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Commercial lubricant use among HIV-negative men who have sex with men in Los Angeles: implications for the development of rectal microbicides for HIV prevention

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Abstract

To inform the development and assess potential use of rectal microbicide gels for HIV prevention among men who have sex with men (MSM), we examined the dynamics and contexts of commercial lubricant use during receptive anal intercourse (RAI) within this population. From 2007–2010, 168 HIV-negative MSM living in Los Angeles who practice RAI completed computer-assisted self-interviews, which collected information on their last sexual event with ≤3 recent partners, at baseline, 3 months, and 1 year study visits. Logistic generalized linear mixed models were used to identify individual- and sexual event-level characteristics associated with commercial lubricant use during RAI at the last sexual event within 421 partnerships reported by participants over the course of follow-up. During RAI at their last sexual event, 57% of

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partnerships used a condom and 69% used commercial lubricant. Among partnerships that used commercial lubricant, 56% reported lubricant application by both members of the partnership, 66% first applied lubricant during sex, but before penetration, and 98% applied lubricant at multiple locations. The relationship between substance use and commercial lubricant use varied by condom use (interaction p-value=0.01). Substance use was positively associated with commercial lubricant use within partnerships that used condoms during RAI at their last sexual event (adjusted odds ratio [AOR]=4.47, 95% confidence interval [CI]: 1.63–12.28), but no association was observed within partnerships that did not use condoms (AOR=0.66, 95% CI: 0.23–1.85). Commercial lubricant use during RAI was also positively associated with reporting more sexual partners (AOR=1.18, 95% CI: 1.05–1.31), while older age (units= 5 years) (AOR=0.75, 95% CI: 0.61–0.94), homelessness (past year) (AOR=0.32, 95% CI: 0.13–0.76), and having sex with an older (>10 years) partner (AOR=0.37, 95% CI: 0.14–0.95) were negatively associated with commercial lubricant use. These factors should be considered in the development of rectal microbicide gels to enhance their acceptability and use among MSM.

Keywords

commercial lubricant use; receptive anal intercourse; MSM; MSM partnerships; rectal microbicides; HIV prevention

Introduction

Men who have sex with men (MSM) remain disproportionately affected by HIV/AIDS in the United States (US) (Centers for Disease Control and Prevention, 2013). Although MSM practice a range of sexual behaviors (Rosenberger et al., 2011), one factor contributing to their disproportionate burden of HIV is the efficiency of transmission via anal intercourse (AI), particularly receptive anal intercourse (RAI) (Baggaley, White, & Boily, 2010; Grulich & Zablotska, 2010; Jin et al., 2010). Given the risk associated with AI and the widespread use of commercial lubricants among MSM to reduce friction and enhance sexual pleasure during AI (Carballo-Dieguez, O'Sullivan, et al., 2007; Carballo-Dieguez et al., 2000; Clark et al., 2013; Kinsler et al., 2010), topically applied rectal microbicides in the form of gels or lubricants are in development to prevent HIV infection (McGowan, 2014).

Findings from numerous studies and small Phase I trials suggest both placebo (Carballo-Dieguez et al., 2008; Carballo-Dieguez, Exner, et al., 2007; Pines et al., 2013) and anti-retroviral containing (Anton et al., 2012; McGowan et al., 2013; Ventuneac et al., 2010) rectal microbicide products are safe and acceptable. Phase II trials are now underway to assess the safety, acceptability, and pharmacodynamics of various rectal microbicide gel formulations (McGowan, 2014). To facilitate the uptake of effective rectal microbicide gels, previous studies have investigated the frequency of lubricant use, product preferences, and barriers to lubricant use among those who practice AI (Carballo-Dieguez, O'Sullivan, et al., 2007; Carballo-Dieguez et al., 2000; Javanbakht, Murphy, Gorbach, LeBlanc, & Pickett, 2010). However, additional data on the dynamics of commercial lubricant use at the sexual event-level among MSM are needed to inform the development of rectal microbicide gels acceptable for use during AI.

