



Designing for two: How enhancing human-centered design with behavioral nudges unlocked breakthroughs to promote young women's psychological safety and access to reproductive care in Tanzania

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ABSTRACT

Adolescent girls and young women (AGYW; ages 15–24) in sub-Saharan Africa face many barriers to accessing preventive sexual and reproductive health (SRH) services. We drew upon the strengths of two complementary approaches, human-centered design and behavioral economics, to craft a holistic, highly-tailored, and empathetic intervention to motivate AGYW to seek contraception and HIV self-test kits at community drug shops. To encourage engagement, we embedded “nudge” strategies at different opportunity points (uncovered during our design research) along the care-seeking and service delivery journey. Our *Malkia Klabu* intervention is a loyalty program designed to enhance drug shops' role as SRH providers through which AGYW earned punches for shop purchases redeemable for small prizes; free SRH products could be requested at any time. From our 4-month pilot in Shinyanga, Tanzania, we assess the extent to which different behavioral nudge strategies motivated behaviors as predicted by synthesizing findings from (1) in-depth interviews with AGYW and shopkeepers, (2) shop program records, (3) shop observations, and (4) customer exit surveys. Overall, we find that AGYW and shopkeepers were motivated by many intervention features as intended and consistent with hypothesized mechanisms. We found strong evidence of *social norms* for helping to spread awareness of *Malkia Klabu* among peers, prize *incentives* for drawing AGYW back to shops, and the opt-out *default* membership gift of an HIV self-test kit for encouraging testing uptake and exploration of contraceptives. Shopkeepers in both arms noted increased community status from distributing HIV self-testing kits (*ego*). *Malkia Klabu* shopkeepers experienced increased customer traffic and business revenues (*incentives*), which reduced shopkeepers' gatekeeping tendencies and earned them additional recognition as champions of AGYW well-being. Integrating human-centered design and behavioral economics was effective for developing an innovative and effective intervention that simultaneously met the different needs of economic actors in support of public health priorities.

1. Introduction

Adolescent girls and young women (AGYW; age 15–24) in sub-

Saharan Africa are disproportionately at risk for poor sexual and reproductive health (SRH) outcomes, comprising 80% of new HIV adolescent infections and bearing 44% of reported unintended births

Abbreviations: AGYW, adolescent girl and young women; HCD, human-centered design; HIVST, HIV self-testing; IDI, in-depth interview; SRH, sexual and reproductive health.

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(Hubacher et al., 2008; UNAIDS, 2016). Prevention failures are multi-faceted, including stigma, lack of perceived risk, provider biases, and other barriers to care-seeking (McCoy et al., 2009; Michielsen et al., 2010; Napierala Mavedzenge et al., 2011; Sieverding et al., 2018). New SRH products, such as HIV self-testing (HIVST) kits, expressly designed for self-care (Napierala Mavedzenge et al., 2016) and delivered through community-based channels such as privately-owned drug shops (Rutta et al., 2009), hold promise for overcoming many barriers to access.

However, to meet AGYW's SRH needs, new person-centered approaches are required to address persistent behavioral barriers. In Shinyanga, Tanzania, we developed and operationalized an intervention to motivate AGYW to seek SRH services (contraception and HIVST kits) available at community drug shops using two complementary approaches for uncovering hidden influences on behavior. As a methodological foundation, we used the empathic process of human-centered design (HCD) to generate insights defining AGYW's and shopkeepers' needs and motivations, and designed an intervention for both groups (Hunter et al., 2021). To enhance its effectiveness, reproducibility, transportability, and eventual scaling, we incorporated myriad behavioral economics strategies to leverage different influential emotional and environmental factors on individual decision-making (Dolan et al., 2012) for beneficial health behaviors. With this combination, we posited that incorporating evidence-based social science theory into the HCD process increases the likelihood that the resulting solution's core elements can predictably and reliably motivate behavior, and thus will be effective when more universally adapted to other contexts. Our integrated approach is illustrated in Fig. 1, in which we describe how concepts from behavioral economics add theoretical and analytical depth to each step of the HCD process, along with the methods employed.

1.1. Designing an evidence-based intervention

To develop acceptable and applicable interventions for demand-creation, HCD can yield highly-tailored, person-centered solutions which are thought to hold greater promise for being effective compared to more traditional public health approaches (McCoy et al., 2017;

Nemeth, 2004). HCD is a creative, empathetic approach for problem-solving that relies on rapid prototyping and iterative testing of candidate solutions to develop innovative solutions that meet users' needs (IDEO.org, 2015). A creative spectrum of information streams (e.g., interviews, direct observation, photography, shadowing, storytelling) is used to gain rich insights into drivers of behavior but is not intended to create generalizable scientific knowledge (Tolley, 2017). While steps can vary, the process typically begins with *empathizing* with the intended user population to understand what matters to them. This is used to *define the problem* from users' perspectives, followed by *ideation* to generate a plethora of solution ideas. The most compelling ideas advance to *prototyping* to test simple representations of the solutions with potential users and stakeholders, whose feedback is used to iteratively refine solutions during the final *piloting* step. HCD embraces rapid assessment and fast failures.

Notably, the HCD process can reveal how individual motivations, preferences, and behaviors are shaped by everyday dynamic (often fleeting) influences; these insights fuel the brainstorming of vast possible solutions unconstrained by feasibility, and hence can yield breakthrough ideas. HCD recognizes that influences on individual behavior cannot always be articulated or predicted. While public health practitioners and policymakers have increasingly gained interest in HCD for its nimbleness and ability to craft tailored, creative solutions, its application has relied heavily on participants' intuition to drive the process, lacking a framework to systematize and ground ideas in social science theories (Tantia, 2017). To increase transparency and reproducibility, descriptions of HCD-derived public health interventions are emerging in the academic literature (Bazzano et al., 2017), and their evaluations often show greater satisfaction, usability, and effectiveness compared to traditional interventions (Altman et al., 2018). Still, these studies seldom articulate *how* the solutions are influencing users' behaviors, and thus limit adaptation for scaling (Altman et al., 2018). New initiatives calling for improved transparency and documentation, such as the HCDEXchange Quality and Standards Framework for Adolescent SRH Programming (2022) (HCDEXchange, 2022), may partially mitigate these limitations.

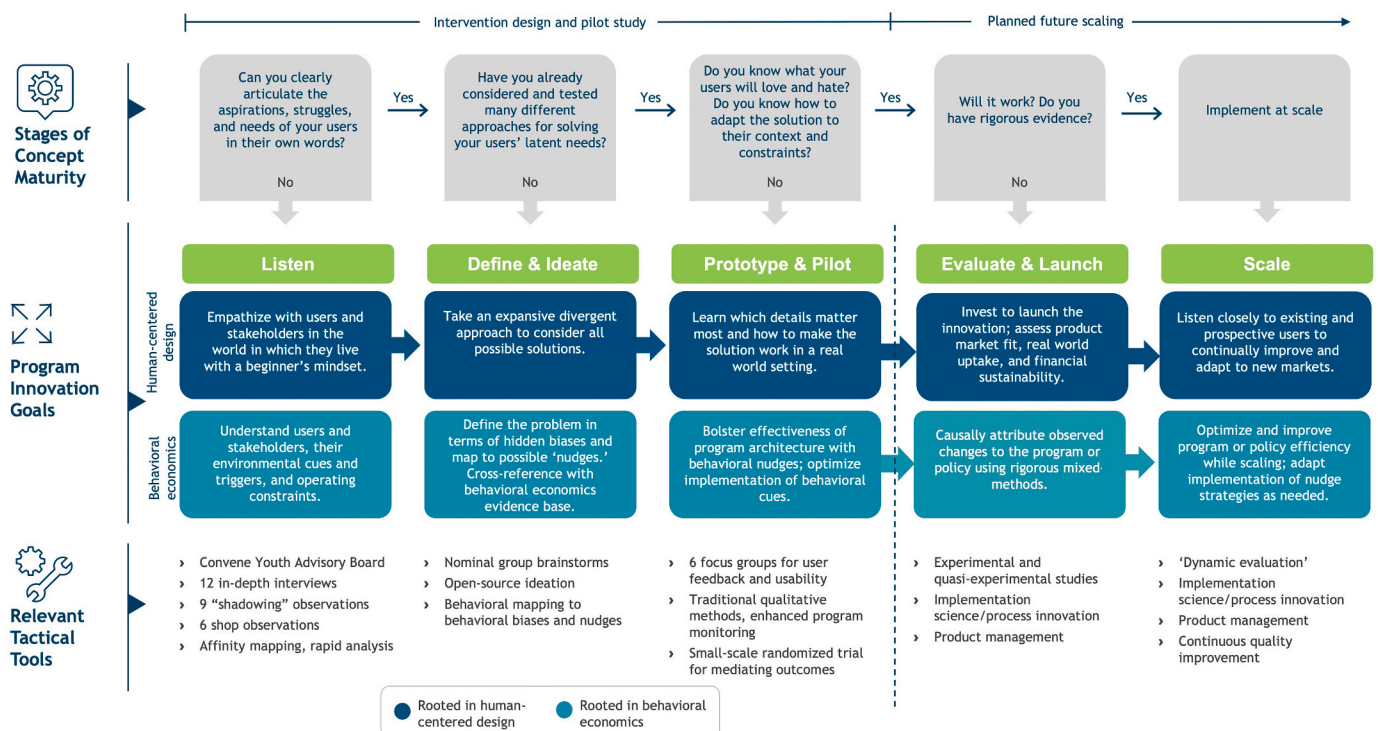


Fig. 1. Using complementary approaches from human-centered design and behavioral economics to design and scale *Malkia Klabu*.

