

## ORIGINAL ARTICLE

# Acceptability and effectiveness of using mobile applications to promote HIV and other STI testing among men who have sex with men in Barcelona, Spain

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## ABSTRACT

**Objective** To evaluate the acceptability and effectiveness of a pilot intervention programme using gay geosocial mobile applications (apps) to offer rapid HIV and other STI tests to men who have sex with men (MSM) in Barcelona between December 2015 and March 2016.

**Methodology** We offered rapid HIV, syphilis and hepatitis C testing by sending private messages on apps for sexual and social encounters. Acceptance was defined as the proportion of users who favourably responded to the message and effectiveness was defined as the proportion of users who attended our facilities among those who were interested in attending. To identify variables associated with the response to the messages, multivariate logistic regression was used. Adjusted OR (OR<sub>a</sub>) and 95% CIs were calculated. We collected information on sociodemographics, sexual behaviours and app usage from the contacted user profiles and from users who attended our facilities. A descriptive analysis was carried out.

**Results** 2656 individual messages were sent. Overall, a 38.4% response rate was obtained, 83.0% of them found it acceptable to receive the unsolicited message, and 73.2% effectiveness was obtained. Responders had higher odds of being 45 years or older (OR<sub>a</sub>=1.48; 95% CI 1.06 to 2.08), being connected at the moment the message was sent or during the previous hour (OR<sub>a</sub>=1.92; 95% CI 1.38 to 2.68), having a profile photo not exposing bare chest or abdomen (OR<sub>a</sub>=1.44; 95% CI 1.07 to 1.92) and using the Grindr app (OR<sub>a</sub>=1.39; 95% CI 1.12 to 1.73). Of those who were tested and took the survey (n=77), 45.5% had not taken an HIV test in over a year, 24.7% had had a previous STI diagnosis, 51.4% had reported anal sex without condom and 52% had consumed alcohol or drugs for sex.

**Conclusions** The response rate, acceptance and effectiveness observed in this study indicate that this strategy could be a useful tool for promoting STI testing among high-risk MSM population.

## INTRODUCTION

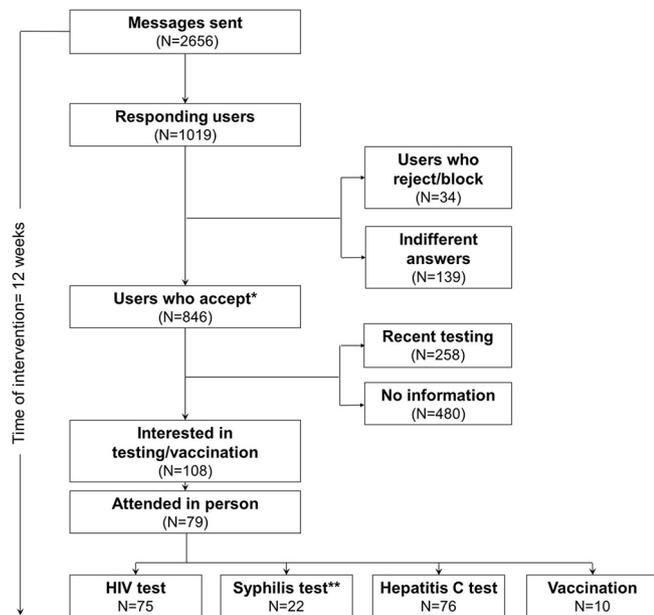
Early diagnosis of HIV infection allows patients to undergo timely antiretroviral therapy, decreasing

HIV transmission, and improving morbidity and mortality rates,<sup>1,2</sup> with a strong impact on the incidence of HIV infection at the community level.<sup>3</sup> However, late diagnosis of HIV infection is estimated to occur in 47% of patients in the European Union (EU), and as many as 17% of infected individuals are unaware of their serological status.<sup>4</sup> In 2015, late diagnosis of HIV accounted for 46.5% and 39% of cases in Spain and Barcelona, respectively.<sup>5,6</sup>

Since 2005, the principal cause of HIV transmission in the EU has been sexual relations among men who have sex with other men (MSM). In 2015, 42% of new HIV cases occurred in MSM, the only group that showed an increase.<sup>7</sup> During the same year in Spain, 53.6% of new HIV cases were attributed to MSM,<sup>5</sup> and this proportion was even greater in large cities such as Barcelona (72.6%).<sup>6</sup>

