

Who do you reach? A Norwegian pilot project on HIV self-testing that targeted men who have sex with men

ABSTRACT

HIV self-testing reduces barriers associated with other HIV testing services, such as concerns about confidentiality and inconvenience. This article demonstrates who might benefit from this approach to HIV testing by describing the characteristics of men who have sex with men (MSM) who took interest in a Norwegian pilot project on HIV self-testing. Of the MSM users, 27 percent reported that they had never been tested for HIV. Not disclosing one's same-sex sexuality, particularly among non-gay-identified MSM, was associated with a higher probability of never having been tested for HIV and choosing to test with an HIV self-test because of its anonymity. Never having been tested for HIV was also associated with a higher probability of choosing to test with an HIV self-test due to anonymity. The results suggest that the HIV self-tests' ability to reach MSM who otherwise would not be tested is partly because it is an anonymous HIV testing alternative.

KEYWORDS: MSM; HIV self-testing; anonymity; confidentiality; barriers to HIV testing.

INTRODUCTION

Interventions aiming to increase HIV testing in at-risk populations, such as men who have sex with men (MSM), are a key strategy in the effort to limit the spread of HIV. During recent years, the World Health Organization (WHO) has recommended HIV self-testing as an additional HIV testing service that may reach individuals who otherwise would not be tested (1). There has also been an increase in the availability of HIV self-tests, which are now available in several countries, such as the UK, the US, France, Italy, and Denmark (2). HIV self-testing enables end users to perform an HIV rapid test on their own, as well as to read and interpret the test result themselves. This article demonstrates who might benefit from such an approach to HIV testing.

As in other Western countries, MSM are overrepresented in the Norwegian HIV statistics (3, 4). The continuous spread of HIV is likely to be driven by individuals living with HIV without being aware of it, and HIV morbidity and mortality are associated with late diagnosis (5, 6, 7). Therefore, increasing HIV testing and early linkage to care is crucial both for preventing new HIV infections and for ensuring the health of people living with HIV (8, 9, 10). MSM are advised to test for HIV at least annually, or more frequently depending on sexual behavior (2, 11, 12). Convenience sample survey data indicate that between 50 and 70 percent of MSM have been tested for HIV in the past year (13, 14, 15). By contrast, findings from American and British population-based studies suggest that as few as 50 to 60 percent of the MSM population have *ever* been tested for HIV and that only 15 to 35 percent have been tested for HIV in the past year (16, 17, 18, 19, 20). In other words, the proportion of MSM who have either never been tested for HIV or who are not tested for HIV annually is considerable.

A range of factors are influencing MSM's decisions to be tested, or not to be tested, for HIV, including sexual behavior and perceived risk of acquiring HIV. Based on data from the

British probability survey, the third National Survey of Sexual Attitudes and Lifestyles (Natsal-3), Mercer et al. (16) propose a lower perceived risk of HIV acquisition as a possible explanation for the low levels of HIV testing in the past year among MSM. A majority of MSM in the study considered themselves “not very much” or “not at all at risk” of acquiring HIV. Moreover, results from the same study show that the proportion of MSM who had been tested for HIV increased with increasing numbers of sexual partners (20). This finding aligns with previous studies showing that never having been tested for HIV is associated with a lower prevalence of reported sexual risk behaviors, such as unprotected (condomless) anal intercourse (UAI) and an increased number of sexual partners (e.g. 21, 22, 23). Using the same Natsal-3 data, Clifton et al. (24) examined the relationship between HIV testing, risk perception, and sexual behavior in more depth and found that a majority of those reporting recent sexual risk behavior rated themselves as “not very much” or “not at all at risk for HIV” and that they had not been tested for HIV recently. On the other hand, large proportions of those who correctly perceived themselves to be at risk of HIV had not been tested either. This illustrates that, although sexual risk behavior is associated with having been tested for HIV, there are still MSM who evade HIV testing despite being at risk of acquiring HIV.

In addition to sexual behavior and perceived risk, other factors associated with never testing for HIV among MSM include concerns about confidentiality, privacy, and perceived lack of anonymity in the testing situation, not identifying as gay, not being open about being gay or one’s same-sex sexuality, only having had female sexual partners in the past year, living in rural areas, not living in large urban or metropolitan areas, lower levels of educational attainment, and youth and old age (21, 23, 25, 26, 27, 28, 29, 30, 31). These factors serve as individual and structural barriers to HIV testing among MSM. Reaching MSM who otherwise are not tested for

HIV thus requires the simultaneous delivery of several different HIV testing interventions that each reduce or overcome such barriers (31, 32, 33).

Studies indicate that, among new approaches which aim to increase HIV testing rates, HIV self-testing is an effective strategy for reaching MSM who are rarely or never tested for HIV (33, 34, 35). Previous research on HIV self-testing has shown that it has the potential to increase the frequency of testing among gay and bisexual men at high risk of HIV infection, as well as among those who have not been tested recently (36, 37, 38, 39). By enabling end users to perform the test themselves, HIV self-testing addresses the barriers present in the existing clinic- and community-based HIV testing services, by offering a more convenient means of testing and by strengthening anonymity and privacy when taking an HIV test (27, 30, 31, 35, 40, 41, 42, 43, 44, 45, 46, 47). Consequently, there is reason to believe that HIV self-testing is a more acceptable means of testing for MSM who are especially concerned about confidentiality and anonymity, and therefore do not choose to be tested at HIV testing services.

