

Repeat Voluntary HIV Counseling and Testing (VCT), Sexual Risk Behavior and HIV Incidence in Rakai, Uganda

Joseph K. B. Matovu · Ronald H. Gray ·
Noah Kiwanuka · Godfrey Kigozi ·
Fred Wabwire-Mangen · Fred Nalugoda ·
David Serwadda · Nelson K. Sewankambo ·
Maria J. Wawer

Published online: 3 October 2006
© Springer Science+Business Media, LLC 2006

Abstract We examined the effects of repeat Voluntary HIV counseling and testing (VCT) on sexual risk behaviors and HIV incidence in 6,377 initially HIV-negative subjects enrolled in a prospective STD control for HIV prevention trial in rural Rakai district, south-western Uganda. Sixty-four percent accepted VCT, and of these, 62.2% were first time acceptors while 37.8% were repeat acceptors. Consistent condom use was 5.8% in repeat acceptors, 6.1% in first time acceptors and 5.1% in non-acceptors. A higher proportion of repeat acceptors (15.9%) reported inconsistent condom use compared to first-time acceptors (12%) and non-acceptors (11.7%). Also, a higher proportion of repeat acceptors (18.1%) reported 2+ sexual partners compared to first-time acceptors (14.1%) and non-acceptors (15%). HIV incidence rates were 1.4/100 py (person-years) in repeat acceptors, 1.6/100 py in first

time acceptors and 1.6/100 py in non-acceptors. These data suggest a need for intensive risk-reduction counseling interventions targeting HIV-negative repeat VCT acceptors as a special risk group.

Keywords Repeat · VCT · HIV · Incidence · Rakai · Uganda

Introduction

Voluntary HIV counseling and testing (VCT) services are a major component of HIV prevention, treatment and care efforts. Posttest counseling gives high-risk HIV-uninfected individuals the opportunity to change their high-risk behavior and potentially, the behavior of their sex and drug-using partners. As a result, expansion of VCT services has been advocated as a central component of public health efforts to bring down HIV incidence through reductions in high-risk behaviors. However, while the effect of VCT is more pronounced in HIV-infected individuals and serodiscordant couples (Allen et al., 2003; Marks, Crepaz, Senterfitt, & Janssen, 2005; Voluntary HIV-1 Counseling and Testing Efficacy Study Group, 2000), its effects in seronegative individuals are not well documented (Weinhardt, Carey, Johnson, & Bickham, 1999; Wolitski, Macgowan, Higgins, & Jorgensen, 1997). In addition, available evidence suggests that between 26 and 66% of HIV tests are being performed on persons who have previously tested HIV-negative (Fernyak, Page-Schafer, Kellogg, McFarland, & Katz, 2002; Leaity et al., 2000; MacKellar et al., 2002; Norton, Elford, Sherr, Miller, & Johnson, 1997). Since repeat testing requires substantial personnel and

J. K. B. Matovu · N. Kiwanuka · G. Kigozi · F. Nalugoda
Rakai Health Sciences Program/Uganda Virus Research
Institute, Entebbe, Uganda

R. H. Gray (✉)
Johns Hopkins Bloomberg School of Public Health, Room
4547 615 N Wolfe St, Baltimore, MD 21205, USA
e-mail: rgray@jhsph.edu

F. Wabwire-Mangen · D. Serwadda
Institute of Public Health, Makerere University, Kampala,
Uganda

N. K. Sewankambo
Makerere Medical School, Makerere University, Kampala,
Uganda

M. J. Wawer
Mailman School of Public Health, Columbia University,
New York, NY, USA

financial resources, understanding whether or not persons who have had repeated exposure to VCT gain any preventive benefits is critical for HIV prevention efforts.