In a study conducted among MSM in Peru, commercial lubricant use at the last RAI event was associated with younger age, engaging in unprotected RAI, having sex with a main partner, and willingness to use rectal microbicides in the future (Kinsler et al., 2010). However, additional research is needed among MSM in the US on the relationship between commercial lubricant use and characteristics at both the individual- and sexual event-level, as many of these characteristics have previously been associated with HIV infection among MSM, including: young age, African-American race, low-income, substance use, having multiple sexual partners, having main partners, having older partners, and engaging in unprotected RAI with HIV serodiscordant partners (Bingham et al., 2003; Buchbinder et al., 2005; Hall et al., 2008; Koblin et al., 2006; Plankey et al., 2007; Prejean et al., 2011; Robertson et al., 2004; Sullivan, Salazar, Buchbinder, & Sanchez, 2009). Assuming that current commercial lubricant use will correlate with future use of rectal microbicide gels, such research will allow for a better understanding of potential rectal microbicide use patterns among those at greatest risk of HIV infection in the US.

To inform the development of acceptable rectal microbicide gels and assess their potential use among MSM in the US, we examined the dynamics of commercial lubricant use during RAI as well as individual- and sexual event-level characteristics associated with its use at the last sexual event within partnerships reported by a cohort of high-risk, racially/ethnically diverse, and mostly low-income HIV-negative MSM.

Methods

Study design

MSM (N=422) in Los Angeles who practice RAI were followed for one year as part of a longitudinal study (2007–2010) designed to examine barriers to rectal microbicide trial participation and identify the best format for the delivery of educational materials on rectal microbicides. Racially/ethnically diverse MSM were recruited via flyers and advertisements posted online and at three community-based service organizations: the University of California, Los Angeles Clinical AIDS Research and Education (UCLA CARE) Center, AIDS Project Los Angeles (APLA), and the Friends Community Center. Eligible individuals were ≥18 years-old, anatomically male, willing to test for sexually transmitted infections, including HIV, willing to provide informed consent, and self-reported RAI within the past year. By design, ~50% of participants were HIV-positive. Over 90% of HIV-positive participants were recruited at the UCLA CARE Center or APLA, which provide services to HIV-infected individuals, while 67% of HIV-negative participants were recruited at the Friends Community Center, which primarily serves low-income, substance-using MSM. All participants who reported being HIV-negative were tested for HIV using rapid tests and confirmatory Western Blots, while those who reported being HIV-positive either (1) had their HIV status confirmed via medical records maintained at the UCLA CARE Center or APLA or (2) were tested for HIV using rapid tests and confirmatory Western Blots.

Study procedures

During baseline, three months, and one year study visits, participants completed computer-assisted self-interviews (CASIs), which collected information on socio-demographics,

substance use, sexual behaviors, and commercial lubricant use. Participants were compensated up to $105 for completing all three visits. Study procedures were approved by the Human Subjects Protection Committees at UCLA, APLA, and the Friends Research Institute, Inc.

Measures

Individual-level characteristics—CASIs collected the following information at baseline: age, gender (male or transgender female), race/ethnicity, sexual identity, education, annual income, employment, homelessness (past year), and substance use (past six months). Global data on sexual activity and commercial lubricant use in the past month were also collected at each visit.

Sexual event-level characteristics—Sexual event-level characteristics refer to partner characteristics as well as behaviors practiced during the sexual event. At each visit, CASIs collected partner-specific data for ≤3 recent sexual partners (i.e., last partner [P1], second to last partner [P2], and third to last partner [P3]) and included a partner tracking system to identify partnerships continuing over time. Age, race/ethnicity, HIV status, and partner type (main vs. non-main) were collected for each reported partner.

