

## ORIGINAL ARTICLE

# Sex on demand: geosocial networking phone apps and risk of sexually transmitted infections among a cross-sectional sample of men who have sex with men in Los Angeles county

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## ABSTRACT

**Background** Geosocial networking applications (GSN apps) used for meeting sexual partners have become increasingly popular with men who have sex with men (MSM) since 2009. The current study aimed to determine if self-identified HIV-negative, MSM clinic attendees who used GSN apps have an increased incidence of sexually transmitted infections (STI) compared to self-identified HIV-negative, MSM attendees who met sexual partners via in-person venues, such as bars or clubs or through MSM-specific hook-up websites.

**Methods** Data were collected between August 2011 and January 2013 on all self-identified HIV-negative, MSM clients visiting the L.A. Gay & Lesbian Center for STI screening. A total of 7184 individuals tested for STIs and self-reported behaviours on drug use and social networking methods to meet sexual partners. Multivariate logistic regression models were used to analyse the results.

**Results** Individuals who used GSN apps for meeting sexual partners had greater odds of testing positive for gonorrhoea (OR: 1.23; 95% CI 1.04 to 1.46) and for chlamydia (OR: 1.35; 95% CI 1.12 to 1.62) compared to individuals who met partners through in-person methods only. There were no significant differences in syphilis and HIV incidence between those who met partners via in-person venues only, on the internet or through GSN apps.

**Conclusions** The present study concludes that sexual health clinic MSM attendees who are meeting on GSN apps are at greater risk for gonorrhoea and chlamydia than MSM attendees who meet in-person or on the internet. Future interventions should explore the use of these novel technologies for testing promotion, prevention and education.

## INTRODUCTION

Social networking methods have changed considerably for men who have sex with men (MSM) seeking anonymous sexual partners since the HIV epidemic began in the early 1980s. At the start of the epidemic, many MSM visited locations such as public restrooms, cruising areas, adult book stores and bathhouses, or used personal advertisements, to meet anonymous sex partners.<sup>1</sup>

As personal computing hardware and social networking software developed in the 1990s, methods for meeting anonymous partners slowly shifted

from interactions at physical locations to interactions over the internet. By the late 1990s, MSM were increasingly using internet sites such as *Gay.com* and *Craigslist* to network with potential sex partners.<sup>2-3</sup> Sites including *Manhunt*, *Dudesnude* and *Adam4Adam* were developed in the early 2000s to cater specifically to those who wanted to use the internet as a medium for meeting sexual partners.

Since 2001, various studies have found that MSM who used the internet to locate sexual partners, compared to those who did not, had a greater odds (OR 1.68) of engaging in unprotected anal intercourse (UAI),<sup>4</sup> a 3.4 higher odds of having anonymous sex,<sup>5</sup> and a higher average number of partners in the past 6 months (9.8 vs 5).<sup>6</sup> Reporting on this pattern of a greater likelihood of UAI with online partners compared to offline partners has continued with the more recent 2009 publication of the work of Rosser *et al.*<sup>7</sup> Furthermore, these researchers reported that Latino MSM had UAI with almost twice as many men first met online compared to offline.<sup>8</sup> The authors cogently opine that 'efficiency appears to be the primary risk associated with meeting partners online'.

From 2009 to 2013, geosocial networking applications (GSN apps) including *Grindr*, *Scruff* and *Recon* have been used increasingly among the MSM community to meet anonymous partners. *Grindr* was the first of these GSN apps, allowing registered users to use their smart phone's global positioning system (GPS) to locate and network with other users who are physically nearby. In 2013, *Grindr* reported that it had six million users in 192 different countries around the world with 2.5 million users added in 2012.<sup>9</sup>

Despite the popularity of this emerging social networking method, there is little published research on the sexual behaviours or the risk of sexually transmitted infections (STI) of users of these GSN apps. Burrell *et al* compared the demographics of 105 study participants recruited through *Grindr* with those recruited through traditional media.<sup>10</sup> *Grindr* study participants were younger ( $p < 0.0001$ ), more likely to identify as Caucasian ( $p < 0.01$ ), and reported a greater number of sexual partners in the past 2 weeks ( $p < 0.05$ ) compared to individuals recruited through emails or phone calls.

