ART (mos)	68.29 (69.95)	—

Providers identified literacy issues for which an adherence nurse or clinic staff may be required to go through the program with patients, potentially increasing burden on clinic staff. Patients noted that too much information delivered through a mobile platform may be overwhelming and reduce motivation to use the program. Another issue identified by both patients and providers, particularly younger patients, was privacy and anonymity of the program. Patients did not want the program to be easily identifiable as an HIV-related program on personal devices, as this may result in unintentional disclosure of HIV status. Providers emphasized the need for such programs to be HIPAA compliant and pass security tests if there is an exchange of patient health information.

Both patients and providers noted that important health-related issues would be better addressed in-person with a healthcare provider who could answer questions, address patient concerns, and provide empathy and support. Patients perceived that DHIs may feel "*cold*" and "*impersonal*." Patients indicated that social support is an important benefit of in-person interactions and they believed it would be challenging and likely impossible to translate this support through technology devices.

Providers indicated that continuous access to cell phones, data plans, and capability to download mobile applications may be potential barriers for certain subpopulations of PLWH (i.e., low socioeconomic status). These issues may be particularly salient among the subgroups most at-risk for treatment drop-out and inadequate adherence, including people who use drugs or people who have significant mental health concerns. Providers were concerned that many patients may not have smartphones and/or do not know how to operate advanced features, particularly the older generation of patients.

Provider-targeted DHIs

The development of DHIs designed for providers as the target market emerged as a theme among the provider focus groups. Participants expressed several potential barriers including provider and clinic staff turnover, the need for checks and balances on both the patient and provider sides, and the potential for tasks to *"fall through the cracks"*. Providers expressed concern for diffusion of responsibility to occur among the team of providers which may result in tasks not being completed (e.g., failure to follow-up with a housing referral).

Perceived facilitators to DHI adoption and usability

Patient-targeted DHIs

Participants agreed that DHIs have the potential to improve certain aspects of treatment. Specifically, patients and providers noted that medication and appointment reminders would be helpful. Participants commented that DHIs may be most appropriate and more effective for newly diagnosed patients as a means of additional support during a challenging time when they are processing their HIV status, learning about HIV

Table 2 | Emergent themes related to barriers and facilitators of digital health intervention (DHI) adoption

	Patient perspective	Provider perspective	Representative quote
Barriers to DHI adoption			
Patients attending to content	X	X	*"People with short attention spans...they're gonna be clicking through."* (Patient, FG 3); *"The biggest challenge would be to keep them focused because most of them, it's hard to sit in one place for an extended amount of time."* (Provider, FG 6)
Age & the "Digital Divide"	X	X	*"For some people, yes, it's [DHIs] going to work, but it's more of an age group situation than who it will and won't work for them, in my opinion."* (Patient, FG 1) *"The internet has become so complicated. I don't wanna mess with all the passwords and all that kind of stuff."* (Patient, FG 4) *"It's trying to make sure that you got the right fit for the right generation, or the right learning style, or the right communication style...because what works for me, won't work for my mother, which isn't gonna work for my son."* (Patient, FG 3)
Impersonal	X	X	*"A computer's not gonna talk to you."* (Patient, FG 2) *"I wouldn't necessarily like it. I like the interaction of a human being."* (Patient, FG 4)
Too much information is overwhelming	X		*"Like when after first finding out I think, um, it felt a little overwhelming, seeing like this stack of papers, with all this information on it. I feel like maybe seeing it maybe all in an iPad or something it would seem not like where I can go through it slowly or whatever but having a stack of papers where- with all this- telling me all this stuff about it- uh- it was a little overwhelming sometimes."* (Patient, FG 3)
Privacy and confidentiality	X	X	*"A lot of people got that privacy issue. I would too...anybody can get hacked."* (Patient, FG 1)
Length and frequency of program	X	X	*"As long as it's not like long. It'll be like, oh, five minutes, oh, three minutes. Something short that they'll learn something from it, but it'll be like they sat through it all."* (Provider, FG 7)
Patient Literacy		X	*"I think if you have the adherence nurse or whoever this designated person is with that patient and you're working along with a tablet that would be fine, but there are a lot of literacy issues with this population."* (Provider, FG 8)
Patient & Provider Self-Motivation	X	X	*"It would be a matter of the provider saying this app is available and then the person would have to be self-motivated to use the app."* (Provider, FG 8) *"Unless that physician knows about this program, what good does it do me?"* (Patient, FG 4)
Access to smartphones and data plans		X	*"They're not gonna have that kind of phone...I mean the app is a great idea. Maybe when the government-issued phones get onboard and they start issuing the smartphones to the clients."* (Provider, FG 6)
Facilitators to DHI adoption			
Entertaining and appealing (i.e., interactive, games)	X	X	*"Honestly, if y'all came out with this [sample intervention content] I wouldn't take it...'cause it's nothing really appealing to me, and I know everything that's on here. I'm not saying that I know everything, but my point is I'll do it if it's appealing."* (Patient, FG 4) *"Make it a game cuz I've got a lot of clients that'll sit there on their phone and just be playing a game."* (Provider, FG 2)
Include testimonials	X	X	*"People that's been [living with HIV] that's still alive. Let them make tapes. You know, put 'em on DVD. Include it with the packet, that way if they want they got it for backup. In case they don't wanna read all that paperwork. They could look at testimonials."* (Patient, FG 2) *"Having advice. Maybe telling them what to do. Even have like a person to call if you need advice or stuff like that. Even having comments from other people that are going through the same situation."* (Provider, FG 7)

