

**Title: Digital vending machine technology to deliver HIV self-tests to men who have sex with men**

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## **Abstract**

**Objective:** Technology-based approaches to distribute HIV self-tests (HIVST) have the potential to increase access to HIV testing in key populations. We evaluate the acceptability and feasibility of using vending machine technology in a community setting to distribute HIVST to men who have sex with men at high-risk of HIV.

**Methods:** Firstly, a pre-development survey of targeted potential users explored attitudes towards HIV self-testing and the use of a vending machine to deliver HIVST. Secondly, participatory design workshops between designers and community volunteers informed the production of a bespoke vending machine dispensing free BioSure© HIVST. Uptake of HIVST and user experiences were evaluated using information supplied directly from the machines interface (number of tests dispensed, user demographics), an online questionnaire and semi-structured interviews.

**Results:** The pre-development survey found that 32% of 232 sauna users had never tested for HIV, despite high risk behaviours. A total of 265 testing kits were dispensed: mean age 31(18-70); 4%(7) had never tested for HIV before and 11%(22) had tested within the last 1-5 years. Uptake of tests was significantly higher via the vending machine compared to outreach testing by community workers in the same venue during a comparable period (34 vs 6 tests per month). Qualitative interviews and online questionnaires demonstrated high acceptability for this intervention, which was considered accessible and appropriately targeted.

**Conclusions:** Vending machine technology to distribute HIVST was feasible and acceptable. This intervention could be used in different settings to improve access to HIV testing for key populations

## Introduction

Gay, bisexual and other men who have sex with men (MSM) are at higher risk of HIV acquisition globally (1, 2). Despite the overall decline in HIV incidence, and high awareness of HIV, the rates of HIV diagnoses among MSM in low, middle and high-income settings continues to increase (3), mainly because HIV testing uptake and frequency remains suboptimal in this population. In the UK, approximately 25% of MSM have never tested for HIV and approximately 50% have not tested in the previous year (4).

Regular HIV testing is recognised as a key strategy for reducing HIV transmission and morbidity. Testing enables early access to care and treatment for those diagnosed with HIV and provides opportunities for HIV negative individuals to access prevention interventions including pre-exposure prophylaxis (5). Although, there has been a substantial increase in the availability of testing options, MSM continue to face significant barriers to testing, for instance, stigma, confidentiality concerns, delays in getting appointments and long waiting times in clinics where testing is traditionally provided (6, 7). HIV self-testing (HIVST), in which the user collects a sample (oral fluid or blood), tests, and reads the results themselves, has been shown to reduce barriers and increase first-time and repeat testing in MSM (8, 9). There is evidence that HIVST is acceptable to key populations including MSM in low, middle and high-income settings (10-12). HIVST has the potential to reduce key barriers for some individuals by increasing confidentiality, privacy and convenience compared to testing by health care professionals. Disaggregating HIV testing from a medical environment also provides opportunities for innovative and targeted service delivery. Technology-based approaches such as vending machines to distribute HIVST have the potential to expand access to HIV testing, increasing first-time and repeat testing in a wide variety of settings while reducing healthcare costs as outreach workers are not needed. Depending on the setting, HIVST distributed by a vending machine could be potentially available 24 hours, 7 days a week. A single pilot study exploring the acceptability of vending machines to dispense HIVST kits among MSM in the USA showed that this type of intervention was acceptable to users due to increased confidentiality and convenience(13). However,

evidence to inform the design and implementation of technology-based HIVST interventions for MSM is lacking. There is also a lack of evidence exploring how the delivery of technology-based approaches affects the acceptability and uptake of HIVST, particularly when free HIV testing is available through a variety of other services.

The aims of this study were to determine the feasibility of using vending machine technology to distribute HIVST to MSM in a sex on premises venue (sauna); and to explore the acceptability of using this technology in the context of known barriers and facilitators to HIVST among MSM.

## **Methods**

### **Study Design**

This mixed methods study sought to evaluate the feasibility and acceptability of using vending machine technology to distribute HIVST to high risk MSM.

### **Study Setting**

This study was conducted in a sex-on-premises venue (sauna) frequented by MSM in central Brighton and Hove (UK), which has a population of 273,000 and an adult HIV prevalence of 17% (14). Brighton and Hove have a good coverage of HIV and STI testing available in sexual health clinics and community venues. The sauna has approximately 400 clients each week. HIV testing (rapid point of care HIV testing) is provided in the sauna by community workers from a voluntary organisation for 3 hours twice a week. We chose this venue because previous research has demonstrated that saunas may represent important sites of HIV transmission among MSM (15, 16)

### **Preliminary survey**

Sauna users were invited to self-complete an anonymous survey to determine HIV testing history, self-reported sexual behaviour, HIV risk perceptions, and their views on HIV self-testing. Men were recruited between September and December 2015. All men were given a study information leaflet on arrival at the sauna by reception staff. The information leaflet provided a link to the online survey, which was also available on the

sauna website. Data were analysed using descriptive statistics including frequencies and percentages.