For the last sexual event with each reported partner, participants reported whether they used any substances, whether they had RAI, and if they reported having RAI, whether condoms or commercial lubricant were used. Those who reported using commercial lubricants were asked about the following dynamics of use: the amount of lubricant used, where lubricant was applied, who applied the lubricant, when lubricant was applied, the frequency of lubricant application, and whether lubricant application interrupted sex.

Additional information was collected for P1 only on the following: whether the participant believed P1 ever had concurrent partners, whether drugs, money or other goods were ever exchanged for sex within the partnership, the duration of RAI at the last sexual event, the location of the last sexual event, and the level of intimacy within the partnership (measured using the Partnership Assessment Scale) (Gorbach & Holmes, 2008).

Statistical analysis

To identify individual- and sexual event-level characteristics associated with commercial lubricant use during RAI at the last sexual event within reported partnerships, we modeled commercial lubricant use using logistic generalized linear mixed models with individual random effects to account for the correlation between sexual events with different partners nested within the same individual. Although some partnerships were continuing over time, there was not enough information in the data to fit a model with partnership random effects. Therefore, we restricted our analysis to the first observation for continuing partnerships. We examined unadjusted and adjusted odds ratios (OR) and corresponding 95% confidence intervals (CI) for each of the individual- and sexual event-level characteristics of interest; however, we selected our final model based on *a priori* knowledge of factors associated with sexual risk behaviors and HIV seroconversion among MSM. Analyses considering sexual event-level characteristics collected for P1 only (listed above) were limited to the

partnerships for which they were collected. For consistency, adjusted effect estimates for these characteristics were only adjusted for sexual event-level characteristics collected for all reported partners. Finally, because differences between MSM who use commercial lubricants by condom use could have implications for rectal microbicide gel uptake among those at greatest risk, we examined whether the relationship between commercial lubricant use during RAI and any of the characteristics of interest differed by condom use through the inclusion of interaction terms in our model. Statistical analyses were conducted using SAS 9.2 (SAS Institute, Inc.; Cary, NC).

Sample selection

Given our goal to inform the development of rectal microbicide gels and assess their potential use for HIV prevention, we restricted our analysis to HIV-negative participants. Of the 210 HIV-negative participants, 209 reported partner-specific data for ≥1 recent sexual partner at ≥1 visit. Of those participants, 168 reported having RAI at their last sexual event with reported partners and whether commercial lubricant was used during RAI at those events. Thus, our sample consists of 168 HIV-negative MSM who reported on commercial lubricant use during RAI at their last sexual event with 421 non-continuing, recent sexual partners.

Results

Our sample was racially/ethnically diverse (39% White, 25% African-American, and 27% Hispanic), low-income (~50% reported an annual income <$9,800), and had a mean age of 35.5 years (SD=10.8) (Table 1). Substance use (past six months) was common with 57% of participants reporting any substance use (cocaine, methamphetamine, inhalants, sedatives, hallucinogens or opioids). Most participants (82%) reported recent RAI (past month), and of those 89% sometimes or always used commercial lubricant during RAI.

Of the 421 partnerships reported by participants during follow-up, 25% were with main partners and 66% were with partners within 10 years of age (Table 2). During RAI at their last sexual event, 57% of partnerships used condoms and 69% used commercial lubricant. Among partnerships that used commercial lubricant, both partners applied lubricant in 56% of partnerships, 66% first applied lubricant during sex, but before penetration, and 74% reapplied lubricant at least once (Table 3). Although participants reported commercial lubricant application interrupted sex in 52% of partnerships, it only bothered participants in 3% of those partnerships. Five percent of partnerships used 50mL of commercial lubricant, yet 98% applied lubricant at multiple locations: directly on the partner's penis=75%, around the participant's anus=96%, inside the participant's anus=74%, inside the condom=26%, and outside the condom=88%.