We assert that by identifying the underlying mechanisms behind an intervention’s effects, promising HCD solutions can be more readily adapted across contexts. We further posit that incorporating evidence-based social science theory during HCD solution brainstorming and ideation helps ensure the effectiveness of the resulting solution. In our intervention design process for the *Malkia Klabu* intervention (described below), we used strategies from behavioral economics to inform ideation of candidate solutions. Behavioral economics has a rigorous theoretical foundation based in microeconomics and cognitive psychology, and offers a framework for identifying simple and scalable ways to influence behavior by leveraging systematic biases and heuristics (Dolan et al., 2012). Behavioral economics hypothesizes that patterns of behavior result from the unconscious influences of emotional and contextual factors on individual decision-making (Loewenstein G et al., 2007; O’Donoghue and Rabin, 1999; Tversky and Kahneman, 1974). Traditional public health programs typically address information gaps and rely on individuals’ intrinsic motivation to remain healthy (Deci and Ryan, 2008). This ignores the fact that decisions are influenced by emotions, contexts, and systems, often outside of conscious awareness.

In contrast, behavioral economics theorizes that simple changes to the decision-making context can change behavior without relying on intrinsic motivation (Codagnone et al., 2014; Dolan et al., 2012; Thaler and Sustein, 2008; Walton, 2014). Small changes to the environment, messaging, or intra-personal interactions can influence behavior, bridging the gap between intention and action (Dolan et al., 2012; Thaler and Sustein, 2008). Mounting empirical evidence shows that behavioral economics can offer simple, inexpensive, and effective solutions for many health behavior challenges (Ashraf et al., 2014; Hallsworth et al., 2016; Liu et al., 2019; McCoy et al., 2017; Sibanda et al., 2017; Yotebieng et al., 2016). These tools include, for example, incentives, social influence, commitments, and reminders, which are increasingly used to address a spectrum of health behaviors (Dolan et al., 2012).

Given the similar focus on individual behavior in response to emotional and environmental cues, we hypothesized that behavioral economics strategies (alone or in combination) could enhance the effectiveness of our HCD resulting solution in ways that subtly addressed both AGYW’s and shopkeepers’ needs. Insights from our HCD research

Table 1
Behavioral economics “nudge” strategies designed for *Malkia Klabu*.

Relevant nudge strategy from MINDSPACE ^a	Targeted user need ^b	Intervention design feature	Hypothesized mechanism	Strength of empirical evidence
Messenger	Societal forces, including the educational system, impede young women’s knowledge of and access to contraception in order to exert control over young women’s sexual behavior.	Using earphones, watching informational videos on HIVST and contraceptive methods explained by age peers.	Information about SRH will be more relevant and valued when coming from a communicator with whom one shares similar characteristics or values.	Some, but subtle.
Incentives	With little income or control over when they will get money or how they use their time, young women’s basic needs are often unmet. Young women seek out SRH products only after engaging in risk behaviors. Shopkeepers rely on a limited set of strategies to ensure their businesses’ survival, but largely fail to proactively innovate within their business.	AGYW club members could make small purchases at participating shops to earn small prizes of increasing value.	The prospect of earning prizes will encourage AGYW to return to shops, creating a loyal customer base for shopkeepers. The incentive to return to the shop for future purchases is heightened by the increasing perceived value of the prizes.	Strong
Norms	Young women are surrounded by gatekeepers. There is a widespread moral imperative to control young women’s behavior. Only some products are deemed acceptable for young women (e.g., pads, but not contraception), and consultative screening and questioning can be used to enforce shopkeepers’ gatekeeping role for SRH products as well as to determine clinical need.	Special club for AGYW, spread by word of mouth. Card has symbols representing SRH products that AGYW can point to and receive without hassle or questions.	AGYW will be more receptive to a program that is specifically developed for AGYW, and especially if they know other AGYW who are participating. By enabling nonverbal communication for sensitive products, fewer AGYW will fear asking for these products and fewer shopkeepers will revert to gatekeeping, harassing behaviors.	Strong Minimal
Defaults	HIVST is exciting and confusing. Some question their ability to perform HIVST correctly and have lingering concerns about the oral test’s validity.	Upon membership sign-up, free HIVST kit given as opt-out gift.	AGYW will be more likely to take and use an HIVST kit when they no longer must first ask for it.	Strong
Salience	Shopping is typically a mundane chore that entails purpose-driven, fast interactions without browsing or comparison shopping.	Placed sample products openly in a bright pink display with easy-to-understand information cards.	AGYW will be more likely to pay attention to SRH information if it is made more attractive, physically accessible (placement in the shop, having sample products to explore), and understandable.	Some
Affect	Shopping is typically a mundane chore that entails purpose-driven, fast interactions without browsing or comparison shopping.	AGYW-friendly branding entailed overarching ‘queen’ imagery; prizes were perceived “luxury” items, obtained via a blind grab from a sequined mystery bag.	AGYW will recognize the girl-friendly branding and have a pleasurable shopping experience, including winning prizes.	Some
Commitment	Shopkeepers feel they are serving the greater social good, but often revert to gatekeeping tendencies for AGYW customers.	Shopkeepers consent to participate in a study benefitting AGYW and officially sanctioned by local authorities.	Shopkeepers’ moral sense of purpose to provide important health products to vulnerable populations will be reinforced.	Minimal
Ego	Shopkeepers seek the recognition, confidence and power that comes with their association with healthcare professionals.	Program participation appeals to shopkeepers’ self-image as a health provider rather than businessperson.	Shopkeepers will enable AGYW to access SRH services rather than act as gatekeepers.	Some

AGYW = adolescent girl and young women; HIVST = HIV self-testing; SRH = Sexual and reproductive health.

Note: Priming was not used as part of the solutions included in the intervention design.

^a Dolan et al., (2012).

^b Hunter et al., (2021).

highlighted many missed opportunities that ultimately steered AGYW away from getting preventive SRH services, including a widespread community moral imperative to police young women's behavior, AGYW doing frequent and mundane shopping for others without considering new products, and shopkeepers harassing AGYW seeking SRH products despite wanting to be viewed as beneficial health providers (Hunter et al., 2021). In our solution brainstorming, we explored embedding different “nudges,” or small alterations in how choices are presented, informed by the MINDSPACE framework (Dolan et al., 2012), targeted toward these opportunity points. Amid the growing phylogeny of behavioral biases and organizational taxonomies (Behavioural Insights Team, 2014; DellaVigna, 2009; Pinto et al., 2014), we chose MINDSPACE as an accessible, yet diverse set of strategies for our program co-designers, including community participants without specialized scientific training, to reference. To ensure that the final integrated intervention incorporated theory- and evidence-based strategies, we categorized each intervention element according to the type of nudge strategy it sought to leverage and the corresponding need(s) of end users it was intended to address (see Table 1).

1.2. The *Malkia Klabu* intervention and pilot

Our intervention, *Malkia Klabu* or “Queen Club,” is loyalty program through which AGYW could earn small-value prizes (250–1500 TSh; \$0.11–\$0.67 USD), discreetly use card symbols to request free SRH products, and access hands-on informational SRH displays at “girl-friendly” drug shops (Hunter et al., 2021). In a 4-month cluster randomized trial of 20 drug shops in Shinyanga Region, we found that shops implementing *Malkia Klabu* effectively increased AGYW patronage, distributed 140% more HIVST kits to AGYW, provided them with more contraception, and made more referrals to facilities for contraception compared to business-as-usual shops (Hunter et al., 2023). Qualitative data indicated that the *Malkia Klabu* program reshaped the role of drug shopkeepers to be providers of information and resources rather than SRH gatekeepers, and shows promise for greater scaling vis-à-vis the adaptability of the intervention to a wide range of needs and stages of readiness among AGYW, its ability to capitalize on AGYW social networks for driving membership, its responsiveness to AGYW's needs for privacy, and its positive contributions to the income and community standing of drug shopkeepers (Cabrera et al., 2021).

1.3. Aims of this paper

Given the intervention's effectiveness, in this paper, we examine to what extent the behavioral strategies underpinning certain intervention design features influenced AGYW's and shopkeepers' behaviors as intended from our mixed-methods pilot evaluation. As influences on behavior change can be difficult for participants to articulate, particularly if reacting unconsciously, we synthesize results from multiple quantitative and qualitative data sources. We discuss our findings in reference to both understanding how HIVST and contraception can be effectively delivered to AGYW through drug shops, and the larger discourse on incorporating evidence-based nudge strategies from behavioral economics into the HCD process.

