ORIGINAL PAPER

TITLE: Stick To It: Pilot study results of an intervention using gamification to increase HIV and sexually transmitted infection screening among young men who have sex with men in California

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ABSTRACT

Background: In the United States, young men who have sex with men (YMSM) experience a disproportionate burden of HIV and sexually transmitted infections (STIs). Mobile health (mHealth) interventions, including those that incorporate elements of games (‘gamification’), have the potential to improve YMSM engagement in desirable sexual health services and behaviors. Gamification leverages theory and tools from behavioral science to motivate people to engage in a behavior in a context of fun.

Objective: Determine whether an intervention using gamification is acceptable and feasible to YMSM in California and potentially increases repeat HIV/STI screening.

Methods: Eligible YMSM were: 1) 18-26 years, 2) born as and/or self-identified as male, 3) reported male sexual partners, and 4) lived in a zip code adjacent to one of the two study clinics in Oakland and Hollywood, California. The gamification intervention, Stick To It, had four components: 1) recruitment (clinic-based and online), 2) online enrollment; 3) online activities, and 4) ‘real-world’ activities at the clinic. Participants earned points through online activities that could be redeemed for a chance to win prizes during HIV/STI screening and care visits.

The primary outcomes were acceptability and feasibility measured with participant engagement data and in-depth interviews. The secondary outcome was the intervention’s preliminary effectiveness on repeat HIV/STI screening within 6 months, restricted to the subset of men who provided consent for review of medical records and who had ≥6 months of follow-up. Outcomes were compared to a historical control group of similar YMSM who attended study clinics in the twelve months prior to intervention implementation.

Results: Overall, 166 (53%) of 313 eligible YMSM registered. After registration, 93 (56%) participants completed enrollment and 31 (19%) completed ≥1 online activity in the subsequent 6 months. Points were redeemed in clinic by 11% of the 166 users (27% and 5% of those recruited in the clinic and online, respectively). Despite modest engagement with the intervention, participants provided a positive assessment of the program in qualitative interviews, with several stating that they were motivated by the inclusion of game elements in the HIV/STI testing experience.

The analysis of repeat HIV/STI testing was assessed among 31 YMSM who consented to medical record review and who had ≥6 months of follow-up. During follow-up, 15 (48%) received ≥2 HIV/STI tests compared to 157 (30%) of a historical comparison group of 517 similar YMSM who lived in the same zip codes and who received care at the same clinics before the intervention (OR=2.15, 95% confidence interval: 1.03, 4.47, P=.04).

Conclusions: The intervention was feasible and acceptable to study participants. Among the subset of participants recruited in the clinic, repeat HIV/STI screening was higher than a comparison group of similar YMSM attending the same clinic in the prior year.
**Trial Registration:** Clinicaltrials.gov NCT02946164

**Keywords:** Gamification; men who have sex with men; HIV screening; STI screening; self-determination theory; game design; game elements; incentives; intrinsic motivation
INTRODUCTION

In the United States, men who have sex with men (MSM) experience a disproportionate burden of HIV and other sexually transmitted infections (STIs). Gay and bisexual men account for 70% of new HIV diagnoses,[1] and if current rates continue, 1 in 6 MSM may be diagnosed with HIV in their lifetime.[2] Young MSM (YMSM) 13-24 years of age are at particularly high risk, accounting for 25% of new diagnoses among all MSM and overall, nearly 1 out of 5 new diagnoses in the U.S. [3] The epidemiologic data for other STIs is similarly concerning: the rate of primary and secondary syphilis increased 19% from 2014-2015,[4] with MSM comprising 60% of new cases, and the estimated rate of gonorrhea among MSM in six U.S. jurisdictions more than doubled from 2010 to 2015.[5] Homophobia, stigma, and discrimination may partially explain these worrying trends, along with prevention fatigue and complacency, especially among YMSM who did not experience the initial years of the HIV epidemic.[6, 7]

