Acceptability and Use Determinants for Digital Health Technologies for HIV Services: A Qualitative Study of Emergency Care Patients in Nairobi, Kenya

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Abstract

Digital health technologies (DHTs) to improve access to HTS (HIV testing services) may enable reaching higher-risk populations missed by current programming, including young adults < 25 years. In 2017, Kenya's Ministry of Health introduced BeSure™, a DHT providing information on HIV, self-testing, and facility geo-location. Given increased risks for HIV among injured populations, this study aimed to assess the acceptability of BeSure™ as an example DHT for enhancing HTS in this population at a Kenyan emergency department (ED). Purposive sampling was used and after providing a brief description of the tool to participants, in-depth interviews (IDIs) were completed using a semi-structured guide between August and November 2023. Deductive and inductive analysis were applied using a codebook based on a published framework for healthcare intervention acceptability, using core themes of affect, burden, ethicality, coherence, opportunity cost, and perceived effectiveness. Among 24 participants, the median age was 25, half were female, and 58% had achieved a level of education of secondary school or below. Few participants (21%) were aware of BeSure™ prior to completing data collection. Participants highlighted barriers to awareness, including the lack of widespread marketing of the tool and apathy towards health-related matters, though strategic advertisement within healthcare encounters and using social media platforms including TikTok and Facebook (especially for young adult participants) could facilitate awareness. Participants underscored barriers to potential use, including low access to technology in rural communities, persisting stigma towards HIV and low perceived HIV risk (especially among older participants). Participants of all age groups examined found the tool widely acceptable across the predetermined domains. These qualitative data highlight the acceptability DHTs for HTS enhancement among injured populations in Nairobi, Kenya. They also underscore the lack of awareness of BeSure™ among this population with a higher-risk HIV profile, suggesting that

targeted advertisement, demand creation, stigma consideration may be critical to the implementation of these technologies.

Introduction

HIV and physical injury levy significant health burdens in low-and middle-income countries (LMICs); with high incidences of both in African nations [1]. Concurrently those most likely to need emergency care for injuries in general are persons at risk for HIV acquisition, including young adults and males, commercial sex workers, men who have sex with men, and people who inject drugs and transgender persons (also known as key populations at risk for HIV) [2-6]. Studies have also found that injured populations have higher HIV prevalence than the general population in African countries like Kenya [7, 8], demonstrating the potential utility of emergency care settings for HIV testing services (HTS). A prospective study completed in 2021 found that <6% of injured persons treated at the Kenyatta National Hospital (KNH) emergency department (ED) were offered HTS, but among those tested ~10% were newly diagnosed persons living with HIV (PLHIV)[9] [10]. Although universal screening for HTS is recommended during health facility encounters in Kenya, delivery in EDs has not been achieved [11, 12].

Digital health technologies (DHTs) to improve access to HTS, and specifically HIV self-testing programming, have been designed and implemented with success globally [13]. DHTs in Kenya may be particularly useful in contemporary HIV prevention programs, as the epidemic becomes increasingly concentrated in higher-risk populations that have more barriers to interfacing with health services and requiring more innovative targeting[14]. Such higher-risk populations may be presenting more to EDs, making these venues appropriate settings to explore targeted HIV programming [15]. In Kenya, the Ministry of Health has highlighted priority populations for HIV testing and prevention efforts including young adults aged 18-24 years [16]. HIV prevention programming in the region has neglected this age group [17], and young adults aged 18-24 are estimated to account for 38% new infections in Kenya. As such, digital technologies implemented

in settings that provide care to persons with higher-risk profiles for HIV [15], like the ED, may have the potential to direct resources to priority populations such as young adults. However, no prior studies have examined such technologies specifically within emergency care populations in Kenya. Indeed, understanding such tools align with the digital health policy landscape in Kenya, where the Digital Health Act of 2023 established a new agency with goals of integrating and governing e-health into routine service delivery[18].

