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HIV infection and factors associated with condom ordering via a social health mobile application
for men who have sex with men in a randomized control trial of Mobile Messaging for Men

By

Carol Davis
Master of Public Health

Epidemiology

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Patrick Sullivan, DVM, PhD, Dipl. ACVPM (Epi)
Committee Chair

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Carol Davis

B.S.
Massachusetts Institute of Technology
2015

Thesis Committee Chair: Patrick Sullivan, DVM, PhD, Dipl. ACVPM (Epi)

An abstract of
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Abstract

HIV infection and factors associated with condom ordering via a social health mobile
application for men who have sex with men in a randomized control trial of Mobile
Messaging for Men
By Carol Davis

HIV remains one of the United States' greatest public health burdens, disproportionately affecting gay and bisexual men who have sex with men (GBMSM). Condoms are a proven tool of HIV prevention and there is a paucity of literature addressing the determinants of which GBMSM in the United States order condoms from distribution platforms/distributors. Mobile apps have been proven as effective, acceptable, and usable public health prevention tools for addressing HIV prevention among GBMSM, including among the high impacted GBMSM populations in rural Southern United States. The Mobile Messaging for Men trial, from January 2018 to October 2019, tested the efficacy of a social-cognitive theory-based HIV prevention app among GBMSM that offered multiple features, including an ordering platform for free condoms and condom-compatible lubricant. This study evaluated the uptake of condom ordering among GBMSM in three US cities by applying the information, motivation, and behavioral skills (IMB) framework to identify factors associated with condom ordering. Our study revealed that when offered the opportunity to order free condoms via a mobile app, 37% of GBMSM ordered condoms at least once during a nine-month period. According to our model, the only significant associations of condom ordering in our cohort were with HIV status and testing history: men who were HIV negative and not recently tested were more likely to order condoms via the mobile app than men who were HIV positive (RR = 1.60, 95% CI: 1.16-2.19). Future work to better understand the connection between HIV testing and mobile app prevention services could be important to increasing the success of these innovative condom delivery services among men who may not be adequately accessing other prevention and clinical services.

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BACKGROUND

Despite recent advances in treatment and prevention, HIV remains one of the United States'

greatest public health burdens with an annual diagnosis rate of 11.1 per 100,000 adults and

approximately 1.06 million prevalent cases in 2019 [1]. HIV disproportionately affects gay,

bisexual and other men who have sex with men (GBMSM) [1, 2]. In 2019, male-to-male sexual

contact (MMSC) accounted for approximately 70% of new HIV diagnoses (66% attributed to

MMSC and 4% attributed to MMSC and injection drug use) [1]. Four strategic pillars have been

identified to help the United States meet its goal of ending the HIV epidemic by 2030 [3]. One of

these pillars, prevention, will rely on innovative partnerships as a key component of success [3]

and the uptake of proven prevention tools such as condom use [4].

As smart phone ownership becomes nearly ubiquitous [5], mobile apps and mobile health

technology have grown as innovative public health prevention tools with proven efficacy [6-13],

and acceptability and usability among men who have sex with men [14, 15]. Mobile apps have

also been proven acceptable and feasible as HIV prevention and treatment tools among heavily

impacted GBMSM populations in rural Southern United States [16]. One such app, the

HealthMindr app, is a social-cognitive theory-based HIV prevention app designed for GBMSM

of all serostatuses. Methods regarding app-specific development and a complete feature list of

the HealthMindr app have been published elsewhere [15, 17]. The mobile app relevant to this

study is M-Cubed, a HealthMindr variant that includes prevention messages and app-based

condom and condom-compatible lubricant ordering [17].

Condoms are a proven method for HIV prevention among the GBMSM community [4, 18] and a critical prevention tool to reduce sexual risks of HIV transmission and acquisition [4]. Despite their proven efficacy and broad availability, according to one survey, approximately 2/3 of men reported having condomless anal sex in the last 12 months [19]. Increasing condom use above current levels will be an important tactic in meeting United States HIV prevention goals [20, 21]. Free condom distribution is a strategy of making condoms available and thus increasing their use. One study found that 59% of GBMSM surveyed online had received free condoms, with some groups, such as younger, or more-educated men having higher acquisition. Additionally, after receipt of free condoms, 73% of GBMSM reported using them [22]. A pilot study of the HealthMindr app found that 64% of men ordered condoms and of those 87% reported using the ordered condoms [15]. However, this pilot study did not describe the characteristics of GBMSM who did or did not order or use study condoms.

