Attitudes toward scale-up of an Intensive Combination Approach to Rollback the Epidemic in Nigerian adolescents (iCARE) intervention for youth in Nigeria: results of a mixed methods early-implementation study

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Abstract

Background Youth living with HIV (YLH) are disproportionately impacted by HIV with poor outcomes along the entire HIV care continuum. In a 2020–2022 pilot study, iCARE Nigeria, successfully tested a combination intervention incorporating mobile health technology and peer navigation to: 1) improve testing and linkage to HIV care for young men, especially young men who have sex with men (YMSM) and 2) improve medication adherence and treatment outcomes for YLH. The intervention was scaled up to 5 sites in 3 Nigerian cities. Implementation research was used to understand site perspectives on feasibility, readiness and potential facilitators and barriers soon after scale-up commencement.

Methods An explanatory mixed-methods implementation study was conducted, including quantitative surveys on adoption and reach among peer navigators (PNs) and other study staff (55 testing, 172 treatment), and interviews and focus group discussions with PNs and other study staff in both intervention groups ($n = 31$). Data were analyzed using descriptive statistics (quantitative) and directed content analysis using the Consolidated Framework for Implementation Research and RE-AIM (qualitative).

Results Early into scale-up, PNs and other study staff in the testing and treatment interventions reported high readiness, adoption, feasibility, and appropriateness. Facilitating factors and strategies across both interventions, included supportive institutional culture, ongoing supportive supervision, provision of a manual and training, relevant PN working experiences, communication methods designed to ensure anonymity of targeted youth (testing)

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or confidentiality (treatment), and access to cellular data and internet. Facilitators specific to each intervention were also identified including PN knowledge of the MSM community, using multiple social media platforms for outreach (testing) and problem-solving by PN and staff to respond to client needs (treatment). Barriers in both interventions included client financial and transportation challenges, and societal stigma. Intervention-specific barriers included legal limitations for MSM and few YMSM friendly clinics (testing), limited client financial resources and cell-phone access (treatment).

Conclusions Implementers of the initial scale-up of both components of the iCARE Nigeria intervention reported high readiness and adoption, supported by implementation strategies and facilitating factors including intervention design. These results are important for informing future work to scale-out iCARE and similar interventions to new settings.

Trial registration ClinicalTrials.gov number, NCT 04950153, retrospectively registered July 6, 2021, https:// clinicaltrials.gov/.

Contributions to the literature

- Despite progress in developing evidence-based interventions (EBIs) for youth with or at risk of HIV, less is known about driving EBI scale-up to end the HIV epidemic.
- We observed positive attitudes towards iCARE Nigeria, an approach combining peer navigators and digital health interventions to increase HIV testing, linkage to care and HIV medication adherence among youth including young men-who have-sex with men in Nigeria.

  Barriers exist to iCARE implementation including financial resources, access to transportation and cell phones, societal stigma, and legal limitations for clinics which will be tracked and addressed as feasible as the study progresses.
- The study demonstrates that comprehensive training strategies, supportive institutional cultures, and peer-led implementation approaches can contribute to the successful adoption, integration, and scale-up of interventions like iCARE into existing healthcare systems, overcoming barriers at multiple levels.

Introduction

Despite marked improvements in HIV testing and scale-up of antiretroviral therapy (ART) globally, many countries have not yet met the UNAIDS public health targets of 95% of people living with HIV (PLHIV) diagnosed, 95% on ART, and 95% virally suppressed. In Nigeria, home to the fourth largest global HIV pandemic, progress remains below UNAIDS targets at 73–89-78 [21]. These outcomes are disproportionately worse among young people living with HIV (YLH) who face challenges engaging and remaining in care and adhering to ART; only 33% of 15–24 year-olds in Nigeria are estimated to have achieved viral suppression in 2018 [27]. Further,

young men who have sex with men (YMSM) have higher rates of seropositivity in HIV testing compared with the general population in Nigeria [14]. With intersecting factors such as legal context (the illegality of homosexuality in the country and lack of legal protection for Lesbian Gay Bisexual Transgender Queer + (LGBTQ +) rights, [5], social context (including structural stigma and violence), inaccurate risk assessment, and healthcare access further impeding access to and success with treatment among this key population (KP), YLH and YMSM urgently need effective interventions to improve HIV testing, linkage to care, and viral suppression [19].

Growing data supports the role for peer-led and mHealth interventions to improve HIV testing and care outcomes for youth including YLH ("Improving Outcomes for Adolescents and Young Adults Living With HIV," 2023). In addition, social media interventions have been shown to reduce missed HIV appointments, improve care engagement, and increase viral suppression for PWH, including for MSM [31]. Social network-based interventions have also been shown to be feasible and effective for increasing HIV testing and education among MSM populations in several African countries, and use of digital and social media messaging has been shown to have high sustainability and reach for multiple health outcomes [12, 13]. Peer-led community interventions, have also been shown to be effective in increasing HIV self-testing among MSM [33].

