

# Bridging the science-to-service gap: Implementation of a supervised HIV self-testing intervention among young adults at a tertiary education institution in Zimbabwe

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## Research

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## Abstract

**Background:** The evidence-based practices of implementation science constitute the integration of study findings into routine practice of public health interventions such as HIV testing services (HTS). While young people are at high risk of HIV infection, a national survey showed that adolescents and youths were less likely to go for an HIV test. This study aimed to develop and implement a systematic and multifaceted HIV self-testing (HIVST) intervention to promote the uptake of HTS among young people.

**Methods:** The study was conducted at Africa University, Mutare where desk and literature review was conducted to gather evidence on HIVST. Multiple stakeholder consultation was carried out to understand contextual enablers and barriers that either promote or undermine adoption of the intervention. Strategies for situation analysis and evidence gathering included community engagement meetings, training of implementers and conducting a baseline survey. A consensus group adapted the Consolidated Framework for Implementation Research (CFIR) to understand the realities of context and intervention while the Reach, effectiveness, adoption, implementation, maintenance (RE-AIM) guide was used to analyze the intervention implementation and evaluation survey.

**Results:** The baseline enquiry indicated that the CFIR dimensions which positively influences intervention implementation were: network, network and communications, preparation of implementation, availability of resources, planification, implication and formally appointed internal leadership while origin of intervention and self-efficacy had negatively influenced implementation. Evaluating the intervention fidelity using the RE-AIM framework revealed that high performance with regard to reach, effectiveness, adoption and implementation but low maintenance. This study also applied the APEASE criteria (affordability, practicability, effectiveness, acceptability, side effects, and equity) for selecting the final components used in implementation.

**Conclusion:** Combining literature search, documents review, stakeholder consultation, together with provider and end-user engagement can potentially improve intervention delivery for closed populations such as Universities. Blending program agents with systematic process of activities correspondingly enhance HTS uptake among young people. The utilization of the CFIR and RE-AIM analytical frameworks in this study, offered flexible and simplified implementation and analysis of the intervention.

## Contribution To Literature

- Involving policy makers, implementers and product end-users at design, development, execution and evaluation stages of an intervention can promote program ownership and commitment thus, sustaining the intervention implementation.
- The two implementation science frameworks of CFIR and RE-AIM are complementary; CFIR can identify modifiable factors that has the potential to undermine or promote intervention adoption while RE-AIM can evaluate practice change introduced by intervention implementation.
- Implementation science strategies can provide the best way to address discrepancies in the complex HIV treatment, prevention and care cascades.

## Background

The Sub-Saharan Africa region is home to 12% of the global population yet the region accounts for 71% of the global burden of HIV infections [1]. Zimbabwe is among the 10 countries in sub-Saharan Africa with the highest HIV prevalence of 14% and in 2016, an estimated 30,000 deaths in the country were AIDS-related [2,3]. HIV Testing Services (HTS) offers the ultimate entry to HIV treatment and care, and the optimal identification of HIV infected individuals is critical to achieving the aims of the 2015 World Health Organizational (WHO) "treat-all" recommendations [4].

The 95-95-95 UNAIDS global treatment targets towards the diagnosis of 95% of people living with HIV, of whom 95% will be on treatment and 95% of those on treatment will be virally suppressed by 2030 [5]. In Africa, delay in HIV/AIDS diagnosis contributes significantly to high rates of early mortality [6-8]. Barriers to the uptake of HTS include stigma concerns, fear of prognosis, diminished HIV risk awareness, and the inconvenience, transportation and opportunity costs incurred [9,10]. New client-centered approaches to testing such as 'self-testing' have recently been used to address some of these barriers [11-14].

HIV self-testing (HIVST) involves the individual collecting their own sample and conducting the test in private before interpreting the result either assisted or unassisted [15]. Although HIVST enables users to know their HIV status, it does not provide a definitive diagnosis. This approach has the potential to substantially scale-up access to HTS among hard-to-reach, and high-risk populations including young people [16].

The concept of HIVST was well received by most key stakeholders who include HIV activists, policymakers, healthcare workers, and academics with an insistence on the need for adequate research before adoption [11]. However, very little is known on the essential components required for selecting and guiding the strategy to address contextual barriers [17]. While many developed countries have adopted self-testing as part of their HIV policies by 2018, most of sub-Saharan Africa was still considering embracing the intervention [18]. Preliminary positive findings from acceptability and feasibility pilot research in Zimbabwe informed the adoption of HIVST by the Ministry of Health and Child Care (MOHCC) [11].

Regulation of HIVST strategies is key because test results can have significant implications on mental health, health-seeking and sexual behavior, and HIV transmission. Areas of supervision include adherence to quality standards for the self-test kits, logistics of distribution and the nature of marketing/advertising messages [19]. Testing technologies include simple-to-use oral HIV tests that offer high sensitivity and specificity [13,14,20,21].

Young people are disproportionately vulnerable to HIV acquisition, both socially and economically [1,22-24]. HIV-related deaths among young people have more than tripled since 2000, and HIV/AIDS is ranked the second cause of death among adolescents worldwide [25]. A national survey in 2015 showed that only 46% of young women and 47% of young men had comprehensive knowledge of HTS and HTS uptake among adolescents and youths in Zimbabwe was low [2]. Only 39% of men and 63% of women (aged 15-24 years) who had had sexual intercourse within 12 months preceding the survey reported having been tested for HIV [2]. Concerns about confidentiality and privacy were the key barriers to HTS among young people [26]. Another national survey in 2016 showed that HIV positive young people were less likely to have undergone HIV testing and the average HTS coverage was 52% [27]. Thus, it was important to implement strategies aimed at increasing HTS among the young population.

Traditionally, top-down approaches were used in developing of public health interventions that are derived from behavior change theories assumed to be one size fits all [28]. However, this has caused implementation and sustainability challenges because the end-users are not consulted. End-user adherence and program effectiveness have been found to be significantly associated with empowering both implementers and end-users in designing interventions tailored to their specific contexts [29,30]. Zimbabwe focused on facility-based HTS strategies that were complimented by annual HTS campaigns and partner-supported mobile outreach efforts. According to the Operational and Service Delivery Manual for the prevention, treatment and care of HIV in Zimbabwe (2017), additional innovative and client-centered HTS strategies such as HIVST along the lines of differentiated service delivery [31].

