# Positive Links for Youth: Incorporating youth voice to adapt a mobile health intervention for youth with HIV in the US South

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## Abstract

**Background:** Youth and emerging adults with HIV (YWH) are less likely to engage in care and achieve viral suppression, compared with other age groups. YWH also have a high degree of self-efficacy and willingness to adopt novel care modalities, including mobile health (mHealth) interventions. Interventions to increase care engagement could aid YWH in overcoming structural and social barriers and leveraging youth assets to improve their health outcomes.

**Objective:** We used an assets-based framework, Positive Youth Development, and human-centered design principles to adapt an existing mHealth intervention, PositiveLinks (PL) to support care engagement for 18-29-year-olds with HIV.

**Methods:** We conducted a formative evaluation including semi-structured interviews with 14 YWH and focus groups with 26 stakeholders (providers, nurses, case managers, clinic staff). Interviews covered barriers to care, provider communication, and concerns or suggestions about mHealth interventions. The research team compiled responses into families and used thematic analysis. In the second phase, design thinking processes informed adaptation of the existing PositiveLinks platform using data from three YWH's real time use suggestions. Throughout the formative evaluation and adaptation, a Youth Advisory Board (YAB) provided input.

**Results:** YWH and stakeholders identified common elements of an mHealth intervention that would support care engagement including: the convenience of addressing needs through the App, virtual support groups to support interconnection, short videos or live chats with other YWH or providers, appointment and medication reminders, and medical information from a trustworthy source. Stakeholders also mentioned the need for youth empowerment. Concerns included worries about confidentiality, unintentional disclosures of status, urgent content in an unmoderated forum, and the impersonality of virtual platforms. Design suggestions from YWH included suggestions on appearance, new formatting for usability of the virtual support group, and prioritization of local content.

Based on the feedback received, iterative changes were made to transform PL into Positive Links for Youth (PL4Y). Final votes

on adaptations were made by the YAB. The overall appearance of the platform was changed, including logo, color, and font. The virtual support group was divided into three channels which support hashtags and content searches. The 'Resources' and 'Frequently Asked Questions' sections were condensed and revised to prioritize South Texas-specific content.

**Conclusions:** Our assets-based framework supported YWH and stakeholder input in the transformation an mHealth intervention to meet the needs of 18-29 yos in South Texas. The human-centered design approach allowed YWH to suggest specific changes to the intervention's design to support usability and acceptability. This adapted version, Positive Links for Youth (PL4Y), is now ready for pilot testing in the final phase of this implementation science project. Clinical Trial: n/a

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# **Original Manuscript**

# Original Paper

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## Introduction

## Background

Youth living with human immunodeficiency virus (YWH) face elevated morbidity and mortality compared with other age groups [1]. Challenges for YWH in achieving viral suppression are partially attributable to fewer care engagement opportunities, and greater likelihood of missing appointments and medication nonadherence [2–4]. Interventions to increase care engagement could aid YWH in overcoming structural and social barriers to improve their health outcomes. YWH often seek mobile health technologies to support care engagement, but few were developed or adapted with their input or needs in mind.

Most YWH have a high degree of self-efficacy and willingness to adopt novel care modalities, particularly technological innovations [5]. In 2018, a national survey revealed 45% of adolescents report being online almost constantly, and 95% of teens own a smartphone [6]. Mobile health interventions (mHealth) are well suited to these digital natives. Data show that mobile phone applications serve as an acceptable and often preferred way for adolescents to receive sexual health information and to successfully engage those susceptible to HIV [7–10]. Considering the developmentally-appropriate desire for self-determination found among YWH, they may appreciate mHealth interventions offering an expanded range of services, particularly functions that support self-management of HIV and digital connections [11,12]. However, the majority of current mHealth interventions offer a limited number of functions, such as medication or appointment reminders [7,8,10,13].