The institutional context

In Norway, HIV testing options are generally restricted to testing in infectious diseases wards in hospitals and tests conducted by general practitioners at the doctor's office. In the capital, Oslo, there are additional HIV testing options, such as sexual health clinics and, since the end of 2012, non-governmental organizations have established community-based HIV rapid testing services outside the ordinary healthcare system. HIV testing services in Norway are free of charge. The community-based testing services are designed to remove barriers to testing for hard-to-reach groups that are otherwise not being tested for HIV in the standard healthcare system (48). For instance, such services do not require the advance scheduling of an appointment and do not require that users state their name or social security number, thus representing a more convenient and

anonymous testing option. Occasionally, these community-based HIV testing services are also offered in other, larger Norwegian cities, such as Bergen and Stavanger, but the greatest variety of regular HIV testing options is located in Oslo. In other words, being tested for HIV is more convenient in Oslo than in other places in Norway. Furthermore, Oslo is the only city in Norway where the HIV testing options that ensure a high degree of anonymity are available on a regular basis.

For MSM, accessing HIV testing usually presupposes disclosing one's same-sex sexual behavior, and requesting an HIV test may be perceived as implicit disclosure of engaging in such behavior (49, 50, 51, 52). This may represent a substantial barrier for MSM who are not open about their same-sex sexuality, of which many presumably do not identify themselves as gay. Non-gay-identified MSM may constitute a significant proportion of the MSM population, indicated by population-based studies showing that, of men who reported male sex partners in the past five years, 28 percent identified as heterosexual or straight (53). For these MSM, the more anonymous community-based HIV testing services may be a better alternative but, because it is necessary to meet in person, some may still find it challenging. In response, Gay & Lesbian Health Norway (GLHN), a non-governmental organization that has worked with HIV prevention in Norway since 1983, introduced a pilot project for HIV self-testing in 2016, funded by The Norwegian Directorate of Health. The purpose of the pilot project was to test the feasibility of an HIV self-test distribution model. This included evaluating its ability to reach out to individuals in the MSM population who are difficult to reach with existing HIV testing services and who therefore are rarely or never tested for HIV, before considering a continuation of the distribution as a regular service. During the pilot period, which lasted from the 7 to 21 October 2016, it was possible to order HIV self-testing kits, including a rapid HIV finger-prick test and a user manual, free of charge from the GLHN website.

The GLHN phone number and information about the opening hours of the organization's chat service were listed in the user manual, in case users had questions or otherwise needed support. Since the end of this pilot period, HIV self-tests have not been officially available in Norway.

The objective of this article is to illustrate who might benefit from HIV self-testing, by describing the characteristics of MSM who took an interest in the GLHN pilot project. In particular, we will examine whether the pilot project was successful in reaching MSM who have rarely or never been tested for HIV. By strengthening anonymity in the testing situation, HIV self-testing has the potential to facilitate HIV testing among MSM for whom concerns about confidentiality and anonymity issues prevent them from being tested by other testing services. Thus, we expect the probability of never having been tested for HIV to be higher for non-gay-identified MSM and MSM who do not disclose their same-sex sexuality. Secondly, we will address the question of anonymity directly by examining the relationship between never having been tested for HIV, sexual identity, not disclosing one's same-sex sexuality, and choosing to test with an HIV self-test because it is anonymous. Furthermore, by being a more convenient testing option, regardless of the region of residence in Norway, we expect that a substantial amount of the MSM who ordered the HIV self-test live in places in Norway other than Oslo.

DATA, MEASUREMENT, AND METHOD

Sample and data collection

In the period 7 to 21 October 2016, individuals aged 18 years or older with Norwegian postal addresses could order HIV self-test kits on the GLHN website. Before reaching the page where potential users filled out their order information, they had to go through the pages of an electronic questionnaire. All participants were informed that answering the survey was voluntary and not a prerequisite for ordering an HIV self-test (i.e. it was possible to go through the pages of the

questionnaire without answering the questions). Our data was collected from all these individuals (i.e. the participants in the GLHN HIV self-test pilot project) who answered the electronic questionnaire and ordered the HIV self-test kit. The questionnaire was completed 1,172 times; however, it was possible to complete the questionnaire and order an HIV self-test several times, in addition to participating in the survey without ordering an HIV self-test. We restricted our sample to those that had answered the questionnaire and ordered the HIV self-test only once (N=1,025). Furthermore, we excluded respondents who reported that they were women (N = 162) or transgender (N=11), respondents who were unsure about their gender identity (N= 5), and men who exclusively have sex with women (N=67), as well as MSM who did not report their HIV testing history (N=22). Our analytical sample consisted of 849 respondents, all of whom were MSM. We argue that even though the sample was small and we excluded some respondents, the results of this study are generalizable to the total MSM participants in the GLHN HIV self-test pilot project.