The information, motivation, and behavioral skills (IMB) model provides a framework for identifying determinants of HIV-preventative behaviors by positing that those who are knowledgeable of risks, motivated toward prevention, and confident in their capacity to enact and benefit from prevention tools will be more likely to take preventive measures [23, 24]. Previous studies using the IMB model to understand drivers of behavior have established motivation and behavior as determinants of condom use amongst men and women in the United States [25, 26]. Specifically, having condoms in one's possession when they are needed is a determining factor of condom use in a sexual encounter [26], which is in line with previously reported results regarding use of free condoms [22]. These data suggest that condom distribution, such that GBMSM have condoms available when needed, is an important component of a

program to promote condom use and thus HIV prevention. In many disproportionately HIV-affected areas, such as the rural South [2], access to free condom distribution in clinics may be limited [27], so creative and more far-reaching means of condom distribution, such as remote ordering platforms, are needed.

Although there are limited studies addressing free condom uptake in the United States and procurement worldwide, there is a paucity of literature addressing the determinants of which GBMSM in the United States order condoms from distribution platforms/distributors. Our analysis aimed to evaluate the uptake of condom ordering among GBMSM in three US cities enrolled in a trial of the Mobile Messaging for Men (M-Cubed) app by applying the IMB framework to identify factors associated with condom ordering.

METHODS

Study Design

Data were collected from January 24, 2018, to October 31, 2019 as part of the Mobile Messaging for Men trial. The methods of this study have been published previously [17] and are summarized here. Participants were eligible for the trial if they were ≥18 years; assigned male sex at birth and currently identified as male; reported anal intercourse with a male partner in the past year; were current residents of the Atlanta, Detroit, or New York City metropolitan areas; owned and used an Android or iOS smartphone; were able to read and understand English without assistance; and met serostatus criteria. Eligible and consenting participants were randomized to either the intervention or waitlist control group within 18 strata based on serostatus, city, and race/ethnicity. Participants in the intervention arm received access to the M-

Cubed mobile app (based on the HealthMindr platform) for 9 months, whereas the waitlist

control group received the option to access the app for 3 months at the end of the 9-month

follow-up period [15]. The M-Cubed mobile app contains many features, including an ordering

platform for free delivery of at-home HIV and STI screening kits, condoms, and condom-

compatible lubricant.

All subjects were offered participation in baseline, 3, 6, and 9-month surveys. The baseline

behavioral survey collected information related to demographics; HIV and STI status and testing

history; condom use; PrEP use and adherence for HIV negative participants; ART use and

adherence for HIV positive participants; risk reduction perceptions, beliefs, and behaviors;

mobile phone and data usage; internet and information access; and psychosocial covariates. The

follow-up surveys addressed sexual risk behaviors and use of prevention services.

Measures

We analyzed data from participants randomized to receive the intervention arm, who had the

opportunity to order condoms from the app during the study. Data on condom ordering from the

mobile platform over the 9-month trial were available from administrative records for fulfillment

of condom orders; data were dichotomized by participant to create the outcome variable: never

ordered condoms during trial period vs. ordered condoms at least one time in trial period.

Three main effects of interest (indicators of the Information, Motivation, and Behavioral skills

[IMB] model) and potential covariates were identified based on literature review and are

presented in Table 1. In our application of the IMB model to our study question, information was

defined as having correct information about the transmission and prevention of HIV/AIDS [23, 24]. We identified perception of condom efficacy as a proxy for underline information because condoms are an established, effective form of HIV prevention [18]. Therefore, those with a high perception of condom efficacy were assumed to have a high level of information about HIV prevention. As applied to HIV prevention, motivation is defined as a desire or willingness to act on what a person knows about HIV prevention [23, 24]. We identified the baseline measure of intent to use condoms every time a subject has anal sex for the next 3 months as a proxy for being motivated to use condoms and therefor to obtain/order condoms. Behavioral skill is defined as having the capability to initiate preventive behaviors – for example, having the skills to communicate with a partner about condoms and to use condoms correctly [23, 24]. We identified participants' 3-month history of condomless anal sex as a proxy for behavioral skills; having recently used condoms suggests a subject has the capability to use condoms in the future. Figures 1-3 depict how the information, motivation, and behavioral skills variables are posited to influence condom ordering. Motivation and behavioral skills are hypothesized mediators of the effect of information on condom ordering (Figure 1). Information and behavioral skills are hypothesized mediators of the effect of motivation on condom ordering (Figure 2). These proxies (perception of condom efficacy, intent to use condoms, history of condom use) were the exposures of interest in our analysis. All other baseline sociodemographic and behavioral characteristics were considered as control variables.