## mHealth Interventions and care engagement for YWH

A few mHealth interventions focusing on YWH have shown promising results [9,10,13,14]. One mobile intervention that included peer navigation and a webcomic series increased entry to care, decreased rates of loss to follow up, and supported sustained viral load suppression for YWH [9]. A

review of various mHealth intervention modalities for 18-34 year-olds living with HIV found advantages of these interventions included: improved accessibility to information, enhanced self-efficacy, and reduced negative feelings about HIV diagnoses [13]. MHealth intervention implementation faces the challenge of needing continuous updates based on input from stakeholders and App users [10].

Few studies in the existing literature describe how mHealth interventions can be tailored to needs of YWH or adaptation processes that ensure YWH play an active role in intervention design. The Positive Youth Development (PYD) framework suggests that youth involvement and empowerment can lead to better health and less risk taking for youth [15–17]. Aligned with PYD, peer empowerment, knowledge seeking, and taking responsibility for health outcomes leads to improved engagement in health promoting processes and resilience for gay and bisexual youth with HIV [18]. These data suggest that the PYD framework may be used to incorporate youth input into intervention design and, ideally, lead to more impactful interventions.

YWH in South Texas experience significant barriers to care engagement for HIV, making the region an important location to study innovative interventions [19]. South Texas is disproportionately affected by the HIV epidemic, and molecular cluster analysis signals particular risk for people under age 30 [20]. Young black and Hispanic men who have sex with men both experience structural racism, which may alienate them from healthcare services [4,21]. Despite these risk factors, South Texas also has a strong history of collaborative work between community clinics, the county health system, and the local health authority to end the HIV epidemic [1]. These factors make the region an ideal site to create and implement a new mHealth intervention targeted specifically towards YWH.

## Investigation goals and significance

The aim of this investigation is to collaborate with YWH and create space for their voices and input to adapt an existing mHealth intervention, PositiveLinks (PL) to improve care engagement in 18-29-year-olds living with HIV in South Texas [22]. PL is a clinic-based multimodal HIV care intervention

that increases care engagement and viral suppression [22]. The platform includes daily medication adherence, mood, and stress self-assessment, appointment reminders, secure messaging with clinic providers, and an online anonymous peer support network [22]. We used qualitative research and human centered design thinking processes in this adaptation to ensure YWH input, as interventions are more effective when impacted communities are involved in their design and implementation [5]. We conducted a formative evaluation using data from semi-structured interviews with YWH to understand acceptable and desired intervention characteristics [19]. Subsequently, we used design thinking processes to aid in our adaptation of PL [15]. A youth advisory board (YAB) of YWH provided input throughout the formative evaluation and adaptation phases. This manuscript describes findings from each phase to enhance understanding of components of mHealth interventions that are accepted and sought after by YWH.

## Methods

Adaptation of the existing mHealth intervention, Positive Links for Youth (PL4Y), was informed by three data sources: 1) components of the formative evaluation that addressed acceptable mHealth interventions, 2) a human-centered design thinking process, and 3) YAB input (Figure 1). The project follows implementation science best practices and uses a Positive Youth Development (PYD) framework to inform study activities. All three components were overseen by the design working group, which included the PI, study coordinator, research assistants, and the scientists, clinic staff, and software designers on the original PL team.

## Youth Advisory Board role and input

PL4Y began with the creation of a YAB of 18-29 year olds living with HIV in South Texas [16,19]. As described previously, YAB structure and format evolved in response to the COVID pandemic and feedback from YAB members. YAB engagements occurred quarterly, with input collected via surveys through the Qualtrics platform to preserve YAB member anonymity. YAB members provided specific input on potential adaptations including: logo, graphics, community message board content,

and resources.