The questionnaire included measures that have previously been used and tested in large population-based studies on sexual health, such as Natsal, The National Health and Nutrition Examination Survey (NHANES) and The National Longitudinal Study of Adolescent to Adult Health (ADD Health). The study was approved by the Norwegian Center for Research Data (NSD). The survey was anonymous, and informed consent was implied by the participants' participation in the survey after reading the introduction to the survey. The introduction contained information about the aims of the study and the dissemination of the study results.

Variables

Two outcome variables were analyzed. The first outcome variable was HIV testing history. All respondents were asked if they ever had taken an HIV test. Those confirming that they had been

tested for HIV received a follow-up question: “When was the last time you tested for HIV?” The answers to the follow-up question consisted of eight categories¹. When describing our sample, we recoded the original eight categories into two categories, and included those who answered that they had never been tested for HIV in a separate category. The HIV testing history variable thus consisted of the following categories: 1) less than two years, 2) two years or more, and 3) never tested. Due to the small sample size, we used a dichotomous variable in the main analyses. For this purpose, MSM who had never been tested for HIV were coded as one, whereas those who had been tested for HIV were coded as zero.

Our second outcome variable was whether MSM ordered the HIV self-test because it provided anonymity in the testing situation. All respondents were asked the following question: “Why are you choosing to test with a self-test?” Those selecting the response category “The test is anonymous” were coded as one; otherwise, as zero.

Disclosure and sexual identity

There are several possible ways we could have combined sexual identity and disclosure of same-sex sexuality in the analyses. Unfortunately, the sample size imposed some clear limitations on this study. Our measure of disclosure and sexual identity was based on a two-by-two table, differentiating between disclosure and non-disclosure, and between identifying as gay or not. First, we developed a dichotomous variable on disclosure using the question: “Does your closest family know that you have sexual relationships with men?” The respondents could choose between seven

¹ 1) Less than 3 months ago, 2) between 13 weeks and 6 months ago, 3) between 7 months and 1 year ago, 4) between 13 months and 2 years ago, 5) between more than 2 years and 4 years ago, 6) between more than 4 years and 9 years ago, 7) more than 10 years ago, and 8) I can’t answer (only one respondent in this category, who was excluded).

response categories²: Those answering that all or most of their close family members knew that they had sex with men were coded as one; otherwise, as zero. Second, we developed a dichotomous variable on sexual identity. The respondents were asked to report their sexual identity within six different response categories: 1) heterosexual, 2) homosexual, 3) bisexual, 4) lesbian, 5) queer, and 6) I am unsure of my sexual orientation. Those answering “lesbian” were excluded. Those answering “homosexual” were coded as one; otherwise, as zero. Based on these two dichotomous variables, we defined the following four groups: 1) gay-identified, disclosing MSM; 2) gay-identified, non-disclosing MSM; 3) non-gay-identified, disclosing MSM; and 4) non-gay-identified, non-disclosing MSM. We acknowledge that there is a difference between the terms “gay” and “homosexual”. However, most respondents answered the survey in Norwegian, in which the corresponding response category was “homofil”. “Homofil” is equivalent to the English term “gay”, and we labelled the groups accordingly.

Control variables

We included sexual behavior, age, education, immigrant background, and place of residence as control variables. Sexual behavior was determined by two questions. First, all respondents were asked to report on the number of male sex partners they had during the previous year within 13 categories³. We organized the number of male sex partners as six dummy variables: 1) none, 2) one, 3) 2–4, 4) 3–4, 5) 5–9, and 6) 10 or more. Second, all respondents answering that, during the last six months, they had had UAI with a casual male partner were coded as one; otherwise, as zero. Ages were organized as four dummy variables, 1) 18–24, 2) 25–34, 3) 35–49, and 4) 50 and

² 1) Yes, all close family members know that I have sex with men, 2) Yes, most close family members know that I have sex with men, 3) Yes, a few close family members know that I have sex with men, 4) No, nobody in my family knows that I have sex with men, 5) I don't know if somebody knows, 6) I don't have any family/I don't have any contact with my family, 7) I don't have sexual relationships with men (responses in this category are excluded).

³ 1) None, 2) 1, 3) 2, 4) 3-4, 5) 5-9, 6) 10-14, 7) 15-19, 8) 20-29, 9) 30-39, 10) 40-49, 11) 50-59, 12) 100-199, 13) 200 +

above, where the youngest age group (18–24) was used as a reference group. Education was coded into a dichotomous variable, so that MSM who had any university/university college education were coded as one; otherwise, as zero. The variable regarding immigrant background was derived from the respondent's and his mother's birthplace. Respondents who were born, or whose mothers were born, in Eastern Europe, South America, the Middle East, Asia/Oceania, or Africa, were defined as MSM with an immigrant background. The place of residence was represented by six dummy variables relating to different regions of Norway: 1) Oslo, 2) East, 3) South, 4) West, 5) Middle, and 4) North.