The Intensive Combination Approach to Rollback the Epidemic in Nigerian Adolescents Study (iCARE Nigeria) consisted of two multifaceted interventions incorporating mobile health technology (mHealth), social media outreach, and comprehensive peer navigation and support (PN) (Fig. 1) [29]. The 12-month single-site pilot studies demonstrated feasibility, acceptability, and effectiveness for both interventions and resulted in insights used to adapt the intervention and strategies explored in this paper. In the testing intervention 339 participants
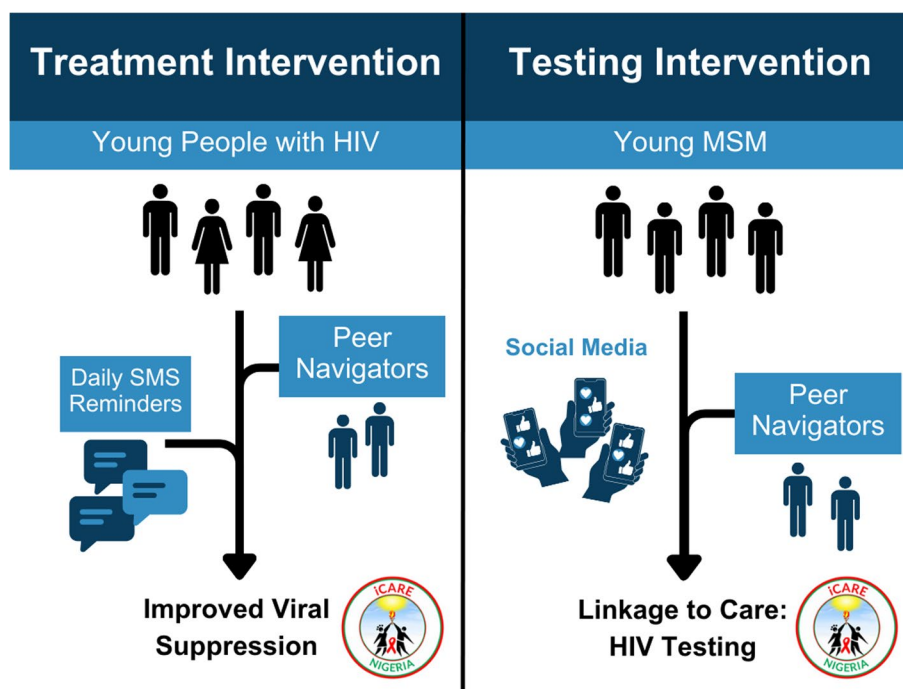
Fig. 1 iCARE Treatment and Testing Intervention design

were tested for HIV, and 36 (10.6%) had confirmed HIV infection, and of those, 31 (86.1%) linked to HIV care [14]. Eighty-three percent of those tested were recruited via social media. Participation in the treatment intervention was associated with a 71% increase in virologic suppression at 48 weeks, 87% of participants were retained in care, and all participants were satisfied with the intervention. Building on this success, the interventions were expanded at the pilot site and scaled up to five additional clinical sites in three states in Nigeria.

The process of scale-up requires understanding the factors associated with success or failure of implementation, including attitudes towards the intervention and the process of implementation itself [7]. Results from these pilot studies have been published, with descriptions of strategies and contextual factors [4, 14, 17, 29]. Implementation research methods can guide this process [15]. As such, implementation research can help to identify the facilitators, barriers, and perspectives to achieving implementation outcomes to inform adaptation of existing strategies or new strategies needed for implementation success [29].

We used explanatory mixed methods to understand perceptions of program implementers early in the scale-up of the two iCARE interventions on readiness and initial planned adoption. We also assessed facilitators and barriers as well as strategies employed by the study team to achieve these and other implementation outcomes.

These results were important to measure early in the course of the intervention to allow the study team the flexibility to adapt intervention strategies as needed to optimize implementation outcomes.

Methods
The Standards for Reporting Implementation Studies (StaRI) was used (additional File 1) for reporting results.

Study setting
The scale-up of the iCARE Nigeria testing and treatment interventions was implemented at the HIV care programs at five academic centers in four states in Nigeria (Lagos University Teaching Hospital, LUTH: Lagos State University Teaching Hospital, LASUTH; Nigerian Institute of Medical Research, NIMR; Jos University Teaching Hospital, JUTH; and Olabisi Onabanjo University Teaching Hospital, OOUTH) and expansion at the pilot site (the Infectious Diseases Institute at the University of Ibadan, IDI). Scale-up sites included central clinics which had experience in HIV care and research and between one and three satellite HIV clinics (treatment arm only) resulting in 17 total treatment sites and 6 testing sites. These sites were chosen based on previously established relationships and proximity with the parent site (IDI), having at least 100 eligible youth in care.

The interventions have been previously described by Taiwo et al. [30] and Garofalo et al. [14]. The iCARE

testing intervention used a combination approach (social media outreach, and peer navigation) to support HIV testing and linkage to care for young men, especially YMSM, an important key population (KP), in Nigeria. Peer navigators (PN) were trained to implement iCARE, including conducting social media messaging and outreach via a range of general and YMSM-focused social media platforms, offering HIV rapid tests to young men connected from these platforms in client-chosen settings (at home, in the community, etc.), and peer navigation to promote linkage to HIV care for individuals who tested positive for HIV (Fig. 1). The social media platforms were those available and in use in the public domains (Grindr, Facebook and WhatsApp). The two-way messaging was delivered using Dimagi software. The iCARE treatment intervention integrated daily, personalized two-way text message reminders along with peer navigation and support to promote ART adherence for YLH receiving care at the clinical sites (Fig. 1). Peer navigators were YLH who were virologically suppressed and clinically stable, with many having previous peer champion or leadership roles in the clinic. PN were assigned to 5 study participants and matched based on gender and age where possible. PNs contacted participants virtually or in person a minimum of every two weeks to provide support and identify potential barriers to adherence, working with study and clinical staff to facilitate any needed referrals [29].