2. Methods

2.1. Study design and setting

We conducted a mixed-methods evaluation of the *Malkia Klabu* intervention aimed at increasing AGYW patronage and provision of HIVST kits, contraception, and health facility referrals to AGYW in Shinyanga, Tanzania. Shinyanga is a resource-limited, semi-rural region where HIVST kits were not available outside of research settings during this pilot. HIV prevalence among young women (5.1%) is more than double that among young men, and 34% of women aged 15–19 have

already begun childbearing (Ministry of Health, Community Development, Gender, Elderly and Children (MoHCDEG) Ministry of Health, 2016; Tanzania Commission for AIDS, 2013). We evaluated *Malkia Klabu* in a 4-month cluster-randomized trial (August–December 2019) at 20 drug shops, randomized 1:1 to the intervention or comparison arm (NCT04045912); all shops were provided with OraQuick HIVST kits to give to AGYW for free, but only intervention shops implemented *Malkia Klabu* through which AGYW could also access free contraception (Hunter et al., 2023). In the current analysis, we include process data from six additional shops, which participated in program piloting to facilitate implementation learning. This study was approved by the Tanzania National Institute of Medical Research and the University of California, San Francisco.

2.2. Intervention features

Development of *Malkia Klabu* and its features have previously been described (Hunter et al., 2021, Hunter et al., 2023). Here, we detail the behavioral nudges incorporated into its design (also see Table 1). To counter misinformation and misconceptions surrounding contraception, we hypothesized that videos given by age peer narrators could heighten the credibility of information being conveyed, thus harnessing the influence of *messengers*. By enabling club members to earn prizes, we aimed to *incentivize* AGYW to visit shops repeatedly. By further requiring a shop purchase for earning a loyalty card punch, we hypothesized that the sales revenue would also *incentivize* shopkeepers to treat AGYW customers favorably. To help navigate the constant watch of gatekeepers amid larger social stigma, we hypothesized that *social norms* among AGYW networks could progressively build awareness about *Malkia Klabu*. Similarly, symbols that AGYW could point to for hassle-free SRH product requests were hypothesized to reinforce proactive product-seeking among AGYW and interrogation-less provision among shopkeepers as *normative* behaviors. To increase the likelihood that AGYW would get and use an HIVST kit when none were previously available, we made receiving an HIVST kit a *default* opt-out gift upon joining *Malkia Klabu*. To increase the *salience* of SRH information and products while shopping, we developed the colorful sample product display to be attractive and physically accessible. Further, we aimed to counter negative emotions often associated with SRH care-seeking with positive *affect* through girl-friendly “queen” imagery and prizes with luxury appeal. For shopkeepers, we hypothesized that study participation with signed written consent may act like a *commitment* for serving a vulnerable population and enhance their moral sense of purpose for providing essential health products. Likewise, we hypothesized that being chosen to deliver HIVST kits to the community through the study would enhance shopkeepers' *egos* as healthcare providers and positively reinforce their beneficial role serving AGYW.

2.3. Data sources

To assess the intervention's nudge strategies, we synthesize findings from: (1) in-depth interviews (IDIs) with participating AGYW and shopkeepers, (2) shop program records, (3) shop observations, and (4) AGYW customer exit surveys. These methods and other results are described in related papers reporting the trial's primary outcomes (Hunter et al., 2023), intervention implementation barriers and facilitators (Cabrera et al., 2021), and ancillary sub-studies (Chiu et al., 2021; Tubert et al., 2021). Here, we summarize the methods used for each data source and the data used for this paper's aims.

2.4. In-depth interviews and analysis

We analyzed IDI data from 11 AGYW and 26 drug shop owners and dispensers (half from the intervention arm) conducted December 2019 through March 2020 after the trial ended (Cabrera et al., 2021). AGYW respondents were recruited from a subset of the 56 AGYW customers

completing exit surveys (see below) who agreed to be contacted for an interview; 11 AGYW were successfully contacted and available (10 recruited from four intervention shops). AGYW respondents completed semi-structured interviews (~30–60 min) about their experiences visiting a drug shop, using an HIVST kit or contraception, and engaging with *Malkia Klabu*. For study shopkeepers, researchers invited each, in person or by phone, to interview. Shopkeepers offering *Malkia Klabu* were asked questions about the adoption, fidelity, acceptability, and sustainability of the program; comparison arm shopkeepers were asked about contraception and HIVST kit provision to AGYW. All IDIs were conducted by two Tanzanian researchers fluent in Kiswahili. Participants gave written informed consent. IDI audio-recordings were transcribed and translated to English.

Five researchers not otherwise associated with the intervention design or implementation analyzed IDI transcripts in two rounds. First, four researchers identified emergent codes through an iterative, modified grounded theory process (Charmaz, 2006), organized into a codebook, which was piloted and refined with additional transcripts. Two team members conducted dual coding for each transcript. For thematic development, all four researchers independently read excerpts within a code to identify recurring ideas, comparing themes across coders, taking into account within- and between-group comparisons. As cross-cutting themes related to different intervention design features emerged, we then conducted a second round of analysis with an additional set of codes informed by the MINDSPACE strategies used for designing *Malkia Klabu* (see Table 1). A fifth team member then reviewed all excerpts to additionally apply the MINDSPACE-informed codes. Thematic development for each relevant nudge strategy followed a similar process of identifying recurring ideas and groupings.

2.5. Shop program records

During program implementation, shopkeepers completed customer logs tracking AGYW interactions and transactions for study-related commodities (i.e., HIVST kits, prizes), reviewed and collected weekly by research staff who kept their own restocking records (Chiu et al., 2021; Hunter et al., 2023). We report the number of visits by AGYW, *Malkia Klabu* cards distributed and used, prizes given, HIVST kits distributed and returned, other SRH products distributed (i.e., oral pills, condoms, emergency contraception, pregnancy tests), and health facility referrals provided (i.e., for HIV, family planning, or pregnancy).

2.6. Shop observations

In our pilot trial, we conducted 355 shop observations (up to 15 3-h time blocks per shop) to quantify AGYW patronage at baseline (July–August 2019; $N = 109$), midline (October–November 2019; $N_{\text{control}} = 59$; $N_{\text{intervention}} = 60$), and endline (November–December 2019; $N_{\text{control}} = 63$; $N_{\text{intervention}} = 64$). We randomly sampled five observation day/time blocks (e.g., Wednesday, 10am to 1pm) per shop per time point, each of which included at least one weekend, weekday, morning, and afternoon observation; if the shop was closed during a scheduled time block, the observation was attempted at the same time one week later. During each 3-h continuous time block, research staff noted the apparent sex and age of all customers entering the shop, and what they interacted with in the shop (Hunter et al., 2023; Tubert et al., 2021). We descriptively report the customer demographics and the frequency of AGYW customers' engagement with HIVST and *Malkia Klabu* program features (e.g., informational videos, product display, symbol card).

2.7. Customer exit surveys

To assess program experiences and interactions with shopkeepers, we surveyed AGYW customers exiting study shops in 3-h time blocks starting November 2019 ($N = 56$ from 15 shops; $N_{\text{control}} = 9$; $N_{\text{intervention}} = 47$). Note that, given the substantial difference in the pilot trial's

primary outcome, AGYW patronage (Hunter et al., 2023), we anticipated more AGYW customers to be eligible for exit surveys at intervention shops than comparison shops during the recruitment windows. AGYW giving verbal consent were administered the survey in the shop's back storage room or other nearby private location. Sample characteristics are given elsewhere (Tubert et al., 2021). We report on how AGYW became aware of the program or HIVST kit availability, their reasons for choosing the shop, and their experiences with *Malkia Klabu* features.

3. Results

The behavioral nudge strategies embedded within *Malkia Klabu* are presented in Table 1, organized by the user need the strategy responds to, the intervention feature designed to address it, our hypothesized mechanism for behavior change, and the strength of empirical evidence from our data. We present results sequentially following how a typical AGYW participant would encounter the nudges while engaging with the intervention.

3.1. Norms: word travels fast among AGYW

When “shopping” for SRH products, cultural norms disapproving of adolescent sexuality combined with a common moral imperative to govern AGYW's behaviors influence what AGYW can purchase (Hunter et al., 2021). Without general demand creation, we intended for *Malkia Klabu* to be perceived as an exclusive and private club for AGYW; while not explicitly asked to do so, we hypothesized that AGYW would be both more receptive to a specialized program and invite their peers.

We found strong evidence that social norms among AGYW helped fuel awareness of *Malkia Klabu*, which was mainly spread by word of mouth. Many AGYW participants influenced their sisters, friends, and neighbors to join *Malkia Klabu*, and accompanied others to participating shops. Compared to business-as-usual comparison shops, shopkeeper records show a large increase in AGYW customers at intervention shops (Fig. 2), cumulatively about 10-fold higher than comparison shops over the study period (Supplement Table S1). From exit surveys, more AGYW in intervention shops than comparison shops found out about the shop from friends and family (66% vs. 33%) and visited with a friend (55% vs. 22%); 74% chose the shop because of *Malkia Klabu* (Table 2). AGYW fueled interest by promoting the girl-friendly prizes they received, which also served as a visual validation of the rumored clubs' benefits. For example, one AGYW noted:

Participant [P]: I was told by my friend ... She told me that in that shop, there is a *Malkia* program which, when I go to join it, I will be given an HIVST kit free of charge, and then I went to join.