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Beyond the demographic profiles of users, the literature is unclear as to the amount of risk-taking behaviour and associated sexual morbidity among users of these GSN apps. Using the geolocation feature within Grindr, Rice *et al* randomly recruited 195 young MSM, based on their location in either West Hollywood or Long Beach, CA, to participate in a behavioural survey. Of the individuals electing to participate, only 14.7% reported UAI with their last partner met on Grindr.<sup>11</sup> In a study conducted between October 2010 and March 2011, Landovitz *et al* deployed research teams to gay nightclubs and venues throughout Los Angeles, and recruited participants by sending standardised messages to nearby Grindr users via the app's geolocation feature; 46% of respondents reported at least one instance of UAI in the past 3 months among this sample.<sup>12</sup> Furthermore, Rendina *et al* recruited New York City users through banner advertisements in the apps and found that a greater proportion of Grindr users had never tested for HIV when compared to a population-based sample of MSM in New York City.<sup>13</sup> To the best of our knowledge, no previous studies have analysed the association between use/non-use of these GSN apps and STI and HIV outcomes.

The primary aim of the current study is to determine whether self-identified HIV-negative, MSM clinic attendees who use GSN apps have greater STI and HIV incidence compared to self-identified HIV-negative, MSM clinic attendees who meet sexual partners in person or via internet social networking methods. Specifically, we hypothesise that the flexibility of GSN apps makes meeting partners quicker and easier, which in turn, leads to increased anonymous sex and higher incidence of STIs and HIV, compared with meeting potential sexual partners through the internet or in-person social networking methods.

## MATERIALS AND METHODS

### Data collection

Data were collected electronically in face-to-face interviews (behavioural risk assessments) by STI/HIV testing counsellors for an 18-month period from August 2011 to January 2013, and included all MSM who presented to either the Los Angeles or West Hollywood locations of the L.A. Gay & Lesbian Center (LAGLC) for screening and/or treatment of STIs, and who identified their serostatus as HIV negative prior to testing. An MSM was defined as an individual who had a biological sex and current gender identity of male and, either (1) identified as gay or bisexual or (2) had sex with another man in the past year. MSM with a self-reported HIV+ serostatus were excluded from the analysis since previous studies have documented changes in risk behaviours following seroconversion.<sup>14 15</sup> Data were analysed for the first visit only among MSM who received services multiple times during the study period. A total of 7184 visits from unique individuals met the inclusion criteria for the analysis.

STI/HIV testing counsellors conducted the behavioural risk assessments for all clients who received testing or treatment services at the LAGLC during the study period. Included on the assessment were questions about demographics, drug use, recent sexual behaviour and social networking methods used to meet sexual partners.

Demographic variables included age group, race/ethnicity, and education level. Individuals who identified multiple races or ethnicities were classified as 'Other'. Since drug use has been reported to be associated with STI incidence, clients were also asked about their use of four drugs: ecstasy, methamphetamine (meth), inhaled nitrates and cocaine in the past 12 months.

Clients were asked about the types of social networking used to meet sexual partners. These social networking methods

ranged from in-person venues, such as bars and circuit parties, to websites, such as *Manhunt.com* and *AdamforAdam.com* to GSN apps, such as *Scruff* and *Grindr*. Based on their responses to these questions, there were seven possible combinations of in-person, internet and app social networking methods used to meet sexual partners. These categories were then condensed into three social networking strata: (1) MSM who exclusively networked in-person to meet sexual partners; (2) MSM who networked with sexual partners via the internet only or the internet and in-person and (3) MSM who reported at least one GSN app, regardless of whether they also networked in-person or through internet sites to meet sexual partners.

Following this behavioural assessment, MSM clients were instructed to self-collect urine and rectal samples for *Neisseria gonorrhoea* (NG) and *Chlamydia trachomatis* (CT). A lab technician subsequently collected a throat swab to test for pharyngeal NG and drew blood to test for syphilis using RPR (rapid plasma reagin), and for HIV using an OraQuick Rapid Antibody Test (OraSure Technologies). Sufficient blood was saved for pooled nucleic acid amplification testing (NAAT) for those specimens with negative HIV antibody results.

Following specimen collection, clients who reported STI symptoms were treated presumptively and then advised to return in 3 months for routine testing. Clients who were asymptomatic at intake but tested positive for NG, CT or syphilis were contacted via phone for treatment follow-up. Clients testing positive for HIV via the NAAT HIV test were contacted by a dedicated linkage to care specialist who scheduled a disclosure appointment and assisted the client in either initiating HIV care with the LAGLC or another HIV care provider.

