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Using Technology to Support HIV Self-Testing Among Men Who Have Sex with Men

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Abstract

Purpose of review—Technology-based HIV-self testing (HST) interventions have the potential to improve access to HIV testing among gay, bisexual and other men who have sex with men (MSM), as well as address concerns about HST use, including challenges with linkage to appropriate follow-up services. This review examines studies that use technology-based platforms to increase or improve the experience of HST among MSM.

Recent findings—Seven published studies and eight funded studies were included in this review. Comprehensive prevention interventions with free HST kit distribution and interventions that provide free HST kits and support the HST process address a greater number of barriers (e.g., access, correct use of testing kits, and correct interpretation of results) than studies that only distribute free HST kits through technology-based platforms.

Summary—By addressing HIV testing barriers and specific HST concerns, these interventions address a critical need to improve first time and repeat testing rates among MSM. Additional research is needed to determine the efficacy of recent formative HST interventions. If proven efficacious, scale-up of these strategies have the potential to increase HIV testing among MSM via expanded HST uptake.

Keywords

Men who have sex with men; MSM. technology; HIV testing; HIV self-testing

Introduction

Globally, gay, bisexual and other men who have sex with men (MSM) are among those at highest risk of HIV infection [1–3]. While overall HIV incidence has declined in many countries, HIV epidemics among MSM are expanding in most low, middle and high income

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Conflicts of Interest

None

countries [1–3]. In the United States (US), MSM represent approximately 2% of the population but account for over two-thirds of new infections [4]. Most concerning is the high rate of new infections among Black, Latino and young MSM (YMSM) [5].

Worldwide, approximately 50% of HIV-infected individuals are unaware of their status [6] and this proportion is higher among MSM [7]. The United Nation's 90-90-90 targets aim to increase diagnosis of those infected to 90% by 2020 [8]. Testing facilitates entry into HIV care and treatment for those diagnosed with HIV, and serves to link HIV-negative individuals to behavioral and biomedical prevention including pre-exposure prophylaxis (PrEP) [7]. However, many MSM face substantial barriers to facility- and community-based HIV testing including stigma, confidentiality concerns, inconvenience (e.g., transportation, time), and the lack of MSM-competent healthcare providers [9–12]. HIV self-testing (HST), in which an individual collects a specimen (oral fluid or blood), conducts the test, and interprets the results themselves, may minimize testing barriers and increase first time and repeat testing among MSM [13, 14].

Though there are several HST kits on the market worldwide, only the oral OraQuick In-Home HIV Test (only kit approved in the US [15]) and three blood tests are currently approved by the International Medical Device Regulators Forum, which makes them eligible for purchase with major donor funding [16]. Prior studies show that HST is an acceptable and feasible testing option for MSM in various high, middle and low income countries [17–20]. However, some policymakers, healthcare providers, researchers, and MSM have voiced concerns about HST including misclassified early HIV infections due to a longer window period than facility-based blood tests, the need for confirmatory testing, a lack of formal pre- and post-test counseling, linkage to care challenges, user error, and cost [18, 20, 21]. Technology-based approaches- including those that use MSM-specific geospatial networking apps, social media, standalone smartphone apps, and videoconferencing- may help expand access to HST and address other HST-related concerns by providing expert advice to aid end users in correctly using and interpreting the results of HST. Given that many MSM are early adopters of new technologies [22, 23], these strategies may be feasible in the US and other global contexts. This review of recent literature includes published studies and studies in progress that use technology to distribute HST kits or support the HST process among MSM.

Methods

We searched titles and abstracts in PubMed from 1/1/2016 to 5/10/17 using the search strategy outlined in Figure 1. Abstracts of the 152 publications identified through the search were reviewed to determine if they described technology-based strategies for HST distribution or interventions that supported the HST process. Articles that described the distribution of HST to confirm eligibility for technology-based prevention interventions were excluded. In addition, we searched NIH RePORTER to identify currently funded grants that include technology-based interventions that distribute or support HST for MSM (Table 1).