One example technology in Kenya is BeSure™, a HIV-focused mobile and web-based digital health technology.Kenya's National AIDS and STI Control Programme (NASCOP), in collaboration with local and international partners, implemented a DHT entitled BeSure™ in 2017 to increase access to HTS and treatment, though anecdotally, its utilization has been low [19]. BeSure™ was maintained as an open-access resource by Kenya's NASCOP through mid-2023, at which time it was taken offline for redesign and updating. [19]. The mobile-based applicationand associated web resource provides HIV testing and treatment information, map-based locations for HIV care sites, and guidance around test results throughout Kenya. The BeSure™ interface offers multiple follow-up options including toll-free calls, text messages and WhatsApp™ to connect clients with trained clinical staff to assist with self-testing understanding of results. Despite the potential of technologies like BeSure™ to streamline HIV prevention and testing , characterization of their use, integration into health services, and their impact on clinical outcomes has been limited [20]. This study aimed to explore the acceptability of the BeSure™ technology as an example DHT for enhancing HTS among emergency care patients in Nairobi, and to identify determinants to the use of DHTs for HTS in this care setting.

Methods

Design and Sampling

The target population included adults who presented to the KNH emergency department for physical injury, enrolled in the parent study which aimed to assess implementation of the HIV Enhanced Access Testing in Emergency Department (HEATED) program in Nairobi, Kenya which commenced before sub-sampling began [21]. This program was a institutional and behavioral intervention aiming to improve HIV testing in the emergency department among injured patients. Among patients who consented to follow-up contact,urposive sampling was applied to yield equal distribution across gender and age strata (younger or older than 25 years) among the sub-sample of participants who had consented to follow-up. These strata were selected given possible differences in perceptions across gender, and because young adults are a priority population for HIV services in Kenya [16]. Inclusion criteria for the parent study were applied, including being older than 18 years old, non-pregnant, not prisoners of the state and those who had consented to further contact in the parent study. Additionally, only participants that reported access to a smartphone were included in interviews to enable fruitful conversation around digital health technologies including smartphone-based applications. Participant sampling from parent study population using eligibility criteria further described in flow diagram in Figure 1. Selection bias introduced by this eligibility criteria is acknowledged, but findings should still be generalizable given high smartphone penetrance across Kenya, and that clients with smartphones are the application's target audience.

Data collection

Eligible participants were randomly selected from the sub-sample, then screened for consent and enrolment via telephone. Only patients enrolled in the parent study who had provided consent in taking part in follow-up contact were approached for the qualitative study. Consenting patient participants were scheduled for an in-depth interview (IDI) at a convenient and confidential location at the hospital. Participants were compensated with 1,000KSH.

Before beginning the IDI, written consent was obtained where the research question was described, and participants were provided a pamphlet of the BeSure^{TM} application in English and Kiswahili (Supplementary Material 1). As the BeSure^{TM} tool was offline in 2023, the actual application was unavailable for use during pre-planned data collection for this study, and participants were interviewed on its concept after description of its features. A semi-structured guide was developed based on Sekhon and colleagues' prospective theoretical acceptability framework (TFA), psychology-grounded constructs developed systematically based on scoping review of studies evaluating healthcare intervention acceptability, effectiveness and tolerability [22, 23]. The guide included sections on barriers and facilitators to awareness of digital health technologies and determinants of use of the BeSure^{TM} as an example tool (Supplementary Material 2). A section was also included to understand views on digital health technologies in general, to understand perceptions of the broader landscape and contextualize responses about BeSure^{TM} as an example tool (Supplementary Material 2). Questions were crafted to gather perceptions on DHTs in general and the broader landscape, to address threats to generalizability caused by the example tool being offline at the time of data collection

IDIs were undertaken between August and December 2023, facilitated by a Kenyan research team member with training in qualitative methods and fluent in both English and Kiswahili, with the addition of a notetaker in the room with the participant. Interview debriefs were reviewed by the study team within one day after the interview to determine additions to the codebook or challenges in data collection. Interviews were conducted until thematic saturation was achieved, as determined by interviewer, notetaker and data analysis team after reviewing debriefs based on constant comparison to existing codes, until at least three debriefs had no new themes identified. A unique identification number was used for all qualitative data collection and analysis activities. Interview recordings were translated to English and transcribed manually. Transcripts were imported into Dedoose Version 9 software for management and coding.

