Distribution Agreement

In presenting this thesis or dissertation as a partial fulfillment of the requirements for an advanced degree from Emory University, I hereby grant to Emory University and its agents the non-exclusive license to archive, make accessible, and display my thesis or dissertation in whole or in part in all forms of media, now or hereafter known, including display on the world wide web. I understand that I may select some access restrictions as part of the online submission of this thesis or dissertation. I retain all ownership rights to the copyright of the thesis or dissertation. I also retain the right to use in future works (such as articles or books) all or part of this thesis or dissertation.

Bradley Wagenaar   3.5.2012

HIV Knowledge and Associated Factors among Internet-Using Men Who Have Sex with Men (MSM) in South Africa and the United States

by

Bradley H. Wagenaar
Master of Public Health
Global Epidemiology

Patrick Sullivan

Faculty Thesis Advisor / Thesis Field Advisor

HIV Knowledge and Associated Factors among Internet-Using Men Who Have Sex with Men (MSM) in South Africa and the United States

By

Bradley H. Wagenaar
Bachelor of Arts
St. Olaf College
2008

Faculty Thesis Advisor: Patrick Sullivan, BS, DVM, PhD

An abstract of

a thesis submitted to the Faculty of the

Rollins School of Public Health of Emory University

in partial fulfillment of the requirements for the degree of

Master of Public Health

in Global Epidemiology

2012

Abstract

HIV Knowledge and Associated Factors among Internet-Using Men Who Have Sex with Men (MSM) in South Africa and the United States

By Bradley H Wagenaar

Background:

We compared factors associated with low HIV/AIDS knowledge among internet-using MSM in South Africa and the United States.

Methods:

1,154 MSM in the US and 439 MSM in South Africa, recruited through Facebook.com, completed an online survey using a US-validated HIV knowledge scale (HIV-KQ-18). Separate multivariable logistic regression models were built, one for the US and one for South Africa, using a dichotomized variable of scoring less than and equal to 13/18 ("low knowledge") on the HIV-KQ-18 as outcome.

Results:

Median knowledge scores were 16/18 for both groups of respondents. For South African MSM, factors associated with low knowledge were: a high school education or less (adjusted odds ratio [aOR]: 2.5, 95% confidence interval [CI]: 1.4-4.6), not using condom-compatible lubrication during last anal sex with another man (aOR: 1.9, CI: 1.0-3.5), number of gay or bisexual acquaintances (aOR: 0.89, CI: 0.81-0.99), being unemployed (aOR: 2.2, CI: 1.0-4.6), and testing HIV negative (aOR: 0.30, CI: 0.16-0.59) or testing HIV positive (aOR: 0.15, CI: 0.03-0.74) compared to those never HIV tested. For US MSM, associated factors were: a high school education or less (aOR: 2.7, CI: 1.9-3.8), low pride and acceptance of homosexuality (aOR: 1.3, CI: 1.2-1.5), age 18-24 (aOR: 2.3, CI: 1.3-3.8) or age 50+ (aOR: 3.2, CI: 1.6-6.3) compared to age 25-29, Hispanic ethnicity compared to white non-Hispanic (aOR: 1.9, CI: 1.1-3.2), and testing HIV positive (aOR: 0.34, CI: 0.16-0.69) or testing HIV negative (aOR: 0.59, CI: 0.39-0.89) compared to those tested.

Conclusions:

Those developing programs for MSM in South Africa should weigh these data and other relevant factors, and might consider focusing education services towards MSM with limited education, less integration into gay/bisexual communities, no HIV testing history, limited use of condom-compatible lube, and the unemployed. In the United States, Hispanic MSM, those with limited education, no HIV testing history, low pride/acceptance of homosexuality, and those aged 18-24 or 50+ may be at risk for gaps in HIV knowledge.

HIV Knowledge and Associated Factors among Internet-Using Men Who Have Sex with Men (MSM) in South Africa and the United States

By

Bradley H. Wagenaar
Bachelor of Arts
St. Olaf College
2008

Faculty Thesis Advisor: Patrick Sullivan, BS, DVM, PhD

A thesis submitted to the Faculty of the

Rollins School of Public Health of Emory University

in partial fulfillment of the requirements for the degree of

Master of Public Health

in Global Epidemiology

2012

Table of Contents

Introduction

Since the emergence of HIV as a global pandemic in the 1980s, men who have sex with men (MSM) have shared a disproportionately large burden of infection in many high-income countries in Western and Central Europe, Australia, and North America [1]. Due to this recognized high burden, MSM represent a large target population for resources on HIV/AIDS prevention, treatment, and research in these areas. By contrast, Africa's HIV/AIDS epidemic has long been understood primarily as a "heterosexual epidemic", with an estimated 80% of HIV infections being tied to heterosexual transmission [2]. This focus has led to HIV/AIDS prevention efforts in Africa being targeted primarily to heterosexuals.

Recent epidemiological evidence has shown that MSM in Africa share a disproportionate burden of HIV infection [3]. Prevalence estimates of MSM in Africa range from 1-4% of the general population, but high levels of HIV infection and a high prevalence of MSM also engaging in sex with women has led MSM transmission to be linked to over 20% of all HIV cases in several countries of the Middle East, North Africa, and West Africa [4-6]. These data are at odds with the fact that most African countries have not dedicated any national HIV/AIDS funds to specifically target HIV/AIDS among MSM [6].

The 2009 UNAIDS report on universal access for MSM and transgender people highlights the global failure in addressing the needs of MSM regarding HIV/AIDS education, prevention, treatment, research, and care. One of the foci of this report is increasing access to HIV/AIDS prevention materials for MSM and transgender individuals [7]. Although increasing HIV/AIDS knowledge alone is not sufficient to promote sustainable behavior change, accurate knowledge of transmission and prevention of HIV is necessary if MSM are to adopt risk reduction strategies.

Globally, reporting on HIV knowledge among MSM is sparse. Only 33 out of 147 low and middle income countries (LMIC) reported knowledge data through the 2008 United Nations General Assembly Special Session (UNGASS) [8]. Only 2 of these 37 countries reporting UNGASS HIV knowledge data were

in Africa, with Nigeria and Mauritius reporting that only 44% and 48% of MSM respectively could "correctly identify ways of preventing sexual transmission of HIV and could correctly reject major misconceptions about HIV transmission" [8]. Additionally, across all low and middle-income countries reporting knowledge scores, less than half of MSM held correct HIV knowledge.

Other studies from Sudan and Kenya indicate that MSM in Africa may have low knowledge regarding HIV prevention and transmission. More than half (55%) of a sample of MSM in Sudan and 35% of respondents in Mombasa, Kenya did not understand the link between anal sex and HIV infection [9-10]. By contrast, over 90% of samples of MSM in Malawi, Botswana, and Namibia understood that HIV can be transmitted through anal sex with a man [11]. However, of these samples, only 57%, 50%, and 85% respectively had ever received educational materials on preventing HIV transmission between men.

Data on levels and correlates of HIV/AIDS knowledge in Africa are essential to develop effective prevention and education strategies. Previous studies of HIV knowledge among MSM have focused on levels of HIV knowledge, but have not systematically examined factors associated with low knowledge. The present study aims to fill this gap by examining factors associated with low HIV/AIDS knowledge among MSM in South Africa and the United States using a validated HIV knowledge scale.

We chose to focus on South African and US MSM because: (1) the HIV-KQ-18 knowledge scale has only been previously validated and described among populations in the US, (2) South Africa has a large population of people living with HIV/AIDS, representing 25% of all those living in Sub-Saharan Africa, and (3) there is emerging evidence that MSM in South Africa share a disproportionate burden of HIV infection [1, 12]. This information will support the development and scale up of educational programs to address the specific needs of MSM, and may aid in optimizing existing prevention programs for MSM.

Methods

1,154 internet-using MSM in the United States and 439 in South Africa were recruited through banner advertisements on Facebook.com targeted to men who stated they were interested in men on their Facebook profiles. Facebook ads were displayed in South Africa from June 1 to June 30, 2010 and in all US states from October 1 to November 30, 2010. Banner ads included a range of images, including groups of men, individual men of a range of ethnic and racial backgrounds, and rainbow-themed images. Facebook users who clicked on the banner ads were taken to an internet-based survey. To be eligible to begin the survey men had to report male-to-male sex in the past year.

The survey collected information on participant demographics (age, race, education, and employment), sexual orientation, the number of friends, colleagues, or acquaintances they felt identified as gay or bisexual, HIV testing behavior, knowledge of HIV transmission, condom and water-based lubrication use, and questions on gay identity. HIV knowledge was quantified using the brief HIV knowledge scale (HIV-KQ-18), an internally consistent and stable HIV knowledge scale shown to be appropriate for low-literacy populations [13]. Questions in the HIV-KQ-18 focus on basic HIV transmission and prevention and are summed to form an index of overall HIV knowledge (0-18) with non-responses and "don't know" coded as incorrect.

Gay identity was quantified using a modified version of the US-validated "Gay Identity Questionnaire" consisting of 20 questions summed to form an index of decreasing pride and acceptance of homosexuality as one moves from 0 to 80 [14]. Race in the US was classified into white non-Hispanic, black non-Hispanic, Hispanic, and other (including Asian/Pacific Islander, Native American/Alaska Native, Multi-Racial, and other). Race in South Africa was classified into black African, white/European/African, and other (including Asian, colored, and other). For both groups of respondents, individuals responding "don't know" for previous HIV testing were coded as not being tested and individuals who indicated receiving "indeterminate" HIV results were coded as testing HIV negative.

Statistical analyses were conducted using SAS 9.2 (Cary, NC, USA). Statistical significance was assessed using an alpha value of .05 and two-tailed tests. Individuals were excluded from analyses if they did not report being male and having had male-to-male sex in the past year (n=15 US; n=80 South Africa) or if no knowledge questions were answered (n=883 US; n=85 South Africa). Individuals excluded for not answering any knowledge questions did not have significantly different age or gay/bisexual peer network distributions using t-tests.

Separate multivariable logistic regression models were built, one for the US and one for South Africa, using the dichotomous "low knowledge" variable as our outcome. Knowledge scores were dichotomized using a data-derived cutoff of greater than or less than and equal to 13/18 correct, with 19.9% and 15.3% scoring at this level or below in the US and South Africa respectively (Figure 1; Figure 2). We dichotomized knowledge this way because the proportional odds assumption was grossly violated for use of ordinal logistic regression with raw scores, and because there is no standard cutoff for a critical level of knowledge for the HIV-KQ-18. As a sensitivity analysis, changing this "critical knowledge" cutoff to other possible cut points of 14, 15, or 16 out of 18 correct on the knowledge scale did not meaningfully change factors associated or their magnitudes.

Variables considered for inclusion into each model were age, race, education, sexual orientation, HIV testing behavior, employment status, number of gay or bisexual friends known, having and/or had a female sex partner, relationship status (male or female), condom and lubrication use, and score on the gay identity scale. Backward selection procedures (α =.05) were used to arrive at the final models. Wald chi-square tests were used to establish significance of individual predictors, whereas likelihood ratio tests (LRT) were used to evaluate significance of groups of predictors (race, HIV-testing behavior). Hosmer and Lemeshow's goodness of fit test was used to determine if final models were adequate.

Results

Basic demographics showed both groups of respondents to be primarily of white race, homosexual sexual orientation, and having had sex with only men (Table 1). Median knowledge scores were 16/18 correct for both cohorts, with 13.4% (59) and 17.1% (197) respondents in South Africa and the United States correctly responding to all 18 knowledge questions, respectively.

For South African MSM, less than 70% of respondents correctly answered that all pregnant women infected with HIV will not have babies born with AIDS, that a natural skin condom does not work better against HIV than a latex condom, and that a person can get HIV from oral sex (Table 2). For US MSM, less than 70% of respondents correctly answered that there is a female condom that can help decrease a woman's chance of getting HIV, and that a natural skin condom does not work better against HIV than a latex condom.

Hosmer and Lemeshow goodness-of-fit tests for each final model revealed no significant lack-of-fit (SA, p=.60; US, p= .95). Sexual orientation, having/and or had a female sex partner, sexual relationship status, and condom use were eliminated from both final models through backward elimination.

Factors Associated with Low Knowledge among Both Cohorts

Controlling for all other factors in the final models, compared to MSM with greater than 12 years of education, men with less than 12 years of education were 2.5 and 2.7 times as likely to score "low" on HIV knowledge in South Africa and the US, respectively (SA, p= .003; US, p<.001; Table 3). Additionally, previous HIV testing as a group predictor was significantly associated with higher HIV knowledge scores (SA, p<.001; US, p=.006). South African MSM testing HIV positive were 85% (p=.02) less likely to score low on HIV knowledge, and men who tested HIV negative were 70% (p<.001) less likely, both compared to men never HIV tested. US MSM testing HIV positive were 66% (p=.003) less

likely to score in the lowest quintile of knowledge scores, and men who tested HIV negative were 41% (p=.012) less likely, both compared to men never HIV tested.

Factors Associated with Low Knowledge among South African MSM

First, unemployed South African MSM were 2.2 times as likely to score low on knowledge scores, compared to those who were employed (p=.042). Second, MSM not using condom-compatible lubrication during last anal sex with another man were 1.9 times as likely to score low on HIV knowledge (p=.036). Last, for each ten point increase in the number of gay or bisexual friends known, the odds of scoring low on HIV knowledge decreased 11% (p=.024).

Factors Associated with Low Knowledge among MSM in the United States

For each ten point increase on the gay identity scale (decreasing pride and acceptance of homosexuality) the odds of scoring in the lowest quintile on knowledge scores increased by 30% for US MSM (p<.001). Age as a group predictor was significantly associated with knowledge scores (p=.002). Compared to US MSM age 25-29, those age 18-24 and 50+ were 2.3 (p=.002) and 3.2 (p<.001) times as likely to score in the lowest quintile on knowledge scores, respectively. Finally, race as a construct was significantly associated with the odds of scoring low on HIV knowledge (p=.049). Compared to white non-Hispanics, Hispanics were 1.9 times as likely to score low on HIV knowledge (p=.018).

Discussion

Among Facebook-using MSM in the US and South Africa, HIV/AIDS knowledge levels were high: the median respondent in both groups of respondents missed only 2 out of 18 questions. In both US and South African MSM, men with less than a high school education had significantly lower HIV/AIDS knowledge. This is in corroboration with a large body of research around the world showing that as general education level increases, so does knowledge of HIV/AIDS prevention and transmission [15-18].

Efforts to increase general educational opportunities for MSM in South Africa and the US, would be helpful inherently, and might also support higher HIV/AIDS knowledge.

Second, previous HIV testing was associated with having higher knowledge for MSM in the US and South Africa. Although causality is unclear from our study design, we hypothesize that MSM who have tested for HIV and received negative results gain some knowledge through contact with testing facilities, while individuals testing positive show a trend towards further increased knowledge due to continued contact with healthcare providers, educational materials, or peer groups. According to our data, traditional HIV/AIDS education and counseling associated with voluntary counseling and testing centers (VCT), hospitals, or other care centers is associated with higher levels of HIV knowledge among MSM.

Among South African MSM, having fewer acquaintances gay or bisexual was associated with lower HIV/AIDS knowledge, which could indicate that, in South Africa, peer networks are key avenues where HIV/AIDS information is shared. Additionally, after accounting for HIV testing behavior, not using condom-compatible lubrication during anal sex was associated with lower HIV knowledge in South Africa. South African MSM who receive condom-compatible lubrication from a community based organization or an NGO may also receive educational materials, making use of lubrication use a marker for access to outreach or comfort with service utilization.

For US MSM, there was a trend towards lower HIV knowledge among some racial and age groups. Hispanic MSM had significantly lower HIV/AIDS knowledge and black non-Hispanic MSM showed a trend towards lower knowledge, compared to White non-Hispanic MSM. Thirty years after HIV was first propelled into global consciousness, US MSM of color are at risk for gaps in HIV knowledge at a time when new HIV infections among these men are increasing.