Studies show that repeat HIV-negative testers are about twice as likely as non-repeat testers to report recent high-risk sexual behaviors (MacKellar et al., 2002; Matambo et al., 2006), and the likelihood of receiving an HIV-positive test result on any given testing occasion is much greater (i.e., almost twice as likely) for those receiving a repeat HIV test than those receiving an initial test (Fisher, DelGado, Melchreit, & Spurlock-McLendon, 2002). These findings suggest that HIV-negative repeat testers do not reduce their sexual risk behavior in response to repeated VCT. Glick (2004, unpublished) suggested two reasons why repeat HIV-negative testers do not reduce their sexual risk behavior: first, a negative test result leads individuals to revise downward the estimated probability that their partner(s) are HIV-infected, hence also their risk of becoming infected by their partners; second, “altruistic” individuals who test negative may increase or at least not reduce risky behavior because they realize they are less of a danger to others. In this context of continued risk, repeat testing constitutes a missed opportunity for more targeted prevention interventions during posttest counseling (Leaity et al., 2000) and highlights a need for a re-evaluation of current HIV testing and counseling protocols to address risk behaviors associated with repeat testing in HIV-uninfected persons.

Because majority of the repeat testers’ sexual risk behaviors remain largely unchanged following repeat VCT (MacKellar et al., 2002; Ryder et al., 2005), studies have reported high HIV acquisition rates in repeat testers ranging from 1.3/100 py (person years) among repeat testers at publicly funded HIV testing sites in San Francisco, USA (FERNYAK et al., 2002), 1.7/100 py in repeat testers presenting with sexually transmitted diseases (STDs) in Italy (Suligoi et al., 1999), and 2.3/100 py in repeat anonymous testers in Catalonia, Spain (Nascimento et al., 2004). There is also evidence that over 75% of HIV-negative repeat testers acquire HIV within one year of receiving their last HIV-negative test results (MacKellar et al., 2002). Collectively, these findings re-affirm reports from other studies (Fisher et al., 2002; Kellogg et al., 2001), suggesting that HIV-negative testers who seek repeated counseling and testing services are also more likely to have high rates of HIV acquisition (FERNYAK et al., 2002).

However, while these findings provide us with a clear understanding of risk behaviors and HIV acquisition rates in HIV-negative testers who accept repeat testing, majority of these studies were conducted in Europe (Leaity et al., 2000; Nascimento et al., 2004; Norton et al., 1997; Suligoi et al., 1999) or the United States of America (Kalichman et al., 1997; Kellogg et al., 2001; MacKellar et al., 2002), and among high-risk groups such as men who have sex with men (MSM), persons presenting with STDs, or injection drug users (IDU). It is likely that these studies may not provide a complete description of the patterns of sexual risk-taking behaviors and HIV acquisition rates in repeat HIV-negative testers in the general population or in populations where these high-risk sexual practices are less prevalent, as in much of Africa (Wawer et al., 2005a). In this secondary analysis of data, we describe the effects of repeat VCT on sexual risk behavior and HIV incidence in 6,377 initially HIV-negative persons enrolled in a prospective community cohort in rural Rakai district, southwestern Uganda. This study is unique in that it provides information on the effects of repeat VCT in the general population, and sexual risk behaviors and HIV incidence rates have been reported on repeat acceptors, first-time acceptors and non-acceptors of VCT.

Methods

Setting

Rakai district lies in the southwestern part of the country and is bordered by Masaka and Sembabule districts in the North, Mbarara district in the West, Kalangala district in the East and Lake Victoria and the United Republic of Tanzania in the South. The first cases of AIDS in Uganda were reported along the shores of Lake Victoria in Rakai district in 1982 (Mugerwa, Marum, & Serwadda, 1996; Serwadda et al., 1985). During the late 1980s, HIV prevalence in Rakai averaged between 25 and 35% in main trading centers on the Trans-African highway, 12–25% in secondary road trading villages, and <10% in off-road agrarian villages (Serwadda et al., 1992). However, trend analyses of HIV prevalence data conducted since 1994 suggest that HIV prevalence among adult residents (15–49 years) has declined by about 35%, from 17.6% in 1994/95 to 11.4% in 2002/03, although HIV incidence has not declined overall (1.3/100 py in 1994/95 and 1.7/100 py in 2002/03) (Wawer et al., 2005b).