Interviewer [I]: Did you believe your friend?

P: Yes, I believed her, because I was seeing many girls coming in and out of the shop buying the drugs and getting the gifts with their *Malkia* cards.

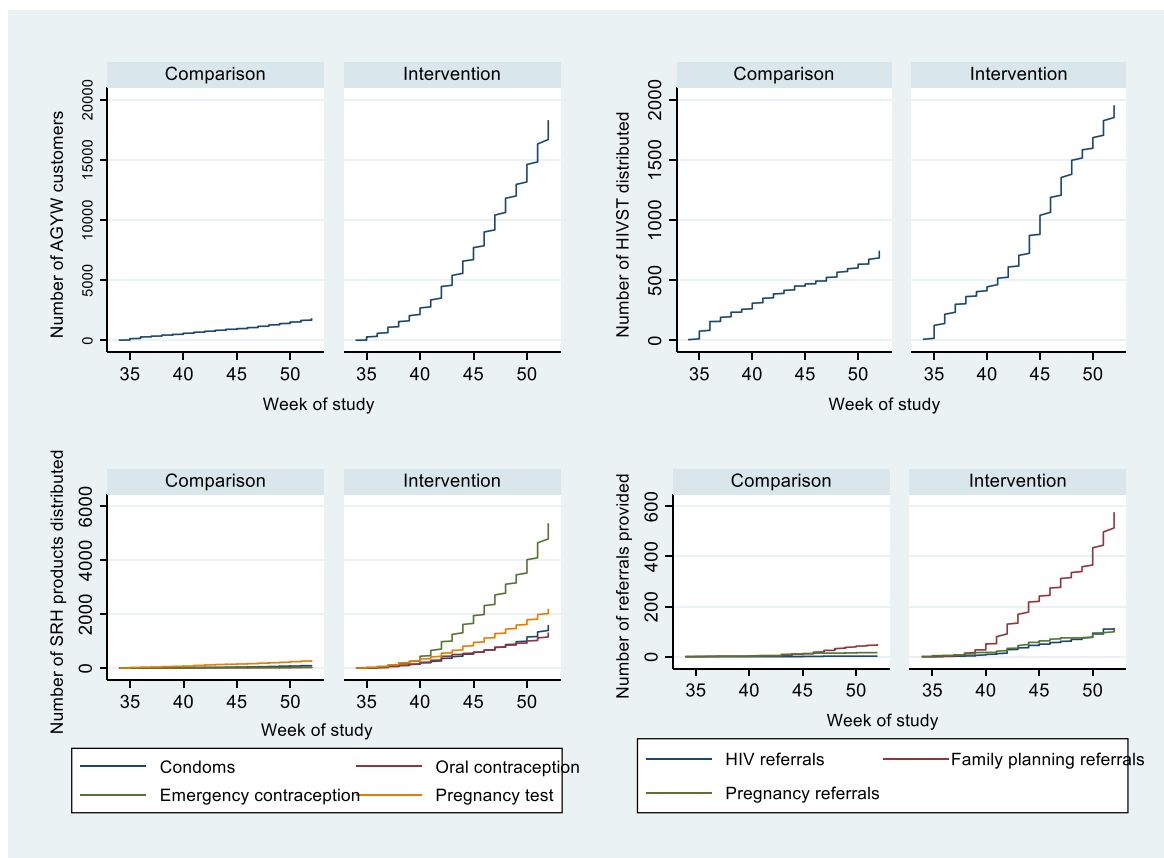
- AGYW 114, age 15, employed, out of school, living with a relative

Unexpectedly, we found that girls were also motivated by social incentives. AGYW wanted their peers to benefit from the SRH services, such as receiving a free HIVST kit, and felt rewarded in doing so. When telling their friends about the program, some AGYW mentioned the HIVST kit first:

Firstly, I told her about checking her health status by using such an amazing testing kit that even myself I liked it. I told her that you are not injecting a syringe or blood; you only use your own saliva to check yourself. I also told her about the other things like the gifts and where the shop is located.

- AGYW 107, age 21, employed, out of school, living with a parent

We also hypothesized that the symbol card, containing symbols for



AGYW = adolescent girl and young woman (age 15-24)
 HIVST = HIV self-test kit
 SRH = sexual and reproductive health

Fig. 2. Cumulative number of adolescent girls and young women receiving products and services.

SRH products available to *Malkia Klabu* members that girls could point to for hassle-free requests, would mitigate shopkeeper’s gatekeeping behaviors and allay AGYW’s apprehension about verbally requesting sensitive products. Among AGYW reporting symbol card use in exit surveys, all indicated that the salesperson understood the symbol, only 27% were asked why they wanted the product, and none felt judged (Table 3). From IDIs, both AGYW and shopkeepers reported using the symbol card as a silent tool to request SRH products, even when other customers were present.

If there were people inside, I used to wait until they go. If they continue to exist, I buy the drug and wait for them till they leave, then I tell [the shopkeeper] to give me something I wanted by showing him the back of the card.

- AGYW 104, age 22, unemployed, mother living with parents

The last customer who came to the shop was in need of those products found at the back of the card, so she just showed me what she wanted, and I gave it to her.

- Dispenser 28, intervention

However, the symbol card was seldom used during shop observations—only during 13% and 4% of AGYW transactions observed at intervention shops at midline and endline, respectively (Supplement Table S2).

3.2. Salience: attention girl shoppers

AGYW’s shopping experiences are often a mundane chore with little

attention paid to new products or SRH products readily available at drug shops (Hunter et al., 2021). To increase the saliency of SRH products while shopping, we designed an open, bright pink display with sample SRH products and accessible information cards for hands-on learning. We found some evidence that the display was noticed, but it was infrequently used during observations at intervention shops—only by 18% (16 of 91) of AGYW customers at midline, declining to 4% (9 of 247) at endline (Supplement Table S2). From IDIs, some AGYW participants indicated that the display made the shop look more attractive, and thus invited curiosity:

Just when I saw it ... I had to ask because it was something new ... and the way the pictures were posted ..., it was my first time seeing it ... It is very attractive to see at the pharmacy.

- AGYW 105, age 24, mother living with a parent

Some interviewees reported that the display was as a conversation starter, providing shopkeepers with an opportunity to counsel and educate AGYW about SRH items:

I saw it on the first day when I got the test ... I was asking him about that [display] and the things on it before he started explaining to me about the card.

- AGYW 105, age 24, mother living with a parent

Intervention shopkeepers mentioned that the display invited questions from adult customers and was used to further counsel them on different products available.

Table 2
Characteristics of shop visits from client exit surveys with adolescent girls and young women by study arm.

	Comparison arm	Malkia Klabu arm	p
Visit characteristics	N = 9	N = 47	
Previously been to shop	6 (67%)	43 (91%)	0.04
Visit frequency in last month	N = 6	N = 43	0.26
Once	1 (17%)	2 (5%)	
A few times	2 (33%)	25 (58%)	
Once a week	1 (17%)	3 (7%)	
More than once a week	0 (0%)	8 (19%)	
Almost daily	2 (33%)	5 (12%)	
How did you first find out about this shop	N = 9	N = 47	0.14
From a friend	1 (11%)	27 (57%)	
From family	2 (22%)	4 (9%)	
From people on the street/another shop	1 (11%)	2 (4%)	
Was passing by	4 (44%)	10 (21%)	
Other	1 (11%)	4 (9%)	
Reason for choosing this shop			
Malkia Klabu	–	35 (74%)	–
Because they provide HIVST	0 (0%)	3 (6%)	0.44
Convenient location	1 (11%)	0 (0%)	0.02
Know the shopkeeper	3 (33%)	3 (6%)	0.02
Other reason	6 (67%)	15 (32%)	0.05
Travel companion			
Came with friend	2 (22%)	26 (55%)	0.07
Came alone	7 (78%)	19 (40%)	0.04
Came with children	0 (0%)	1 (2%)	0.66
Came with other relative	0 (0%)	1 (2%)	0.66
Purchase made for self (vs. other)	6 (67%)	45 (96%)	0.01
Came to shop to receive Malkia Kadi punch	–	27 (57%)	–
HIV and SRH			
Ever tested for HIV	8 (89%)	39 (83%)	0.66
Awareness of availability of HIVST at shop	N = 9	N = 47	0.01
Yes, aware before today	5 (56%)	41 (87%)	
No, found out today	0 (0%)	3 (6%)	
No, still not aware HIVST are available	4 (44%)	3 (6%)	
How did you learn about HIVST availability	N = 5	N = 44	0.28
From a friend	1 (20%)	21 (48%)	
From salesperson	4 (80%)	19 (43%)	
Through Malkia Klabu	–	4 (9%)	

P-values from chi-squared tests for categorical variables.