In adjusted analyses (Table 4; Model 1), commercial lubricant use during RAI was positively associated with condom use during RAI (adjusted OR [AOR]=4.94, 95% CI: 2.58–9.48) and having sex in the participant or their partner's home (AOR=2.70, 95% CI: 1.13–6.44). In our final adjusted analysis (Table 4; Model 2), commercial lubricant use during RAI was positively associated with reporting more sexual partners (AOR=1.18, 95% CI: 1.05–1.31), while older age (units= 5 years) (AOR=0.75, 95% CI: 0.61–0.94),

homelessness (past year) (AOR=0.32, 95% CI: 0.13–0.76), and having sex with an older (>10 years) partner (AOR=0.37, 95% CI 0.14–0.95) were negatively associated with commercial lubricant use. The relationship between substance use and commercial lubricant use varied by condom use (interaction p-value=0.01). Substance use was positively associated with commercial lubricant use within partnerships that used condoms during RAI at their last sexual event (AOR=4.47, 95% CI: 1.63–12.28), but no association was observed within partnerships that did not use condoms (AOR=0.66, 95% CI: 0.23–1.85).

Discussion

In this cohort of high-risk, racially/ethnically diverse, mostly low-income HIV-negative MSM in Los Angeles, 89% of participants used commercial lubricant during ≥1 RAI event in the past month and 69% of partnerships used commercial lubricant during RAI at their last sexual event. These findings are consistent with those from previous studies conducted among MSM in other US cities (Calabrese, Rosenberger, Schick, Novak, & Reece, 2013; Carballo-Dieguez, O'Sullivan, et al., 2007; Carballo-Dieguez et al., 2000). Within most partnerships, commercial lubricant was applied by both partners during RAI at their last sexual event, yet participants in <5% of partnerships reported commercial lubricant use was bothersome and interrupted sex despite reapplication in 74% of partnerships. These findings suggest commercial lubricant use during RAI is not only common among MSM, but may also be a highly acceptable practice.

However, several features of the dynamics of commercial lubricant use during RAI within our sample suggest the introduction of rectal microbicide gels into the sexual repertoire of MSM may not be as seamless as originally hypothesized. While the optimal timing and frequency of rectal microbicide application remains unknown, it will depend on the interaction of various host/behavioral, viral, and microbicide factors (Hendrix, Cao, & Fuchs, 2009). Thus, rectal microbicides may not confer protection against HIV infection immediately following application. However, given that 67% of partnerships first applied commercial lubricant after the initiation of sexual contact, application prior to any sexual contact may be less acceptable. Further, it has been estimated that ≥50mL of a rectal microbicide gel may need to be applied directly to the rectum to ensure sufficient protection (Carballo-Dieguez, Exner, et al., 2007). Yet, only 5% of partnerships used 50mL of commercial lubricant during RAI at their last sexual event and 98% applied commercial lubricant at multiple locations. Thus, while current commercial lubricant use practices should inform the development of rectal microbicide gels to enhance their acceptability among MSM, intensive counseling on the appropriate frequency, timing, and location of rectal microbicide application must accompany the delivery of rectal microbicides to maximize their effectiveness.

Several individual- and sexual event-level characteristics were associated with commercial lubricant use during RAI at the last sexual event within partnerships. Commercial lubricant use was associated with younger age and having more sexual partners, both of which are associated with HIV seroconversion among MSM (Hall et al., 2008; Koblin et al., 2006; Prejean et al., 2011). Thus, rectal microbicide gels may be highly acceptable among many high-risk MSM. However, having sex with older partners, which is also a risk factor for HIV

infection among MSM (Bingham et al., 2003), was inversely associated with commercial lubricant use. Although additional data are needed to understand the mechanism underlying this finding, age-specific campaigns may be needed to enhance the use of rectal microbicide gels among all high-risk MSM.

