

Use of Saliva as a Lubricant in Anal Sexual Practices Among Homosexual Men

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Objectives: Compared with other sexually active adults, men who have sex with men (MSM) are more frequently infected with several pathogens including cytomegalovirus, hepatitis B virus, and Kaposi sarcoma-associated herpesvirus. Because one common element between these organisms is their presence in saliva, we evaluated saliva exposure among MSM in a heretofore relatively unrecognized route—via use of saliva as a lubricant in anal sex.

Methods: MSM in a San Francisco population-based cohort were interviewed regarding use of saliva by the insertive partner as a lubricant in various anal sexual practices.

Results: Among 283 MSM, 87% used saliva as a lubricant in insertive or receptive penile-anal intercourse or fingering/fisting at some point during their lifetime; 31%–47% did so, depending upon the act, in the prior 6 months. Saliva use as a lubricant was more common among younger men and among HIV-infected men when with HIV-infected partners. Even among MSM following safe sex guidelines by avoiding unprotected penile-anal intercourse, 26% had anal exposure to saliva via use as a lubricant.

Conclusions: Among MSM, use of saliva as a lubricant is a common, but not ubiquitous, practice in anal sex. The findings provide the rationale for formal investigation of whether saliva use in this way contributes to transmission of saliva-borne pathogens in MSM.

Key Words: homosexual, saliva, lubricant, anal intercourse

(*J Acquir Immune Defic Syndr* 2009;00:000–000)

In contrast to other sexually active adults, men who have sex with men (MSM) are at greater risk for infection with a variety of pathogens including cytomegalovirus (CMV),¹ hepatitis B virus (HBV),² and the more recently discovered

Kaposi sarcoma-associated herpesvirus (KSHV).^{3,4} Why these pathogens are disproportionately represented among MSM is not well understood. Although a simply greater number of partners among some MSM could be responsible, the other common link between these 3 pathogens is their presence in saliva.^{5–12} For example, for one of the organisms, KSHV, saliva is the body fluid that most commonly harbors the virus.^{5,6} HBV, although most commonly found in blood, is also commonly shed in saliva; between 15%–67% of individuals with chronic infection have detectable HBV DNA in saliva.^{11–14} In the largest studies of CMV, HIV-infected men, in particular, commonly harbor CMV in their saliva with 50%–60% prevalence.^{7,9}

Directly investigating the role of saliva in spreading pathogens is difficult, but for at least HBV and KSHV, there is evidence for saliva as a conduit in transmission.^{15–17} Hence, it is surprising that limiting exposure to saliva as a means for avoiding infection has received little attention. For example, for CMV, guidelines for the prevention of opportunistic infections among HIV-infected persons note the presence of CMV in saliva, but only recommend as an intervention the use of condoms.¹⁸ For HBV, guidelines make no mention of the role of saliva.¹⁸ It is only for KSHV where caution regarding a specific saliva-exchanging act, kissing, is given.¹⁸ In part, the lack of attention to saliva may stem from the belief that exposure to saliva, via kissing, is ubiquitous and cannot be avoided. However, kissing is common among both heterosexual adults and MSM, yet CMV, HBV, and KSHV all are less common among the heterosexual population.^{1–4,19} This suggests that kissing alone is not the sole means of spreading these organisms. Despite this, very little is known about what other avoidable practices might spread saliva from person to person.

One relatively unrecognized mode in which saliva may be exchanged among MSM is via the use of saliva for lubrication in anal-based sexual activities, a practice acknowledged in condom failure research,^{20,21} anecdotally in internet-based forums,²² and more recently as underemphasized components of broad surveys of sexual practices among MSM.^{23,24} To systematically address the prevalence and determinants of the use of saliva as a lubricant in anal sexual acts, we examined a population-based sample of MSM.

METHODS

Population and Sampling

Participants were part of the San Francisco Young Men's Health Study (SFYMHS), a population-based cohort study of

Received for publication March 31, 2008; accepted October 9, 2008.

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Supported by National Institutes of Health (K01 HD052020, T32 MH19105, U01 CA078124, R01 CA119903, P30 MH062246, and P30 AI027763) and the University of California University wide AIDS Research Program (CC99-SF-001).

Parts of the data were presented at the 7th International Conference on Malignancies in AIDS and Other Immunodeficiencies: Basic, Epidemiologic, and Clinical Research, April 28–29, 2003, Bethesda, MD.

