TITLE:

Social media for ART adherence and retention in adolescents and young adults: the Vijana-SMART study
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1. LIST OF ABBREVIATIONS

HIV  Human Immunodeficiency Virus
AIDS  Acquired Immunodeficiency Syndrome
AYA  Adolescents and Young Adults
ART  Antiretroviral Therapy
ERC  Ethics Review Committee
IRB  Institutional Review Board
KNH  Kenyatta National Hospital
NASCOP  National AIDS and STI Control Program
ODK  Open Data Kit
UW  University of Washington
IDI  In-depth interview
FGD  Focus group discussion
HCW  Healthcare worker
CAB  Community Advisory Board

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5. SUMMARY

HIV-infected adolescents and young adults (AYA) show lower ART adherence, higher loss to follow-up and higher AIDS-related mortality than other age groups. Innovative approaches are needed that address AYA’s unique needs and improve their adherence and retention in HIV care. There is evidence that peer support and mobile messaging with healthcare workers (HCW) are two strategies that may be effective in this group, but their evaluation has been limited and no interventions have combined them. Since 2014, youth-run virtual support groups have spontaneously started at HIV clinics, using the mobile social media application WhatsApp. These groups present valuable case studies from which the proposed project will develop a structured social media intervention that combines peer and HCW support to improve ART adherence and retention, guided by the preferences of AYA. The SPECIFIC AIMS are to (1) Characterize the existing WhatsApp groups through in-depth interviews with members and detailed content analysis of the group’s communications during a 6-week observation period. This will define the elements and features desired by AYA in a social media intervention. (2) Guided by findings from Aim 1, behavioral theory, and the study team’s ongoing research on mobile messaging to improve ART adherence, to develop and refine structured content for a reproducible WhatsApp
intervention that incorporates peer and HCW interaction. (3) Pilot the structured intervention for 6 months in another clinic and evaluate its uptake, acceptability and impact on intermediate outcomes ART knowledge, depression and stigma, compared with controls enrolled prior to the intervention. Uptake will be assessed by comparing characteristics of screened and enrolled individuals. Acceptability will be evaluated by detailed content analysis of communications within the WhatsApp pilot.

6. INTRODUCTION/ BACKGROUND

Youth make up a growing proportion of the HIV-infected population and have poor outcomes. In 2014, approximately 4 million people age 15-24 years old (referred to here as ‘youth’) were living with HIV globally, 75% of them in sub-Saharan Africa (1). Successes in expanding early infant HIV diagnosis programs and optimization of pediatric HIV treatment have resulted in growing numbers of HIV-infected children who are surviving to adulthood (Figure 1). Furthermore, youth have a higher risk of HIV acquisition than any other age stratum, accounting for 34% of new HIV infections globally (2).

Despite tremendous expansion of global access to antiretroviral therapy (ART), HIV morbidity and mortality in youth remains high. Good estimates of the impact of HIV on youth are limited by the fact that those age 10-15 years are typically grouped together as children and those >15 years old are considered adults, partially obscuring shortcomings in youth HIV care. Despite this limitation, it is clear that HIV is the leading cause of death among adolescents age 10-19 in Africa and the second leading cause of death among adolescents globally (3). Whereas overall AIDS-related deaths decreased by 30% between 2005 and 2012, adolescent AIDS-related deaths increased by 50% in the same period (2). This alarming observation is thought to be partly due to high loss to follow-up (4,5) and poor adherence to ART (6,7) in this age group. This has a clear impact on the health of these youth and poses a transmission risk with implications for control of the overall HIV epidemic. Studies suggest poor retention and adherence among youth is associated with psychological distress (8,9), lack of social and familial support (10), stigma, negative experiences with healthcare workers (HCW) (11), and medication-related challenges (12). Adolescence and young adulthood is a period of enormous developmental and social transition in which emerging autonomy, limited self-efficacy and increased mobility combine to present unique vulnerabilities and challenges to HIV treatment. There is an urgent need for tailored interventions that address barriers to retention and adherence among youth, especially in sub-Saharan Africa (13).

7. LITERATURE REVIEW

Peer support can improve youth HIV treatment outcomes. Emergence of highly influential peer relationships among youth is a central feature of adolescent development (14). While peer interactions can have negative effects through normalization of inappropriate behavior (15), peers can constructively influence health behavior by providing social support, establishing norms, building confidence, and disseminating information from trusted sources (16). In the context of HIV care, peer relationships can support treatment through support groups or individual counseling from trained peers. Peer support groups have been shown to improve youth ART adherence and retention in care (10,17,18). Their impact on the pediatric to adult care transition
has not been evaluated. Peer support may reduce isolation, build psychosocial resources and provide relatable behavior modeling in the context of diminishing adult involvement in care.