Technology-based platforms to distribute HST kits

Three articles described the use of online platforms to distribute HST kits to MSM. Two of these studies were conducted by members of the same research team and used Grindr to advertise free HST kits in two high HIV incidence areas in Los Angeles County, US [24*, 25*]. Individuals who clicked on the ads were directed to the study webpage where they selected their preference for receiving a rapid oral fluid test. In the first study [24*], options included mail via US Postal Service, an electronic pharmacy voucher or a PIN for a vending machine located outside of the Los Angeles Gay and Lesbian Center. In the second study [25*], options included a code for ordering and shipping through a pharmacy website, as well as pharmacy vouchers and a vending machine PIN. After selecting their preference for receiving the HST kit, individuals were invited to participate in an online study; eligibility criteria included age ≥ 18 and self-identification as MSM and Black/African American or Hispanic/Latino. Enrolled participants completed an online survey assessing demographics, HIV testing and sexual risk. Two weeks after study staff confirmed test acquisition, participants were invited to complete a follow-up online survey on the HST experience. The number of test requests were similar in both studies (n=334) [24*], (n=333) [25*]; a majority of participants requested mailed tests (67%) [24*], (74%) [25*]. Based on data from participants completing baseline surveys (n=122) [24*], (n=125) [25*], the studies enrolled samples of primarily Latino MSM, many of whom reported recent sexual risk and suboptimal testing behaviors (e.g., never tested, last test >1 year ago). Self-reported HST kit use was only available for a small number of study participants who completed post-HST surveys (n=57) [24*], (n=56) [25*]. Among those, a large majority found the HST kits easy to use and reported a preference for HST over clinic-based testing.

In Guangzhou, China, Zhong et al. developed a social entrepreneurship testing model to increase HST and linkage to care among adult MSM [26**]. Study participants completed an online survey assessing demographic characteristics, sexual risk, and testing behaviors and preferences. Upon survey completion, participants paid a \$23 refundable deposit through a study-developed online platform to receive rapid blood specimen kits by mail to test for HIV and syphilis. After completing the tests, participants took pictures of the results and uploaded them to the online platform. After study staff interpreted results and provided feedback to participants, the test kit deposit was refunded. A total of 380 participants completed the online survey, 198 purchased testing kits, and 178 reported test results. Among those who purchased kits, the primary reasons were convenience (46%), privacy (40%), ease of use (6%) and accuracy (6%). Approximately 67% reported that they would use HST kits in the future if they were available for free. Of the 7 individuals newly identified as HIV-positive, 100% were linked to HIV care.

Technology-based interventions with HST distribution

A number of HIV prevention interventions delivered online or through apps included free HST kit distribution. Sullivan et al., conducted a pilot study to test the usability of a comprehensive, theory-based HIV prevention app for MSM [27**]. The HealthMindr app provides self-assessment tools, HIV prevention recommendations and reminders (e.g., condom use, HIV testing, PrEP screening), prevention and treatment service locators, and

the ability to order free condoms and HIV test kits. Results from a 4-month pilot study with 121 MSM from two US cities indicated high levels of app satisfaction, perceived usefulness, and usability. Features that enabled participants to determine how frequently they should test, compare HIV test options, and create a testing plan were frequently used. Ordering HIV testing kits and condoms was the most frequently accessed feature; over half of participants ordered at least one HIV testing kit during the study with 84% choosing HST over a home specimen collection kit. Nearly 80% of pilot participants tested for HIV during the trial and 56% tested more than once.

We identified five funded studies in NIH RePORTER aimed at developing, refining, or testing technology-based prevention interventions for MSM that incorporate HST distribution (Table 1). Funded as part of the Adolescent Trials Network for HIV Interventions, two studies plan to refine existing theory-based HIV prevention apps designed for adult MSM to increase HIV testing and PrEP uptake among YMSM (aged 15–24) in the US [mPIs: Biello, Mayer; mPIs: Liu, Scott]. In both studies, HST will be offered through the app during a pilot trial that will assess intervention feasibility and acceptability. Two additional US-based studies focus on increasing HIV testing among MSM. One study is adapting the HealthMindr app [27**] to deliver in-app messages that encourage MSM to engage in prevention services. The app will include a feature that allows users to order free HST kits [PI: Sullivan]. Another study is testing a peer-led HIV prevention intervention for Latino and Black MSM delivered through Facebook. Free HST kits are provided through the intervention with the aim of increasing HIV testing and linkage to HIV care [PI: Young]. A study in China is developing and testing an intervention that combines app-based HIV risk reduction and motivational behavior change messages with HST to increase repeat HIV testing and reduce sexual risk behaviors among MSM [PI: Operario].