## Formative evaluation of acceptable mHealth intervention components

The formative evaluation of care engagement for YWH in South Texas occurred from October 2020 through December 2021. Fourteen YWH were recruited from 6 HIV treatment centers in South Texas using flyers and direct outreach to clinic staff and providers. Eligibility criteria included being 18-29 years of age, residing in South Texas, fluent in either English or Spanish, and reported current or past challenges with care engagement. Stakeholders from 6 regional HIV treatment centers were also recruited. Stakeholders included twenty-six office, nursing, and provider staff of the regional HIV treatment centers who provided input either through six focus groups or three individual interviews. Interview and focus group guide development was based on the Theory of Planned Behavior (TPB) theoretical model, a framework of PYD, and additional themes supplied by the YAB. YWH were asked about first-hand experiences that affect their care engagement as young people residing in South Texas. Stakeholders were asked to describe their experiences and beliefs serving YWH and to provide system-level insights regarding strategies for care engagement. A transcription service was used to transcribe individual interviews and focus groups. Transcripts were reviewed and edited by the interviewer (CJ) for accuracy. Transcripts were uploaded into NVivo 1.6.2, which allows for tracking of responses by stakeholder or YWH characteristics and by clinic site.

The qualitative analysis team (QAT) created a master codebook of themes from TPB and PYD theoretical frameworks for thematic analysis [15–17]. The QAT included 4 research assistants with training in qualitative analysis (CJ, AC, HL, NMH), 5 faculty level researchers with content expertise in HIV care engagement (AT, AN, KI, RD, BT), and one youth development expert (SK). A member of the primary coding team independently coded the transcript inductively (CJ, AC, HL), with review by the QAT lead (BT). Secondary coders (CJ, AC, HL, NMH) expanded on coding as needed. At this stage, the QAT also examined themes by participant type and noted differences between YWH and stakeholder perspectives. The QAT resolved differences in coding by consensus and confirmed

revisions to codebooks. The full QAT participated in the final round of coding, where all themes

were reviewed, representative quotes discussed, and themes were renamed, merged, or discarded. For

this analysis, we reviewed themes on advantages and disadvantages of mHealth interventions in

general and themes regarding specific mHealth intervention components desired by YWH or

stakeholders.

## Human-centered Design Adaptation of Positive Links by YWH

Three "Think-Aloud" interviews were conducted with YWH using human centered design principles

to ensure end-user input informs an iterative adaptation process [17,18]. Recruitment of three

participants occurred from existing YAB members (n=2) and the same recruitment strategies from

the formative evaluation (n=1). The same eligibility criteria were used for the YWH in the formative

evaluation. Two Think Aloud sessions were in-person at a local clinic, and one was virtual via Zoom.

Three researchers were present for interviews (CJ, AC, NMH) and a modified system usability scale

guided conversation [23]. Think-Aloud interviewees reviewed each aspect and function of the App

by walking through it on their phone and using it in real time. They provided suggestions on possible

design changes and usability. Adaptation recommendations were categorized by ease of

implementation and frequency. The common suggestions that were feasible within the scope of the

project were conveyed to the UVA App development team for final design and development.

## Ethical Considerations

All YWH and stakeholders in the formative evaluation and human centered design components

reviewed an IRB-approved information sheet about the study and provided verbal consent to

participate. YWH participants in the focus groups and Think-Aloud sessions received a $25

electronic gift card for participation. Stakeholders did not receive monetary incentives for

participation. YAB members also received a $25 electronic gift card upon completion of each survey.

This protocol was approved by the UT Health San Antonio and University Health Institutional

Review Boards.

## Results

## Acceptability and concerns regarding mHealth interventions from the formative evaluation

Data from the qualitative interviews with YWH and stakeholders revealed common themes about benefits and challenges of an mHealth care engagement intervention. Overall, YHW and stakeholders felt ease of access to resources, labs, and clinic personnel would be a benefit, and that the anonymous virtual support group could help YWH feel less isolated. They did have concerns about confidentiality on an mHealth platform and potential pitfalls of the virtual support group, including need for moderation and issues with virtual connections (Table 1).