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HIV infection in MSM. Full details on the sampling have been previously described.²⁵ Briefly, the SFYMHS obtained a probability sample of unmarried men, aged 18–29 years, residing in the 21 census tracts in San Francisco with the highest accumulation of AIDS cases. Men who self-identified as homosexual/bisexual, or reported having sex with another man within the prior 5 years, were invited to participate. This cohort was followed at 6-month intervals, and in the present study, we have evaluated the use of saliva as a lubricant in anal-based sexual acts, about which questions were introduced in 2001.

Measurements

Sexual Behavior

At each study visit, participants completed a self-administered questionnaire that covered sociodemographic characteristics and sexual behavior including number of partners with whom the participant engaged in various sexual practices, the HIV serostatus of partners, and condom use. In particular, participants were asked about penile–anal intercourse and practice of “fingering” or “fisting,” where one man inserts his finger or fist into another man’s anus. Insertive acts referred to when the participant inserts his penis (for anal intercourse) or finger/fist (for fingering/fisting) into his partner’s anus; receptive acts referred to when the participant’s partner inserts his penis or finger/fist into the participant’s anus. For these insertive and receptive acts, participants were asked about the use of saliva as a lubricant during their lifetime and the 6 months before the study visit. For example, to determine the frequency of saliva use as a lubricant for receptive fingering/fisting over a participant’s lifetime, participants were asked “Thinking about the times when another man put his finger or fist into your rectum, how often do you think the other man used his own saliva (spit) as a lubricant (lube)?” Use in the prior 6 months of saliva as a lubricant was measured according to partner type, categorized by the participant’s perception of their partner’s HIV infection status.

Statistical Analysis

We first performed analyses to determine the prevalence of saliva use as a lubricant in penile–anal intercourse and fingering/fisting over participants’ lifetimes and over the prior 6 months. Logistic regression was then used to evaluate determinants of using saliva as a lubricant in the prior 6 months for one of the acts, penile–anal intercourse. Factors associated with saliva use as lubricant in unadjusted models at a *P* value <0.20 were subsequently evaluated in a multivariable model.²⁶ In models in which we assessed the effect of HIV serostatus of our participants and their partners, individual participants could be represented more than once. To accommodate potential nonindependence in these models, we used generalized estimating equations in Stata version 9.1 (Stata Corp, College Station, TX). Interaction terms were evaluated in these models to assess whether the effect of given characteristics of our participants on saliva use as a lubricant differed according to their partner’s HIV infection status.

RESULTS

Of the 283 MSM enrolled in the SFYMHS at the time questions on saliva use were introduced, the median age was 35 years (interquartile range 33–36) and approximately 75% identified as white, 4.9% as African American, 10% as Latino, 4.6% as Asian, and 4.6% as “other.” The majority (65%) of participants had at least a 4-year college degree, and the median annual income was between \$30,000 and \$40,000, with 22% below \$24,000 and 20% above \$60,000. Seventeen percent were HIV infected.

Lifetime Use of Saliva as a Lubricant in Insertive and Receptive Anal Sexual Acts

Overall, of the 283 participants, 87% reported using saliva as a lubricant in an insertive and/or receptive anal sexual practice (ie, penile–anal intercourse or fingering/fisting) at some point during their lifetime (80% as insertive partner and 84% as receptive partner). For penile–anal intercourse, 63% reported ever using saliva as a lubricant, whereas the insertive partner and 68% reported saliva use as the receptive partner. For fingering/fisting, 72% reported saliva use at some point as the insertive partner and 77% as the receptive partner. When quantifying the frequency of saliva use as a lubricant in penile–anal intercourse or during fingering/fisting over their lifetime, the majority of participants (47%–58%, depending on act) reported “some of the times”, 3.2%–20% reported “most of the times”, and less than 3% reported “all of the times”.

Saliva Use as a Lubricant in Insertive and Receptive Anal Sexual Acts in the Past 6 Months

To estimate the recent use of saliva as a lubricant and more precisely determine the frequency of such use, participants were asked about their use of saliva over the past 6 months. Of the 283 participants, 91% reported having any type of sexual contact with other men in the prior 6 months. Of these sexually active men, 31% reported saliva use in the prior 6 months with at least 1 partner in insertive penile–anal intercourse, 31% in receptive penile–anal intercourse, 47% in insertive fingering/fisting, and 45% in receptive fingering/fisting. When restricted to only those men who practiced each of the respective acts (with or without saliva) in the 6 months before the visit, the prevalence of saliva use during the act was, as expected, somewhat higher (Table 1). In terms of the number of partners with whom participants used saliva as a lubricant, the median was between 0 and 1 partner, depending on act. However, there was considerable variability with as many as 4.5%–12% of participants reporting saliva use with ≥ 5 partners.