Proctor et al. (2013) defined implementation science (IS) as the methods utilized to enhance the adoption and implementation of clinical interventions such as HIVST [32]. The evidence-based practices (EBP) in IS promotes integration of study findings into routine practice [33] because it constitutes the 'how to' component targeting transformation of practice [32]. IS comprises of developing strategies aimed at overcoming barriers while enhancing the effectiveness of interventions through bridging the science-to-service gap [34, 35]. According to Proctor et al. (2009), IS utilizes 'top down/bottom up', 'push/pull', and 'carrot/stick' tactics all packaged into a single approach [36].

An effective implementation intervention make diverse consultations to introduce system-level change, thus facilitating integration and sustainability of interventions into the pre-existing infrastructure [37] while providing support for health professionals to modify work practices, and aim for behavior change in patients/clients [38]. The HTS program is traditionally conducted at the primary healthcare level and the introduction of HIVST at a tertiary institution level where the population is predominantly young and sexually active could promote uptake of HTS [23].

## Aim

This study aimed to increase HTS options by developing a complementing HIVST program for students at a tertiary education institution through a participatory approach of IS. The multifaceted intervention implementation sought to determine the acceptability, feasibility, local relevance and effect of establishing the HIVST intervention by targeting students and healthcare providers. The study also sought to ascertain potential adaptation and sustainability of the intervention among key administrative stakeholders and health care workers.

## Methods

### Study Design

This was a pilot study which used IS strategies to promote the systematic uptake of the EBP of HIVST into routine practice. Despite the numerous healthcare practices having an empirical-base that guide care delivery, utilizing the evidence is not part of routine practice [39]. Titler (2018) also noted that the disparity between the available evidence-based recommendations and the application of these recommendations to improve population health is associated with poor health outcomes. Figure 1 shows the Evidence Integration Triangle [40] used to understand the uptake of HIVST initiative in this study.

Empirical evidence, end-user perspectives and relevant stakeholders input were utilized in the development of the SAYS (Swipe And know Your Status) initiative at Africa University (AU). Implementation of the initiative adopted Leask et al.'s principle of co-creation in which they hypothesized that the development of a public health intervention is a collaborative effort involving both academics and stakeholders [28]. In co-creating the HIVST intervention at the university, the end-users, service providers, and policy makers at both institutional and national levels were consulted to ensure integration of the HIVST intervention with the pre-existing HTS. Figure 2 shows the systematic flow of the process of intervention mapping implemented in this pilot study.

### Baseline enquiry to promote EBP

#### Step 1. Identifying the need, program planning and stakeholder engagement

To identify gaps related to practice, healthcare facility HTS register reviews were conducted at the two main health facilities serving the University by the research team made up of FMM (Public Health Physician), RAK (Public Health and M & E Specialist) and MT (Social Scientists), EMC (Public Health Nursing Specialist), MM (Psychotherapist and Mental Health Expert), and WM (Social Scientist, Monitoring and Evaluation Officer). The team also did an extensive literature review of how HIVST programs were implemented in different setting by searching for HIVST-related articles on databases such as Google Scholar, MEDLINE in PubMed, EMBASE, EBSCOhost and Scopus with the help of a librarian. After the reviews, the research team and implementing team (health professionals) represented by TM (Nurse) met to map the activity timelines, discuss on the stakeholders to be consulted and material required for the successful implementation of the initiative.

The MOHCC which is the custodian of the national HTS program was consulted through the office of the Manicaland Provincial Medical Director's Office which offered two HIV/STI/TB focal persons (CU and QM) who also acted as program trainers. The research team, implementers and the MOHCC representatives met twice during the months February to April

2018 to draft proximal program objectives, the HIVST Project Training of Trainers Facilitators Manual Hand Book (Additional File 1) and Training Evaluation Forms for participants (Additional File 2).

## **Step 2. Community engagement to identify program barriers and enablers**

The implementing team led by TM, organized a community dialogue session held on campus where participants were purposively-selected according to their roles on campus and in HTS programming. The session was attended by a total of 83 participants who included student board leaders, Dean of Students, campus club representatives, hostel wardens, Non-governmental organization (NGO) representatives from Students and Youth Working on Reproductive Health Action Team (SAYWHAT) and Fairfield Buddies, and the research team. The session also included representatives from three other institutions of higher education. The aim was to introduce the SAYS initiative and identify potential barriers and enablers of implementing the intervention at an institution of higher learning.

A second community engagement meeting held at Old Mutare Hospital was attended by 17 local adolescents and young adults (16 to 27 years) who were not university students. The group was made up of Community Adolescent Treatment Support (CATS) members some of whom were living with HIV, five hospital nurses working in the Opportunistic Infections Clinic, six members of the AU Peer Network Club and their patron (TM). The aim was to discuss pertinent issues related to HIV/AIDS screening/testing methods and experiences.

## **Step 3. Capacity building through training of implementers and development of intervention materials.**

Thirteen (2 males and 11 females) purposively-selected community health worker group which was made up of university lecturers and scientists with a medical, nursing and laboratory-based background were trained in May 2018. The objective was to provide a background and rationale of the initiative, share key findings and lessons learnt during the MOHCC pilot study. The workshop which was facilitated by CU and QM also equipped participants with knowledge and skills on HIVST counseling.

Another training session was conducted with health workers from the two local health facilities, psychotherapist (MM) and 26 Peer Educators (PEs) (11 female and 15 males) who would be crucial in the implementation of the program. PEs also known as "Champions" from among the students were responsible for providing psychosocial and emotional support to other students within the institutional environment. To cater for the culturally and linguistically diverse pan African environment at the University, the PEs were from different nationalities and a third of them were fluent in either French or Portuguese languages.

