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Distribution of HIV Self-tests by Men Who have Sex with Men (MSM) to Social Network Associates

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Abstract
Internet-recruited gay, bisexual, and other men who have sex with men (MSM) were offered HIV self-tests (HIVSTs) after completing baseline, 3-, 6-, and 9-month follow-up surveys. The surveys asked about the use and distribution of these HIVSTs. Among 995 who reported on their distribution of HIVSTs, 667 (67.0%) distributed HIVSTs to their social network associates (SNAs), which resulted in 34 newly identified HIV infections among 2301 SNAs (1.5%). The main reasons participants reported not distributing HIVSTs included: wanting to use the HIVSTs themselves (74.9%); thinking that their SNAs would get angry or upset if offered HIVSTs (12.5%); or not knowing that they could give the HIVSTs away (11.3%). Self-testing programs can provide multiple HIVSTs and encourage the distribution of HIVST by MSM to their SNAs to increase awareness of HIV status among persons disproportionately affected by HIV.

Keywords HIV self-test · Secondary distribution · HIV prevention

Resumen
Hombres gais, bisexuales y otros hombres que indicaron tener contacto sexual con hombres (MSM, por sus siglas en inglés) fueron reclutados por el Internet y se les ofreció autopruebas del VIH (HIVST, por sus siglas en inglés) después de completar una encuestas inicial y encuestas de seguimiento a los 3, 6 y 9 meses. Las encuestas recogieron datos sobre el uso y distribución de estas autopruebas del VIH. De los 995 MSM que indicaron distribuir las autopruebas, 667 (67.0%) distribuyeron las autopruebas a personas en sus redes sociales (SNA, por sus siglas en inglés), resultando en 34 nuevas infecciones por el VIH identificadas entre 2,301 SNA (1.5%). Las razones principales por las que algunos participantes no distribuyeron las autopruebas del VIH incluyen: el deseo de utilizar las autopruebas del VIH para sí mismos (74.9%); pensar que las SNA se enfadarían o molestarían si se les ofreciesen autopruebas del VIH (12.5%); o no saber que podían distribuir las autopruebas del VIH (11.3%). Los programas que proporcionen múltiples autopruebas del VIH podrían alentar la distribución de las autopruebas por parte de los MSM a las SNA para aumentar el conocimento sobre el estado del VIH entre personas afectadas de manera desproporcionada por el VIH.

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Introduction

The primary goal outlined in the 2021 U.S. National HIV/AIDS Strategy (NHAS), supported by the Ending the HIV Epidemic in the U.S. (EHE) initiative, is to reduce the number of new HIV infections by 75% by 2025 and by 90% by 2030 [1, 2]. HIV testing is one of the cornerstones of HIV prevention efforts and a gateway to accessing pre-exposure prophylaxis and antiretroviral therapy [1]. The U.S. Centers for Disease Control and Prevention (CDC) recommends HIV testing at least once for all Americans aged 13–64 years [3],

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and at least annually for sexually active gay, bisexual, and other men who have sex with men (MSM) [4], a group disproportionately affected by HIV [5]. However, many MSM in the U.S. are not being tested for HIV as recommended [6], which contributes to delayed testing in this population [7]. For example, a national survey reported that the median interval since last HIV test was 3.0 years, and 1.3 years among sexually active MSM [7].

Despite concerted efforts to scale up HIV prevention activities for MSM, barriers to HIV testing persist. National HIV Behavioral Surveillance data indicate that perceived low risk was one of the main reasons reported by MSM who did not test in the past year [8]. There are several barriers to HIV testing among MSM, including discrimination, racism, homophobia [9], and anticipated stigma [10]. HIV self-testing offers a unique opportunity for MSM who might be experiencing challenges using traditional testing services to learn their HIV status, and it has been found to be highly acceptable and feasible among diverse populations, including MSM [11–13]. In our randomized controlled trial (RCT), the Evaluation of Rapid HIV Self-testing Among MSM Project (eSTAMP), we found that 76.6% of participants in the intervention arm, who received HIV self-tests (HIVSTs) by mail, reported testing three or more times during the study year, compared to 22.0% of participants in the control arm, who only received HIV prevention information and resources to locate local HIV testing services. Additionally, the cumulative number and percentage of newly identified HIV infections was higher among participants in the intervention arm (25/1325; 1.9%) than in the control arm (11/1340; 0.8%) [14].

Social and sexual networking strategies have been used as an approach to identify persons at high risk for HIV infection [15]. Peer-driven networking strategies [16] have also been used to leverage the potential of HIV self-testing [16–18]. Specifically, peer-based distribution of HIVSTs (also called "secondary distribution") to members of one's social network (e.g., family, friends) or sexual network (e.g., main partners, casual partners) may be an effective strategy to increase testing coverage among populations at an elevated risk for acquiring HIV, including MSM. In one study, MSM and those who were willing to use HIVSTs themselves reported high levels of willingness to distribute HIVSTs to their friends, sexual partners, family members, and other acquaintances (collectively referred to as social network associates, SNAs) [19]. Few studies have examined the demographic and behavioral characteristics associated with the distribution of HIVSTs by MSM to their SNAs. Understanding how these characteristics impact the decision to distribute HIVSTs could help public health planners determine whether the secondary distribution of HIVSTs would work better in some subpopulations than in others (e.g., people who live in certain geographic regions, represent a specific age group, or those who have never tested for HIV). In addition, understanding the reasons why people at risk for HIV refrain from distributing HIVSTs to their SNAs (e.g., concerns about negative reactions) offers insight into the barriers of distributing HIVSTs. Research on the distribution of HIVSTs to SNAs has shown promise in identifying preliminary positive test results. In an HIV self-testing distribution study of persons with HIV, 90.0% reported giving at least one HIVST to an SNA [20]. Of the 31 HIVST SNA results provided by the study participants, 2 (6.5%) were positive [20].