Use of Saliva as a Lubricant in Penile–Anal Intercourse According to HIV Serostatus

We examined the use of saliva as a lubricant according to the HIV serostatus of the participants and of their partners. Focusing on penile–anal intercourse, we found that among HIV-infected participants who engaged as insertive partners, there was a significantly higher percentage of partnerships where saliva was used as a lubricant when these men were involved with HIV-infected partners (57%) as compared with

TABLE 1. Prevalence and Magnitude of Saliva Use as a Lubricant in Insertive and Receptive Anal Sexual Acts in the Prior 6 Months Among Homosexual Men Reporting Any Participation (With or Without Saliva Use) in These Acts During the Reporting Period

Act	No. Who Engaged in Act at Least Once	No. (%) Who Used Saliva During Act at Least Once	No. Partners With Whom Saliva Was Used, Median (IQR)	No. (%) Who Used Saliva With 5 or More Partners
Insertive penile–anal intercourse	177	79 (44.6)	0 (0–1)	8 (4.5)
Receptive penile–anal intercourse	173	80 (46.2)	0 (0–1)	8 (4.6)
Insertive fingering/fisting	182	121 (66.5)	1 (0–2)	21 (11.5)
Receptive fingering/fisting	167	116 (69.5)	1 (0–2)	17 (10.2)

IQR, interquartile range.

HIV-uninfected partners (6.7%, $P = 0.007$) (Table 2). Similarly, among HIV-infected participants who engaged as receptive partners in penile–anal intercourse, there was a significantly higher percentage of partnerships where saliva was used as a lubricant when these men were involved with HIV-infected partners (72%) compared with HIV-uninfected partners (30%, $P = 0.002$). The patterns were similar, although not as marked and not reaching conventional statistical significance, among the HIV-uninfected participants (Table 2).

Determinants of Saliva Use as a Lubricant

In addition to the role of HIV infection status, we evaluated other potential determinants of the use of saliva as a lubricant in penile–anal intercourse. Because of the importance of HIV infection status (as described above), these analyses were initially stratified according to partner’s HIV serostatus (Table 3). For insertive penile–anal intercourse, in unadjusted analyses, we again observed the importance of HIV infection status. Compared with HIV-uninfected participants, HIV-infected participants were less apt to use saliva as a lubricant when their partners were HIV uninfected [odds ratio = 0.09, 95% confidence interval (CI) = 0.01 to 0.70] but were more apt to do so when their partners were HIV infected (odds ratio = 2.9, 95% CI = 0.94 to 9.2). That these measures of effect were different was reflected in the P value for

interaction ($P = 0.002$). For the other characteristics evaluated (age, race/ethnicity, income, and education), there were no important differences according to partner’s HIV infection status (P values for interaction > 0.20), and hence, all partner types were analyzed together (Table 3, all partners). For age, the odds of using saliva as a lubricant decreased by 15% (95% CI = 2% to 25%) with every additional year. There was no significant effect of race/ethnicity, education, or income. When age, income, participant HIV infection status, and partner HIV infection were evaluated together in a multivariable model, there continued to be a significant role for age (odds ratio = 0.84, 95% CI = 0.73 to 0.96) and the effect of the participant’s HIV infection status continued to qualitatively differ according to partner’s infection status (P value for interaction = 0.001). Income was not significant at conventional levels of statistical significance.

We observed a similar pattern when evaluating determinants of saliva use as a lubricant in receptive penile–anal intercourse (Table 3). Again, the effect of HIV infection status in our participants differed markedly according to the HIV infection status of their partners ($P < 0.001$ for interaction), but the effects of age, race/ethnicity, education, and income did not vary according to partner’s HIV infection status. In a multivariable model with age, income, and participant and partner HIV infection status, only the effect of

TABLE 2. Proportion of Participants Who Used Saliva as a Lubricant During Penile–Anal Intercourse in the Prior 6 Months, According to Participant and Partner HIV Infection Status

Role of Participants	Participant HIV Infection Status	Partner HIV Infection Status*	No. Participants Engaging in Act With Partner	No. (%) Participants Reporting Saliva Use as a Lubricant During Act	Odds Ratio (95% CI)†	P
Insertive‡	Infected	Uninfected	15	1 (6.7)	Reference	
	Infected	Infected	21	12 (57.1)	13.5 (2.0 to 89.4)	0.007
	Uninfected	Uninfected	112	50 (44.6)	Reference	
	Uninfected	Infected	32	10 (31.3)	0.62 (0.30 to 1.3)	0.20
Receptive§	Infected	Uninfected	20	6 (30.0)	Reference	
	Infected	Infected	25	18 (72.0)	5.4 (1.9 to 15.3)	0.002
	Uninfected	Uninfected	115	45 (39.1)	Reference	
	Uninfected	Infected	23	5 (21.7)	0.45 (0.19 to 1.04)	0.06

*Denotes participants’ perception of partners’ HIV infection status.