Empirical strategy

Even though the dependent variables were dichotomous, we preferred to follow the trend of using linear probability models (LPM) instead of logistic regression. The major advantage of LPM is its interpretability. A one-unit increase in X_1 is associated with a given percentage point increase in the probability that Y (e.g. never tested for HIV) is 1. The LPM and logistic regression fit about equally if the probabilities are moderate (between 0.20–0.80). In our case, 27 percent of the sample had never been tested for HIV, and 43 percent chose to test with an HIV self-test because it is anonymous; thus, within the preferred range. For cross-sectional data, heteroscedasticity is the norm (54) and the use of robust standard errors is preferable. Our sample size was small; thus, using the `vce(hc3)` option would provide better heteroscedasticity-robust estimates (55). `hc3` robust standard errors were used in all the analyses and are reported in parentheses. However, logistic regression was used on all analyses without violating the results (available on request). Statistical analyses were performed using Stata/MP 14.2.

Previous research has documented a range of factors that are associated with MSM's HIV testing behavior. In this study, we primarily focus on whether sexual identity and disclosure of

same-sex sexuality affect the MSM HIV self-test users' probability of 1) ever having been tested for HIV and 2) choosing to test with an HIV self-test because it is anonymous. Since it is well established that sexual behavior influences HIV testing behavior among MSM (e.g. 20) control variables for the number of male sex partners and UAI only in the first analysis. Our main control variables (disclosure and sexual identity) may be correlated with sexual behavior and may affect HIV testing behavior in different directions. For this reason, Model 3 introduces the sexual behavior variables and other control variables.

RESULTS

Sample characteristics

Table 1 presents the sample's distribution on the variables used in the analyses. The sample consisted of 849 MSM who had ordered an HIV self-test kit. 49 percent had been tested for HIV during the last two years, 23 percent had not been tested within the last two years, while 27 percent had never been tested for HIV. 43 percent answered that they chose to test with an HIV self-test because it is anonymous.

Based on sexual identity and disclosure of same-sex sexuality, we divided the sample into four groups. The largest group was gay-identified, disclosing MSM (64%); followed by non-gay-identified, non-disclosing MSM (18%); gay-identified, non-disclosing MSM (13%); and non-gay-identified, disclosing MSM (5%). Among gay-identified, disclosing MSM, 54 percent had been tested for HIV within the last two years and 21 percent had never been tested for HIV. 35 percent of this group also chose to test with an HIV self-test because it is anonymous. 47 percent of gay-identified, non-disclosing MSM had been tested for HIV within the last two years. However, a rather large part of this group had never been tested for HIV (39%). In this group, 50 percent reported that they chose to test with an HIV self-test because it is anonymous. Among non-gay-

identified, disclosing MSM, 56 percent had been tested for HIV within the last two years, while 22 percent had never been tested for HIV. 37 percent of this group chose to test with an HIV self-test because it is anonymous. 33 percent of non-gay-identified, non-disclosing MSM had been tested for HIV within the last two years, which is rather few compared to the other groups, and 45 percent answered that they had never been tested for HIV. In the same group, 66 percent reported that they had chosen to test with an HIV self-test because it is anonymous.

(Table 1 about here)

Regarding the central topic of this study, the prevalence of those who had never been tested for HIV was clearly highest among non-disclosing MSM, among both gay- and non-gay-identified MSM. Additionally, these groups more often stated that they had chosen to test with an HIV self-test because it is anonymous.

The first measure of sexual behavior was the number of male sex partners participants had during the previous year. Having had 3–4 male sex partners during the previous year (29%) was most common, followed by 5–9 (18%), 2 (17%), 10 or more (17%), 1 (14%), and none (6%). The main trend is that a greater number of partners is associated with a higher prevalence of having been tested for HIV within the past two years, while we found the opposite trend among MSM who had never been tested for HIV. The second measure of sexual behavior was whether they had practiced UAI. 66 percent of the sample answered yes to this question, of which 54 percent had been tested for HIV within the last two years, and 27 percent had never been tested for HIV.

The age distribution of the sample had a reverse U-shape. The fewest respondents were found in the oldest age group (11%), followed by the youngest age group (22%). Furthermore, it is worth noting that more than half of the youngest age group had never been tested for HIV, and

half of them chose to test with an HIV self-test due to its anonymity. By comparison, 47 percent of MSM 50 years and older also chose the HIV self-test due to anonymity. With regard to education, a small majority had higher educational attainment (54%). There was a tendency for the prevalence of those who had never been tested for HIV, and of those who chose to test with an HIV self-test due to anonymity, to be higher among the lower educated group. There was a clear predominance of respondents without an immigrant background in the sample; however, the groups were relatively similar with respect to whether they had been tested for HIV (27% versus 28%) and chose the HIV self-test because it is anonymous (both 43%). Concerning place of residence, the percentage ranged from 35 percent living in Oslo to 7 percent living in the Northern region of Norway. There was a tendency for MSM living in Western or Northern regions in Norway to more frequently report that they had never been tested for HIV (37% and 42%), and that they chose the HIV self-test due to anonymity (49% and 55%) compared to MSM living in other places in Norway.