All PNs received a two-week intensive training before the study commenced including HIV epidemiology, treatment, and prevention, privacy and confidentiality, professionalism (including telephone and social media etiquette), mental health, and sexual health. Training included traditional didactic sessions, individual and group activities, and role-play. PNs were also provided the materials and the study protocol as a resource which was affectionately referred to as "the iCARE bible" by the study coordinators [4]. Testing PNs were paid study staff. Treatment PNs were existing clients at their respective clinics and were provided a stipend for study activities.

Data collection procedures
Quantitative
We developed surveys assessing determinants of planned adoption (including perceived complexity, efficacy and relative advantage), feasibility, appropriateness, reach, and organizational readiness as early implementation outcomes. We selected from measures prioritized by the umbrella consortia, PATC^{3}H, funded by NIH to develop and scale interventions focusing on youth living with or at risk for exposure to HIV [10]. Survey responses were on Likert scales from 1–7 (with 1 being "not at all "and 7 being "to a very great extent") or 1–5 (1 "strongly disagree", to 5 "strongly agree"). Surveys were administered to include all PNs and other study staff (program managers, study coordinators) from the testing and treatment interventions. Organizational readiness was only assessed among study staff who were responsible for program introduction and management and who were therefore aware of the organizational context (e.g. intervention supervisors, program managers and coordinators). Surveys were self-administered within three months of the initial iCARE training and start of the interventions.

Qualitative
Interview guides were designed to focus on key potential barriers and facilitators to intervention implementation according to domains described in the Consolidated Framework for Implementation Research 1.0 (CFIR): outer setting, inner setting, intervention, process, and characteristics of individuals [10]. Direct content analysis was used to identify which subdomains emerged as important and were included in results. Interview guides also explored additional implementation outcomes using RE-AIM, including feasibility, adoption and acceptability and effectiveness [18]. Definitions of constructs are provided in Additional file 2. In-depth-interviews were conducted with PNs and focus group discussions were conducted with other study staff from each of the six central sites. All PNs were asked to participate, with purposeful sampling based on willingness to participate and availability. Data collectors were experts in qualitative methods (LRH, AA) who were not involved in study implementation, All qualitative data were collected via Zoom due to COVID-19 restrictions. Interviews were recorded and transcribed.

Data analysis
Quantitative
Quantitative data included demographic and survey information. Questions worded negatively towards iCARE adoption or reach (i.e., that iCARE is too complex for the setting) were reverse coded before analysis. Descriptive statistics were used to report means and standard deviation (SD) for numeric variables and frequencies/percentages for categorical variables.

Qualitative
Interview transcripts were imported into Dedoose for deductive and inductive coding [8]. A priori codes incuded each implementation outcome (Acceptability, Adoption, Feasibility) and Effectiveness, CFIR domain, respondent type (testing or treatment, peer navigator or other study staff), and core iCARE strategy components (peer navigators, community testing, linkage to care, social media/SMS,); new codes were added as additional

themes were identified. Transcripts were coded by at least two study authors (RS, AK or LRH). All coding was reviewed and discussed, with discrepancies discussed and resolved (LRH and AA). Once thematic saturation was reached, the remaining transcripts were coded by one author (RK for treatment and AK for testing) and reviewed by LRH. Directed content analysis was used to group coded excerpts into predetermined categories with additional groups added as needed.

Human subjects

All sites reviewed and approved the iCARE study. In Nigeria these were: University of Ibadan (19/0123), University of Lagos (APP/4087) Olabisi Onabanjo University Teaching Hospital (OOUTH) (4001/2021), Lagos State University Hospital (LaSUTH) (06/10/1493), Jos University Teaching Hospital (127/XXXI/619) and Nigerian Institute of Medical Research (NIMR) (21/007). In the US, Ann & Robert H. Lurie Children's Hospital (IRB 2019–2466) and Northwestern University (STU00207490) approved this study with a waiver of documentation of written consent for data collection. All individuals gave verbal informed consent prior to interviews and reviewed a consent statement prior to survey completion.

Results

Participant demographics

All individuals implementing iCARE were sent and received, surveys. Overall, 117 PN (24 testing, 93 treatment) and 110 other study staff (31 testing, 79 treatment) completed surveys. Mean age among testing and treatment peer navigators was 24.8 and 21.7 years respectively, whereas mean age among other study staff was 41.2 and 41.5 years respectively. Males comprised 70.9% of testing and 34.3% of treatment implementers.

The mean duration of program implementation prior to assessment ranged from 1.1 to 2.6 months. (Additional File 3).

A total of 31 implementers participated in qualitative data collection. We conducted key informant interviews (KIIs) with five PNs, from the one iCARE site, that was continuing in the scale-up phase, while the remainder of PNs newer to the project and other study staff (total $n = 26$) participated through focus group discussions (FGDs); the latter approch reflected limited resources. The mean age among testing and treatment implementers was 24.4 and 23.3 years respectively. All implementers from the testing intervention and 13 (56.6%) in the treatment intervention were male. (Additional file 3).

Survey results

Almost all survey respondent implementers from both the testing and treatment interventions had positive attitudes towards adoption and appropriateness of the iCARE intervention (Table 1). Most respondents agreed or strongly agreed that iCARE's procedures were easy to understand (95.2%, $n = 216$), iCARE was consistent/compatible with youth needs (93.4%, $n = 212$), and more effective than existing interventions (91.2%, $n = 207$). Most respondents also agreed or strongly agreed that youth would benefit from iCARE (97.8%, $n = 222$), and iCARE would be successful in linking youth in care (93.8%, $n = 213$). However, 24.2% of PNs compared to 5.7% of other study staff had some concerns about the complexity of iCARE. Full results are in Additional files 4–7.