The eSTAMP trial evaluated the effect of providing HIV self-tests on frequency of testing and identification of HIV infection [14]. In the intervention arm of the eSTAMP study, participants who distributed HIVSTs reported demographic information about the SNAs to whom they gave these HIVSTs, and the results of the tests performed with these kits, to the extent that they knew this information. In this analysis we describe: (1) the likelihood of distributing HIVSTs by demographic and behavioral characteristics of study participants; (2) the reasons for not distributing HIVSTs to SNAs; and (3) the likelihood of SNAs testing positive for HIV by their own demographic characteristics and by the distributor's demographic and behavioral characteristics.

Methods

A detailed description of eSTAMP has been published previously [14]. Briefly, from March 2015 through November 2016, 2665 internet-recruited MSM participated in a 12-month longitudinal, 2-arm RCT. Eligibility criteria included: male sex at birth, identifying their gender as male, being at least 18 years of age, residing in the U.S., having had anal sex with at least one man in the past 12 months, and reported having tested HIV-negative or being unaware of their HIV status. This analysis is limited to the 1325 participants in the intervention arm of the eSTAMP study.

Participants in the intervention arm had access to online resources to locate local HIV testing services and were asked to complete a baseline survey and quarterly surveys during a 12-month period (i.e., at 3, 6, 9, and 12 months). After completing the baseline survey, participants in the intervention arm were mailed 4 HIVSTs that had at least 6 months remaining prior to their expiration date: two oral fluid tests (OraQuick® In-Home HIV Test, OraSure Technologies, Inc.) and two finger-stick blood tests (SURE CHECK® HIV 1/2 Assay, Chembio Diagnostics, Inc.; used under an investigational device exemption from FDA). Participants were not prompted or encouraged to distribute the HIVSTs to SNAs, and after completing the 3-, 6-, and 9-month surveys, participants could request replacement HIVSTs for those they

reported having used themselves or distributed to SNAs. The protocol was approved by the Emory University Institutional Review Board in Atlanta, Georgia.

Among eSTAMP participants who responded to the questions about distributing HIVSTs in any follow-up survey, we computed the proportions who reported distributing one or more tests, overall and stratified by various participant characteristics, along with Clopper–Pearson exact 95% confidence intervals (CIs). We also computed *p*-values using Fisher's exact test for participant characteristics with two categories and using a permutation test for participant characteristics with more than two categories. In addition, we computed the pairwise differences in proportions, along with exact (score) 95% CIs and Barnard's exact test *p*-values. Furthermore, we used McNemar's test to compare the proportions of participants who reported distributing any OraQuick or Sure Check tests.

Participants who responded that they had not distributed HIVSTs since the previous survey were asked why they had not distributed tests to SNAs. They could select from nine prespecified reasons or write a free-text response. In each follow-up survey, participants could provide multiple reasons and could repeat reasons on subsequent surveys. We reviewed all responses, created new reasons based on the most common free-text responses, and then selected the top nine reasons, each of which were reported by at least 5% of all responding study participants. These top nine reasons consisted of five prespecified reasons and four composite reasons. The composite reasons resulted from combining similar prespecified or new reasons. We then computed the numbers and observed proportions of reasons that participants gave for not distributing the HIVSTs, overall and at each follow-up survey, along with Clopper–Pearson exact 95% CIs (see Table 2).

To determine whether participants distributed HIVSTs to the same SNAs or not, we matched SNAs using information provided by the participants (e.g., initials, name, or nickname; age; gender; and race/ethnicity) within each follow-up survey. SNAs who had a positive test result from any of the HIVSTs within a particular survey were classified as having an "identified HIV infection." In turn, SNAs who had a positive result within a particular survey were classified as having a "newly identified HIV infection" when the participant reported either that (a) the SNA did not already know that he/she had HIV or (b) the participant did not know whether the SNA already knew that he/she had HIV. See the Supplementary Notes for more details.

Among the unique SNAs for whom one or more test results were reported, we computed the proportions of SNAs who had an identified HIV infection and who had a newly identified HIV infection, both overall and stratified by various participant and SNA characteristics. We computed adjusted proportions, along with 95% CIs, using generalized estimating equation (GEE) methods (based on the binomial distribution with the logit link function) with an exchangeable correlation, which accounts for the correlation between SNAs within participants ("clusters"). Additional details on the GEE weighting methods to deal with categories with no positive HIVST results and the sensitivity analyses to assess the impact of weighting choices can be found in the Supplementary Notes. Due to small sample sizes and unstable estimates for transgender persons, the GEE analysis of SNA gender was restricted to male and female SNAs. We also computed *p*-values using generalized score tests (GSTs). All calculations were performed using SAS software, version 9.4 (SAS Institute, Inc., Cary, NC).

Results

Among the 1325 intervention arm participants, 995 (75.1%) responded to the questions about distributing HIV self-tests in any follow-up survey. Most (73.7%) of the respondents were < 35 years of age, 61.3% were non-Hispanic White, 8.7% were non-Hispanic Black, and 21.2% were Hispanic. One-third of participants ($n = 328$; 33.0%) reported not distributing any HIVSTs on the surveys that they answered, whereas 667 (67.0%) participants reported distributing tests as follows: only OraQuick tests ($n = 127$; 12.8%); only Sure Check tests ($n = 63$; 6.3%); both types of tests ($n = 477$; 47.9%). Comparing the percentages of participants who distributed any OraQuick tests and who distributed any Sure Check tests, more participants distributed OraQuick tests ($n = 604 = 127 + 477$; 60.7%) than Sure Check tests ($n = 540 = 63 + 477$; 54.3%) (difference = 6.4%; approximate 95% CI 4.0%, 8.9%; McNemar's test p-value < 0.001). Collectively, the 667 participants who reported distributing HIVSTs gave away a total of 2862 tests (1546 OraQuick and 1316 Sure Check tests).