(Table 2 about here)

Linear probability analyses

Table 2 presents the results of the linear probability model, using four models. In Model 1, we explore how our four categories (gay-identified, disclosing MSM; gay-identified, non-disclosing MSM; non-gay-identified, disclosing MSM; and non-gay-identified, non-disclosing MSM) correlate with never having been tested for HIV. To test the sensitivity of the estimated parameters, we include control variables in Model 2. In Model 3 we explore the correlation between sexual behavior and HIV testing history with control variables. Model 4 includes all variables of interest.

The coefficient for the reference group in Model 1 (gay-identified, disclosing MSM) indicates that 21 percent (regression coefficient 0.21, $vce(hc3) = 0.017$) of this group had never been tested for HIV. Compared to the reference group, gay-identified, non-disclosing MSM had an 18 percentage points (regression coefficient 0.18, $vce(hc3)=0.049$) greater probability of never having been tested for HIV. Furthermore, non-gay-identified, non-disclosing MSM had a 24 percentage points (regression coefficient 0.24, $vce(hc3) = 0.017$) greater probability of never having been tested for HIV. However, among those who disclosed their same-sex sexuality, there was no significant difference between gay- or non-gay-identified MSM with respect to never having been tested for HIV. These results point in the direction of a strong positive correlation between non-disclosure of same-sex sexuality and not having been tested for HIV. At the same time, much of the variation is unexplained, as we can see from the low R-squared at 0.05.

In the next model, we include control variables to test the robustness of the main variables, but also variables that might influence HIV testing behavior among MSM. The results in Model 2 point in the same direction with respect to disclosure of same-sex sexuality and HIV testing history. The estimates are quite robust when including control variables; however, the estimate for gay-identified, non-disclosed MSM is relatively reduced from Model 1 to Model 2 compared to the estimates for non-gay-identified, non-disclosing MSM. This may be because the reference group had changed and its characteristics possibly correlated with not identifying as gay and non-disclosure of same-sex sexuality.

The results illustrate that age is important for MSM's HIV testing history. The reference group in Model 2 consists of the youngest age group (18 to 24 years). The coefficients for the other age groups in Model 2 are negative and statistically significant, indicating that MSM in older age groups were more likely to have been tested for HIV.

The more highly educated participants were more likely to have been tested for HIV, with 7 percentage points difference compared to those with lower education, while the coefficient for immigrant background is not significant. Compared to MSM living in Oslo (reference group), MSM living in Eastern, Western, and Northern regions of Norway were more likely to have never been tested for HIV. Compared to Model 1, the R-squared is 0.17 and higher, but still much of the variation is unexplained.

Model 3 shows the correlation between sexual behavior and HIV testing history with control variables. 59 percent (regression coefficient 0.59, $vce(hc3) = 0.056$) of the reference group (lower educated MSM in the youngest age group, living in Oslo, who had one male sex partner during the previous year, and no UAI with a casual male partner during the last six months) had never been tested for HIV. MSM who had less than five male sex partners during the previous year were not significantly different from the reference group. Having had five to nine or ten or more male sex partners were associated with a decrease in the probability of never having been tested for HIV, at 16 and 26 percentage points respectively (regression coefficient -0.16, $vce(hc3) = 0.059$; regression coefficient -0.26, $vce(hc3) 0.054$). MSM reporting that they had practiced UAI with a casual male partner during the last six months were not significantly different from those who had not practiced UAI with a casual male partner. R-squared is only 0.18, indicating that much of the variation is unexplained.

Including all variables, Model 4 indicates that disclosure of same-sex sexuality and age are strongly correlated with HIV testing history. MSM who do not disclose their same-sex sexuality and/or are between 18 to 24 years are more prone to never having been tested for HIV. Conversely, those who had more than five male sexual partners during the previous year were more likely to have been tested for HIV.

Table 3 presents the results of the second linear probability model with the dependent variable indicating whether the HIV self-test was chosen due to anonymity or not. Model 1 includes the dependent variable from our first LPM (not tested for HIV) and the four categories (gay-identified, disclosing MSM; gay-identified, non-disclosing MSM; non-gay-identified, disclosing MSM; and non-gay-identified, non-disclosing MSM). In Model 2, control variables are included.

(Table 3 about here)

The results from Model 1 show that 32 percent of the reference group (gay-identified, disclosing MSM who had been tested for HIV) chose to test with an HIV self-test because it is anonymous. Among MSM who had never been tested for HIV, 17 percentage points (regression coefficient 0.17, $vce(hc3) = 0.039$) more chose the HIV self-test due to its anonymity compared to those who had been tested for HIV. Non-disclosing MSM, both gay- and non-gay-identified, were more likely to choose to test with an HIV self-test due to anonymity (11 (regression coefficient 0.11, $vce(hc3) = 0.052$) and 26 percentage points (regression coefficient 0.26, $vce(hc3) = 0.046$) respectively). Including the control variables in Model 2 does not alter these results. MSM who had never been tested for HIV were 16 percentage points more likely to choose the HIV self-test because it is anonymous compared to the reference group. The greatest probability was found among non-gay-identified, non-disclosing MSM, of which six out of ten chose to test with an HIV self-test because it is anonymous. The coefficients of the control variables are jointly insignificant. The strong statistical insignificance of the control variables, and virtually no change in R-squared between Model 1 and Model 2, may indicate that age, education, immigrant background, and place

of residence do not affect MSM's decisions to test with an HIV self-test because it is anonymous, while the strongest correlation was found for MSM who do not disclose their same-sex sexuality.