Other study staff highly rated the availability of resources, organizational capacity, and readiness (Table 2a). The majority of other study staff agreed or strongly agreed (score 6 or 7) with their sites having key resources, including adequate staff (70.4% testing, 60.5% treatment), leadership support (84% testing, 84% treatment), organizational systems (77.3% testing,

Table 1 Attitudes of peer navigator and other study staff implementers towards adoption and appropriateness of iCARE Nigeria testing and treatment interventions

	Treatment		Testing		All
	Other study staff	PN	Other study staff	PN	
Total survey respondents[a]	100 (79)	100 (93)	100 (31)	100 (24)	100 (227)
Adoption (agree or strongly agree)	**% (N)**	**% (N)**	**% (N)**	**% (N)**	**% (N)**
Not too complex for setting	94.9 (75/79)	76.3 (71/93)	93.5 (12/31)	70.8 (17/24)	77.1 (175/227)
Procedures easy to understand	93.6 (73/78)	96.8 (90/93)	93.5 (29/31)	100 (23/23)	95.2 (216)
Compatible/consistent with youth needs	96.2 (73/78)	95.7 (89/93)	93.5 (29/31)	91.3 (21/23)	93.4 (212)
More effective than existing interventions	96 (76/79)	93.5 (87/93)	77.4 (24/31)	83.3 (20/24)	91.2 (207)
Youth would benefit	97.4 (76/78)	100 (93/93)	96.8 (30/31)	95.8 (23/24)	97.8 (222)

[a] missing responses are excluded

Table 2 Attitudes of other study staff (2a) towards resources, organizational capacity and readiness and of peer navigators (2b) towards individual preparedness for implementation of testing and treatment arms of iCARE Nigeria early in scale-up. Total respondents for each question are noted as missing responses were excluded

Table 2a	Other study staff Treatment (N=79)[a] % (N)	Other study staff Testing (N=31)[a] % (N)
Response ranges for agree: 1 not at all-7 very great extent[a]		
We have adequate staff (n=71 treatment, 27 testing)		
1–5	39.4 (28)	25.8 (8)
6–7:	60.5 (43)	70.4 (19)
Champions exist (n=75 treatment, 28 testing)		
1–5	25.3 (19)	16.7 (5)
6–7	74.6 (56)	83.4 (23)
Champions exist and have the ability to garner resources (n=74 treatment, 29 testing)		
1–5	28.4 (21)	29 (9)
6–7	71.6 (53)	68.5 (20)
Leadership support within organization (n=74 treatment, 31 testing)		
1–5	17.6 (13)	16.1 (5)
6–7	82.5 (61)	83.8 (26)
Organizational systems in place to support iCARE (n=66 treatment, 30 testing)		
1–5	19.7 (15)	33.3 (10)
6–7	67.1 (51)	66.7 (20)
Can be integrated into clinic (n=77 treatment, 29 testing)		
1–5	23.4 (18)	37.9 (11)
6–7	76.7 (59)	62.0 (18)
Communicates with community leaders (n=31 testingl)		
1–5	Not asked	29 (9)
6–7	Not asked	70.9 (22)
Organization commitment (n=30 testing)		
1–5	Not asked	33.3 (10)
6–7	Not asked	66.7 (20)
Community member commitment (n=28 testing)		
1–5	Not asked	46.4 (13)
6–7	Not asked	53.5 (15)
Table 2b		
To what extent do you agree:	**PN Treatment (total N=93) % (N)**	**PN Testing (total N=24) % (N)**
How prepared are you to give intervention (range 1-10 (very prepared)) (n=75 treatment, 22 testing)		
1-8	18.6 (14)	4.5 (1)
9-10: very prepared	81.3 (61)	95.5 (21)
How confident are you to deliver iCARE (range 1-10 (very confident)) (n=93 treatment, 24 testing)		
1-8	31.2.7 (29)	12.9 (4)
9-10 Very confident	68.8 (64)	83.3 (20)

[a] Missing responses are excluded and total respondents are noted

PN: peer navigator

66.7% treatment), organizational and community member commitment 66.7% and 53.4% testing, respectively), and champions (70.0% testing, 71.6% treatment), including the ability to get needed resources (70.0% testing, 71.6% treatment). Most (87.5%) of testing peer navigators and 67.8% of treatment peer navigators felt they were very prepared to deliver iCARE, with similar rates for confidence (83.3% for testing and 68.8% for treatment) (Table 2b).