In every demographic and behavioral category considered in this analysis, more than 60% of participants reported distributing HIVSTs to their SNAs (Table 1). The percentages of participants who reported distributing HIVSTs vary somewhat by their demographic characteristics, including age group [ranging from 62.7% (18–24 years) to 70.9% (45–54 years)], race/ethnicity [66.4% (Hispanic/Latino) to 74.4% (other/mixed)], education [66.4% (greater than high school) and 71.0% (high school/equivalent or less)], and geographic region [64.3% (Midwest) to 69.1% (West)]. The percentages of participants who reported distributing HIVSTs also vary somewhat by participant risk behaviors in the 3 months prior to study enrollment, including whether the participants had any condomless anal sex with a male partner [62.8% (No) and 68.3% (Yes)], any condomless anal or vaginal sex with a female partner [66.6% (No) and 83.3% (Yes)], any non-prescription injection drug use [66.8%

Table 1 Numbers and percentages of eSTAMP intervention arm participants who reported distributing HIV self-tests (HIVSTs) to social network associates by baseline participant demographic and behavioral characteristics, United States, 2015–2016

Baseline characteristics	Reported distributing HIVSTs		Fisher's exact test or permutation test *p* value*	Percentage point difference (95% CI)	Barnard's exact test *p* value**
	n/N (%)	95% CI			
Overall	667/995 (67.0)	64.0, 70.0			
Age (years)			0.435		
18–24	185/295 (62.7)	56.9, 68.2		Reference	–
25–34	302/438 (68.9)	64.4, 73.3		6.2 (− 0.9, 13.3)	0.083
35–44	106/157 (67.5)	59.6, 74.8		4.8 (− 4.7, 13.9)	0.407
45–54	61/86 (70.9)	60.1, 80.2		8.2 (− 4.0, 18.9)	0.165
55–76	13/19 (68.4)	43.4, 87.4		5.7 (− 20.7, 24.9)	0.901
Race/Ethnicity			0.918		
Hispanic or Latino	140/211 (66.4)	59.5, 72.7		Reference	–
Non-Hispanic White	408/610 (66.9)	63.0, 70.6		0.5 (− 6.8, 8.3)	0.900
Non-Hispanic Black or African American	58/87 (66.7)	55.7, 76.4		0.3 (− 12.0, 12.0)	0.979
Non-Hispanic Asian	32/48 (66.7)	51.6, 79.6		0.3 (− 16.2, 14.6)	0.992
Other/mixed race	29/39 (74.4)	57.9, 87.0		8.0 (− 10.1, 21.8)	0.347
Education level			0.320		
Less than or equal to high school diploma/GED	93/131 (71.0)	62.4, 78.6		4.6 (− 4.8, 12.8)	0.327
Greater than high school diploma/GED	573/863 (66.4)	63.1, 69.5		Reference	–
Geographic region			0.727		
South	286/431 (66.4)	61.7, 70.8		2.0 (− 6.4, 10.9)	0.732
West	161/233 (69.1)	62.7, 75.0		4.8 (− 4.6, 14.2)	0.360
Midwest	110/171 (64.3)	56.7, 71.5		Reference	–
Northeast	110/160 (68.8)	61.0, 75.8		4.4 (− 5.8, 14.7)	0.531
Any unprotected anal sex with a male partner in past 3 months			0.142		
No	137/218 (62.8)	56.1, 69.3		Reference	–
Yes	530/776 (68.3)	64.9, 71.6		5.5 (− 1.9, 13.0)	0.133
Any unprotected anal or vaginal sex with a female partner in past 3 months			0.122		
No	646/970 (66.6)	63.5, 69.6		Reference	–
Yes	20/24 (83.3)	62.6, 95.3		16.7 (− 8.2, 28.5)	0.106
Any non-prescription injection drug use in past 3 months			0.103		
No	659/987 (66.8)	63.7, 69.7		Reference	–
Yes	7/7 (100.0)	59.0, 100.0		33.2 (− 21.5, 37.6)	0.125
Any non-injection drug use in past 3 months			0.266		
No	462/700 (66.0)	62.4, 69.5		Reference	–
Yes	203/291 (69.8)	64.1, 75.0		3.8 (− 2.9, 10.1)	0.267
HIV testing history (prior to enrollment in study)			0.457		
Tested in past 12 months	426/624 (68.3)	64.5, 71.9		4.7 (− 3.0, 12.5)	0.222
Ever tested, but not in past 12 months	131/206 (63.6)	56.6, 70.2		Reference	–
Never tested	110/165 (66.7)	58.9, 73.8		3.1 (− 6.9, 12.8)	0.610

Some characteristics had small amounts of missing data (1–4 observations) and thus the row totals (*N*) within a particular characteristic may not sum to 995

SNA social network associate; *n* number reported ever distributing study home HIV self-tests; *N* number of participants reporting baseline demographic and behavioral characteristics; *CI* confidence interval

*These *p*-values were computed using Fisher's exact test for characteristics with 2 levels and using a permutation test for characteristics with more than 2 levels

**These *p*-values were computed using Barnard's exact test

Table 2 Frequencies of reasons given by eSTAMP intervention arm participants for not distributing study HIV self-tests (HIVSTs), ever and on four follow-up surveys, United States, 2015–2016