DISCUSSION

HIV self-testing is considered to be a strategic approach for reaching MSM who have rarely or never been tested for HIV. For that reason, GLHN introduced a pilot project on HIV self-testing in 2016 as a means to increase HIV testing rates among MSM in Norway. This study provides insights on who might be interested in such an approach to HIV testing, by examining data reported by the MSM participants in the GLHN pilot project. We have done this by directly addressing the anonymity and privacy associated with HIV self-testing, which we argue is one of the most important features that this testing alternative contributes to HIV prevention. We used linear probability models to assess whether sexual identity and disclosure of same-sex sexuality affect the MSM HIV self-test users' probability of 1) never having been tested for HIV and 2) choosing to test with an HIV self-test because it is anonymous. Our main results show that non-gay-identified, non-disclosing MSM may be especially interested in HIV self-tests and we assert that this is partly because HIV self-testing is anonymous. These findings are important for HIV prevention policies and for considerations of how to distribute HIV self-tests in ways that are effective in reaching out to MSM who would otherwise not be tested.

First, we show that the GLHN pilot project was successful in reaching MSM who had not been tested for HIV during the last two years or who had never been tested for HIV. This supports the notion that HIV self-testing has the potential to reach MSM who are rarely or never tested for HIV. Next, we examined the relationship between sexual identity, disclosure of same-sex sexuality, and never having been tested for HIV. Our results show that MSM who are not open about their same-sex sexuality have a higher probability of never having been tested for HIV.

These estimates are robust and do not change after including controls for sexual behavior, age, education, immigrant background, and region of residence. Although there is an association between non-disclosure of same-sex sexuality and never being tested, for both gay- and non-gay-identified MSM, the probability of never having been tested for HIV is higher among MSM who do not identify as gay than among those who do.

These results are in line with previous research that has shown that a non-gay sexual identity and not being open about one's same-sex sexuality are associated with never being tested for HIV (21, 23, 26, 28, 29, 30). Non-gay-identified MSM and MSM who are not open about their same-sex sexuality may be hesitant to be tested for HIV by testing services which require disclosure of same-sex sexuality. In practice, this includes all HIV testing services where meeting in person is necessary. Since HIV self-testing evades this issue, we assumed that it would be an attractive alternative, especially for non-disclosing MSM. Our results support this assumption: MSM who do not disclose their same-sex sexuality, irrespective of whether they identify as gay or not, have a higher probability of choosing to test with an HIV self-test because it is anonymous. These estimates are robust and do not alter after the inclusion of control variables, of which none are significant, indicating that anonymity is equally important across different age groups, regions of residence, and education levels. That non-disclosure of same-sex sexuality is associated with a higher probability of choosing to test with an HIV self-test because it is anonymous is congruent with previous research that has shown that living one's sex life with men in secrecy is associated with accessing unauthorized HIV self-tests online among MSM (43).

Importantly, never having been tested for HIV is also positively associated with a higher probability of choosing to test with an HIV self-test due to its anonymity. This suggests that the anonymity provided by HIV self-tests is attractive for MSM who have never been tested for HIV

generally, regardless of their sexual identity and whether they are open about their same-sex sexuality or not. For instance, some MSM may prefer HIV testing options where only they have access to their HIV test results, despite being open about their same-sex sexuality. HIV self-testing represents such an option.

Our results also show that HIV self-tests are successful in reaching young MSM who have never been tested for HIV. Compared to MSM users in older age groups, MSM aged 18 to 24 years were more likely to never have been tested for HIV. This is in line with previous research showing a strong age trend in HIV testing history among MSM (21, 25). Based on our analyses, we cannot determine whether the young MSM in our study have not been tested for HIV because, for example, they have not had sex until very recently, or whether this is due to barriers. Nevertheless, if HIV self-tests lower the threshold for taking the first HIV test among young MSM, it may serve as a convenient starting point for HIV testing and thereby lay the foundation for regular testing routines in this group.

Concerning sexual behavior, having a higher number of male sexual partners is associated with a lower probability of never having been tested for HIV. This is in line with prior research findings showing that never having been tested for HIV is associated with a lower prevalence of reported sexual risk behaviors (e.g. 20, 21, 22, 23). However, previous research has also demonstrated that the relationship between sexual behavior, perceived HIV risk, and HIV testing behavior is not entirely straightforward (24). Some MSM do not perceive themselves to be at risk of HIV, despite engaging in behaviors that expose them to risk; others do not test for HIV despite correctly perceiving themselves to be at risk. This is important to keep in mind when considering that, among the MSM in the present study, a substantial proportion of, not only those who have

not been tested within the last two years, but also those who have never been tested for HIV, report that they have had five or more male sexual partners and practiced UAI.