Although more tools than ever are available to prevent HIV and STIs, nearly all require a behavioral component to maximize effectiveness. For example, biomedical prevention strategies such as pre-exposure prophylaxis (PrEP) require MSM to locate a care provider, attend regular medical visits, adhere to the drug, be regularly screened for HIV/STIs and monitored for side effects, and use condoms or other methods to avoid STIs. While traditional behavioral approaches relying on information, education, and communication have had some success, a new field of behavioral science leverages people’s systematic biases and heuristics to positively change behavior.[3–5] These approaches use tools from behavioral economics and psychology to influence behavior and include financial and in-kind incentives, social influence, commitments, and reminders. In addition, several studies have
demonstrated that incorporating elements of games into health programs, an approach known as *gamification*, can harness the motivational power of these same tools (e.g., incentives, commitments, reminders) in a context of fun.[8, 9]

Interventions using gamification are not games in the traditional sense. Instead, they are programs that include *elements* of games such as a reward system (e.g., points, badges, leaderboards), elements of chance and surprise, and/or a social component (e.g., connection, collaboration, and competition).[10] Ongoing and completed studies in the U.S. and elsewhere, including several intended for MSM, have demonstrated the feasibility and acceptability of gamification for improving engagement in HIV prevention and care services.[11-20] Programs incorporating gamification may be especially advantageous for YMSM given their engagement with technology, social media, and games. Indeed, a growing body of evidence suggests that the internet and social media are effective ways to share sexual health information with MSM, and YMSM in particular.[21-29] It is therefore unsurprising that a generation of interventions drawing on gamification for YMSM is currently underway, including programs to reduce sexual risk behaviors and to improve antiretroviral therapy (ART) adherence.[13-16]

In order to test the potential of gamification for HIV/STI prevention, we developed and piloted *Stick To It*, an HIV/STI prevention intervention that incorporates elements of gamification to increase repeat HIV and STI screening among YMSM (ages 18-26 years). We chose to focus our intervention on routinization of HIV/STI screening as it is the gateway to HIV and STI treatment, which can lead to reduced onward transmission,[30] and also serves as a critical first step to accessing prevention strategies such as PrEP. CDC recommends frequent HIV/STI screening of high-risk MSM (i.e., at 3-6 month intervals).[31] a
strategy supported by mathematical models and observational data indicating that smaller screening intervals could reduce transmission of STIs,[32, 33] are cost-effective,[34] and will reduce undiagnosed HIV infection.[35, 36] Repeat HIV screening is also critical for men on pre-exposure prophylaxis,[37] and to reduce undiagnosed HIV infections, especially as 52% of HIV infections among YMSM are undiagnosed.[38] We hypothesized that an intervention using gamification that was developed through an iterative, human-centered and game-design process and leveraged existing technology would be feasible and acceptable to YMSM and could increase repeat HIV/STI screening.

METHODS

Study Overview

Between October 2016 and June 2017 we conducted a pilot study at two sexual health clinics operated by the AIDS Healthcare Foundation in Hollywood and Oakland, California. The mixed-methods evaluation strategy included data from surveys with participants, medical record reviews, intervention engagement data, and in-depth interviews with participants in order to determine intervention acceptability and feasibility and its preliminary association with repeat HIV/STI screening within 6 months. The study was pre-registered at clinicaltrials.gov (NCT02946164) and the study protocol has been published.[39]

Theoretical Framework

Gamification, “the use of game-design elements in non-game contexts,” [8, 9] is hypothesized to amplify the motivational power of financial and non-financial incentives in addition to other benefits. It is informed by Self-Determination Theory,
which posits that external rewards can be internalized and generate lasting *intrinsic motivation* (defined as engaging in activities “because of the positive feelings resulting from the activities themselves”) if they are experienced in a context that satisfies three basic psychological needs: *autonomy, competence*, and *relatedness*. [40] It is hypothesized that gamification has the potential to create such a context. [8, 40] In addition, gamification builds on economic and behavioral economic theory about how incentives and rewards motivate engagement in health behaviors.[41-43]

Gamification interventions can be described by their ‘game mechanics’, the mechanisms that define how the intervention works, and their theme. The game theme is a narrative or story that serves to connect game components and is critical to maximizing participant engagement.[38] Our intention was to test several simple game mechanics (described below) that could together be incorporated into existing or future mHealth interventions, with the theme easily customized to various target populations.