Study Description

The Rakai community cohort was established in 1994 for a prospective community randomized trial of the control of sexually transmitted diseases for prevention of HIV (1994–99), and has continued annual surveillance thereafter (Wawer et al., 1999; Gray et al., 2001). Censuses and surveys were done at 10–12 month intervals for all consenting adults aged 15–49 years who were resident in rural communities in Rakai district. Subjects completed an extensive socio-demographic, health and behavioral interview, and venous blood for HIV and STD diagnoses was obtained from all consenting participants. HIV was detected by two separate enzyme immunosorbent assays (Vironostika HIV, Organon Teknika, Charlotte, NC, USA and Cambridge Biotech, Worcester, MA, USA) with Western blot confirmation of discordant enzyme immunoassay results and recent HIV seroconverters (HIV WB, Bio-Merieux-Vitek, St Louis, MO, USA). Participants provided written informed consent at each survey visit, and the study was approved by institutional review boards in Uganda and the USA.

Study Population

A total of 6,377 initially HIV-negative participants provided an interview and a blood sample at two or more annual surveys. All participants who provided a blood sample were offered free access to home-based VCT either as individuals or as couples (Matovu, Kigozi, Nalugoda, Wabwire-Mangen, & Gray, 2002; Matovu et al., 2005). For purposes of this analysis, the population was stratified into persons who declined VCT ($n = 2,294$, 36.0%); persons who were first time VCT acceptors ($n = 2,539$, 39.8%), and persons who received repeat VCT on two or more occasions ($n = 1,544$, 24.2%).

Measures

Socio-demographic Characteristics

Data on age, gender, education, and marital status were obtained through face-to-face, home-based interviews conducted by same-sex interviewers.

Sexual Behaviors

Participants were asked if they had had penile–vaginal intercourse in the six months preceding the survey, and

all those that responded in the affirmative were further asked about the number of sexual partners they had had sex with in the past six months. Self-reported number of sexual partners was coded as ‘1’ if the participant reported only one sexual partner in the past six months or ‘2+’ if the participant reported two or more sexual partners during the referent period. All participants reporting sexual intercourse in the past six months were asked about whether or not they had used condoms with any of their sexual partners during the referent period, and persons who reported condom use in the past six months were further asked about consistency of condom use. Participants were considered to have used condoms consistently if they reported condom use with all sexual partners in the past six months. All those that reported condom use with some but not all sexual partners were considered to be inconsistent condom users.

Data Analyses

We assessed the characteristics of persons who declined or accepted VCT on one or more occasions. We examined the association between VCT acceptance and socio-demographic (age, gender, education and marital status) and behavioral characteristics (number of sex partners and condom use in the six months prior to interview, and current non-regular sexual relationships), using multivariable logistic regression to estimate the adjusted prevalence odds ratios (APOR) and 95% confidence intervals (95% CI) among VCT acceptors versus non-acceptors. HIV incidence was estimated as the number of HIV seroconverters per 100 person-years (py) of observation with the assumption that infection occurred at the mid-point of the interval between the last HIV-negative result and the first HIV-positive result. The adjusted incidence rate ratios (adj. IRR) and 95% confidence intervals of HIV acquisition associated with repeat VCT were estimated by multivariable Poisson regression model, adjusting for person years of exposure that each individual contributed to the analysis.

Results

Population Characteristics

A total of 6,377 initially HIV-negative persons were enrolled into the study, 54% of whom were females while 46% were males. Overall, 64% accepted VCT (4,083 of 6,377), 50.4% of whom were females while

49.6% were males. Of those accepting VCT, 62.2% (2,539 of 4,083) were first-time acceptors while 37.8% (1,544 of 4,083) were repeat acceptors. Acceptance of VCT was high in both males ($n = 2,949$, 68.6%) and females ($n = 3,428$, 60.1%). Compared with non-acceptors of VCT, repeat VCT acceptors were older (40+ years: 24.5% vs. 19.9%, POR = 1.31, 95% CI: 1.12, 1.53), more likely to be male (52.5% vs. 40.4%, POR = 1.63, 95% CI: 1.43, 1.87) and were better educated (post-primary education: 27.5% vs. 20.8%, POR = 1.45, 95% CI: 1.24, 1.69) (Table 1).