### **Design of vending machine**

Participatory design workshops involving LGBT community volunteers product designers, and technology engineers were organised to design a bespoke digital vending machine to distribute Biosure HIVST. The workshops utilised service design tools such as personas (the process of creating characters to theoretically explore individuals' thoughts and behaviours) (17), the construction of user journeys, and mock-ups for the design and likely interaction with the vending machine.

The outcome of these workshops was the development of a bespoke vending machine to distribute Biosure HIV self-tests, free of charge, and with a simple adaptable user-friendly interface (interface can be modified to attract more users during special events such as Christmas, LGTB events etc) capable of capturing epidemiological and background data on users (**Figure 1**). Biosure HIVST are rapid HIVST that detect HIV 1 and 2 antibodies. It requires a blood sample from a finger prick and the result is available after 15 minutes. We selected Biosure HIVST because at the time of the study it was the only legally approved HIV Self-test in the UK. The Biosure HIVST is a second-generation HIV test with a window period (the time between potential exposure to HIV and the time when the test will give an accurate result) of approximately 4 to 9 weeks (18). Biosure HIVST have a sensitivity and specificity of 99% with optimal performance in the hands of lay users (19). A sticker with detailed information about linkage to care (contact for the nearest Sexual Health clinic) and support in case of a reactive result (helpline details) was developed following the co-design workshop with users and attached to the HIVST kit. Information on the HIV window period and when to test next was also provided with the kit.

### **Vending machine evaluation**

The vending machine began distributing HIVST in June 2017. The evaluation was conducted between June 2017 and March 2018. Demographic characteristics of vending machine users including age, place of residency, and period since last HIV test were

collected via the vending machine's user-friendly touchpad screen. A link to an online structured questionnaire was provided via a SMS text message sent by the vending machine to users' cell phone, to gather additional information about acceptability and user-experience of the vending machine and HIVST. The number of tests distributed by the vending machine were compared with the number of tests performed by community workers during the same period.

Semi-structured telephone interviews with survey respondents who provided contact details were conducted. Interviews were guided by topic guides exploring experience and attitudes towards the HIVST and vending machines. Posters and flyers advertising the research were posted throughout the sauna prior to recruitment. Recruitment to this qualitative sub-study continued until data-saturation. Interviews were audio-recorded and transcribed smart verbatim.

Participants were offered £10 for completing the questionnaire and £20 for participating in telephone interviews.

### **Analysis**

Demographic characteristics of participants of the pre-development survey, vending machine users and participants of the qualitative interviews were analysed using descriptive statistics. Interviews were analysed using framework analysis (20), which is a matrix-based approach to identifying important and recurring themes based on a combination of a-priori issues and recurring attitudes and emergent experiences generated by participants. Data was systematically classified into themes. Repeated analysis produced further sub-themes, and quotes were cross-coded to themes in an Excel framework generating a detailed referencing of interviews.

### **Ethical considerations**

The study received ethical approval from the Brighton and Sussex Medical School Research Governance and Ethics Committee (ER/JV95/6)

## **Results**

### **Vending machine pre-development survey**

A total of 232 sauna clients responded to the survey. Not all respondents completed all the survey questions. Thirty-seven per cent of respondents were between 45–64 years old and 23% between 25 and 34 years old (**Table 1**). 44% felt they were not at risk of HIV infection despite evidence of high risk sexual behaviour demonstrated by low levels of condom use. Thirty-two percent of respondents had never tested for HIV. Ninety-three per cent of respondents would consider collecting a HIVST at the sauna with 40% wanting to test in the venue, while 53% would prefer to test at home. Most respondents were willing to pay a small amount of money (between £5 and £10) for the convenience of accessing HIVST using a vending machine.

### **Uptake of HIV self-testing via the vending machine**

A total of 265 HIVST kits were accessed between June 2017 and March 2018, median age of users were 31 years (18-70 years). Twenty-three per cent (60) had either never tested for HIV (10) or had not tested in the last 12 months (53) despite reporting high levels of unprotected anal sex. Uptake of HIV tests was seven times greater via the vending machine compared to testing conducted by community outreach workers in the same venue and study period 265 vs 40 (34 vs 6 tests per month) (**Figure 2**).

### **Acceptability and experience of using HIVST via vending machine**

#### ***User experience questionnaire***

Fifty-two vending machine users responded to the optional anonymous on-line questionnaire. Fifty-one per cent (26) had engaged in condomless anal sex with new or casual partners during the last 6 months, confirming the high levels of sexual risk behaviour of the population attending the sauna. Forty-six respondents confirmed they had a negative HIV self-test, and only one participant had a reactive test. This participant was previously diagnosed with HIV and was not engaged with HIV services. The participant re-engaged with HIV services following the linkage to care information provided with the HIVST. Three survey respondents did not provide information about

the result of their HIVST. Ninety-four per cent of respondents stated that they would use the vending machine again and/or recommend it to others.