CU, QM, MT and FMM facilitated the three day training which equipped participants with background and rationale of the HIVST program, share key findings of the pilot program, discuss self-awareness and its role in counseling. Participants were mentored on counseling principles, techniques and process through presentations, group discussions, and peer counseling role-plays. The workshop was also used as an opportunity to develop program messages that were to be printed on flyers and banners, and these were submitted to the Provincial Office of Health Promotion for review and approval before printing. Survey data collection tools were developed and PEs were trained on research data collection and associated ethical issues. Participants were given program t-shirts and hats to promote visibility.

## **Step 4. Baseline Survey**

A baseline campus-wide cross-sectional survey aiming at identifying the barriers and enablers was conducted, analyzed and reported between June and August 2018. The survey also aimed to understand the student and health worker perspectives and experiences with regards to HTS. Conveniently-selected students were interviewed using semi-structured questionnaires

while providers and university management were interviewed as key informants. The interview guides were guided by selected elements from the Consolidated Framework of Implementation Research (CFIR) to explore students' knowledge of the HTS and HIVST programs, describe the key characteristics of students who were likely to get tested and identify the issues and perceptions around HIVST intervention's feasibility, acceptability, local relevance demand, practicality and potential sustainability among the key administrative stakeholders. The interview guides enquired about the components of HTS and supporting milestones as recommended by WHO [41] and these are displayed in Table 1.

Table 2 shows the CFIR guide used in survey questionnaire development [42]. The data collection team were ten purposively-selected trained PEs supervised by FNNM, MT and WM. The baseline interview responses elicited data which was classified either as enablers or barriers to HIVST thus, guiding intervention choice components. The observed enablers and barriers to HIVST were compared with the findings in systematic reviews [43-45].

The authors mainly concentrated on the modifiable factors which this study was most likely to address and non-modifiable factors were disseminated to national HTS program stakeholders for action. Findings from the community dialogues, discussions during training and survey interviews were analyzed according to the CFIR guide which is a standard approach that produces actionable findings for improving the effectiveness of implementation of public health interventions [42].

## **Step 5. Identifying the acceptability, feasibility and local relevance of the SAYS initiative**

A multidisciplinary consensus group comprising of FMM, MT, WM, TM, CU, MM and ten PEs met twice to discuss on strategies to be employed in intervening by reviewing the available evidence from community dialogue narratives, training evaluations and survey responses. The team focused on identifying how the evidence fit into the intervention and how non-fitting factors could be adjusted to suit the intervention components. This was done by stratifying the responses into enabling and barrier factors which were operationalized during program implementation. The collaborating consensus group members also contributed their experiences and expertise in the various components of the intervention.

Table 3 displays the scoring grid on practicability and acceptability of the intervention constructs against the HTS components as agreed by the different stakeholders during the consensus meetings. The scoring grid was used to assess the influence of the constructs on the components of the HTS components proposed by WHO. The scores ranging from -2 to 2 were assigned by consensus.

## **Intervention phase**

The intervention was implemented from August 2018 to February 2019. HIVST kits were kept at the university laboratory for quality assurance under the oversight of a Medical Laboratory Scientist and providers collected the kits based on demand. PEs equipped fellow students with information on the SAYS initiative by creating awareness while simultaneously encouraging students to be tested by word of mouth. Emails advertising the initiative were also sent to all student through the University Registrar's desk.

Print materials (pamphlets) were handed out to potential participants and video materials were distributed via student WhatsApp groups to encourage increased regular repeat testing as well as early access to HIVST [18]. The materials were also adopted for use by translating them to French and Portuguese languages to support the pan-African environment at the university. A one day Health Fare Gala was held in September 2018 to sensitize the students and offer more information on the initiative. This event which was open to all students, was hosted by the implementing team in collaboration with SAYWHAT and PSI.

'Supervised' self-testing and counseling meant that the service was offered by a trained healthcare professional or PE. Clients were able to conduct their own HIV test in private, using appropriate supplied test kits, and where necessary support and supervision was rendered by the healthcare workers. Clients needing HTS still had the choice of a regular voluntary counseling and testing conducted by a health worker, or self-testing in private. Students had the option of conducting the self-testing exercise in a room identified for the purpose at the health facility or taking the kit to the hostel/other private space.

Peer Educators assisted in disbursing HIVST kits when the nurses were overwhelmed. At the time of disbursement students provided their demographic information including mobile contact, received orientation and information materials from the provider/PE. The information materials constituted detailed instructions for use, linkage to care, and disposal of used testing swabs. Information on how to use HIVST kits alleviated misinterpretation and misconception of results, thus promoting intervention uptake [10, 47]. Clearly labeled protected bins were placed in the testing room and in strategic points at the hostels for the purposes of disposal. While facilitating infection prevention and control, this effort also provided information on uptake and use of kits through physical counts of the used swabs.

The OraQuick rapid HIV 1/2 antibody test (OraSure Technologies, Bethlehem, PA, USA) which was prequalified by WHO [48] was used for conducting self-testing. A total of 750 kits were availed for use through a donation from OraSure Technologies Inc. Test kit distribution was restricted to the two health facilities serving the University where trained staff could monitor the distribution by PEs during the normal working hours. Kit disbursement registers were used to capture number of kits collected and socio-demographic data of participants without taking down client names. Follow-up messages were sent via phone text by the nurses to participant within 24 to 48 hours of collecting the kit. This was mainly done as a way of checking how the student was coping and if they required any additional services like one-on-one counselling or linkage to care.

## End-line evaluation survey

Ten data clerks (PEs) were used to collect data from 349 conveniently sampled participants (who had or had not self-tested) using a semi-structured questionnaire as well as purposively selected key informants and a data sheet guiding collection of statistics from the health facility registers. The evaluation aimed to ascertain the feasibility, acceptability and local relevance of the HIVST intervention (March to April 2019). The survey questionnaire development was guided by the RE-AIM (Reach, Effectiveness, Adoption, Implementation, Maintenance) framework of evaluating interventions [49]. The study participants were asked on acceptability, potential concerns, perceived effectiveness of implementation and recommendations for adoption as well as sustainability of the intervention using semi-structured self-administered questionnaires. The findings of the survey were used as reinforcement to enhance self-testing sustainability through rapid evidence review of the HIVST program to inform practice and policy.