Coding and analysis

A codebook was developed using *a priori* themes for deductive analysis. These themes were generated based on hypothesized barriers and facilitators to use of the tool, as well as Sekhon and colleagues' prospective theoretical acceptability framework (TFA), psychology-grounded constructs developed systematically based on scoping review of studies evaluating healthcare intervention acceptability, effectiveness and tolerability [22, 23]. Themes incorporated into the codebook included affect, burden, ethicality intervention coherence, opportunity cost, and perceived effectiveness. Each of these themes represented a parent node to which codes were attributed in the analysis, and each parent node had an operational definition to be used by coders. Affect was defined as positive or negative feelings expressed about the digital health tool; burden was defined as any description of high or low perceived effort in using the digital health tool; ethicality was defined as the digital health tool aligning well with patient values; intervention coherence was defined as recognition of the digital health tool's intended outcomes of improve

access to HTS; opportunity cost was defined as losses attributed to use of the digital health tool; and perceived effectiveness was defined as the digital health tool being expected to achieve improved access to HTS.

Inductive and deductive thematic analysis was conducted on IDI transcripts. *A priori* themes were extracted based on the original codebook and categorized according to the sampling strata. Themes emerging during the coding process were added to the codebook for inductive analysis. For these themes, study personnel would report if themes emerged while coding a transcript, and themes would be discussed between two study members until consensus was reached before being added to the codebook. One quarter of transcripts were coded independently by two trained research study personnel and concordance analysis was conducted for internal validity of the codebook. Once >85% concordance was achieved, one trained research study personnel completed coding for the subsequent transcripts.

Ethics

The study was approved by the University of Nairobi ethics and research committee (Protocol Number: P667/08/2022) and the institutional review board of Rhode Island Hospital (Protocol number: 1953237-1).

Results

Participant demographic profiles

This qualitative study sampled 24 participants who had been treated in the KNH ED. The sample comprised 12 males and 12 female participants aged between 18 and 42. More than two-thirds of the participants were aged between 18 and 29 (n=17, 70.8%). All participants reported use and familiarity with smartphones and mobile applications. Participants provided their insights and perceptions regarding digital health applications in HIV-related services, particularly the use of BeSure^{TM} application to enhance testing and other services in Kenya. Table 1 shows the demographic profiles of the participants.

Participants aged greater than 24 were more likely to be working (100%) compared to younger participants (50%). The majority of participants had achieved a secondary school level of education (54%). In terms of clinical history, the majority of participants did not have a primary care physician (67%), had previously been tested for HIV (83%), did not have any medical conditions (87.5%), and had not had condomless sex in the last 6 months (54%). The majority of participants were aware that HIV self-tests exist (79%).

Facilitators and barriers to awareness

Systemic and structural

The majority of the participants reported being unaware of the BeSure™ DHT (80%) but commented on facilitators and barriers to awareness. Many participants highlighted that they would have been aware of the digital health tool with further advertisement. In terms of preferred mode of advertisement, commonly raised was promotion at health facilities where patients received care (Code frequency (CF) = 42) and social media marketing of the tool (CF=41). All young adult participants (100%) specifically highlighted the use of social media platforms, such as Instagram™ and TikTok™, as a useful mode (compared to 75% of older participants).

> *"You know in this generation, it works better if they could take the whole aspect to Instagram, TikTok and campaign about it; talk to students and the elderly and let them know about [the tool]"* (Participant 23, Female 23 years old)

Suboptimal advertisement was highlighted frequently as a barrier to awareness (CF=9). Multiple participants raised concern around marketing to patients presenting for acute injury given the difficulty engaging or remembering in this setting.