This study was approved by the University of California, Los Angeles South General Institutional Review Board #5 (IRB00004474; Project No. 13-000604). Due to the retrospective design, a waiver of consent was requested and approved by the IRB.

### Statistical analyses

$\chi^2$  Tests were used to assess interdependence of social networking method and demographic variables (age group, race/ethnicity, and education level) and illicit drug use variables (meth, nitrates, ecstasy and cocaine). Predictors were then inserted into a multinomial logistic regression to model social networking method as a function of demographics and drug use.  $\chi^2$  Tests were also used to assess interdependence of social networking methods and STI results.

Univariate logistic regressions were used to model positivity for (1) NG, (2) CT, (3) syphilis and (4) HIV as a function of each demographic and drug use variable. Three multivariable logistic regression models were then fitted to each STI outcome: an initial model had all demographic variables as predictors; the second model had all demographics and, additionally, the four drug use variables, and the third model had demographics, all drug use variables and the three-level social networking variable as predictors. All analyses were performed using SAS V.9.3 (Cary, North Carolina, USA).

## RESULTS

Of 7184 unique individuals included in the analysis, 34% met sex partners through in-person social networking only, 30% met partners using the internet only or in combination with in-person social networking, and 36% met partners using GSN apps only or in combination with the other methods (table 1). Bivariate analyses showed that individuals who were under the age of 40 years, identified as Caucasian, Asian or other, or were

**Table 1** Frequency distribution of means of meeting sexual partners for clients at the L.A. Gay & Lesbian Center, August 2011—January 2013 (n=7184)

Means of meeting sex partners	n	%	Social network classification
In person* only	2423	33.7	In person (33.7%; n=2423)
Internet† only	1594	22.2	Internet and in person (30.2%; n=2172)
In person and internet	578	8.0	
GSN phone apps‡ only	1222	17.0	Any GSN App (36%; n=2589)
In person and phone app	583	8.1	
Internet and phone app	502	7.0	
In person, internet and phone app	282	3.9	
Total	7184	100.0	

\*In-person communication modes include bar/club; street; private sex party; bathhouse; gym; circuit parties.

†Internet communication modes include Manhunt; Adam4Adam; Craigslist; Bareback; DudesNude; Other Internet Site.

‡Phone app communication modes include Grindr; Scruff; Jack'd; Recon; other phone application.

college graduates or above, used app social networking methods to meet sexual partners in greater proportions than individuals who were 40 years or over, identified as African-American or Hispanic, or were not college graduates (table 2). Furthermore, bivariate tests showed that app users reported ecstasy and cocaine use in greater proportions in comparison with those who met through in-person or internet social networking methods. Bivariate tests showed that individuals who used app social networking methods also had a greater proportion of NG and CT infections when compared with MSM who used in-person and internet social networking methods to meet sexual partners. However, individuals who used app social networking methods had a lower proportion of HIV when compared with the other social networking methods.

In multivariate models, controlling for demographics and drug predictors (table 3), individuals who used GSN apps to meet sexual partners had greater odds of testing positive for NG compared with individuals who used in-person social networking only (adjusted OR (AOR): 1.25; 95% CI 1.06 to 1.48) and individuals who used internet or in-person social networking (AOR: 1.42; 95% CI 1.19 to 1.70); the difference between individuals using internet social networks and in-person only social networks was not significantly different ( $p=0.19$ ). MSM in age categories under 30 years had substantially greater odds of NG compared with individuals in categories 30 years or over. MSM who used meth in the past year also had greater odds of NG over non-users (AOR: 1.84; 95% CI 1.45 to 2.34).

Individuals who used GSN apps to meet sexual partners had greater odds of testing positive for CT compared with individuals who only used in-person social networking methods in multivariate models (AOR: 1.37; 95% CI 1.13 to 1.65). The AOR comparing individuals who used app networks and in person networks was not significant ( $p=0.05$ ). Younger MSM generally had greater odds of testing positive for CT compared with older MSM, with exceptions for neighbouring age groups. MSM who used meth ( $p=0.0004$ ) and/or cocaine ( $p=0.03$ ) in the past year had greater odds of chlamydia infection. Social networking method was not a significant predictor of either syphilis or HIV prevalence in multivariate analyses.