## Context

The study was carried out at Africa University, a tertiary education institution 18 km north of the Zimbabwean eastern border city of Mutare. Participating health facilities (AU Clinic and Old Mutare Hospital) were purposively-selected and the study population was 1,690 university students from 29 African countries and service providers at the facilities. Enrollment statistics at the time showed that 53% of the students were females, 32% were international students, 65% of the students lived on campus and 25% were housed in University-recommended hostels in Mutare City.

## Data Management and Analysis

Data collectors (PEs) were responsible for conducting the informed consent process and issuing questionnaires to students while WM and MT interviewed the health workers and university management. Tools were pre-tested at a tertiary institution

and its corresponding health facility in Mutare City for clarification, reliability and validity of the data extraction tools. FMM, PTM (Public Health Officer) and WM were responsible for data entry and analysis. Qualitative data from dialogue sessions and open-ended survey questions were thematically coded before content analysis was done while quantitative data was imported into Epi Info version 7.2.1.0 (CDC, USA) for Chi-squared test of association and multivariate analysis at 95% confidence interval and 5% level of significance.

## Ethical clearance and permission

Ethical clearance was issued by the Medical Research Council of Zimbabwe and the Africa University Research Ethics Committee. Permission to carry out the intervention and data collection activities was granted by the Provincial Medical Director of Manicaland and the AU administration.

## Results

### Baseline enquiry to promote Evidence-Based Practice

#### Step 1. Identifying the need, program planning and stakeholder engagement

Literature revealed that the 'complexity of the HIV epidemic calls for young people to be at the center of its prevention' and interventions should focus on equipping young people to assess their personal HIV risk exposures and stimulate preventative measures [23, 50, 51]. However, the desk review of HTS registers at AU showed a low uptake of HTS with only 95 students (48 males and 47 females) having been tested for HIV during the 12 months of 2017. There were notable gaps within the HTS program at provider and end-user levels.

Health workers were not trained in HIVST and were occasionally burdened by workloads for them to offer the comprehensive pre- and post-test counseling. The MOHCC supported the SAYS initiative through capacity building and local NGOs offered technical support. There were few nurses who were responsible for the HTS and the students felt that the nurses could easily recognize them if they presented for testing due to the small size of the community. During program development meetings, team members resolved that the baseline assessment activities would run for six months followed by a six month implementation of the intervention before conducting an evaluation survey.

#### Step 2. Community engagement to identify program barriers and enablers

The dialogue sessions identified several barriers and enablers to be addressed using the CFIR Framework. Barriers included the absence of comprehensive pre- and post-test counseling in HIVST programs, language (English versus French or Portuguese) and limited knowledge of the HIVST intervention. Students expressed the need for exhaustive pre-test counseling before collecting the HIVST and the need to develop ways of dealing with possible health and mental effects of HIVST, particularly after a reactive result. With limited knowledge of the intervention, some students were skeptical of their individual ability to self-test. Language barrier was also a major concern as first year students from French and Portuguese speaking countries who were still in the English language intensive classes would have challenges understanding the intervention materials if English was the only language used. Healthcare provider barriers included limited staff at the facilities and lack of knowledge on the HIVST.

Enablers included personality assessment during screening and training the PEs for counseling, and awareness campaigns. Use of PEs would enable the participants to freely express themselves to someone of their age [52]. To promote privacy, it was optional to disclose one's status. Competing demands such as busy student lecture and exam schedules and being on attachment were not modifiable within the scope of the study.

## **Step 3. Capacity building through training of facilitators and development of intervention materials.**

The training workshops used pre- and post-testing to ascertain participants' knowledge of HIVST and basic counseling skills before and after the training sessions. All participants scored higher during the post-tests which was an indication of understanding of the taught concepts. The participants were informed on the HIVST process including aspects of approaches, purposes and principles of counseling in addition to self-awareness sessions. The sessions equipped participants with a systematic approach to peer counseling, documenting dispensed kits and strategic disposal of used test kits. Participants perceived the capacity building sessions as one way of developing leadership skills in young adults.

## **Step 4. Baseline Survey**

The 232 participants of the baseline survey constituted 87 males and 124 females and the majority (47%) of these were in the age group 20-24 years. Of those who had tested for HIV before ( $n=121$ ), the majority (92%) were tested off-site (facilities other than the two health centers serving AU). 79% agreed to the statement 'HIV self-test kits should be made available to the general public'. The main advantages of HIVST cited by participants were privacy and anonymity while the main disadvantages were the absence of professional counseling, the possibility of self-harm after testing positive and misinterpretation of test result.

## **Step 5. Identifying the acceptability, feasibility and local relevance of the initiative**

The 16 individuals who took part in the consensus process proposed that the seven HTS components recommended by WHO be operationalized. Although the majority of HTS components were acceptable, the feasibility of individual components varied. Despite linking participants to care being a vital component of HIVST, some participants considered taking the student's mobile contact during kit disbursement as an infringement of privacy. The nurses were uncertain about the feasibility of the text message being able to motivate the students to take up post-test services at the two facilities hence, the messages were to emphasize the need for linking to post-test care either on-site or off-site. The consensus group findings were used to populate the six components of the affordability, practicability, effectiveness, acceptability, side-effects, equity, sustainability (APEASE) criteria [53,54] as displayed on Table 4. Table 5 (Additional File 3) shows the facilitators and barriers to implementing the SAYS initiative across the seven HTS components as observed during the consensus process.

## **Using RE-AIM to evaluate the implementation of the SAYS initiative**

The RE-AIM framework [55] was used to evaluate the intervention implementation and end-line survey. A total of 349 (158 males and 191 females) and 11 key informants were interviewed during the end line survey.