**Study Population and Recruitment**

Young men were eligible if they met the following inclusion criteria: 1) 18-26 years old, 2) were born as and/or self-identified as male, 3) reported male sexual partners at the time of enrollment (any kind of sexual contact(s) and/or relationship), and 4) their zip code of residence surrounded one of the two study clinics so that study participants could realistically visit a study site. The inclusion criteria were intended to be as narrow as possible while permitting participation of higher-risk populations served by the participating clinics. For this reason, we increased the upper age limit
from 24 to 26 years and permitted inclusion of self-identifying men (including transgender men) who met the other inclusion criteria.

Participants were recruited in-person at study sites by clinic and research staff as well as online via advertising on various social networking sites (e.g., Grindr, Facebook, Instagram, Craigslist) and through flyers placed in the community. Participants completed a screening questionnaire, informed consent, and study registration online at the project website (see Multimedia Appendix 1) irrespective of how they were recruited.

**Intervention Description**

The intervention development process was influenced by game design and human-centered design and has been previously described along with the proposed theory of change.[39, 44] In brief, a series of in-depth interviews with clinic staff and focus group discussions with YMSM solicited feedback about specific game elements followed by an iterative design testing process. Qualitative data collection was punctuated by design meetings with the project team to refine and finalize game elements, such as how to make use of points, whether to use a leaderboard and/or social component, the frequency of participant interaction, when or if to incorporate prizes, and how to make use of elements of chance. The final intervention consisted of four components (see **Figure 1**): 1) recruitment, 2) online enrollment; 3) online activities, and 4) ‘real-world’ activities that occurred at the clinic. Participants earned points through the online activities, which were then redeemed for a chance to win prizes during clinic visits. These components were connected through a gumball machine theme, selected by YMSM, and the program name of *Stick To It*, which also alluded to adoption of a regular HIV/STI screening schedule.
The online enrollment process consisted of an eligibility survey, informed consent, a short survey to collect socio-demographic characteristics, and an introduction to the intervention and testing locations. This consisted of a brief, written tutorial, entering the date of last HIV/STI screening which was used to set a digital countdown timer for the next recommended screening three months from the last test, and a five-question multiple choice quiz on a topic related to sexual health. Participants earned points for each step and all subsequent activities. Throughout the program, participants could also invite friends to join the intervention, and would earn points for their enrollment.

After enrollment, the intervention consisted of periodic quizzes that could be completed for points; every three weeks users were prompted via SMS and email to visit their dashboard on the intervention website to take a new quiz. Quizzes were
short, whimsical, included questions that tested knowledge of sexual health information germane to YMSM, and were derived from the well-known “Ask Dr. K” online column.[45] The quizzes had two primary goals: 1) display the approaching quarterly screening date on the countdown timer on the participant’s personalized dashboard, and 2) provide participants the opportunity to accumulate points, increasing their chance of winning prizes at the clinic, and thereby increasing motivation to seek HIV/STI screening.

The final component of the intervention took place at the clinic where participants could be screened for HIV/STIs and/or redeem their points for a chance to win prizes. Prizes were determined via spins of a gumball machine, whereby points were used to ‘purchase’ spins and prizes were determined by the color combinations of gumballs, with an expected average prize cost of $5 per screening visit. Points could only be redeemed in clinic, a purposeful game mechanic intended to increase motivation to engage in regular sexual health services. After screening, the countdown timer was reset for the next quarterly screening date and the participant continued to receive new quizzes until the next visit or study end.