### ***Qualitative Interviews***

Ten vending machine users consented to telephone interviews. The median age (IQR) was 40 (26-46) years. All had tested for HIV in the past with 90% reporting a test in the last 12 months. These men had wide experience of HIV testing services (sexual health clinic, General Practice, community-based services - including HIVST), and varied patterns of STI testing.

### **Perceived benefits of using HIVST via vending machine**

Overall, HIVST via the vending machine was highly acceptable and the further provision of vending machines was advocated. At least three participants intended to recommend the intervention to friends who did not test due to various known barriers and suggested this informal expedited distribution as a method to support and encouraging further self-testing.

*...Friends often say they're a bit worried, they need to get a test done and they haven't been in [to an STI clinic]. They find there's that barrier to going in, and you might just say 'I've got a self-test here, do you want it?' and that's happened once or twice with me. (Gay man, 34 years, last test: 4months ago)*

The 'convenience' of eliminating barriers posed by sexual health clinics were especially valued. But this term ('convenient') frequently contained references to both the time-demands of using clinics and the stigma/embarrassment-related dynamics of attending clinical services.

*...I think pros definitely were the convenience - the fact that I could just do it at home, I didn't have to make an appointment and I didn't have to wait... and I also didn't have to talk to anyone about it. (Gay man, 45 years, last test: 1month ago)*

The self-test kits were routinely used by the users within a few hours or a few days of using the vending machine, although some participants also took additional kits home for future use: after a sexual risk (with various understandings of the window period); to displace future clinic attendance; to test sexual partners prior to condomless sex; or

for secondary distribution. All participants suggested additional sites for vending machines: gay bars/clubs; medical settings (high-street pharmacies and General Practices); universities/colleges; and sexual health clinics, with two rationales: so that those faced with a long wait could take away an HIVST, and/or to self-test at clinics (in privacy, but with support available).

*...perhaps it might be an idea to have something like that for starters at the NHS drop in. Instead of me taking up 15 minutes of a nurse's time and waiting for hours, I could just literally walk in and use a machine there, you know?. (Gay man, 33 years, last test: 5months ago)*

### **Perceived concerns of using HIVST via vending machine**

Several participants had concerns about receiving a reactive/positive result in isolation without immediate personal support.

*I really think I would freak out 100%. I don't know what I would do. That would happen regardless of whether I was doing it at home or in a clinical setting. I would hope that wouldn't be a reason for people not to do it at home. (Gay man, 26 years, last test: 5months ago)*

Another concern related to the potential risks of displacing comprehensive screening for sexually transmitted infections (STI). Two participants pointed out that the weekly community outreach testing service offered at the same sauna, included instant-result syphilis tests as well as HIV, plus self-sampling swabs for bacterial STIs, and they suggested that the vending machine's limitation of supplying only HIVST risked being counter-productive in STI prevention. For at least three participants, access to the HIV self-test had already displaced intentions or routine patterns of comprehensive STI screening at clinics. One participant (who had used several HIVST) acknowledged this effect and stated that they would now only attend a clinic if they recognised STI symptoms.

*If you're going to queue up at the clinic you're going to do more than just a HIV test. So HIV tests as a portable kit is fine but then people aren't being checked for other things as well. (Gay man, 48 years, last test: 10months ago)*

Several users had used the HIVST delivered by the vending machine for risk assessment prior to condomless sex, and these men either underestimated or were unaware of the 3-month window period. At least one participant felt this would become normalised. Another had been given the self-test kit by a sexual partner who had previously used a kit themselves. Knowledge and understanding of the window period was poor overall.

*...but what the self-testing kit does do, which is what I use it for predominantly, is if you're in a relationship and you know that you're going to start having sex on a regular basis without condoms, then you can proactively use that at home in your own comfort to show each other you both haven't got HIV and then get on with what you want to get on with. (Gay man, 34 years, last test: 3 months ago)*

## **Discussion**

In this study of MSM attending a community sex-on-premises venue in a city with a high prevalence for HIV infection, we found that uptake of HIVST distributed via a vending machine was greater than current HIV rapid testing provided by community volunteers in the same setting. HIVST in this setting was highly acceptable. All users interviewed thought that the intervention would facilitate more frequent testing. They particularly valued the convenience and privacy of the intervention, suggesting that the intervention has the potential to increase the proportion and frequency of testing among MSM. Fear of receiving a reactive/positive test in isolation, and displacement of comprehensive STI testing (as uptake of accessible HIVST might discourage full screening) were the main concerns. Another concern was the potential use of HIVST to screen partners and inform decisions about condomless sex. In this context, the poor understanding of the window period among users of the HIVST kit dispensed by the vending machine, could lead to individuals with acute HIV infection unknowingly transmitting HIV to sexual partners. The concerns about HIVST are in keeping with previous studies looking at barriers and facilitators of HIVST among MSM (21, 22) (12). We found no concerns about individuals' capacity to navigate the vending machine's interface, any expectation of pre-test counselling, or the ability of individuals to perform the Biosure self-test.