Reasons for not distributing study HIVSTs*	Ever *N* = 674 % (95% CI)	FU1 (3-month) *N* = 346 % (95% CI)	FU2 (6-month) *N* = 330 % (95% CI)	FU3 (9-month) *N* = 380 % (95% CI)	FU4 (12-month) *N* = 377 % (95% CI)
(a) I wanted to use the self-tests myself	74.9 (71.5, 78.2)	73.1 (68.1, 77.7)	72.1 (66.9, 76.9)	63.9 (58.9, 68.8)	65.5 (60.5, 70.3)
(b) I thought they [SNAs] would get upset or angry	12.5 (10.1, 15.2)	8.1 (5.4, 11.5)	6.7 (4.2, 9.9)	7.6 (5.2, 10.8)	8.5 (5.9, 11.8)
(c) I didn't know I could give the self-tests away	11.3 (9.0, 13.9)	9.2 (6.4, 12.8)	7.0 (4.5, 10.3)	6.1 (3.9, 8.9)	3.4 (1.8, 5.8)
(d) I was afraid others would think I have HIV	11.1 (8.9, 13.7)	12.1 (8.9, 16.1)	5.8 (3.5, 8.8)	5.5 (3.5, 8.3)	4.0 (2.2, 6.5)
(e) The self-tests expired	11.0 (8.7, 13.6)	6.6 (4.3, 9.8)	7.6 (5.0, 11.0)	7.4 (5.0, 10.5)	7.7 (5.2, 10.9)
(f) I did not know anyone who was interested, or I haven't had the opportunity to distribute self-tests	10.7 (8.5, 13.3)	6.6 (4.3, 9.8)	7.0 (4.5, 10.3)	9.2 (6.5, 12.6)	5.8 (3.7, 8.7)
(g) I was concerned it might affect my relationships, or I was concerned about awkwardness or embarrassment	10.2 (8.1, 12.8)	5.8 (3.6, 8.8)	4.2 (2.3, 7.0)	8.2 (5.6, 11.4)	8.5 (5.9, 11.8)
(h) I would rather they [SNAs] talk to a counselor when they get an HIV test, or SNAs are already testing or prefer clinics	8.2 (6.2, 10.5)	5.5 (3.3, 8.4)	5.5 (3.3, 8.5)	5.0 (3.0, 7.7)	5.0 (3.1, 7.8)
(i) I was concerned about test accuracy, or I was concerned they [SNAs] wouldn't perform or read the self-tests correctly	5.8 (4.1, 7.8)	3.8 (2.0, 6.3)	3.9 (2.1, 6.6)	3.4 (1.8, 5.8)	2.9 (1.5, 5.2)

Reasons (a) through (e) are prespecified reasons. Reasons (f) through (i) are composite reasons

SNA social network associate; *FU* follow-up survey; *N* total number of participants who gave any reason for not distributing, ever (over the course of the study) and on the four individual follow-up surveys at 3, 6, 9, and 12 months; % percentage of participants who chose each specific reason, ever and at four individual follow-up surveys; *CI* confidence interval

*These reasons are not mutually exclusive. Participants may have given more than one specific reason at each follow-up survey and may have repeated reasons on subsequent surveys. The texts of these reasons were edited for clarity

(No) and 100.0% (Yes)], and any non-injection drug use [66.0% (No) and 69.8% (Yes)]. In addition, the percentages vary somewhat by HIV testing history prior to enrollment [63.6% (tested over 12 months ago) to 68.3% (tested in past 12 months)]. None of the differences in the percentages of participants distributing HIVSTs by participant demographic and behavioral characteristics were statistically significant (all Fisher's exact test p-values > 0.10, all Barnard's exact test p-values > 0.08; see Supplementary Notes).

Of the 995 participants, 674 gave one or more specific reasons for not distributing HIVSTs during at least one of the four follow-up periods (Table 2). The nine most common reasons that participants gave for not distributing HIVSTs were: (a) they wanted to use the HIVSTs themselves (n = 505; 74.9%); (b) they thought their SNAs would get angry or upset if they offered them HIVSTs (n = 84; 12.5%); (c) they didn't know that they could give the HIVSTs away (n = 76; 11.3%); (d) they were afraid that others would think that they had HIV (n = 75; 11.1%); (e) the HIVSTs expired (n = 74; 11.0%); (f) they did not know anyone who was interested in the HIVSTs or did not have the opportunity to distribute them (n = 72; 10.7%); (g) they were concerned that it might affect their relationships, or be awkward or embarrassing (n = 69; 10.2%); (h) they would rather their SNAs talk to a counselor when testing, or SNAs are already testing or prefer clinics (n = 55; 8.2%); and (i) they were concerned about test accuracy or that their SNAs wouldn't perform or read the HIVSTs correctly (n = 39; 5.8%). Over the course of the study, the frequencies of reasons (a), (c), and (d) each decreased by at least 5% points. By contrast, the frequencies of reasons (b), (e), (f), (h), and (i) remained roughly constant, whereas the frequency of reason (g) increased slightly. Note that (a), (c), and (e) pertained to logistical reasons for not distributing, (b), (d), and (f) pertained to anticipated reactions and dynamics between the participants and their SNAs, (g) pertained to participants' perceptions about SNAs' testing preferences, and (h) pertained to participants' concerns about self-test performance and result interpretation by SNAs.

Of the 667 participants who reported distributing HIVSTs, 658 participants (98.7%) responded to questions about the 2301 SNAs to whom they distributed HIVST kits, corresponding to a total of 2737 test results (1467 OraQuick and 1270 Sure Check test results). These participant-reported SNA HIVST results were negative (n = 1842; 67.3%), positive (n = 57; 2.1%), invalid (n = 21; 0.8%), and "I don't know the result of the test" (n = 817; 29.9%). Overall, based on all the HIVST results, 52 SNAs (adjusted

percentage: 2.2%; 95% CI 1.5, 3.1) had an identified HIV infection and 34 SNAs (adjusted percentage: 1.3%; 95% CI 0.9, 2.1) had a newly identified HIV infection (Table 3). There were few statistically significant differences in the percentages of SNAs who had identified infections and newly identified HIV infections by distributor demographic and behavioral characteristics (most GST p-values > 0.05). Specifically, there only were statistically significant differences in the percentages of SNAs who had identified infections and newly identified HIV infections by distributor education level (GST p-values = 0.028 and 0.006, respectively) and in the percentages of SNAs who had newly identified HIV infections by distributor non-injection drug use in the past 3 months (GST p-value = 0.002).