Sexual Behaviors

Repeat acceptors were significantly more likely to report consistent condom use than non-acceptors of VCT (5.8% vs. 5.1%, APOR = 1.53, 95% CI: 1.05, 2.23) but

there was no significant difference in consistent condom use between first-time acceptors and non-acceptors of VCT (6.1% vs. 5.1%, APOR = 1.06, 95% CI: 0.77, 1.46). Also, repeat acceptors were significantly more likely to report inconsistent condom use in the past six months than non-acceptors of VCT (15.9% vs. 11.7%, APOR = 1.39, 95% CI: 1.12, 1.73) but there was no significant difference in inconsistent condom use between first-time acceptors and non-acceptors of VCT (12% vs. 11.7%, APOR = 1.00, 95% CI: 0.82, 1.22). There was no significant difference in self-reported multiple sexual partnerships (i.e., 2 or more sexual partners in the past six months) between repeat acceptors and non-acceptors of VCT (18.1% vs 15%, APOR = 0.84, 95% CI: 0.68, 1.06) but first-time acceptors were significantly less likely to report multiple sexual partnerships than non-acceptors of VCT (14.1%

Table 1 Socio-demographic and behavioral characteristics, and HIV incidence in initially HIV-negative subjects who declined or accepted VCT in Rakai, Uganda

Characteristics	Non-acceptors of VCT		First time VCT acceptors		Repeat VCT Acceptors	
	$n = 2,294$	%	$n = 2,539$	%	$n = 1,544$	%
Age group						
15–19	308	13.4	268	10.6	65	4.2
20–29	981	42.8	1159	45.7	667	43.2
30–39	549	23.9	593	23.4	434	28.1
40+	456	19.9	519	20.4	378	24.5
Sex						
Female	1,368	59.6	1327	52.3	733	47.5
Male	926	40.4	1212	47.7	811	52.5
Education						
None	210	9.2	242	9.5	120	7.8
Primary	1,608	70.1	1760	69.3	999	64.7
Post-primary	476	20.8	537	21.2	425	27.5
Marital status						
Never married	272	11.9	350	13.8	164	10.6
Currently married	1,885	82.2	2071	81.6	1299	84.1
Divorced/Widow/Separated	137	6.0	118	4.7	81	5.3
Risk behaviors						
<i>No. of sexual partners (past 6 months)</i>						
1	1,950	85.0	2,181	85.9	1,264	81.9
2+	344	15.0	358	14.1	280	18.1
<i>Condom use (past 6 months)</i>						
No use	1,908	83.2	2078	81.8	1208	78.2
Inconsistent use	269	11.7*	305	12.0	246	15.9*
Consistent use	117	5.1**	156	6.1	90	5.8**
<i>Current non-regular relationship</i>						
Yes	430	18.7	490	19.3	292	18.9
No	1,864	81.3	2049	80.7	1252	81.1
HIV Incidence	Incidence	Incidence/	Incidence	Incidence/	Incidence	Incidence/
	cases/py	100 py	cases/py	100 py	cases/py	100 py
	66/4,038	1.6	76/4,658	1.6	48/3,488	1.4
IRR (95% CI)		1.00 ^a		1.00 ^b (0.72, 1.39)		0.85 ^b (0.58, 1.23)

^a Referent group

^b Adjusted for age, gender, education, marital status, current non-regular sexual relationship, condom use and self-reported number of sexual partners in the past six months; CI, confidence interval; IRR, incidence rate ratio; py, person year; * $P < 0.01$; ** $P < 0.05$ (repeat vs non-acceptors of VCT)

vs 15%, APOR = 0.75, 95% CI: 0.61, 0.92). There was no significant difference in the proportion reporting current non-regular sexual relationships between repeat acceptors and non-acceptors of VCT (18.9% vs. 18.7%; APOR = 1.02, 95% CI: 0.77, 1.34) or between first-time acceptors and non-acceptors of VCT (19.3% vs. 18.7%; APOR = 1.07, 95% CI: 0.83, 1.37).