HIV diagnostic testing outside the typical health-care circuit is a valuable strategy for reducing HIV diagnosis delay in high-risk groups such as MSM.<sup>8</sup> Since 2009, a rapid HIV test has been offered by pharmacies in Catalonia, with 9344 tests conducted by 2014 (of which 1.0% were positive). In 2014, community centres in Catalonia conducted 10 868 HIV tests with a 2.0% incidence of new cases. Moreover, the Barcelona's Public Health Agency (ASPB) has a programme that offers rapid HIV and syphilis tests in gay saunas for the MSM collective, performing 463 tests between 2012 and 2013, with an annual incidence of 4.7% and 6.1% per year, respectively.<sup>9</sup>

The MSM population has pioneered the use of social networks and the internet to search for information about sexual health, arranging dates and sexual encounters, and looking up pornography.<sup>10</sup> In addition, smartphone use has boosted the development of applications (apps) intended for sex encounters. Most of these apps use the global positioning system (GPS) to provide information about the geographical proximity of users, thereby facilitating personal encounters. The MSM users of these apps have a high prevalence of risky sexual practices, and accordingly a high incidence of STIs.<sup>11–17</sup>



**Figure 1** Flow chart of the 2656 contacted users of the application-based pilot intervention programme in Barcelona, Spain (2016). \*From users who favourably rated the message, 258 users had recent testing or regularly attended other testing programmes, and 480 did not mention reasons for not attending. \*\*The stock of syphilis tests was depleted temporarily during the intervention period.

Some studies have shown that most users of these apps are willing to participate in prevention measures advertised by the apps<sup>18 19</sup>; thus, these apps provide an opportunity to implement prevention strategies and promote sexual health.<sup>11 20–22</sup>

The objective of this study was to evaluate the feasibility, response, acceptance and effectiveness of a pilot programme offering rapid HIV and other STI tests to MSM who use apps for sex encounters in the city of Barcelona. Furthermore, this study allowed us to describe the epidemiological characteristics of the contacted users.

## METHODS

We performed a community-based, cross-sectional study in Barcelona, Spain, between December 2015 and March 2016. We contacted MSM users of apps for sexual and social encounters who were over the age of 18, and were either using the app at the time the message was sent or had used the app during the previous 7 days.

## Process description

We created a blank user profile in the most commonly used apps among MSM in Spain (Grindr, PlanetRomeo and Wapo).<sup>11</sup> The user profile can provide basic demographic information and free text. The launch screen of each app displays a photographic list of the users ordered by geographical proximity. The ASPB has two different geographical locations: Lesseps Square in the north, and Drassanes Avenue in the inner city. As these apps use GPS, we decided to focus on the two locations available. The investigators sent a private picture message to all near users through the ‘chat’ option, in order of proximity to at least 50 users, offering them the possibility to take rapid HIV, syphilis and hepatitis C tests, as well as to be vaccinated against hepatitis A and B in one of our two centres. The message was sent in work days and schedules from the centres’ facilities (09:00–19:00),

avoiding repeating users already contacted. We clearly expressed that all services were free of charge and totally confidential. We also gathered self-reported characteristics from each user profile, such as the type of photograph, age and time since the last connection. We provided inperson pretest and post-test counselling to users who agreed to take a test or get vaccinated. Data on sociodemographics, sexual health, app usage and sexual practices were collected through personal interviews with the users who were tested. We also asked these users to complete a self-administered satisfaction survey, rating general satisfaction in a scale of 1–10 and collecting intention to recommend the intervention. Individuals who obtained a positive result on a test were referred to the healthcare system facilities according to a pre-established protocol.

## Analysis

We performed a descriptive analysis of the characteristics of the contacted users, computing the prevalence of categorical variables and median (and IQR) of discrete quantitative variables.