## DISCUSSION

The present study hypothesised that the efficiency of GSN apps tends to skew the user population toward riskier encounters with a higher than average prevalence of STIs. The study found that self-identified HIV-negative, MSM clinic attendees who met sexual partners via GSN phone apps have a greater incidence of gonorrhoea and chlamydia, when compared with self-identified HIV-negative, MSM clinic attendees who used in-person or internet networking methods to meet sexual partners in Los Angeles County, California. This study did not find a relationship between social networking method and prevalence of HIV or syphilis.

Our study has numerous limitations. Although *Grindr*, *Scruff*, *Jack'd* and *Recon* do not have website equivalents, the popular MSM sexual meet-up websites of *Adam4Adam* and *Manhunt* developed app equivalents which were not explicitly asked about in the behavioural assessment process. Therefore, we may have underestimated the number of users of these GSN apps, but an option for 'Other App' on the behavioural assessment was meant to capture apps outside of the aforementioned four GSN apps. Additionally, the data were obtained from an organisation whose primary mission is to test and treat STIs, and there may be a substantial selection bias towards MSM with risky sexual experiences because those experiences may have prompted initiation of screening services.<sup>16</sup> However, the CDC recommends that MSM with multiple partners test quarterly, and initiation of screening may have been due to this recommendation instead of a risky event.<sup>17</sup> This study is not generalisable to MSM inside Los Angeles County, but it may be generalisable to MSM who test for STIs at other LGBT-identified clinics in Los Angeles County. More specifically, MSM who do not attend LGBT clinics may exhibit different sexual risk patterns than MSM who do attend these clinics.

Although Los Angeles County has many areas that identify as gay-friendly, the use of these GSN phone apps may well differ in suburban or rural areas that do not have gay-centred venues, thus eliminating in-person networking as an easy way to meet sexual partners, and may present possibly lower levels of risk in areas that have heightened degrees of homophobia. Lack of association between social networking method and HIV/syphilis may be explained by the relatively low number of syphilis and HIV infections during the observation period, as well as the cross-sectional nature of the study, but there may be other explanations.

Future studies should focus on the potential relationships between long-term or relatively consistent use of these GSN apps and HIV/syphilis incidence. Forthcoming public health efforts may also engage GSN app developers on increasing and emphasising partner notification when advertising their services. As of this writing, the GSN app *Mister* has engaged in a promotional campaign with a testing app called *HULA* which allows users to upload their results and share these results with potential partners.<sup>18</sup> This collaboration may lead to safer sexual encounters among MSM who use GSN apps for anonymous sex-seeking behaviour. Given that mobile technologies allow for a variety of functions beyond locating anonymous sexual partners, the feasibility and effectiveness of various culturally competent, electronic applications that emphasise wellness through testing promotion, prevention and education should be explored.<sup>19</sup> Technological advances which improve the efficiency of meeting anonymous sexual partners may have the unintended effect of creating networks of individuals where users may be more likely to have sexually transmissible infections than other, relatively less efficient social networking methods.

**Table 2**  $\chi^2$  tests for demographics, drugs, and STIs by means of meeting sexual partners, August 2011—January 2013 (n=7184)