Drug use was evaluated based on the Drug Use Disorders Identification Test (DUDIT). Based on previous literature, a threshold of 6 was used to identify hazardous drug use [28]. Alcohol use

was evaluated using the Alcohol Use Disorders Identification Test (AUDIT). A threshold of 8 was used to identify hazardous alcohol use [29].

Subjects evaluated their perception of condom efficacy at preventing HIV on a 0 to 100 scale, where 0 indicated a belief that condoms offered no protection and 100 indicated a belief that condoms offered complete protection. Estimated logit plots were used to evaluate the distribution of this perception and its association with condom ordering; after visual inspection of the logit plots, perception of condom efficacy was categorized into quintiles for modeling. Age at enrollment was also evaluated with estimated logit plots and based on visual inspection of the plots was included in the model as a continuous variable.

Counts and frequencies were used to describe baseline sociodemographic characteristics and measures of the IMB model, overall and stratified by condom ordering. Differences in characteristics by condom ordering were evaluated by chi-square (all categorical variables), and Mann Whitney U tests (age).

Data analysis

Log binomial regression was conducted to examine bivariate and multivariate associations between independent predictors and condom ordering. In the multivariate model (in which all covariates selected a priori, regardless of univariate results, and main effects of interest were considered together) no interaction effects between the three main exposures of interest were considered. Backwards selection was used to identify the most parsimonious explanatory model, with only those covariates that were significantly associated (p-value <0.05) being retained. The

three main effects of interest (perception of condom efficacy, intent to use condoms for the next 3 months, and 3-month history of condomless anal sex) were retained in the backwards selection model, regardless of significance level. Crude and adjusted risk ratios and 95% confidence intervals were reported. Based on the described conceptual models, we also planned a mediation analysis of variables of the IMB model (motivation and behavioral skills as mediator of information's effect on condom ordering [Figure 1], and information and behavioral skills as mediator of motivation's effect on condom ordering [Figure 2]).

All data cleaning and analysis was conducted using SAS 9.4.

RESULTS

Sample baseline characteristics

Of the 1226 GBMSM randomized to the Mobile Messaging for Men (M-cubed) trial, 611 (50%) were randomized to receive the mobile app intervention for nine months and comprised the analytic sample for this study. Over one third of men allocated to the M-cubed app intervention ordered condoms at least once during the nine-month trial period (Table 2). Among the 225 men who ordered condoms, most (n=204, 91%) only ordered condoms once in the nine-month period. Some men (n=17, 8%) ordered condoms twice in the nine-month period, 3 men (1%) ordered 3 times, and 1 man (0%) ordered condoms 4 times (data not shown in Table).

Baseline characteristics of participants, overall and by condom ordering status, are provided in Table 2. Among all participants assigned to the intervention arm, most were White and non-Hispanic, and over a quarter were Black. The average age of participants was 36 years and

participants were roughly equally recruited among Atlanta, Detroit, and New York City.

Approximately one quarter of participants reported 2-4 male sexual partners in the last three

months, and an annual income of less than or equal to $14,999. Over half of respondents

reported a 4-year college degree or graduate education at baseline. Approximately three quarters

of participants reported no history of exchanging things for sex and three-quarters were

employed or on active duty at baseline. Participants predominantly reported having only male

sexual partners, identified as gay or homosexual, and did not report any homelessness in the last

12 months. Most participants did not report hazardous drug or alcohol use at baseline.

As expected, given that the study was recruited to include a balance of men living with HIV,

men at high risk of HIV acquisition and men at low risk of HIV acquisition [17], there was a

roughly equal distribution of participants by HIV status and by 3-month HIV testing history. In

univariate analyses, the prevalence of ordering condoms was mostly consistent among

demographic, geographic and behavioral subgroups of participants. (Table 2). The proportions of

men ordering condoms differed significantly only for city and HIV status and 3-month testing

history (p<0.05, Table 2).

Indicators of the IMB model at baseline survey are also reported in Table 2. At baseline,

participants who ordered and who did not order condoms were roughly evenly distributed by

perceptions of condom efficacy and intent to use condoms for all anal sex over the next three

months. Most men had condomless anal sex in the previous three months to the baseline survey.

The proportions of men ordering condoms did not differ significantly amongst the different strata

of the information, motivation, or behavioral skills domain (p>0.05, Table 2).