Table 2 | *Continued*

	Patient perspective	Provider perspective	Representative quote
Include peer mentors or in-person sessions as an adjunct	X	X	*"If it would be like, maybe a class, and teaching people how to use it."* (Patient, FG 5) *"I would say, like she said, a number so they can call so they don't feel like they're talking to a machine which is what they feel majority of the time due to the fact that it can get so busy that you won't speak to a client that you spoke to yesterday until next week or the week after and you're like, oh snap, I have to call this client back, he left me a message two weeks ago."* (Provider, FG 7) *"I think patients like in-person sessions. They like having that relationship. They like having that point person that they really connect with…I think to have that as your foundation because then they establish a relationship, and then maybe they have a couple of phone calls or a few, some text messages or something, and then this follow-up with the person again. In between they're getting some of those things? I think that would be a program that would be very attractive to patients."* (Provider, FG 8)
Include educational content (i.e., nutrition, treatment options, medication, substance use)	X		*"The encouragement, the problem solving, social support, self-worth, coping with stress, depression, alcoholism and drugs. I think that would be something really good to have for a person coming in to this particular situation."* (Patient, FG 1) *"So if I get intoxicated enough that I throw up, you know, do I take my pill again?" You know, different things like that. I wish they were more educated on different circumstances from, like travel, like if you're going into different time zones."* (Patient, FG 3)
Include medication reminders	X	X	*"Maybe some new app or something that has a better program in it for like – 'Beep, beep. Take your medicine.'"* (Patient, FG 3)
Use as a platform to initiate difficult topics of conversation	X	X	*"Providers should come up with some way of giving the information if you want it. Instead of, per se, you gotta come to the clinic and ask a doctor or a counselor, it just pop up on your cell phone."* (Patient, FG 4) *"Even my male doctor, I've had to say some things, and I gotta whisper to him. Then I am thinking, 'Why am I so embarrassed to talk to him about this stuff?' But I know that I have to, and I do, but a lot of people don't. A lot of people can't mention stuff, so the computer program might be something you might want to set up."* (Patient FG 1)
Promote standardized conversations with patients		X	*"Two-fold…you can go and get additional information about that, if you so desire…it can also – the doctor can also [use it as] a promotional tool."* (Patient, FG 4) *"I mean I think I don't think about it in this step wise approach, and I have more of a like a global just thought of what are the issues. Maybe a little motivational interviewing in an interview, but I wouldn't go through these things in such a methodical way. Like I wouldn't prioritize transportation, which I think is so smart. [Laughter]I mean, instead of exploring why don't you take your medicine, just asking, 'Can you make it to pick up your medicine? Can you make it to your appointments?'"*(Provider, FG 8)
Patient tracking and coordinated care		X	*"Apps on the collaborative care side might be helpful for us, like managing our team-based approach. Some type of—and I'm so technologically not savvy, but some type of hub where we can upload information from each area that we're covering."* (Provider, FG 8)
Include scare tactics and personalized feedback for risk behaviors		X	*"We all know that the egg in the pan, that had some effect, though, that when they—"This is your brain on drugs." You know what I mean? Actual "This is gonna happen," you know what I mean? The stuff that's going to happen—you know what I mean? If you continue to—you know what I mean?—actually seeing or I don't know, but cuz I remember that egg in the pan."* (Provider, FG 6)
Dissemination methods to increase uptake			