3.3. Defaults: get your free HIV self-test kit

To create awareness of HIVST kits not widely available in Tanzania at the time and increase AGYW’s confidence to independently perform the test (Hunter et al., 2021), we made receiving an HIVST kit a default opt-out gift upon joining *Malkia Klabu*. Along with informational videos and the product display to facilitate learning, we hypothesized that AGYW would be more likely to take and use an HIVST kit if they did not have to first ask for it. We found strong evidence that this default contributed to higher distribution of HIVST kits compared with non-*Malkia Klabu* shops which distributed free HIVST kits to AGYW upon request (Fig. 2). After being initiated to HIVST, some club members continued requesting HIVST kits from shops rather than going for free facility-based testing:

I just felt like testing. I frequently go to the hospital for the test, but after learning about *Malkia Klabu* from the pharmacist, I was convinced and interested. I took the test and went to test, then I kept getting the test from there.

- AGYW 102 age 24, self-employed, married with one child

As HIVST kits are intended for private, anonymous use, data on kit use are not available. However, program data showed that study shops

Table 3
Engagement with *Malkia Klabu* program features from client exit surveys with adolescent girls and young women.

Program feature	n	%	N
Heard of <i>Malkia Klabu</i>	44	94%	47
Member of <i>Malkia Klabu</i>	41	93%	44
Joined before	40	98%	41
Joined today	1	2%	41
Used symbols on <i>Malkia Klabu</i> today	11	27%	41
Salesperson understood symbol	11	100%	11
Salesperson asked questions about why wanted product	3	27%	11
Felt like salesperson was judging you	0	0%	11
Earned a punch on card today	33	80%	41
Had to make a purchase to earn punch	24	73%	33
Items Purchased			24
Panadol	16	67%	
Other	8	33%	
Feelings about earning another punch			33
Very happy	30	91%	
Somewhat happy	2	6%	
Neutral	1	3%	
Somewhat unhappy	0	0%	
Very unhappy	0	0%	
Drew from mystery bag today	28	68%	41
Prize received from mystery bag			28
Body scent	4	14%	
Lip product	2	7%	
Lotion	4	14%	
Nail polish	2	7%	
Pads	11	39%	
Soap	4	14%	
Other	1	4%	
Feelings about mystery bag draw			28
Very happy	26	93%	
Somewhat happy	2	7%	
Feelings about mystery bag prize			28
Liked it a lot	25	89%	
Somewhat liked it	2	7%	
Somewhat didn't like it	1	4%	
Reasons for joining <i>Malkia Klabu</i>			
For surprise gifts	34	83%	41
For free sexual health products	25	61%	41
Because friend is a member	11	27%	41
Pressured by salesperson	1	2%	41
Other reasons	11	27%	41

consistently received used kits for safe, anonymous disposal (28% of those distributed), and many AGYW IDI respondents voiced preferences for the privacy, painlessness, and speed of the oral self-test over blood-based testing (Cabrera et al., 2021).

We also found strong evidence that AGYW participants felt more comfort for addressing broader SRH needs after first experiencing HIVST:

He showed me an HIVST kit and said you can have it and go to test for yourself, whether at home or any place of your interest. I decided to take it and I tested myself in order to know my health status. And as the days went on, I went to take a pregnancy test, I also tested myself in order to know how I am.

- AGYW 104, age 22, unemployed, mother living with parents

Distribution of contraceptives also increased in intervention shops relative to those in the comparison arm (Fig. 2). Notably, while the number of referrals for HIV and pregnancy concerns also increased, referrals for contraception followed a much steeper trajectory.

3.4. Incentives: “They like all the gifts!”

With little income and control over their time, AGYW’s basic needs are often unmet, including preventive SRH products often sought only in response to an acute need (Hunter et al., 2021). Correspondingly, AGYW were not perceived as valued customers for shopkeepers who generally did not innovate their business beyond a limited set of sales strategies

(Hunter et al., 2021). We created the loyalty program as the backbone of the *Malkia Klabu* intervention to address both AGYW’s limited purchasing power and shopkeepers’ business needs: members earned card punches for shop purchases. We hypothesized that the prospect of earning prizes of increasing value, chosen to meet basic needs (e.g., lotions, soap, menstrual pads), encourages AGYW to make repeat purchases, creating a valuable customer base for shopkeepers.

Both AGYW and shopkeepers were highly motivated by the incentive structure. Compared to AGYW customers surveyed existing comparison shops, more at intervention shops were repeat customers (91% vs. 67%), 30% of whom visited more than once a week in the last month (Table 2). Further, 83% of AGYW joined *Malkia Klabu* for the gifts and 89% liked their prize “a lot” (Table 3). Requiring a purchase to earn a punch did not seem to deter AGYW: 57% of AGYW specifically came to the intervention shop for a loyalty card punch (Table 2). The distribution of loyalty cards and prizes (Fig. 3), and the return of completed cards accelerated over time. During IDIs, some AGYW said they offered to run errands for others using the allure of earning prizes, which were products without the same stigma as adolescent sexuality. One AGYW participant who reported completing four loyalty cards indicated:

... even my mother knows. I told her that when she is in need of drugs at the medical shop, she should ask me to go and buy [them] for her because I have a *Malkia* card; when I go to buy the drug, I get the gift.

- AGYW 104, age 22, unemployed, mother living with a parent

When asked about how the program has helped them, many AGYW described the benefits of receiving free feminine products because they would not normally buy these items for themselves.

The program has helped me a lot, since it has made me capable of getting the things which I couldn’t afford before ... Like bathing soaps, spray.

- AGYW 111, age 17, student with boyfriend, living with a parent

By offering free HIVST and prizes, intervention shopkeepers not only saw more customers and distributed more contraceptives (Fig. 2), but also greater revenue from AGYW’s shop purchases and purchases of HIVST kits by non-AGYW:

Through ladies, some of the medicines have been massively sold, for example [antibiotics], Panadol, and chest cough. So, for that my income has been increasing.

- Dispenser 2, intervention

When adults came in and found me talking to girls about the test, they also became interested in knowing their health status and were buying the test.

- Dispenser 28, intervention

Despite the business upside of providing more SRH services to AGYW through *Malkia Klabu*, it did not fully offset gatekeeping tendencies for some shopkeepers who reported intentionally withholding beneficial information, though AGYW ultimately received their wanted product.

I used to look at them according to their age before giving the kits ... I was not counselling everyone who came to [get] the kits. I was looking at unfaithful age—she should have only one partner.

-Shop owner 36, intervention

3.5. Affect: the golden crown

To break through the mundaneness of AGYW’s daily shopping chores (Hunter et al., 2021), we designed *Malkia Klabu* with girl-friendly branding entailing ‘queen’ imagery to reference girls’ larger life aspirations, with prizes perceived as “luxuries.” Intervention shops displayed a discreet golden crown sticker visible outside, while the loyalty

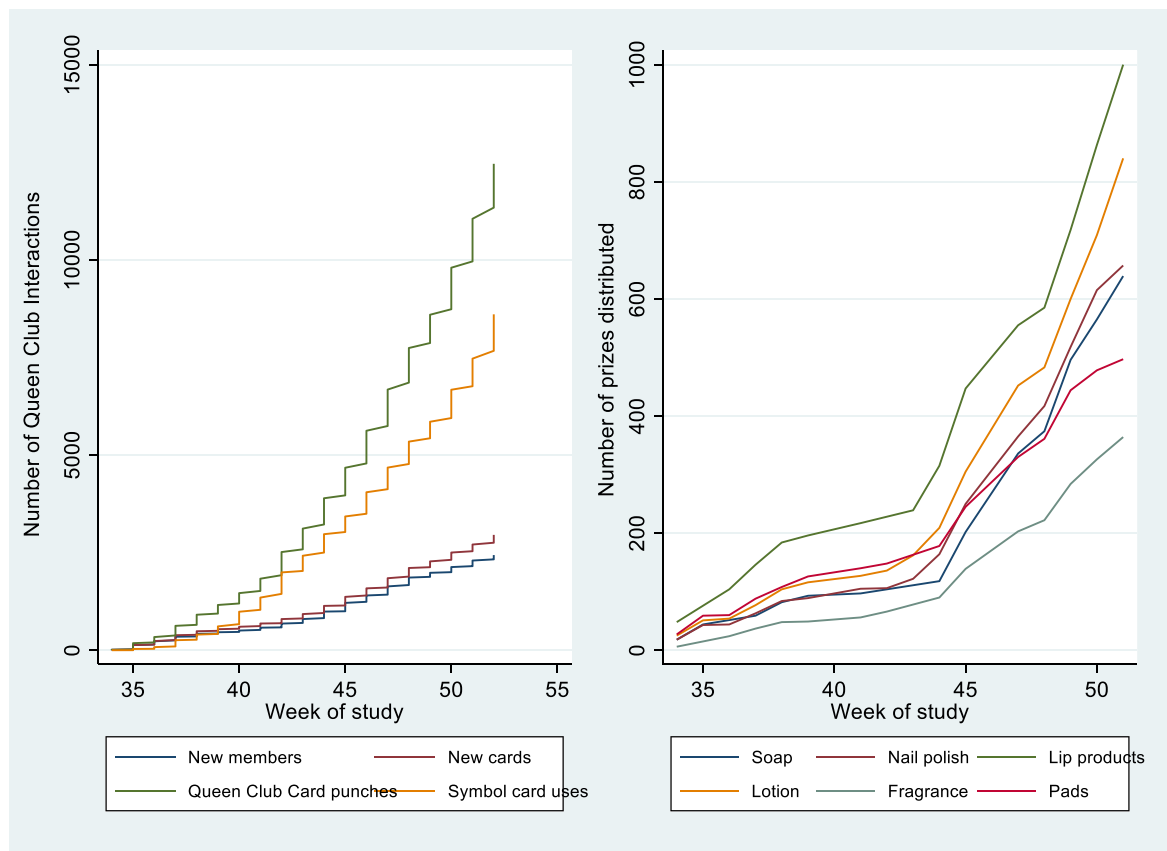


Fig. 3. Cumulative trends for *Malkia Klabu* engagement and prizes given among intervention shops.

card incorporated crown and jewel images. We intended the queen branding to resonate with AGYW, positively linking their shopping experience to girl-friendly program elements, rather than fearing SRH care-seeking.