Technology-based interventions to support the performance of HST

Technology-based interventions that assist MSM with the process of conducting HST can address concerns about user error, falsely interpreting results, and poor linkage to HIV care or prevention services. Two published articles and one funded study describe interventions that use videoconferencing to provide counseling to MSM during the HST process. Maksut and colleagues assessed the feasibility of providing peer-based counseling via video chat to YMSM conducting HST [28**]. The US-based study enrolled 20 YMSM, 80% of whom were Black YMSM. During the video chat session, peers provided pre-test counseling, guidance during self-administration of the test, and post-test counseling. All participants reported high satisfaction with this testing method, a desire to use it again in the future and willingness to recommend it to their friends. A second study used an electronic health record system for MSM and transgender women in Thailand to offer participants three options for HIV testing and counseling: in-person pre-test counseling, testing and post-test counseling; online pre-test counseling and in-person testing and post-test counseling; and pre-test counseling, supervised HST and post-test counseling all provided online [29]. Only 25 of 186 (13%) participants chose the fully online testing option; however, participants in this arm were more likely to be younger, bisexual, never tested, tested over a year ago, and diagnosed HIV-positive. A funded study in Thailand is using videoconferencing to provide

online HIV testing (including HST), counseling, and linkage to care or prevention services for 18–24-year-old MSM [PI: Guadamuz].

Another funded study is using an innovative approach to supporting the HST process through the use of virtual reality (VR) to improve the HST experience for adolescent MSM and transgender women, ages 14–19 in the US. Investigators propose to develop an app that will feature character-driven realistic scenarios that are engaging, interactive, and user-centric and will allow users to virtually experience all steps of the HST process, from buying the test to planning action steps based on results [mPIs: Adams-Larsen, Hightow-Weidman].

Finally, one study developed technology-based enhancements for current HST kits ([30*] (Table 1). In the US, commercially available HST kits provide only a toll-free number option for post-test counseling. If individuals who have a reactive result do not call the number, delays in confirmatory testing and linkage to care may occur. In addition, commercially available tests do not link those testing negative to additional prevention services. To address these deficiencies, Wray et al. developed a “smart” HST kit using Bluetooth low energy beacons that, when linked with a smartphone app on a participant’s phone, enable study staff to detect when test kits are opened. Participants receive a post-test counseling phone call within 24 hours of opening the test kit. Results of usability testing with 10 MSM found that the system reliably detected kit opening in 90% of cases and participant feedback about the intervention was positive.

Conclusion

Technology-based approaches that provide or support HST show promise for increasing first time and repeat testing among MSM by addressing HIV testing barriers and HST concerns, though to varying degrees. For example, studies that distributed free HST to MSM using advertisements on Grindr eliminated cost and access as barriers to HST uptake [24*, 25*]. The HST distribution study in China increased access to HST by providing free testing kits (after refund) and addressed additional concerns associated with HST use such as inaccurate interpretation of results and lack of linkage to HIV care [26**]. Approaches focused primarily on HST kit distribution address key overall HIV testing barriers such convenience, confidentiality, and stigma; however, in general they only address HST concerns related to cost and access. In contrast, completed [27**, 28**, 29, 30*] or ongoing studies (Table 1) that provide free HST as part of comprehensive HIV prevention interventions or interventions designed to support HST performance have the added advantage of addressing general HIV testing barriers as well as a greater number of HST-specific concerns such as a lack of pre- and post-test counseling, user error, and misinterpretation of results. Importantly, these interventions actively facilitate linkage to HIV care or prevention and thus may have greater potential to curb epidemics among MSM by increasing the likelihood of antiretroviral therapy uptake (for treatment or prevention) and repeat testing.