Most of the MSM self-test users reported that they lived in places in Norway other than Oslo. In Oslo, there are several testing options, ranging from multiple clinics to anonymous community-based services whereas, in the rest of Norway, testing services for HIV are restricted to hospitals and general practitioners. Consequently, it is easier to access HIV testing in Oslo compared to the rest of Norway, other large cities included. HIV self-tests offer the possibility of being tested for HIV where there were previously no testing options available at all or they were limited to, for example, general practitioners. Prior studies have also identified that living in rural areas, as opposed to metropolitan areas, is associated with never being tested for HIV (25, 26, 29), possibly due to the lack of HIV testing services. In the present study, living in Northern, Eastern, and Western regions of Norway (i.e. outside the capital, Oslo) is associated with a higher probability of never having been tested for HIV (before including all variables). These findings suggest that the convenience of HIV self-testing may be particularly important in places where there are few HIV testing options.

Our study has several limitations. The largest Norwegian social networking website for lesbian, gay, bisexual and transgender (LGBT) people covered the launch of the pilot project. This initiated a high demand for HIV self-test kits that, in combination with a labor-intensive distribution model involving packing and mailing the HIV self-test kits, precluded other distribution strategies. Other planned distribution strategies included peer-based distribution at venues for MSM, such as gay saunas/bath houses and other cruising areas—a strategy that has proven successful in other studies (56). The high demand for HIV self-test kits also ruled out the initiation of a marketing strategy on Google and Facebook. This may have had an impact on the

recruitment of study participants and may partly explain why the sample consists mostly of gay-identified MSM with a non-immigrant background. A marketing strategy involving Facebook and Google would possibly have enabled recruitment of a broader spectrum of the heterogeneous MSM population. If so, this would have permitted analyses based on a more meaningful and nuanced representation of sexual identity categories, instead of including sexual identity as a dichotomous variable (i.e. gay/non-gay). Whether such distribution strategies are efficient in recruiting a more diverse sample of MSM is a challenge for future research.

While the sample is homogeneous with regard to sexual identity and country of birth, the study sample is diverse with respect to other variables, such as the respondents' places of residence in Norway and disclosure of same-sex sexuality. However, the disclosure variable is a measure of being open to one's immediate family. Not being open to one's immediate family does not necessarily exclude being open to, for instance, a general practitioner. A final limitation, as in all studies on sexual health, is that this study relies on self-reported data on sexual behavior, which is subject to recall and desirability bias (57, 58).

CONCLUSION

The results in this study clearly illustrate that HIV self-testing provides an opportunity to reach out to MSM who have never been tested for HIV and who are in need of HIV testing. Specifically, we demonstrate that HIV self-tests may be particularly beneficial for non-gay-identified MSM who are not open about their same-sex sexuality and who may therefore be hesitant about being tested by existing HIV testing services. The effectiveness of HIV self-tests in reaching MSM who do not disclose their same-sex sexuality is partly because HIV self-testing is anonymous.

Two HIV self-test users contacted GLHN because they received a positive result from their test. Furthermore, two HIV self-test users who had also tested positive contacted a center for

people affected by HIV in Norway. In total, this gives four positive HIV self-tests. However, it is possible that there were more HIV self-test users who tested positive but did not contact GLHN or similar organizations. Only one of the HIV self-test users testing positive was confirmed to be linked to care at an infectious diseases ward. This illustrates the challenge in linking HIV self-test users to care, which has been one of the main objections to the implementation of HIV self-testing (40, 59).

Public health policies should support the inclusion of HIV self-testing as a supplemental alternative to other HIV testing services, through distribution models guaranteeing a high degree of anonymity. Future HIV self-test services should also develop efficient link-to-care strategies. As HIV self-tests are made more accessible, future research should continue to assess uptake, user characteristics, and, preferably, address the effect of HIV self-testing on the overall HIV situation.

COMPLIANCE WITH ETHICAL STANDARDS

Conflicts of interest

All authors declare that they have no conflicts of interest.

Ethical approval

This article does not contain any studies with human participants or animals performed by any of the authors.

Informed consent

Informed consent was obtained from all individual participants included in the study.

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Table 1. Descriptive statistics for MSM HIV self-test users in the GLHN pilot project. Percent.