> *"It's somehow hard to remember [the app] because at that time [in the hospital] I was in pain such that I was straining to answer the questions"* (Participant 9, Male 39 years old)

Others reported that healthcare settings may provide effective venues for this education and awareness (CF=42), and simply require strategic targeting regarding where in a facility (for example, in the wards), when in the care process (for example, after treatment and stabilization), who on the care team (for example, providers actively involved in care or department heads) and the how the communication is happening (for example, providers taking a gentle approach to patients).

"[patients] will have to stay for some time, so you guys can talk to them during that time while they are in the wards" (Participant 21, Male 25 years old)

"*when someone is still at the A&E, first thing is they're scared and terrified. So I think, it would be better to actually walk arid the wards and try create awareness around there. I believe most patients in the wards have recovered from their initial shock, stabilized a little and can listen or pay attention*" (Participant 2, Female 23 years old)

"you can reach them through the dispensaries in those areas so that before or after treatment, they are told about the app and what it can do" (Participant 18, Male 23 years old)

"*you can appoint people to create awareness in different times so that even when the patient wakes up even from coma, there will be someone to educate them"* (Participant 14, Male 25 years old)

"Yeah, in the hospital you can use the departments to talk to people, maybe by the head of departments, though it might get a little hard in the casualty department because maybe someone is in pain, but some will agree to talk. But I think in the hospital, the department can help by telling the members of staff. Or the nurses who are there nursing them, they are the right people, or the doctors. You can use them because as they administer treatments and tests, they can be able to talk to the patient, and they will be ready since they are in pain, they will just listen to the doctor" (Participant 6, Female 36 years old)

Some participants indicated that structural or government-level failures create barriers in awareness to such applications, and that the responsibility may lie beyond healthcare institutions, at the systems level. On the other hand, one participant shared that high-level government intervention would not effectively address the lack of awareness of such tools, alluding to a lack of trust in the Kenyan government.

*"maybe it's the health sector that is quiet about it; the blame is on the health sector" (*Participant 7, Female 29 years old)

"I think we don't need any external input, because if the government gets involved people will think it's a scam and run away from it…we don't need the politicians to chip in. (Participant 23, Female 23 years old)

Interpersonal

Interpersonal barriers to awareness such as apathy towards health-related topics were reported (CF=9), limiting interest or attention towards digital technologies focused on HIV prevention. Older adults highlighted this apathy more frequently (33% compared to 17% in young adults).

> *"others would see no importance in [the digital health tool], they'll be like…so what?"* (Participant 6, Male 36 years old)

Facilitators and barriers to use

None of the interviewed participants had used the BeSure™ DHT, but participants commented on potential barriers and facilitators to using it as an example digital health technology.

Systemic and structural

Access to technology was the most frequently reported theme mediating potential use of a digital health tool (CF=19 as a facilitator, CF=30 as a barrier). Owning a smartphone was not frequently reported as a barrier, and many participants highlighted how prevalent smartphones are in Kenya. Participants specifically highlighted how digital literacy was common among young populations, and high smartphone penetrance was reported to help surpass systemic barriers to use. Rather than access to smartphones themselves, participants reported access to data and the internet as a barrier to using a digital health technology. Additionally, while young populations were highlighted as digitally literate, rural populations were highlighted as a demographic that may face barriers to use of a digital health technology.

> "*the youth bracket mostly and all of them know how to operate a phone" (*Participant 3, Male 24 years old)

"most people are illiterate, and some can have hard time going through notice boards and things like that, but almost everyone nowadays owns a smartphone" (Participant 14, Male 25 years old)

"*for somebody who has a smartphone and somebody who has the space but doesn't have the data might have a challenge" (*Participant 4, Female 23 years old)

"*yes, people living in rural areas who are not used to operating smartphones [will face challenges]"* (Participant 17, Female 23 years old)

Interpersonal

Interpersonal influences and beliefs were also reported as mediators to potential use of such a tool. Stigma concerns (CF=16) were raised as interpersonal barriers to use of a phone-based tool focused on HIV, even after being primed by the data collector about the BeSure™ as an example DHT (Supplementary Material 2). Apathy (CF=14) was reported as another interpersonal barrier to use wherein there may not be interest in engaging with a health-related digital tool even if made aware.