The programme was defined as feasible if the investigators’ profiles remained active on the apps for longer than 1 week; this is because most of these apps could remove profiles who offer services. The response rate was calculated by dividing the number of users who responded to the private message by the total number of users contacted. Acceptance was defined as the number of users who favourably responded to the private message sent via the apps, divided by the number of users who responded to the message. We classified user responses as *positive* if the user provided gratefulness, congratulation or interest response, *negative* if the user showed any kind of disagreement, and *indifferent* if it was impossible to classify the response into either one of these two categories. We calculated effectiveness as the number of users who actually took the tests or got vaccinated, divided by the number of users who responded to the message showing an interest in doing so. Because variables were categorical, we used the Pearson  $\chi^2$  test to compare the profile of users who responded to the private message with that of users who did not respond. To identify factors associated with user response, we performed a multivariate logistic regression analysis using all possible equations method.<sup>23</sup> Adjusted OR and 95% CIs were calculated.

A descriptive analysis of the characteristics of users who took the test or got vaccinated was performed. Also, we did a descriptive analysis of the satisfaction survey responses. For both descriptive analyses we present proportions for categorical variables and the median (and IQR) for discrete quantitative variables.

All statistical analyses were carried out using the Stata V.13 program.

## RESULTS

The three investigator profiles created were active during the entire study period, and contacted a total of 2656 app users (1029 in Grindr, 768 in PlanetRomeo and 859 in Wapo). The median age of these users was 32 years (IQR: 27–39). Of the 1149 users whose profile caption indicated their reason for using the app, 72.2% explicitly indicated they were looking for a sexual encounter.

Of the 2656 users contacted by the investigators, 1019 responded to the message and 846 responded favourably. Thus, the global response rate was 38.4% (42.2% in Grindr, 35.4% in PlanetRomeo and 36.4% in Wapo;  $P=0.005$ ), and the global acceptance was 83.0% (83.2% in Grindr, 81.3% in PlanetRomeo and 84.4% in Wapo;  $P=0.606$ ). Of those who

**Table 1** Associated factors of the message response of the 2656 users contacted with the application-based pilot intervention programme, Barcelona 2016

Variables	Answered		Unanswered		Total, N	OR	P values*	OR <sub>a</sub> †	95% CI	P values
	n	%	n	%						
Age (years)										
<25	129	36.1	228	63.9	357	1		1		
25–34	381	38.6	605	61.4	986	1.11	0.403	1.14	0.88 to 1.47	0.326
35–44	248	38.5	396	61.5	644	1.11	0.408	1.19	0.90 to 1.57	0.213
45 or more	113	44.0	144	56.0	257	1.39	0.050	1.48	1.06 to 2.07	0.022
Time since last connection										
Within the last hour	959	39.7	1456	60.3	2415	1.99	<0.001	1.93	1.38 to 2.69	<0.001
Over an hour ago	60	24.9	181	75.1	241	1		1		
Profile photo										
No photo	102	29.6	242	70.4	344	1		1		
Bare chest or abdomen	295	29.0	511	31.2	806	1.37	0.023	1.21	0.89 to 1.66	0.216
Other (only face, dressed, landscapes and others)	621	41.3	883	58.7	1504	1.67	<0.001	1.43	1.08 to 1.92	0.014
Application used										
Grindr	434	42.2	595	57.8	1029	1.33	0.004	1.39	1.21 to 1.73	0.003
PlanetRomeo	272	35.4	496	64.6	768	1		1		
Wapo	313	36.4	546	63.6	859	1.04	0.668	1.14	0.91 to 1.42	0.247
Schedule of sent message										
08:00–14:00	283	35.8	507	64.2	790	1				
14:00–17:00	387	40.6	567	59.4	954	1.22	0.043			
17:00–19:00	349	38.3	563	61.7	912	1.11	0.298			
Place attended for intervention										
Lesseps	525	40.0	787	60.0	1312	1.14	0.084			
Drassanes	494	36.8	850	73.2	1344	1				
Total	1019	38.4	1637	61.6	2656					

\*Univariate logistic regression.

†Multivariate logistic regression, adjusted by age, time of last connection, type of photograph and application used.

OR<sub>a</sub>, adjusted OR.

responded favourably, 108 (12.8%) were interested in attending the programme facilities, 258 (30.5%) stated they were going to take the tests elsewhere or had already taken them, and the remaining 480 (56.7%) provided no information (figure 1). Among the 108 users who were interested in attending the facilities, 79 attended, which gives an effectiveness of 73.2% without differences between apps ( $P=0.920$ ).