**Table 1.** Summary of perceived benefits, challenges, and critiques of an mHealth care engagement intervention expressed by 18–29-year-olds living with HIV and stakeholders.

| *Benefits* | *Challenges* |
|---|---|
| • Increased accessibility of care team | • Potential confidentiality concerns |
| • Increased access to accurate information about health issues and available resources | • Lack of streamlined features |
| • App-based medication/appointment reminders | • Difficulty connecting to other members in the virtual setting |
| • Ability to track treatment progress through improvements in lab parameters | • Need for moderation of virtual support group with potential for cyberbullying |
| • Improved access to a safe community through a virtual support group | • Live chat could trigger negative/ apprehensive feelings |
| • Anonymity provided by virtual support group platform | |

### *Perspectives on benefits of the mHealth intervention*

<u>Accessibility to care and knowledge</u>: Youth and stakeholders believed the App would be highly effective in connecting patients with providers and case managers. Youth noted having an App on their smartphone could increase accessibility to their care team, making them more likely to participate in their care. They stated having the App could aid them in understanding what programs they can apply to and how to do so without having to physically be in a clinical setting.

> *"You'll be more likely to actually participate in that if it's, you know, easy. It's, like, virtual; so that's a big thing." (Youth Voice [YV] 8)*

> *"If you have a phone or some type of smart device, you would be able to access it wherever you*

*are." (YV5)*

Stakeholders further identified that particularly in the COVID-19 era, the virtual nature of the App provided a unique benefit of enabling patients to connect with their support network without meeting in person. They further thought this benefit extended beyond COVID-19, as patients in rural settings would also have improved access to community.

*"We don't know how many people are at home alone." (Stakeholder Voice [SV] 9)*

Furthermore, youth and stakeholders felt the App could improve access to trustworthy information. Youth thought the App could centralize accurate information in an accessible resource.

*"You may not want to ask the doctor, but just, like, you want a quick question answered." (YV6)*

Advantages of a virtual support group: Youth recognized the benefits of a virtual support group, a safe community of people with similar life experiences, and the potential for an App to create a sense of camaraderie with like-minded people.

*"I think with a support group, it's, like, knowing that you're not alone and that, like, it's not a end-of-the-world thing; and you're not dying. You know, you have other people who are living with it and surviving; and it kind of decreases that stigma because you know that there are millions, you know, that are dealing with the same issue." (YV6)*

Additionally, youth and shareholders both appreciated the benefits of anonymity associated with an App-based support group. Youth noted that not needing to visit a physical location to gain resource access is a meaningful addition to their privacy.

*"It's good because it's like I don't have to go and park there to go see somebody." (YV13)*

Stakeholders specifically believed newly diagnosed patients would also be able to ask about symptoms without feeling guilt. Additionally, they identified the anonymity of the App may enable more people to feel comfortable contributing to the community without fear of being judged.

*"Like if they want us to stay a little bit more anonymous but have some place where they can talk to some other people that are going through something similar, or to be like, hey, I'm having*

*these weird symptoms, anybody else experienced that or whatever." (SV25)*

Reminders: YWH noted App-based medication reminders would have been helpful when they were recently diagnosed and had not already established a routine of taking their medications.

*"I think it would be good for other people that are barely starting, so they can remember to drink their meds." (YV3)*

Youth and stakeholders reported they would welcome both medication refill and appointment reminders.

*"Oh, that would definitely be helpful -- medication reminders for sure because I will go to my very last, like, tablet; and I will forget, and then it's a hassle." (YV6)*

Stakeholders further identified that the reminders may provide encouragement to youth by tracking their progress in treatment. In addition, stakeholders believed the ability to share this progress with a community would empower youth to continue engaging with care.

*"Hey, your viral load was this high and look how it is now. I think it would be helpful, you know, when they become undetectable or they can, you know, share with partners." (SV18)*

Users reported they wished to have "testimonials/videos of people living with HIV," and "facilitated conversations" on the App.

## *Disadvantages of an mHealth Intervention*

Confidentiality and anonymity: Although the App being on a smartphone increases the ease of access, youth and stakeholders expressed concerns about increased opportunities for unintentional disclosure if someone else sees the App on their smartphone. Both groups identified that notifications may be a particular risk for exposure.