Demographic category	n				%		
	Total	In person only	Internet and In person	Any GSN app	In person only	Internet and in person	Any GSN app
Age group	p<0.0001						
<20	153	35	50	68	1.4	2.3	2.6
20–24	1201	366	315	520	15.1	14.5	20.1
25–29	1756	608	449	699	25.1	20.7	27.0
30–39	2211	727	624	860	30.0	28.7	33.2
40–49	1321	460	495	366	19.0	22.8	14.1
50+	542	227	239	76	9.4	11.0	2.9
Race/ethnicity	p<0.0001						
Caucasian	3564	1073	1125	1366	44.3	51.8	52.8
Black/African–American	478	206	141	131	8.5	6.5	5.1
Hispanic	2248	899	626	723	37.1	28.8	27.9
Asian/PI	675	180	219	276	7.4	10.1	10.7
Other	215	63	60	92	2.6	2.8	3.6
Refused/declined	4	2	1	1	0.1	0.0	0.0
Education	p<0.0001						
8th grade or below	80	50	12	18	2.1	0.6	0.7
Some high school	112	57	29	26	2.4	1.3	1.0
High school graduate/GED	848	351	254	243	14.5	11.7	9.4
Some college	1874	636	560	678	26.2	25.8	26.2
College graduate	3552	1140	1060	1352	47.0	48.8	52.2
Post-graduate study/degree	718	189	257	272	7.8	11.8	10.5
Ecstasy use	p=0.0002						
Yes	657	216	161	280	8.9	7.4	10.8
No	6524	2206	2010	2308	91.0	92.5	89.1
Refused/declined	3	1	1	1	0.0	0.0	0.0
Meth use	p<0.0001						
Yes	525	139	226	160	5.7	10.4	6.2
No	6653	2282	1944	2427	94.2	89.5	93.7
Refused/declined	6	2	2	2	0.1	0.1	0.1
Nitrate use	p<0.0001						
Yes	1289	327	420	542	13.5	19.3	20.9
No	5892	2096	1751	2045	86.5	80.6	79.0
Refused/declined	3	0	1	2	0.0	0.0	0.1
Cocaine use	p<0.0001						
Yes	855	302	177	376	12.5	8.1	14.5
No	6326	2120	1995	2211	87.5	91.9	85.4
Refused/declined	3	1	0	2	0.0	0.0	0.1
Gonorrhoea infection	p<0.0001						
Yes	922	290	232	400	12.0	10.7	15.4
No	5445	1822	1677	1946	75.2	77.2	75.2
Refused/declined	817	311	263	243	12.8	12.1	9.4
Chlamydia infection	p=0.001						
Yes	783	224	227	332	9.2	10.5	12.8
No	5563	1879	1679	2005	77.5	77.3	77.4
Refused/declined	838	320	266	252	13.2	12.2	9.7
Syphilis infection	p=0.24						
Yes	95	28	36	31	1.2	1.7	1.2
No	6198	2057	1852	2289	84.9	85.3	88.4
Refused/declined	891	338	284	269	13.9	13.1	10.4
HIV infection	p=0.04						
Yes	171	69	54	48	2.8	2.5	1.9
No	6413	2119	1932	2362	87.5	89.0	91.2
Refused/declined	600	235	186	179	9.7	8.6	6.9
Total	7184	2423	2172	2589	100.0	100.0	100.0



**Table 3** Multivariate logistic regression results of STIs regressed on means of meeting sexual partners controlling for demographics and drugs, August 2011—January 2013