US MSM age 18-24 or 50+ were at significantly increased risk for low HIV knowledge compared to men age 25-29. That these two age groups have the lowest HIV knowledge is troubling because sex

with older partners has been shown to be associated with HIV infection, and US MSM age 50+ have an estimated HIV prevalence of 25% compared to 10.5% for men age 18-24 [19-20]. Tailored educational interventions, perhaps using social media for young MSM, and other creative methods to reach older MSM are urgently needed.

A novel finding of the current study is that low pride and acceptance of homosexuality was one of the factors most strongly associated with low HIV/AIDS knowledge among US MSM. Low pride and acceptance of homosexuality may correlate with willingness or ability of US MSM to access prevention services or with the extent of peer networks through which HIV education is shared. Additional studies are needed to characterize how gay identity formation in the United States may be related to other HIV-associated factors, especially in light of the recently questioned relationship between internalized homophobia and risky sexual behaviors [21].

Limitations

This study has several limitations. First, our findings are not generalizable to all MSM, or all Facebook-using MSM, in either the United States or South Africa. Nevertheless, according to publically available data, 58.6% (136,937,240) of over-18 individuals in the US and 8.5% (3,446,000) of over-20 South Africans have Facebook accounts [22-24]. Compared to the general population, our samples over-represent individuals who identify as white in South Africa (91.1% versus 9.6%) and individuals who identify as black in the United States (33% versus 12.6%) [22, 25]. This indicates that even though our sample is not representative of the population as a whole, internet-based surveys can achieve good penetration into at-risk populations in both the US and South Africa.

Second, since our Facebook advertisements were only targeted to men who explicitly state that they are "interested in" men, our sample likely consists of men who are more open with their sexuality than are MSM in general. Third, recall bias, sample selection bias, and/or social desirability bias could cause underreporting of HIV status, male sex partners, or unprotected sex and could result in

misclassification. However, we judge that these biases, if they exist, are not strongly heterogeneous among those scoring high/low on HIV knowledge or between cohorts. Fourth, our choice to dichotomize the knowledge data was empirical; further research is needed to characterize epidemiologically significant critical levels of HIV/AIDS knowledge. Last, the HIV-KQ-18 knowledge scale was not developed or validated for use with MSM or with South Africans, and some of the items, such as the item about natural skin condoms, are somewhat outdated.

Conclusions

Those developing programs for MSM in South Africa should weigh these data and other relevant information, and might consider focusing educational services towards MSM who have lower education levels, less integration into gay or bisexual communities, no HIV testing history, limited use of condom-compatible lube, and who are unemployed. In the United States, Hispanic MSM, those who have low pride and acceptance of homosexuality, those who have not tested for HIV, those with less than a high school education, and those aged 18-24 or over 50 may be at risk for gaps in HIV knowledge.

As we begin to work with recently acknowledged at risk populations, such as MSM in South Africa, or strive to strengthen service delivery in the US, programs must be tailored to populations most at risk. As further research is conducted, our study shows that online surveys are one appropriate way to reach populations of MSM in the US and South Africa.

References

1. UNAIDS (2008) 2008 report on the global AIDS epidemic. Geneva, Switzerland. Available:

http://www.unaids.org/en/dataanalysis/epidemiology/2008reportontheglobalaidsepidemic. Accessed

2011 March 29.

2. Hunter DJ (1993) AIDS in sub-Saharan Africa: the epidemiology of heterosexual transmission and the

prospects for prevention. Epidemiology 4(1): 63-72.

3. Baral S, Sifakis F, Cleghorn F, Beyrer C (2007) Elevated risk for HIV infection among men who have sex

with men in low- and middle-income countries 2000–2006: a systematic review. PLoS Med 4: e339.

4. Mumtaz G, Hilmi N, McFarland W, Kaplan RL, Akala FA, et al (2011) Are HIV Epidemics among Men

Who Have Sex with Men Emerging in the Middle East and North Africa?: A Systematic Review and Data

Synthesis. PLoS Med 8(8): e1000444.

5. Caceres CF, Konda K, Segura ER, Lyerla R (2008) Epidemiology of male same-sex behavior and

associated sexual health indicators in low- and middle-income countries: 2003-2007 estimates. Sexually

Transmitted Infection 84(Suppl 1): i49-i56.

6. Smith AD, Tapsoba P, Peshu N, Sanders EJ, Jaffe HW (2009) Men who have sex with men and HIV/AIDS

in sub-Saharan Africa. Lancet 374: 416-22.

7. UNAIDS (2009) UNAIDS Action Framework: universal access for men who have sex with men, and

transgender people. Geneva, Switzerland: UNAIDS/UNDP.

8. Adam PCG, de Wit JBF, Toskin I, Mathers BM, Nashkhoev M, et al. (2009). Estimating levels of HIV

testing, HIV prevention coverage, HIV knowledge, and condom use among men who have sex with men

(MSM) in low-income and middle-income countries. J Acquir Immune Defic Syndr 52(2): S143- S151.

9. Geibel S, Luchters S, King'Ola N, Esu-Williams E, Rinyiru A, et al. (2008) Factors associated with self-

reported unprotected anal sex among male sex workers in Mombasa, Kenya. Sex Trans Dis 35: 746–52.

10. Elrashied S (2006) Prevalence, knowledge and related risky sexual behaviors of HIV/AIDS among receptive men who have sex with men (MSM) in Khartoum State, Sudan, 2005. In: AIDS 2006—XVI International AIDS Conference. Toronto, Canada.

11. Fay H, Baral SD, Trapence G, Motimedi F, Umar E, et al. (2011). Stigma, health care access, and HIV knowledge among men who have sex with men in Malawi, Namibia, and Botswana. AIDS and Behavior, 15: 1088-1097.

12. Baral S, Burrell E, Scheibe A, Brown B, Beyrer C, et al. (2011). HIV risk and associations of HIV infection among men who have sex with men in Peri-Urban Cape Town, South Africa. BMC Public Health 11: 766.

13. Carey PM, Schroder KEE (2002) Development and psychometric evaluation of the brief HIV knowledge questionnaire. AIDS Educ Prev 14(2): 172-182.

14. Brady S, Busse WJ (1994) The Gay Identity Questionnaire: a brief measure of Homosexual Identity Formation. J Homosex 26(4): 1-22.

15. Noden BH, Gomes A, Ferreira A (2010) Influence of religious affiliation and education on HIV knowledge and HIV-related sexual behaviors among unmarried youth in rural central Mozambique. AIDS Care 22(10): 1285-1294.

16. Haile BJ, Chambers JW, Garrison JL (2007) Correlates of HIV knowledge and testing: Results of a 2003 South African survey. Journal of Black Studies 38(2): 194-208.

17. UNICEF (2004) Girls, HIV/AIDS and education. Available: http://www.unicef.org/publications/files/Girls_HIV_AIDS_and_Education_(English)_rev.pdf. Accessed 2011 July 15.

18. Upreti D, Regmi P, Pant P, Simkhada P (2009) Young people's knowledge, attitude, and behavior on STI/HIV/AIDS in the context of Nepal: A systematic review. Kathmandu University Medical Journal 7(28): 383-391.

19. Morbidity and mortality weekly report (2010) Prevalence and awareness of HIV infection among men who have sex with men – 21 cities, United States, 2008. 59(37): 1201-1207.

20. Hurt CB, Matthews DD, Calabria MS, Green KA, Adimora AA, et al. (2010) Sex with older partners is associated with primary HIV infection among men who have sex with men in North Carolina. J Acquir Immune Defic Syndr 54(2): 185-190.

21. Newcomb ME, Mustankski B (2011) Moderators of the relationship between internalized homophobia and risky sexual behavior in men who have sex with men: a meta-analysis. Archives of Sexual Behavior 40(1): 189-99.

22. US Census Bureau (2010) State and county quickfacts. Available: http://quickfacts.census.gov/qfd/states/00000.html. Accessed 2011 July 22.

23. Facebook (2011) Targeting your ad. Available: https://www.facebook.com/ads/create/. Accessed 2011 July 22.

24. Statistics South Africa (2010) Mid-year population estimates. Statistical release P0302. Available: http://www.statssa.gov.za/publications/P0302/P03022010.pdf. Accessed 2011 July 22.

25. Central Intelligence Agency (2011). The world factbook: South Africa. Available: https://www.cia.gov/library/publications/the-world-factbook/geos/sf.html#. Accessed 2012 January 5.

Tables

Table 1. Demographic and behavioral characteristics of 1,154 US and 439 South African men who have sex with men (MSM) who completed online Facebook HIV survey, June-November 2010.

Demographic or behavioral characteristic	US MSM n (%) unless noted	IQR	South African MSM n (%) unless noted	IQR
HIV knowledge (number correct / 18)	16 (median)	3	16 (median)	3
Number acquaintances gay or bisexual	20 (median)	51	20 (median)	40
Gay identity scale	15 (median)	23	11 (median)	16
Age	26 (median)	20	30 (median)	13
18-24	500 (43.3)		117 (26.7)	
25-29	183 (15.9)		96 (21.9)	
30-39	163 (14.1)		140 (31.9)	
40-49	191 (16.6)		60 (13.7)	
50+	117 (10.1)		26 (5.9)	
Race/Ethnicity (South Africa)				
White/European/African			400 (91.1)	
Black African			20 (4.6)	
Other			19 (4.3)	
Race/Ethnicity (United States)				
White non-Hispanic	557 (48.3)			
Black non-Hispanic	381 (33.0)			
Hispanic	108 (9.4)			
Other	108 (9.4)			
Sexual Orientation				
Homosexual/ Gay	975 (84.5)		422 (96.4)	
Bisexual	149 (12.9)		12 (2.7)	
Heterosexual	3 (0.3)		1 (0.2)	
Unsure	18 (1.6)		1 (0.2)	
Other	5 (0.4)		2 (0.5)	
Missing	4 (0.4)		1 (0.23)	
Entire Life Had Sex With:				
Only men	620 (53.7)		266 (60.7)	
Both men and women	534 (46.4)		172 (39.3)	
Education				
More than high school	901 (78.1)		186 (42.4)	
High school or less	253 (21.9)		253 (57.6)	
HIV testing history				
Never tested for HIV	161 (14.0)		57 (13.0)	
Positive last HIV test	133/993 (13.4)		25/382 (6.5)	
Negative / indeterminate last HIV test	860/993 (86.6)		357/382 (93.5)	
Condom use at last sex				
No anal sex last sex with partner	284 (24.6)		101 (23.0)	
No condom last anal sex with partner	492/870 (56.6)		173/338 (51.2)	
Used condom last anal sex with partner	378/870 (43.4)		165/338 (48.8)	
Currently in a sexual relationship (M or F)	511 (44.4)		258 (58.8)	
Currently employed	733 (63.9)		383 (88.3)	
Condom-compatible lube use last anal sex	861 (74.6)		349 (79.5)	

Table 2. 1,154 US and 439 South African men who have sex with men (MSM) who completed online Facebook survey answering HIV-KQ-18 questions correctly, incorrectly, "don't know", or by skipping, June-November 2010.

HIV-KQ-18 Question (correct answer)	US MSM			South African MSM		
	Correct n (%)	Incorrect n (%)	Don't Know/ Skipped n (%)	Correct n (%)	Incorrect n (%)	Don't Know / Skipped n (%)
1. Coughing and sneezing DO NOT spread HIV (T)	948 (82.1)	122 (10.6)	84 (7.3)	390 (88.8)	37 (8.4)	12 (2.7)
2. A person can get HIV by sharing a glass of water with someone who has HIV (F)	1045 (90.6)	37 (3.2)	72 (6.2)	403 (91.8)	31 (7.1)	5 (1.1)
3. Pulling the penis out before a man climaxes/cums keeps his partner from getting HIV during sex (F)	1029 (89.2)	53 (4.6)	72 (6.2)	392 (89.3)	21 (4.8)	26 (5.9)
4. A woman can get HIV if she has anal sex with a man (T)	982 (85.1)	100 (8.7)	72 (6.2)	377 (85.9)	40 (9.1)	22 (5.0)
5. Showering or washing one's genitals / private parts after sex keeps a person from getting HIV (F)	1043 (90.4)	30 (2.6)	81 (7.0)	425 (96.8)	6 (1.4)	8 (1.8)
6. All pregnant women infected with HIV will have babies born with AIDS (F)	830 (71.9)	151 (13.1)	173 (15.0)	286 (65.1)	109 (24.8)	44 (10.0)
7. People who have been infected with HIV quickly show serious signs of being infected (F)	1078 (93.4)	22 (1.9)	54 (4.7)	416 (94.8)	6 (1.4)	17 (3.9)
8. There is a vaccine that can stop adults from getting HIV (F)	989 (85.7)	33 (2.9)	132 (11.4)	376 (85.6)	22 (5.0)	41 (9.3)
9. People are likely to get HIV by deep kissing / putting their tongue in their partner's mouth (F)	907 (78.6)	104 (9.0)	143 (12.4)	372 (84.7)	34 (7.7)	33 (7.5)
10. A woman cannot get HIV if she has sex during her period (F)	1004 (87.0)	34 (2.9)	116 (10.1)	416 (94.8)	5 (1.1)	18 (4.1)
11. There is a female condom that can help decrease a woman's chance of getting HIV (T)	792 (68.6)	142 (12.3)	220 (19.1)	333 (75.9)	52 (11.8)	54 (12.3)
12. A natural skin condom works better against HIV than a latex condom (F)	790 (68.5)	19 (1.6)	345 (29.9)	256 (58.3)	10 (2.3)	173 (39.4)
13. A person will NOT get HIV if they are taking antibiotics (F)	1066 (92.4)	18 (1.6)	70 (6.1)	415 (94.5)	6 (1.4)	18 (4.1)
14. Having sex with more than one partner can increase a person's chance of becoming infected with HIV (T)	1088 (94.3)	33 (2.9)	33 (2.9)	427 (97.3)	9 (2.1)	3 (0.68)
15. Taking a test for HIV one week after having sex will tell a person if she or he has HIV (F)	916 (79.4)	81 (7.0)	157 (13.6)	333 (75.9)	47 (10.7)	59 (13.4)
16. A person can get HIV by sitting in a hot tub or a swimming pool with a person who has HIV (F)	1048 (90.8)	30 (2.6)	76 (6.6)	418 (95.2)	6 (1.4)	15 (3.4)
17. A person can get HIV from oral sex (T)	880 (76.3)	162 (14.0)	112 (9.7)	301 (68.6)	79 (18.0)	59 (13.4)
18. Using Vaseline or baby oil with condoms lowers the chance of getting HIV (F)	1000 (86.7)	29 (2.5)	125 (10.8)	387 (88.2)	13 (3.0)	39 (8.9)

Table 3. Multivariable logistic regression models for 1,154 US and 439 South African men who have sex with men (MSM) using scoring in lowest quintile on HIV-KQ-18 knowledge scores as outcome.