Fewer partnerships reported by participants who reported homelessness in the past year used commercial lubricant during RAI, which is of concern given the high HIV prevalence among homeless and low-income MSM in the US (Robertson et al., 2004). This finding may be explained by the cost associated with purchasing commercial lubricants. However, condoms and commercial lubricant are often distributed for free by community-based service organizations in Los Angeles, which many participants in our sample may have benefited from given the study's recruitment strategy. Thus, this finding may also speak to the non-portability of commercial lubricant or the lack of storage space for commercial lubricant among homeless MSM who may practice RAI in public spaces. This hypothesis is further supported by the observed association between commercial lubricant use and having sex in the participant or their partner's home. Therefore, the availability of low cost and easily portable rectal microbicides may influence their uptake among low-income, high-risk MSM.

In contrast to findings from studies conducted among MSM in Peru, which documented a bivariate association between unprotected RAI and commercial lubricant use (Clark et al., 2013; Kinsler et al., 2010), we observed a strong association between condom use and commercial lubricant use during RAI. These discrepant findings may be due to socio-cultural differences between the US and Peru, which could impact sexual practices among MSM. However, given that rectal microbicides may only confer partial protection against HIV infection, our findings are encouraging as condoms will need to be used along with rectal microbicides. While the use of even partially effective rectal microbicides could result in decreased condom use, it is also possible that if rectal microbicide gels are used as commercial lubricants are currently used among MSM, efforts to promote rectal microbicides could increase condom use.

Finally, substance use was associated with commercial lubricant use within partnerships that did not use condoms during RAI at their last sexual event. The two most commonly used substances at the last sexual event were methamphetamine and amyl nitrates, both of which reduce the sensation of pain during RAI (Drumright, Patterson, & Strathdee, 2006). In a qualitative study of motivations behind methamphetamine use among HIV-positive MSM, the decreased sensation of pain and enhanced sexual pleasure associated with methamphetamine use were reported as primary motivators of its use (Semple, Patterson, & Grant, 2002). If substance use in non-condom using partnerships within our sample was motivated by a desire for enhanced sexual pleasure, commercial lubricant may have been used within such partnerships to reduce friction during RAI and further enhance sexual pleasure. Because condom use has been associated with reduced sexual pleasure,(Carballo-Dieguez & Bauermeister, 2004) substance use within condom using partnerships may not have been motivated by a desire for increased sexual pleasure, and thus may not have had an effect on commercial lubricant use within those partnerships. While additional research is needed to explain the mechanism underlying the relationship between substance use and

commercial lubricant use in the absence of condom use, our findings suggest that rectal microbicide gels may be acceptable to substance-using MSM at greatest risk of HIV infection.

Our study has several limitations. First, our sample does not represent a random selection of RAI practicing MSM in Los Angeles as most participants were recruited from the Friends Community Center, which largely serves low-income, substance-using MSM. Additionally, our analysis is not based on a random sample of partnerships as partner-specific data were only collected for ≤3 recent partners at each visit. Moreover, we restricted our analysis to partnerships in which the participant reported having RAI at the last sexual event. Thus, while our findings may not be generalizable to all RAI practicing partnerships, our findings may be most applicable to partnerships among high-risk MSM in greatest need of new HIV prevention strategies. Second, due to the sensitive nature of information on sexual behaviors and substance use, participants may have under-reported such behaviors. However, given that CASIs were utilized to administer study questionnaires, such under-reporting was likely minimized relative to data collection via face-to-face interviews (Ghanem, Hutton, Zenilman, Zimba, & Erbelding, 2005; Turner et al., 1998). Finally, we cannot be certain of the accuracy of partner characteristics as partners were not directly interviewed as part of the study.

Despite these limitations, a major strength of our study is its focus on commercial lubricant use at the sexual event-level within RAI practicing partnerships reported by high-risk, racially/ethnically diverse MSM. Consistent with previous studies, our findings suggest commercial lubricants are widely used among MSM. However, in our study we were also able to examine the dynamics of commercial lubricant use and identify several features of commercial lubricant use that may serve as barriers to the uptake of rectal microbicide gels within this population. Thus, our findings can inform the development of acceptable rectal microbicide gels and campaigns to enhance their likelihood of use by those at greatest risk of HIV infection in the US.