HIV Incidence

There were 190 seroconversions in 12,184 person years of follow-up, for an overall HIV incidence of 1.6/100 py. HIV incidence was 1.6/100 py in non-acceptors, 1.6/100 py in first-time acceptors and 1.4/100 py in repeat acceptors of VCT (Table 1). There was no significant difference in HIV acquisition between repeat acceptors and non-acceptors of VCT (1.4/100 py vs. 1.6/100 py, adj. IRR = 0.85, 95%CI: 0.58, 1.23), or between first-time acceptors and non-acceptors of VCT (1.6/100 py vs. 1.6/100 py, adj. IRR = 1.00, 95%CI: 0.72, 1.39).

Condom Use and HIV Incidence by Self-reported Number of Sexual Partners

Table 2 shows results of a separate sub-group analysis of condom use associated with self-reported number of sexual partners in the past six months. Consistent condom use was low and did not significantly differ by self-reported number of sexual partners or VCT exposure. In persons reporting only one sexual partner in the past six months, *inconsistent* condom use was significantly higher in repeat acceptors (9.8%) than in non-acceptors of VCT (7.2%; APOR = 1.42, 95%CI: 1.08, 1.86). However, in persons reporting two or more sexual partners in the past six months, *inconsistent* condom use was higher, but not significantly different in repeat acceptors (43.6%) compared to non-acceptors of VCT (37.2%; APOR = 1.34, 95%CI: 0.92, 1.96).

In persons reporting only one sexual partner in the past six months, HIV incidence was similar in repeat acceptors ($n = 1,264$, incidence = 1.4/100 py) and non-acceptors of VCT ($n = 1,950$, incidence = 1.4/100 py) (Table 2). However, in persons reporting multiple sexual partners in the past six months, HIV incidence was lower but did not significantly differ between repeat acceptors ($n = 280$, incidence = 1.1/100 py) and non-acceptors of VCT ($n = 344$, incidence = 2.9/100 py; adj. IRR = 0.49, 95%CI: 0.21, 1.17) or between first-time acceptors ($n = 358$, incidence = 1.4/100 py) and non-acceptors of VCT ($n = 344$, incidence = 2.9/100 py; adj. IRR = 0.58, 95%CI: 0.25, 1.37).

Table 2 Condom use and HIV incidence in persons reporting 1 or 2± sexual partners by VCT exposure status in Rakai, Uganda

	Persons reporting one partner in past 6 months						Persons reporting 2± partners in past 6 months							
	Non-acceptors of VCT		First time VCT acceptors		Repeat VCT acceptors		Non-acceptors of VCT		First time VCT acceptors		Repeat VCT acceptors			
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%		
Condom use														
No use	1717	88.1	1889	86.6	1068	84.5	191	55.5	189	52.8	140	50.0		
Inconsistent use	141	7.2*	172	7.9	124	9.8*	128	37.2	133	37.2	122	43.6		
Consistent use	92	4.7	120	5.5	72	5.7	25	7.3	36	10.1	18	6.4		
HIV Incidence														
Incidence cases/py	50/3,478	1.4	67/4,027	1.7	41/2,846	1.4	16/560	2.9	9/631	1.4	7/641	1.1		
Incidence/100 py	1.00 ^a		1.15 ^b		1.00 ^b		1.00 ^a		0.58 ^b		0.49 ^b			
IRR (95%CI)			(0.79, 1.67)		(0.66, 1.51)		(0.25, 1.37)		(0.25, 1.37)		(0.21, 1.17)			

^a Referent group

^b Adjusted for age, gender, marital status, education, current non-regular relationship and condom use in the past six months

CI, Confidence Interval; py, person years; IRR, incidence rate ratio

* $P < 0.05$ (repeat vs non-acceptors of VCT)

Discussion

In this rural African population, we found no significant difference in self-reported multiple sexual partnerships or HIV incidence between repeat acceptors and non-acceptors of VCT. These findings are consistent with previous studies in London (Leaity et al., 2000; Norton et al., 1997), Catalonia (Nascimento et al., 2004) and Ontario (Ryder et al., 2005), which found that repeat VCT acceptors were less likely to change their sexual behaviors following repeat VCT. In the Ontario study, most HIV-negative repeat testers described their sexual behavior and their perception of what constitutes risky sexual behavior as unchanged following repeat HIV-negative tests and some participants believed that the repeat negative test confirmed that their current sexual behavior, such as sex without a condom, was safe. There were also beliefs among repeat HIV-negative testers that a repeat negative test following sexual risk behavior confirmed the belief that they were immune from HIV infection (Ryder et al., 2005). These findings suggest that HIV-negative persons who accept repeat VCT are more likely to engage in high-risk sexual practices, despite the potential benefits associated with repeat VCT education.