Multivariable analysis of variables associated with condom ordering

Associations between potential confounders and indicators of the IMB model and condom ordering were analyzed (Table 3). After backwards selection, no covariates were retained as significant, and only the main exposures of interest (proxies for information, motivation, and behavioral skills) were retained. The full multivariable model containing all covariates was better fitting than the empiric model containing only the exposures of interest (AIC empiric = 798.89, AIC full = 772.77, data not shown). According to the multivariate model, condom ordering was associated with HIV status and three-month testing history. During the nine-month trial period, men who were HIV negative and had not tested in the last three months were more likely to order condoms than men who were HIV positive (Table 3).

There was no association for the indicators of information, motivation, or behavioral skills, except that in the empirical model ordering was higher among those men with the highest perception of condom efficacy (risk ratio for information score of 99-100 = 0.83 [0.59-0.97], compared to referent group information score of 0-80; data not shown in Table). Given this lack of association, we did not conduct the planned mediation analysis.

DISCUSSION

Condoms are a critical component of HIV prevention [18] and a critical resource for reducing the HIV epidemic in the United States [4]. Despite this, there is limited literature regarding which GBMSM use free condom distribution programs, and no reports to our knowledge of the frequency of ordering free condoms from app-based prevention tools. We evaluated condom ordering by demographics and domains of the information, motivation, and behavioral skills

model. Our study revealed that when offered the opportunity to order free condoms via a mobile app, 37% of GBMSM ordered condoms at least once during a nine-month period (Table 2). Condom ordering was associated with HIV status/3-month testing history and the highest perception of condom efficacy (Table 3). Although we have previously described uptake of condom ordering in a small pilot study of this app [15], to our knowledge this study is the first report of app-based condom ordering for GBMSM living with HIV and the first attempt at identifying factors associated with ordering condoms via a mobile app.

There are important public health programmatic implications to documenting that men will order condoms when provided the opportunity. Although fewer men (about 1/3 of men) ordered condoms in our study than in the pilot study, where 2/3 of men ordered condoms [15], the findings that a large proportion of men were willing to obtain condoms is important. Obtaining condoms has been shown to be associated with increased condom use [15, 22, 26]; getting condoms into the hands of GBMSM is programmatically important to HIV prevention. Distributing condoms through an app might also allow reach of this prevention commodity to GBMSM living in rural areas; rural GBMSM are less likely to access HIV testing and receive free condoms [27].

According to our model, the only significant associations of condom ordering in our cohort were with HIV status and testing history: men who were HIV negative and not recently tested were more likely to order condoms via the mobile app. We hypothesize that these GBMSM may not be receiving free condoms while at other HIV services, such as while getting tested at a clinic, and therefore providing other avenues for obtaining condoms is important to distributing

condoms to the HIV negative, non-testing population. Another hypothesis is that men who are obtaining (and perhaps using) condoms perceive themselves as lower risk for HIV transmission and therefore are less likely to get an HIV test. There may be implications for differentiated HIV service delivery by mobile app among communities that have a lower perception of risk or communities that do not have access to other services. Further studies that elucidate the value of mobile prevention apps for communities and men with limited access to prevention services will be important to the implementation of efficacious HIV prevention apps.

Limitations

There were several potential limitations in our study. First, our study had some selection bias towards more educated men, in that over 85% of subjects studied had more than a high-school education; in 2021, only 63% of US adults 25 and older have more than a high school education [30]. This selection bias may limit the external generalizability of our study. Our study exclusively recruited online, which also introduces selection bias in who may have enrolled in the study. Second, all variables that were self-reported during the baseline survey were subject to misclassification due to recall bias. Social desirability bias is a known issue regarding self-reported condom behaviors [31, 32]. We attempted to minimize this concern by conducting electronic surveys, which have been proven to reduce the risk of social desirability bias occurring [33]. Lastly, there is a threat to external generalizability of our results due to the enrollment quotas outlined in the trial protocol [17]. Our study recruited only from three urban areas, and therefore the results are not generalizable to GBMSM in rural settings, a disproportionately impacted group [16]; additional studies with the app platform are currently being undertaken. Additional studies to understand the applicability of mobile app condom

distribution platforms for GBMSM in rural settings will be beneficial to understanding the feasibility and uptake of these distribution platforms among this population.

Conclusions

Condom usage is a critical tool for HIV prevention [18], and increasing condom distribution will be necessary to slowing, and eventually ending, the HIV epidemic. We aimed to describe the use of app-based condom distribution among GBMSM. When provided the opportunity, men will order free condoms. We identified some subsets of men that are more likely to order condoms. Offering these options for condom ordering to HIV negative men who do not test regularly is an important service; these men might be limited on their ability or desire to access other clinical services and could benefit disproportionately from innovative service delivery options such as mobile apps. Future work to better understand the connection between HIV testing and mobile app prevention services could be important to increasing the success of such services.