### Factors associated with user response

After multivariate adjustment, the following variables were associated with user response: (1) being 45 years of age or older (adjusted OR (OR<sub>a</sub>)=1.48; 95%CI 1.06 to 2.08), (2) being connected at the moment the intervention message was sent or during the previous hour (OR<sub>a</sub>=1.92; 95%CI 1.38 to 2.68), (3) having a profile photo not exposing a bare chest or abdomen (OR<sub>a</sub>=1.44; 95%CI 1.07 to 1.92), and (4) using the Grindr app (OR<sub>a</sub>=1.39; 95%CI 1.12 to 1.73) (table 1).

### Users who attended the intervention facilities

Of the 79 users who attended for testing or vaccination, 42.5% did so on the same day or the day after the intervention message was sent. Of the 77 individuals who took the survey, 46.7% were born abroad, 62.3% had a university-level education and 81.8% were employed. Of the users who took the HIV test, 7.8% of them had never previously done so and 45.4% had not taken one for over a year. Approximately 25% reported having an STI during the 12-month period prior to the test. The most common infections were *Pthirus pubis* (crabs) and gonorrhoea

(7.8% and 6.5%, respectively). Of the 75 HIV tests performed, one 26-year-old man gave a positive result, representing 1.3% prevalence (95%CI 0.17 to 9.24). There were no reactive tests for syphilis and hepatitis C. The characteristics of the users who attended the intervention and took the survey are summarised in table 2.

Regarding sexual practices, 51.4% of survey respondents who engaged in anal sex with casual partners claimed to have had anal penetration without a condom during the previous 12 months, of whom 75.3% did not know the serological status of any of their casual partners. They had a median of 10 sexual partners in the previous 12 months (IQR: 6–20), and 72.7% had met their last casual sex partner via an app. Approximately half (50.7%) of survey respondents said that they had used drugs, alcohol ( $\geq 4$  standard units of alcohol) or sexual stimulants for their sexual encounters (table 2).

We found that 59.7% of survey respondents used these apps on a daily basis (or on at least 6 days per week), and that 71.4% did so during the evening. Looking for sex was the main reason for connecting to the apps (44.2%), and 67.5% of respondents claimed that their number of sexual partners had increased since installing the apps. Grindr was the most widely used app (62.3%) (table 3).

The satisfaction survey, taken by 70 users (90.9%), presented an average score of 9.7 out of 10. All individuals (100%) who took this survey stated they would recommend this service to friends and acquaintances.

**Table 2** Characteristics of the 79 users who attended HIV and other STI testing facilities in the application-based pilot intervention programme, Barcelona 2016

Variables	Median	IQR	n	%	Variables	n	%
Sociodemographic characteristics					Place where last non-steady partner was met		
Age (years)	32	26–37	77		Web (chat)	4	5.2
Country of origin					Application	56	72.7
Spain			41	53.3	Friends	4	5.2
Other			36	46.7	Sauna	2	2.6
City of residence					Disco/bar	7	9.1
Barcelona			73	92.2	Other	4	5.2
Other			6	7.8	Drugs used for sext (last 12 months)		
Highest educational level					Any drug	40	52.0
Primary			5	6.5	Used drugs (multiple selection)		
Secondary			14	18.2	Erection enhancers	10	13.0
Professional training			10	13	Alcohol	21	27.3
University			48	62.3	Poppers	23	29.9
Employment status					Cannabis/hash	12	15.6
In paid employment			63	81.8	Ecstasy/MDMA	2	2.6
Unemployed			5	6.5	Crystal methamphetamine	1	1.3
Retired/impairment			2	2.6	Amphetamines	2	2.6
Student			7	9.1	GHB/GBL	3	3.9
Sexual orientation					Ketamine	2	2.6
Homosexual			59	76.6	LSD	2	2.6
Bisexual			15	19.5	HIV and STIs		
Heterosexual			1	1.3	HIV previous serological status		
NA			2	2.6	Negative	69	89.6
Steady sex partner (more than 2 months)					Positive	2	2.6
Have steady partner			17	22.1	Unknown	6	7.8
Condomless anal sex in the last 12 months*			14	82.4	Results of HIV tests performed		
Non-steady sex partners (last 12 months)					Negative	74	98.7
Has had non-steady partner(s)			77	100	Positive	1	1.3
HIV status of non-steady partner(s)					Time since last HIV test		
Negative			6	7.8	Less than 6 months	22	28.6
Positive			13	16.9	6–11 months	20	26.0
Unknown			58	75.3	More than 1 year	35	45.4
Condomless anal sex in the last 12 months*			37	51.4	Any STI during the last 12 months	19	24.7
Number of sexual partners in the last month	2	1–4	77				
Number of sexual partners in the last 12 months	10	6–10	77				

\*Both insertive and receptive, among users who reported to practise anal sex.