Table 2 | *Continued*

	Patient perspective	Provider perspective	Representative quote
Completion in the clinic	X	X	*"Do the IPad in the examination room. There's sometimes you sit back there quite a bit before you see the doctor."* (Patient, FG 2)
Language	X	X	*"I would always tell my doctor, 'Would you please Ghettofy [simplify] that for me because I'm not understanding what you're sayin'."* (Patient, FG 2) *"Are you looking to broaden that and not just be English? Because there's other cultures that might have HIV, like Latino, Cambodian, African... Because not everybody speaks English. This is America."* (Provider, FG 6)
Multiple delivery modalities	X	X	*"[Also}, give them a CD that way they can use it on down the road if they want."* (Patient, FG 2) *"I'm not savvy on the computers so, the DVD I think, everybody's got a DVD."* (Patient, FG 2)
Target younger PLWH or newly diagnosed	X	X	*"I think, would be great for someone that's just starting on their meds and dealing with it. But, you know- but, as far as someone in my position, these things have all been figured out long ago."* (Patient, FG 1)
Waiting room televisions as educational tools instead of TV programming	X	X	*"I know some places have programming on the TV that it's about their clinic, but they make it a show and they'll entertain [the patient] while they're waiting, and you don't even realize it's there and you're watching it. I think that'll help them."* (Provider, FG 7) *"They've got two TV screens in the waiting room here at the lobby. Instead of having a computer program that's interactive, just have something that's running. That's your program base that's informational that you can read."* (Patient, FG2)

treatment, and making lifestyle changes. *"After first finding out [HIV status] I think, um, it felt a little overwhelming, seeing like this stack of papers, with all this information on it. I feel like maybe seeing it maybe all in an iPad or something it would seem like where I can go through it slowly..."* Patients noted that digital tools would decrease the need for paper-based educational materials and resource handouts. A recurring theme among patients was the belief that you can never have too much education and repetition of information is important which is an added benefit of DHIs.

Participants highlighted the need to justify the credibility and value of such a program in order to solicit patient buy-in and increase program utilization. Patients reported using the internet to increase their HIV-related knowledge; however, they were concerned that the sources were not credible and viewed DHIs as a solution to being confident in the credibility of the source. Both patients and providers noted that DHIs may promote patient-provider discussion of uncomfortable topics. *"Yeah, a lot of doctors don't bring up this stuff. I have to bring this stuff up, and I'm bashful about certain things I talk about, even though he's my doctor..."*

Patients identified several helpful topics in addition to the topics provided in the sample intervention: nutrition, reviewing HIV treatment options and services throughout treatment, medication education, and testimonials regarding patients' experiences living with HIV. Patients noted that a harm reduction approach to address drug and alcohol misuse and medication adherence would be helpful: *"So if I get intoxicated enough that I throw up, you know, do I take my pill again?"* Furthermore, patients reported wanting the opportunity to share their story and help personalize the program. Suggestions included having a "narrative" section allowing patients to write his or her own story related to HIV or provide an advice section that future program participants would be able to view and learn from their experiences.

Providers perceived the use of scare tactics (e.g., 'this is your brain on drugs' commercials), personalized feedback interventions for risky behaviors (e.g., substance use), and developing an "action plan" for uncertain situations (e.g., drinking to intoxication and taking medications) as being useful content to include in patient-targeted DHIs. Providers suggested that providing patients with education regarding the different roles of healthcare providers (e.g., case managers, social work, physician, nurse) and strategies to navigate the healthcare system may improve patient ownership of their healthcare.

Provider-targeted DHIs

Participants noted minimal knowledge of such programs beyond electronic health record systems and indicated the potential for such programs to improve clinic work flow and patient care. Providers liked the stepwise structure of the content outlined in the sample intervention as it provided a desired *"...framework when I'm going through issues with adherence"* and promoted a standardized discussion between patients and providers of important HIV management topics.