Mobile health (mHealth) can supplement in-person support from HCW. Sustaining supportive clinical relationships throughout the transition to adult care is important to maintaining continuity of care. In the adult care setting there has been success in improving ART adherence through reminders, education, and support from HCW delivered through mobile phone messages (typically by short message service, SMS) (19). This approach has received particular attention in resource-limited settings as a means to supplement overstretched clinic-based services. Greater benefit was observed with interactive, bidirectional communication with HCW, suggesting dynamic interaction and tailored responses to patient questions are especially important (20). In our ongoing study of SMS messages to improve ART adherence in pregnant and post-partum women (mobile solutions for Women and Children’s Health, mobile WACh-X) (21), we have observed that mobile messaging extends the reach of the clinic, enabling HCW to provide timely advice and identify issues without a clinic visit (Figure 2). Studies of the impact of mHealth on HIV treatment in youth are limited but show promise (22,23). ‘Virtual’ connection with HCW through communication technology may enable youth to access medical advice while overcoming concerns about stigma and promoting more open communication.

Social media are ideally suited to deliver a flexible intervention that integrates HCW and peer transition support. Social media are interactive forms of digital content and communication such as Facebook, WhatsApp and blogs (24). Unlike SMS, which is designed for 1-to-1 communication, social media offer the capacity for dynamic interaction with a network of contacts, allowing integration of HCW and peer support (Table 1). Global access to the internet and social media has grown exponentially, especially among young people: in Kenya, 53% of 18-34 year-olds access the internet and 87% of those use social networking sites such as Facebook and Twitter (25). No large-scale analysis has been published of social media use in Kenyan youth, but small studies suggest high access (26). Moreover, social media based peer support networks have arisen spontaneously in HIV-infected youth in Kenya, demonstrating the feasibility of this platform.

Two novel youth-initiated social media groups provide ideal case studies. In 2014, a group of 25 AYA patients receiving HIV care at Mbagathi District Hospital, Nairobi, created an informal virtual support group through the mobile social media application, WhatsApp. The group remains youth-run and has grown explosively, to over 250 members, with most newly initiating AYA patients now joining. A similar program has been established at Kenyatta National Hospital (KNH), named Operation Triple Zero, which now includes ~90 members. Some adult counselors have been invited into the groups and are occasionally consulted on clinical questions. The youth-driven creation of these groups is not only an indication of the popularity and utility of social media in this population, but serves as a valuable case study from which we will develop a desirable, reproducible intervention and test its generalizability in another clinic.

Table 1. Social media strengths.

- Acceptable and increasingly accessible to youth
- Accommodating of high mobility
- Multiplies HCW reach
- Single platform can accommodate group and 1-to-1 interaction
- Balances privacy needs with accessibility
- Communication can be tailored to individual needs

Figure 2. Sample mobile WAChX participant messages
8. RATIONALE

Interactive social media present an opportunity to connect HIV-infected AYA with peers and HCW, to provide information and support to overcome barriers to HIV care and improve ART adherence and retention in care (Figure 3). The organic formation of a WhatsApp peer support group at Mbagathi and KNH clinics present ideal case studies through which to understand the features and functions desired by AYA in such a group. This study applies our team’s experience with mobile health, social media and adolescent health, to generate a standardized intervention grounded in the needs and priorities of HIV-infected AYA, and pilot it in preparation for future large-scale randomized evaluation.

This study is based on the Theory of Planned Behavior, which posits that ART adherence behavior is determined by an individual’s attitude toward ART adherence, subjective norms concerning ART adherence and perceived behavior control. These factors determine the individual’s intention to adhere, and, combined with the individual’s actual behavioral control, this determined the individual’s behavior (Figure 4). This theory drives our analysis and intervention development.

9. HYPOTHESIS & STUDY QUESTIONS:

Our overarching hypothesis is that a standardized social media intervention that integrates interaction with peers and HCW will improve ART adherence and retention in HIV care by AYA, by increasing their HIV-related knowledge and perceived social support and reducing their depression and stigma. We hypothesize that participants in the existing WhatsApp group will report that the group is beneficial and will use it frequently for advice and support, and that adaptation of the existing group will yield an acceptable, reproducible intervention.

10. OBJECTIVES

10.1 Broad Objectives
The broad objective of this study is to develop an interactive social media intervention to improve AYA retention in HIV care and adherence to ART, and evaluate its acceptability and impact on intermediate outcomes.
10.2 Specific Objectives

Aim 1: To characterize the function, content and reach of two existing informal WhatsApp peer support groups for AYA living with HIV. We will enroll members and non-members of the existing WhatsApp groups at Mbagathi and KNH:

a. Conduct in-depth interviews (IDIs) to gain a detailed understanding of the experiences of group members, reasons for non-participation by non-members, and desired features in a social media tool to support HIV care.

b. Using methods developed in studies of social media usage by US adolescents, conduct content analysis of the group’s WhatsApp communications to characterize the nature, topics, and frequency of messages.

c. Evaluate access of AYA patients to WhatsApp by conducting surveys at 3 HIV clinics in Nairobi.

Hypothesis: The WhatsApp groups will be perceived as beneficial and will be used frequently for advice and support. Participants will desire additional information and structured discussion with peers and HCW. A majority of AYA will have access to WhatsApp.

Aim 2: To develop a standardized yet flexible WhatsApp intervention that integrates peer and HCW support, guided by AYA and HCW feedback. Findings from Aim 1 will be used to develop structured WhatsApp content to support ART adherence and retention. We will conduct focus group discussions (FGDs) with AYA and HCW to optimize content, messaging frequency and balance of HCW and peer involvement.

Hypothesis: Adaptation of the existing WhatsApp group will yield an acceptable, reproducible intervention while retaining flexibility for spontaneous discussions that engage youth.