†As estimated by generalized estimating equations.

‡For each partner type, participants were asked “In the last 6 months, with how many men did you put penis in the man’s rectum (with or without a condom)?” For men who indicated that they had had insertive anal intercourse within the past 6 months, the following question was asked: “With how many of these men did you use your own saliva as a lubricant (“lube”)?”

§For each partner type, participants were asked “In the last 6 months, with how many men put their penis in your rectum (with or without a condom)?” For men who indicated that they had had receptive anal intercourse within the past 6 months, the following question was asked: “How many of these men used their own saliva as a lubricant (“lube”)?”

TABLE 3. Determinants of Saliva Use as a Lubricant During Insertive and Receptive Penile–Anal Intercourse

	HIV-Uninfected Partners*		HIV-Infected Partners*		All Partners†	
	Odds Ratio (95% CI)	P	Odds Ratio (95% CI)	P	Odds Ratio (95% CI)	P
Insertive participation						
Age, per year	0.85 (0.73 to 0.99)	0.04	0.88 (0.71 to 1.1)	0.25	0.85 (0.75 to 0.98)	0.02
HIV infection status of participant						
Uninfected	Reference	—	Reference	—	—	—
Infected	0.09 (0.01 to 0.70)	0.02	2.9 (0.94 to 9.2)	0.07	‡	—
Race/ethnicity						
White	Reference	—	Reference	—	Reference	—
Other	0.76 (0.30 to 1.9)	0.56	0.34 (0.06 to 1.8)	0.21	0.65 (0.28 to 1.52)	0.32
Education						
Postgraduate	Reference	—	Reference	—	Reference	—
≤4 yrs college	1.6 (0.73 to 3.3)	0.25	1.2 (0.38 to 3.5)	0.80	1.36 (0.71 to 2.6)	0.35
Income						
≥\$60,000	Reference	—	Reference	—	Reference	—
\$30,000–59,999	1.3 (0.59 to 2.8)	0.53	1.0 (0.28 to 3.9)	0.95	1.2 (0.61 to 2.5)	0.57
<\$30,000	1.4 (0.51 to 4.0)	0.50	2.4 (0.57 to 10.4)	0.23	1.8 (0.76 to 4.3)	0.18
Receptive participation						
Age, per year	0.92 (0.80 to 1.1)	0.27	0.84 (0.67 to 1.1)	0.13	0.89 (0.79 to 1.0)	0.08
HIV infection status of participant						
Uninfected	Reference	—	Reference	—	—	—
Infected	0.67 (0.24 to 1.9)	0.44	9.3 (2.5 to 34.7)	0.001	n/a‡	—
Race/ethnicity						
White	Reference	—	Reference	—	Reference	—
Other	1.3 (0.54 to 3.3)	0.54	0.38 (0.07 to 2.2)	0.28	1.0 (0.45 to 2.3)	0.98
Education						
Postgraduate	Reference	—	Reference	—	Reference	—
≤4 yrs college	1.1 (0.49 to 2.3)	0.87	1.14 (0.35 to 3.7)	0.82	1.1 (0.58 to 2.2)	0.72
Income						
≥\$60,000	Reference	—	Reference	—	Reference	—
\$30,000–59,999	1.5 (0.68 to 3.2)	0.33	0.89 (0.22 to 3.6)	0.87	1.4 (0.69 to 2.8)	0.35
<\$30,000	2.0 (0.71 to 5.5)	0.19	2.4 (0.52 to 11.0)	0.26	2.1 (0.92 to 5.0)	0.08

*Denotes participants' perception of partners' HIV infection status.

†As estimated by generalized estimating equations.

‡Effect of HIV infection status in participant differed according to partner's HIV infection status (P value for interaction = 0.002 for insertive participation and <0.001 for receptive participation), obviating the all-partners analysis.