### **Reach**

Reach refers to the absolute number, proportion, and representativeness of individuals who were willing to participate in the initiative [49]. By the end of the six months of the intervention implementation, 744 students had collected HIVST kits. Student characteristics were associated with the uptake of kits. The median age of students who participated in the intervention phase was  $22\pm4.8$  years. The majority of students who collected the HIVST kits were females (56%) and 69% were either first or second year students. Younger men ( $\leq 24$  years) were less likely to self-test compared to younger women [Odds ratio (OR)=0.34; 95% Confidence interval (CI)=0.22-0.52]. Students who had more than two years of study were more likely to self-test than first and second year students (OR=2.09; 95%CI= 1.31-3.31) and female students in their 3<sup>rd</sup> or 4<sup>th</sup> year of study were more likely to self-test than their male counterparts (OR=1.69; 95%CI=1.25-2.28). Male students who collected the kits were less likely to have been exposed to PE counselling when compared to female students who collected the kits.

(OR=0.67; 95%CI=0.50-0.90). Older students (>24 years) were more likely to opt to go and test at the hostels or some other private place when compared to younger students (OR=2.40; 95%CI=1.47-3.92) while younger student were less likely to participate in couple counselling (OR=0.41; 95%CI=0.24-0.70) and those who had previously tested for HIV were more likely to self-test during the pilot intervention at AU than first time testers (OR=9.44; 95%CI=4.55-19.6).

## **Effectiveness**

Effectiveness is the impact of an intervention on outcomes, including potential negative effects, quality of life, and economic outcomes [49]. The SAYS initiative managed to increase the HTS uptake rate from 6.3% of the 12 months of 2017 to 49.6% for the six month period of this pilot intervention. The actual proportion of students who know their status at the institution is beyond the scope of this study. It was also difficult to ascertain the number of reactive results because none of the students who self-tested disclosed their results.

## **Adoption**

### **Setting**

Adoption entails the absolute number, proportion, and representativeness of settings and intervention agents who are willing to initiate the program [49]. There are eleven institutions of higher education in Mutare City that are eligible for inclusion in the program roll-out. Limitations in the size of the program budget dictated that the pilot be only carried out at one institution. Representative from the three higher education institutions that attended the community dialogue session all expressed willingness to participate in such a program.

## **Participants**

The evaluation survey revealed that participating in the intervention did not differ significantly with most of the characteristics measured (age, gender, marital status, nationality, year of study, receiving an email about the HIVST program). However, those who read an HIVST pamphlet were more likely to self-test than those who did not read the pamphlet (OR=4.03; 95%CI=2.33-6.34) and students who were counseled by PEs were more likely to collect an HIVST kit when compared to those who were not counseled by a PE (OR=2.06; 95%CI=1.90-3.05). Reasons for not participating varied from having recently tested, fear of a positive result and a belief that one was negative since they were abstaining.

## **Implementation**

The 'Implementation' element in RE-AIM constitutes the intervention agents' fidelity to the various elements of an intervention's protocol [49]. The planning meetings, dialogue sessions and trainings were executed as scheduled. There was a huge influx of students collecting kits as result of the response to the hype of the launch event during the initial phases of implementation and the clinic staff were overwhelmed while most of the PEs were busy with lectures. A member of the research team, WM assisted in kit disbursement during the first two weeks, which was a deviation from the implementation protocol. Although the number of student visiting the clinic decreased over time due to busy schedules like exam times or vacation breaks, the participants continued to collect kits for self-testing. After noting the reluctance of participants to seek post-test services at the facilities, follow-up messages included the off-site option.

## **Maintenance**

Maintenance refers to the extent to which a program become part of the routine organizational practices [49]. About 88% of the evaluation survey participants who had self-tested reported that knowing their HIV status triggered risky behavior change and the majority recommended that the health facilities acquire more self-testing kits. The implementing team members who were interviewed six months post-intervention period revealed that the providers, end-users and institution were strongly interested in continuation of the intervention. The health centers had contracted an NGO which was supplying them with 50 HIVST kits monthly, although these were inadequate considering the increased demand for self-testing among the students. There were limited funds to conduct more sessions and trainings and the institution was liaising with stakeholders for funding. For sustainable operation, the implementers had to identify a reliable source of funding to ensure continued HIVST operation effectiveness.

## Discussion

Enhancing the implementation of HIV testing/screening programs is a significant issue not only in Zimbabwe but globally as evidenced by the low testing rates among young people cited in literature from different countries [55]. The study outlines the systematic process in the development, implementation and evaluation of an intervention involving many aspects. Implementation and evaluation of HIVST interventions has the potential to alleviate the perceived barriers while promoting the facilitators of HIVST among end-users, healthcare workers and policy makers [16]. It was apparent that investing in supervised HIVST was more effective when compared to the facility-based HTS.

The consensus process after the baseline assessment showed that most of the CFIR constructs had a positive impact on the HTS components in the implementation of the intervention. External constructs, internal constructs (such as network communications, preparation of implementation and availability of resources), and the processes of the intervention dominated the positive influence on the intervention implementation. Gathering evidence before implementing the intervention and utilizing stakeholders who had a record of being successfully involved in a similar intervention enhanced implementation. Similar findings that were also cited in a community-based dengue fever prevention intervention in Burkina Faso [56]. The use of program champions like PEs in this study enhanced the impact of the intervention as reported by Craig et al. [57]. Policy, advocacy, and stakeholder mobilization was an essential part of all the CFIR constructs and this could be attributed to the complex ethical issues around HIV/AIDS.

The sequence of strategies used for the application of intervention components across the implementation stages aimed to maintain temporality [58]. The initiative differentiated implementation into four processes which were: planning, engaging, executing, and evaluation/reflecting and these processes were also followed by Damschroder et al. [46]. The phased strategy were vital to ensure that important components of the program were not missed, real-time feedback was issued, and adjustments were made timely. According to the authors knowledge this was the first HIVST intervention that specifically targeted an institutionalized population of young people in the country since most HIVST interventions were conducted using community-wide samples and results were generalized across the population.