†Intentional drug use before or during sex.

NA: not answered. MDMA: 3,4-Methylenedioxymethamphetamine . GHB: gamma-Hydroxybutyric acid . GBL: gamma butyrolactone . LSD: Lysergic acid diethylamide .

## DISCUSSION

This study demonstrates that offering free, confidential HIV and other STI tests via apps is feasible, widely accepted and also effective.

### Pilot programme evaluation

The feasibility of our method depended on whether the app developers blocked the investigators' profiles due to complaints from other users. During this study, the investigators' profiles were not blocked by the app developers at any point, and thus remained active throughout the study, as observed by other studies targeting the MSM population using apps.<sup>15 19</sup> However, to promote sexual health, it would be advantageous to establish formal collaboration between the app developers and public health organisations.

The response rate in our study exceeded the rate observed in a previous study that directly contacted individuals through one of these apps. This is likely because we offered a service

(rapid tests and vaccinations) to the MSM population, instead of describing the usage of the app itself, which was the aim of the other study.<sup>15</sup>

Acceptance and effectiveness of our study are quite satisfactory. While we were unable to find other studies that used the exact same methodology, our results appear to have higher rates than those of similar published studies.<sup>18 24</sup> This improved acceptance and effectiveness could be because our programme follows the 2014 European guide recommendations for conducting HIV tests, for example, being in close geographical proximity to the target population, offering free tests within a short period of time and guaranteeing confidentiality.<sup>25</sup> In fact, we believe that our method would have been even more effective if the testing had been performed in areas where services are scarce. Indeed, a large portion of the users who responded favourably to our message claimed to use services available in the geographical area.

**Table 3** Characteristics of app usage by the 79 users who attended HIV and other STI testing facilities in the app-based pilot intervention programme, Barcelona 2016

Variables	Median	IQR	n	%
<b>App use characteristics</b>				
<b>History of use</b>				
Less than 1 year			14	18.2
1–3 years			28	36.4
4 or more years			34	44.2
NA			1	1.3
<b>Frequency of use during the last month</b>				
6–7 days a week			46	59.7
2–5 days a week			29	37.7
1 day a week or less			1	1.3
NA			1	1.3
<b>Time of use during the day</b>				
Morning (06:00–12:00)			6	7.8
Afternoon (12:00–18:00)			3	3.9
Evening/night (18:00–00:00)			55	71.4
Early morning (00:00–06:00)			4	5.2
Indifferent use			8	10.4
NA			1	1.3
<b>Day of use during the week</b>				
Weekdays			15	19.5
Weekend			29	37.7
Indifferent			32	41.6
NA			1	1.3
Number of apps used	2	2–3		
<b>Last used app</b>				
Grindr			48	62.3
PlanetRomeo			10	13.0
Wapo			9	11.7
Tinder			3	3.9
Other			2	2.6
NA			5	6.5

Apps, applications; NA, not answered.

### Characteristics of the app users

Most users in our study said they connected to the apps to search for sexual partners, reaffirming previous reports on the MSM population.<sup>13 19</sup> This puts this app-based intervention in a strategic position to promote sexual health, as these apps encourage sexual encounters among individuals with a high prevalence of STI antecedents, multiple sexual partners and a high level of drug use during sex.<sup>17 19</sup>

From our analysis, we identified the typical characteristics of users who responded to intervention messages. First, Grindr users were more likely to reply to the message than those connected to the other apps, implying a relation with more use of this app in the Spanish population.<sup>11</sup> Second, users who were connected at the moment the message was sent, or during the previous hour, were also more likely to respond, suggesting they had accessibility to establish contact. Third, individuals who had no profile photo, or those who had a photo of a bare chest or abdomen, were less likely to respond, probably because this type of user seeks anonymity, and as such is less likely to attend the facilities. Finally, as seen in other studies, younger individuals had a lower response rate than older individuals, reflecting the fact that the younger population is less willing to participate in HIV prevention and screening programmes.<sup>26</sup> Thus, future

intervention programmes should be tailored to the young MSM population.