"*HIV is associated with a lot of stigma and it would be hard for people to engage in such issues publicly*" (Participant 20, Male 22 years old)

294 *"No, I don't think [internet access is an issue]. Because people look for bundles from anywhere when they want to do other*
295 *things. So, [internet access] is not an excuse; maybe some people don't use because they don't want to"* (Participant 9, Male
296 39 years old)
297
298 Compared to older participants, young participants reported high perceived HIV risk as a facilitator to use of such a tool (CF=2).
299 Conversely, older participants more commonly reported low perceived HIV risk as a barrier to use of an HIV-related tool (CF=4).
300 *"Yeah, it's good because some of us have trust issues when it comes to our partners"* (Participant 25, Female 20 years old)
301
302 *"Maybe most of the people are afraid of knowing their status. It's like you get out there and tell someone you want to test them*
303 *for HIV, they will back off"* (Participant 9, Male 39 years old)

Acceptability

Acceptability themes extracted and coded from participant interviews are displayed in Figure 2. After learning about BeSure™ as an example of a digital health technology for HIV service enhancement (Supplementary Material 2), the majority of participants (CF=47, 75% participants) made positive remarks about the tool, indicating their positive affect. More young adults made positive comments (83%) about the tool than did older participants (67%).

> "To me personally…when I have this app it would be easier to identify pharmacies… I think it's a good app because it does not disclose your identity, and you'll only need to contact the professional advice you on what to do" (Participant 5, Male 22 years old)

> *"[BeSure] is a good one, it can really help sometimes you want to know about your status or maybe you have the virus, it can help, advice and encourage you and I love it"* (Participant 19, Female 31 years old)

The tool aligned well with participant ethicality or values (CF=36, 54% participants) around healthcare for HIV, specifically including privacy, anonymity, convenience and cost. Participants reported how this digital tool for HIV testing addresses persisting HIV stigma by preserving anonymity and privacy. Others alluded to how the digital tool could help with the fear of being diagnosed with HIV in a

formal patient encounter, or how it could help empower by providing resources to connect to care. Similar proportions of participants reported that the tool aligned with their values across younger and older participants.

"I would use of because of the privacy; since there are people who HIV is not a big deal to them and there are others who would not like people to know if they have the virus" (Particpant 22, Female 21 years old)

"maybe after testing I find out that maybe the results are not good; so, maybe you can go back to the app again and talk to a professional. So, it comes in handy and help someone without having to be told or forced. You just see it yourself. For I see it as very helpful at that point." (Participant 4, 23 years old)

"The app is open to everyone and it's good because of the privacy; once you get to test yourself and know your status, it will only be between you and your family; another thing is that, the app can encourage me and remind me I'm not alone; so, the app can give you strength" (Participant 24, Female 31 years old)

Participants had high coherence of the tool (CF=50, 83% participants), and were able to explain how the BeSure^{TM} application could be used to achieve its aim of enhancing HIV service delivery. Participants were able to report specific features of the tool and outline its function. High coherence was observed with similar proportions across younger and older participants.

"I would follow up on my [HIV] status, because sometimes you can miss your appointments" (Participant 25, Female 20 years old)

"there are counselors, so if I have issues, [BeSure] allows you to call someone and talk to them"" (Participant 17, Female 28 years old)

"even be able to educate others that it's not mandatory that you to the hospital to get tested but you can do it for yourself and guide them [with BeSure]" (Participant 6, Female 36 years old)

The majority of participants considered the application to have low technical burden for use (CF=42, 58% participants). After learning about BeSure™, participants mentioned it would be easy to learn how to use and operate daily. One participant highlighted it accessibility and that its video resources would enable illiterate clients to use the tool.