## Study strengths and limitations

Using the systematic process of reviewing evidence, coordination from multiple stakeholders and peer networking was crucial in ensuring implementation and intervention fidelity which simplified the process of HTS delivery [35]. The involvement of the program end-users during the different stages was consistent with recommendations by Medical Research Council [59]. Self-testing in a familiar and private place may result in less errors and being aware that there is another individual for moral support and guidance (PEs) reduced anxiety associated with HIV testing [60]. Blending expertise of the research, implementing and policy making teams that were made up of professionals from different backgrounds introduced diversity of sentiments at different steps of the intervention, especially during the consensus process. Systematic reviews were used to identify and correct gaps in using the CFIR and RE-AIM frameworks and being cognizant of the reported pitfalls helped in shaping initiative designing.

Although the intervention was successfully implemented, it also had its limitations. The intervention was conducted at one institution of higher learning which is a private university, a context which made it difficult to generalize the intervention to other public institutions of higher learning. The program funds were limited and the study could only be conducted at one institution despite the interest from other institutions of higher learning. Although the self-test kits were issued to participants without taking down names, the presence of peer educators supervising process might have made some participants nervous and uncomfortable. Using self-reporting for data collection during the surveys could have also resulted in socially-desirable responses. The HIVST kits were provided for free by different peer educators as well as clinic staff hence, it is possible that some students participated more than once although the use of PEs who could recognize fellow students helped limit this challenge. Students were reluctant to use the post-test services and a qualitative study to ascertain the reasons behind this finding could help future intervention implementers to avoid the non-response.

## Conclusion

As the impact of HIV/AIDS on young people continues to increase, new approaches to fight the pandemic must include matching scientific evidence with practice. The utilization of the CFIR framework aided in identifying elements that enabled or disabled intervention development and implementation. The framework was also vital in developing solutions to modifiable barriers noted during the intervention design stages. The baseline enquiry indicated that network, network and communications, preparation of implementation, availability of resources, planification, implication and formally appointed internal leadership simplified intervention implementation while origin of intervention and self-efficacy had negative influence on implementation. Evaluating the initiative using the RE-AIM framework revealed that high performance with regard to reach, effectiveness, adoption and implementation but low maintenance.

## Abbreviations

APEASE	Affordability, practicability, effectiveness, acceptability, side-effects, equity, sustainability
AU	Africa University
CATS	Community adolescents treatment support
CFIR	Consolidated Framework of Implementation Research
EBP	Evidence-based practice
HIV/AIDS	Human Immuno-deficiency Virus/ Acquired Immunodeficiency Syndrome
HIVST	HIV Self-testing
HTS	HIV testing services
IS	Implementation Science
M & E	Monitoring and Evaluation
MOHCC	Ministry of Health and Child Care
PEs	Peer Educators
PI	Principal Investigator
PSI	Population Services International
RE-AIM	Reach, effectiveness, adoption, implementation, maintenance

SAYS	Swipe and know your status
SAYWHAT	Students and Youth Working on Reproductive Health Action Team
WHO	World Health Organization
ZDHS	Zimbabwe Demographic Health Survey
ZIMPHIA	Zimbabwe Population-based HIV Impact Assessment

## Declarations

### Ethics Approval and Consent to participate

This study was approved by the health research ethics committees of Medical Research Council of Zimbabwe in 2018 (Reference Number: MRCZ/A/2360). The program was conducted in accordance with the principles of good clinical practice (GCP). All participants consented to participating in the study by completing a written consent form.

### Consent for publication

Not applicable

### Availability of data and materials

The datasets generated or analyzed during the current study are available from the corresponding author on reasonable request.

### Competing interests

The authors declare that they have no competing interests.

### Funding

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### Authors' contributions

FMM and RAK wrote the study design with support of MT, TM, WM, CU, MM, EMC and QM. MT and WM conducted the interview while PTM analyzed the data with support of WM and FMM. The first drafts of the article was prepared by PTM. All authors reviewed the different versions of the manuscript. All the authors read and approved the final manuscript

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## Tables

**Table 1. Components of the HIV testing and counselling services and supporting milestones according to WHO [41].**

HTS component	Definition and supporting milestone activities
1. Policy, advocacy and stakeholder mobilization	An enabling policy environment comprehensively addressing political, economic, social, legal and health issues to encourage individuals to know their status  Milestone: Practice engages stakeholders for political commitment in regulating environment affecting supply of resources (policies, supplies and commodities), mobilization of commitment among community members and involve coordination from a range of stakeholders to ensure increased uptake of HTS.
2. Community mobilization	Social mobilization for HTS by providing adequate information and support on all aspects of HTS.  Milestone: Practice assesses the community's ability to freely talk about HIV/AIDS, handling of HTS with sensitivity and respect to increase acceptance of HIV as a community issue.
3. Supply and management of commodities	Reliable and affordable supplies of essential commodities for the provision of quality services.  Milestone: Practice identifies commodity management system in place for accessibility and effective use at service delivery and referral levels (procurement, distribution, use, resources for commodity management).
4. Service delivery	Activities that include the assessment, strategic planning as well as M&E of program. M&E helps in ensuring confidentiality and counseling are present, intervention integration into HTS program, patient flow, and referral use and quality assurance (e.g. staff competency, client satisfaction, minimum standards and tools for healthcare workers).  Milestone: Practice determines current and required infrastructure, site readiness, staff selection, referral networks and time-frame for implementing the initiative and meet end-user's needs effectively.
5. Capacity building and training	Attainment of skills, strengthening of organization and systems, and establishing and support linkages and networks.  Milestone: Practice conducts an assessment of training needs for different essential personnel (e.g. counsellors, test kit issuing staff, volunteers) to ensure coordination in the effective running of the HTS.
6. Management and coordination	Ensuring that policies, guidelines, systems, resources (human, financial, and material) roles, responsibilities and deadlines are translated into program activities and implemented for equitable distribution of HTS services.  Milestone: Practice establishes required operational issues (e.g. a clear vision for the planning and implementation of initiative, management of daily activities, M&E and quality assurance) and areas of coordination (follow up phone calls for tracking and linking HIV positive clients to treatment and care).
7. Determining costs and financing	HTS practice requires securing of adequate financing for all aspects of the program to enable scaling up of the existing services to meet demand of services.  Milestone: Practice identifies strategies to minimize costs, resource mobilization, cost sharing/recovery, estimating costs by developing a costing framework.