HIV and STI Screening

At screening visits, clients were typically screened for HIV with the INSTI™ HIV-1/2 antibody test, (bioLytical, Vancouver, CA) and the Clearview® COMPLETE HIV 1/2 assay. Those with a non-reactive result were further screened with the Abbott ARCHITECT® Ag/Ab Combo (Abbott Architect i1000r, Abbott Park, IL) test to detect acute and recent HIV infections. Anatomic site screening included oropharyngeal, rectal, and urethral for N. gonorrhoeae and C. trachomatis (Hologic APTIMA CT/NG assay (San Diego, CA)), followed by a blood draw for syphilis (rapid plasma reagin
screening with *Treponema pallidum* particle agglutination confirmation; Fujirebio, Japan). Clients with positive test results and recent sex partners were treated according to AHF clinical protocols in accordance with CDC and State of California STD treatment guidelines.[31, 46]

**Outcomes**

The primary outcomes were intervention acceptability and feasibility. We assessed acceptability with the following indicators of intervention engagement: completion of registration, completion of onboarding (setting the testing timer and completing the first quiz), completion of subsequent quizzes, recruitment of friends, redemption of points in the clinic, and HIV/STI screening (during the study period). In addition, an ancillary qualitative study with a subset of participants assessed acceptability of the intervention as well as aspects that could affect the feasibility of future implementation on a larger scale and the intervention’s relevance for other population groups. Note that changes in sexual behavior were pre-registered as a secondary outcome in our analysis plan on clinicaltrials.org, but data on this outcome were not available in the medical record for most participants and is therefore not presented.

Among a subset of participants, we assessed the intervention’s preliminary effectiveness on repeat HIV/STI screening within 6 months, defined as the proportion of men in the intervention who received ≥2 HIV tests over 6 months of follow-up. This exploratory analysis was restricted to men who enrolled by January 30, 2017 (in order to have at least 6 months of follow-up) and those who were recruited in the clinics. This was because only men recruited in the clinic provided HIPAA authorization for review of medical records and were screened at baseline.
(tests within the previous 30 days of enrollment were counted as baseline tests).

**Data Collection**

Data were collected for the pilot study in several ways. We collected detailed data on website analytics and participant engagement with the intervention, including completion of online activities, redemption of points, and HIV/STI screening encounters. Two brief pre- and post-pilot online surveys were requested of all *Stick To It* participants to assess socio-demographics at baseline and, at endline, barriers and facilitators to testing, perceptions of the intervention, and opportunities for improvement.

To understand whether the intervention had preliminary effects on repeat HIV/STI screening compared to the standard of care, medical records were reviewed for *Stick To It* participants who received services at the two participating clinics and who signed HIPPA authorization. We compared these data to a historical comparison group of 18-26 year old YMSM who received care at the same clinics during the six months preceding the intervention (January-September 2016) and who resided in the same eligible zip codes. Although our analysis plan specified a comparison group of approximately the same size as the intervention group,[39] for efficiency we included all 517 YMSM who met these criteria in the comparison group. In addition to being YMSM attending the same study clinics, the mean age (23 years) and sex of sex partners (83% men only) was the same in the historical comparison group and the *Stick To It* group.

In the final two months of the pilot study, we conducted a qualitative study consisting of 15 in-depth interviews with *Stick To It* participants. Interviews were conducted in English by trained staff in a private room at study clinics or via phone and followed standard qualitative procedures.[47, 48] A semi-structured interview
guide covered pre-determined issues (to ensure systematic data collection) but the interviewer was free to change the sequence and wording of questions to ensure that unexpected themes could emerge. Interviews were audio recorded, with participant’s consent, and later summarized according to intervention component (i.e., quizzes, peer recruitment). Interviews focused on whether the intervention was relevant, motivating, and culturally appropriate. We purposefully selected a diverse group of YMSM from different racial and ethnic groups and men who had different levels of engagement with the intervention. Participants were compensated $50 and interviews continued until theme saturation was reached.[47]

Data Analysis

We first describe the study population and intervention acceptability and feasibility by examination of the quantitative indicators of intervention engagement. This included the proportion of YMSM who completed registration, completed online enrollment (setting the testing timer and completing the first quiz), and redeemed points. We stratified most analyses by whether participants were recruited in the clinic or online, given that these groups had different baseline characteristics, and because those recruited in the clinic were typically screened that day. We supplemented these data with insights about acceptability and feasibility from the qualitative interviews. The qualitative data were analyzed using a content analysis approach.[49] One researcher coded the data from the interviews according to pre-determined codes such as the components of the intervention (e.g., quizzes, inviting friends, prizes, clinic-based activities) as well as elements of the users’ experience (e.g., recruitment, SMS messages).