Covariates	US MSM aOR (95% CI)[a]	South African MSM aOR (95% CI)[a]
Gay identity scale (10 point change)	1.3 (1.2 – 1.5)[†]	n.s.
Education level <12 years	2.7 (1.9 – 3.8)[†]	2.5 (1.4 – 4.6)*
Not employed	n.s.	2.2 (1.0 – 4.6)*
Did not use lube last anal sex with man	n.s.	1.9 (1.0 – 3.5)*
Number acquaintances gay or bisexual (10 point change)	n.s.	0.89 (0.81 – 0.99)*
HIV testing history[b]		
Never HIV tested	1 (reference)	1 (reference)
Tested HIV positive	0.34 (0.16 – 0.69)*	0.15 (0.03 – 0.74)*
Tested HIV negative	0.59 (0.39 – 0.89)*	0.30 (0.16 – 0.59)*
Age group[c]		
25-29	1 (reference)	
18-24	2.3 (1.3 – 3.8)*	
30-39	1.5 (0.77 – 2.8)	
40-49	1.4 (0.76 – 2.7)	
50+	3.2 (1.6 – 6.3)[†]	
Racial/Ethnic group[d]		
White non-Hispanic	1 (reference)	
Hispanic	1.9 (1.1 – 3.2)*	
Black non-Hispanic	1.5 (0.98 – 2.3)	
Other race	1.0 (0.56 – 1.9)	

*P < .05 (Wald X^2)

[†] P < .001 (Wald X^2)

n.s. = eliminated through backward selection for given model

[a] Variables considered for inclusion into each model: age, race, education, sexual orientation, HIV testing behavior, employment status, number of gay or bisexual friends known, having and/or had a female sex partner, relationship status, condom and lubrication use, and scores on the gay identity scale. Backward selection procedures (α =.05) were conducted separately for US and South African MSM.

[b] Construct p-values for HIV testing history were p=.006 (US MSM) and p<.001 (South African MSM).

[c] Construct p-values for age group were p=.002 (US MSM) and non-significant (South African MSM).

[d] Construct p-values for racial/ethnic group were p=.049 (US MSM), non-significant (South African MSM).
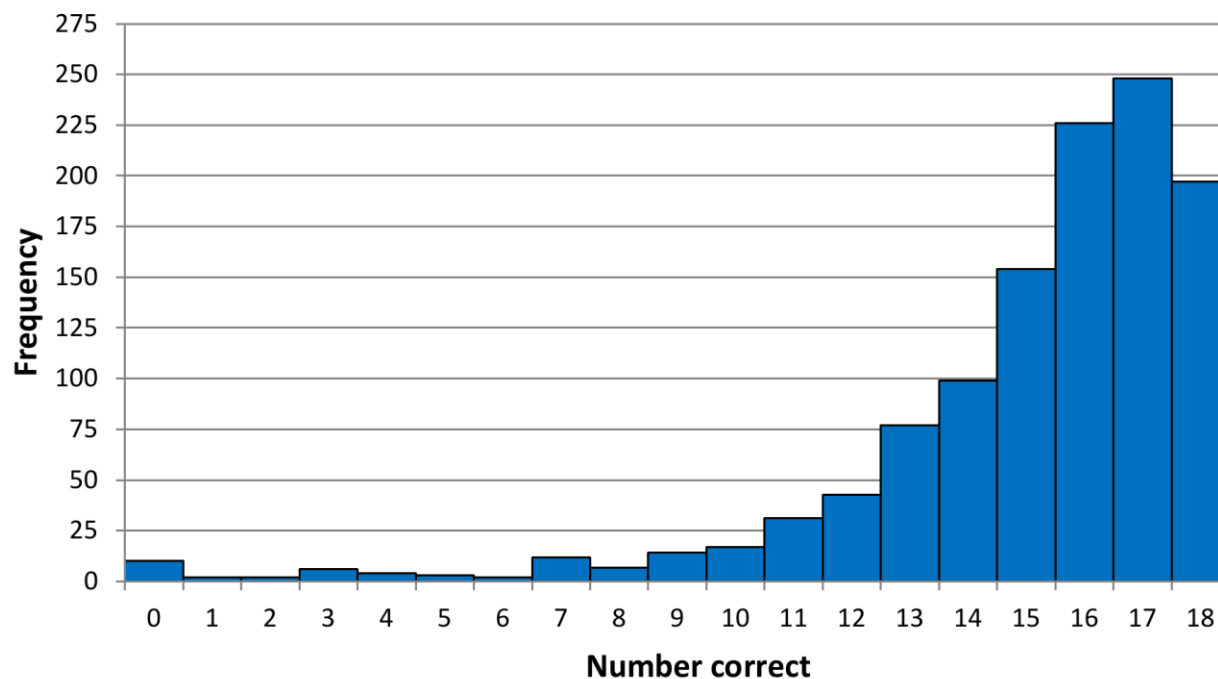
Figures

Figure 1. Histogram of number correct on the HIV-KQ-18 knowledge scale for 1,154 US men who have sex with men (MSM) who completed online Facebook survey, June-November 2010.
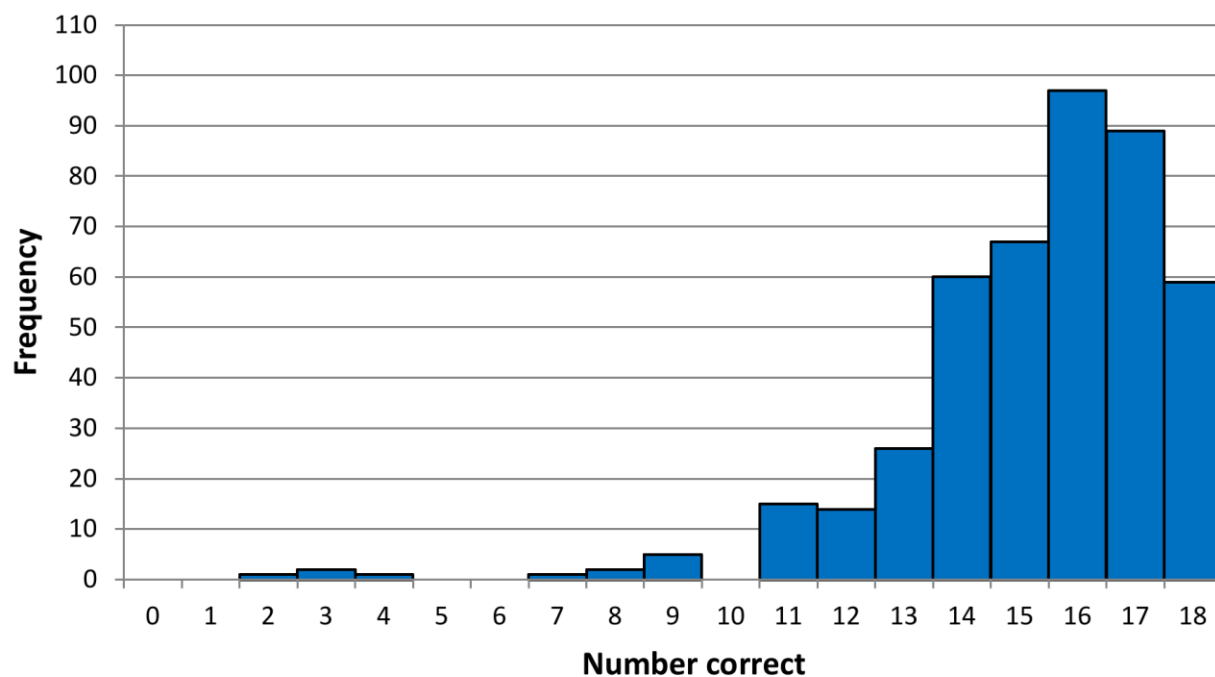

Figure 2. Histogram of number correct on the HIV-KQ-18 knowledge scale for 439 South African men who have sex with men (MSM) who completed online Facebook survey, June-November 2010.

Appendices

Internet Survey for South Africa and United States

Emory University Men's Health Survey

Introduction, age, sex and race

Thank you for your interest in our survey. Please take note of the following information:

1. Your answers are anonymous: we don't have any information about who you are beyond the questions you answer.

2. Some questions are about sensitive topics; you can choose not to answer any question that you are not comfortable with.

3. If you have any questions or comments, you may contact the Principal Investigator, Dr. Rob Stephenson, at RBSTEPH@EMORY.EDU.

What is your age? *

What is your sex? *

- ○ Male

- ○ Female

Race, education, residence

Do you consider yourself to be Hispanic or Latino?

- ○ Yes

- ○ No

- ○ Don't Know

- ○ Prefer not to answer

Which racial group do you consider yourself to be in?

- ○ Asian/Pacific Islander

- ○ Black/African-American

○ White/Caucasian

○ Native American/Alaska Native

○ Multi-Racial

○ Prefer not to answer

○ Other [   ]

What is the highest grade in school you completed?

○ College, post graduate, or professional school

○ Some college, Associate's degree, and/or Technical school

○ High school or GED

○ Some high school

○ Less than high school

○ Never attended school

○ Don't Know

What state do you live in?

○ Alabama

○ Alaska

○ American Samoa

○ Arizona

○ Arkansas

○ California

○ Colorado

○ Connecticut

○ Delaware

○ District of Columbia

○ Federated States of Micronesia

○ Florida

○ Georgia

○ Guam

○ Hawaii

○ Idaho

○ Illinois

○ Indiana

○ Iowa

○ Kansas

○ Kentucky

○ Louisiana

○ Maine

○ Marshall Islands

○ Maryland

○ Massachusetts

○ Michigan

○ Minnesota

○ Mississippi

○ Missouri

○ Montana

○ Nebraska

○ Nevada

○ New Hampshire

○ New Jersey

○ New Mexico

○ New York

○ North Carolina

○ North Dakota

○ Northern Mariana Islands

○ Ohio

○ Oklahoma

○ Oregon

○ Palau

○ Pennsylvania

○ Puerto Rico

○ Rhode Island

○ South Carolina

○ South Dakota

○ Tennessee

○ Texas

○ Utah

○ Vermont

○ Virgin Islands

○ Virginia

○ Washington

○ West Virginia

○ Wisconsin

○ Wyoming

Health Insurance

Are you currently employed?

○ Yes

○ No

What kind of health insurance or coverage do you currently have?

☐ Private health insurance or HMO

☐ Medicaid

☐ Medicare

☐ Tricare/Champus

☐ Veterans Administration coverage

☐ No health insurance

☐ Some other health insurance [   ]

☐ Don't know

Orientation, knows gay/bi men

What is your sexual orientation?

○ Homosexual/ Gay

○ Heterosexual/ Straight

○ Bisexual

○ Unsure

○ Other [   ]

Do you have any friends, colleagues or acquaintances that identify themselves as a gay or bisexual man?

○ Yes

○ No

Approximately how many people do you know that identify themselves as a gay or bisexual man?

○ 1

○ 2

○ 3

○ 4

- ○ 5
- ○ 6
- ○ 7
- ○ 8
- ○ 9
- ○ 10
- ○ 11
- ○ 12
- ○ 13
- ○ 14
- ○ 15
- ○ 16
- ○ 17
- ○ 18
- ○ 19
- ○ 20
- ○ 21
- ○ 22
- ○ 23
- ○ 24
- ○ 25
- ○ 26
- ○ 27
- ○ 28
- ○ 29
- ○ 30
- ○ 31
- ○ 32

- ○ 33
- ○ 34
- ○ 35
- ○ 36
- ○ 37
- ○ 38
- ○ 39
- ○ 40
- ○ 41
- ○ 42
- ○ 43
- ○ 44
- ○ 45
- ○ 46
- ○ 47
- ○ 48
- ○ 49
- ○ 50
- ○ 51
- ○ 52
- ○ 53
- ○ 54
- ○ 55
- ○ 56
- ○ 57
- ○ 58
- ○ 59

- ○ 60
- ○ 61
- ○ 62
- ○ 63
- ○ 64
- ○ 65
- ○ 66
- ○ 67
- ○ 68
- ○ 69
- ○ 70
- ○ 71
- ○ 72
- ○ 73
- ○ 74
- ○ 75
- ○ 76
- ○ 77
- ○ 78
- ○ 79
- ○ 80
- ○ 81
- ○ 82
- ○ 83
- ○ 84
- ○ 85
- ○ 86
- ○ 87

- ○ 88
- ○ 89
- ○ 90
- ○ 91
- ○ 92
- ○ 93
- ○ 94
- ○ 95
- ○ 96
- ○ 97
- ○ 98
- ○ 99
- ○ 100
- ○ More than 100

Experience as a gay/bi man

I would now you to answer some questions about your experience about being a gay/ bisexual man:

	Yes	No
Due to your sexual orientation were you ever made fun of as a child?	○	○
Due to your sexual orientation did you experience violence as a child?	○	○
Due to your sexual orientation have you experienced violence as an adult?	○	○
Due to your sexual orientation have you ever been made fun of as an adult?	○	○
As a child did you hear people say that gay men would grow up alone?	○	○
	Yes	No
As a child did you ever hear that gays are not normal?	○	○
As a child did you ever feel that your gayness hurt your family?	○	○
Have you ever had to pretend to be straight?	○	○

	Yes	No
Have you ever experienced job discrimination due to your sexual orientation?	○	○
Have you ever had to move away from family due to your sexual orientation?	○	○
	Yes	No
Have you ever experienced police harassment due to your sexual orientation?	○	○

Experiences as a gay/bi man page 2

I would now like you to answer some more questions about being a gay/ bisexual man. Please mark how much you agree with the following statements.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I doubt that I am homosexual but still am confused about who I am sexually	○	○	○	○	○
I don't act like most homosexuals do, so I doubt that I am homosexual	○	○	○	○	○
I have homosexual feelings but I doubt that I am homosexual	○	○	○	○	○
I cannot imagine sharing my homosexual feelings with anyone	○	○	○	○	○
I don't want people to know that I may be homosexual although I'm not sure if I am homosexual or not	○	○	○	○	○
	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I may be homosexual and I am upset about the thought of it	○	○	○	○	○
I dread having to deal with the fact that I may be homosexual	○	○	○	○	○
I'm probably homosexual even though I maintain a heterosexual image in both my personal and public life	○	○	○	○	○
I don't mind if homosexuals know that I have homosexual thoughts and feelings, but I don't want others to know	○	○	○	○	○

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I tolerate rather than accept my homosexual thoughts and feelings	○	○	○	○	○

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
My homosexuality is a valid private identity that I do not want to be made public	○	○	○	○	○
I am definitely homosexual but I do not share that knowledge with most people	○	○	○	○	○
I accept but would not say that I am proud of the fact that I am definitely homosexual	○	○	○	○	○
I am very proud to be gay and make it known to everyone around me	○	○	○	○	○
I frequently confront people about their irrational homophobic feelings	○	○	○	○	○

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I am not about to stay hidden as gay for anyone	○	○	○	○	○
I am openly gay with everyone, but it doesn't make me feel all that different from heterosexuals	○	○	○	○	○
My heterosexual friends, family and associates think of me as a person who happens to be gay, rather than as a gay person	○	○	○	○	○
I generally feel comfortable being the only gay person in a group of heterosexuals	○	○	○	○	○
I am openly gay around gays and heterosexuals	○	○	○	○	○

Experience of racism

I would now like you to answer some more questions about your experiences of race.

	Yes	No
Due to your race were you ever made fun of as a child?	○	○
Due to your race did you ever experience violence as a child?	○	○

Due to your race have you ever been made fun of as an adult?	○	○
Due to your race have you ever been treated rudely or unfairly?	○	○
Due to your race have you ever experienced police harassment?	○	○
Due to your race have you ever faced job discrimination?	○	○
Due to your race have you ever felt uncomfortable in white gay spaces?	○	○
Due to your race have you ever had difficulty in finding lovers?	○	○
Due to your race have you ever been objectified sexually?	○	○
Due to your race have you ever been rejected for sex?	○	○

Sex partner types

I would now like to you to answer some questions about your relationships.

In your entire life, have you had sex with: *

○ Only women

○ Only men

○ Both men and women

○ I've never had sex

Current relationship details

Are you currently in a sexual relationship?

○ Yes

○ No

Additional questions for those with male and female partners

Name of MRMSP

In the next few screens we're going to ask some questions about your most recent male sex partner -- that is, the last guy you had sex with.

To make the questions easier to ask, we'd like you to enter a nickname for this partner -- not his

real name, but maybe his initials, a pet name you have for him, or a word that will remind you of where you met him or what you liked best about him.

What is a nickname for the last man you had sex with?

| your last male partner |

MRMSP Age and race

We will next ask some questions about [question("value"), id="266"] .