*"Somebody else gets access to your account, and I mean, that's biggest my fear… Maybe getting notifications when I didn't want to get a notification and it kind of exposing me." (YV7)*

Design critiques: Some youth mentioned having too many settings in the App may limit the utility of

the application. They wanted an App with streamlined features and access to educational literature.

Additionally, youth expressed concerns about potential redundancy of notifications on the App, as

other applications show the same notification in multiple locations.

*"It's just redundant when I'm using the same device over and over again." (YV6)*

Youth and stakeholders voiced concerns the App may be impersonal. Some youth expressed it was

difficult to connect with the people in an online community. One participant reported negative

experiences with prior online communities of people living with HIV.

*"But I just never really, I never really identified – or like connected with any of them. They were*

*… people from (other countries). But no Hispanic people." (YV11).*

Additionally, youth reported using online resources did not feel like a conversation, and they missed

in-person interactions.

*"Going to an actual in-person group, having the actual in-person interaction with people for me*

*would have more of an impact than just kind of talking to someone on my phone." (YV5)*

Despite the potential impersonal experience, stakeholders acknowledged many things are virtual

nowadays, and people are more accustomed to virtual settings than in the past.

*"But a lot of things just nowadays is really virtual, just like what we're doing here today. You*

*know, a lot of it is just really impersonal." (SV3)*

Concerns for unmoderated interactions: Youth were concerned that without moderation, there was

the possibility of smaller communities developing within mHealth interventions and online

communities, which could make it less approachable to new users. Additionally, concerns were

voiced about the lack of moderation of virtual forums, allowing users to write irrelevant or offensive

posts. One participant described their experience reading comments on a thread for a virtual

discussion group:

*"Every time you scroll down and you think you're done, there's like 20 more in the bottom and*

*they're just saying random stuff." (YV9)*

Youth and stakeholders had concerns regarding the potential for "trolls" or "cyberbullying". They were particularly concerned about who would be able to download and join the App community following implementation.

> *"Maybe if a certain type of group of people get ahold of it… They have easy access to basically come on and troll everybody." (YV14)*

Stakeholders additionally expressed concerns about delayed responses to urgent messages if they were written in the live chats, given staff are not constantly monitoring the service. However, they believe this risk could be mitigated by educating patients that urgent messages should not be conveyed through the App and that messages will be reviewed within a designated time.

> *"Patients may just send the chat like saying… I have fever and shortness of breath. And then Friday at 5:30 and nobody's there in the chat feature. So, I think that that's a little bit dangerous." (SV18)*

Youth voiced apprehension about how video support groups/live chats would affect them. One user expressed they might experience a *"feeling of insignificance, just because maybe somebody is going through it worse than you are." (YV2)*

Additionally, youth stated concerns about how listening to other people's testimonies may *"make it more real for them" (YV5)* and it is unpleasant if people minimize their experience on the App. They additionally expressed doubt that people will use the App to chat with others, but rather users who wanted to have a conversation would move to another platform.

> *"But I don't think that they're going to really utilize just this App to message back and forth. Because they'll be like, "Hey, you're cool." "Oh, you're cool, too. Here's my Instagram." And then they're going to use that." (YV13)*

## Design suggestions from YWH derived from Think-Aloud sessions

YWH wanted to know who would see the information they put into the App about their own medication adherence, mood, or stress. App users have the ability to give daily medication, stress,

and mood "check ins" to log their emotions. Think-Aloud participants wanted to know who can read their check-ins to ensure that no one is looking at their data without their consent.

Participants had specific suggestions regarding improving the aesthetic of the App for a more "modern look." Specifically, participants had strong feelings against the original color scheme of the App and the old logo, which featured two chain links. The original blue color scheme was deemed "too medical" by many participants, who suggested either a "plain" or "vibrant" color scheme. Participants were quick to point out incorrect scaling on thumbnails and visually unappealing color schemes that reduced the visual charm of the original App.