Regarding the SNA demographic characteristics (Table 4), the adjusted percentages of SNAs who had an identified HIV infection vary narrowly by SNA age group (ranging from 0.0 to 5.3%; GST p-value = 0.081), race/ethnicity (1.1–3.6%; p-value = 0.398), and gender (2.4%, males vs. 0.0%, females; p-value < 0.001). Likewise, the adjusted percentages of SNAs who had a newly identified HIV infection vary narrowly by SNA age group (ranging from 0.0 to 2.5%; p-value = 0.465), race/ethnicity (0.9–2.0%; p-value = 0.768), and gender (1.4%, males vs. 0.0%, females; p-value = 0.021).

Discussion

In this study of sexually active MSM, two-thirds of participants in the intervention arm of eSTAMP reported distributing HIVSTs to their SNAs, even though the study team did not provide any messaging, training, or guidance on the distribution of HIVSTs. This unprompted distribution of HIVSTs by participants to people in their social networks resulted in 52 HIV infections being identified among SNAs overall, and of these, 34 were classified as newly identified HIV infections [14]. Although the percentages of those with an identified HIV infection and those with a newly identified HIV infection vary somewhat by demographic and behavioral characteristics of participants, most of the differences were not statistically significant. Notably, more than half of participants in nearly every socio-demographic category chose to distribute HIVSTs to their SNAs suggesting robust willingness and feasibility of secondary HIVST distribution. These findings support the inclusion of secondary HIVST distribution as part of an HIV prevention program for sexually active MSM.

Many reported not distributing tests on at least 1 of the 4 follow-up surveys. Understanding the reasons for not distributing tests will allow program planners to overcome barriers in implementing HIVST distribution (secondary distribution) interventions. The main reason for not distributing tests was a logistical one (e.g., "I wanted to use the HIVSTs myself"). However, the proportion citing this reason decreased over the follow-up survey periods, which indicates that participants might have become more aware of the opportunity to order more self-test kits, and thus were not saving kits from each order for themselves. Some reasons reported for not distributing HIVSTs to SNAs (e.g., "I was afraid that others would think I have HIV" and "I was concerned it might affect my relationships") pertain to perceived reactions and dynamics between the participants and the SNAs, which may reflect an uncertainty on how to approach a conversation on HIVST distribution. Instructions on and tools for the secondary distribution of HIVSTs, including communication guidance on how to address negative reactions or perceptions from SNAs, might allay these concerns and aid in skill-building to support the distribution of HIVSTs. In addition, qualitative studies might be needed to help contextualize the relationships between distributors and their SNAs to better understand the barriers and facilitators of peer-based distribution. Finally, some participants reported concerns about HIVST performance, that the SNAs would not perform the test correctly, or that the SNAs would misinterpret the result. In addition, some participants preferred that their SNAs talk to a counselor when getting an HIV test, or they believed that their SNAs were already testing or preferred clinic-based testing, which suggests that HIV self-testing should not replace facility and community-based testing strategies but should instead complement them.

HIV self-testing is one strategy to increase availability of testing to unreached populations under the EHE initiative [21], and HIVST distribution may be a sound strategy for increasing the frequency of screening for sub-populations with high risk for HIV infection [22]. A cost-effectiveness analysis of eSTAMP, based on the intervention cost of $449,510, estimated that HIV self-testing potentially averted 3.34 transmissions and thus saved 14.86 quality-adjusted life years and nearly $1.6 million in lifetime HIV treatment costs [23], which provides further support for implementing HIV self-testing strategies more widely in the U.S.

Since the novel coronavirus disease 2019 (COVID-19) pandemic, there has been an increased need to promote and implement HIV self-testing, as traditional in-person HIV testing has been disrupted. Although the data from this study were collected prior to the pandemic, the findings support peer-based distribution of HIVST as a modality to increase the reach of HIV self-testing. CDC has encouraged health departments and community-based organizations to consider implementing HIV self-testing programs [24]. The CDC's HIVST distribution program provided an option to fill the need for increased access to HIV testing. In this program, persons over the age of 17 could order two HIVSTs online, every 90 days, but

Table 3 Numbers and proportions of unique social network associates (SNAs) who had identified HIV infections and newly identified HIV infections by distributor demographic and behavioral characteristics at baseline, eSTAMP, United States, 2015–2016