"As long as you I am someone who is used to operating a smartphone, I don't think it can be hard to me" (Participant 17, Female 28 years old)

"there are video resources that they can watch, step-by-step" (Participant 14, 25 years old)

Few participants (CF=3, 8% participants) made comments that specifically signified a low opportunity cost for use of the tool. That being said, two female participants highlighted savings generated by the tool in access to HIV testing services.

"*it is cheaper, instead of travelling to the hospital, I could just buy data and know more about [the services]"* (Participant 6, Female 36 years old)

"it is easier than telling [my partner] to miss work to go get tested" (Participant 2, Female 23 years old)

The majority of participants reported high perceived effectiveness of the tool (CF=17, 58% participants), highlighting how the tool could achieve a particular health or social outcome. Many participants specifically mentioned how the digital tool could be used to enhance HIV testing. High perceived effectiveness of the tool was reported by the vast majority among young participants (75%) and less than half of older participants (42%). Of note however, older participants mentioned the effectiveness of the tool to empower community access to care beyond just the individual.

"it conserves people's privacy and so makes it…easier to get tested" (Participant 17, 28 years old)

refer someone else to the nearest place where they can get the services they need" (Participant 16, 42 years old)

Comparison to digital health landscape

In general, participants were not aware of digital health technologies. When probed, participants shared diverse areas in which they had encountered DHTs in Kenya, including tools for pharmaceuticals, emergency services, electronic medical records and wearable technologies. Two young adult participants mentioned MyDawa™ [24], a pharmaceutical delivery service. Another young male highlighted a Red Cross application, which was primarily for emergency medical services. Another highlighted the KenyaEMR platform, used for health data storage. Two female participants mentioned wearable health technologies, but that these technologies were not widespread in Kenya. One participant specifically highlighted that exposure to DHT is low in Kenya, and that the country is not taking advantage of existing technologies.

> *"With MyDawa we ordered some medicine and was delivered [by MyDawa]"* (Participant 4, Male 23 years old)
>
> *"[Red Cross app] is mainly for booking; maybe you have an event and you need a team of first aid"* (Participant 14, Male 25 years old)
>
> *"'Kenya EMR' is an online platform where where health data is entered for clients"* (Participant 16, Female 42 years old)
>
> *"I see people can be able to monitor their health especially those with disorders such as pressure, when they wear those smart buds"* (Participant 7, 29 years old)
>
> *"So, we have the gadgets and we don't know how powerful they are"* (Participant 23, Female 23 years old)

Discussion

The primary aim of this study was to explore perceptions around acceptability of digital health technologies for HIV testing service enhancement, using BeSure™ as an example digital health technology, and to identify determinants of theoretical use of such a technology. Key findings included that there was widespread acceptability of the tool across multiple constructs; there was widespread lack of awareness of the example tool and other tools, perceived to be driven by inadequate and inappropriate marketing, structural barriers, and apathy towards health-related matters; there were several barriers to participants' theoretical use of the tool including cost of and access to internet services and HIV-associated stigma; and that participants had a limited knowledge of and exposure to digital health tools in their everyday lives.

Participants found DHT in general, and BeSure™ specifically, to be highly acceptable for HIV testing enhancement across age groups. Applying Sekhon and Cartwright's TFA constructs [22], participants reported a positive affect towards the tool, high coherence of its utility, and perceived it as effective, with a low burden for use and in alignment with their value system. These findings reinforce studies showing widespread acceptability of patient-facing DHTs in Kenya among vulnerable groups [25-28], though literature from the region assessing DHT use in emergency care populations specifically was limited. EDs may be a venue to reach 'the last mile' with HIV programming in LMICs given their contact with patients of higher-risk profiles [15], and so widespread acceptability of a DHT for HTS within an emergency care population supports their potential.