Aim 3: To pilot the intervention in another clinic setting and evaluate its uptake, acceptability and impact on participant attitudes and experiences. Intervention acceptability and usage will be assessed through content analysis of WhatsApp communications during a 6-month period. ART knowledge, adherence, depression, social support and stigma will be compared in intervention vs. historical control participants using questionnaires.

Hypothesis: AYA will find the intervention acceptable and will interact with it frequently. Compared to controls, pilot participants will report increased ART knowledge and adherence, and decreased stigma and depression after the pilot.
11. METHODOLOGY

11.1 Study Design
This study will involve 1) characterization of an existing youth-led social media group, 2) development and refinement of a standardized social media group, and 3) piloting the standardized group among AYA at a second clinic site. The procedures, outcomes and participant characteristics for the 3 study aims are summarized in Table 2 and Figure 5.

11.2 Study Area Description
The study will be conducted in Nairobi, Kenya, at three HIV care facilities, Mbagathi District Hospital, Kenyatta National Hospital (KNH) and Kayole II Sub-district Hospital. All facilities serve HIV-infected adults and children in the urban and peri-urban Nairobi area.
Table 2. Summary of proposed eligibility, procedures and outcomes for study aims

<table>
<thead>
<tr>
<th>Aim 1</th>
<th>Aim 2</th>
<th>Aim 3</th>
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<tr>
<td><strong>Characterize reach, function, content and possible improvements of existing informal WhatsApp groups</strong></td>
<td><strong>Develop and refine standardized WhatsApp group, guided by user feedback</strong></td>
<td><strong>Pilot standardized group in another clinic setting</strong></td>
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| **Outcomes of Interest** | - AYA technology access  
- AYA desires  
- WhatsApp group functions and content | - AYA, HCW, peer counselor, caregiver preferred WhatsApp group features  
- Development of support group content | - WhatsApp group uptake and participation  
- Impact on AYA ART knowledge, adherence, depression, stigma |
| **Population** | HIV-infected AYA enrolled in care who are members and non-members of existing WhatsApp support groups | - HIV-infected AYA  
- HCW & peer counselors involved in AYA HIV care | HIV-infected AYA on ART |
| **Age range** | 14-24 | - AYA: 14-24  
- HCW: ≥18 | 14-24 |
| **Study site** | Mbagathi District Hospital  
Kenyatta National Hospital | Mbagathi District Hospital  
Kenyatta National Hospital  
Kayole II Sub-district Hospital | Kayole II Sub-district Hospital |
| **Data collection** | In-depth interviews  
Content analysis of WhatsApp group communications | Technology survey | Focus group discussions  
- Screening questionnaire  
- Baseline and follow-up questionnaires  
- Content analysis of WhatsApp group communications |
| **Study follow-up** | Cross-sectional | Cross-sectional (6 weeks’ communications) | Cross-sectional | Cross-sectional | 6 months |
| **Inclusion criteria** | Aware of HIV status  
Communicate in WhatsApp groups during 6 weeks sampling period | HIV+ and HIV- attending study sites on sampling days  
AYA:  
- Aware of HIV status  
- Has access to WhatsApp  
- Literate  
HCW:  
- Involved in AYA HIV care  
Caregiver:  
- Primary caregiver of an HIV-infected AYA | | Screening:  
- On ART  
- Aware of HIV status  
Pilot participation, additionally:  
- Has access to WhatsApp  
- Literate |
| **Participant numbers** | 40 (20 age <18, 20 age ≥18)  
~350 | 600 (200 at each site)  
(100 HIV+ at each site + 100 HIV- at each site) | AYA: 6 focus groups (3 age <18, 3 age ≥18), 60 participants  
HCW & peer counselors: 2 focus groups, 20 participants  
Caregivers: 3 focus groups, 30 participants | 110 (55 year 1 controls, 55 year 2 intervention) |
| **Recruitment** | Flyers & outreach at clinic  
Gain permission to join WhatsApp groups | Outreach at clinic  
Flyers & outreach at clinic | Flyers & outreach at clinic |
| **Specimen collection** | None | None | None |
11.3 Study Population

Study populations for each of the aims are summarized in Table 2. Four study populations will be included in the study:

1. HIV-infected and uninfected AYA attending Mbagathi, KNH and Kayole II.
   Inclusion criteria for Aim 1 survey
   a. Age 14-24
   b. Receiving care at study site

2. HIV-infected AYA at Mbagathi and KNH.
   Inclusion criteria for Aim 1 IDI:
   a. Age 14-24
   b. Aware of HIV status
   c. The sample will be stratified into members of the existing WhatsApp groups and AYA who are not members of the groups

   Inclusion criteria for Aim 1 content analysis:
   a. Members of existing WhatsApp groups
   b. Active communicators during the period of observation (6 weeks)

3. HIV-infected AYA patients at Kayole II.
   Inclusion criteria for Aim 2 FGDs:
   a. Age 14-24
   b. HIV-infected
   c. Aware of HIV status
   d. Has access to WhatsApp
   e. Can read and write WhatsApp messages

   Inclusion criteria for Aim 3 pilot:
   a. Age 14-24
   b. HIV-infected
   c. On ART
   d. Has access to WhatsApp
   e. Can read and write WhatsApp messages