	HIV testing history			HIV self-test due to anonymity	Sample % (N)
	Last two years	More than two years	Never		
Sample	49 (419)	23 (197)	27 (233)	43 (362)	849
<i>Disclosure and sexual identity</i>					
Gay-identified, disclosing MSM	54	26	21	35	64 (545)
Gay-identified, non-disclosing MSM	47	14	39	50	13 (114)
Non-gay-identified, disclosing MSM	56	22	22	37	5 (41)
Non-gay-identified, non-disclosing MSM	33	22	45	66	18 (149)
<i>Sexual behavior</i>					
<i>Number of male sexual partners (previous year)</i>					
None	15	40	46	52	6 (48)
1	35	28	38	35	14 (120)
2	38	29	33	49	17 (144)
3–4	46	23	31	48	29 (246)
5–9	62	17	21	40	18 (150)
10 or more	78	14	8	33	17 (141)
Unprotected anal intercourse with a casual male partner (last six months)	54	23	27	43	66 (557)
<i>Age groups</i>					
18–24	42	5	52	50	22 (187)
25–34	57	18	25	39	36 (309)
35–49	51	35	14	40	30 (257)
50 and above	35	43	22	47	11 (96)
Lower education	43	21	37	47	46 (389)
Higher education	55	25	20	39	54 (460)
Non-immigrant	48	24	27	43	89 (757)
Immigrant	59	13	28	43	11 (92)
<i>Region of residence</i>					
Oslo	62	18	19	38	35 (294)
Eastern	42	26	32	43	29 (244)
Southern	45	26	28	41	10 (88)
Western	42	21	37	49	10 (89)
Trøndelag	54	28	18	43	8 (72)
Northern	29	29	42	55	7 (62)

Table 2. The probability of never having tested for HIV: Linear probability model regression estimates, vce(hc3) in parentheses.

	Model 1	Model 2	Model 3	Model 4
Disclosure and sexual identity				
Gay-identified, disclosing MSM	ref	ref	ref	ref
Gay-identified, non-disclosing MSM	0.18 *** (0.049)	0.14*** (0.047)		0.14** (0.047)
Non-gay-identified, disclosing MSM	0.01 (0.069)	-0.04 (0.065)		-0.06 (0.064)
Non-gay-identified, non-disclosing MSM	0.24*** (0.017)	0.23*** (0.044)		0.19*** (0.044)
Sexual behavior				
<i>Number of male sex partners (previous year)</i>				
None			0.09 (0.080)	0.05 (0.082)
1			ref	ref
2			-0.05 (0.059)	-0.05 (0.058)
3-4			-0.07 (0.054)	-0.6 (0.052)
5-9			-0.16** (0.059)	-0.14** (0.057)
10 or more			-0.26*** (0.054)	-0.25*** (0.052)
Unprotected anal intercourse with a casual male partner (last six months)			-0.01 (0.038)	-0.1 (0.037)
<i>Age groups</i>				
18-24		ref	ref	ref
25-34		-0.22*** (0.046)	-0.23*** (0.045)	-0.21*** (0.045)
35-49		-0.35*** (0.045)	-0.35*** (0.043)	-0.35*** (0.044)
50 and above		-0.30*** (0.032)	-0.28*** (0.056)	-0.31*** (0.055)
Lower education		ref	ref	ref
Higher education		-0.07* (0.032)	-0.06* (0.032)	-0.06^ (0.032)
Non-immigrant		ref	ref	ref
Immigrant		-0.02 (0.050)	-0.01 (0.049)	-0.03 (0.051)
<i>Region of residence</i>				
Oslo		ref	ref	ref
Eastern		0.08* (0.037)	0.07^ (0.038)	0.05 (0.038)
Southern		0.08 (0.050)	0.05 (0.049)	0.05 (0.049)
Western		0.11* (0.054)	0.10^ (0.053)	0.08 (0.053)
Trøndelag		-0.04 (0.047)	-0.05 (0.050)	-0.057 (0.053)
Northern		0.17*** (0.067)	0.17* (0.067)	0.15** (0.066)
Constant	0.21*** (0.017)	0.43*** (0.046)	0.59*** (0.056)	0.54*** (0.056)
R-squared	0.05	0.17	0.18	0.18

*** p<0.001, ** p<0.01, * p<0.05, ^ p<0.10

Table 3. The probability of choosing to test with an HIV self-test because it is anonymous: Linear probability model regression estimates, vce(hc3) in parentheses.

	Model 1	Model 2
Never tested	0.17*** (0.039)	0.16*** (0.042)
<i>Disclosure and sexual identity</i>		
Gay-identified, disclosing MSM	ref	ref
Gay-identified, non-disclosing MSM	0.11* (0.052)	0.10^ (0.054)
Non-gay-identified, disclosing MSM	0.01 (0.080)	0.01 (0.082)
Non-gay-identified, non-disclosing MSM	0.26*** (0.046)	0.26*** (0.047)
<i>Age groups</i>		
18–24		ref
25–34		-0.05 (0.047)
35–49		-0.3 (0.049)
50 and above		-0.02 (0.060)
Lower education		ref
Higher education		-0.03 (0.036)
Non-immigrant		ref
Immigrant		0.01 (0.056)
<i>Region of residence</i>		
Oslo		ref
Eastern		-0.02 (0.043)
Southern		-0.02 (0.060)
Western		0.04 (0.061)
Trøndelag		0.03 (0.064)
Northern		0.08 (0.068)
Constant	0.32*** (0.021)	0.36*** (0.051)
R-squared	0.08	0.08

*** p<0.001, ** p<0.01, * p<0.05, ^ p<0.10