Some questions will be about [question("value"), id="266"] in general and some will be about your relationship with [question("value"), id="266"].

What is [question("value"), id="266"]'s current age?
(if you an unsure of the exact age, choose an age that you think is close)

- ○ 19 or younger
- ○ 20
- ○ 21
- ○ 22
- ○ 23
- ○ 24
- ○ 25
- ○ 26
- ○ 27
- ○ 28
- ○ 29
- ○ 30
- ○ 31
- ○ 32
- ○ 33
- ○ 34

- 35
- 36
- 37
- 38
- 39
- 40
- 41
- 42
- 43
- 44
- 45
- 46
- 47
- 48
- 49
- 50
- 51
- 52
- 53
- 54
- 55
- 56
- 57
- 58
- 59
- 60
- 61
- 62

- 63
- 64
- 65
- 66
- 67
- 68
- 69
- 70
- 71
- 72
- 73
- 74
- 75
- 76
- 77
- 78
- 79
- 80
- 81
- 82
- 83
- 84
- 85
- 86
- 87
- 88
- 89

- ○ 90
- ○ 91
- ○ 92
- ○ 93
- ○ 94
- ○ 95
- ○ 96
- ○ 97
- ○ 98
- ○ 99
- ○ 100
- ○ (don't know)

Is [question("value"),id="266"] Hispanic?

- ○ Yes
- ○ No
- ○ Don't know

What race is [question("value"),id="266"]? *(check one)*

- ○ Asian/Pacific Islander
- ○ Black/African-American
- ○ White/Caucasian
- ○ Native American/Alaska Native
- ○ Mixed race
- ○ Don't know
- ○ Other

Is [question("value"),id="266"] someone that you feel or felt committed to above all others

(someone you might call your boyfriend, significant other, life partner, or husband)?

○ Yes

○ No

○ Don't know

Is [question("value"),id="266"] an exchange partner *(someone who you have sex with in exchange for money, drugs, food, or something else of value)*?

○ Yes

○ No

○ Don't know

Please rate the strength of your relationship with [question("value"),id="266"] on a scale from 1 (weak) to 10 (strong):

(weak)									*(strong)*
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
○	○	○	○	○	○	○	○	○	○

MRMSP first sex and disclosure

In what year did you **first** have sex with [question("value"), id="266"]?

○ 2010

○ 2009

○ 2008

○ 2007

○ 2006

○ 2005

○ 2004

○ 2003

○ 2002

○ 2001

○ 2000

○ 1999

○ 1998

○ 1997

○ 1996

○ 1995

○ 1994

○ 1993

○ 1992

○ 1991

○ 1990 or before

New Page

Did you and [question("value"),id="266"] talk about both your HIV status and his HIV status **before you first had sex**?

○ Yes

○ No

○ Don't know

New Page

In what year did you **most recently** have sex with [question("value"), id="266"]?

○ 2010

○ 2009

○ 2008

○ 2007

○ 2006

○ 2005

○ 2004

○ 2003

○ 2002

○ 2001

○ 2000

○ 1999

○ 1998

○ 1997

○ 1996

○ 1995

○ 1994

○ 1993

○ 1992

○ 1991

○ 1990 or before

Last sex timing and activities

The last time you had sex with [question("value"),id="266"], what kinds of sex did you have?

Please check all the types of sex you had.

☐ Oral sex (penis in the mouth)

☐ Anal sex (penis in the butt)

☐ Mutual masturbation (J/O)

☐ Frottage (rubbing against each other)

Last sex details (prurient)

Now we'd like to ask you about the last time you had sex with **[question("value"),id="266"]**.

The last time you had sex with [question("value"),id="266"], did you have receptive anal sex? (this means that you were the bottom)

○ Yes

○ No

○ Don't know

The last time you had sex with [question("value"),id="266"], did you have insertive anal sex? (this means that you were the top).

○ Yes

○ No

○ Don't know

Oral sex and condoms

The last time you had oral sex with [question("value"),id="266"], check which of these things happened -- or both.

☐ I gave him a blow job (his penis was in my mouth)

☐ He gave me a blow job (my penis was in his mouth)

Last sex: where, alcohol, drugs

We'd next like to ask some questions about the situation in which you and [question("value"),id="266"] last had sex.

Where were you and [question("value"),id="266"] the last time you had sex?

○ Sex club

○ Sex resort

○ Public restroom

○ Truck stop/rest area

○ Car

○ Local hotel room

○ The home that [question("value"),id="266"] and I share

○ Circuit party or rave

○ Bath house

○ My home

○ Park

○ [question("value"),id="266"]'s home

○ On vacation in a different city

○ Other, *please specify:*

[   ]

The last time you had sex with [question("value"),id="266"], were you buzzed or drunk on alcohol?

○ Yes

○ No

○ Don't know

The last time you had sex with [question("value"),id="266"], were you high on drugs?

○ Yes

○ No

○ Don't know

The last time you had sex with [question("value"),id="266"], did you know his/her HIV status?

○ Yes

○ No

○ Don't know

Hot states

This page asks some things about the last time you had sex with [question("value"),id="266"]. Think back to that time, and how you might have felt just before you had sex. Then please read the questions carefully, and mark any that apply to that last time you had sex with [question("value"),id="266"].

Check all statements that apply to the last time you had sex with [question("value"),id="266"]:

☐ [question("value"),id="266"] did not want to use a condom

☐ [question("value"),id="266"] was very, very hot and sexy

- ☐ I was lonely and depressed and had sex in order to feel good

- ☐ I was in love with [question("value"),id="266"]

- ☐ I was feeling very, very hot and horny

- ☐ I trusted [question("value"),id="266"] a lot

- ☐ I had to interrupt sex in order to look for condoms

- ☐ I felt like bringing up condoms would spoil a romantic, magic moment

- ☐ I was having sex in a public place and was afraid of getting caught

- ☐ I wanted to feel really close and connected to [question("value"),id="266"]

- ☐ I was having sex with a group of people, and none of them was using a condom

- ☐ I or [question("value"),id="266"] was having difficulty maintaining an erection

- ☐ I was afraid of losing [question("value"),id="266"]

- ☐ I really wanted to please [question("value"),id="266"]

- ☐ I was in a bookstore, sex club, backroom, or bathhouse, and was having a really good time

- ☐ [question("value"),id="266"] asked me to trust him

- ☐ I was too drunk/high to remember

- ☐ I felt afraid of [question("value"),id="266"] and could not mention condoms

- ☐ I felt [question("value"),id="266"] would abandon me if I asked to use condoms

Last sex with a woman

I would now like to ask you about the last time you had sex with a woman.

How long ago was the last time you had sex with a woman?

- ○ In the past month

- ○ 2-3 months ago

- ○ 4-6 months ago

- ○ 7-12 months ago

- ○ More than a year ago

The last time you had sex with a woman, did you have vaginal sex, where you put your penis in her vagina?

○ Yes

○ No

Condom errors

In the past 6 months, have you had anal sex as a top and used a condom?

○ Yes

○ No

HIV knowledge

The next set of questions ask about your HIV knowledge. For each statement, please click "True", "False", or "I don't know." If you do not know, please do not guess; instead, please click the button: "I don't know."

	True	False	Don't Know
A woman cannot get HIV if she has sex during her period.	○	○	○
A person can get HIV by sitting in a hot tub or a swimming pool with a person who has HIV.	○	○	○
Showering, or washing one's genitals/private parts, after sex keeps a person from getting HIV.	○	○	○
A natural skin condom works better against HIV than does a latex condom.	○	○	○
A person can get HIV by sharing a glass of water with someone who has HIV.	○	○	○
	True	False	Don't Know
There is a female condom that can help decrease a woman's chance of getting HIV.	○	○	○
A woman can get HIV if she has anal sex with a man.	○	○	○
A person can get HIV from oral sex.	○	○	○
There is a vaccine that can stop adults from getting HIV.	○	○	○
Using Vaseline or baby oil with condoms lowers the chance of			

	True	False	Don't Know
Using Vaseline or baby oil with condoms lowers the chances of getting HIV.	○	○	○

	True	False	Don't Know
All pregnant women infected with HIV will have babies born with AIDS.	○	○	○
Taking a test for HIV one week after having sex will tell a person if she or he has HIV.	○	○	○
People are likely to get HIV by deep kissing (putting their tongue in their partner's mouth), if their partner has HIV.	○	○	○
A person will NOT get HIV if he is taking antibiotics.	○	○	○
Coughing and sneezing DO NOT spread HIV.	○	○	○

	True	False	Don't Know
Having sex with more than one partner can increase a person's chance of becoming infected with HIV.	○	○	○
Pulling out the penis before a man climaxes/cums keeps his partner from getting HIV during sex.	○	○	○
People who have been infected with HIV quickly show serious signs of being infected.	○	○	○

Copy of HIV knowledge

The next set of questions ask about your HIV knowledge. For each statement, please click "True", "False", or "I don't know." If you do not know, please do not guess; instead, please click the button: "I don't know."

	True	False	Don't Know
A person will NOT get HIV if he is taking antibiotics.	○	○	○
People who have been infected with HIV quickly show serious signs of being infected.	○	○	○
A woman cannot get HIV if she has sex during her period.	○	○	○
Showering, or washing one's genitals/private parts, after sex keeps a person from getting HIV.	○	○	○
Using Vaseline or baby oil with condoms lowers the chance of getting HIV.	○	○	○

	True	False	Don't Know
Pulling out the penis before a man climaxes/cums keeps his	○	○	○

	True	False	Don't Know
partner from getting HIV during sex.	○	○	○
There is a female condom that can help decrease a woman's chance of getting HIV.	○	○	○
A person can get HIV from oral sex.	○	○	○
A person can get HIV by sharing a glass of water with someone who has HIV.	○	○	○
There is a vaccine that can stop adults from getting HIV.	○	○	○

	True	False	Don't Know
A person can get HIV by sitting in a hot tub or a swimming pool with a person who has HIV.	○	○	○
People are likely to get HIV by deep kissing (putting their tongue in their partner's mouth), if their partner has HIV.	○	○	○
A woman can get HIV if she has anal sex with a man.	○	○	○
Taking a test for HIV one week after having sex will tell a person if she or he has HIV.	○	○	○
All pregnant women infected with HIV will have babies born with AIDS.	○	○	○

	True	False	Don't Know
Having sex with more than one partner can increase a person's chance of becoming infected with HIV.	○	○	○
A natural skin condom works better against HIV than does a latex condom.	○	○	○
Coughing and sneezing DO NOT spread HIV.	○	○	○

Ever tested for HIV and when

Have you ever been tested for HIV?

○ Yes

○ No

○ Don't know

In what year did you was your **most recent** HIV test?

○ 2010

○ 2009

○ 2008

○ 2007

○ 2006

○ 2005

○ 2004

○ 2003

○ 2002

○ 2001

○ 2000

○ 1999

○ 1998

○ 1997

○ 1996

○ 1995

○ 1994

○ 1993

○ 1992

○ 1991

○ 1990 or before

New Page

Details of last HIV test

When you got tested in [question("value"), id="337"], where did you get tested?

○ Private doctor's office (including HMO)   ○ Sexually transmitted disease clinic

○ Emergency room   ○ HIV counseling and testing site

○ Military   ○ HIV/AIDS street outreach program/Mobile Unit

○ Community health center/public health clinic

○ Hospital (inpatient)

○ At home

○ Drug treatment program

○ Correctional facility (jail or prison)

○ Other

[_____]

○ Blood bank/Plasma center

What was the result of your most recent HIV test in [question("value"), id="337"]?

○ Negative

○ Positive

○ Indeterminant/Inconclusive

○ Didn't get the results of my last HIV test

○ Prefer not to Answer

For men with a male partner

If there were a service in which you could go with your male partner and receive your HIV test results together, do you think you would use this service?

○ Yes

○ No

New Page

The next questions ask about if you use lubrication, or "lube", for anal sex.

Have you heard of a liquid called water-based lubricant, or "lube", that you use when you are having anal sex to make it easier to insert the penis?

○ Yes

○ No

New Page

This question asks about how you would feel about two options after having an HIV test.

Imagine that you take an HIV rapid test in your doctor's office or in your community. After 20 minutes, the HIV counselor tells you that you have a "reactive" rapid test. She explains that this means that it's possible that you have HIV, but this result needs to be confirmed.

However, imagine you also know that: 5 out of 10 people (50%) with a reactive rapid test have HIV.

Would you prefer (click on one choice):

███████████████████████   ███████████████████████████

Kevin's questions on confirmatory testing

IPV

Please answer the following questions about things that you might have done in the past 12 months.

	Yes	No
In the last 12 months have any of your partners ever tried to hurt you, this includes pushing, holding you down, hitting you with his fist, kicking, attempting to strangle, attacking with a knife, gun or other weapon?	○	○
In the last 12 months have any of your partners ever used physical force or verbal threats to force you to have sex when you did not want to?	○	○
In the last 12 months have you ever tried to hurt any of your partners, this includes pushing, holding him down, hitting him with your fist, kicking, attempting to strangle, attacking with a knife, gun or other weapon?	○	○
In the last 12 months have you ever used physical force or verbal threats to force any of your partners to have sex when they did not want to?	○	○

New Page

Now we'll ask you some questions about health care.

Have you visited a doctor, nurse or health care provider in the past 12 months?

○ Yes

○ No

Hepatitis B previous diagnosis

Has a doctor or nurse ever told you that you have Hepatitis B?

- ○ Yes

- ○ No

- ○ Don't know

Hepatitis vaccine

A vaccine is a shot that can prevent you from getting certain infections or diseases. Hepatitis vaccine is given several times as a shot in the arm. Usually there are several months in between the shots. Have you ever had a vaccine for hepatitis?

- ○ Yes

- ○ No

- ○ Don't know

New Page

You mentioned more than one reason you didn't get a hepatitis vaccine. Of these reasons, which was the main reason you didn't get a vaccine?

New Page

Please say how much you agree or disagree with the following statements.

	Strongly Agree	Agree	Neither agree or disagree	Disagree	Strongly Disagree
Contracting HIV would be very serious to me	○	○	○	○	○
The thought of contracting HIV scares me	○	○	○	○	○
When I think about contracting HIV I feel nauseous	○	○	○	○	○
If I contracted HIV my career would be endangered	○	○	○	○	○

When I think about contracting HIV it makes me very anxious	○	○	○	○	○
Contracting HIV would jeopardize my relationship with my partner.	○	○	○	○	○
Contracting HIV would jeopardize my relationships with my family.	○	○	○	○	○
My views of myself would change dramatically if I contracted HIV.	○	○	○	○	○
My financial security would be greatly endangered if I contracted HIV.	○	○	○	○	○
Contracting HIV would be more serious than other diseases.	○	○	○	○	○
If I contracted HIV, my whole life would change.	○	○	○	○	○
Thinking about contracting HIV stops me from sleeping	○	○	○	○	○
Thinking about contracting HIV stops me from enjoying sex with my partner(s).	○	○	○	○	○

How serious would it be for YOU if:

	Not at all serious	A little serious	Somewhat serious	Serious	Very serious
YOU contracted HIV?	○	○	○	○	○
YOUR PARTNER contracted HIV?	○	○	○	○	○

Thank You!

Thank you for taking our survey. Your response is very important to us.

If you have questions or comments, you may contact the Principal Investigator, Dr. Rob Stephenson of Emory University, at RBSTEPH@EMORY.EDU.

To find an HIV testing location near you, please visit:

www.hivtest.org

To get more information about HIV, please visit:

www.cdc.gov/hiv

Otherwise, you can close your browser.