During Think-Aloud sessions, participants reported certain design aspects were non-intuitive, reducing the ease of use of certain features within the App. Participants suggested re-organizing the community message board from a single thread to allow participants to self-organize threads, optimizing the search bar for resources and FAQs, having convenient "learn more" hyperlinks within lab results, and "read receipts" to confirm whether messages and documents sent on the App were seen by all users, including healthcare providers.

Participants expressed particular interest in finding relevant local resources within South Texas. They were eager to learn about the resources offered within the App but suggested making them more community specific. Participants also found the FAQ section useful for patients newly diagnosed with HIV and suggested including a glossary of acronyms to help newly diagnosed patients understand frequently used terminology in HIV care and on the App. Participants expressed the need for customizability and improved integration of the App on their phone. Specifically, they requested ways to customize the App's home screen icon and modify notification settings to allow for privacy.

Several suggestions made by think-aloud participants were determined to be beyond the scope of the current adaptation, but important to consider in the future. These potential adaptations to the App

include saving posts, blocking specific users, and prioritizing conversations within community message boards. Additionally, YWH requested the ability to add photos to posts, replies, and messages. Participants additionally suggested new features for access to care, such as virtual bus passes, should be incorporated into the App in the future.

## Youth Advisory Board Input

Throughout the adaptation process, we queried the YAB using Qualtrics surveys and made adjustments to our process in response. Topics for the surveys included: desired elements of an mHealth intervention, topics for the community message board, preferred mobile App security options (password, fingerprint, face ID, etc.), and feedback on the design and look of the App. In the final stage of design iteration, responses regarding the graphics and design of the App interface from prior YAB surveys and the Think-Aloud sessions were reviewed by the design working group and the software developers incorporated suggestions into the design of a new look and logo for PL4Y. A Qualtrics survey was distributed to the YAB, asking respondents to rate and rank potential logos and designs (N=11). The top 3 logos and fonts (determined by average ranking and average rating) were implemented into a second Qualtrics survey (N=9). The highest average ranked combination of logo and font was selected as the official logo of PL4Y (Figure 2).

## Adaptation Process

The design working group incorporated findings from the formative evaluation and Think-Aloud sessions into the design of the App. The laboratory section was updated to be more understandable to YWH. The community message board was divided into three channels, allowing members to "like" other posts, and implementing a search by word or hashtag function. The color scheme, font, and logo were updated based on feedback and selected by the YAB, as described above (Figure 2). The "Resources and FAQ" section was condensed and revised to prioritize material relevant to South Texas. This adaptation process is ongoing as we continue to add requested content, such as videos explaining the steps to an HIV clinic visit.

# Discussion

## Principal Results

We incorporated YWH voice throughout the process of an implementation science-informed adaptation of an mHealth care engagement intervention, leading to significant changes in the intervention. YWH identified advantages to mHealth interventions, including ease of access, community building, and reminders about medications and appointments. They also voiced concerns about the potential for loss of confidentiality, impersonality, and lack of content moderation. Based upon feedback from the formative evaluation, Think-Aloud sessions, and the YAB, the intervention was adapted to respond to expressed needs, changing the graphic design and logo, adding South Texas specific resources, an updated representation of laboratory data, and a more user-friendly and youth-appropriate community message board.

The medical literature suggests youth with and without HIV accept App-based mHealth interventions, which can be used to improve health behaviors for youth and emerging adults [9,10,13,14]. An App-based intervention was found to be successful in an adolescent population with asthma, as well as in an adolescent population in recovery following hematopoietic stem cell transplant [24,25]. There have been few studies investigating the utility of App-based interventions in patients with HIV. Aladin *et al.* enrolled 113 patients with HIV and found their App-based intervention was associated with increased communication and engagement with care, particularly when combined with peer navigation and a comic series [9]. However, the vast majority of mHealth interventions are text message based between patient and clinic, and users lack the ability to form connections with each other [26]. Brooks et al. found that App-based interventions were most useful for YWH if they had medical information, reminders, self-efficacy, supported feelings of connection to a community, and reduced stigma around HIV [13]. These promising results indicate users of App-based interventions may benefit from "discussion board" components that allow users to communicate and develop a community. Schnall et al. studied the functions of 15 publicly available

App-based interventions targeting people living with HIV and found 4 enabled communication between peers and providers, 6 had medication reminders, 7 had medication logs, and 6 included a search function [27]. In the present analysis aligns with the existing literature as both users and stakeholders identified all of the above as critical functionalities of an App-based intervention, and these components were included in the final redesign.