We have reported that repeat acceptors were significantly more likely to report inconsistent condom use compared to non-acceptors of VCT. This suggests that HIV-negative repeat VCT acceptors are at an increased risk of HIV infection, given that only consistent condom use has been found to be protective against HIV/STDs acquisition (Ahmed et al., 2001; Winer et al., 2006). In addition, the finding that repeat VCT acceptors reporting two or more sexual partners in the past six months were also more likely to report inconsistent condom use points to a serious public health dilemma and call for a need to design intensive risk-reduction interventions targeting repeat VCT acceptors as a special high-risk group. Also, improved risk-reduction messages that stress the importance of safer sex practices (including partner reduction and consistent condom use) can help repeat testers to realize their continued vulnerability to the continued risk of HIV infection.

This study had limitations. VCT was provided in a research context as part of the STD control for HIV prevention trial that involved visiting homes of the participants and collection of blood samples. VCT services were also largely provided in participants' homes. Thus, the findings may not be applicable to other settings where passive VCT services are provided at stand-alone clinics or as part of routine STD clinic services. Also, participants offered VCT as part of a

research study might be less inclined to change behavior than other persons who autonomously seek counseling and testing services, and who may be more motivated to accept behavior change (Weinhardt et al., 1999). Despite these limitations, our findings confirm results reported elsewhere, suggesting that HIV-negative persons who receive repeat VCT are less likely to change their sexual risk behavior in response to repeated counseling when compared to those who do not use these services or who only use these services on one occasion.

Because repeat HIV-negative testers are less likely to reduce their sexual risk behaviors following repeated VCT (FERNYAK et al., 2002; McFarland, Kellogg, Dilley, & Katz, 1997; Ryder et al., 2005), VCT providers should design risk-screening tools to identify HIV-negative testers who are most likely to engage in high-risk sexual practices so as to tailor appropriate pre- and posttest counseling messages to appropriate target groups. By identifying and dealing with HIV-negative testers who are most likely to engage in high-risk behaviors, HIV test counselors can help repeat testers to re-assess their own risk for HIV infection and plan on how to reduce the said risk.

In addition, while VCT providers encourage HIV-negative testers to seek additional testing to rule out the possibility of recent HIV infection, it is important to note that such repeat testing can only be meaningful in the context of increased safer sexual practices during the inter-testing period. HIV-negative repeat testers should, therefore, be helped to realize that the risk of HIV infection remains apparent regardless of the number of previous HIV-negative tests one has had— as long as they and/or their sexual partner(s) continue to engage in high-risk behavior, such as unprotected anal or vaginal intercourse (Ryder et al., 2005). Studies suggest that repeat HIV-negative testers are more likely to believe that they are immune from HIV infection or “lucky in choosing HIV-uninfected partners” (Matovu et al., 2005; Ryder et al., 2005). VCT providers should identify and appropriately deal with these false beliefs during pre and posttest counseling sessions for, if not addressed, they can promote a dangerous illusion of invulnerability which can facilitate additional risk behavior (Fisher et al., 2002). Thus, in accordance with published guidelines, HIV test providers should routinely assess HIV testing history, improve client awareness of personal risks, and negotiate a realistic and incremental plan for reducing those risks (MacKellar et al., 2002).

In conclusion, these findings from rural Africa suggest that repeat testers are less likely to reduce their sexual risk behaviors following repeat VCT and

HIV incidence is comparable between repeat acceptors and non-acceptors of VCT. Since majority of the repeat testers are persons who continue to engage in high-risk sexual behaviors, our findings suggest an urgent need for intensive, individualized risk-reduction counseling interventions to address risk-taking behaviors associated with repeat testing in HIV-uninfected persons (Solomon et al., 2006). In addition, further research is needed to better understand enabling, reinforcing or debilitating factors that promote or inhibit risk-reducing behavior change in HIV-negative persons who have had repeated exposure to VCT.