Furthermore, acceptability of DHTs in this subpopulation align well with current Kenyan national health policy direction. DHT use in this subpopulation may support Ministry of Health's 2023-2030 HIV prevention strategies, including implementing a precision approach based on vulnerability and risk as well as integration of HIV prevention into essential services, namely emergency care [29]. Our findings further support the goal of Kenya's recently-established Digital Health Agency in characterizing the integration e-health solutions into delivery of health services [18]. Our findings further highlight key areas to address to better harness the potential of DHTs in this setting, highlighting the need for continued implementation studies of such tools assessing their adoption and ease of integration into routine health services and national systems.

Specifically, articipants highlighted key barriers to address and facilitators to leverage for theoretical use of BeSure as an example DHT for HTS. The lack of widespread and strategic marketing limited awareness of the tool, and participants highlighted that promoting such a tool within health facilities could be effective, but should strategically consider timing, location and which personnel are involved in this promotion. While there is theoretical value to leveraging emergency care venues for HIV prevention interventions given emergency patients tend to be at higher risk of HIV [15], participants highlighted the challenges of DHT promotion within this important venue, given the acuity of a patient's illness or injury.

Notably, Yew et al. recently published systematic review identifying barriers and facilitators to DHT implementation in LMIC health systems and similarly report the importance of incorporating DHTs during moments where patients and staff can meaningfully engage

in the technology [30]. Significant work has been done in the field of demand creation for HTS globally, and lessons learned can be applied to increasing awareness and use of digital tools for HTS in emergency care. For example, evidence-based strategies like mobilization, couple- and motivation-oriented counseling, peer-led interventions, conditional fixed value incentives, and SMS could be applied [31]. Qualitative data from participants highlighted how apathy related to health would be a barrier to building awareness and use of digital health, and perhaps targeted user design or structured incentives could help as have been identified in related studies [32]. Addressing barriers and leveraging facilitators identified in this study while learning from previous work could improve future implementation of DHTs for HTS in emergency care populations.

While digital literacy and access to smartphones were not emphasized in this sample of urban young adults, cost of data and internet were. These findings underscore the need for sustainable funding for digital health interventions such as those described in the country's recently passed Digital Health Act [18], as well as structural interventions to increase access to the internet across the country such as Starlink's expansion in the country in 2024 [33]. Stigma was highlighted as a key modifier to use of the BeSure™ technology, as some participants preferred the tool given its protection of user privacy and anonymity while others feared that use of the tool could be stigmatizing itself. This duality emphasizes the importance of continuing to acknowledge, study and address persisting stigma in HIV testing interventions in Kenya [34]. Additionally, perhaps a DHT with a broader focus beyond just HIV may help maintaining desired privacy, as has been demonstrated in an assessment of a digital health intervention among Kenyan female sex workers [35].

Several thematic differences were observed between older and younger participants that may assist in better targeting tools like BeSure™. In the sample, more young adult participants made positive comments about the tool and the vast majority perceived the tool be very acceptable. Young adult participants were more likely to mention the use of social media, including TikTok, Instagram and Facebook, as a facilitator,, reflecting high smartphone and internet penetrance (~96% population) in Kenya [33]. They were also more likely to report perceiving HIV risk as a facilitator, which correlates with epidemiologic trends of the increasing incidence of new infections among Kenyan youth [1]. Targeting young adults with a digital HTS tool in Kenyan emergency care may therefore best implemented leveraging social media platforms [36, 37]. No clear thematic differences were observed across genders in this study, suggesting the need for further exploration into the targeting or perception of these technologies across genders within this subpopulation.

Our study had several limitations. Firstly, BeSure™, was not accessible during the data collection period, limiting our ability to get real-time user experience data and thus ecological validity. However, crafting of the interview guide took this into account, and our questions assessed awareness and use of BeSure™ as an example DHT, and focused on the broader digital health landscape, improving generalizability of our findings. Additionally, conducting such acceptability research while a tool is offline is not uncommon in digital health, where findings can inform successful tool relaunch. Additionally, selection bias was present given we sampled from a population of urban youth with significant digital literacy and familiarity with access to smartphones. This degree of