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Figure 1. Information, motivation, and behavioral skills model for ordering condoms: behavioral skills and motivation as mediators of the effect of information on ordering
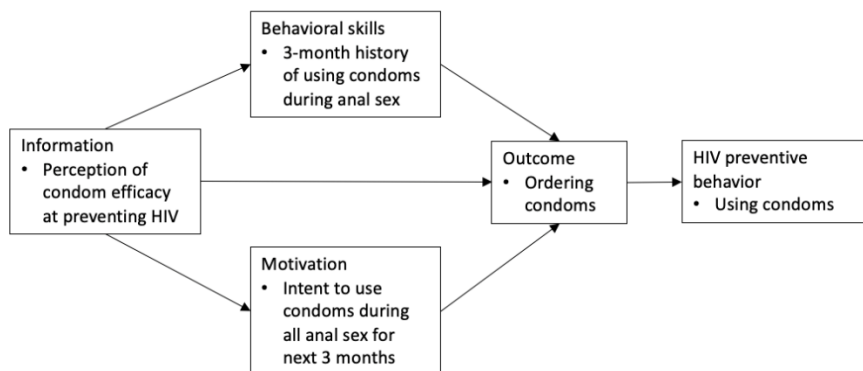

Figure 2. Information, motivation, and behavioral skills model for ordering condoms: behavioral skills and information as mediators of the effect of motivation on ordering
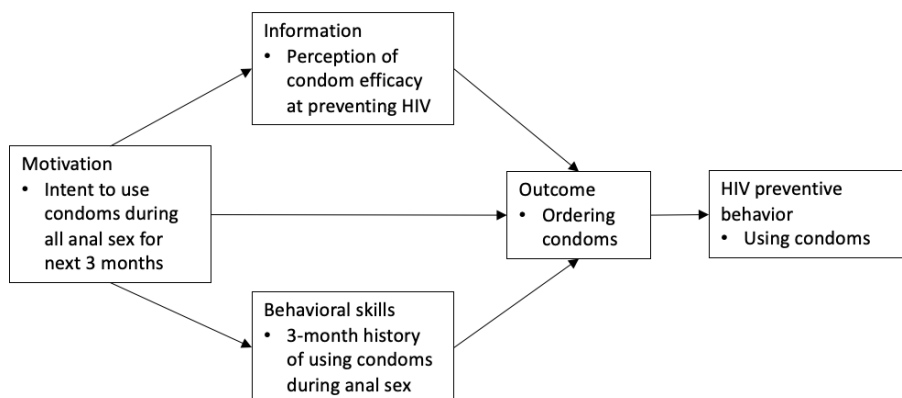

Figure 3. Information, motivation, and behavioral skills model for ordering condoms: effect of behavioral skills on ordering confounded by information and motivation
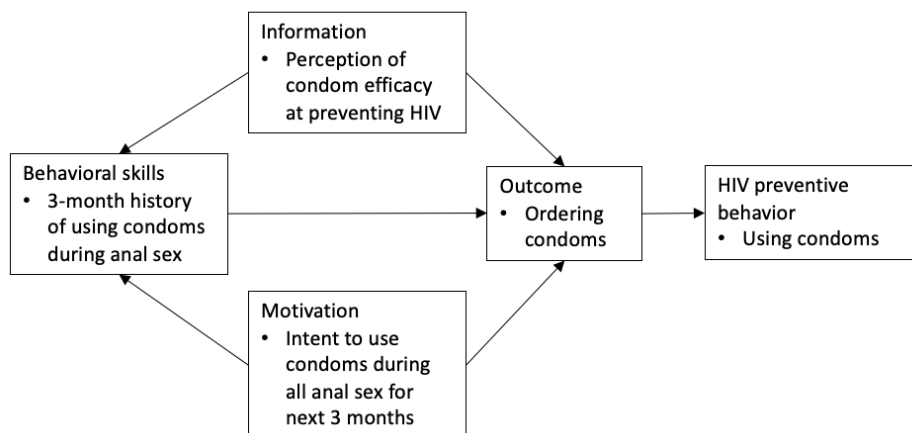
Table 1. Potential indicators of condom ordering by domain in a January 2018 – October 2019 study of an app-based HIV intervention for GBMSM[a] in Atlanta, New York City, and Detroit