We found some evidence that *Malkia Klabu* branding helped draw AGYW into participating shops. Some AGYW reported looking for the golden crown symbol.

You find the golden crown sign on the wall ... You know that this is a *Malkia Klabu* pharmacy.

- AGYW 102, age 24, self-employed, married with one child

Notably, while the monetary value of prizes was small (250–1500 TSh; \$0.11–\$0.67 USD), the prizes chosen were intended to have an additional perceived emotional value:

A present is a present! It does not matter the size!

-AGYW 105, age 24, single mother of young child, living with her mother

In IDIs, AGYW expressed feeling “good” and “happy” to get prizes, and over 90% of AGYW in exit surveys reporting being “very happy” about earning another punch (Table 3). One AGYW club member described feeling relatively more important due to *Malkia Klabu*'s exclusive focus on girls' needs:

That's what I like ... girls have been given a higher priority than boys.

- AGYW 117, age 17, student, living with both parents

We note that instances of stigmatizing interactions with shopkeepers were absent from IDI respondents' experiences. Further, some shopkeepers said that they forged closer relationships with their AGYW customers. When speaking about interactions with girls in *Malkia Klabu*, one female shopkeeper said:

Absolutely! They became so familiar with me and they loved me so much and until today they use to come to the shop, they call me “the great Queen” and I reply, “the junior Queen.”

-Dispenser 42, intervention

3.6. Messenger: relating to peer narrators

With few trusted sources to turn to, AGYW have limited knowledge of contraception, and many questions and misconceptions (Hunter et al., 2021). We hypothesized that having informational videos about contraceptive methods featuring age peer narrators could enhance the perceived credibility of the information being conveyed, thus harnessing the influence of messengers. Videos were observed being used somewhat more often than SRH product displays (see Table S2). Some IDI evidence suggests that the information was slightly more notable to AGYW viewers, even if specific messenger attributes were not verbalized:

I did not have any more questions because the videos had told it all ... how to use the test and the *Malkia Klabu* ... so the explanations were enough for me.

- AGYW 102, age 24, self-employed, married with one child

3.7. Ego: boosting shopkeepers' standing in their community

For shopkeepers, being perceived as healthcare providers rather than for-profit businesspersons can garner community recognition and standing (Hunter et al., 2021). Stocking HIVST kits boosted the status of all shops as a trusted source of health information and advice:

We are praised for being a counseling center, most people come in for counseling. The reason for that is that we are not there simply for the business, but we rather provide services.

- Shop owner 5, comparison

[When people] came and found out we have HIVST kits, people got surprised [and wonder] why don't other shops have it. So we have gotten status through this program.

-Dispenser 28, intervention

The addition of the *Malkia Klabu* intervention cultivated notoriety for servicing AGYW. For instance, some intervention shopkeepers also received recognition from parents.

I first give them instructions and advice on self-protection ... the parents even know me and recognize my contribution to the society.

-Shop owner 12, intervention

One shopkeeper mentioned that parents had come with their daughters to directly express their gratitude.

3.8. Commitment: for the greater good

To counter gatekeeping tendencies for AGYW customers and encourage study engagement, we sought to capitalize on shopkeepers' predisposed empathy by screening for and inviting only those willing to support AGYW SRH into our study. However, all but one randomly sampled shopkeeper who could not be contacted and was otherwise eligible, agreed to participate. From IDIs, shopkeepers in both arms reiterated the importance of AGYW health needs:

I believe [SRH] would be useful to be taught at that age; it helps them make the right choices later ... We should not wait for them to be infected and start telling them that they should have used condoms.

-Shop owner 24, comparison

Only a few intervention shops explicitly credited the study for reinforcing their moral sense of purpose to support a vulnerable population. For example:

Without [the study], I wouldn't be here. I wouldn't give the appropriate service It helped me to be close to the people who are in need.

-Shop owner 13, intervention

Control shops also distributed HIVST kits to AGYW, albeit at lower levels and more slowly (Fig. 2, Supplement Table S1); no shop failed to distribute any HIVST kits to AGYW.

4. Discussion

In designing a person-centered intervention to address the acute SRH needs of AGYW using HCD, we sought to enhance the replicability and adaptability of the resulting solution by incorporating evidence-based nudges from behavioral economics. From our mixed-methods evaluation data, we found that many of the incorporated nudge strategies motivated AGYW and shopkeepers as intended. Among AGYW, we found strong evidence that the program's prizes incentivized AGYW to engage with the program. While these results accord with prior well-documented effects of micro-incentives on behavior change (Giles et al., 2014; Mantzari et al., 2015), there are three notable differences in how *Malkia Klabu*'s prize incentives were used. First, rather than directly condition on SRH utilization or health outcomes as others have done (de Walque et al., 2012; Yotebieng et al., 2016), our incentives targeted an upstream behavior—repeated shop visits with a purchase—to both support shop revenues and create more opportunities for AGYW to learn about, engage with, and consider contraception in a non-coercive manner, consistent with a person-centered, rights- and choice-based approach (World Health Organization, 2014). Even in this resource-constrained setting and population subgroup, AGYW were able to find funds for small purchases to remain engaged. In this way, *Malkia Klabu* was designed to appeal broadly to AGYW, thereby maximizing consumer applicability and coverage, while including elements to meet specific SRH goals.

Second, the structuring of prize incentives built upon organic behaviors that also benefited shopkeepers and helped align motivations across the ecosystem of actors that AGYW seeking SRH products needed to navigate, many of whom would otherwise act as gatekeepers. In some instances, the prospect of getting prizes was used by AGYW as a non-stigmatized reason to visit shops with explicit approval from family members. This is similar to how cash rewards facilitated support and compliance from male partners for avoiding sexually transmitted infections (Packel et al., 2012). Among shopkeepers, while some still had reservations about AGYW's contraceptive use, all nonetheless distributed SRH products to AGYW through *Malkia Klabu*; some shopkeepers even became AGYW champions and felt socially rewarded. Business revenue from *Malkia Klabu* members' purchases strongly incentivized shopkeepers to cater to AGYW customers, but direct evidence for a beneficial effect of pre-committing to serving AGYW vis-à-vis study participation was limited, suggesting a need to better disentangle these mechanisms in the future. Third, the prizes were chosen to have an emotional cache greater than their monetary value, a strategy shown to be effective for other public health behaviors (Curtis et al., 2007; Judah et al., 2009). Though only some AGYW verbalized this perceived delight, the lack of first-hand testimonial may reflect social desirability bias toward downplaying the influences of external motivators (i.e., over-attributing the effects to intrinsic motivation) and/or the larger difficulty in ascribing causal attribution to unconscious influences of behavioral nudges.

Beyond aligning incentives, other program features aimed at capitalizing on increasing opportunities to encourage SRH familiarity and uptake had mixed results. HIVST kits given as a default membership gift ensured high exposure to a new product, a strategy commonly used in marketing. Further, experiencing a common prevention behavior via HIV testing fostered familiarity with other SRH choices oftentimes not proactively considered. Awareness of *Malkia Klabu* was amplified with social validation through AGYW peer networks, importantly avoiding broader social proscription—a necessary and central element for influencing adolescent SRH outcomes (Pulerwitz et al., 2019). Though only a minority of AGYW customers were observed used the symbol card and product displays, the benefits of these tools were mentioned by both AGYW and shopkeepers, and they may have critically reduced the friction of learning and asking about SRH for specific individuals while filling a much-needed information gap for some AGYW with little health knowledge. There was also less direct evidence for the saliency of *Malkia Klabu* branding and the value of informational videos from AGYW peers, though we cannot wholly dismiss their potential unconsciousness influences.