Annotated SAS 9.3 Programming Code

```
*Annotated code for African MSM;
*Data coding;
*Remove labels;

data temp1;
set brad.Africamsm;

*creating knowledge variable;

knowledge = 0;

if var102 = 1 then knowledge = 1;
if var103 = 0 then knowledge = knowledge +1;
if var104 = 0 then knowledge = knowledge +1;
if var105 = 1 then knowledge = knowledge +1;
if var106 = 0 then knowledge = knowledge +1;
if var107 = 0 then knowledge = knowledge +1;
if var108 = 0 then knowledge = knowledge +1;
if var109 = 0 then knowledge = knowledge +1;
if var110 = 0 then knowledge = knowledge +1;
if var111 = 0 then knowledge = knowledge +1;
if var112 = 1 then knowledge = knowledge +1;
if var113 = 0 then knowledge = knowledge +1;
if var114 = 0 then knowledge = knowledge +1;
if var115 = 1 then knowledge = knowledge +1;
if var116 = 0 then knowledge = knowledge +1;
if var117 = 0 then knowledge = knowledge +1;
if var118 = 1 then knowledge = knowledge +1;
if var119 = 0 then knowledge = knowledge +1;

*creating percent correct;
percent_correct = knowledge/18;

numanswered = 0;

array number{18} var102 var103 var104 var105 var106 var107 var108 var109 var110 var111 var112
var113 var114 var115 var116 var117 var118 var119;

do i = 1 to 18;
if number{i} = 1 then numanswered = numanswered + 1;
if number{i} = 0 then numanswered = numanswered + 1;
if number{i} = 9 then numanswered = numanswered + 1;
end;

*creating correct over number answered;
correctoveranswered = knowledge/numanswered;
```

```
percent_correct = percent_correct*100;
correctoveranswered = correctoveranswered*100;

*creating missing knowledge variable;

missingknowledge = knowledge;

array number{18} var102 var103 var104 var105 var106 var107 var108 var109 var110 var111 var112
var113 var114 var115 var116 var117 var118 var119;

do i = 1 to 18;
if number{i} = '.' then missingknowledge = '.';
end;

*removing formats;
Proc DataSets Lib = Brad;
Modify Africamsmnoformat;
FORMAT _all_;

*fixing implausible and inconsistent values;
if id = 103369597 then var50 = '.';
if id = 103689782 then var6 = 22;

*creating transformed knowledge variable to try linear regression;
logknowledge = log(knowledge);
sqrtknowledge = sqrt(knowledge);
eknowledge = exp(knowledge);
recipknowledge = 1/(knowledge);

*creating age category variables;

if var5 GE 18 and var5 LE 24 then agecat = 1;
if var5 GE 25 and var5 LE 29 then agecat = 2;
if var5 GE 30 and var5 LE 39 then agecat = 3;
if var5 GE 40 and var5 LE 49 then agecat = 4;
if var5 GE 50 and var5 LE 100 then agecat = 5;

*sub setting analyses to only MSM and eligible individuals;
if orient = '2' and var47 = '1' then delete;
if orient = '2' and var47 = '4' then delete;
if orient = '.' and var47 = '4' then delete;
if var83 = 2 then delete;
if var6 = 40 then var6 = '.';
if var5 = 16 then delete;
if var5 = 17 then delete;

*creating know any other gay/bisexual individuals variable also limiting number of gays known to 101;
if manygays LT 1100 then gayknown = 0;
```

```
if manygays GE 1100 then gayknown = 1;
if manygays = 1100 then manygays = 101;
if manygays = . then manygays2=0;
if manygays = . then manygays = 0;

*eliminating those who did not answer any knowledge questions;
if numanswered = 0 then delete;

*creating highschool or less variable;
if var6 LE 12 then HSorless = 1;
if var6 GT 12 then HSorless = 0;

*creating female sex partner variable;
if var47=1 then FSP = 1;
if var47=3 then FSP = 1;
if var47=2 then FSP = 0;
if var47=4 then FSP = 0;

*creating sexual orientation variables;
if orient=1 then Homosexual=1;else homosexual=0;
if orient=3 then Bisexual = 1;else bisexual=0;
if orient=2 then Otherorient = 1;
if orient=4 then Otherorient = 1;
if orient=5 then Otherorient = 1;
if orient=1 then Otherorient = 0;
if orient=3 then Otherorient = 0;
if orient=2 then NotHomosexual = 1;
if orient=4 then NotHomosexual = 1;
if orient=5 then NotHomosexual = 1;
if orient=1 then NotHomosexual = 0;
if orient=3 then NotHomosexual = 1;
if nothomosexual = . then nothomosexual = 0;

*creating HIV testing variable;
if evertest=1 and hresult=1 then Testpositive=1;else testpositive=0;
if evertest=0 then nevertest = 1;else nevertest=0;
if evertest=1 and hresult=0 then testnegative=1;
if evertest=1 and hresult=2 then testnegative=1;
if evertest=1 and hresult=3 then testnegative=1;
if evertest=1 and hresult=7 then testnegative=1;
if evertest=1 and hresult=1 then testnegative=0;
if testnegative = . then testnegative = 0;
if evertest = . and hresult = . then nevertest = 1;

*creating race variables;
if race = 1000 then BlackAfrican = 1; else BlackAfrican = 0;
if race = 1001 then WhiteEuropeanAfrican = 1; else WhiteEuropeanAfrican = 0;
if race = 1002 then Otherrace = 1;
```

```
if race = 1003 then Otherrace = 1;
if race = 1004 then Otherrace = 1;
if race = 1001 then Otherrace = 0;
if race = 1000 then Otherrace = 0;
if Otherrace = . then Otherrace = 0;

*creating condom use and anal / vaginal sex variables;
if var56 = 1000 then condomwholetime = 1; else condomwholetime = 0;
if var56 = 1001 then condomparttime = 1; else condomparttime = 0;
if var56 = 1002 then condomnotatall = 1; else condomnotatall = 0;
if var56 = 1000 then analnocondom = 0;
if var56 = 1001 then analnocondom = 0;
if var56 = 1002 then analnocondom = 1;
if analnocondom = . then analnocondom = 0;
if var64 = 1002 then vagnocondom = 1;else vagnocondom=0;
if var55 = 1001 then noanallasttime = 1;
if var55 = '.' then noanallasttime = 1;
if noanallasttime = '.' then noanallasttime = 0;
if var56 = 1002 then analnocondom2 = 1;
if var56 = 1001 then analnocondom2 = 1;
if analnocondom2 = '.' then analnocondom2 = 0;
if var56 = 1000 then analusecondom = 1; else analusecondom = 0;
if var55 = 1000 then do;
if var56 = 1001 then condomuse = 1;
if var56 = 1002 then nocondomuse = 1;
if var56 = 1000 then condomuse = 1;
if var55 = 1001 then condomuse = 0;
if var55 = 1001 then nocondomuse = 0;
if var56 = '.' then nocondomuse = 1;
if var56 = '.' then condomuse = 0;
end;

if nocondomuse = '.' then nocondomuse = 0;
if condomuse = '.' then condomuse = 0;
if var55 = 1001 then noanalsexlasttime = 1;
if var55 = 1000 then noanalsexlasttime = 0;
if var55 = '.' then noanalsexlasttime = 1;
where condomuse = 0 and nocondomuse = 0 and noanalsexlasttime = 0;

*creating relationship variable;
if relate = 1000 then inrelationship = 1;
if relate = 1001 then inrelationship = 0;
if relate = . then inrelationship = 0;

*creating employment variable;
if employ = 1000 then employed = 1;
if employ = 1001 then employed = 0;
if employ = . then employed = 0;
```

```
if employed = . then employed = 0;
if employ = 1001 then notemployed = 1; else notemployed = 0;


*creating median or above variable and lowest knowledge variables;
if knowledge GE 16 then medianorabove = 1; else medianorabove = 0;
if knowledge LE 14 then lowestquarter = 1; else lowestquarter = 0;
if knowledge LE 13 then lowestfifth = 1; else lowestfifth = 0;


*creating initial homophobia variables before creating gay identity index;
if var30 = 4 then incloset = 1;
if var30 = 5 then incloset = 1;
if var31 = 4 then upset = 1;
if var31 = 5 then upset = 1;
if incloset = . then incloset = 0;
if upset = . then upset = 0;
if var32 = 4 then nodeal = 1;
if var32 = 5 then nodeal = 1;
if nodeal = . then nodeal = 0;
if var36 = 4 then private = 1;
if var36 = 5 then private = 1;
if private = . then private = 0;
if var44 = 4 then comfortable = 1;
if var44 = 5 then comfortable = 1;
if comfortable = . then comfortable = 0;
if var45 = 4 then comfortable2 = 1;
if var45 = 5 then comfortable2 = 1;
if comfortable2 = . then comfortable2 = 0;
if var15 = 1000 then violencechild = 1; else violencechild = 0;
if var19 = 1000 then notnormal = 1; else notnormal = 0;
if var24 = 1000 then violencepolice = 1; else violencepolice = 0;


*creating lube use variable;
if var76 = 1000 then nolube = 0;else nolube = 1;
if var76 = 1000 then usedlube = 1; else usedlube = 0;


*creating gay identity scale homophobia index;
homophobia = 0;

array number{13} var26-var38;

do i = 1 to 13;
if number{i} = 1 then homophobia = homophobia - 2;
if number{i} = 2 then homophobia = homophobia - 1;
if number{i} = 4 then homophobia = homophobia + 1;
if number{i} = 5 then homophobia = homophobia + 2;
end;

array number{7} var39-var45;
```

```
do i = 1 to 7;
if number{i} = 1 then homophobia = homophobia + 2;
if number{i} = 2 then homophobia = homophobia + 1;
if number{i} = 4 then homophobia = homophobia - 1;
if number{i} = 5 then homophobia = homophobia - 2;
end;

homophobanswer = 0;

array number{20} var26-var45;

do i = 1 to 20;
if number{i} = 1 then homophobanswer = homophobanswer + 1;
if number{i} = 2 then homophobanswer = homophobanswer + 1;
if number{i} = 3 then homophobanswer = homophobanswer + 1;
if number{i} = 4 then homophobanswer = homophobanswer + 1;
if number{i} = 5 then homophobanswer = homophobanswer + 1;
end;

homophobiaadded = homophobia+40;

*FOLLOWING INITIAL SUBMISSION TO PLOS ONE, REVISIONS = DO NOT FORCE DEMOGRAPHIC DATA
INTO ANY MODEL, ENSURE THAT ONLY "TRUE" MSM ARE INCLUDED, USE ONLY SOUTH AFRICAN MSM;

*creating clarified age variable;
if agecat = 1 then a1824 = 1; else a1824 =0;
if agecat = 2 then a2530 = 1; else a2530 =0;
if agecat = 3 then a3040 = 1; else a3040 =0;
if agecat = 4 then a4050 = 1; else a4050=0;
if agecat = 5 then a50plus = 1; else a50plus =0;

*limiting to South Africa;
if country NE 1000 then delete;

*limiting to "TRUE" MSM;
if var47=4 then delete;
run;

*revised model for South Africa only;
proc logistic data=temp1 descending;
model lowestfifth = notemployed manygays nolube HSorless testnegative testpositive /rsq lackfit;
units manygays = 10 50 100;
contrast 'moo' manygays 10;
test testpositive, testnegative;
run;

*Annotated code for US MSM;
```

```
*Data coding;
*Remove labels;
data temp1;
set bradus.usmsm;

PROC DATASETS lib=bradus;
        MODIFY usmsmfullnoformat;
        FORMAT _all_;
        INFORMAT _all_;
        end;
proc datasets lib=work;
        modify temp1;
        attrib _all_ label='';
        end;

*building knowledge variables;
knowledge = 0;

if var102 = 1 then knowledge = 1;
if var103 = 0 then knowledge = knowledge +1;
if var104 = 0 then knowledge = knowledge +1;
if var105 = 1 then knowledge = knowledge +1;
if var106 = 0 then knowledge = knowledge +1;
if var107 = 0 then knowledge = knowledge +1;
if var108 = 0 then knowledge = knowledge +1;
if var109 = 0 then knowledge = knowledge +1;
if var110 = 0 then knowledge = knowledge +1;
if var111 = 0 then knowledge = knowledge +1;
if var112 = 1 then knowledge = knowledge +1;
if var113 = 0 then knowledge = knowledge +1;
if var114 = 0 then knowledge = knowledge +1;
if var115 = 1 then knowledge = knowledge +1;
if var116 = 0 then knowledge = knowledge +1;
if var117 = 0 then knowledge = knowledge +1;
if var118 = 1 then knowledge = knowledge +1;
if var119 = 0 then knowledge = knowledge +1;
percent_correct = knowledge/18;

*number of knowledge questions answered
numanswered = 0;

array number{18} var102 var103 var104 var105 var106 var107 var108 var109 var110 var111 var112
var113 var114 var115 var116 var117 var118 var119;

do i = 1 to 18;
if number{i} = 1 then numanswered = numanswered + 1;
if number{i} = 0 then numanswered = numanswered + 1;
if number{i} = 9 then numanswered = numanswered + 1;
```

```
end;

*number correct over number answered and percent_correct;
correctoveranswered = knowledge/numanswered;
percent_correct = percent_correct*100;

*number missing;
missingknowledge = knowledge;

array number{18} var102 var103 var104 var105 var106 var107 var108 var109 var110 var111 var112
var113 var114 var115 var116 var117 var118 var119;

do i = 1 to 18;
if number{i} = '.' then missingknowledge = missingknowledge +1;
end;

*crosschecking number missing;
missingknowledge = 18-numanswered;

*creating age variable;
if var5 GE 18 and v5 LE 24 then agecat = 1;
if var5 GE 25 and v5 LE 29 then agecat = 2;
if var5 GE 30 and v5 LE 39 then agecat = 3;
if var5 GE 40 and v5 LE 49 then agecat = 4;
if var5 GE 50 and v5 LE 100 then agecat = 5;

*eliminating ineligibles;
if var83 = 2 then delete;
if var8 = '2' and var47 = '1' then delete;
if var8= '2' and var47 = '4' then delete;
if numanswered = 0 then delete;

*creating education variables;
if var126=1 then GreaterthanHS=1;
if var126=2 then Greaterthanhs=1;
if var126=3 then GreaterthanHS=0;
if var126=4 then Greaterthanhs=0;
if var126=5 then GreaterthanHS=0;
if var126=6 then Greaterthanhs=0;
if var126=9 then GreaterthanHS=0;
if var126=1 then HSorless=0;
if var126=2 then HSorless=0;
if var126=3 then HSorless=1;
if var126=4 then HSorless=1;
if var126=5 then HSorless=1;
if var126=6 then HSorless=1;
if var126=9 then HSorless=1;
if HSorless = . then HSorless = 0;
```

```
*creating female sex partner variables;
if var47=1 then FSP = 1;
if var47=3 then FSP = 1;
if var47=2 then FSP = 0;
if var47=4 then FSP = 0;
if FSP = . then FSP = 0;

*creating homosexual and bisexual variables;
if var8=1 then Homosexual=1;else homosexual=0;
if var8=3 then Bisexual = 1;else bisexual=0;
if var8=2 then NotHomosexual = 1;
if var8=4 then NotHomosexual = 1;
if var8=5 then NotHomosexual = 1;
if var8=1 then NotHomosexual = 0;
if var8=3 then NotHomosexual = 1;
if Nothomosexual = . then Nothomosexual = 0;

*creating orientation variables;
if var8=2 then Otherorient = 1;
if var8=4 then Otherorient = 1;
if var8=5 then Otherorient = 1;
if var8=1 then Otherorient=0;
if var8=3 then Otherorient=0;
if otherorient = . then otherorient = 0;
if otherrace = . then otherrace = 0;

*creating testing variables;
if var66=1 and var73=1 then Testpositive=1;else testpositive=0;
if var66=0 then nevertest = 1;else nevertest=0;
if var66=1 and var73=0 then testnegative=1;
if var66=1 and var73=2 then testnegative=1;
if var66=1 and var73=3 then testnegative=1;
if var66=1 and var73=7 then testnegative=1;
if var66=1 and var73=1 then testnegative=0;
if testnegative = . then testnegative = 0;

*fixing data entry inconsistencies or implausible values;
if var12 = . then var12=0;
if var12 = 10238 then var12=101;

*creating relationship variable;
if var48 = 10250 then relationship =1;
if var48 = 10251 then relationship =0;

*creating employed variable;
if var7 = 10120 then Employedd = 1;
if var7 = 10121 then Employedd = 0;
```

```
*creating race variables;
if var122 = 1 then Hispanic =1; else Hispanic = 0;
if var123 = 2 then BlackNH = 1;
if var123 = 2 and var122=1 then BlackNH = 0;
if var123 = 3 then WhiteNH = 1;
if var123 = 3 and var122=1 then WhiteNH = 0;
if var123 = 2 then Otherrace = 0;
if var123 = 3 then Otherrace = 0;
if var123 = 1 then Otherrace = 1;
if var123 = 4 then Otherrace = 1;
if var123 = 5 then Otherrace = 1;
if var123 = 6 then Otherrace = 1;
if var123 = 7 then Otherrace = 0;
if var122 = 1 then Otherrace = 0;

*creating condom use variables;
if var276 = 1 then analnocondom1 = 1;
if var276 = 2 then analnocondom1 = 1;
if var276 = 3 then analnocondom1 = 0;
if var276 = 4 then analnocondom1 = 1;
if var276 = 9 then analnocondom1 = 1;
if var279 = 1 then analnocondom1 = 1;
if var279 = 2 then analnocondom1 = 1;
if var279 = 3 then analnocondom1 = 0;
if var279 = 4 then analnocondom1 = 1;
if var279 = 9 then analnocondom1 = 1;
if var276 = 1 then condomwholetime = 0;
if var276 = 2 then condomwholetime = 0;
if var276 = 3 then condomwholetime = 1;
if var276 = 4 then condomwholetime = 0;
if var276 = 9 then condomwholetime = 0;
if var276 = 1 then condomparttime = 0;
if var276 = 2 then condomparttime = 1;
if var276 = 3 then condomparttime = 0;
if var276 = 4 then condomparttime = 1;
if var276 = 9 then condomparttime = 0;
if var276 = 1 then condomnotatall = 1;
if var276 = 2 then condomnotatall = 0;
if var276 = 3 then condomnotatall = 0;
if var276 = 4 then condomnotatall = 0;
if var276 = 9 then condomnotatall = 0;
if var279 = 1 then condomwholetime2 = 0;
if var279 = 2 then condomwholetime2 = 0;
if var279 = 3 then condomwholetime2 = 1;
if var279 = 4 then condomwholetime2 = 0;
if var279 = 9 then condomwholetime2 = 0;
if var279 = 1 then condomparttime2 = 0;
```

```
if var279 = 2 then condomparttime2 = 1;
if var279 = 3 then condomparttime2 = 0;
if var279 = 4 then condomparttime2 = 1;
if var279 = 9 then condomparttime2 = 0;
if var279 = 1 then condomnotatall2 = 1;
if var279 = 2 then condomnotatall2 = 0;
if var279 = 3 then condomnotatall2 = 0;
if var279 = 4 then condomnotatall2 = 0;
if var279 = 9 then condomnotatall2 = 0;
if condomwholetime = . then condomwholetime = 0;
if condomparttime = . then condomparttime = 0;
if condomnotatall = . then condomnotatall = 0;
if condomwholetime2 = . then condomwholetime2 = 0;
if condomparttime2 = . then condomparttime2 = 0;
if condomnotatall2 = . then condomnotatall2 = 0;
if condomwholetime = 1 and condomwholetime2 = 1 then condomwholetime5 = 1; else
condomwholetime = 0;
if condomparttime = 1 and condomparttime2 = 1 then condomparttime5 = 1;
if condomparttime = 1 and condomparttime2 = 0 then condomparttime5 = 1;
if condomparttime = 0 and condomparttime2 = 1 then condomparttime5 = 1;
if condomnotatall = 1 and condomnotatall2 = 1 then condomnotatall5 = 1;
if condomwholetime5 = . then condomwholetime5 = 0;
if condomparttime5 = . then condomparttime5 = 0;
if condomnotatall5 = . then condomnotatall5 = 0;
if var279 = 1 then analnocondom2 = 1;
if var279 = 2 then analnocondom2 = 1;
if var279 = 3 then analnocondom2 = 0;
if var279 = 4 then analnocondom2 = 1;
if var279 = 9 then analnocondom2 = 1;
if analnocondom = . then analnocondom = 0;
if analnocondom = 1 then analnocondom2 = 1;
if analnocondom = 0 then analnocondom2 = 0;
if analnocondom = '.' then analnocondom2 = 0;
if var276 = 1 then RAnocondom = 1;
if var276 = 2 then RAnocondom = 0;
if var276 = 3 then RAnocondom = 0;
if var276 = 4 then RAnocondom = 0;
if var276 = 9 then RAnocondom = 0;
if var279 = 1 then IAnocondom = 1;
if var279 = 2 then IAnocondom = 0;
if var279 = 3 then IAnocondom = 0;
if var279 = 4 then IAnocondom = 0;
if var279 = 9 then IAnocondom = 0;
if RAnocondom = . then RAnocondom = 0;
if IAnocondom = . then IAnocondom = 0;

*creating median or above knowledge variable, lowest fifth variable, and other cut off values for
sensitivity analyses;
```

```
if knowledge GE 16 then medianorabove = 1; else medianorabove = 0;
if knowledge LE 13 then lowestfifth = 1; else lowestfifth = 0;
if knowledge LE 11 then eleven = 1; else eleven = 0;
if knowledge LE 12 then twelve = 1; else twelve = 0;
if knowledge LE 14 then fourteen = 1; else fourteen = 0;
if knowledge LE 15 then fifteen = 1; else fifteen = 0;

*creating initial homophobia variables BEFORE data was categorized into gay identity index.
if var15 = 10239 then violencechild = 1; else violencechild = 0;
if var19 = 10239 then notnormal = 1; else notnormal = 0;
if var24 = 10239 then violencepolice = 1; else violencepolice = 0;
if var30 = 4 then incloset = 1;
if var30 = 5 then incloset = 1;
if var31 = 4 then upset = 1;
if var31 = 5 then upset = 1;
if incloset = . then incloset = 0;
if upset = . then upset = 0;
if var32 = 4 then nodeal = 1;
if var32 = 5 then nodeal = 1;
if nodeal = . then nodeal = 0;
if var36 = 4 then private = 1;
if var36 = 5 then private = 1;
if private = . then private = 0;
if var44 = 4 then comfortable = 1;
if var44 = 5 then comfortable = 1;
if comfortable = . then comfortable = 0;
if var45 = 4 then comfortable2 = 1;
if var45 = 5 then comfortable2 = 1;
if comfortable2 = . then comfortable2 = 0;

*creating lubrication variable and different condom variables;
set bradus.stigmaanalyze;
if var96 = 1 then condomchange = 1;
if condomchange = . then condomchange = 0;
if var76 = 10357 then nolube = 0; else nolube = 1;
if var76 = 10357 then usedlube = 1; else usedlube = 0;
if noanallasttime = 1 then nocondom = 0;
if noanallasttime = 1 then condom = 0;
if var276 = 1 then nocondom = 1;
if var279 = 1 then nocondom = 1;
if var276 = 9 then nocondom = 1;
if var279 = 9 then nocondom =1;
if var276 = 2 then condom = 1;
if var276 = 3 then condom = 1;
if var276 = 4 then condom = 1;
if var279 = 2 then condom = 1;
if var279 = 3 then condom = 1;
if var279 = 4 then condom = 1;
```

```
if nocondom = 1 then condom = 0;
if condom = 1 then nocondom = 0;
if condom ='.' then condom = 0;
if nocondom ='.' then nocondom =1;

*fixing other implausible values;
if VRID = 4328 then noanallasttime = 0;
if VRID = 4328 then condom = 1;

*creating no anal last sex variable;
if var295O743 = 1 then noanallasttime = 0;
if var295O743 = 0 then noanallasttime = 1;

*fixing testing variables and implausible values;
if VRID = 3174 then testnegative = 1;
if VRID = 4170 then nevertest = 1;
if VRID = 2996 then nevertest = 1;
if VRID = 3304 then testnegative = 1;
if VRID = 4328 then testnegative = 1;
if VRID = 1622 then nevertest = 1;
if VRID = 3832 then testnegative = 1;
if VRID = 750 then testnegative = 1;
if VRID = 2648 then nevertest = 1;
if VRID = 3029 then nevertest = 1;
if VRID = 2264 then testnegative = 1;
if VRID = 2555 then testnegative = 1;

*creating homophobia index variables;
homophobia = 0;

array number{13} var26-var38;

do i = 1 to 13;
if number{i} = 1 then homophobia = homophobia - 2;
if number{i} = 2 then homophobia = homophobia - 1;
if number{i} = 4 then homophobia = homophobia + 1;
if number{i} = 5 then homophobia = homophobia + 2;
end;

array number{7} var39-var45;

do i = 1 to 7;
if number{i} = 1 then homophobia = homophobia + 2;
if number{i} = 2 then homophobia = homophobia + 1;
if number{i} = 4 then homophobia = homophobia - 1;
if number{i} = 5 then homophobia = homophobia - 2;
end;
```

```
*creating variable number of homophobia questions answered:
homophobanswer = 0;

array number{20} var26-var45;

do i = 1 to 20;
if number{i} = 1 then homophobanswer = homophobanswer + 1;
if number{i} = 2 then homophobanswer = homophobanswer + 1;
if number{i} = 3 then homophobanswer = homophobanswer + 1;
if number{i} = 4 then homophobanswer = homophobanswer + 1;
if number{i} = 5 then homophobanswer = homophobanswer + 1;
end;

*creating final gay identity index;
if homophobanswer GE 1 then do;
homophobiaadded = homophobia + 40;

*fixing coding errors and implausible values;
if whiteNH = 0 and BlackNH=0 and Hispanic=0 and otherrace=0 then otherrace=1;

*FOLLOWING INITIAL SUBMISSION TO PLOS ONE, REVISIONS = DO NOT FORCE DEMOGRAPHIC DATA
INTO ANY MODEL, ENSURE THAT ONLY "TRUE" MSM ARE INCLUDED;

if var47=. then delete;
if var47=1 then delete;
if var47=4 then delete;

*clarifying age category variable;
if agecat = 1 then a1824 = 1; else a1824 =0;
if agecat = 2 then a2530 = 1; else a2530 =0;
if agecat = 3 then a3040 = 1; else a3040 =0;
if agecat = 4 then a4050 = 1; else a4050=0;
if agecat = 5 then a50plus = 1; else a50plus =0;

*creating variables for ttests;
if numanswered = 0 then allmiss = 1; else allmiss = 0;

run;

*initial model;
proc logistic data=temp1 descending;
model eleven = var5 condom nocondom homophobiaadded nolube HSorless testpositive testnegative
hispanic blackNH otherrace/rsq lackfit;
units homophobiaadded = 5 10 20;
test condom, nocondom;
test testpositive, testnegative;
test hispanic,blackNH,otherrace;
run;
```

```
*revised model;
proc logistic data=temp1 descending;
model lowestfifth = homophobiaadded testpositive testnegative a2530 a3040 a4050 a50plus
testpositive testnegative HSorless hispanic blackNH otherrace/rsq lackfit;
units homophobiaadded = 5 10 20;
contrast 'homophob' homophobiaadded 10;
test testpositive, testnegative;
test hispanic,blackNH,otherrace;
test a2530,a3040,a4050,a50plus;
run;

*ttests;
proc ttest data=temp1;
class allmiss;
var var12;
run;
```