Table 3 | Sample intervention shown to participants

Module	Description of topics covered in each step
Step 1: Education & Introduction	• The role medication plays in successful treatment of HIV • Increase your knowledge about HIV and medications • Increase your confidence to properly take your medications • Learn ways to help problem-solve situations that make it difficult to take your medications.
Step 2: Transportation to Appointments	• Resolutions and problem-solving transportation issues • Provides examples of ways to increase the chances of remembering appointments and medications
Step 3: Obtaining Medications	• Develop a plan for continuing to get your medication • Privacy and confidentiality concerns when talking to the pharmacist or other healthcare providers
Step 4: Communicating with Health Care Providers	• Techniques and strategies to help make you more comfortable with asking health care providers' questions.
Step 5: Coping with Side-Effects	• Develop a treatment schedule for taking medications with the help of your doctor to minimize side effects • Rethink the meaning of side effects (e.g., medications are in your bloodstream and working) • Discuss the importance of taking medications despite the side effects
Step 6: Formulating a Daily Medication Schedule	• Create a detailed schedule of an average day of pill-taking • Consider things such as where you are and what you are doing at different times • Create reminders to take your medications throughout the day based on your schedule
Step 7: Storing Medications	• Safe and proper medication storage for when you are not at home.
Step 8: Cues for Pill-Taking	• Provided colored adhesive dots that act as reminders for you to take your medications. • Where to place colored adhesive dots • Other reminders (e.g., alarms and different ways of thinking about taking medications)
Step 9: Response to Slips in Adherence	• Dealing with slips and forgetting to take your medications • How to avoid ways of thinking that can impact your adherence
Step 10: Review	• Review earlier steps through a short 10-question quiz • Provided correct answers for any questions answered incorrectly
HIV Beliefs	• Beliefs and myths that some people have about HIV and medications
Encouragement	• Strategies for staying motivated to meet your goals for taking medications
Problem Solving	• Problem-solving skills regarding HIV and medications
Social Support	• Strengthen the support you get from people around you
Self-Awareness	• Skills to feel confident that you can do what your doctors recommend
Coping with Stress	• Stress reduction, and ways to relax and not worry so much
Depression	• Dealing with sadness and depression
Alcohol and Drugs	• How alcohol and drug use impacts HIV medications and ways to reduce use

Providers noted such a framework would ensure all important topics were discussed with each patient and promote initiation of more challenging topics that providers reported frequently avoiding or overlooking during appointments (e.g., substance use, adherence, transportation challenges).

Providers highlighted the potential utility of DHIs to improve provider communication and patient tracking throughout the HIV care continuum. Specifically, providers expressed desire for a DHI that could be accessed through a smartphone or tablet device. "*Apps on the collaborative care side might be helpful for us, like managing our team-based approach. Some type of hub where we can upload information from each area… [have] total access to what's going on…we need some sort of tracking device and hubs for our information.*" There was consensus among physicians and other advanced care practitioners for use of a DHI for tracking patient referrals and services currently in place for patients that are not logged in electronic health record systems (e.g., addiction treatment services). Providers suggested having a database with easy access to referral contact information in an effort to "*help make it more navigable for the patient.*" The providers noted that having community-based referral information readily available via DHI during the clinic appointment may improve clinic work flow by preventing unnecessary referrals to case managers or social workers.

Perspectives to promote uptake

Program structure

Providers identified several important program features to promote uptake among patient-targeted DHIs. Providing adapted versions of HDIs that are sensitive to language (e.g., primarily Spanish) and cultural diversity would likely increase reach and acceptability among the target population. Additionally, incorporating motivational interviewing strategies into the DHI for topics related to adherence and substance use may prove valuable. Providers discussed the pros and cons of varying program durations, with mixed preferences on most effective program length. *"They wouldn't want to sit ten times for one hour, but if you had a longer session the first time and then said every time you come back, if it's a weekly appointment for this intervention, if they knew that today is 40 minutes, but every subsequent appointment is gonna be 20 or 25 or something like that, they might be more willing to enroll in a program that was structured that way. Because they're always in a hurry."* On the other hand, patients expressed concern that a multi-session program delivered in the clinic is unrealistic and noted that most patients would likely only complete one session of a program.

Patients and providers noted that having an in-person follow-up to the DHI program may overcome the lack of empathy provided by a DHI and might be a nice adjunct to such a program. For example, patients recommended having a mentor who is also living with HIV (similar to a sponsor model in Alcoholics Anonymous). Providers suggested engaging family members or people within the patient's immediate social support network in the DHI program. There was consensus among participants that users of the DHI may require basic technology education upon initiation of the program.