Domain	Indicators[b]	Model inclusion
Demographics	Age	Modeled continuously
	Race/ethnicity	White, Black, Hispanic, Other
	Education	<= High school graduate/obtained GED, some post-high school education, 4-year college degree, any graduate education
	City/metropolitan area	Atlanta, Detroit, New York City
	Income	<=$14,999; $15,000-$39,999; $40,000-$74,999; >=$75,000
	Employment status	Employed (full/part-time)/active duty, unemployed, retired/other
	Sexual identity	Gay or homosexual, straight or heterosexual/bisexual/other
	Homelessness	Not homeless last 12 months; homeless last 12 months, not currently; homeless last 12 months, currently homeless
Behavioral characteristics	# Male sexual partners	0, 1, 2-4, 5+
	History of exchanging things for sex	Yes, No
	HIV status and 3-month testing history	HIV negative, not tested; HIV negative, tested; HIV positive
	History of hazardous drug use	Yes, No
	History of hazardous alcohol use	Yes, No
Information	Perceptions of condom efficacy	0-80, 81-91, 92-96, 97-98, 99-100
Motivation	Intent to use condoms, next 3 months	Definitely not likely, probably not likely, somewhat likely, probably likely, definitely likely
Behavioral skills	Had condomless anal sex, last 3 moths	Did not have sex; had sex, always used a condom; had sex, did not always use a condom

[a] GBMSM: Gay, bisexual and other men who have sex with men
[b] All indicators are based on self-reported values at baseline survey

Table 2. Distributions of baseline characteristics and indicators of IMB[a] model of GBMSM[a] in Atlanta, New York City and Detroit by condom ordering in the Mobile Messaging for Men intervention group (N=611), data collected January 2018-October 2019

Characteristic	Total n (%)	Never Ordered Condoms n (%)	Ordered >= 1 Time n (%)	p-value
Total Observations	611	386 (63)	225 (37)	
Sociodemographic and behavioral characteristics				
Age (in years) [mean (SD)]	36 (12)	37 (13)	35 (12)	0.06
Race/ethnicity				
White	256 (42)	153 (60)	103 (40)	0.48
Black	198 (32)	132 (67)	66 (33)	
Hispanic	86 (14)	56 (65)	30 (35)	
Other[b]	71 (12)	45 (63)	26 (37)	
Education level[c]				
<= High school graduate/obtained GED	86 (14)	60 (70)	26 (30)	0.42
Some post-high school education	192 (31)	114 (59)	78 (41)	
4-year college degree	187 (31)	119 (64)	68 (36)	
Any graduate education	145 (24)	92 (63)	53 (37)	
Gender of sexual partners				
No partners	34 (6)	20 (59)	14 (41)	0.85
Male partners only	543 (89)	345 (64)	198 (36)	
Male & female partners	34 (6)	21 (62)	13 (38)	
Number MSPs[d] last 3 months				
0	34 (6)	20 (59)	14 (41)	0.19
1	169 (28)	118 (70)	51 (30)	
2-4	230 (38)	137 (60)	93 (40)	
5 +	178 (29)	111 (62)	67 (38)	
City/metropolitan statistical area				
Atlanta	239 (39)	159 (67)	80 (33)	0.03
Detroit	166 (27)	91 (55)	75 (45)	
New York City	206 (34)	136 (66)	70 (34)	
Annual income[e]				
<= $14,999	146 (24)	100 (68)	46 (32)	0.52
$15,000 - $39,999	201 (33)	124 (62)	77 (38)	
$40,000 - $74,999	162 (27)	99 (61)	63 (39)	
>= $75,000	100 (16)	63 (63)	37 (37)	

Characteristic	Total n (%)	Never Ordered Condoms n (%)	Ordered >= 1 Time n (%)	p-value
Employment status[f]				
Employed (full-time, part-time)/active duty	444 (73)	276 (62)	168 (38)	0.66
Unemployed	116 (19)	76 (66)	40 (34)	
Retired/other[g]	49 (8)	33 (67)	16 (33)	
Sexual identity				
Gay or homosexual	523 (86)	324 (62)	199 (38)	0.13
Straight or heterosexual/bisexual/other[h]	88 (14)	62 (70)	26 (30)	
History of exchanging things for sex[i]				
No	466 (76)	289 (62)	177 (38)	0.27
Yes	143 (23)	96 (67)	47 (33)	
HIV status and testing history, last 3 months[j]				
HIV negative, not tested	204 (33)	110 (54)	94 (46)	0.0006
HIV negative, tested	200 (33)	130 (65)	70 (35)	
HIV positive	192 (31)	139 (72)	53 (28)	
Homelessness[k]				
Not homeless last 12 months	548 (90)	345 (63)	203 (37)	0.88
Homelessness last 12 months, not currently homeless	40 (7)	25 (63)	15 (37)	
Homelessness last 12 months, currently homeless	22 (4)	15 (68)	7 (32)	
Drug use				
No hazardous drug use	502 (82)	313 (62)	189 (38)	0.36
Hazardous drug use	109 (18)	73 (67)	36 (33)	
Alcohol use				
No hazardous alcohol use	466 (76)	301 (65)	165 (35)	0.19
Hazardous alcohol use	145 (24)	85 (59)	60 (41)	
Indicators of IMB(a) model				
Information: perceptions of condom efficacy[l]				
0-80	123 (20)	73 (59)	50 (41)	0.24
81-91	121 (20)	70 (58)	51 (42)	
92-96	118 (19)	73 (62)	45 (38)	
97-98	87 (14)	55 (63)	32 (37)	
99-100	157 (26)	110 (70)	47 (30)	