Distributor characteristics	SNA had an identified HIV infection[†]			SNA had a newly identified HIV infection[‡]		
	n/N (%)	Adj.% (95% CI)	GST *p* value*	n/N (%)	Adj.% (95% CI)	GST *p* value*
Overall	52/2301 (2.3)	2.2 (1.5, 3.1)		34/2301 (1.5)	1.3 (0.9, 2.1)	
Age (years)			0.273			0.552
18–24	12/629 (1.9)	2.0 (1.0, 3.9)		6/629 (1.0)	1.1 (0.4, 2.9)	
25–34	16/1110 (1.4)	1.4 (0.7, 2.8)		12/1110 (1.1)	1.0 (0.4, 2.1)	
35–44	17/327 (5.2)	4.3 (2.3, 7.8)		13/327 (4.0)	2.8 (1.3, 6.1)	
45–54	6/187 (3.2)	3.4 (1.5, 7.9)		3/187 (1.6)	2.0 (0.7, 6.0)	
55–63	1/48 (2.1)	1.4 (0.2, 8.0)		0/48 (0.0)	0[#] (0[#], 12.6)	
Race/Ethnicity			0.651			0.603
Hispanic or Latino	11/489 (2.2)	2.3 (1.2, 4.4)		8/489 (1.6)	1.6 (0.8, 3.2)	
Non-Hispanic White	31/1355 (2.3)	2.2 (1.3, 3.5)		22/1355 (1.6)	1.4 (0.8, 2.7)	
Non-Hispanic Black or African American	6/244 (2.5)	2.6 (1.2, 5.6)		2/244 (0.8)	0.8 (0.2, 3.2)	
Non-Hispanic Asian	1/91 (1.1)	0.9 (0.1, 5.5)		1/91 (1.1)	0.8 (0.1, 5.3)	
Other/mixed race	3/122 (2.5)	2.1 (0.5, 8.3)		1/122 (0.8)	0.6 (0.1, 3.6)	
Education level			0.028			0.006
≤ High school diploma/GED	3/336 (0.9)	0.9 (0.3, 2.8)		0/336 (0.0)	0[#] (0[#], 1.9)	
> High school diploma/GED	49/1961 (2.5)	2.4 (1.7, 3.4)		34/1961 (1.7)	1.6 (1.0, 2.5)	
Geographic region			0.277			0.748
South	30/1007 (3.0)	3.1 (2.0, 4.7)		18/1007 (1.8)	1.7 (0.9, 3.2)	
West	8/518 (1.5)	1.6 (0.8, 3.3)		6/518 (1.2)	1.3 (0.6, 3.0)	
Midwest	7/371 (1.9)	1.8 (0.6, 5.0)		5/371 (1.3)	1.0 (0.3, 3.1)	
Northeast	7/405 (1.7)	1.2 (0.4, 3.8)		5/405 (1.2)	0.8 (0.2, 3.7)	
Any unprotected anal sex with a male partner in past 3 months			0.742			0.329
No	9/462 (1.9)	2.0 (0.9, 4.3)		4/462 (0.9)	0.9 (0.3, 2.7)	
Yes	43/1839 (2.3)	2.3 (1.5, 3.3)		30/1839 (1.6)	1.5 (0.9, 2.4)	
Any unprotected anal or vaginal sex with a female partner in past 3 months			0.460			0.644
No	49/2207 (2.2)	2.1 (1.5, 3.1)		32/2207 (1.4)	1.3 (0.8, 2.1)	
Yes	3/92 (3.3)	3.7 (1.2, 10.9)		2/92 (2.2)	2.0 (0.5, 7.1)	
Any non-prescription injection drug use in past 3 months			0.759			0.549
No	51/2262 (2.3)	2.2 (1.5, 3.1)		33/2262 (1.5)	1.3 (0.8, 2.1)	
Yes	1/38 (2.6)	3.1 (0.5, 17.0)		1/38 (2.6)	3.1 (0.5, 17.0)	
Any non-injection drug use in past 3 months			0.188			0.002
No	41/1528 (2.7)	2.5 (1.7, 3.7)		31/1528 (2.0)	1.9 (1.2, 3.0)	
Yes	11/760 (1.4)	1.5 (0.7, 3.2)		3/760 (0.4)	0.4 (0.1, 1.1)	
HIV testing history (prior to enrollment in study)			0.053			0.240
Tested in past 12 months	21/1487 (1.4)	1.4 (0.9, 2.2)		15/1487 (1.0)	0.9 (0.5, 1.6)	
Ever tested, but not in past 12 months	16/434 (3.7)	3.6 (1.9, 6.9)		12/434 (2.8)	2.7 (1.2, 5.9)	
Never tested	15/380 (3.9)	3.9 (1.9, 7.7)		7/380 (1.8)	1.5 (0.5, 4.9)	

SNA social network associate; *n* number of SNAs who ever had an identified HIV infection or a newly identified HIV infection; *N* number of unique SNAs within a category; *Adj.%* adjusted percentage of SNAs who ever had an identified HIV infection or a newly identified HIV infection; *CI* confidence interval

*The *p*-values were computed using generalized score tests (GSTs)

[#]In a category with zero positive tests, the point estimate and the lower confidence bound were set to zero

[†]SNAs were classified as having an "identified HIV infection" if they had a positive test result on any HIVST within a particular survey

[‡]SNAs were classified as having a "newly identified HIV infection" if they had a new positive result within a particular survey and the study participant reported either that (a) the SNA did not already know that she/he was HIV-positive or (b) the participant did not know whether the SNA already knew that she/he was HIV-positive

Table 4 Numbers and proportions of unique social network associates (SNAs) who had identified HIV infections and newly identified HIV infections by their demographic characteristics, eSTAMP, United States, 2015–2016

SNA characteristics	SNA had an identified HIV infection[†]			SNA had a newly identified HIV infection[‡]		
	n/N (%)	Adj.% (95% CI)	GST *p* value*	n/N (%)	Adj.% (95% CI)	GST *p* value*
Age (years)			0.081			0.465
15–24	9/825 (1.1)	1.1 (0.5, 2.6)		6/825 (0.7)	0.8 (0.3, 2.1)	
25–34	27/1016 (2.7)	2.5 (1.6, 3.8)		20/1016 (2.0)	1.5 (0.9, 2.7)	
35–44	9/299 (3.0)	3.1 (1.5, 6.3)		5/299 (1.7)	1.7 (0.7, 4.2)	
45–54	7/121 (5.8)	5.4 (2.2, 12.4)		3/121 (2.5)	2.5 (0.7, 8.5)	
55–70	0/39 (0.0)	0[#] (0[#], 8.9)		0/39 (0.0)	0[#] (0[#], 7.1)	
Race/Ethnicity			0.398			0.768
Hispanic or Latino	12/481 (2.5)	2.6 (1.4, 4.7)		9/481 (1.9)	1.8 (0.9, 3.8)	
Non-Hispanic White	27/1299 (2.1)	1.9 (1.2, 3.1)		17/1299 (1.3)	1.1 (0.6, 2.1)	
Non-Hispanic Black or African American	10/264 (3.8)	3.6 (1.7, 7.3)		6/264 (2.3)	2.0 (0.6, 6.4)	
Non-Hispanic Asian	1/119 (0.8)	1.3 (0.3, 5.2)		1/119 (0.8)	1.3 (0.3, 5.5)	
Other/mixed race	1/83 (1.2)	1.1 (0.1, 10.2)		1/83 (1.2)	0.9 (0.1, 12.1)	
Gender			< 0.001			0.021
Male	49/2017 (2.4)	2.4 (1.7, 3.4)		32/2017 (1.6)	1.5 (0.9, 2.3)	
Female	0/244 (0.0)	0[#] (0[#], 1.5)		0/244 (0.0)	0[#] (0[#], 1.3)	
Transgender (MTF)	1/14 (7.1)	–		1/14 (7.1)	–	
Transgender (FTM)	1/7 (14.3)	–		1/7 (14.3)	–	