Delivery modality

Participants agreed that making DHIs accessible via multimodal delivery methods may increase uptake and acceptability (e.g., web-based vs. mobile platform vs. DVDs). Patients indicated that this may accommodate the range of technological literacy among patients. Both patients and providers recommended utilizing existing technology within the organizational structure to provide educational information. Specifically, they suggested using clinic televisions to provide basic HIV-related educational information (e.g., healthy vs. unhealthy viral load or CD4 counts). Patients reported that they would prefer this type of programming to general television programming.

Providers identified the environment in which DHIs are delivered as important. They noted that a group setting that is not too "school-like" may be a useful delivery format that promotes program motivation and sustained attention; however, providers emphasized that this delivery modality should not encompass didactics and lecturing, rather it should promote group member involvement through activities and discussion. Regardless of delivery method, providers agreed that requiring completion of the program in the clinic setting (rather than at home) would ensure the highest completion rates.

Patients expanded on the provider perspectives through identification of several additional components. Specifically, patients noted that the use of veteran HIV patients to deliver educational information (i.e., "testimonials") would decrease reading demand and thereby alleviate literacy barriers, promote attention to the program, and increase personalization. Additionally, they suggested delivering the intervention on a tablet device while patients are in the exam room waiting for the doctor. Patients reported that this strategy may increase program completion and privacy. Patients recommended providing a copy of the digital health tools for those who want to review it later or would like to share the information with friends and family.

DISCUSSION

The present study examined patient and provider perspectives on the use of DHIs to assist with HIV disease management and strategies to promote uptake and acceptability among PLWH. Focus groups included discussions on the utility of DHIs, barriers and facilitators to program usage, and content preferences. DHIs have not been widely disseminated in HIV clinical settings; consequently, participants in this study did not have prior experience with HIV-related DHIs. However, participants were familiar with other health-related mobile applications. Participants in this study were provided with a sample of intervention content (Table 3) and were asked to describe their preferences related to the delivery of this intervention. Understanding patient and provider concerns and preferences for DHIs is an important step in informing the development of DHIs and implementation approaches to increase uptake and acceptability in HIV clinical settings. In general, both patients and providers perceived DHIs as having utility to assist patients in managing HIV disease; however, several concerns were expressed that should be considered among developers of DHIs and among clinicians who prescribe or recommend DHIs to their patients.

Patients described a need for increased social support and a desire for empathic in-person interaction as important components that DHIs may not be able to provide. Patients and providers expressed concern about DHIs feeling "cold" and "impersonal." This could be a product of patients' repeated experiences with in-person interactions with treatment providers in the clinic setting. Alternatively, patients may have been unable to visualize different types of DHI programs and how they might be used to either assist in communication with providers or as a tool to help the patient manage HIV treatment. Inclusion of videos and audio of providers may lessen this concern. Further, enabling coaching via in-app messaging or FaceTime may eliminate this concern. Patients also noted that structuring the program to include patient testimonials and narratives would promote content interest. It is possible that DHIs may prove most effective as an adjunctive treatment component. For example, patients may benefit most from the use of DHIs in conjunction with in-person interactions delivered by patient navigators, case managers, or adherence nurses in the clinic setting. Research is needed to better understand how to promote “empathy” and a “personal touch” through use of DHIs. Intervention developers should consider inclusion of coaching components in smartphone applications that have the capability of providing patients with support and feedback in real time from credible personnel.

Providers should assess certain patient characteristics to appropriately prescribe specific digital health tools to patients. Patients with attention challenges may benefit from short, incremental intervention delivered in the clinic setting. Patients with less technology experience may be intimidated by introducing new forms of technology; thus, prescribing DHIs using technology platforms that the patient has experience with is essential to promoting adoption. Providers should assess psychosocial factors that may impede DHI usage such as limited access to smartphones and data plans, patient literacy and language/cultural barriers, and patient concerns regarding privacy and confidentiality.

One emergent theme during the provider focus groups was the need for technology-based tools beyond electronic health record systems designed specifically for treatment providers. There are over 200 HIV-related mobile health applications marketed for PLWH on either android or apple platforms. A review of mobile applications found that only 55 applications promoted HIV prevention and care services, and the majority of these apps focused on providing disease-specific educational information only. No mobile applications were identified for treatment providers as the target market [25].