Technology-based HST approaches face a number of implementation challenges. Following the 2016 WHO recommendation to offer HST [31], some countries have yet to develop or finalize HST regulations or policies; however, HST is available through informal channels in many settings [16]. Some of the technology-based HST approaches presented in this review

may not currently be feasible in low and middle-income countries where these technologies are not yet widely accessible. As technology infrastructures in low-resource countries continue to expand rapidly, there may be opportunities to deliver similar interventions in the near future. In the meantime, interventions that rely on currently available technologies (e.g., social media, videoconferencing) should be developed to support HST use among MSM in global settings.

Given the high proportion of YMSM worldwide who are infected with HIV but unaware of their status [6], there is an urgent need to increase HIV testing among this population. Technology-supported HST may be especially appealing to this age group. However, countries that require parental permission for testing minors may inhibit sexual minority youth participation in technology-supported HST interventions [31]. In the US, most states allow minors to provide consent for an HIV test without parental permission [32]. However, the Federal Drug Administration has only approved use of the OraQuick In-Home HIV Test for individuals over the age of 17 [15]. Although there is no biological evidence that the test is less effective for younger individuals, this restriction may create an additional barrier for YMSM.

Finally, all of the completed or ongoing studies included in this review provided HST for free, which addresses a major barrier to uptake. For HST to become a viable commercial option for MSM across geographical locations, the price of testing kits must be reduced. The entry of new blood-based HST kit options into the global market is likely to increase competition and eventually reduce kit costs [16].

Given the formative nature of many of the reviewed studies, future research is needed to determine the efficacy of technology-based HST interventions for MSM. However, an important benefit of technology-based interventions is the ability to rapidly scale up those shown to be efficacious with low marginal costs [33]. Further, additional research should focus on developing HST interventions for YMSM, particularly those under age 18. Although implementation challenges exist, technology-based HST interventions have great potential to address suboptimal testing rates among MSM, increase awareness of diagnosis among those infected with HIV, and link MSM to appropriate HIV care or prevention services.

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- 25*. Rosengren AL, Huang E, Daniels J, et al. Feasibility of using Grindr™ to distribute HIV self-test kits to men who have sex with men in Los Angeles, California. *Sexual health*. 2016 This study also distributed HST kits to MSM in a high HIV prevalence area in the US by promoting free kits on Grindr, an MSM-specific geospatial networking app.
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- 27**. Sullivan PS, Driggers R, Stekler JD, et al. Usability and Acceptability of a Mobile Comprehensive HIV Prevention App for Men Who Have Sex With Men: A Pilot Study. *JMIR mHealth and uHealth*. 2017; 5(3):e26. This pilot study of a comprehensive prevention intervention addressed concerns about HST use by providing crucial information about the strengths and weaknesses of HST (e.g., privacy vs. longer window period than facility-based tests) by offering comparisons to other testing options. [PubMed: 28279949]
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Key Points

- HST represents an important strategy for addressing HIV testing barriers and can help increase first time and repeat HIV testing among MSM.
- Technology-based HST approaches can help address identified concerns with HST use such as cost, a lack of pre- and post-test counseling, incorrect administration of tests, inaccurate interpretation of results, and challenges with linkage to HIV care and prevention services.
- Comprehensive prevention interventions and interventions that support the process of HST performance and provide free HST kits address more HST concerns than approaches focused primarily on distributing free HST kits.
- Although implementation challenges exist, technology-based HST interventions have great potential to address suboptimal testing rates among MSM, increase awareness of diagnosis among those infected with HIV, and link MSM to appropriate HIV care or prevention services.