IRB approval

EMORY UNIVERSITY | Institutional Review Board

TO: Robert Stephenson, PhD
        Principal Investigator

CC: Sullivan   Patrick   Epidemiology

DATE: June 18, 2010

RE: **Notification of Exempt Approval**
        IRB00044470
        An online survey of men who have sex with men in South Africa, Namibia, Kenya and
        Ivory Coast

This is your notification that your above referenced study has received Exempt approval on:
6/18/2010.

The research study cited above has been reviewed and it has been determined that it meets the
criteria for exemption under 45 CFR 46.101(b)(2) and thus is exempt from further IRB rerview.
The IRB will be apprised of this decision at its next meeting.

In addition a waiver of documentation of informed consent was granted.

Any reportable events (serious adverse events, breaches of confidentiality, protocol deviation or
protocol violations) or issues resulting from this study should be reported immediately to the IRB
and to the sponsoring agency (if any). Any amendments (changes to any portion of this research
study including but not limited to protocol or informed consent changes) must have IRB approval
before being implemented.

All correspondence and inquires concerning this research study must include the IRB ID, the
name of the Principal Investigator and the Study Title.

Sincerely,

Donna Dent, MS, MISM, CIP
Lead, Research Protocol Analyst
Emory University Institutional Review Board
This letter has been digitally signed

Published Paper in Public Library of Science One (PLoS ONE)

PLoS one

HIV Knowledge and Associated Factors among Internet-Using Men Who Have Sex with Men (MSM) in South Africa and the United States

Bradley H. Wagenaar[1]*, Patrick S. Sullivan[1], Rob Stephenson[2]

1 Department of Epidemiology, Rollins School of Public Health, Emory University, Atlanta, Georgia, United States of America, **2** Hubert Department of Global Health, Rollins School of Public Health, Emory University, Atlanta, Georgia, United States of America

Abstract

Background: We compared factors associated with low HIV/AIDS knowledge among internet-using MSM in South Africa and the United States.

Methods: 1,154 MSM in the US and 439 MSM in South Africa, recruited through Facebook.com, completed an online survey using a US-validated HIV knowledge scale (HIV-KQ-18). Separate multivariable logistic regression models were built, one for the US and one for South Africa, using a dichotomized variable of scoring less than and equal to 13/18 ("low knowledge") on the HIV-KQ-18 as outcome.

Results: Median knowledge scores were 16/18 for both groups of respondents. For South African MSM, factors associated with low knowledge were: a high school education or less (adjusted odds ratio [aOR]: 2.5, 95% confidence interval [CI]: 1.4–4.6), not using condom-compatible lubrication during last anal sex with another man (aOR: 1.9, CI: 1.0–3.5), number of gay or bisexual acquaintances (aOR: 0.89, CI: 0.81–0.99), being unemployed (aOR: 2.2, CI: 1.0–4.6), and testing HIV negative (aOR: 0.30, CI: 0.16–0.59) or testing HIV positive (aOR: 0.15, CI: 0.03–0.74) compared to those never HIV tested. For US MSM, associated factors were: a high school education or less (aOR: 2.7, CI: 1.9–3.8), low pride and acceptance of homosexuality (aOR: 1.3, CI: 1.2–1.5), age 18–24 (aOR: 2.3, CI: 1.3–3.8) or age 50+ (aOR: 3.2, CI: 1.6–6.3) compared to age 25–29, Hispanic ethnicity compared to white non-Hispanic (aOR: 1.9, CI: 1.1–3.2), and testing HIV positive (aOR: 0.34, CI: 0.16–0.69) or testing HIV negative (aOR: 0.59, CI: 0.39–0.89) compared to those tested.

Conclusions: Those developing programs for MSM in South Africa should weigh these data and other relevant factors, and might consider focusing education services towards MSM with limited education, less integration into gay/bisexual communities, no HIV testing history, limited use of condom-compatible lube, and the unemployed. In the United States, Hispanic MSM, those with limited education, no HIV testing history, low pride/acceptance of homosexuality, and those aged 18–24 or 50+ may be at risk for gaps in HIV knowledge.