Predictor	Gonorrhoea (n=6356)		Chlamydia (n=6335)		Syphilis (n=6282)		HIV (n=6569)	
	p Value	OR (95% CI)	p Value	OR (95% CI)	p Value	OR (95% CI)	p Value	OR (95% CI)
Age group (REF=30–39)		p<0.0001		p=0.007		p=0.08		p=0.17
<20	0.0015	2.00 (1.31 to 3.08)	0.002	1.98 (1.28 to 3.07)	0.79	0.82 (0.19 to 3.59)	0.73	0.87 (0.38 to 1.99)
20–24	<0.0001	1.53 (1.24 to 1.89)	0.04	1.27 (1.01 to 1.59)	0.83	0.93 (0.50 to 1.76)	0.02	0.57 (0.35 to 0.92)
25–29	0.0005	1.40 (1.16 to 1.69)	0.16	1.16 (0.94 to 1.42)	0.11	0.59 (0.31 to 1.12)	0.19	0.76 (0.51 to 1.15)
40–49	0.04	0.78 (0.61 to 0.99)	0.33	0.89 (0.70 to 1.13)	0.23	1.41 (0.80 to 2.47)	0.35	0.80 (0.50 to 1.28)
50+	0.40	0.86 (0.61 to 1.22)	0.91	1.02 (0.72 to 1.44)	0.07	1.96 (0.94 to 4.10)	0.06	0.41 (0.16 to 1.05)
Ethnicity (REF=Caucasian)		p=0.1		p=0.73		p=0.1		p=0.0001
Asian/PI	0.04	0.74 (0.56 to 0.98)	0.32	1.15 (0.88 to 1.50)	0.70	0.83 (0.32 to 2.14)	0.03	1.84 (1.06 to 3.20)
Black	0.36	1.14 (0.86 to 1.52)	0.74	1.05 (0.77 to 1.45)	0.31	1.54 (0.67 to 3.56)	<0.0001	3.22 (1.95 to 5.31)
Hispanic	0.35	1.08 (0.92 to 1.28)	0.42	1.08 (0.90 to 1.30)	0.02	1.80 (1.10 to 2.95)	0.13	1.35 (0.91 to 1.99)
Other	0.47	1.15 (0.78 to 1.70)	0.30	1.25 (0.83 to 1.88)	0.11	2.21 (0.84 to 5.81)	0.90	0.93 (0.33 to 2.65)
Education (REF=college grad)		p=0.1		p=0.04		p=0.81		p<0.0001
<High school	0.82	0.92 (0.45 to 1.89)	0.68	1.17 (0.57 to 2.40)	0.67	1.37 (0.31 to 6.01)	0.0018	4.81 (1.79 to 12.90)
Some HS	0.37	1.27 (0.76 to 2.11)	0.85	1.06 (0.59 to 1.92)	0.95	0.95 (0.22 to 4.20)	0.19	2.07 (0.70 to 6.11)
HS grad	0.15	1.18 (0.94 to 1.48)	0.002	1.47 (1.16 to 1.86)	0.73	1.12 (0.58 to 2.16)	<0.0001	4.30 (2.78 to 6.65)
Some college	0.23	1.11 (0.94 to 1.33)	0.16	1.15 (0.95 to 1.39)	0.39	1.24 (0.75 to 2.05)	0.0002	2.19 (1.46 to 3.29)
Postgrad	0.03	0.71 (0.52 to 0.97)	0.54	0.91 (0.68 to 1.23)	0.32	0.62 (0.24 to 1.59)	0.34	0.66 (0.28 to 1.55)
Drug predictors								
Meth	<0.0001	1.84 (1.45 to 2.34)	0.0004	1.59 (1.23 to 2.06)	<0.0001	3.53 (2.08 to 5.97)	0.0007	2.13 (1.38 to 3.30)
Ecstasy	0.13	1.20 (0.95 to 1.53)	0.56	0.92 (0.70 to 1.21)	0.48	0.75 (0.34 to 1.66)	0.55	1.17 (0.70 to 1.97)
Nitrates	0.08	1.18 (0.98 to 1.42)	0.15	1.15 (0.95 to 1.40)	0.29	1.30 (0.80 to 2.13)	0.03	1.50 (1.03 to 2.19)
Cocaine	0.44	1.09 (0.88 to 1.36)	0.03	1.29 (1.02 to 1.63)	0.81	0.92 (0.46 to 1.84)	0.57	1.15 (0.72 to 1.83)
Means of meeting sex partners		p=0.0004		p=0.004		p=0.57		p=0.26
Internet (REF=in person)	0.19	0.88 (0.73 to 1.06)	0.21	1.14 (0.93 to 1.39)	0.29	1.32 (0.79 to 2.20)	0.55	0.89 (0.61 to 1.30)
Phone app (REF=internet)	0.0001	1.42 (1.19 to 1.70)	0.05	1.20 (1.00 to 1.45)	0.66	0.89 (0.54 to 1.48)	0.31	0.81 (0.54 to 1.22)
Phone app (REF=in person)	0.0099	1.25 (1.06 to 1.48)	0.001	1.37 (1.13 to 1.65)	0.55	1.18 (0.69 to 2.01)	0.10	0.72 (0.49 to 1.07)

The epidemiology of GSN apps is newly emerging and is likely still evolving, and studies analysing behavioural risks for contraction and transmission of STIs and HIV should include questions on social networking methods. These studies should incorporate questions on frequency of use, predominant circumstances and locations of use, duration of use over time, and type of GSN apps used to meet sexual partners. Furthermore, prevention strategies should use these apps to effectively disseminate information on how to best prevent the contracting and spreading of HIV and other STIs. Technology is redefining sex on demand; prevention programs must learn how to effectively exploit the same technology, and keep pace with changing contemporary risk factors for STI and HIV transmission.