4. HCW and peer counselors who work in AYA HIV care at Kayole II.
   Inclusion criteria for Aim 2:
   a. Age ≥18
   b. Nurse, clinical office, physician, counselor, peer counselor
   c. Involved in AYA HIV care

5. Caregivers of HIV-infected AYA at KNH, Mbagathi and Kayole II.
   a. Age ≥18
   b. Primary caregiver of HIV-infected AYA

11.4 Sample Size Determination

Sample sizes for qualitative data collection in Aims 1 and 2 were determined based on the number of interviews and focus group discussions needed to achieve saturation of concepts. It is estimated that 40 interviews and WhatsApp messaging spanning 6 weeks will be sufficient to achieve saturation in Aim 1, and 14 focus group discussions with 10 participants each will be sufficient to achieve saturation in Aim 2.
For the technology survey in Aim 1, assuming the true prevalence of WhatsApp access is 50%, a sample size of 300 participants (of each HIV status) will yield a 95% confidence interval 44.2-55.8% prevalence over all 3 sites. It will also allow 80% power to detect a difference of 9.9% in the prevalence of WhatsApp access between HIV-infected and -uninfected individuals.

For Aim 3, with 55 participants offered the intervention and 55 control participants, assuming 10% attrition over the course of the 6-month pilot, α=0.05 and two-sided t-test we will have 80% power to detect a difference in mean depression score of 4.1 vs. 1.6 in control vs. pilot participants (on the 27-point PHQ9 scale) (8), and in ART knowledge score of 23 vs. 27 (on the 36-point LifeWindows ART information scale) (27).

11.5 Recruitment, Screening and Consent Procedures
AIM 1: AYA in-depth interviews (IDIs)
A convenience sample of AYA attending the Mbagathi and KNH HIV clinics will be recruited through flyers and in-person outreach. Flyers will include brief information about study goals and a description of what is involved in participating in an IDI. Flyers will be posted in waiting rooms and examination rooms at the clinic. Clinicians at the clinics will also be given information about the study and encouraged to refer their AYA patients. Interested patients will be able to contact the study by phone or in-person at the clinics. Discussions between study staff and potential participants will be conducted in a private sound-proof room to maintain privacy. Interested patients will be asked screening questions to assess eligibility and, if eligible (see inclusion criteria above), be invited to participate in the study. Our goal is at each site to recruit 10 participants age <18 and 10 participants ≥18 from each group (total 40 participants).

At the time of enrollment, a study staff member will read the written informed consent form to the participant and their parent/guardian. Adolescents under the age of 18 are minors, but those who support themselves, are married, are pregnant or have children are considered emancipated minors in Kenya and able to provide informed consent independently. For non-emancipated adolescents whose parents/guardians accompany them to clinic, permission of the parent/guardian and assent of the adolescent will be required. For non-emancipated adolescents who are not accompanied by their parents to clinic, we will request a waiver of parental permission. Our justification for waiving parental permission is that the study activities present minimal risk, which will be adequately protected against (see section 12.4), and these adolescents’ parents may not be involved in their HIV care, or even aware of their HIV status. For these adolescents, obtaining parental permission may therefore require status disclosure, generate elevated risk of harm, or present a barrier to study participation. The participant and their parent/guardian, as appropriate, will be allowed to ask questions, and will give written consent for participation in and audio recording of the interview and collection of locator information. Study staff will collect locator information including phone numbers and will book the participant to return for the IDI.

AIM 1: WhatsApp content analysis
All communication in the existing WhatsApp groups during a 6-week observation period will be sampled. In order to gain access to the group’s communications, a member of the study team will approach the group’s youth administrators and request permission to join the group for a 6-week period.

Given the size of the two WhatsApp groups, obtaining individual informed consent from all group members would be impractical. We will therefore request a waiver of individual consent on the grounds that the activities present minimal risks that can be adequately protected against (see
section 12.4). We will consult our community advisory board (CAB) and administrator members of the *WhatsApp* groups as a form of collective informed consent. Group administrators will provide written informed consent. Any other group members who are reached in person during other study activities at KNH and Mbagathi District Hospital will also provide written informed consent. Before our study accesses the groups, an announcement will be made through *WhatsApp* of our intention to observe, and time will be given for members to contact the study with questions or concerns before the study joins.

**AIM 1: Technology access survey**
A convenience sample of AYA attending the Mbagathi, KNH and Kayole II clinics will be recruited through in-person outreach during a pre-specified 2-week period. Participants will be approached by study staff, who will assess eligibility by asking the AYA’s age and verifying that they are a patient at the clinic. If the participant is eligible, study staff will briefly describe the survey and what it involves and obtain the participant’s verbal consent to participate. It will not be assumed that AYA are aware of their HIV status, so the description and survey will not mention HIV.