To determine the intervention’s preliminary effectiveness on repeat HIV/STI
screening within 6 months, we compared the frequency of repeat screening among participants recruited in the clinic to the historical comparison group. We assessed whether the proportion who received repeat screening was statistically different using a chi-squared test with alpha=0.05. We also expressed this comparison as an odds ratio (OR) and 95% confidence interval. Similar to other small pilot studies of online sexual health interventions,[50, 51] this analysis was considered to be preliminary, as the pilot study was primary focused on feasibility and acceptability and was not powered for an effectiveness analysis.

**Protection of Human Subjects**

The Committee for Protection of Human Subjects at the University of California, Berkeley approved this study.

**RESULTS**

During the study period, 629 people completed the online eligibility survey and 313 YMSM met the eligibility criteria. Of these, 166 (53%) registered for *Stick To It*, which included completing the online informed consent and baseline survey and creating an account on the *Stick To It* website. Of the 166 participants, 45 were recruited in the two participating clinics and 121 were recruited online (primarily Grindr). Compared to the YMSM who were recruited online, YMSM recruited in the clinic were slightly older (mean age 23.4 vs. 22.8), had higher levels of education (51% vs. 26% reported a college degree), were less likely to be students (44% vs. 52%), were more likely to be employed (82% vs. 61%), and had higher income (31% vs. 19% earned $30,000 or more annually, *Table 1*). Men recruited online were more likely
to self-identify as Latino (50% vs. 27%), while men recruited in the clinic were slightly more likely to self-identify as Asian (22% vs. 11%) or African-American (9% vs. 3%).

Table 1. Characteristics of young MSM (YMSM) who enrolled into Stick To It intervention, stratified by recruitment location (clinic vs. online), California, 2016-2017.

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<th>Recruitment Location</th>
<th>Total (n=166)</th>
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<tr>
<td></td>
<td>Clinic (n=45)</td>
<td>Online / Other (n=121)</td>
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<tr>
<td>Age</td>
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<td>%</td>
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<tr>
<td>18-20 years</td>
<td>5</td>
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<td>21-22 years</td>
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<td>33.3</td>
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<td>23-26 years</td>
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<tr>
<td>Mean (years)</td>
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<td>22.8</td>
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<tr>
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**Intervention Acceptability and Feasibility**

Overall, participants in the qualitative interviews provided a positive assessment of *Stick To It*, with several participants noting that they were motivated by the inclusion of games into the HIV/STI testing experience, which was otherwise stressful. One participant explained, “*Trying to gamify the testing process makes it a little bit less stressful, a little bit less anxiety*” (Oakland, Clinic, 25 years). Another participant noted, “*It’s cool… I like the quizzes, I think the questions are pretty fun. I also like the fact that it encourages people to get tested…I think it’s a really good program*” (Los Angeles, Online, 23 years).

Nevertheless, although most participants liked the program, some did not think that it was helpful for them individually because they reported that they were already regular testers and/or did not need additional encouragement. Likewise, participants ranged in how they perceived the prizes, from high levels of enthusiasm to interest only in high-value prizes (which were perceived by some as too difficult to win). For example, one participant explained, “*In general I thought it was well intentioned, but I did not really see any benefit. And there’s two reasons. One is the prizes…they were not something I wanted. And the second [reason] was I get tested for STDs without any encouragement, it’s just something you do*” (Los Angeles, Online, 25 years). In this way, participants saw value in the program in general but differed about whether it was personally motivating.