digital literacy may not be present across all Kenyan populations, though given the high internet penetrance should not significantly limit the generalizability of our findings. Additionally, the target user audience of BeSure includes those with smartphones. While differences in perceptions between older and younger adult participants emerged among participants, more than 70% of participants were younger than 30 years old, and so understanding the acceptability of this tool among those greater than 45 years was limited. Most emergency care patients in LMICs are youth [38], so our findings are likely generalizable for DHTs implemented for these patients. Additionally, per the design of this study, participants were enrolled from a broader study wherein they had been exposed to an HIV testing intervention in an ED [21], potentially limiting generalizability of our findings across groups who had not received this intervention, though the vast majority of participants interviewed did not remember undergoing the HIV testing intervention.

Ultimately, there was widespread acceptance of the BeSure™ tool in specific and DHTs for HTS enhancement within emergency care populations. The landscape for DHTs for HIV programming is expanding in Kenya, and it is important to understand acceptability, identify determinants of use and assess impact of such technologies ahead of scaled implementation. As the HIV epidemic continues to become concentrated in sub-populations in Kenya and other countries in the Africa [1], viable digital health technologies like BeSure™ may be useful in targeting resources for precision prevention of HIV.

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Tables

Table 1. Demographic and clinical characteristics of interviewed population

		Overall n=24	***Older adult n=12***	***Young adult n=12***
Age (median, IQR)		25 [23.0 30.0]	30 [28.8, 33.8]	23 [20.8, 23.0]
Gender (n, %)	Female	12 (50.0)	6 (50.0)	6 (50.0)
	Male	12 (50.0)	6 (50.0)	6 (50.0)
Relationship status (n, %)	Monogamous	2 (8.3)	1 (8.3)	1 (8.3)
	Polygamous	1 (4.2)	1 (8.3)	0 (0.0)
	Married	7 (29.2)	6 (50.0)	1 (8.3)
	Separated (Still Married)	1 (4.2)	0 (0.0)	1 (8.3)
	Single	12 (50.0)	3 (25.0)	9 (75.0)
	Wishes Not to Disclose	1 (4.2)	1 (8.3)	0 (0.0)
Education level achieved (n, %)	Beyond Secondary School	10 (41.7)	5 (41.7)	5 (41.7)
	Primary School	1 (4.2)	1 (8.3)	0 (0.0)
	Secondary School	13 (54.2)	6 (50.0)	7 (58.3)
In school (n, %)	No	21 (87.5)	12 (100.0)	9 (75.0)
	Yes	3 (12.5)	0 (0.0)	3 (25.0)
Current employment (n, %)	No Job / Not Working Currently	6 (25.0)	0 (0.0)	6 (50.0)
	Self-Employed	6 (25.0)	3 (25.0)	3 (25.0)
	Work Labourer	9 (37.5)	6 (50.0)	3 (25.0)
	Working Professional	3 (12.5)	3 (25.0)	0 (0.0)
Has a primary care provider (n, %)	No	17 (70.8)	8 (66.7)	9 (75.0)
	Yes	7 (29.2)	4 (33.3)	3 (25.0)
Never previously tested for HIV (n, %)	No	4 (16.7)	0 (0.0)	4 (33.3)
	Yes	20 (83.3)	12 (100.0)	8 (66.7)
Condomless sex in the last 6 months (n, %)	No	13 (54.2)	6 (50.0)	7 (58.3)
	Wishes not to disclose	2 (8.3)	0 (0.0)	2 (16.7)
	Yes	9 (37.5)	6 (50.0)	3 (25.0)
Aware that HIV self-tests exist (n, %)	Missing	1 (4.2)	1 (7.7)	0 (0.0)
	No	5 (20.8)	2 (16.7)	3 (25.0)
	Yes	19 (79.2)	10 (83.3)	9 (75.0)

Figures

Figure 1. Eligibility diagram describing sub-study sampling from parent study population, August – November 2023

Figure 2. Thematic mapping acceptability of BeSure™ digital health technology for HIV service enhancement among emergency care patients at Kenyatta National Hosptial, August - November 2023