Introduction

Since the emergence of HIV as a global pandemic in the 1980s, men who have sex with men (MSM) have shared a disproportionately large burden of infection in many high-income countries in Western and Central Europe, Australia, and North America [1]. Due to this recognized high burden, MSM represent a large target population for resources on HIV/AIDS prevention, treatment, and research in these areas. By contrast, Africa's HIV/AIDS epidemic has long been understood primarily as a "heterosexual epidemic", with an estimated 80% of HIV infections being tied to heterosexual transmission [2]. This focus has led to HIV/AIDS prevention efforts in Africa being targeted primarily to heterosexuals.

Recent epidemiological evidence has shown that MSM in Africa share a disproportionate burden of HIV infection [3]. Prevalence estimates of MSM in Africa range from 1–4% of the general population, but high levels of HIV infection and a high prevalence of MSM also engaging in sex with women has led MSM transmission to be linked to over 20% of all HIV cases in several countries of the Middle East, North Africa, and West Africa [4–6]. These data are at odds with the fact that most African countries have not dedicated any national HIV/AIDS funds to specifically target HIV/AIDS among MSM [6].

The 2009 UNAIDS report on universal access for MSM and transgender people highlights the global failure in addressing the needs of MSM regarding HIV/AIDS education, prevention, treatment, research, and care. One of the foci of this report is increasing access to HIV/AIDS prevention materials for MSM and transgender individuals [7]. Although increasing HIV/AIDS knowledge alone is not sufficient to promote sustainable behavior

change, accurate knowledge of transmission and prevention of HIV is necessary if MSM are to adopt risk reduction strategies.

Globally, reporting on HIV knowledge among MSM is sparse. Only 33 out of 147 low and middle income countries (LMIC) reported knowledge data through the 2008 United Nations General Assembly Special Session (UNGASS) [8]. Only 2 of these 37 countries reporting UNGASS HIV knowledge data were in Africa, with Nigeria and Mauritius reporting that only 44% and 48% of MSM respectively could "correctly identify ways of preventing sexual transmission of HIV and could correctly reject major misconceptions about HIV transmission" [8]. Additionally, across all low and middle-income countries reporting knowledge scores, less than half of MSM held correct HIV knowledge.

Other studies from Sudan and Kenya indicate that MSM in Africa may have low knowledge regarding HIV prevention and transmission. More than half (55%) of a sample of MSM in Sudan and 35% of respondents in Mombasa, Kenya did not understand the link between anal sex and HIV infection [9–10]. By contrast, over 90% of samples of MSM in Malawi, Botswana, and Namibia understood that HIV can be transmitted through anal sex with a man [11]. However, of these samples, only 57%, 50%, and 85% respectively had ever received educational materials on preventing HIV transmission between men.

Data on levels and correlates of HIV/AIDS knowledge in Africa are essential to develop effective prevention and education strategies. Previous studies of HIV knowledge among MSM have focused on levels of HIV knowledge, but have not systematically examined factors associated with low knowledge. The present study aims to fill this gap by examining factors associated with low HIV/AIDS knowledge among MSM in South Africa and the United States using a validated HIV knowledge scale.

We chose to focus on South African and US MSM because: (1) the HIV-KQ-18 knowledge scale has only been previously validated and described among populations in the US, (2) South Africa has a large population of people living with HIV/AIDS, representing 25% of all those living in Sub-Saharan Africa, and (3) there is emerging evidence that MSM in South Africa share a disproportionate burden of HIV infection [1,12]. This information will support the development and scale up of educational programs to address the specific needs of MSM, and may aid in optimizing existing prevention programs for MSM.

Methods

1,154 internet-using MSM in the United States and 439 in South Africa were recruited through banner advertisements on Facebook.com targeted to men who stated they were interested in men on their Facebook profiles. Facebook ads were displayed in South Africa from June 1 to June 30, 2010 and in all US states from October 1 to November 30, 2010. Banner ads included a range of images, including groups of men, individual men of a range of ethnic and racial backgrounds, and rainbow-themed images. Facebook users who clicked on the banner ads were taken to an internet-based survey. To be eligible to begin the survey men had to report male-to-male sex in the past year.

The survey collected information on participant demographics (age, race, education, and employment), sexual orientation, the number of friends, colleagues, or acquaintances they felt identified as gay or bisexual, HIV testing behavior, knowledge of HIV transmission, condom and water-based lubrication use, and questions on gay identity. HIV knowledge was quantified using the brief HIV knowledge scale (HIV-KQ-18), an internally consistent and stable HIV knowledge scale shown to

be appropriate for low-literacy populations [13]. Questions in the HIV-KQ-18 focus on basic HIV transmission and prevention and are summed to form an index of overall HIV knowledge (0–18) with non-responses and "don't know" coded as incorrect.

Gay identity was quantified using a modified version of the US-validated "Gay Identity Questionnaire" consisting of 20 questions summed to form an index of decreasing pride and acceptance of homosexuality as one moves from 0 to 80 [14]. Race in the US was classified into white non-Hispanic, black non-Hispanic, Hispanic, and other (including Asian/Pacific Islander, Native American/Alaska Native, Multi-Racial, and other). Race in South Africa was classified into black African, white/European/African, and other (including Asian, colored, and other). For both groups of respondents, individuals responding "don't know" for previous HIV testing were coded as not being tested and individuals who indicated receiving "indeterminate" HIV results were coded as testing HIV negative.

Statistical analyses were conducted using SAS 9.2 (Cary, NC, USA). Statistical significance was assessed using an alpha value of .05 and two-tailed tests. Individuals were excluded from analyses if they did not report being male and having had male-to-male sex in the past year (n = 15 US; n = 80 South Africa) or if no knowledge questions were answered (n = 883 US; n = 85 South Africa). Individuals excluded for not answering any knowledge questions did not have significantly different age or gay/bisexual peer network distributions using t-tests.

Separate multivariable logistic regression models were built, one for the US and one for South Africa, using the dichotomous "low knowledge" variable as our outcome. Knowledge scores were dichotomized using a data-derived cutoff of greater than or less than and equal to 13/18 correct, with 19.9% and 15.3% scoring at this level or below in the US and South Africa respectively (Figure 1; Figure 2). We dichotomized knowledge this way because the proportional odds assumption was grossly violated for use of ordinal logistic regression with raw scores, and because there is no standard cutoff for a critical level of knowledge for the HIV-KQ-18. As a sensitivity analysis, changing this "critical knowledge" cutoff to other possible cut points of 14, 15, or 16 out of 18 correct on the knowledge scale did not meaningfully change factors associated or their magnitudes.

Variables considered for inclusion into each model were age, race, education, sexual orientation, HIV testing behavior, employment status, number of gay or bisexual friends known, having and/or had a female sex partner, relationship status (male or female), condom and lubrication use, and score on the gay identity scale. Backward selection procedures (α = .05) were used to arrive at the final models. Wald chi-square tests were used to establish significance of individual predictors, whereas likelihood ratio tests (LRT) were used to evaluate significance of groups of predictors (race, HIV-testing behavior). Hosmer and Lemeshow's goodness of fit test was used to determine if final models were adequate.

Results

Basic demographics showed both groups of respondents to be primarily of white race, homosexual sexual orientation, and having had sex with only men (Table 1). Median knowledge scores were 16/18 correct for both cohorts, with 13.4% (59) and 17.1% (197) respondents in South Africa and the United States correctly responding to all 18 knowledge questions, respectively.

For South African MSM, less than 70% of respondents correctly answered that all pregnant women infected with HIV will not have
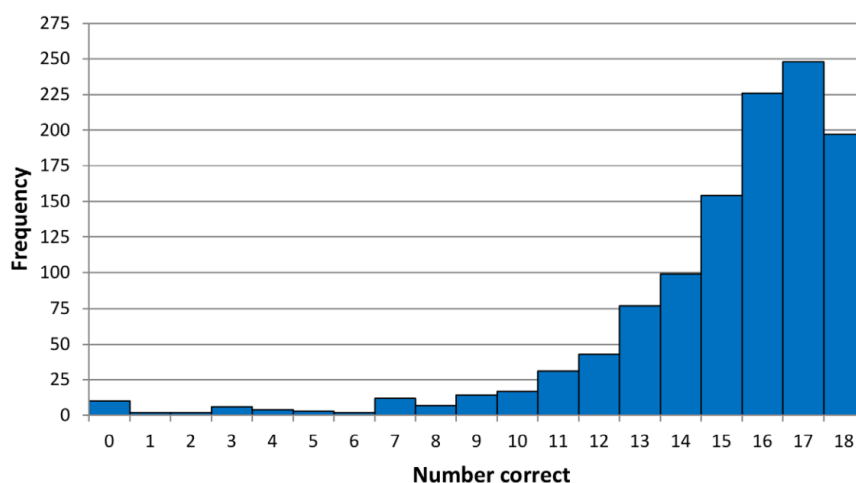
Figure 1. Histogram of number correct on the HIV-KQ-18 knowledge scale for 1,154 US men who have sex with men (MSM) who completed online Facebook survey, June–November 2010.
doi:10.1371/journal.pone.0032915.g001

babies born with AIDS, that a natural skin condom does not work better against HIV than a latex condom, and that a person can get HIV from oral sex (Table 2). For US MSM, less than 70% of respondents correctly answered that there is a female condom that can help decrease a woman's chance of getting HIV, and that a natural skin condom does not work better against HIV than a latex condom.

Hosmer and Lemeshow goodness-of-fit tests for each final model revealed no significant lack-of-fit (SA, p = .60; US, p = .95). Sexual orientation, having/and or had a female sex partner, sexual relationship status, and condom use were eliminated from both final models through backward elimination.

Factors Associated with Low Knowledge among Both Cohorts

Controlling for all other factors in the final models, compared to MSM with greater than 12 years of education, men with less than 12 years of education were 2.5 and 2.7 times as likely to score "low" on HIV knowledge in South Africa and the US, respectively (SA, p = .003; US, p<.001; Table 3). Additionally, previous HIV testing as a group predictor was significantly associated with higher HIV knowledge scores (SA, p<.001; US, p = .006). South African MSM testing HIV positive were 85% (p = .02) less likely to score low on HIV knowledge, and men who tested HIV negative were 70% (p<.001) less likely, both compared to men never HIV tested.
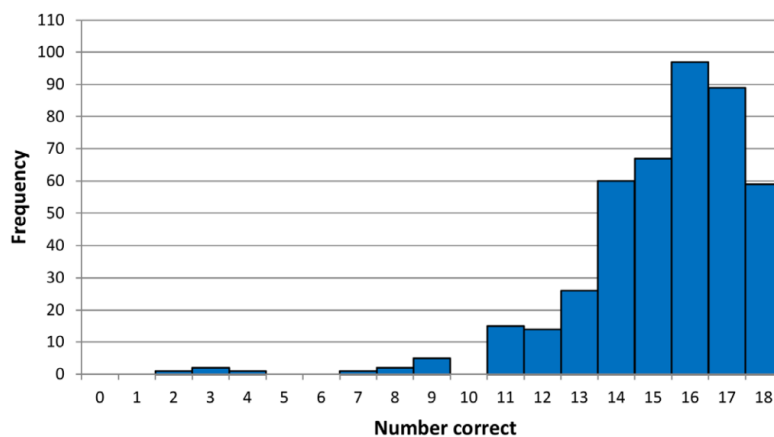

Figure 2. Histogram of number correct on the HIV-KQ-18 knowledge scale for 439 South African men who have sex with men (MSM) who completed online Facebook survey, June–November 2010.
doi:10.1371/journal.pone.0032915.g002

Table 1. Demographic and behavioral characteristics of 1,154 US and 439 South African men who have sex with men (MSM) who completed online Facebook HIV survey, June–November 2010.

Demographic or behavioral characteristic	US MSM		South African MSM	
	n (%) unless noted	IQR	n (%) unless noted	IQR
HIV knowledge (number correct / 18)	16 (median)	3	16 (median)	3
Number acquaintances gay or bisexual	20 (median)	51	20 (median)	40
Gay identity scale	15 (median)	23	11 (median)	16
Age	26 (median)	20	30 (median)	13
18–24	500 (43.3)		117 (26.7)	
25–29	183 (15.9)		96 (21.9)	
30–39	163 (14.1)		140 (31.9)	
40–49	191 (16.6)		60 (13.7)	
50+	117 (10.1)		26 (5.9)	
Race/Ethnicity (South Africa)				
White/European/African			400 (91.1)	
Black African			20 (4.6)	
Other			19 (4.3)	
Race/Ethnicity (United States)				
White non-Hispanic	557 (48.3)			
Black non-Hispanic	381 (33.0)			
Hispanic	108 (9.4)			
Other	108 (9.4)			
Sexual Orientation				
Homosexual/ Gay	975 (84.5)		422 (96.4)	
Bisexual	149 (12.9)		12 (2.7)	
Heterosexual	3 (0.3)		1 (0.2)	
Unsure	18 (1.6)		1 (0.2)	
Other	5 (0.4)		2 (0.5)	
Missing	4 (0.4)		1 (0.23)	
Entire Life Had Sex With:				
Only men	620 (53.7)		266 (60.7)	
Both men and women	534 (46.4)		172 (39.3)	
Education				
More than high school	901 (78.1)		186 (42.4)	
High school or less	253 (21.9)		253 (57.6)	
HIV testing history				
Never tested for HIV	161 (14.0)		57 (13.0)	
Positive last HIV test	133/993 (13.4)		25/382 (6.5)	
Negative / indeterminate last HIV test	860/993 (86.6)		357/382 (93.5)	
Condom use at last sex				
No anal sex last sex with partner	284 (24.6)		101 (23.0)	
No condom last anal sex with partner	492/870 (56.6)		173/338 (51.2)	
Used condom last anal sex with partner	378/870 (43.4)		165/338 (48.8)	
Currently in a sexual relationship (M or F)	511 (44.4)		258 (58.8)	
Currently employed	733 (63.9)		383 (88.3)	
Condom-compatible lube use last anal sex	861 (74.6)		349 (79.5)	

doi:10.1371/journal.pone.0032915.t001

US MSM testing HIV positive were 66% (p = .003) less likely to score in the lowest quintile of knowledge scores, and men who tested HIV negative were 41% (p = .012) less likely, both compared to men never HIV tested.

Factors Associated with Low Knowledge among South African MSM

First, unemployed South African MSM were 2.2 times as likely to score low on knowledge scores, compared to those who were

Table 2. 1,154 US and 439 South African men who have sex with men (MSM) who completed online Facebook survey answering HIV-KQ-18 questions correctly, incorrectly, ''don't know'', or by skipping, June-November 2010.