**AIM 2: AYA, HCW and caregiver focus group discussions (FGDs)**
A convenience sample of AYA attending the Kayole II Sub-district Hospital HIV clinic will be recruited through flyers and in-person outreach by study staff. Flyers and in-person outreach will include brief information about study goals and a description of what is involved in participating in a FGD. Interested patients will be able to contact the study by phone or in-person at the study room at Kayole II Sub-district Hospital. Flyers will be posted in waiting rooms and examination rooms at the clinic. Clinicians at Kayole II Sub-district Hospital will also be given information about the study and encouraged to recruit their AYA patients. A convenience sample of HCW working at the Kayole II Sub-district Hospital HIV clinic will be approached by study staff, who will explain the study goals and activities and invite the HCW to participate. Our goal is to recruit 2 FGD (~10 participants) for HCW and peer counselors, 3 FGDs (~30 participants) for AYA age <18 and 3 FGDs (~30 participants) for AYA age ≥18. A convenience sample of caregivers of AYA receiving care at KNH, Mbagathi and Kayole II clinics will be recruited through flyers and in-person outreach by study staff. Flyers and in-person outreach will include brief information about study goals and a description of what is involved in participating in a FGD. Interested patients will be able to contact the study by phone or in-person at the study room at each of the study sites. Flyers will be posted in waiting rooms and examination rooms at the clinic, and distributed to clinicians and support group coordinators.

Interested participants will be asked a set of screening questions and, if eligible (see eligibility criteria), be invited to participate in the study. At the time of enrollment, a study staff member will read the written informed consent sheet to the participant. For non-emancipated adolescents whose parents/guardians accompany them to clinic, permission of the parent/guardian and assent of the adolescent will be required. For non-emancipated adolescents who are not accompanied by their parents to clinic, we will request a waiver of parental permission. The participant and their guardian, as appropriate, will be allowed to ask questions, and will give written consent for participation and audio recording of the discussion, and collection of locator information. Study staff will collect locator information including phone numbers and will book the participants to return for the FGD.

**AIM 3: Intervention pilot**
The target population for Aim 3 is AYA receiving ART at Kayole II Sub-district Hospital. Patients will be recruited through flyers and in-person outreach by study staff at the clinic. Flyers and in-person outreach will include brief information about study goals and a description of what is involved in participating in the pilot. Interested patients will be able to contact the study by phone...
or in-person at the study room at the Kayole II Sub-district Hospital clinic. Flyers will be posted in waiting rooms and examination rooms at the clinic. Clinicians and support group facilitators at Kayole II Sub-district Hospital will also be given information about the study and encouraged to relay the information to their AYA patients. Interested participants will first provide verbal consent to complete a screening questionnaire that will assess eligibility and record sociodemographic data. Eligible participants will then be invited to enroll in the pilot.

Pilot participation will require written consent. At the time of enrollment, a study staff member will read the written informed consent form to the participant. Young adults over 18 and emancipated adolescents will provide independent written consent. For non-emancipated adolescents whose parents/guardians accompany them to clinic, permission of the parent/guardian and assent of the adolescent will be required. For non-emancipated adolescents who are not accompanied by their parents to clinic, we will request a waiver of parental permission.

11.6 Data Collection Procedures
AIMS 1 & 2: AYA, HCW and caregiver IDIs and FGDs
IDIs and FGDs will be performed in a private room at the clinic from which the participant was recruited: Mbagathi, KNH or Kayole II. IDIs and FGDs will be conducted by a trained qualitative interviewer fluent in English and Kiswahili. Before the IDI or FGD begins, socio-demographic information will be collected in standardized questionnaires using a tablet-based system (Open Data Kit, ODK). For AYA, sociodemographic data to be collected include age, HIV treatment history, HIV status disclosure, family socio-economic status, education level and technology access. For HCW, data include age, professional role, time in practice and technology access. For caregivers, data include age, HIV status, HIV treatment history, HIV disclosure status, number and HIV status of children, treatment status of children, and technology access. The interviewer will then describe procedures and norms for the IDI/FGD and participants will be given a chance to ask questions. Participants will be reminded that their participation is voluntary and may refuse to answer any question or end the interview at any time. Participants will receive unique identification numbers and will not be addressed by their names to maintain confidentiality. The interviewer will then will ask questions and facilitate a discussion based on a discussion guide. Aim 1 IDIs will last approximately 1 hour and Aim 2 FGDs will last 1.5 – 2 hours. In Aim 2 FGDs, participants will be presented with example messages developed for the standardized WhatsApp intervention. The IDI/FGD will be audio recorded and the facilitator will take written notes. Discussions will be conducted in English or Kiswahili, depending on participant preferences. Notes will be compared to audio-recordings to fill in missing information, transcribed and translated to English (if necessary). Transcribed data will be de-identified. Audio-recorded interviews will be destroyed as soon as the transcripts have been validated, within 6 months of completion of the IDI/FGD. Participants will be provided refreshments and Ksh 400 (approximately $4) to compensate for their time and transportation expenses to participate in the study. We will provide this monetary compensation to each participant at the conclusion of each IDI/FGD.

AIM 1: WhatsApp content analysis
The study will have access to the WhatsApp group for a period of 6 weeks. At the end of this period, all messages will be downloaded and identifiers such as names and phone numbers permanently deleted from the messages. Messages will be translated to English and content analyzed qualitatively and quantitatively.