Table 3 Summary of selected iCARE intervention facilitators and barriers for implementation according to consolidated framework for implementation research domain for both testing and treatment unless noted

CFIR Domain	Facilitators	Barriers
Inner Setting	• Supportive **institutional culture** at for piloting/adopting new practices & interventions	**Lack of resources** to meet all client's needs (testing) Some **clinics were not KP friendly**
Intervention Characteristics	• **Peer navigation** is key strategy believed to be effective, and acceptable to participants • **Social media** provides anonymity on platforms participants are comfortable interacting	**Need for response** to medication reminders resulted in some fatigue from peers
Process	• **Provision of phones and data bundles** for peer navigators allowed them to be effective in their roles prompting feasibility & adoption • **Stakeholder engagement** especially with community-based and key population-friendly organizations promoted readiness & adoption (testing) • **Training and peer-to-peer exchange** helped study staff to feel prepared for and effective in their roles • **Leveraging pilot site experience for training**	• **Areas with limited phone coverage or physically distant** • **Financial resources for PNs**
Characteristics of Individuals	• **Peer navigators experienced with HIV testing** and social media platforms (testing) • **Peer navigators with shared lived experience** (HIV, MSM) • **Other study staff very supportive of PN work** • **Ability to work as a team**	
Outer Setting	• **Widespread** community **cellphone and internet coverage** • **Availability of social media platforms** • Positive relationships with **health facilities friendly to MSM (testing)** • **Availability of clinics which were "key population friendly"**[a]	• **Community attitudes and misinformation about HIV**, required additional education before engaging in testing intervention • **Illegality of homosexuality and lack of legal protections for LGBTQ + rights** created legal limitations for TMSM and YMSM friendly clinics in the testing intervention • **Limited availability of clinics which were "key population friendly"** • **Variable participant access to sufficient data or IT infrastructure** for engagement via mobile phone or internet • **Structural stigma/violence towards HIV and MSM** • **Cellphones changed or lost by peers** hindered communication

[a] Availability of key-population friendly clinics varied based on the location so this was both a barrier and facilitator

Qualitative results

The qualitative data also revealed important facilitators as well as some barriers early in the scale-up most of which were shared by the two interventions (Table 3). In explanatory mixed methods, these supported and helped explain the overall positive reports of adoption, feasibility, and appropriateness of the intervention, and allowed exploration of potential reach and acceptability.

Facilitators to implementation of iCARE in scale-up sites
Inner setting

Institutional culture, including readiness to and experience in adopting other innovations, was identified by respondents in both testing and treatment interventions as a facilitator of iCARE's adoption. One study staff member in the testing intervention stated that "*It is quite easy, I think, to bring projects into the institution, because the institution itself provides a good platform for*

collaboration and constitution of projects." (Other study staff, testing).

Another respondent shared, "*Counsellors, everybody are actually interested. They're actually interested. Actually I think they're more interested than being resistant to the project. Because I get to, to you know talk about iCARE to almost everybody in the clinic and the nurses… …I think all the clinicians are actually part of the project (Other study staff, treatment).*"

Intervention characteristics

The use of peer navigation as a core strategy for both testing and treatment interventions was identified as critical for perceived success and acceptability. Examples included PNs being important to ensure access to care and reduce stigma in testing for "*smooth enrollment into care for the [HIV] positive [clients] and…smooth access to their drugs and follow up care.*" (PN testing).

In the treatment intervention, study staff also noted how the PNs were core to acceptability and effectiveness., *"...for the peer navigators, I think they've (peers) really enjoyed (peer navigators)... most of them feel like they're in this world of their own. And no one really understands what they're going through but having someone who has similar experiences as theirs, has [made] some of them open up a bit more." (Other study staff, treatment).*

Testing PNs noted that their role in assisting with linkage to care after testing, and education (in contrast with other interventions among the MSM key population), was important to acceptability.

The adaptability of being able to use multiple social media platforms for the testing intervention (both MSM specific and general) was also an important strategy to increase the potential for adoption and effectiveness in engagement. One treatment PN agreed describing the uses of each platform.

> *"The one most effective is Grindr because it filters [people's age] and ...location so that's the most effective and that is what people usually use most" (PN testing)*

In addition to using social media for better reach of the YMSM in the testing intervention, the anonymous aspect of social media use in iCARE was also highlighted as an appropriate and acceptable strategy because it provided a safe, more engaging option for outreach: *"the Internet creates a particular platform where they can talk to you anonymously. And they expect to get a bit of reply, and they also want [a reply] actually (PN testing)".*

In the treatment intervention, the confidential, coded nature of text reminders was noted as an important facilitator, with one PN explaining that clients liked the text format of reminders because of *"the fact that the text message is being personalized to them..... Nobody sees the message, just them only." (PN treatment).*

Process
A number of process strategies were identified as key facilitators to promote feasibility and adoption, including provision of phones and data bundles for PNs, successful engagement of key stakeholders, effective training via formalized training sessions and a manual, learning between peers and sites and supportive supervision. The importance of the provision of phone and data was noted by one PN (testing) *"[the] iCARE program came into town, we are given the phone for the program from the training and data is always available so for me, to navigate my peers on social media is as easy as drinking water." (PN testing).*

Stakeholder engagement was also critical to the sense of readiness, feasibility and adoption, particularly for the testing intervention. Partnerships between community based-organizations (CBOs) and healthcare facilities aided PN recruitment and in the testing intervention also provided sites with an option for YMSM key population friendly care coordination, although this was rated high for only one-half of staff respondents. One staff member, while reflecting on the challenges of connecting iCARE clients from the testing interventions to KP-friendly HIV services, discussed the importance of the many stakeholders engaged in identifying KP friendly facilities.

> *"with the help of the CBOs we met with some gatekeepers, stakeholders, MSM influencers that are older MSM, ... for us to meet with them for referrals, for support and we asked them their challenges and if they are KP friendly." (Other study staff, testing)*

Staff from both interventions commented on both the effectiveness of the training and clarity of the manual in helping the study team to address challenges during navigation.