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## REFERENCES

- 1 Binson D, Pollack L, Paul J, *et al*. Differential HIV risk in bathhouses and public cruising areas. *Am J Public Health* 2001;91:1482–6.
- 2 McFarlane M, Bull SS, Rietmeijer CA. The Internet as a newly emerging risk environment for sexually transmitted diseases. *JAMA* 2000;284:443–6.
- 3 Benotsch EG, Kalichman S, Cage M. Men who have met sex partners via the internet: prevalence, predictors, and implications for HIV prevention. *Arch Sex Behav* 2002;31:177–83.
- 4 Liao A, Millett G, Marks G. Meta-analytic examination of online sex-seeking and sexual risk behavior among men who have sex with men. *Sex Transm Dis* 2006;33:576–84.
- 5 Taylor M, Aynalem G, Smith LV, *et al*. Correlates of internet use to meet sex partners among men who have sex with men diagnosed with early syphilis in Los Angeles County. *Sex Transm Dis* 2004;31:552–6.
- 6 Ng RA, Samuel MC, Lo T, *et al*. Sex, drugs (methamphetamines) and the internet: increasing syphilis among MSM in California, 2004–2008. *Am J Public Health* 2013;103:1450–6.

## Key messages

- ▶ MSM clinic attendees who use GSN apps are at greater risk for gonorrhoea when compared with those who meet in-person or on the internet.
- ▶ MSM clinic attendees who use GSN apps are at greater risk for chlamydia when compared with those who meet in-person.
- ▶ Further studies need to be conducted to understand the relationship between GSN app use and syphilis/HIV incidence.

- 7 Rosser BR, Oakes JM, Horvath KJ, *et al.* HIV sexual risk behavior by men who use the Internet to seek sex with men: results of the Men's INternet Sex Study-II (MINTS-II). *AIDS Behav* 2009;13:488–98.
- 8 Rosser BR, Miner MH, Bockting WO, *et al.* HIV risk and the internet: results of the Men's INternet Sex (MINTS) Study. *AIDS Behav* 2009;13:746–56.
- 9 PRNewsWire, "Happy Fourth Birthday, Grindr!" <http://www.prnewswire.com/news-releases/happy-fourth-birthday-grindr-199838981.html> (accessed 16 Jul 2013).
- 10 Burrell ER, Pines HA, Robbie E, *et al.* Use of the location-based social networking application GRINDR as a recruitment tool in rectal microbicide development research. *AIDS Behav* 2012;16:1816–20.
- 11 Rice E, Holloway I, Winetrobe H, *et al.* Sex risk among young men who have sex with men who use Grindr, a smartphone geosocial networking application. *J AIDS Clin Res* 2012;S4:005. doi:10.4172/2155-6113.S4-005
- 12 Landovitz RJ, Tseng C, Weissman M, *et al.* Epidemiology, Sexual Risk Behavior, and HIV Prevention Practices of Men who Have Sex with Men Using GRINDR in Los Angeles, California. *J Urban Health* 2013; 90:729–39.
- 13 Rendina JH, Jimenez RH, Grov C, *et al.* Patterns of Lifetime and Recent HIV Testing Among Men Who Have Sex with Men in New York City Who Use Grindr. *AIDS Behav* Published Online First: 8 Aug 2013. doi:10.1007/s10461-013-0573-2
- 14 Colfax GN, Cornelisse P, Buchbinder SP, *et al.* Sexual risk behaviors and implications for secondary HIV transmission during and after HIV seroconversion. *AIDS* 2002;16:1529–35.
- 15 Van Kesteren NM, Hospers HJ, Kok G. Sexual risk behavior among HIV-positive men who have sex with men: a literature review. *Patient Educ Couns* 2007;65:5–20.
- 16 Fenton KA, McManus S, Erens B, *et al.* Measuring sexual behaviour: methodological challenges in survey research. *Sex Trans Inf* 2001;77:84–92.
- 17 U.S. Centers for Disease Control and Prevention, STD Treatment Guidelines for Special Populations, 2010. <http://www.cdc.gov/std/treatment/2010/specialpops.htm#msm> (accessed 7 Mar 2014).
- 18 Maron, Dina Fine. "You've Got Mail...about STDs" *Scientific American*, November 21, 2013. <http://www.scientificamerican.com/article/youve-got-mail-about-stds/>
- 19 Huang Y, Nelson KE, Lin Y, *et al.* Syphilis among men who have sex with men (MSM) in Taiwan: its association with HIV prevalence, awareness of HIV status, and use of antiretroviral therapy. *AIDS Behav* 2013;17:1406–14.