Acknowledgment The study was supported by grants RO1 A134826 and RO1 A13426S from the National Institute of Allergy and Infectious Diseases; grant 5P30HD06826 from the National Institute of Child Health and Development; the World Bank STI Project, Uganda; the Glaxo Wellcome Foundation, and the Winkler Foundation. We are grateful to Dr SK Sempala [RIP] (Former Director, Uganda Virus Research Institute) for his support. Part of this paper was presented at the Uganda Virus Research Institute, Entebbe, Uganda, on November 28, 2003.

References

- Ahmed S., Lutalo T., Wawer, M. J., Serwadda, D., Sewankambo, N. K., Nalugoda, F., et al. (2001). HIV incidence and sexually transmitted diseases prevalence associated with condom use: A population study in Rakai, Uganda. *AIDS*, *15*, 2171–2179.
- Allen, S., Meitzen-Derr, J., Kautzman, M., Zulu, I., Trask, S., et al. (2003). Sexual behavior of HIV discordant couples after HIV counseling & testing. *AIDS*, *17*, 733–740.
- Fernyak, S. E., Page-Schafer, K., Kellogg, T. A., McFarland, W., & Katz, M. H. (2002). Risk behaviors and HIV incidence among repeat testers at publicly funded HIV testing sites in San Francisco. *Journal of Acquired Immune Deficiency Syndromes*, *31*, 63–70.
- Fisher, J. D., DelGado, B. P., Melchreit, R., & Spurlock-McLendon, J. (2002). The dynamics of repeat HIV testing, and interventions for repeat HIV testers. *AIDS and Behavior*, *6*(2), 183–191.
- Gray, R. H., Wabwire-Mangen, F., Kigozi, G., et al. (2001). Randomized trial of presumptive sexually transmitted disease therapy during pregnancy in Rakai, Uganda. *American Journal of Obstetrics and Gynecology*, *185*, 1209–1217.
- Kalichman, S. C., Schaper, P. E., Belcher, L., Abush-Kirsh, T., Cherry, C., et al. (1997). It's like a regular part of gay life: Repeat HIV antibody testing among gay and bisexual men. *AIDS Education and Prevention*, *9*(3 Suppl), 41–51.
- Kellogg, T. A., McFarland, W., Perlman, J. L., Weinstock, H., Stephanie, B., Katz, M. H., et al. (2001). HIV incidence among repeat HIV testers at a County Hospital, San Francisco, California, USA. *Journal of Acquired Immune Deficiency Syndrome*, *28*(1), 59–64.
- Leaty, S., Sherr, L., Wells, H., Evans, A., et al. (2000). Repeat HIV testing: High-risk behavior or risk-reduction strategy? *AIDS*, *14*, 547–552.
- MacKellar, D. A., Valleroy, L. A., Secura, G. M., Bartholow, B. N., et al. (2002). Repeat HIV testing, risk behaviors, and HIV seroconversion among young men who have sex with men: a call to monitor and improve the practice of prevention. *Journal of Immune Deficiency Syndrome*, *29*(1), 76–85.
- Marks, G., Crepaz, N., Senterfitt, J. W., & Janssen, R. S. (2005). Meta-analysis of high-risk sexual behavior in persons aware and unaware they are infected with HIV in the United States: Implications for HIV prevention programs. *Journal of Acquired Immune Deficiency Syndrome*, *39*, 446–453.
- Matambo, R., Dauya, E., Mutswanga, J., Makanza, E., Chandiwana, S., et al. (2006). Voluntary counseling and testing by nurse counselors: what is the role of routine repeated testing after a negative result? *Clinical Infectious Diseases*, *42*, 569–571.
- Matovu, J. K., Gray, R. H., Makumbi, F., Wawer, M. J., et al. (2005). Voluntary HIV counseling and testing acceptance, sexual risk behavior and HIV incidence in Rakai, Uganda. *AIDS*, *19*, 503–511.
- Matovu, J. K., Kigozi, G., Nalugoda, F., Wabwire-Mangen, F., & Gray, R. H. (2002). The Rakai Project counseling programme experience. *Tropical Medicine and International Health*, *7*(12), 1064–1067.
- McFarland, W., Kellogg, T. A., Dilley, J., Katz, M. H. (1997). Estimation of human immunodeficiency virus (HIV) sero-incidence among repeat anonymous testers in San Francisco. *American Journal of Epidemiology*, *146*(8), 662–664.
- Mugerwa, R. D., Marum, L. H., Serwadda, D. (1996). Human immunodeficiency virus and AIDS in Uganda. *East African Medical Journal*, *73*(1), 20–26.
- Nascimento, C. M. R., Casado, M. J., Casabona, J., Ros, R., Sierra, E., et al. (2004). Estimation of HIV incidence among repeat anonymous testers in Catalonia, Spain. *AIDS Research and Human Retroviruses*, *20*(11), 1145–1147.
- Norton, J., Elford, J., Sherr, L., Miller, R., & Johnson, M. A. (1997). Repeat HIV testers at a London same-day testing clinic. *AIDS*, *11*(6), 773–781.
- Ryder, K., Haubrich, D. J., Calla, D., Myers, T., et al. (2005). Psychosocial impact of repeat HIV-negative testing: A follow-up study. *AIDS and Behavior*, *9*, 459–464.
- Serwadda, D., Mugerwa, R. D., Sewankambo, N. K., Lwegaba, A., et al. (1985). Slim disease: A new disease in Uganda and its association with HTLV III infection. *Lancet*, *2*(8460), 849–852.
- Serwadda, D., Wawer, M. J., Musgrave, S. D., et al. (1992). HIV risk factors in three geographical strata of rural Rakai district, Uganda. *AIDS*, *6*, 983–989.
- Solomon, S. S., Solomon, S., Masse, B. R., Srikrishnan, A. K., Beauchamp, G., et al. (2006). Risk reduction counseling is associated with decreased HIV transmission in high-risk Indian heterosexuals. *Journal of AIDS Deficiency Syndrome*, *42*(4), 478–483.
- Suligoi, B., Guiliani, M., Galai, N., Balducci, M., & the STD Surveillance Working Group (1999). HIV incidence among repeat HIV testers with sexually transmitted diseases in Italy. *AIDS*, *13*, 845–850.
- Voluntary HIV-1 Counseling and Testing Efficacy Study Group (2000). Efficacy of voluntary HIV-1 counseling and testing in individuals and couples in Kenya, Tanzania, and Trinidad: A randomized trial. *Lancet*, *356*, 103–112.
- Wawer, M. J., Gray, R. H., Sewankambo, N. K., Serwadda, D., Li, X., Laeyendecker, O., Kiwanuka, N., et al. (2005a). Rates of HIV-1 transmission per coital act, by stage of HIV-1 infection, in Rakai, Uganda. *Journal of Infectious Diseases*, *191*, 1403–1409.