Some SNA characteristics had missing data (1–55 observations) and thus the row totals (*n* or *N*) within a particular characteristic may not sum to 52 or 2301

SNA social network associate; *n* number of SNAs who ever had an identified HIV infection or a newly identified HIV infection; *N* number of unique SNAs within a category; *Adj.%* adjusted percentage of SNAs who ever had an identified HIV infection or a newly identified HIV infection; *CI* confidence interval

*The *p*-values were computed using generalized score tests (GSTs)

[#]In a category with zero positive tests, the point estimate and the lower confidence bound were set to zero

[†]SNAs were classified as having an "identified HIV infection" if they had a positive test result on any HIVST within a particular survey

[‡]SNAs were classified as having a "newly identified HIV infection" if they had a new positive result within a particular survey and the study participant reported either that (a) the SNA did not already know that she/he was HIV-positive or (b) the participant did not know whether the SNA already knew that she/he was HIV-positive

were not given instructions to distribute the HIVSTs. Program participants who had been previously diagnosed with HIV or were taking HIV pre-exposure prophylaxis (PrEP) medications were encouraged to distribute these HIVSTs to their SNA(s) [25]. HIVST distribution provides an opportunity to increase the frequency and reach of HIV testing among MSM [14] and can be a key strategy in a comprehensive program to promote HIV testing among MSM and their SNAs.

There are several limitations to consider. First, about a quarter of participants did not respond to any follow-up survey, and it is unknown whether the experiences of non-respondents might have been different than the experiences of respondents. Thus, we do not know if the observed percentage of participants who reported sharing the HIVSTs with SNAs is an underestimate, and hence there could be more distribution of HIVSTs than captured through the surveys and, in turn, more SNAs who tested positive. Second, distributors of the HIVSTs reported on the characteristics of their SNAs to the best of their knowledge, so information on SNAs may be imprecise. Specifically, there could be under-reporting of positive results because the SNAs had to tell the study participant that they used the HIVST and their test result; indeed, nearly a third of results were not known. Positive results might have been differentially under-reported to study participants. This limitation reduces the accuracy of our estimates and likely leads to underestimating the true proportions of SNAs who obtained a positive test result. Third, it is very likely that the matching process used to estimate the 2301 unique SNAs may have over- or under-matched SNAs, due to inconsistent fidelity in reporting by participants on information about their SNAs or HIVSTs, and due to methods (as stated above) of only trying to match SNA information within a single survey time and not across surveys. Finally, the nature of the reporting of the SNAs' HIVST result, along with the modest sample sizes, may have

hampered our ability to detect meaningful differences in the proportions of SNAs who had an "identified HIV infection" or "newly identified HIV infection," by either distributor or SNA characteristics, so it is possible that we missed important differences.

Conclusion

To meet the goals of NHAS and overcome disruptions in face-to-face services because of the COVID-19 pandemic, new strategies are needed to prevent HIV infections in the U.S. The high percentage of participants who distributed HIVSTs to their SNAs in the current study, even in the absence of specific instructions to do so, is promising. The willingness of study participants to share HIVSTs with their SNAs indicates that this may be an effective strategy to increase awareness of HIV status in the broader community, which in turn may contribute to ending the HIV epidemic in the US. Programs that distribute HIVSTs to MSM could provide multiple kits at one time and encourage secondary kit distribution [24–26]. Providing written instructions or a how-to video guidance may help facilitate the distribution of HIVSTs to their SNAs. Peer-based distribution programs of HIVSTs show promise for increasing awareness of HIV status among social network associates of sexually active MSM.

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Declarations

Conflict of interest CDC authors declare no conflicts of interest.