AIM 1: Technology access survey
A short anonymous survey will be administered that ascertains participants’ use of mobile technology platforms. The survey will not collect any identifiable information. The survey will be
AIM 3: Intervention Pilot
The intervention will be piloted among AYA receiving ART at Kayole II Sub-district Hospital. Following informed consent, participants will complete an enrollment visit in which questionnaire data will be collected using tablet-based ODK forms. Data to be collected include sociodemographic characteristics such as age, family socioeconomic status, education level, technology access, HIV treatment history, social support, depression, stigma, ART knowledge and motivation, ART adherence. Participants will then be added to a WhatsApp group. The form and content of the group will be developed based on the findings of Aims 1 and 2. We anticipate it will consist of a group of AYA, likely of size 5-10, one HCW and one young adult peer counselor. Depending on the desired group size and characteristics, multiple WhatsApp groups may be established, stratified by age, route of infection and time on ART. The same study HCW and peer counselor will staff all groups. Regular scheduled messages will be sent to the group from the HCW and peer counselor to generate discussion and AYA questions will be answered. Content of all WhatsApp conversations in the group or one-to-one between study participants and study staff for the 6-month pilot period will be downloaded for analysis and all names and phone numbers will be permanently deleted. At the end of the pilot period, participants will attend a follow-up visit at which a questionnaire will be administered evaluating social support, depression, stigma, ART knowledge and motivation, ART adherence, and experience of the intervention. Participants will be provided refreshments and KSh 400 (approximately $4) to compensate for their time and transportation expenses to each study visit, provided to participants at the conclusion of each visit.

Participants in the pilot will be enrolled in year 2 of the grant (n=55). In year 1, an equal number (55) control participants will be enrolled according to the same eligibility criteria, and will undergo the same visits and questionnaire data collection activities, but will not participate in the pilot intervention.

11.7 Data Analysis
AIM 1: IDIs
IDI transcripts will be imported into the Dedoose qualitative analysis software. Using a phenomenology approach (28), two study team members will independently review transcripts to identify themes and sub-themes. The Uses and Gratifications Theory of media usage (29) (UGT) will provide a guiding framework to categorize the needs of AYA and how these needs are and are not gratified by the WhatsApp group, and drive development of an intervention responsive to those needs.

AIM 1: WhatsApp content analysis
WhatsApp content will be entered into the Dedoose software for analysis. It will be analyzed quantitatively to evaluate frequency, timing, and clustering of communications; and qualitatively to document the topic areas and types of communication (i.e. questions, support, information). Using methods developed by Dr. Moreno (30-32), two coders will develop a codebook based on inductively derived codes from initial message review, as well as pre-defined codes corresponding to constructs of the Theory of Planned Behavior (16,33), such as attitudes and norms regarding ART, perceived behavior control, and behavior intention. This analysis will be used to inform development of messages and discussion topics for the intervention in Aim 2 (Figure 2).

AIM 2: FGDs
The main goal of the FGDs in Aim 2 is to obtain guidance in the design of the proposed intervention, from its prospective AYA and HCW users. Additionally, caregiver perspectives will inform the needs of AYA and potential benefits of a peer support group for caregivers. Rapid review of FGD transcripts will be conducted to refine message content and style.

**Aim 3: Intervention Pilot**

Table 2 summarizes the outcomes, indicators and data sources for the pilot in Aim 3.

Depression, stigma, ART knowledge, adherence and social support scores at baseline and follow-up will be analyzed as continuous variables using Generalized Estimating Equations (GEE) and compared between historical controls and pilot intervention participants. Intervention acceptability will be described quantitatively as the distribution of frequencies of participant messaging, the proportion of HCW and peer counselor messages that are responded to, and patterns of messaging over time in the pilot.

Qualitative analysis using methods described for Aim 1 will also explore the content of messaging in the pilot and assess salience of discussion topics and potential improvements in a large-scale evaluation of the intervention.

**Table 3. Intervention pilot outcomes**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Indicator</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depression</td>
<td>PHQ-9 score (34)</td>
<td>Enrolment &amp; follow-up questionnaire</td>
</tr>
<tr>
<td>Stigma</td>
<td>Adolescent HIV stigma scale (35)</td>
<td>Enrolment &amp; follow-up questionnaire</td>
</tr>
<tr>
<td>Social support</td>
<td>Social Support Behavior questionnaire (36)</td>
<td>Enrolment &amp; follow-up questionnaire</td>
</tr>
<tr>
<td>Resilience</td>
<td>Connor-Davidson resilience scale (37)</td>
<td>Enrolment &amp; follow-up questionnaire</td>
</tr>
<tr>
<td>ART knowledge</td>
<td>LifeWindows ART information motivation behavior scale score (27)</td>
<td>Enrolment &amp; follow-up questionnaire</td>
</tr>
<tr>
<td>ART adherence</td>
<td>Self-reported using visual analogue scale</td>
<td>Enrolment &amp; follow-up questionnaire</td>
</tr>
<tr>
<td>Intervention acceptability</td>
<td>Frequency of messaging to group Topics generating discussion</td>
<td><em>WhatsApp</em> content analysis</td>
</tr>
</tbody>
</table>

**11.8 Study Materials**

**Equipment:** The grant award includes support to purchase 1 audio recorder and 2 tablets.

**Personnel:** The grant award includes support for UW investigators, KNH investigators, a study coordinator, an administrator and study personnel. Study personnel working in Kenya will be hired through KNH according to standard procedures.