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Table 1

Baseline characteristics of HIV-negative MSM who reported RAI at their last sexual event with recent sexual partners at ≥1 study visit and whether commercial lubricant was used during RAI at those events.

	(N=168)	
	n	%
Male	160	98.8
Race/Ethnicity		
White	63	38.9
African American	40	24.7
Hispanic	43	26.5
Other	16	9.9
Sexual identity		
Gay/homosexual	90	57.0
Bisexual	62	39.2
Straight/heterosexual	6	3.8
≥ High school education	141	87.0
Employment		
Full-time employment	34	21.1
Part-time employment	31	19.3
Unemployed	60	37.3
Other	36	22.4
Annual income < $9,800	74	47.1
Homeless (past year)	74	46.8
Substance use (past 6 months)[a]	85	57.4
Alcohol	112	77.8
Marijuana	78	53.4
Cocaine	57	39.0
Methamphetamine	53	35.3
Inhalants	12	8.3
Sedatives	38	26.0
Hallucinogens	20	13.8
Opioids	19	13.3
Any RAI (past month)	124	81.6
Frequency of lube use during RAI		
Always	63	52.9
Sometimes	43	36.1
Never	13	10.9
Types of commercial lubricant used during RAI		
Water-based (e.g., KY, Astroglide, Wet, etc.)	81	68.1
Silicon-based (e.g., Eros Bodyglide, ID Millennium, etc.)	31	26.1
Oil-based (e.g., Vaseline, Men's Cream, etc.)	31	26.1
Numbing (e.g., lubricant that reduces feeling in butt or penis)	5	4.2

	(N=168)	
	Mean	**SD**
Age (in years)	35.5	10.8
# male sexual partners (past month)	2.4	4.1

Note: Numbers may not sum to column total due to missing data; percents may not sum to 100 due to rounding or omission of one category for binary variables.

Abbreviations: RAI=receptive anal intercourse; SD=standard deviation.

[a]Excludes alcohol and marijuana.

Table 2

Individual-level and sexual event-level characteristics by commercial lubricant use during RAI at the last sexual event with recent sexual partners reported by HIV-negative MSM.

Characteristic	RAI at last sexual event with partner: No commercial lubricant used (N=132)		Commercial lubricant used (N=289)		Total (N=421)	
Individual-level	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Age (in years)	36.6	11.1	35.1	10.4	35.6	10.6
# male sexual partners (past month)	2.0	2.8	4.0	7.1	3.4	6.1
	n	**%**	**n**	**%**	**n**	**%**
White	41	32.5	132	46.5	173	42.2
≥ High school education	104	81.9	255	90.1	359	87.6
Annual income < $9,800	78	62.9	85	30.7	163	40.7
Homeless (past year)	68	55.3	87	31.1	155	38.5
Sexual event-level						
Collected for P1, P2 & P3						
Partner Type						
Main partner	44	35.5	60	20.8	104	25.2
Regular partner	12	9.7	30	10.4	42	10.2
Friend/acquaintance	36	29.0	98	34.0	134	32.5
One-time partner/unknown person	24	19.4	81	28.1	105	25.5
Trade partner	8	6.5	19	6.6	27	6.6
Age mixing						
Partner >10 years younger than participant	29	23.6	57	20.8	86	21.7
Participant and partner within 10 years of age	72	58.5	188	68.6	260	65.5
Partner >10 years older than participant	22	17.9	29	10.6	51	12.9
Partner's HIV status						
HIV-negative	70	56.5	171	59.8	241	58.8
HIV-positive	8	6.5	6	2.1	14	3.4
Unknown	46	37.1	109	38.1	155	37.8
Substance use at last sexual event[a]	50	39.1	105	36.8	155	37.5