HIV-KQ-18 Question (correct answer)	US MSM			South African MSM		
	Correct n (%)	Incorrect n (%)	Don't Know/ Skipped n (%)	Correct n (%)	Incorrect n (%)	Don't Know / Skipped n (%)
1. Coughing and sneezing DO NOT spread HIV (T)	948 (82.1)	122 (10.6)	84 (7.3)	390 (88.8)	37 (8.4)	12 (2.7)
2. A person can get HIV by sharing a glass of water with someone who has HIV (F)	1045 (90.6)	37 (3.2)	72 (6.2)	403 (91.8)	31 (7.1)	5 (1.1)
3. Pulling the penis out before a man climaxes/cums keeps his partner from getting HIV during sex (F)	1029 (89.2)	53 (4.6)	72 (6.2)	392 (89.3)	21 (4.8)	26 (5.9)
4. A woman can get HIV if she has anal sex with a man (T)	982 (85.1)	100 (8.7)	72 (6.2)	377 (85.9)	40 (9.1)	22 (5.0)
5. Showering or washing one's genitals / private parts after sex keeps a person from getting HIV (F)	1043 (90.4)	30 (2.6)	81 (7.0)	425 (96.8)	6 (1.4)	8 (1.8)
6. All pregnant women infected with HIV will have babies born with AIDS (F)	830 (71.9)	151 (13.1)	173 (15.0)	286 (65.1)	109 (24.8)	44 (10.0)
7. People who have been infected with HIV quickly show serious signs of being infected (F)	1078 (93.4)	22 (1.9)	54 (4.7)	416 (94.8)	6 (1.4)	17 (3.9)
8. There is a vaccine that can stop adults from getting HIV (F)	989 (85.7)	33 (2.9)	132 (11.4)	376 (85.6)	22 (5.0)	41 (9.3)
9. People are likely to get HIV by deep kissing / putting their tongue in their partner's mouth (F)	907 (78.6)	104 (9.0)	143 (12.4)	372 (84.7)	34 (7.7)	33 (7.5)
10. A woman cannot get HIV if she has sex during her period (F)	1004 (87.0)	34 (2.9)	116 (10.1)	416 (94.8)	5 (1.1)	18 (4.1)
11. There is a female condom that can help decrease a woman's chance of getting HIV (T)	792 (68.6)	142 (12.3)	220 (19.1)	333 (75.9)	52 (11.8)	54 (12.3)
12. A natural skin condom works better against HIV than a latex condom (F)	790 (68.5)	19 (1.6)	345 (29.9)	256 (58.3)	10 (2.3)	173 (39.4)
13. A person will NOT get HIV if they are taking antibiotics (F)	1066 (92.4)	18 (1.6)	70 (6.1)	415 (94.5)	6 (1.4)	18 (4.1)
14. Having sex with more than one partner can increase a person's chance of becoming infected with HIV (T)	1088 (94.3)	33 (2.9)	33 (2.9)	427 (97.3)	9 (2.1)	3 (0.68)
15. Taking a test for HIV one week after having sex will tell a person if she or he has HIV (F)	916 (79.4)	81 (7.0)	157 (13.6)	333 (75.9)	47 (10.7)	59 (13.4)
16. A person can get HIV by sitting in a hot tub or a swimming pool with a person who has HIV (F)	1048 (90.8)	30 (2.6)	76 (6.6)	418 (95.2)	6 (1.4)	15 (3.4)
17. A person can get HIV from oral sex (T)	880 (76.3)	162 (14.0)	112 (9.7)	301 (68.6)	79 (18.0)	59 (13.4)
18. Using Vaseline or baby oil with condoms lowers the chance of getting HIV (F)	1000 (86.7)	29 (2.5)	125 (10.8)	387 (88.2)	13 (3.0)	39 (8.9)

doi:10.1371/journal.pone.0032915.t002

employed (p = .042). Second, MSM not using condom-compatible lubrication during last anal sex with another man were 1.9 times as likely to score low on HIV knowledge (p = .036). Last, for each ten point increase in the number of gay or bisexual friends known, the odds of scoring low on HIV knowledge decreased 11% (p = .024).

Factors Associated with Low Knowledge among MSM in the United States

For each ten point increase on the gay identity scale (decreasing pride and acceptance of homosexuality) the odds of scoring in the lowest quintile on knowledge scores increased by 30% for US

Table 3. Multivariable logistic regression models for 1,154 US and 439 South African men who have sex with men (MSM) using scoring in lowest quintile on HIV-KQ-18 knowledge scores as outcome.

Covariates	US MSM aOR (95% CI)[a]	South African MSM aOR (95% CI)[a]
Gay identity scale (10 point change)	1.3 (1.2–1.5)[†]	n.s.
Education level<12 years	2.7 (1.9–3.8)[†]	2.5 (1.4–4.6)*
Not employed	n.s.	2.2 (1.0–4.6)*
Did not use lube last anal sex with man	n.s.	1.9 (1.0–3.5)*
Number acquaintances gay or bisexual (10 point change)	n.s.	0.89 (0.81–0.99)*
HIV testing history[b]		
Never HIV tested	1 (reference)	1 (reference)
Tested HIV positive	0.34 (0.16–0.69)*	0.15 (0.03–0.74)*
Tested HIV negative	0.59 (0.39–0.89)*	0.30 (0.16–0.59)*
Age group[c]		
25–29	1 (reference)	
18–24	2.3 (1.3–3.8)*	
30–39	1.5 (0.77–2.8)	
40–49	1.4 (0.76–2.7)	
50+	3.2 (1.6–6.3)[†]	
Racial/Ethnic group[d]		
White non-Hispanic	1 (reference)	
Hispanic	1.9 (1.1–3.2)*	
Black non-Hispanic	1.5 (0.98–2.3)	
Other race	1.0 (0.56–1.9)	

*P<.05 (Wald $\times^2$).
†P<.001 (Wald $\times^2$).
n.s. = eliminated through backward selection for given model.
[a]Variables considered for inclusion into each model: age, race, education, sexual orientation, HIV testing behavior, employment status, number of gay or bisexual friends known, having and/or had a female sex partner, relationship status, condom and lubrication use, and scores on the gay identity scale. Backward selection procedures (α = .05) were conducted separately for US and South African MSM.
[b]Construct p-values for HIV testing history were p = .006 (US MSM) and p<.001 (South African MSM).
[c]Construct p-values for age group were p = .002 (US MSM) and non-significant (South African MSM).
[d]Construct p-values for racial/ethnic group were p = .049 (US MSM), non-significant (South African MSM).
doi:10.1371/journal.pone.0032915.t003

MSM (p<.001). Age as a group predictor was significantly associated with knowledge scores (p = .002). Compared to US MSM age 25–29, those age 18–24 and 50+ were 2.3 (p = .002) and 3.2 (p<.001) times as likely to score in the lowest quintile on knowledge scores, respectively. Finally, race as a construct was significantly associated with the odds of scoring low on HIV knowledge (p = .049). Compared to white non-Hispanics, Hispanics were 1.9 times as likely to score low on HIV knowledge (p = .018).

Discussion

Among Facebook-using MSM in the US and South Africa, HIV/AIDS knowledge levels were high: the median respondent in both groups of respondents missed only 2 out of 18 questions. In both US and South African MSM, men with less than a high school education had significantly lower HIV/AIDS knowledge. This is in corroboration with a large body of research around the world showing that as general education level increases, so does knowledge of HIV/AIDS prevention and transmission [15–18]. Efforts to increase general educational opportunities for MSM in South Africa and the US, would be helpful inherently, and might also support higher HIV/AIDS knowledge.

Second, previous HIV testing was associated with having higher knowledge for MSM in the US and South Africa. Although causality is unclear from our study design, we hypothesize that MSM who have tested for HIV and received negative results gain some knowledge through contact with testing facilities, while individuals testing positive show a trend towards further increased knowledge due to continued contact with healthcare providers, educational materials, or peer groups. According to our data, traditional HIV/AIDS education and counseling associated with voluntary counseling and testing centers (VCT), hospitals, or other care centers is associated with higher levels of HIV knowledge among MSM.

Among South African MSM, having fewer acquaintances gay or bisexual was associated with lower HIV/AIDS knowledge, which could indicate that, in South Africa, peer networks are key avenues where HIV/AIDS information is shared. Additionally, after accounting for HIV testing behavior, not using condom-compatible lubrication during anal sex was associated with lower HIV knowledge in South Africa. South African MSM who receive condom-compatible lubrication from a community based organization or an NGO may also receive educational materials, making use of lubrication use a marker for access to outreach or comfort with service utilization.

For US MSM, there was a trend towards lower HIV knowledge among some racial and age groups. Hispanic MSM had significantly lower HIV/AIDS knowledge and black non-Hispanic MSM showed a trend towards lower knowledge, compared to White non-Hispanic MSM. Thirty years after HIV was first propelled into global consciousness, US MSM of color are at risk for gaps in HIV knowledge at a time when new HIV infections among these men are increasing.

US MSM age 18–24 or 50+ were at significantly increased risk for low HIV knowledge compared to men age 25–29. That these two age groups have the lowest HIV knowledge is troubling because sex with older partners has been shown to be associated with HIV infection, and US MSM age 50+ have an estimated HIV prevalence of 25% compared to 10.5% for men age 18–24 [19–20]. Tailored educational interventions, perhaps using social media for young MSM, and other creative methods to reach older MSM are urgently needed.

A novel finding of the current study is that low pride and acceptance of homosexuality was one of the factors most strongly associated with low HIV/AIDS knowledge among US MSM. Low pride and acceptance of homosexuality may correlate with willingness or ability of US MSM to access prevention services or with the extent of peer networks through which HIV education is shared. Additional studies are needed to characterize how gay identity formation in the United States may be related to other HIV-associated factors, especially in light of the recently questioned relationship between internalized homophobia and risky sexual behaviors [21].

Limitations

This study has several limitations. First, our findings are not generalizable to all MSM, or all Facebook-using MSM, in either the United States or South Africa. Nevertheless, according to publically available data, 58.6% (136,937,240) of over-18 individuals in the US and 8.5% (3,446,000) of over-20 South Africans have Facebook accounts [22–24]. Compared to the general population, our samples over-represent individuals who identify as white in South Africa (91.1% versus 9.6%) and individuals who identify as black in the United States (33% versus 12.6%) [22,25]. This indicates that even though our sample is not representative of the population as a whole, internet-based surveys

can achieve good penetration into at-risk populations in both the US and South Africa.

Second, since our Facebook advertisements were only targeted to men who explicitly state that they are "interested in" men, our sample likely consists of men who are more open with their sexuality than are MSM in general. Third, recall bias, sample selection bias, and/or social desirability bias could cause underreporting of HIV status, male sex partners, or unprotected sex and could result in misclassification. However, we judge that these biases, if they exist, are not strongly heterogeneous among those scoring high/low on HIV knowledge or between cohorts. Fourth, our choice to dichotomize the knowledge data was empirical; further research is needed to characterize epidemiologically significant critical levels of HIV/AIDS knowledge. Last, the HIV-KQ-18 knowledge scale was not developed or validated for use with MSM or with South Africans, and some of the items, such as the item about natural skin condoms, are somewhat outdated.

Conclusions

Those developing programs for MSM in South Africa should weigh these data and other relevant information, and might consider focusing educational services towards MSM who have lower education levels, less integration into gay or bisexual communities, no HIV testing history, limited use of condom-compatible lube, and who are unemployed. In the United States, Hispanic MSM, those who have low pride and acceptance of homosexuality, those who have not tested for HIV, those with less than a high school education, and those aged 18–24 or over 50 may be at risk for gaps in HIV knowledge.

As we begin to work with recently acknowledged at risk populations, such as MSM in South Africa, or strive to strengthen service delivery in the US, programs must be tailored to populations most at risk. As further research is conducted, our study shows that online surveys are one appropriate way to reach populations of MSM in the US and South Africa.

Author Contributions

Conceived and designed the experiments: PSS RS BHW. Performed the experiments: PSS RS BHW. Analyzed the data: BHW. Contributed reagents/materials/analysis tools: PSS RS BHW. Wrote the paper: BHW.

References

1. UNAIDS (2008) 2008 report on the global AIDS epidemic. Geneva, Switzerland. Available: http://www.unaids.org/en/dataanalysis/epidemiology/2008reportontheglobalaidsepidemic. Accessed 2011 March 29.

2. Hunter DJ (1993) AIDS in sub-Saharan Africa: the epidemiology of heterosexual transmission and the prospects for prevention. Epidemiology 4(1): 63–72.

3. Baral S, Sifakis F, Cleghorn F, Beyrer C (2007) Elevated risk for HIV infection among men who have sex with men in low- and middle-income countries 2000–2006: a systematic review. PLoS Med 4: e339.

4. Mumtaz G, Hilmi N, McFarland W, Kaplan RL, Akala FA, et al. (2011) Are HIV Epidemics among Men Who Have Sex with Men Emerging in the Middle East and North Africa?: A Systematic Review and Data Synthesis. PLoS Med 8(8): e1000444.

5. Caceres CF, Konda K, Segura ER, Lyerla R (2008) Epidemiology of male same-sex behavior and associated sexual health indicators in low- and middle-income countries: 2003–2007 estimates. Sexually Transmitted Infection 84(Suppl 1): i49–i56.

6. Smith AD, Tapsoba P, Peshu N, Sanders EJ, Jaffe HW (2009) Men who have sex with men and HIV/AIDS in sub-Saharan Africa. Lancet 374: 416–22.

7. UNAIDS (2009) UNAIDS Action Framework: universal access for men who have sex with men, and transgender people. Geneva, Switzerland: UNAIDS/UNDP.

8. Adam PCG, de Wit JBF, Toskin I, Mathers BM, Nashkhoev M, et al. (2009) Estimating levels of HIV testing, HIV prevention coverage, HIV knowledge, and condom use among men who have sex with men (MSM) in low-income and middle-income countries. J Acquir Immune Defic Syndr 52(2): S143–S151.

9. Geibel S, Luchters S, King'Ola N, Esu-Williams E, Rinyiru A, et al. (2008) Factors associated with self-reported unprotected anal sex among male sex workers in Mombasa, Kenya. Sex Trans Dis 35: 746–52.

10. Elrashied S (2006) Prevalence, knowledge and related risky sexual behaviors of HIV/AIDS among men who have sex with men (MSM) in Khartoum State, Sudan, 2005. In: AIDS 2006—XVI International AIDS Conference. Toronto, Canada.

11. Fay H, Baral SD, Trapence G, Motimedi F, Umar E, et al. (2011) Stigma, health care access, and HIV knowledge among men who have sex with men in Malawi, Namibia, and Botswana. AIDS and Behavior 15: 1088–1097.

12. Baral S, Burrell E, Scheibe A, Brown B, Beyrer C, et al. (2011) HIV risk and associations of HIV infection among men who have sex with men in Peri-Urban Cape Town, South Africa. BMC Public Health 11: 766.

13. Carey PM, Schroder KEE (2002) Development and psychometric evaluation of the brief HIV knowledge questionnaire. AIDS Educ Prev 14(2): 172–182.

14. Brady S, Busse WJ (1994) The Gay Identity Questionnaire: a brief measure of Homosexual Identity Formation. J Homosex 26(4): 1–22.

15. Noden BH, Gomes A, Ferreira A (2010) Influence of religious affiliation and education on HIV knowledge and HIV-related sexual behaviors among unmarried youth in rural central Mozambique. AIDS Care 22(10): 1285–1294.

16. Haile BJ, Chambers JW, Garrison JL (2007) Correlates of HIV knowledge and testing: Results of a 2003 South African survey. Journal of Black Studies 38(2): 194–208.

17. UNICEF (2004) Girls, HIV/AIDS and education. Available: http://www.unicef.org/publications/files/Girls_HIV_AIDS_and_Education_(English)_rev.pdf. Accessed 2011 July 15.

18. Upreti D, Regmi P, Pant P, Simkhada P (2009) Young people's knowledge, attitude, and behavior on STI/HIV/AIDS in the context of Nepal: A systematic review. Kathmandu University Medical Journal 7(28): 383–391.

19. Morbidity and mortality weekly report (2010) Prevalence and awareness of HIV infection among men who have sex with men – 21 cities, United States, 2008. 59(37): 1201–1207.

20. Hurt CB, Matthews DD, Calabria MS, Green KA, Adimora AA, et al. (2010) Sex with older partners is associated with primary HIV infection among men who have sex with men in North Carolina. J Acquir Immune Defic Syndr 54(2): 185–190.

21. Newcomb ME, Mustankski B (2011) Moderators of the relationship between internalized homophobia and risky sexual behavior in men who have sex with men: a meta-analysis. Archives of Sexual Behavior 40(1): 189–99.

22. US Census Bureau (2010) State and county quickfacts. Available: http://quickfacts.census.gov/qfd/states/00000.html. Accessed 2011 July 22.

23. Facebook (2011) Targeting your ad. Available: https://www.facebook.com/ads/create/. Accessed 2011 July 22.

24. Statistics South Africa (2010) Mid-year population estimates. Statistical release P0302. Available: http://www.statssa.gov.za/publications/P0302/P03022010.pdf. Accessed 2011 July 22.

25. Central Intelligence Agency (2011) The world factbook: South Africa. Available: https://www.cia.gov/library/publications/the-world-factbook/geos/sf.html#. Accessed 2012 January 5.