> *"the training had been helpful because it enlighten[s] us more about how to navigate and how to use the social media better than we were using it before." (PN testing)*

Another team member highlighted the utility of the manual provided to the study team saying,

> *"I also think the manual and protocol for the iCARE project also helped a lot because as go through the process and we miss out anything ....we go back to and just look at it [the manual], if we have actually made the right decision, so that of the manual and protocol actually taught us." (Other study staff, treatment)*

The role of the pilot site in the initial training and the model of scale-up of a central site with satellites was also a facilitating strategy for both interventions to support peer-to-peer learning.

> *"one of those things we used to discuss are some of the challenges they face with their peers because we have like four satellites, so when they have come like that for meeting, then we look at the challenges they face at their different satellites sites, and we are able to come up with solutions to those challenges. (Other study staff, testing)"*

Even early in implementation, PNs identified the importance of supportive strategies to ensure safety and prevent emotional burnout, both important for

maintenance. When asked about self-care strategies, one PN (testing) stated,

> *"There are heart breaks you can get because of what some of the peers will be telling you but I think apart from that...I try as much as possible to be confidential not exposing myself to everybody only, like to keep my job a secret and my fellow YMSM, so I think that is what I do to take care of myself." (PN testing)*

Another PN (testing) stated, (during COVID-19) *"I am taking care of myself, I have my hand sanitizer with me, my gloves...my mask, so am taking care of myself. I make sure I eat healthy…".*

Characteristics of Individuals (PNs)

In both interventions, the survey data revealed high levels of organizational readiness and preparedness. Qualitative data suggested that these relationships were explained by past experience of the PN with peer support (treatment) and HIV testing and social media (testing) and lived experience as members of the MSM community (testing) or a person living with HIV (treatment).

> *"Come to think of it, if they (PNs) are not members of the community themselves, it will be very very difficult for us to navigate". The importance of recruiting testing PNs with hands-on experience working with YMSM was echoed by another staff member who stated, "it has also promoted the acceptance within the population also trust so, that's one of the other things that also helped the linkage to care as well as the testing activities within the YMSM population." (Other study staff, testing)*

In the treatment arm, the importance of lived experience was also identified as important for acceptability, with some PNs using their personal experiences as a source of motivation. One PN shared, *"I made myself as a perfect example for her too because I myself have been on the regimen since my childhood, so I made her see reasons why she just have to be strong for herself and all the people around her that loves her" (PN treatment).*

Outer setting

Several key facilitators were identified in the community. One important facilitator was widespread community cellphone and internet coverage. This coverage facilitated the reach of iCARE through ease of access, which supported feasibility, and acceptability (by ensuring anonymity) more than other testing linkage initiatives that relied on in-person communication and outreach. One PN (testing) remarked that now that *"we have everybody with their phones, everybody on the internet...you don't*

have to see the person facially and get to talk to the person anonymously".

Testing PNs additionally cited positive relationships with KP-friendly partnered clinics that provided clients with confirmatory HIV testing (after an initial positive screening test) and care as an important facilitator for acceptability and effectiveness to their navigation efforts, *"Yes, it was good for those who are KP friendly clinics. So they are really welcoming people, they are ready to accept us at any time (PN testing)."*

Barriers to scale-up of iCARE

A number of barriers were also identified for both interventions. These were mostly in the outer setting and characteristics of individuals (peers) domains. Testing staff members noted how the physical distance of local communities presented a significant barrier for navigation activities, stating, *"we need to work in those scattered communities, in order to get more KP members who are interested in our projects to be navigated." (other study staff, testing)* Other community challenges included attitudes and misinformation about HIV amongst the YMSM community often presented a barrier to testing navigation.

> *"A lot of people are misinformed and they don't know the truth about HIV in particular......when we try to talk them like ok try and test yourself, get to know if you are reactive or not...they don't know … we have to educate a lot of people before their orientation about this thing [will have] changed." (PN testing)*

While also a facilitator when available, the lack of KP-friendly healthcare facilities in some settings was a significant barrier to care navigation essential to the intervention. In the treatment intervention, barriers to feasibility included insufficient data or IT infrastructure for YLH to receive SMS/text reminders of two-way medication reminders and mobile-phone based peer support. One (treatment) PN explained how *"Some have challenges with...their phones. Some don't have good phones ….some...are network issues, some have...power problems (PN treatment)."*

Both PN and non-PN study staff in the testing arm identified limited financial resources as having the potential to limit acceptability and feasibility. PNs were concerned that iCARE navigation efforts would be a challenge due to peers' inability to afford transportation costs. Other study staff also identified financial challenges that ultimately prevented optimal testing and treatment.

> *"I think majorly some of them have issues with finances sometimes, making it not easy coming to*

clinic. I was interacting with a participant the other time, he told me that any time he tells his father that he is coming to clinic, then fight will start. The fight is going to start may be because the father do not have money for transportation and where the guy lives is very far." (Other study staff, treatment)

PNs in the testing arm also noted a challenge in meeting client prevention needs, which limited effectiveness.