Characteristic	RAI at last sexual event with partner: No commercial lubricant used		Commercial lubricant used		Total	
Marijuana	28	21.7	64	22.2	92	22.0
Methamphetamine	26	20.5	50	17.4	76	18.3
Ecstasy	6	4.7	6	2.1	12	2.9
Amyl Nitrates (poppers)	11	8.5	34	11.8	45	10.8
Cocaine	24	18.8	30	10.4	54	13.0
Ketamine	3	2.3	0	0.0	3	0.7
Gamma-hydroxybutyric acid	5	3.9	7	2.4	12	2.9
Heroin	9	7.0	3	1.0	12	2.9
Acid	5	3.9	0	0.0	5	1.2
Mushrooms	5	3.9	2	0.7	7	1.7
Oxycontin	4	3.2	1	0.4	5	1.2
Vicodin	6	4.7	2	0.7	8	1.9
Valium	4	3.1	1	0.4	5	1.2
Viagra	9	7.0	20	6.9	29	7.0
Condom used during RAI at last sexual event	44	35.5	191	66.8	235	57.3
Collected for P1 only	**(N=92)**		**(N=169)**		**(N=261)**	
Partner had concurrent partners[b]	50	56.2	83	50.6	133	52.6
Exchanged sex[c]	22	25.0	34	20.2	56	21.9
Last sexual event at home[d]	47	55.3	125	74.4	172	68.0
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**
Duration of RAI at last sexual event (in minutes)	14.8	16.5	19.3	17.5	17.7	17.3
Partnership assessment scale	14.0	8.2	13.8	8.5	13.9	8.4

Note: Numbers may not sum to column total due to missing data; percents may not sum to 100 due to rounding or omission of one category for binary variables.

Abbreviations: RAI=receptive anal intercourse; SD=standard deviation; P1=last sexual partner; P2=second to last sexual partner; P3=third to last sexual partner.

[a] Excludes marijuana.

[b] Participant believes partner ever had other partners concurrent to their partnership.

[c] The participant ever gave his partner drugs, money, or other good in exchange for sex or the partner ever gave the participant drugs, money, or other goods in exchange for sex.

[d] Participant or their partner's home.

Table 3

Dynamics of commercial lubricant use during RAI at the last sexual event with recent sexual partners reported by HIV-negative MSM (N=289).

	n	%
How much commercial lubricant was used?		
5mL or less (1 teaspoon)	60	26.0
About 10mL (2 teaspoons)	85	36.8
About 15mL (3 teaspoons)	50	21.7
About 30mL (6 teaspoons)	24	10.4
About 50mL (10 teaspoons)	12	5.2
Where was commercial lubricant applied?		
Directly on partner's penis	175	75.4
Around participant's anus	223	96.1
Inside participant's anus	171	73.7
Inside condom	47	26.1
Outside condom	157	88.2
Who applied commercial lubricant?		
Participant	44	19.1
Partner	57	24.7
Both	130	56.3
When was commercial lubricant first applied?		
Before any sexual contact	78	33.9
During sex, before penetration	151	65.7
During sex, after penetration	1	0.4
How many times was commercial lubricant reapplied?		
Never	60	26.0
Once	63	27.3
Twice	68	29.4
Three or more times	40	17.3
Did commercial lubricant use interrupt sex?		
It did not interrupt sex	110	48.5
It did interrupt sex, but it did not bother me	113	49.8
It did interrupt sex and it bothered me	4	1.8

Note: Numbers may not sum to column total due to missing data; percents may not sum to 100 due to rounding.

Abbreviations: RAI=receptive anal intercourse.

Table 4

Individual- and sexual event-level characteristics associated with commercial lubricant use during RAI at the last sexual event with recent sexual partners reported by HIV-negative MSM.