Our pilot had several notable limitations. We are unable to rigorously ascribe causal attribution for any given strategy or program feature given the size and complexity of the resulting intervention. Many of the AGYW interviewed were recruited from one high-performing intervention shop, potentially introducing biases in the array of experiences captured. Relatedly, we only interviewed a small number of AGYW recruited from comparison shops, which likely also reflects the disparity in AGYW engagement between comparison and intervention shops. Our AGYW IDI sample, while purposefully selected to reflect heterogeneity in participant characteristics, is unrepresentative of the larger population of AGYW served at study shops, as reflected in the evaluation's quantitative data results, such as the shop observations that involved random sampling of data capture windows. AGYW sampled at intervention shops may have also been more inclined to participate in exit surveys, which may have been perceived as an extension of the *Malkia Klabu* intervention, compared to comparison shops which lacked the same AGYW customer appeal. Further, shopkeepers and AGYW interviewed may have responded with social desirability bias, potentially perceiving additional benefits for continued supply of study commodities and activities.

Limitations notwithstanding, this paper contributes to the emerging literature on better documenting and evaluating human-centered design

processes for public health interventions (Bazzano et al., 2017) and additionally highlights the value-add of incorporating a behavioral economics lens. Though interview responses were disproportionately from AGYW engaging with intervention shops, this enabled us to obtain more in-depth feedback on the array of intervention features, and informs further refinement of *Malkia Klabu* for scaling. The totality of the different program features and nudge strategies allowed for a spectrum of engagement preferences through a high-frequency, low-dose approach that enabled AGYW to consider prevention measures at their own pace, incrementally, and early on in their sexual development rather than waiting for an acute need (e.g., unintended pregnancy, condomless sex). Our pilot demonstrated the synergistic potential of leveraging multiple strategies that may ultimately be needed to solve real-world programmatic challenges involving multiple actors navigating complex, intersecting social and structural systems and sustain beneficial behaviors over time.

Our future research will seek to identify the most essential and impactful features of our *Malkia Klabu* intervention with an eye toward increasing the sustainability and commercial viability of this program in positioning it for scaling. With a firm understanding of the effect of our intervention on intermediate utilization outcomes from this pilot study, measuring its impact on population-level outcomes (e.g., HIV diagnoses and pregnancies among AGYW) will also be needed. Notably, identifying the minimum level of incentives necessary for efficacy will be critical for determining the scalability of *Malkia Klabu* despite demonstrating proof-of-concept. While distributing free products may dampen or distort consumer demand, it may be warranted in contexts where willingness or ability to pay are extremely limited and considering the social benefits from the large positive externalities (Cohen, 2019), as is the case for AGYW in sub-Saharan Africa.

5. Conclusion

By integrating behavioral economics into the human-centered design process, our systematic approach to identifying users' needs at each step of their journey enabled us to identify multiple opportunity points for nudging them toward health-optimizing behavior. This may be a valuable way to develop more person-centered, evidence-based holistic public health programs that first and foremost meet the needs of the actors involved while also creating a basic intervention rubric that can be adapted to other contexts.

Credit author statement

Jenny X. Liu: Conceptualization; Methodology; Investigation; Resources; Writing – original draft; Writing – review & editing; Visualization; Supervision; Project administration; Funding acquisition, **Janelli Vallin:** Validation; Formal analysis; Writing – original draft; Visualization, **Calvin Chiu:** Software; Validation; Formal analysis; Visualization, **F. Abigail Cabrera:** Methodology; Validation; Formal analysis; Data curation, **Lauren Hunter:** Software; Validation; Formal analysis; Investigation; Data curation; Supervision; Project administration, **Aarthi Rao:** Conceptualization; Investigation; Writing – review & editing, **Prosper Njau:** Conceptualization; Resources; Writing – review & editing; Funding acquisition, **Sandra I. McCoy:** Conceptualization; Methodology; Investigation; Resources; Writing – original draft; Writing – review & editing; Supervision; Project administration; Funding acquisition

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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Appendix A. Supplementary data