Our findings add to this existing knowledge base by highlighting the importance YWH place on easy, asynchronous access to services. YWH welcome the ability to message providers or other members of the care team, quick links to online resources for HIV care and social services, and automatic appointment and medication reminders. We discovered many YWH wished for connections to other YWH, something not featured in current mHealth interventions for this demographic, and appreciated the virtual, anonymous format of the PL4Y community message board. Finally, YWH repeatedly emphasized that the graphic design and usability of the intervention should be influenced by what was most acceptable and appealing to YWH. These data influenced our own design adaptation but are also relevant to others framing mHealth interventions for YWH or other youth communities.

Few studies investigate patient thoughts about current mHealth interventions or discuss YWH concerns with this intervention modality. Conserve et al.'s review of seven mHealth interventions found one of the main barriers to the use of mobile technologies included cellular network restrictions [28]. Our findings echo this, as YWH and stakeholders anticipated access to a smartphone could be a primary barrier to utilization of our intervention. We also found additional concerns with mHealth intervention for YWH that, to our knowledge, are not reflected in the existing literature. Many YWH expressed concerns about confidentiality and security of the data on their phone. Others worried that communicating by message, rather than in person or phone, would feel impersonal, and people could be exposed to harmful or disempowering narratives on the community message board. Though our intervention already has robust security and content monitoring

protocols, these concerns will need to be addressed during implementation.

## Limitations

Despite the meaningful findings of this investigation, there are limitations. Our adaptation process incorporated viewpoints of 14 YWH participants and 11 YAB members, but we cannot assume they represent all perspectives of YWH. Furthermore, our participants reflect the South Texas population, with the majority identifying as Hispanic/Latinx, which may limit the generalizability of our findings but also increases our understanding of this population's response to mHealth interventions [29]. Despite these limitations, the present study fills a crucial gap in the literature and identifies crucial barriers and facilitators to the adoption of an App-based mHealth intervention in YWH.

## Conclusions

Although mHealth interventions targeting YWH can improve care engagement, few studies identify which characteristics of these interventions promote and dissuade patient adoption of App-based interventions [9,10,13,14]. Our adaptation process succeeded in incorporating input from a majority Hispanic/Latinx group of YWH in the design of a mHealth intervention. Our process demonstrated that YWH should play integral roles in the design of interventions for this population, as novel concerns were raised that were not reflected in the literature. Our study identifies both barriers and facilitators to App-based mHealth interventions for YWH. We also describe a rigorous and iterative adaptation process that centers youth voice to ensure that the new intervention meets the needs of the community. These findings can be used in the design of future App-based mHealth interventions to promote the adoption of these interventions by YWH.

## Acknowledgements

## Conflicts of Interest

R.D. and K.I. provide consulting services for Warm Health Technology, LLC, that distributes the PositiveLinks app outside Virginia. The other authors declare that they have no financial or nonfinancial interests