			Adjusted[a]			
	Unadjusted		Model 1[b]		Model 2[c]	
Characteristic	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
Individual-level						
Age (units=5 years)	0.90	0.79, 1.03	0.78	0.63, 0.96	0.75	0.61, 0.94
Race/Ethnicity						
White	Ref	-	Ref	-	Ref	-
African American	0.50	0.24, 1.04	0.52	0.20, 1.33	0.49	0.19, 1.29
Hispanic	0.72	0.35, 1.47	0.38	0.15, 0.93	0.32	0.13, 0.83
Other	0.84	0.30, 2.35	0.59	0.16, 2.18	0.66	0.17, 2.48
≥ High school education	1.60	0.70, 3.63	2.05	0.71, 5.94	1.65	0.55, 4.96
Gay identifying	2.41	1.32, 4.40	1.14	0.50, 2.63	1.08	0.46, 2.54
Homeless (past year)	0.34	0.19, 0.62	0.34	0.15, 0.78	0.32	0.13, 0.76
Annual income <$9,800[d]	0.27	0.15, 0.48	-	-	-	-
# male sexual partners (past month)	1.11	1.02, 1.20	1.16	1.04, 1.28	1.18	1.05, 1.31
Sexual event-level[e]						
Collected for P1, P2 & P3						
Main partner	0.58	0.34, 0.99	0.51	0.24, 1.08	0.56	0.26, 1.21
Age mixing						
Partner >10 years younger than participant	0.84	0.46, 1.52	0.92	0.39, 2.18	0.97	0.41, 2.31
Participant and partner within 10 years of age	Ref	-	Ref	-	Ref	-
Partner >10 years older than participant	0.64	0.32, 1.32	0.41	0.16, 1.02	0.37	0.14, 0.95
Serodiscordant partner[f]	0.92	0.57, 1.49	0.79	0.42, 1.50	0.74	0.39, 1.43
Substance use[g]	0.94	0.56, 1.55	1.85	0.87, 3.92	-	-
Condom used during RAI	3.47	2.10, 5.75	4.94	2.58, 9.48	-	-
Condom use by substance use[h]						
Condom used during RAI						

	Unadjusted		Adjusted[a] Model 1[b]		Adjusted[a] Model 2[c]	
Characteristic	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
Substance use[g]	-	-	-	-	0.66	0.23, 1.85
No condom used during RAI at last						
Substance use[g]	-	-	-	-	4.47	1.63, 12.28
Collected for P1 only						
Partner had concurrent partners[i]	0.81	0.46, 1.45	0.69	0.31, 1.57	-	-
Exchanged sex[j]	0.76	0.38, 1.51	1.25	0.43, 3.69	-	-
Last sexual event at home[k]	2.14	1.17, 3.93	2.70	1.13, 6.44	-	-
Duration of RAI at last sexual event (in minutes)	1.02	0.99, 1.04	1.02	0.99, 1.05	-	-
Partnership assessment scale[l]	1.00	0.97, 1.04	0.98	0.94, 1.04	-	-

Abbreviations: RAI=receptive anal intercourse; OR=odds ratio; CI=confidence interval; P1=last sexual partner; P2=second to last sexual partner; P3=third to last sexual partner.

[a] Adjusted for visit, age, race/ethnicity, sexual identity, homelessness, # males sexual partners, partner type, age mixing, partnership serostatus, substance use, & condom use during RAI.

[b] Model 1 - no interaction between condom use and substance use at last sexual event with partner.

[c] Model 2 - interaction between condom use and substance use at last sexual event with partner.

[d] Highly correlated with homelessness and thus excluded from the adjusted model.

[e] Measured at the last sexual event within reported partnerships.

[f] HIV-positive and HIV status unknown partners were defined as serodiscordant.

[g] Substances include: methamphetamine, ecstasy, amyl nitrates, cocaine, ketamine, gamma-hydroxybutyric acid, heroin, acid, mushrooms, oxycontin, vicodin, valium, or viagra.

[h] Condom use by substance use interaction term = 0.01 (model 2).

[i] Participant believes partner ever had partners concurrent to their partnership.

[j] The participant ever gave his partner drugs, money, or other good in exchange for sex or the partner ever gave the participant drugs, money, or other goods in exchange for sex.

[k] Participant or their partner's home.

[l] Highly correlated with partner type, therefore the adjusted OR is not adjusted for partner type.