M&E: monitoring and evaluation, HTS: HIV testing services

**Table 2. Measures and constructs of the analytical framework and their description adapted from Damschroder et al. [46].**

Dimension	Constructs	Description
1. Characteristics of the intervention	1.1 Origin of the intervention	Stakeholders' perception of the origin of the intervention
	1.2 Quality and strength of evidence	Stakeholders' perceptions of the quality and validity of evidence that the intervention will achieve intended outcomes
	1.3 Adaptability	The degree of which the intervention can be adapted or reinvented to meet local needs
	1.4 Complexity	Perceived difficulty of implementing the intervention in terms of duration scope, level of disruption, centrality, and complexity, and the number of steps required to implement it
2. External context	2.1 Network	The degree to which the organization implementing the intervention is networked with external organizations
3. Internal Context	3.1 Structural characteristics	The social architecture, age, maturity and size of the organization implementing the intervention
	3.2 Networks and communications	The nature and quality of social networks and formal and informal communications in the organization
	3.3 Preparation of implementation	Tangible and immediate indicators of organizational commitment to implement the intervention.
	3.4 Commitment of leaders	The commitment, involvement, and responsibility of the leaders and managers of Africa University (the organization implementing the intervention) with regard to implementation.
4. Characteristics of individuals	3.5 Available resources	The amount of resources devoted to implementation and operations, including money, training, and education, physical space, and time.
	4.1 Knowledge and beliefs about the intervention	Individual attitudes towards the intervention and the values attributed to the intervention, as well as knowledge of the facts, truths, and principles related to the intervention.
	4.2 Self-efficacy	Individuals' belief in their own ability to execute action plans to achieve implementation goals.
	5.1 Planification	The degree to which plans, methods, and tasks for implementing an intervention are developed in advance and the quality of these methods.
5. Process	5.2 Implication	Attract and involve appropriate people in the implementation and use of the intervention through a combined strategy of social marketing, education, role modeling, training, and other similar activities.
	5.3 Formally appointed internal leaders for implementation	The members of the association promoting the intervention who have distinguished themselves by their dedication and commitment to implementation.
	5.4 Champions	People who are dedicated to supporting, marketing, and conducting the implementation, and to overcoming the indifference or resistance that the intervention can cause in an organization.

**Table 3. Scoring grid for intervention constructs adapted from Damschroder et al. [46]**

Note	Criteria/explanation
-2	The dimension had a negative influence on the implementation process. Participants were able to present concrete examples of negative influence.
-1	The dimension had a negative influence on the implementation process. Participants were unable to provide concrete examples to explain this influence.
0	Participants could not expect the effective nature of the influence. While some believe that it has had a negative influence, others argue otherwise.
1	The dimension had a positive influence on the process by facilitating some aspects of implementation. Participants were unable to present facts that support their statements.
2	The dimension had a positive influence on the process by facilitating certain aspects of implementation. Participants presented facts that support their statements.

**Table 4. Components included in intervention based guided by the APEASE criteria.**

<b>Component included</b>	<b>Who</b>	<b>When</b>	<b>Rationale for inclusion based on APEASE criteria</b>
Training PEs on intervention	MOHCC Facilitators, Nurses	At baseline and annually	-skills and motivational empowerment of facilitators to enhance the effectiveness. -to sustain the initiative after the current trained peers have graduated from the institution.
Peer Support	Fellow students	Intervention phase	-using individuals from similar social group supports health behavior promotes initiative acceptability. -interpersonal assistance/ guidance to help address individual's psychosocial problems.
Document consultation, audits and feedback	Research Team, Nurses	At baseline and post intervention piloting	-to ascertain existing uptake of HTS at baseline. -to demonstrate the effectiveness after the initiative.
Involving organizational and national leadership on intervention	Nurses	-	-to overcome organizational and policy barriers - to keep up-to-date on changes in regulations and operating procedures
Issuing information pamphlets	PEs/ nurses	At every consultation	-communication to promote HIVST
Hosting a Health Fare Gala	Implementing team with the help of NGO stakeholders	At baseline and annually	-demand creation to promote HIVST -platform to address participant concerns
Use of guidelines and standard operation procedure manuals	Implementing team	-	-normative technical guidance
Follow-up text messages	PEs/nurses	Within 48 hours of issuing a test kit	-prompt action by participants to seek counseling or linkage to care services on-campus or off campus.

*HIVST*: HIV Self-testing, *HTS*: HIV testing services, *PEs*: Peer Educators, *NGO*: Non-governmental Organization, *MOHCC*: Ministry of Health and Child Care of Zimbabwe

**Table 5. Summary of consensus ratings of the various elements of the analytical framework after the baseline assessment**

Construct	HTS Components							
	Policy, advocacy, and stakeholder mobilization	Community mobilization	Supply and management of commodities	Service delivery	Capacity building and training	Management and coordination	Determining costs and financing	
<b>1. Characteristic of intervention</b>								
Origin of intervention	2	1	-2	1	2	2	1	
Quality of strength of evidence	2	2	1	1	2	1	1	
Adaptability	2	2	0	2	2	2	1	
Complexity	2	2	1	2	1	2	1	
<b>2. External context</b>								
Network	2	2	1	2	2	2	0	
<b>3. Internal context</b>								
Structural characteristics	2	1	1	2	2	2	1	
Network and communications	2	2	2	1	2	1	1	
Preparation of implementation	2	2	2	1	2	1	1	
Commitment of leaders	2	1	0	0	1	1	2	
Available resources	2	2	2	2	2	2	2	
<b>4. Characteristics of individuals</b>								
Knowledge and beliefs about the intervention	2	2	1	2	1	2	1	
Self-efficacy	1	1	0	2	1	1	0	
<b>5. Process</b>								
Planification	2	2	1	2	0	2	2	
Implication	2	2	1	2	2	2	1	
Formally appointed internal leaders for implementation	2	2	2	2	2	2	1	
Champions	2	2	1	2	2	2	0	