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# Supplementary Files

# Figures

Triangulation of data sources for adaptation of the mHealth intervention to the needs of youth with HIV (YWH) in South Texas. Three separate sources of feedback were gathered and incorporated into the adaptation: qualitative analysis of feedback specific to mHealth intervention components conducted as a part of a formative evaluation, data from human-centered design thinking-informed 'ThinkAloud' sessions where users walked through the mHealth intervention components and provided real-time feedback, and continuous input from the youth advisory board, including final voting on preferred logo and look for the adapted intervention.
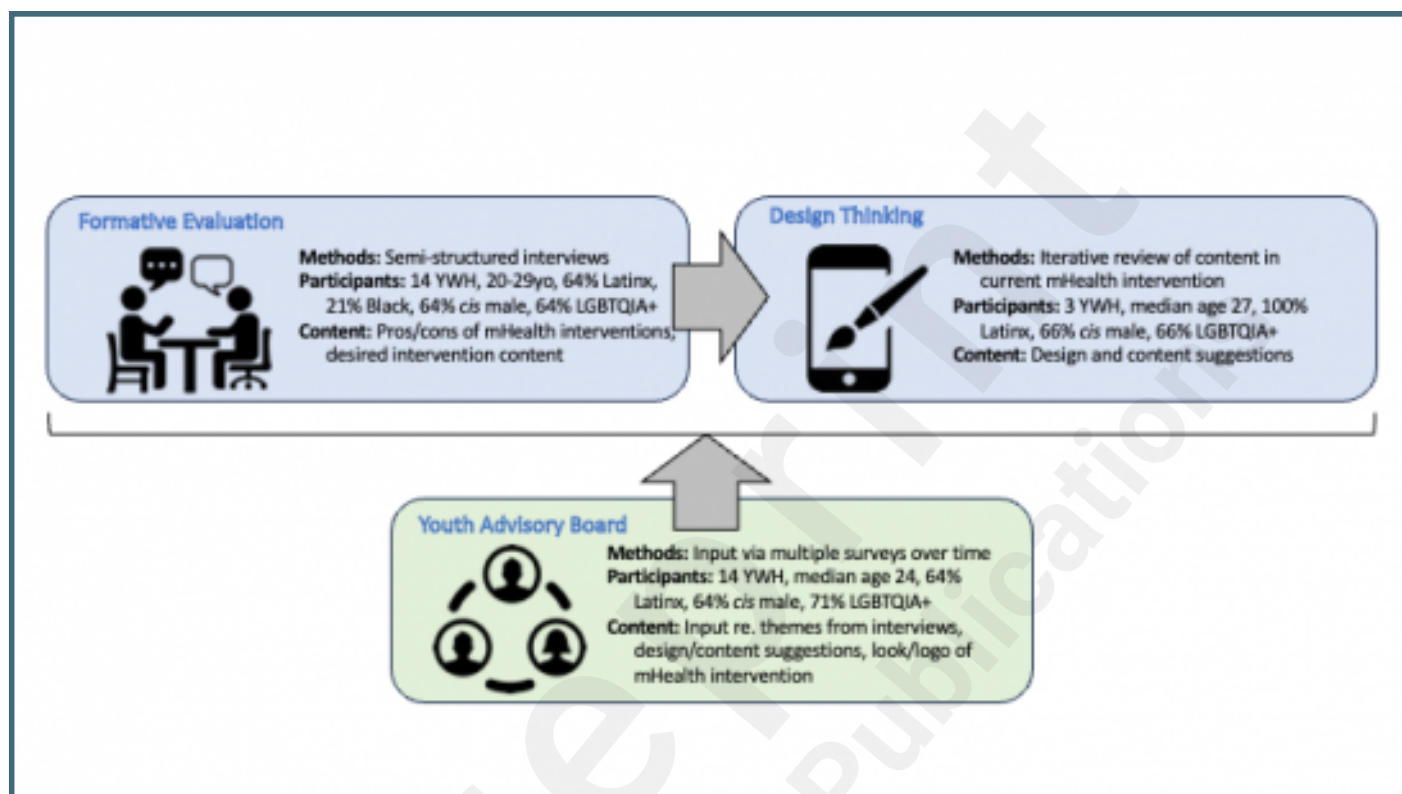
Overview of four human-centered design thinking driven adaptations to the existing intervention to respond to expressed needs of youth with HIV during 'ThinkAloud' sessions and the Youth Advisory Board (YAB).