References

1. Fauci AS, Redfield RR, Sigounas G, Weahkee MD, Giroir BP. Ending the HIV epidemic: a plan for the United States. JAMA. 2019;5(9):844–5. https://doi.org/10.1001/jama.2019.1343.
2. The White House. National HIV/AIDS strategy for the United States 2022–2025. Washington, DC. 2022. Available at: https://www.hiv.gov/federal-response/national-hiv-aids-strategy/national-hiv-aids-strategy-2022-2025. Accessed 6 Oct 2022.
3. Branson BM, Handsfield HH, Lampe MA, Janssen RS, Taylor AW, Lyss SB. Revised recommendations for HIV testing of adults, adolescents, and pregnant women in health-care settings. MMWR Recomm Rep. 2006;55(RR-14):1–17 quiz CE1-4.
4. DiNenno EA, Prejean J, Irwin K, et al. Recommendations for HIV screening of gay, bisexual, and other men who have sex with men—United States, 2017. MMWR Morb Mortal Wkly Rep. 2017;66(31):830–2. https://doi.org/10.15585/mmwr.mm6631a3.
5. Sanchez TH, Zlotorzynska M, Sineath RC, Kahle E, Tregear S, Sullivan PS. National trends in sexual behavior, substance use and HIV testing among United States men who have sex with men recruited online, 2013 through 2017. AIDS Behav. 2018;22(8):2413–25. https://doi.org/10.1007/s10461-018-2168-4.
6. McKenney J, Sullivan PS, Bowles KE, Oraka E, Sanchez TH, DiNenno E. HIV risk behaviors and utilization of prevention services, urban and rural men who have sex with men in the United States: results from a national online survey. AIDS Behav. 2018;22(7):2127–36. https://doi.org/10.1007/s10461-017-1912-5.
7. Pitasi MA, Delaney KP, Oraka E, et al. Interval since last HIV test for men and women with recent risk for HIV infection—United States, 2006–2016. MMWR Morb Mortal Wkly Rep. 2018;67(24):677–81. https://doi.org/10.15585/mmwr.mm6724a2.
8. Dailey AF, Hoots BE, Hall HI, et al. Vital signs: human immunodeficiency virus testing and diagnosis delays—United States. MMWR Morb Mortal Wkly Rep. 2017;66(47):1300–6. https://doi.org/10.15585/mmwr.mm6647e1.
9. Centers for Disease Control and Prevention. HIV and gay and bisexual men. Available at: https://www.cdc.gov/hiv/group/msm/msm-content/prevention-challenges.html. Accessed 6 Oct 2022.
10. Golub SA, Gamarel KE. The impact of anticipated HIV stigma on delays in HIV testing behaviors: findings from a community-based sample of men who have sex with men and transgender women in New York City. AIDS Patient Care STDs. 2013;27(11):621–7. https://doi.org/10.1089/apc.2013.0245.
11. Johnson CC, Kennedy C, Fonner V, et al. Examining the effects of HIV self-testing compared to standard HIV testing services: a systematic review and meta-analysis. J Int AIDS Soc. 2017;20(1):21594. https://doi.org/10.7448/IAS.20.1.21594.
12. Figueroa C, Johnson C, Verster A, Baggaley R. Attitudes and acceptability on HIV self-testing among key populations: a literature review. AIDS Behav. 2015. https://doi.org/10.1007/s10461-015-1097-8.
13. Krause J, Subklew-Sehume F, Kenyon C, Colebunders R. Acceptability of HIV self-testing: a systematic literature review. BMC Public Health. 2013;13:735. https://doi.org/10.1186/1471-2458-13-735.
14. MacGowan RJ, Chavez PR, Borkowf CB, et al. Effect of internet-distributed HIV self-tests on HIV diagnosis and behavioral outcomes in men who have sex with men: a randomized clinical trial. JAMA Intern Med. 2020;180(1):117–25. https://doi.org/10.1001/jamainternmed.2019.5222.
15. Fuqua V, Chen YH, Packer T, et al. Using social networks to reach Black MSM for HIV testing and linkage to care. AIDS Behav. 2012;16(2):256–65. https://doi.org/10.1007/s10461-011-9918-x.
16. Centers for Disease Control and Prevention. Social network strategy for HIV testing recruitment. Available at: https://www.cdc.gov/hiv/effective-interventions/diagnose/social-network-strategy/index.html. Accessed 6 Oct 2022.
17. Lightfoot MA, Campbell CK, Moss N, et al. Using a social network strategy to distribute HIV self-test kits to African American and Latino MSM. J Acquir Immune Defic Syndr. 2018;79(1):38–45. https://doi.org/10.1097/QAI.0000000000001726.
18. Okoboi S, Lazarus O, Castelnuovo B, et al. Peer distribution of HIV self-test kits to men who have sex with men to identify

undiagnosed HIV infection in Uganda: a pilot study. PLoS ONE. 2020;15(1):e0227741. https://doi.org/10.1371/journal.pone.0227741.
19. Sharma A, Chavez PR, MacGowan RJ, et al. Willingness to distribute free rapid home HIV test kits and to test with social or sexual network associates among men who have sex with men in the United States. AIDS Care. 2017;29(12):1499–503. https://doi.org/10.1080/09540121.2017.1313386.
20. Wesolowski L, Chavez PR, Sullivan P, et al. Distribution of HIV self-tests by HIV-positive men who have sex with men to social and sexual contacts. AIDS Behav. 2019;23(4):893–9. https://doi.org/10.1007/s10461-018-2277-0.
21. U.S. Department of Health and Human Services. HIV self-testing programs to improve testing uptake and increase diagnoses. Available at: https://www.hiv.gov/hiv-basics/hiv-testing/learn-about-hiv-testing/hiv-testing-overview. Accessed 6 Oct 2022.
22. Carballo-Diéguez A, Frasca T, Balan I, Ibitoye M, Dolezal C. Use of a rapid HIV home test prevents HIV exposure in a high risk sample of men who have sex with men. AIDS Behav. 2012;16(7):1753–60. https://doi.org/10.1007/s10461-012-0274-2.
23. Shrestha RK, Chavez PR, Noble M, et al. Estimating the costs and cost-effectiveness of HIV self-testing among men who have sex with men, United States. J Int AIDS Soc. 2020;23(1):e25445. https://doi.org/10.1002/jia2.25445.
24. Centers for Disease Control and Prevention. Dear colleague letter: HIV self testing guidance. 2020. Available at: https://www.cdc.gov/nchhstp/dear_colleague/2020/dcl-042820-HIV-self-testing-guidance.html. Accessed 6 Oct 2022.
25. Chavez PR, Emerson B, Lilo E, et al. CDC's direct-to-consumer distribution of 100,000 HIV self-tests. Conference on retroviruses and opportunistic infections. 2022. Virtual [abstract Oral-13].
26. Hecht J, Sanchez T, Sullivan PS, DiNenno EA, Cramer N, Delaney KP. Increasing access to HIV testing through direct-to-consumer HIV self-test distribution—United States, March 31, 2020–March 30, 2021. MMWR Morb Mortal Wkly Rep. 2021;70(38):1322–5. https://doi.org/10.15585/mmwr.mm7038a2.