Search strategy: Article must be published in English between 01/01/16 and 05/10/17, describe an intervention, and include ≥ 1 term in Title/Abstract field from each group listed below:

Group 1) HIV, AIDS

Group 2) test, testing, self-testing, self-test, "self test", "home test", home-testing, "home testing", "home based testing", "home-based testing"

Group 3) technology, mhealth, ehealth, computerized, internet, online, web, "mobile phone*", "cell phone*", smartphone*, app, application, "mobile application*", "short messaging system", "text message", "text messaging", texting, SMS, "Web 2.0", "social media", "social networking", Twitter, Facebook, Grindr, Jack'd, "virtual reality", VR, telemedicine, videoconferencing, "video conferencing", video-conferencing, geospatial, geolocation

Group 4) "men who have sex with men", gay, bisexual, LGBT*, "sexual minority", "sexual identity", YMSM,

Figure 1.
Article search strategy

Table 1

Currently funded grants identified in NIH RePORTER

Principal Investigator(s) Organization Name	Funding period	Project Abstract	Target population	Delivery mode(s)	Type of approach
Young UNIVERSITY OF CALIFORNIA LOS ANGELES	2015–20	Test a peer-led social media (Facebook) intervention designed to increase HST and linkage to care in a RCT. Primary outcome: HST use.	US; African American and Latino MSM	Social media	Technology-based intervention with HST distribution
Opetario BROWN UNIVERSITY	2015–18	Develop and pilot test a combination strategy that incorporates HST with app-based HIV risk reduction and behavior change messages for MSM in China. Pilot test will compare app+ HST to HST alone. Primary outcomes: repeat HST and changes in sexual risk behaviors.	China: MSM	Smartphone App	Technology-based intervention with HST distribution
Sullivan RHODE ISLAND HOSPITAL	2015–19	Develop a new set of prevention messages delivered through the HealthMindr app that encourage engage in prevention behaviors (including HIV testing) and reduce sexual risk behaviors. Messages will be tested using a delayed-onset study design. Primary outcomes: self-reported HIV prevention and risk outcomes.	US: MSM	Smartphone App	Technology-based intervention with HST distribution
Liu & Scott SAN FRANCISCO DEPARTMENT OF PUBLIC HEALTH	2016–17	Adapt an existing HIV prevention app for MSM to increase HIV testing and PrEP uptake among young MSM and test in a pilot RCT. Primary outcomes: intervention usability and acceptability.	US: YMSM ages 15–24	Smartphone App	Technology-based intervention with HST distribution
Biello & Mayer BROWN UNIVERSITY & FENWAY HEALTH	2016–17	Adapt an existing HIV prevention app for MSM to increase HIV testing and PrEP uptake among young MSM and test in a pilot RCT. Primary outcomes: intervention usability, acceptability, and preliminary efficacy for increasing self-reported HIV testing and PrEP uptake.	US: YMSM, ages 15–24	Smartphone App	Technology-based intervention with HST distribution
Wray BROWN UNIVERSITY	2015–18	Refine technology that enables real-time, remote monitoring of HST kits to allow timely delivery of post-test counseling and linkage to additional prevention services. Conduct a pilot RCT to test enhanced HST kit vs. standard HST kit. Primary outcomes: increases in any testing, repeat testing and successful linkage to additional prevention services.	US: MSM	Technology adapted HST kit, Smartphone App	Technology-based intervention to support HST performance
Guadamuz MAHIDOL UNIVERSITY	2016–18	Use online HIV testing via videoconferencing to increase engagement, retention, and linkage of young MSM in HIV prevention, treatment, and care services. A pilot study will conduct online testing using a new HIV rapid diagnostic antibody/antigen based HST kit and results will be read in real-time. Primary outcomes: feasibility and acceptability.	Thailand: YMSM, ages 18–25	Videoconferencing	Technology-based intervention to support HST performance
Adams-Larson & Hightow-Weidman VIRTUALLY BETTER, INC. & UNIVERSITY OF NORTH CAROLINA	2016–18	Develop a virtual reality app that features character-driven realistic scenarios that allow users to virtually experience all steps of the HST process, from buying the test to planning action steps based on results. Usability testing will be conducted. Primary outcomes: feasibility, acceptability, and usability.	US: YMSM, ages 14–19	Virtual reality, Smartphone App	Technology-based intervention to support HST performance