"We've always been having one major problem when you want to get people to tests, they would ask you if you have lubricants, if you don't have condoms, and we use it as regards to, like something to bring people for testing. And now with the scarcity period of lubricants and condoms. Even for now, we have lost some of our clients because we could not provide lubricants and condoms for them.." (PN testing)

For both testing and treatment interventions, the legal environment, societal culture, HIV stigma and threats to physical safety for YMSM were barriers which made the iCARE testing approach very appropriate, consistent with the survey findings. One study staff described,

"Adolescents are people that they have a lot inside but to express it and to tell people what they're going through is really difficult…But iCARE is a platform that they can easily express themselves confidently without trying to, without the fear of being stigmatized". (Other staff, treatment)

Describing the legal environment, another staff member shared,

"We see them online and to test the offline, you know, in this part of the world where this particular set of people… Nigeria policy socially, it is not allowed. So things like that, it is being done discretely, the way we do. That's why we see that when we navigate online, it is on WhatsApp, they are mostly active". (Other study staff, testing)

Discussion

Our explanatory mixed-methods analysis helped to identify and contextualize the attitudes of program implementers early in the scale-up of a multifaceted mobile health intervention, describing initial barriers and facilitators and where additional support and exploration of sustainability strategies may be needed. This intervention combined mobile health technology and peer navigation to improve testing and linkage for young men, especially YMSM as well as medication adherence and viral suppression for YLH. Done at the start of scale-up , results were fed back to the study team shortly after analysis and were used where relevant to strengthen or continue

implementation strategies. We also found high levels of readiness and planned adoption for both the testing and treatment iCARE interventions among study staff (both PNs and other study staff). Study staff felt the interventions were appropriate for the population and provided relative advantage over and above alternatives available to YLH and young men at risk of HIV exposure.

A number of facilitators helped to explain these results spanning CFIR domains, including supportive institutional culture in the inner setting, characteristics of the intervention itself (peer navigation/support and social media use), implementation strategies utilized for study staff training and stakeholder engagement, characteristics of PNs and study team members, strong IT infrastructure and mobile phone penetration, and robust community partnerships with KP-friendly organizations. Friendly clinical services and relationships have similarly been identified as a facilitator for HIV care retention among YMSM [23]. While few barriers to adoption were identified, most were structural factors in the outer setting. Our findings were largely consistent with existing facilitators (individualized support, social media-based outreach to combat stigma) and barriers (structural stigma and violence towards MSM, challenging institutional culture) found in the literature that are described in further detail below, and expands limited findings on peer support and the use of social media for HIV testing in this setting.

Consistent with our findings, peer navigation and social media have been identified as implementation strategies and innovations that promote implementation success. Nonetheless, while there is great enthusiasm for peer support interventions for PWH and indeed YLH, systematic review of effectiveness show mixed outcomes [3, 20]. Some studies, as well as from the iCARE pilot suggest that individualized peer support in particular may be effective in improving care outcomes for YLH [25]. iCARE study staff felt that the intervention components (including peer support) reflected a relative advantage over the standard of care, which in most clinics included teen clubs for adolescents with group-based peer support prior to the intervention. Peer support and education has been shown to be favorable to YLH study participants [11]. Consistent with the relative advantage, other studies have suggested group-based peer support may be less effective than individualized support for improving care outcomes [3]. The strategy of choosing PNs with life experience in both arms was also an important factor associated with positive anticipated outcomes. Lived experience of PNs was recognized in both interventions as a significant factor influencing acceptability, with staff and PNs both describing past experiences in the MSM community and/or lived experience as a person living

with HIV, as a strength of the recruitment strategy and source of motivation for PNs [4, 14, 17, 30]. This finding holds important implications for the selection criteria for studies replicating iCARE.

Our study participants described how social media-based outreach provided a number of advantages to promote HIV testing among YMSM in particular, including flexibility, adaptability, and anonymity. These facilitators helped to navigate (though not dismantle) some of the structural barriers identified in the outer setting, including structural stigma and structural violence towards PWH and MSM [28]. Nigeria is a setting, like other African countries, that has outlawed same-sex-relationships – a harmful practice associated with delays and outright fear of seeking healthcare [26, 28].Therefore, strategies that recognize the potential danger posed by needed outreach have the ability to be transformative in reaching communities at high risk for HIV. Social media-based approaches for HIV testing outreach fall squarely in this space but have not been widely tested among African youth [6].

A positive institutional culture towards integrating youth interventions into the clinical setting was also a noted facilitator in the inner setting in most sites. The majority of study staff described having champions, supportive leaders, and organizational systems in place to support the iCARE intervention. For interventions focusing on MSM, other studies have identified negative institutional culture to be associated with mistrust among MSM which serves as a barrier to intervention delivery and scale-up (Hoyt et al., 2012). In the pilot phase of iCARE as in other literature, changes in institutional culture to be more welcoming to YMSM was identified as an important cultural shift that improved engagement in HIV care among YMSM (personal communications, AA) [32]. A corollary in the outer setting, community stakeholder engagement before and during the study and, when available, "key population-friendly" clinics were noted as important facilitators. In contrast, lack of availability of KP-friendly clinics was an important structural barrier to planned adoption of linkage into care from iCARE in the testing intervention. Reflecting the impact of harmful stigma and discrimination that are often exacerbated by oppressive policy and legislation towards youth and individuals from KPs, the World Health Organization (WHO) recommends a comprehensive and responsive approach to HIV programming for these populations [9].