**11.9 Training Procedures**

Drs. Irene Inwani and Cyrus Mugo will supervise training of personnel in study procedures. This will include research ethics, completion of ODK-based questionnaires and management of the *WhatsApp* intervention. As part of the intervention development in Aim 2, standard operating procedures and discussion topic guide will be produced to guide HCW and peer counselors in delivering the intervention. Study personnel will be trained in these procedures prior to the pilot.
11.10 Quality Assurance Procedures
Adherence to the study protocol will be ensured through weekly reporting of enrollment, follow-up and adverse events to the study PI. These reports will enable monitoring of study activities to ensure compliance and quickly identify and respond to problems or deviations from the protocol. During the pilot phase, intervention messaging will be reviewed weekly to ensure consistent delivery of the intervention in compliance with the protocol, and identify any needs for additional training that may arise.

12. ETHICAL CONSIDERATIONS

12.1 Consent explanation
Consenting procedures are described in section 11.5. Consent forms include the following information:
- Title
- Researchers’ contact information
- Introduction
- Purpose of the study
- Procedures
- Risks, Stress, or Discomfort
- Alternatives to taking part in this study
- Benefits of being in the study
- Funding
- Confidentiality
- KNH/UON ERC and UW IRB contact information
- Study participant statement and signature (written consents only)

12.2 Institutional Review Board
This is a collaborative research proposal that will involve field procedures in Nairobi and data analyses in Nairobi and Seattle. The study will be reviewed by the Kenyatta National Hospital/University of Nairobi (KNH/UON) Ethics and Research Committee (ERC), and the University of Washington Institutional Review Board (IRB). The study will not recruit subjects prior to approval from both the UW IRB and the KNH/UON ERC.

12.3 Risks to subjects
Physical: The study involves no medical interventions therefore we anticipate no risk of serious harm to participants.

Psychological: AYA participating in IDIs, FGDs and the pilot intervention may experience emotional distress associated with discussion of sensitive HIV-related information and concerns about ART adherence.

Other: Participants are at risk of breach of confidentiality, particularly disclosure of HIV status for AYA. This is a risk if participation in study activities is interpreted by others as positive HIV status, if a third party gains access to a participant’s phone and accesses their WhatsApp communications, or if a third party gains access to study records.

Alternative treatments or procedures: Not applicable

12.4 Protection against risks
Recruitment and informed consent: When recruiting participants, study staff will describe the study in general terms in order to maintain discretion. Details will be provided in private. Written informed consent will be obtained. Emancipated minors and AYA over age 18 will provide their
own consent. Non-emancipated minors whose parents/guardians attend care with them will provide assent and their parent/guardian will provide permission. We will request waiver of parental consent for non-emancipated adolescents whose parents/guardians do not accompany them to clinic. Consent materials will be written in age-appropriate language and will be administered by study staff experienced in communicating with youth.

**Psychological risks:** All participants will be informed that their participation is voluntary and that they may withdraw from the study at any time, or refuse to answer any questions. All study staff will be trained in protection of human subjects and the emotional needs of youth.

**Risk of breach of confidentiality:** Study staff will be trained to take all precautions to ensure confidentiality of participation and data prior to study initiation, and will follow standardized operating procedures to minimize the risks of a participant’s loss of confidentiality. Risk of breach of confidentiality of study data is low, due to the following precautions. Collection of IDI, FGD and questionnaire data will be conducted in a private, sound-proof room at each study facility. Audio-recordings of IDIs and FGDs will be uploaded to a password-protected computer and erased from the recorder within one day of interview. Recordings will be erased from the computer within 6 months. Questionnaire data will be transmitted to a secure server daily and erased from the tablets. Tablets and the server to which the data are uploaded will be password-protected. Tablets will be locked in a secure location accessible only to study staff. The link between identifiable participant information and study IDs will be locked in a secure location and destroyed following study completion. *WhatsApp* is end-to-end encrypted, meaning that messages can only be accessed by the people involved in the conversation. The study will access *WhatsApp* using a password-protected tablet. Participants will be counseled at enrollment on the risks of breach of confidentiality through messaging and will be encouraged to password-protect their phones and erase any sensitive communications. Depending on preferences expressed in Aims 1 and 2, *WhatsApp* groups in the pilot intervention may be stratified by participant HIV disclosure status.

**Additional protection for children:** Consistent with US and Kenyan regulations, additional protections will be afforded to participating children. Youth under the age of 18 whose parent/guardian accompanies them to the clinic will provide assent and their parent/guardian will provide permission. We will request a waiver of parental consent for non-emancipated adolescents whose parent/guardian does not accompany them to clinic on the grounds that obtaining parental consent for these individuals would present additional risks and barriers to study participation. Emancipated minors who report being married, being pregnant or having children may provide their own informed consent in accordance with Kenyan regulations. All consent materials will be written in language that is readily understandable for the age group and will be administered by trained study personnel sensitive to the specific emotional needs of youth.

**12.5 Potential benefits**
Participants in the formative data collection (Aims 1 and 2) may benefit directly from sharing their experiences of HIV care and their desired features in a social media support group with a sympathetic audience. Participants in the pilot may benefit directly from additional support and knowledge resulting in improved retention in care, ART adherence and overall wellbeing. Participants may experience indirect benefit due to the study’s generation of data that will lead to improved care for HIV-infected AYA.