Characteristic	Total n (%)	Never Ordered Condoms n (%)	Ordered >= 1 Time n (%)	p-value
Motivation: intent to use[m]				
Definitely not likely	129 (21)	86 (67)	43 (33)	0.68
Probably not likely	115 (19)	68 (59)	47 (41)	
Somewhat likely	105 (17)	69 (66)	36 (34)	
Probably likely	104 (17)	65 (63)	39 (38)	
Definitely likely	148 (24)	89 (60)	59 (40)	
Behavioral skills: had condomless anal sex last 3 months[n]				
Did not have sex	34 (6)	20 (59)	14 (41)	0.75
Had sex, always used a condom	119 (20)	78 (66)	41 (34)	
Had sex, did not always use a condom	454 (74)	286 (63)	168 (37)	

[a]IMB: Information, motivation, behavioral skills; GBMSM: Gay, bisexual and other men who have sex with men

[b]Other includes subjects self-identifying as American Indian/Alaskan Native, Hawaiian/Pacific Islander, Asian, Other or Mixed Race, including with White and Black

[c]One subject who did not order condoms did not report any education information

[d]MSP: Male Sexual Partners

[e]2 subjects did not report any baseline income information, both subjects ordered condoms

[f]2 subjects did not report any baseline employment information, 1 of those ordered condoms, 1 of those did not order condoms

[g]Other includes Unemployed, Unable to work for health reasons, or Other

[h]Other includes the following self-identified subjects: 1 MSM, 1 Non-descriptive, 3 Pansexual, 7 Queer, 1 Sexual

[i]Exchanging includes giving or receiving things, like money, drugs, or a place to stay, in exchange for sex; 2 subjects did not report any history of exchanging things for sex, 1 of those ordered condoms, 1 of those did not order condoms

[j]9 subjects did not report HIV status and were included as missing. 6 HIV negative subjects reported an unknown testing history and so they were included as missing. Of these 15 subjects, 7 did not order condoms, 8 did order condoms

[k]One subject who did not order condoms did not report homelessness status

[l]Subjects evaluated perception of condom efficacy at preventing HIV on a scale of 0 to 100, where 0 = no protection, 100 = complete protection; 5 subjects did not respond to survey question, all of whom did not order condoms

[m]Defined as the intent to use condoms every time subject has anal sex in next 3 months; 1 subject who did not order condoms did not answer the survey question. 9 subjects who answered "Doesn't apply to me" were included as missing, of these 8 did not order condoms, 1 did order condoms.

[n]Four subjects did not answer survey question, 2 of those did not order condoms, 2 of those ordered condoms

Table 3. Characteristics and indicators of IMB[a] model associated with condom ordering among GBMSM[a] in Atlanta, New York City, and Detroit in the intervention group (N=611) of the Mobile Messaging for Men study, data collected January 2018-October 2019