Despite the many facilitators identified, a few important barriers were also described, and most were in the outer setting. In addition to the structural stigma and violence described above, other barriers included variable participant access to mobile phones, insufficient data or IT infrastructure for engagement via mobile phone or internet, and the illegality and lack of legal protections for MSM in the country. Stigma associated with homosexuality and discussing sexual health related topics requires the leveraging of facilitators such as context- and population-specific delivery modalities such as mobile phones for enhancing engagement of YLH in interventions [16, 22]. These barriers are even more salient on the backdrop of an environment with high mobile phone penetration and internet coverage [1, 2, 24], though this infrastructure is not widely nor consistently available to YLH, especially those of lower socioeconomic status. Intervention complexity was noted as a potential concern for the testing intervention; however, this potential barrier was mitigated by the comprehensive training strategies employed by the study and shared lessons from both the pilot site to scale up sites and ongoing between-site learning. PN experience in providing support (treatment) and in testing and self MSM-identity (testing) were noted as providing knowledge and confidence in supporting success in delivering iCARE. In addition, while, the provision of phones and data bundles was a facilitator, it was also a potential barrier to sustainability; findings important for advocacy for sustainability of the interventions.

To address these and other barriers identified, results from these surveys and qualitative work were shared with the implementing and leadership team. Modifications included more frequent data stipends for treatment PNS; and increased payment for testing PNs. In addition commitmenst for provision of condoms and lubricants and a focus on increasing the KP-friendly environment in the study clinics were continued.

Our study had several limitations. One, as designed, the findings reported here were from early in the study; thus, we report potential or emerging rather than longer term implementation outcomes. Another aspect regarding sustainability is that, while program manager and coordinators for both arms as well as testing arm PNs were hired as study staff, treatment arm PNs were provided stipends but not hired as staff; there is active work to identify policy and funding opportunities during the ongoing trial to support itegration of these positions into routine servcies. The timing of this study, which was designed to understand early facilitators and barriers to scale-up, also meant that we were not able speak with clients about their experiences. Though interviewers were not part of the implementing team and were not known to participants, there is potential for social desirability bias affecting themes identified from KII and FGDs. Finally, as we did not collect details on those who did not complete the survey since de-identified, there may be bias introduced in our findings based on who responded.

Conclusion

Overall, we found that the design of both interventions and their implementation strategies have resulted in readiness and early uptake implementation at the scale-up sites in different institutions and states. These results reflect the value of understanding the steps from pilot to scale, and strategies needed to support the new sites to meet the important needs for youth at risk of HIV exposure, particularly YMSM, and those living with HIV. Ongoing measurement of implementation outcomes and factors is planned to further understand and disseminate strategies that will expand the reach and impact of iCARE and similar interventions necessary to end the HIV epidemic in Nigeria and the region.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s43058-024-00671-z.

Supplementary Material 1.

Supplementary Material 2.

Supplementary Material 3.

Supplementary Material 4.

Supplementary Material 5.

Supplementary Material 6.

Supplementary Material 7.

Authors' contributions
AK: worked on the analysis and interpretation of the data and drafted and revised the manuscript. RS: worked on the analysis and interpretation of the data and drafted and revised the manuscript. OA: was involved in the conception and design of iCARE, i interpretation of data results and review and revision of the manuscript. AA: was involved in the conception and design of iCARE, interpretation of data results and review and revision of the manuscript. BT: worked on the analysis and interpretation of the data. OO: was involved in the conception and design of iCARE, review and revision of the manuscript. KK: was involved in the conception and design of iCARE, interpretation of data results and review of the manuscript. AD: was involved in the review and revision of the manuscript. SA: was involved in the conception and design of iCARE, interpretation of data results and review and revision of the manuscript. FA: was involved in the conception and design of iCARE, interpretation of data results and review and revision of the manuscript. AA: was involved in the design of iCARE, interpretation of data results and review and revision of the manuscript. BO: was involved in the design of iCARE, interpretation of data results and review and revision of the manuscript. BT: was involved in the conception and design of iCARE, interpretation of data results and review and revision of the manuscript. LK: was involved in the conception and design of iCARE, interpretation of data results and review and revision of the manuscript. OO: was involved in review and revision of the manuscript. BB: was involved in the design of iCARE, and review of the manuscript. AKJ: was involved in the conception and design of iCARE, interpretation of data results and review and revision of the manuscript. TB: was involved in the data acquisition and review and revision of the manuscript. PJ was involved in the interpretation of data results and review of the manuscript. OMA: was involved in the design of iCARE, review and revision of the manuscript. MC was involved in the review and revision of the manuscript. OA: was involved in the design of iCARE,

interpretation of data results and review and revision of the manuscript. RG: was involved in the conception and design of the study, interpretation of data results and review and revision of the manuscript. AAA: was involved in the conception and design of the study, data acquisition and analysis interpretation of data results and drafting, review and revision of the manuscript. LRH: was involved in the conception and design of the study, data acquisition and analysis interpretation of data results and drafting, review and revision of the manuscript. All authors reviewed and approved the final manuscript.

Data availability
The datasets generated during and/or analyzed during the current study are not publicly available as the qualitative data collection did not include approval for broader dissemination. Quantitative data are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
All sites reviewed and approved the iCARE study. In Nigeria these were: University of Ibadan (19/0123), University of Lagos (APP/4087) Olabisi Onabanjo University Teaching Hospital (OOUTH) (4001/2021), Lagos State University Hospital (LaSUTH) (06/10/1493), Jos University Teaching Hospital (127/XXXI/619) and Nigerian Institute of Medical Research (NIMR) (21/007). In the US, Ann & Robert H. Lurie Children's Hospital (IRB 2019–2466) and Northwestern University (STU00207490) approved this study with a waiver of documentation of written consent for data collection. All individuals gave verbal informed consent prior to interviews and reviewed of a consent statement prior to survey completion.

Consent for publication
Not applicable.

Competing interests
Authors declare no competing interest.

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