**12.6 Compensation**
A nominal travel reimbursement will be provided for participant travel to the study clinic (see section 11.6).
12.7 Importance of the knowledge to be gained
Interventions to improve HIV treatment outcomes in AYA are urgently needed, especially in Kenya and sub-Saharan Africa more broadly, where 4 million HIV-infected AYA live. This study’s findings will be relevant to the health of a large and vulnerable group. The systems we have developed in our prior work on mHealth and peer interventions to improve HIV care will provide strong protections against the risks of breach of confidentiality and emotional distress. The importance of the research therefore outweighs the risks to participants.

13. DATA MANAGEMENT

IDIs and FGDs
IDI and FGD audio recordings and transcripts will be uploaded to a password-protected computer and erased from the recorder within one day of interview. Recordings will be erased once transcripts have been validated, no more than 6 months after generation of the recording.

Questionnaires
All questionnaires will be administered using the tablet-based ODK platform. Tablets will be password-protected and questionnaires will be transmitted to a secure server daily and erased from the tablets. Data will be transmitted via secure socket layer (SSL) and only accessible by authenticated users. Tablets will be stored in a secure, locked office accessible to study staff only. All participants will be assigned a non-identifiable study ID number upon enrollment. All data records will be identified by study ID only. The link between identifiable participant information and study IDs will be locked in a secure, locked location and destroyed following study completion. Study analysts will receive only coded data.

WhatsApp content
WhatsApp is end-to-end encrypted, meaning only members of a group chat can access its content. WhatsApp will be accessed by study staff who have joined the group through a password-protected tablet, stored in a locked office. WhatsApp communications will be exported to a secure web-based server and downloaded to a password-protected computer and all identifiable information such as names and phone numbers will be permanently erased.

Paper records
Consent forms and participant locator information will be stored in paper forms. These will be stored in a secure, locked location and destroyed following study completion.

Data Ownership
The proposed project is a collaborative effort between investigators at the UW and KNH. The aforementioned institutions will jointly share ownership of the data. Study investigators at the UW and KNH will have full access to the data. Authorship on publications, conference presentations, abstracts and other materials generated from this study will reflect contribution to design, execution and analysis of the study.

Data Release/Sharing Policy
This study will comply with the NIH Public Access Policy, which ensures that the public has access to the published results of NIH funded research. It requires scientists to submit final peer-reviewed journal manuscripts that arise from NIH funds to the digital archive PubMed Central upon acceptance for publication.
14. RESULTS DISSEMINATION

A CAB composed of AYA, clinicians and community members that represents the interests and priorities of AYA living with HIV will be established for this study. This CAB will meet twice a year during the study to receive data updates and provide guidance on study implementation and interpretation of findings. Study findings will be shared with the Kenyan Ministry of Health and National AIDS and STI Control Program at its conclusion as a presentation or written report. Findings will be disseminated to the research community in the form of conference presentations and journal articles.

15. STUDY LIMITATIONS

This study is limited by its focus on three clinics in Nairobi. Findings from this study may not be generalizable to other regions. Analysis of the intervention pilot is also limited by small sample size and short follow-up, which impairs our ability to measure the intervention’s clinical impact. This study is formative, and will be used to inform a large cluster-randomized study with longer follow-up to evaluate clinical impact at multiple facilities.

16. STUDY TIMELINE

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### 17. BUDGET

**DETAILED BUDGET FOR ENTIRE BUDGET PERIOD (USD)**

**DIRECT COSTS ONLY**

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<th>NAME</th>
<th>ROLE ON PROJECT</th>
<th>Cal. Mnths</th>
<th>Acad. Mnths</th>
<th>Summer Mnths</th>
<th>INST.BASE SALARY</th>
<th>SALARY REQUESTED</th>
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<td>5,616</td>
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</tr>
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</table>

**SUBTOTALS**

| TOTAL                 | 80,843           | 19,774      | 100,599      |

**CONSULTANT COSTS**

**EQUIPMENT** *(Itemize)*

**SUPPLIES** *(Itemize by category)*

- 1 audio recorder: $70
- 2 tablets: $200

270

**TRAVEL**

**INPATIENT CARE COSTS**

**OUTPATIENT CARE COSTS**

**ALTERATIONS AND RENOVATIONS** *(Itemize by category)*

**OTHER EXPENSES** *(Itemize by category)*

- Dedoose qualitative analysis software license (12 months): $120
- Medical insurance for Kenyan staff: $1,440
- Participant reimbursement: $1,200
- Communication: $400
- UW Kenya service fee: $394

3,554

**CONSORTIUM/CONTRACTUAL COSTS**

**DIRECT COSTS**

**SUBTOTAL DIRECT COSTS FOR INITIAL BUDGET PERIOD** *(Item 7a, Face Page)*

$110,000

**CONSORTIUM/CONTRACTUAL COSTS**

**FACILITIES AND ADMINISTRATIVE COSTS**

4,377

**TOTAL DIRECT COSTS FOR INITIAL BUDGET PERIOD**

$110,000

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Social media for ART adherence and retention in AYA
18. REFERENCES