**Enrollment**

Immediately after registration, participants were prompted to set the testing countdown timer and to answer the first quiz. Overall, 56% of participants
completed both enrollment activities, although 73% of men who were recruited online set the testing countdown timer compared to 62% of men recruited through the clinics (Figure 2). Interviews suggested several explanations for some participants’ inactivity after registration. For some participants, the program benefits were unclear, with one participant explaining, “When I originally joined the program... I just thought it was an online only resource and found out that it’s more than that” (Oakland, Online, 25 years). Men recruited online in particular found that the website offered insufficient guidance on the next steps following enrollment. One participant noted, “I remember kind of waiting and wondering when are they gonna try to get me to go, which clinic are they gonna try to get me to go to, how can I verify that I went if I did go get checked out?” (Los Angeles, Online, 22 years). Other participants indicated that the prizes were insufficiently described during the enrollment process and they didn’t know what they were “playing for” until they received the first program SMS or email.

Figure 2. Engagement in the cascade of intervention activities among young men who have sex with men (YMSM) who registered for the Stick To It program, stratified by recruitment location (clinic vs. online), California, 2016-2017. a,b
a. Data on completion of the first three indicators (setting the testing countdown timer, completing the 1st quiz, and completion of both activities) are from the 166 participants who competed registration. Completion of the remaining intervention engagement indicators (recruiting friends, completion of subsequent quizzes, and redeeming points) is limited to the 164 participants who enrolled by January 30, 2017 in order to have at least 6 months of follow-up.

b. The proportion of participants who completed two or more HIV/STI tests during the study period was evaluated by reviewing medical records for 31 Stick To It participants who received services at the two participating clinics and who signed HIPPA authorization. We compared these data to a historical comparison group of 18-26 year old YMSM who received care at the same clinics during the six months preceding the intervention (January-September 2016) and who resided in the same eligible zip codes. The proportion of participants who completed two or more HIV/STI tests during the study period is not shown for the participants who registered online because only five provided in-person consent for medical record review.

Post-Enrollment Online Activities

Online activities included completion of periodic quizzes and recruiting friends in exchange for points. Of the 164 participants who registered and who had 6 months of follow-up, 31 (19%) completed ≥1 online activity in the 6 months after enrollment. Men recruited through the clinic completed more quizzes: 22% of participants recruited in the clinic answered ≥2 quizzes (one additional quiz
following enrollment) and 16% answered ≥3 quizzes. In comparison, of the men recruited online, 18% answered ≥2 quizzes and 11% answered ≥3 quizzes. Men recruited in clinics were also active on the website longer than men recruited online (days between registration to last login=19.2 vs. 12.9 days) and checked the website more often (mean number of logins: 3.1 vs. 2.1).

In qualitative interviews, most participants reported that they enjoyed the quizzes; some participants continued to answer quizzes even if they did not plan to redeem the points for prizes. However, engagement with quizzes was negatively impacted if participants perceived that the program wasn’t strongly connected to or visible at the clinic, as one participant explained, “I took one or two quizzes. But after I got tested and no one mentioned the program, I stopped doing the quizzes.” (Oakland, Clinic, 21 years).

Only two participants successfully recruited a friend who signed up. Participants provided several reasons for not recruiting friends, including the difficulty in discussing HIV/STI testing with friends in general, apprehension that their invitation might imply that they think their friends are promiscuous, and the perception that friends would not want to participate in the program because they do not think they are at risk for HIV/STIs, because they go to other clinics than the two participating clinics, or because they do not live in the vicinity of the participating clinics. For example, one participant explained: “Would I invite anybody? If it were anonymous, yes I might. But if they had to know that I sent them the invitation, I would not... I’m not gonna say slut shaming, but by me inviting one of my friends to remind him or her to go get tested, I’m sort of saying ‘I know you have the need to go get tested,’ which a lot of times people interpret as ‘really, do I sleep around that much, do you think that about me?’” (Los Angeles, Online, 25 years).
In this way, there was low demand to recruit friends for the program.