### Users who attended the intervention facilities

Almost half of participants turned up to the facilities within 2 days of replying to the message, probably because we offered a very flexible schedule for performing testing and vaccination. Thus, speed, both in terms of user participation and message propagation, could be a primary advantage of our programme when compared with other intervention methods such as outreach in gay venues or primary healthcare testing. This, together with the short time spent in contact with thousands of users, enables a high level of efficiency, a variable that should also be evaluated in terms of cost-effectiveness.

Most users who attended the facilities were young, employed, resident in Barcelona and held university studies, which was consistent with other studies.<sup>14 27</sup> Furthermore, a high percentage of these individuals were born in other countries, possibly because they have fewer resources to access the healthcare system and obtaining information about other test facilities.

Also, 45.4% had not taken the HIV test for at least a year and 7.8% were taking it for the first time. This demonstrates that this type of intervention can help to reduce late HIV diagnosis in the MSM population.<sup>24</sup>

The schedule of use of the apps reported matches with usual after-work or after-study hours. For future interventions, we think the best time for reaching users is the late afternoon/early evening.<sup>29</sup>

As in other studies, the users who responded to our survey were highly satisfied with the intervention we offered.<sup>18 19 24</sup>

### Collateral benefits of the intervention

Direct contact between the users and the investigator through the apps facilitates personalised counselling. This type of intervention, described as *Reaching Out Online*, involves bringing resources of the health system to virtual places where high-risk populations interact.<sup>30</sup>

Apart from the individuals we directly tested and vaccinated, our message likely had a 'reminder effect' for other MSM individuals who chose not to respond. While this added benefit is unmeasurable, it has been demonstrated that receiving a preventative message results to an increase in routine testing among MSM.<sup>31</sup>

### Limitations

Due to the small sample size of users who attended, this study is not representative of the overall MSM population in Barcelona who use the apps for sexual and social encounters. However, as previously described, the characteristics of the app users reached by this programme are in agreement with those reported in studies of other large cities.<sup>12 15 19</sup>

Regarding response rate, some contacts may have been duplicated because a number of individuals use more than one of the apps and/or have more than one profile on the same app. For example, in our study we found that more than 50% of individuals used two or more of these apps. This means that our response rate could be underestimated because an individual with more than one profile would most likely only respond to our message once.

This intervention was limited in terms of time and location, in that we only conducted the intervention for 3 months in two sites in Barcelona. Moreover, our method excludes individuals who only connected to the apps during the weekend or at night,

making it impossible to extrapolate the results to all MSM users of these apps.

### CONCLUSION

This is the first study in Europe that specifically describes the use of apps for sexual encounters and sex-related behaviours, and that evaluates an app-based strategy for promoting sexual health. Endorsing health interventions using apps will be very useful for counteracting HIV and other STIs.

The high response rate, acceptance and effectiveness of our intervention make this strategy a useful tool for the prevention and for promoting rapid HIV and other STI tests in the MSM population. The intervention was successful at attracting individuals with a high number of sexual partners, low use of condom and use of drugs for sexual relations. We were also able to attract a high number of individuals who had never been or had tested in the previous year.

### Key messages

- ▶ Offering free and confidential rapid testing via apps is feasible, widely accepted and effective.
- ▶ Intervention through apps can help to reduce late HIV diagnosis in a high-risk population of men who have sex with men.
- ▶ Formal collaboration between app developers and public health organisation is needed.

**Correction notice** This paper has been amended since it was published Online First. The last author's surname has been corrected.

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**Contributors** MAG: conceptualisation, data curation, formal analysis, investigation, methodology, validation, writing the original draft. MFQ: conceptualisation, investigation, methodology, supervision, validation, review and editing. SMV: investigation, supervision, review and editing. CJ-A: conceptualisation, investigation, review and editing. EDD: supervision, review and editing. JAC: resources, supervision, review and editing. PGdO: conceptualisation, project administration, supervision, review and editing.

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