## Figures

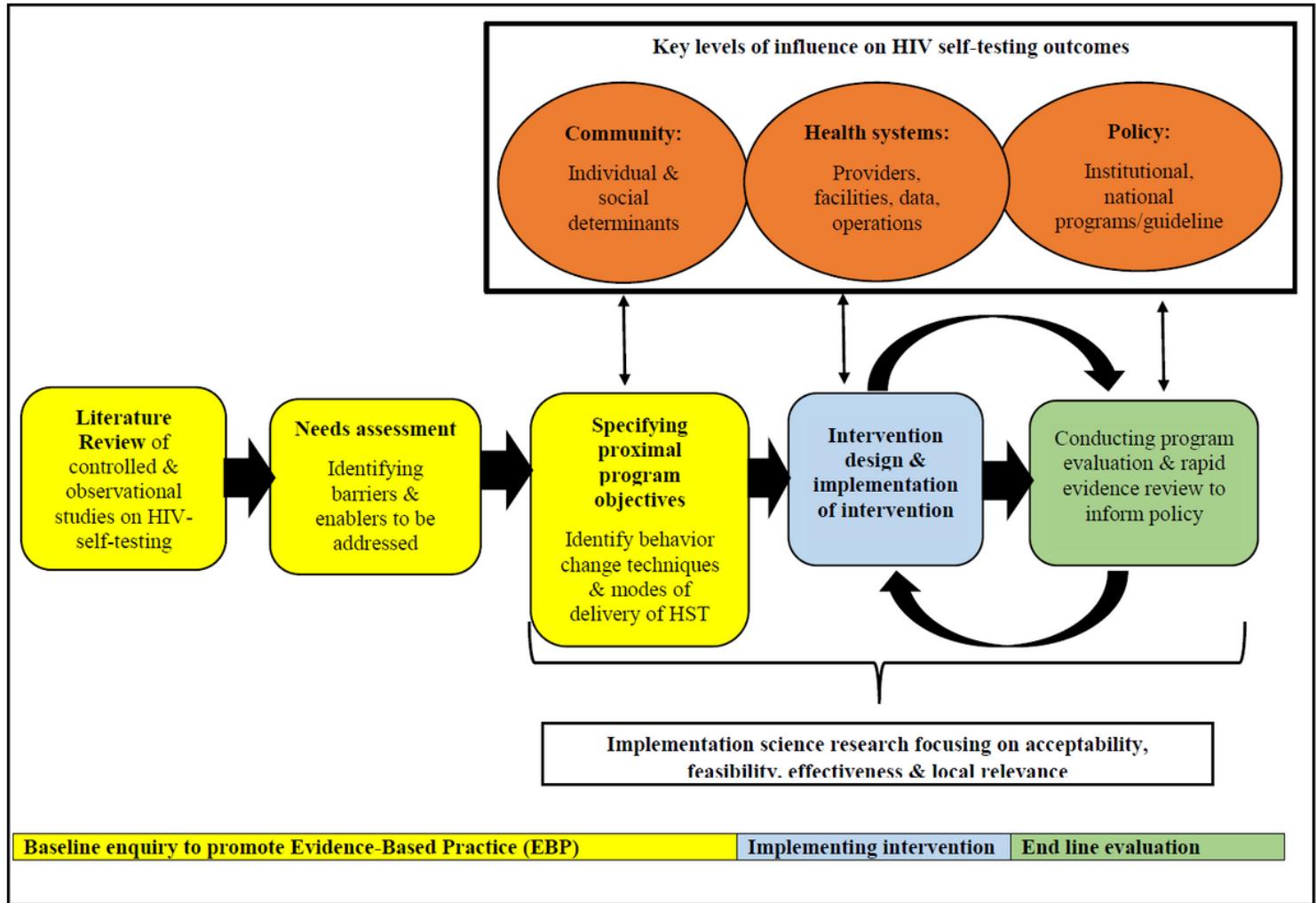


Figure 1

Implementation Science Framework used in this study. Adopted and modified from Sivaram et al. [40]

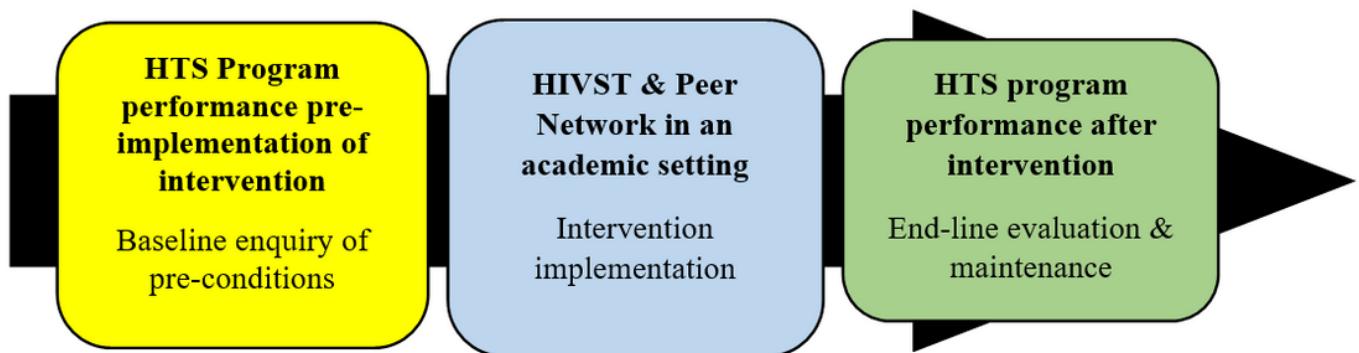


Figure 2

Before-and-after quasi-experimental systematic flow of the processes implementation phases used in this study.

## Supplementary Files

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