Clinic Activities

Overall, 27% and 5% of those recruited in the clinic and online, respectively, redeemed their points in the clinic for a prize. Some participants visited the clinics during the study period but reported that they were not planning on redeeming points in order to increase their chance for higher value prizes at subsequent visits. In addition, although eligible men had to reside near the two AHF clinics, qualitative data revealed that for many men who signed up online, the clinic was perceived as too far away, inconvenient, or too busy. Qualitative data supported this finding, as one man summarized, “If you want guys to be a part of this program, they should be able to get tested at any clinic” (Oakland, Clinic, 25 years).

Preliminary Effectiveness on Repeat HIV/STI Screening

The analysis of repeat HIV/STI testing during the study period was assessed among 31 YMSM recruited in the clinic who also provided consent and HIPAA authorization for review of medical records. During the study period, 15 (48%) received two or more HIV/STI tests compared to 157 (30%) of a historical comparison group of 517 YMSM who lived in the same zip codes and who received care at the same clinics before the intervention (OR=2.15, 95% confidence interval: 1.03, 4.47, \(P=.04\)).

DISCUSSION

We conducted a pilot evaluation of an intervention incorporating gamification to increase repeat HIV/STI screening among YMSM in California. Given that YMSM remain disproportionately impacted by HIV and STIs, novel approaches that bolster proven HIV and STI prevention strategies, such as screening, treatment, and linkage
to PrEP and HIV treatment, may serve an important public health function.[3] Based on quantitative and qualitative data describing engagement with the intervention, we found that the *Stick To It* intervention was acceptable to study participants. We learned valuable insights about desirable intervention features which might increase effectiveness, such as the inclusion of multiple clinics in the same area. Furthermore, among the subset of participants recruited in the clinic, repeat HIV/STI screening was higher than in a comparison group of similar YMSM attending the same clinic in the year prior.

The success of online HIV/STI prevention programs is strongly linked to participant engagement, and we observed modest levels of engagement with *Stick To It*. Despite a somewhat time-consuming sign-up process due to the requirement of online informed consent, 56% of those who registered completed the onboarding process. Notably, among the subset of YMSM recruited entirely online with no contact with the study team, 73% set the testing countdown timer, which activates the reminder system and is a type of “commitment device”, a strategy demonstrated to motivate behavior change.[52-54] In addition, approximately 10% of *Stick To It* users were completing quizzes 30 days or more after enrollment. Furthermore, many men successfully made the transition between desired online ‘digital actions’, such as setting the timer and completing quizzes.

This level of engagement is similar to other online health interventions. Of note, *Stick To It* was intentionally designed for YMSM to enroll online (no enrollment visit), *without* financial incentives to encourage use, and *without* additional research visits. Thus, our engagement data are most appropriate to compare with other primarily online health interventions such as *Just/Us*,[29] the sexual health Facebook intervention for young adults, *SOLVE*,[24] an online game to reduce shame among
MSM, and the Keep It Up! online HIV prevention intervention for young adults. In Just/Us, retention was 51% at 6 months and only 10% were “loyal” visitors.[29] In the SOLVE game, only 444 of 1284 (35%) MSM randomized to the intervention had a minimum level of engagement at 3 months (i.e., baseline survey and game registration) to be included in the per-protocol analysis.[24] In Keep It Up!’s community-based evaluation, only 343 of 755 (45%) people completed the intervention; of these, 42% were lost to follow-up at 3 months.[18] Thus, Stick To It has similar levels of engagement as other online mHealth programs focusing on sexual health, all of which are characterized by a typical pattern of early attrition.[55] In addition, Stick To It exceeded industry standards for mobile apps: data from the private sector suggests that 23% of users abandon an app after one use[56] and the average app loses 77% of its daily active users within the first 3 days after install and loses 90% of users within 30 days.[57]

Although the linkage between digital actions was promising, the linkage between online activities and real-world activities was relatively low, with only 11% of those who registered visiting a study clinic during the pilot study. The intervention was purposefully designed to maximize the linkage between virtual and real-world intervention components, with points earned through various activities only redeemable in the clinic; an intentional game mechanic to drive traffic into the clinics. Nevertheless, the motivational effect of the point system, prizes, and/or redemption process may not have been strong enough to overcome geographical restrictions. Furthermore, some men desired that the program have more visibility at affiliated clinics, even if most activities take place online.