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References

- Altman, M., Huang, T.T.K., Breland, J.Y., 2018. Design thinking in health care. *Prev. Chronic Dis.* 15 <https://doi.org/10.5888/pcd15.180128>.
- Ashraf, N., Bandiera, O., Jack, B.K., 2014. No margin, no mission? A field experiment on incentives for public service delivery. *J. Publ. Econ.* 120, 1–17.
- Bazzano, A.N., Martin, J., Hicks, E., Faughnan, M., Murphy, L., 2017. Human-centered design in global health: a scoping review of applications and contexts. *PLoS One* 12, e0186744.
- Behavioural Insights Team, 2014. Team, B.I., 2014. EAST: Four Simple Ways to Apply Behavioural Insights. Behavioural Insights Team, London.
- Cabrera, A., Willard-Grace, R., Bykhovsky, C., Douglas, K., Hunter, L., Liu, J., McCoy, S. I., 2021. Stakeholder Experiences of an Intervention for Provision of HIV Self-Testing Kits and Contraception to Adolescent Girls and Young Women in Privately Owned Drug Shops in Sub Saharan Africa. In: IAS 2021 Abstract Book. Presented at the 24th International AIDS Society (IAS) Conference, Virtual.
- Charmaz, K., 2006. *Constructing Grounded Theory: A Practical Guide through Qualitative Analysis*. SAGE.
- Chiu, C., Hunter, L.A., McCoy, S.I., Mfaume, R., Njau, P., Liu, J.X., 2021. Sales and pricing decisions for HIV self-test kits among local drug shops in Tanzania: a prospective cohort study. *BMC Health Serv. Res.* 21, 434. <https://doi.org/10.1186/s12913-021-06432-1>.
- Codagnone, C., Veltri, G.A., Lupiáñez-Villanueva, F., Bogliacino, F., 2014. The challenges and opportunities of 'nudging'. *J. Epidemiol. Community Health* 68, 909–911. <https://doi.org/10.1136/jech-2014-203948>.
- Cohen, J.L., 2019. The enduring debate over cost sharing for essential public health tools. *JAMA Netw. Open* 2. <https://doi.org/10.1001/jamanetworkopen.2019.9810> e199810–e199810.
- Curtis, V.A., Garbrah-Aidoo, N., Scott, B., 2007. Masters of marketing: bringing private sector skills to public health partnerships. *Am. J. Publ. Health* 97, 634–641. <https://doi.org/10.2105/AJPH.2006.090589>.
- de Walque, D., Dow, W.H., Nathan, R., Abdul, R., Abilahi, F., Gong, E., Isdahl, Z., Jamison, J., Julu, B., Krishnan, S., Majura, A., Miguel, E., Moncada, J., Mtenga, S., Mwanyangala, M.A., Packel, L., Schachter, J., Shirima, K., Medlin, C.A., 2012. Incentivising safe sex: a randomised trial of conditional cash transfers for HIV and sexually transmitted infection prevention in rural Tanzania. *BMJ Open* 2, e000747. <https://doi.org/10.1136/bmjopen-2011-000747>.
- Deci, E.L., Ryan, R.M., 2008. Facilitating optimal motivation and psychological well-being across life's domains. *Canadian Psychology/Psychologie canadienne* 49, 14–23. <https://doi.org/10.1037/0708-5591.49.1.14>.
- DellaVigna, S., 2009. Psychology and economics: evidence from the field. *J. Econ. Lit.* 47, 315–372. <https://doi.org/10.1257/jel.47.2.315>.
- Dolan, P., Hallsworth, M., Halpern, D., King, D., Metcalfe, R., Vlaev, I., 2012. Influencing behaviour: the mindspace way. *J. Econ. Psychol.* 33, 264–277. <https://doi.org/10.1016/j.joep.2011.10.009>.
- Giles, E.L., Robalino, S., McColl, E., Sniehotta, F.F., Adams, J., 2014. The effectiveness of financial incentives for health behaviour change: systematic review and meta-analysis. *PLoS One* 9, e90347. <https://doi.org/10.1371/journal.pone.0090347>.
- Hallsworth, M., Chaborn, T., Sallis, A., Sanders, M., Berry, D., Greaves, F., Clements, L., Davies, S.C., 2016. Provision of social norm feedback to high prescribers of antibiotics in general practice: a pragmatic national randomised controlled trial. *Lancet* 387, 1743–1752. [https://doi.org/10.1016/S0140-6736\(16\)00215-4](https://doi.org/10.1016/S0140-6736(16)00215-4).
- HCDEXchange, 2022. *Quality and Standards Framework: Principles and Tips to Drive the Effective Application of Human-Centered Design on Adolescent Sexual and Reproductive Health and Global Health Programming*. HCDEXchange.
- Hubacher, D., Mavranezouli, I., McGinn, E., 2008. Unintended pregnancy in sub-Saharan Africa: magnitude of the problem and potential role of contraceptive implants to alleviate it. *Contraception* 78, 73–78. <https://doi.org/10.1016/j.contraception.2008.03.002>.
- Hunter, L.A., McCoy, S.I., Rao, A., Mnyipembe, A., Hassan, K., Njau, P., Mfaume, R., Liu, J.X., 2021. Designing drug shops for young women in Tanzania: applying human-centred design to facilitate access to HIV self-testing and contraception. *Health Pol. Plann.* 36, 1562–1573. <https://doi.org/10.1093/heapol/czab084>.
- Judah, G., Aunger, R., Schmidt, W.-P., Michie, S., Granger, S., Curtis, V., 2009. Experimental pretesting of hand-washing interventions in a natural setting. *Am. J. Publ. Health* 99, S405–S411. <https://doi.org/10.2105/AJPH.2009.164160>.
- Liu, J.X., Shen, J., Wilson, N., Janumpalli, S., Stadler, P., Padian, N., 2019. Conditional cash transfers to prevent mother-to-child transmission in low facility-delivery settings: evidence from a randomised controlled trial in Nigeria. *BMC Pregnancy Childbirth* 19, 32. <https://doi.org/10.1186/s12884-019-2172-3>.
- Loewenstein, G., Brennan, T., Volpp, K.G., 2007. Asymmetric paternalism to improve health behaviors. *JAMA* 298, 2415–2417. <https://doi.org/10.1001/jama.298.20.2415>.
- Mantzari, E., Vogt, F., Shemilt, I., Wei, Y., Higgins, J.P.T., Marteau, T.M., 2015. Personal financial incentives for changing habitual health-related behaviors: a systematic review and meta-analysis. *Prev. Med.* 75, 75–85. <https://doi.org/10.1016/j.ypmed.2015.03.001>.
- McCoy, S.I., Fahey, C., Rao, A., Kapologwe, N., Njau, P.F., Bautista-Arredondo, S., 2017. Pilot study of a multi-pronged intervention using social norms and priming to improve adherence to antiretroviral therapy and retention in care among adults living with HIV in Tanzania. *PLoS One* 12, e0177394. <https://doi.org/10.1371/journal.pone.0177394>.
- McCoy, S.I., Kangwende, R.A., Padian, N.S., 2009. Behavior change interventions to prevent HIV infection among women living in low and middle income countries: a systematic review. *AIDS Behav.* 14, 469–482. <https://doi.org/10.1007/s10461-009-9644-9>.
- Michielsen, K., Chersich, M.F., Luchters, S., De Koker, P., Van Rossem, R., Temmerman, M., 2010. Effectiveness of HIV prevention for youth in sub-Saharan Africa: systematic review and meta-analysis of randomized and nonrandomized trials. *AIDS* 24, 1193–1202.
- Ministry of Health, 2016. Tanzania Demographic and Health Survey and Malaria Indicator Survey (TDHS-MIS) 2015–16 (No. FR3221). MoHCDGEC, MoH, NBS, OCGS, and ICF, Dar Es Salaam, Tanzania, and Rockville. In: Community Development, Gender, Elderly and Children (MoHCDGEC) [Tanzania Mainland], Ministry of Health (MoH) [Zanzibar], National Bureau of Statistics (NBS), Office of the Chief Government Statistician (OCGS), ICF (Maryland, USA).
- Napierala Mavdzenge, S., Luecke, E., Lopez, A., Wagner, D., Hartmann, M., Lutnick, A., Lambdin, B., 2016. HIV Testing Among Key Populations, Adolescent Girls and Men in Eastern and Southern Africa: A Review of Research, Policy and Programming. RTI International, Research Triangle Park, NC.
- Napierala Mavedzenge, S.M., Doyle, A.M., Ross, D.A., 2011. HIV prevention in young people in sub-saharan Africa: a systematic review. *J. Adolesc. Health* 49, 568–586. <https://doi.org/10.1016/j.jadohealth.2011.02.007>.
- Nemeth, C.P., 2004. *Human Factors Methods for Design: Making Systems Human-Centered*. CRC Press.
- O'Donoghue, T., Rabin, M., 1999. Doing it now or later. *Am. Econ. Rev.* 89, 103–124. <https://doi.org/10.1257/aer.89.1.103>.
- Packel, L., Keller, A., Dow, W.H., Walque, D. de, Nathan, R., Mtenga, S., 2012. Evolving strategies, opportunistic implementation: HIV risk reduction in Tanzania in the context of an incentive-based HIV prevention intervention. *PLoS One* 7, e44058. <https://doi.org/10.1371/journal.pone.0044058>.
- Pinto, D., Ibarrraran, P., Stampini, M., Carman, K.G., Guanais, F., Luoto, J., Sanchez, M., Cali, J., 2014. *Applying Behavioral Tools to the Design of Health Projects*. Inter-American Development Bank.
- Pulerwitz, J., Blum, R., Cislighi, B., Costenbader, E., Harper, C., Heise, L., Kohli, A., Lundgren, R., 2019. Proposing a conceptual framework to address social norms that influence adolescent sexual and reproductive health. *J. Adolesc. Health* 64, S7–S9. <https://doi.org/10.1016/j.jadohealth.2019.01.014>.
- Rutta, E., Senauer, K., Johnson, K., Adeya, G., Mbwasi, R., Liana, J., Kimatta, S., Sigonda, M., Alphonse, E., 2009. Creating a new class of pharmaceutical services provider for underserved areas: the Tanzania accredited drug dispensing outlet experience. *Progress in Community Health Partnerships: Research, Education, and Action* 3, 145–153. <https://doi.org/10.1353/cpr.0.0063>.
- Sibanda, E.L., Tumushime, M., Mufuka, J., Mavedzenge, S.N., Gudukeya, S., Bautista-Arredondo, S., Hatzold, K., Thirumurthy, H., McCoy, S.I., Padian, N., Copas, A., Cowan, F.M., 2017. Effect of non-monetary incentives on uptake of couples' counselling and testing among clients attending mobile HIV services in rural Zimbabwe: a cluster-randomised trial. *Lancet Global Health* 5, e907–e915. [https://doi.org/10.1016/S2214-109X\(17\)30296-6](https://doi.org/10.1016/S2214-109X(17)30296-6).
- Sieverding, M., Schatzkin, E., Shen, J., Liu, J., 2018. Bias in contraceptive provision to young women among private health care providers in south west Nigeria. *Int. Perspect. Sex. Reprod. Health.* 44 <https://doi.org/10.1363/44e5418>.
- Tanzania Commission for AIDS (TACAIDS), 2013. Zanzibar AIDS Commission (ZAC), National Bureau of Statistics (NBS), Office of the Chief Government Statistician (OCGS), ICF International. In: Tanzania HIV/AIDS and Malaria Indicator Survey 2011–12: Key Findings (No. SR196). TACAIDS, ZAC, NBS, OCGS, and ICF International (Dar es Salaam, Tanzania).
- Thaler, R.H., Sustein, C.R., 2008. *Nudge: Improving Decisions about Health, Wealth, and Happiness*. Yale University Press, New Haven, CT & London.
- Tolley, E.E., 2017. *Traditional Socio-Behavioral Research and Human-Centered Design: Similarities, Unique Contributions, and Synergies*.
- Tubert, J., Packel, L., Hunter, L.A., Mfaume, R., Njau, P., Ramadhani, A.A., Liu, J.X., McCoy, S.I., 2021. HIV prevention at drug shops: awareness and attitudes among

- shop dispensers and young women about oral pre-exposure prophylaxis and the dapivirine ring in Shinyanga, Tanzania. *AIDS Res. Ther.* 18, 21. <https://doi.org/10.1186/s12981-021-00343-1>.
- Tversky, A., Kahneman, D., 1974. Judgment under uncertainty: heuristics and biases. *Science* 185, 1124–1131. <https://doi.org/10.1126/science.185.4157.1124>.
- UNAIDS, 2016. HIV Prevention Among Adolescent Girls and Young Women. Joint United Nations Programme on HIV/AIDS (UNAIDS), Geneva, Switzerland.
- Walton, G.M., 2014. The new science of wise psychological interventions. *Curr. Dir. Psychol. Sci.* 23, 73–82. <https://doi.org/10.1177/0963721413512856>.
- World Health Organization, 2014. Ensuring Human Rights in the Provision of Contraceptive Information and Services: Guidance and Recommendations, WHO Guidelines Approved by the Guidelines Review Committee. World Health Organization, Geneva.
- Yotebieng, M., Thirumurthy, H., Moracco, K.E., Kawende, B., Chalachala, J.L., Wenzel, L. K., Ravelomanana, N.L.R., Edmonds, A., Thompson, D., Okitolonda, E.W., Behets, F., 2016. Conditional cash transfers and uptake of and retention in prevention of mother-to-child HIV transmission care: a randomised controlled trial. *The Lancet HIV* 3, e85–e93. [https://doi.org/10.1016/S2352-3018\(15\)00247-7](https://doi.org/10.1016/S2352-3018(15)00247-7).
- Hunter LA, Rao A, Napierala S, Kalinjila A, Mnyippembe A, Hassan K, Bertozzi SM, Mfaume R, Njau P, Liu JX, McCoy SI. Reaching Adolescent Girls and Young Women With HIV Self-Testing and Contraception at Girl-Friendly Drug Shops: A Randomized Trial in Tanzania. *J Adolesc Health.* 2023 Jan;72(1):64-72. doi: 10.1016/j.jadohealth.2022.08.013. Epub 2022 Oct 12. PMID: 36241492.