Providers indicated potential for DHIs to promote a team-based approach to patient care, particularly when coordinating care with treatment providers located at off-site clinics or to assist with referrals and patient tracking. Such portable applications could allow for real-time patient tracking of services and on-demand access to content or services to enhance care coordination. This technology has the potential to overcome cracks in a fragmented healthcare system and increase clinic efficiency, work flow, and communication among interdisciplinary providers. Further, these technologies may provide a means of monitoring high-risk patients and promoting quicker re-engagement in care upon treatment drop-out. Future studies should further evaluate provider and systems-level challenges by which DHIs can reduce. Providers in this study highlighted gaps in care coordination and patient tracking across the care continuum. There is a need to improve existing electronic health record systems to accommodate provider communication across sites and ability to track patient referrals and appointment attendance across multiple health care systems.

Results from this study indicated that patients want to be informed about their healthcare; however, feeling overwhelmed, difficulty with initiating sensitive topics, and lack of patient-provider communication are barriers to sustained collaboration throughout the course of treatment. Considering the lifelong nature of HIV, promotion of a collaborative relationship between patients and providers may improve long-term treatment engagement and retention. DHIs may be helpful in supporting this type of patient-provider relationship. Some patients may feel more comfortable expressing concerns or asking important health-related questions through the use of technology. DHIs have the potential to reduce communication barriers among patients and providers. Previous studies among healthcare providers have noted concerns with increasing patients’ access to methods of communication, mostly due to fear of increased work load for providers as a result of increased emails and messages [26, 27]. Mid-level providers may be ideally suited to provide this type of additional support to patients via technology without significantly increasing workload burden. The inclusion of decision trees and identification of relevant resources for patients may promote autonomy and self-efficacy to navigate the healthcare system, thereby decreasing patient reliance on clinic personnel.

LIMITATIONS

Findings from this study should be considered in light of several limitations. Consistent with the exploratory and qualitative nature of this study, the sample size was small and nonrandom. Patient participants were recruited from a single urban HIV clinic, limiting the generalizability of these findings. However, participants in this study reported a range of variability in technology usage patterns and familiarity, which provided unique insights. Future studies should assess perspectives of DHIs among patients not actively engaged in care to determine unique needs associated with that specific subpopulation. In this study, provider experience and comfort with technology was not assessed. Additionally, we did not reach saturation among the provider focus groups in regards to DHIs designed for providers as the target market, and were unable to conduct additional focus groups to explore this emergent theme due to funding limitations and recruitment challenges with providers. However, we reached data saturation in regards to the a priori research themes. This study focused on patient-level interventions; therefore, themes which emerged based on provider-level interventions need to be explored in future studies.

CONCLUSIONS

This study sought to understand patient and provider perspectives on the use of DHIs for HIV disease management and methods to improve uptake among PLWH. DHIs should be developed with input from consumers, including patients, providers, and key stakeholders (e.g., clinic directors). Methods to increase engagement and appeal to the target audience are essential for widespread uptake of DHIs. Developers of DHIs should take into account the target population's learning style and level of education. Specifically, DHIs providing primarily didactic information or using PowerPoint may not be suited for participants with limited literacy. The use of interactive games or activities may better promote learning and interest among such populations. Further, DHIs are likely most beneficial for certain subpopulations of PLWH, which may include individuals who are more tech savvy, younger, or newly diagnosed.

Research is growing in the development and testing of DHIs; however, the field continues to lack an understanding regarding for whom DHIs are best suited and in what capacity DHIs should be delivered to promote optimal uptake and widespread dissemination. Future research should establish for whom DHIs are most effective. Cost-effectiveness studies may also establish the utility of DHIs among patients with limited access to technology devices (e.g., Smartphones with data capabilities). Developers should also consider provider-targeted DHIs to improve clinic work flow and patient care capacity. Thus, providers and clinic staff may be an optimal target population for such tools. Finally, future research should evaluate core elements of DHIs for HIV-related disease management and develop culturally-tailored DHIs for key populations (e.g., newly diagnosed, substance abusing populations). There exists a need to develop effective patient-level DHIs that providers can feel confident in prescribing to their patients for assistance with managing HIV disease.

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