- Wawer, M. J., Gray, R. H., Serwadda, D., Namukwaya, Z., Makumbi, F., et al. (2005b). Declines in HIV prevalence in Uganda: Not as simple as ABC. *Conference on Retroviruses and Opportunistic Infections*. February 22–25; 12: (abstract no. 27LB).
- Wawer, M. J., Sewankambo, N. K., Serwadda, D., et al. (1999). Control of sexually transmitted diseases for AIDS prevention in Uganda: A randomised community trial. *Lancet*, 353, 525–535.
- Weinhardt, L. S., Carey, M. P., Johnson, B. T., & Bickham, N. L. (1999). Effects of HIV counseling and testing on sexual risk behavior: a meta-analytic review of published research, 1985–1997. *American Journal of Public Health*, 89, 1397–1405.
- Winer, R. L., Hughes, J. P., Feng, Q., O'Reilly, S., Kiviat, N. B., et al. (2006). Condom use and the risk of genital human papillomavirus infection in young women. *New England Journal of Medicine*, 354(25), 2645–2654.
- Wolitski, R. J., Macgowan, R. J., Higgins, D. L., & Jorgensen, C. M. (1997). The effects of HIV counseling and testing on risk-related practices and help seeking behavior. *AIDS Education and Prevention*, 9(Suppl. 3), 52–67.