This study has several limitations. First the intervention was designed and developed to reduce as many barriers to testing as possible. Therefore, it was not possible to quantify how many vending machine users accessed telephone post-test counselling, what difficulties they had if any with the interpretation of the tests, and whether individuals with reactive or negative results linked up with sexual health services for confirmatory testing or to access prevention services. However, further development of this technology platform to distribute HIVST can address some of these barriers to some extent. For example, the vending machine could be adapted to deliver STI self-sampling kits along with HIVST kits. The digital interface could offer a link to sexual health services where users could get an appointment for further testing and counselling. Similarly, the vending machine interface could interact with a mobile application that could allow direct communication (videoconferencing) with health care professionals in case of difficulties interpreting results or when support is needed for a reactive/positive result (23, 24). The vending machine was placed in a particular venue frequented by MSM, and therefore it is unclear how another setting would affect effectiveness and acceptability. Our participants suggested other venues where the machines could be placed, including gay bars/clubs, universities/colleges, and medical settings such as hospital outpatient departments and general practices. Finally, although there was a willingness from most sauna users to pay a small amount of money for the convenience of accessing HIVST, the HIVST in this study were provided free of charge. Further work is needed to evaluate the impact of charging on HIVST uptake and acceptability. Our results must be interpreted with caution as they represent the perceptions of a new targeted intervention in a specific population of MSM attending a sexual venue. MSM are likely to use a range of services to test for HIV not only HIVST. Regardless of the platform of distribution HIVST should be considered a complementary option, which should be embedded among existing care pathways to ensure that linkage to care and access to counselling, STI screening, HIV care, and prevention services are readily available. Further research is needed to evaluate the use of this intervention in other settings, to fully explore the unintended consequences of emergent technologies and among other key populations that are not currently accessing testing services, such as ethnic

minorities in high-income settings, and younger people in low and middle-income settings.

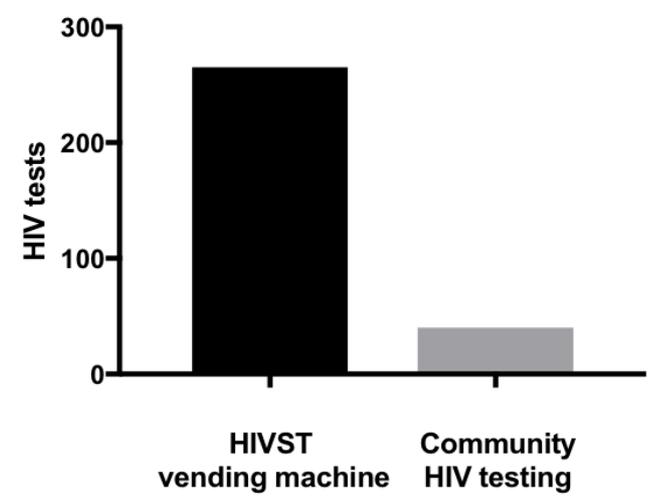
**Key messages**

- HIVST distributed via vending machine technology among MSM was acceptable and feasible
- Fear of receiving a reactive test in isolation, and displacement of comprehensive STI testing were the main concerns stated by vending machine users
- Further work is needed to evaluate the uptake and acceptability of using vending machines in other settings and populations to distribute HIVST

Figure 1. Bespoke vending machine to distribute HIV self-test



**Figure 2. HIV tests accessed using the vending machine vs community testing in the same venue during the same study period. HIVST: HIV self-testing; PoCT=point of care**



**Table 1. Demographic information of participants of the vending machine pre-development survey (n=232)**

<b>Demographic features</b>		<b>Number of responses</b>
<b>Age group, n (%)</b>	25-34 years	64
	35-44 years	44
	44-65 years	103
<b>Recency of HIV Testing, n (%)</b>	In last 12 months	102
	1 to 5 years	36
	> 5 years	19
	Never	74
	No answer	50
<b>Past HIV testing locations</b> (multiple allowed)	Sexual health clinic	98
	GP	5
	Community PoCT	24
	Self-sampling	0
	Self-testing	1
	Hospital	13
	Other	30
	No answer	110
<b>Preferred method of testing in the community</b>	Self-sampling	17
	Self-testing	128
	Any of the above	15
	None of the above	45
	No answer	76

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