	Bivariate Association[b]		Multivariable Association[c]	
	RR	95% CI	RR	95% CI
Sociodemographic and behavioral characteristics				
Age (years)[d]	0.91	0.83-0.99	0.92	0.83-1.02
Race/ethnicity				
White	Ref.		Ref.	
Black	0.83	0.65-1.06	1.00	0.74-1.34
Hispanic	0.87	0.62-1.20	0.86	0.60-1.23
Other[e]	0.91	0.65-1.28	0.95	0.67-1.35
Education level				
<= High school graduate/obtained GED	Ref.		Ref.	
Some post-high school education	1.34	0.93-1.93	1.21	0.84-1.76
4-year college degree	1.2	0.83-1.75	1.04	0.69-1.57
Any graduate education	1.21	0.82-1.78	1.06	0.68-1.65
Gender of sexual partners				
No partners	Ref.		Ref.	
Male partners only	0.89	0.58-1.34	0.66	0.39-1.11
Male & female partners	0.93	0.52-1.67	1	1.0-1.0
Number MSPs[f] last 3 months				
0	Ref.		Ref.	
1	0.73	0.46-1.16	0.68	0.50-0.93
2-4	0.98	0.64-1.51	1.13	0.88-1.45
5+	0.91	0.59-1.43	1.00	1.0-1.0
City/metropolitan statistical area				
Atlanta	Ref.		Ref.	
Detroit	1.35	1.06-1.72	1.12	0.86-1.45
New York City	1.02	0.78-1.32	0.96	0.73-1.26
Annual income				
<= $14,999	Ref.		Ref,	
$15,000 - $39,999	1.22	0.90-1.64	1.25	0.89-1.75
$40,000 - $74,999	1.23	0.91-1.68	1.23	0.85-1.79
>= $75,000	1.17	0.83-1.67	1.27	0.83-1.96
Employment status				
Employed (full-time, part-time)/active duty	Ref.		Ref.	
Unemployed	0.91	0.69-1.20	1.20	0.88-1.63
Retired/other[g]	0.86	0.57-1.31	0.99	0.63-1.54

	Bivariate Association[b]		Multivariable Model[c]	
	RR	95% CI	RR	95% CI
Sexual identity				
Gay or homosexual	Ref.		Ref.	
Straight or heterosexual/bisexual/other[h]	0.78	0.55-1.09	0.68	0.46-1.01
History of exchanging things for sex[i]				
No	Ref.		Ref.	
Yes	0.87	0.67-1.12	0.92	0.69-1.21
HIV status and testing history, last 3 months				
HIV positive	Ref.		Ref.	
HIV negative, tested	1.27	0.94-1.71	1.16	0.84-1.60
HIV negative, not tested	1.67	1.27-2.19	1.60	1.16-2.19
Homelessness				
Not homeless last 12 months	Ref.		Ref.	
Homelessness last 12 months, not currently homeless	1.01	0.67-1.53	1.08	0.72-1.61
Homelessness last 12 months, currently homeless	0.86	0.46-1.60	1.04	0.55-1.99
Drug use				
No hazardous drug use	Ref.		Ref.	
Hazardous drug use	0.88	0.66-1.17	0.89	0.65-1.23
Alcohol use				
No hazardous alcohol use	Ref.		Ref.	
Hazardous alcohol use	1.17	0.93-1.47	1.13	0.88-1.46
Indicators of IMB(a) model				
Information: perceptions of condom efficacy[j]				
0-80	Ref.		Ref.	
81-91	1.04	0.77-1.40	0.92	0.67-1.27
92-96	0.94	0.69-1.28	0.90	0.65-1.24
97-98	0.91	0.64-1.28	0.88	0.62-1.25
99-100	0.74	0.53-1.01	0.86	0.62-1.19
Motivation: intent to use[k]				
Definitely not likely	Ref.		Ref.	
Probably not likely	1.23	0.88-1.71	1.28	0.91-1.80
Somewhat likely	1.03	0.72-1.47	1.09	0.76-1.56
Probably likely	1.13	0.79-1.59	1.11	0.77-1.61
Definitely likely	1.20	0.87-1.64	1.37	0.94-2.01
Behavioral skills: had condomless anal sex last 3 months				
Did not have sex	Ref.		Ref.	
Had sex, always used a condom	0.84	0.52-1.34	1.31	0.64-2.65
Had sex, did not always use a condom	0.90	0.59-1.37	1.55	0.78-3.09

[a]IMB: Information, motivation, behavioral skills; GBMSM: Gay, bisexual and other men who have sex with men

[b]Evaluating each independent variable independently via log binomial regression, without other independent variables and without additional covariates

[c]Evaluating all independent variables and all potential covariates together via log binomial regression
[d]Reporting the risk ratio for a 10-year age difference
[e]Other includes subjects self-identifying as American Indian/Alaskan Native, Hawaiian/Pacific Islander, Asian, Other or Mixed Race, including with White and Black

[f]MSP: Male Sexual Partners

[g]Other includes unemployed, unable to work for health reasons, or other
[h]Other includes the following self-identified subjects: 1 MSM, 1 Non-descriptive, 3 Pansexual, 7 Queer, 1 Sexual

[i]Includes giving or receiving things, like money, drugs, or a place to stay, in exchange for sex

[j]Subjects evaluated perception of condom efficacy at preventing HIV on a scale of 0 to 100, where 0 = no protection and 100 = complete protection

[k]Defined as the intent to use condoms every time subject has anal sex in next 3 months