Although men had to reside in a zip code within defined areas surrounding the two study clinics to be eligible for the study, qualitative data revealed that for
many men who signed up online, the distance to the clinic was perceived as too far or inconvenient. However, some continued to answer quizzes regardless, reporting that the questions were fun and informative. A future study of this approach would benefit from multiple clinics within a defined catchment area and/or home delivery of HIV/STI kits for self-collected specimens that can be returned by mail.[58]

A surprising finding was that men recruited entirely online – without any direct contact with the study team or health clinic – had similar levels of engagement with Stick To It as men recruited in the study clinics. These men received no incentive for signing up for the program or completing digital actions yet 18% completed two or more quizzes during the program and 5% redeemed points. This is very encouraging and demonstrates the potential of our approach. Although men recruited online had predictably much lower engagement in the clinic-based activities (e.g., redemption of points or screening at one of the two study clinics), potentially due to the inclusion of only two clinics, the addition of more sites and/or mailed test kits could expand the reach of these programs to a wider network of YMSM, including those who are not actively engaged in care and/or those in rural areas. Furthermore, this indicates that investment in a fun and engaging online program could modestly increase engagement in HIV/STI screening and other health services with minimal effort after the initial development phase.

This pilot study has several limitations. Like other pilot studies of mHealth interventions,[50, 51] this was a small study with the goal to assess the acceptability and feasibility of a program using theoretically-based game-based elements for HIV/STI prevention among YMSM. However, the study was conducted in only two clinics in California; a larger study incorporating these insights is now needed. In addition, we were only able to assess the primary outcome of repeat
testing among men who were recruited in the clinic and who signed HIPPA authorization (required by IRB to be completed in person) for review of medical records. Thus, although the inclusion of men recruited online was valuable in terms of understanding participant engagement, we could not review their medical records unless they visited a study clinic. Baseline data indicate that men recruited in the clinic and men recruited online are different; therefore, alternative evaluation strategies will be needed in future studies for men recruited online, including alternative options to comply with HIPAA regulations and IRB requirements. In addition, we could only assess medical records at participating study clinics; a future study will explore how to verify testing behavior at multiple clinics within a defined geographic area. Additional research is also needed to apply these tools to maximally benefit specific vulnerable populations such as transgender men and women.

Lastly, it is unlikely that stand-alone gamification interventions could replace other behavioral interventions to increase demand for HIV and STI prevention. Accordingly, we combined known behavior-change mechanisms such as reminders, commitments, and incentives along with standard health services using a game-based approach including a theme. A potential limitation of this approach is that we cannot disentangle the effects of various intervention components. However, the combined approach is likely what has most relevance for future programs, especially if other strategies like home-based self-testing and PrEP are added to the program.[59]

Behavior change is about finding the right tools to motivate different kinds of people.[52] Gamification interventions may resonate particularly well with young people, who are extremely comfortable with games and technology.[11] Our pilot
study suggests that this approach holds promise as a motivational strategy to improve the sexual health of YMSM, especially if coupled with future implementation science research to optimize integration of online activities with real-world health services.
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Conflicts of Interest

None declared.

Multimedia Appendix

Multimedia Appendix 1: Screenshots of the Stick To It website and personalized dashboard
REFERENCES


Abbreviations

ART: Antiretroviral therapy
CDC: Centers for Disease Control and Prevention
HIPAA: Health Insurance Portability and Accountability Act
HIV: Human immunodeficiency virus
mHealth: Mobile health
MSM: Men who have sex with men
OR: Odds Ratio
PrEP: Pre-exposure prophylaxis
STI: Sexually transmitted infection
YMSM: Young men who have sex with men