HIV infection status in our participants continued to be significant, and again, this differed according to their partner's infection status (P value for interaction < 0.001). Neither age nor income was significant at conventional levels of statistical significance.

Use of Saliva as a Lubricant Despite Otherwise Safe Sex Practices

To assess saliva use among MSM who were otherwise practicing safe sex by conventional guidelines, we evaluated the 160 participants who avoided unprotected penile–anal intercourse in the prior 6 months. Among 105 men who reported having no receptive penile–anal intercourse, 17 (16%) were exposed to saliva via fingering/fisting. Of the 55 who reported using a condom with all receptive penile–anal intercourse partners, 24 (44%) were exposed to saliva either via penile–anal intercourse (where saliva was used as a lubricant on top of a condom) or via fingering/fisting. Overall, of the 160 participants who avoided unprotected

penile–anal intercourse, 26% had anal exposure to saliva via its use as a lubricant.

DISCUSSION

The high prevalence of infection among MSM with pathogens such as CMV, HBV, and the more recently discovered KSHV has been well documented but not adequately explained. Because each of these organisms is, in part, considered to be sexually transmitted, much of the focus of their transmission-related investigation in MSM has been on conventional means of sexual contact. However, a common thread between these 3 pathogens is their presence in saliva, and, remarkably, saliva is not often considered as a conduit for sexual transmission. Specifically, other than kissing or oral–anal contact (known as “rimming,” where, in any case, most of the interest has been on exposure to fecal contents), how saliva might be passed from person to person has received little attention. Here, we have documented in

a population-based sample of MSM a high prevalence of the use of saliva in a heretofore relatively unrecognized practice—as a lubricant in penile–anal intercourse and fingering/fisting. Used in this way, potentially pathogen-bearing saliva comes into contact with anal/rectal mucosa, plausibly setting the stage for transmission. Conceivably, the adjunctive trauma and/or deeper penetration associated with the penile–anal intercourse or fingering/fisting acts per se may facilitate transmission in ways that are not present, for example, in oral–anal acts.

We observed different patterns of saliva use by HIV-infected and HIV-uninfected men depending on the HIV serostatus of their partners. This is consistent with another report which showed less frequent use of saliva as a lubricant in anal sex by HIV-uninfected men when with HIV-infected partners compared with all other partners.²³ Our observations suggest that HIV-infected men are less concerned about exchanging saliva in seroconcordant partnerships, perhaps because such men feel “safe”—thinking that nothing worse can be transmitted because they are already HIV infected. However, from a clinical perspective, it may be unfortunate if HIV-infected individuals expose themselves to saliva in this way in that various pathogens (such as CMV and KSHV²⁷) are more frequently found in the saliva of their HIV-infected partners and therefore constitute potential higher risk for transmission. Furthermore, it is HIV-infected persons who are at greatest risk of developing clinical manifestations of these infections if they become infected. Although the role of HIV infection status in determining the use of saliva as a lubricant suggests that some MSM may be thinking about potential transmission of pathogens via saliva used this way, we suspect that most MSM are not aware. This is perhaps best evidenced by our finding of the high frequency of use of saliva as lubricant even among MSM who otherwise were adhering to safe sex guidelines by avoiding unprotected penile–anal intercourse. Lack of awareness of KSHV (and hence its routes of transmission) among MSM has been previously documented,²⁸ and although CMV and HBV are more commonly known about in the community, it is unlikely that their presence in saliva is widely recognized.

We found that although the use of saliva as a lubricant in various anal sexual acts is common among MSM, it is not ubiquitous. For example, in a 6-month period, fewer than half of MSM used saliva in this way. Our observations are consistent with and extend data from a prior report showing that approximately 38% of 809 HIV-uninfected MSM used saliva as a lubricant in anal sex at least once in the prior 6 months.²³ Even among those who did use saliva in this manner, the number of partners with whom they practiced it was highly variable. This variability in the practice and hence in exposure of MSM to saliva via this route could help explain why many but not all MSM are infected with, for example, HBV and KSHV. We were not able, however, to explain much of the variability in this practice with the measurements available to us. It is likely that contextual variables that we unfortunately did not collect, such as the environment where the sexual encounter occurred or the availability of other lubricants, might explain a substantial degree of the variability.

A limitation of our work is the self-reported nature of the use of saliva as a lubricant. However, given that prevention messages do not mention saliva, we do not believe that men have underreported this practice to provide socially desirable responses. Although not a threat to the validity of the data at hand, our lack of data regarding the presence of infection in our participants with saliva-borne pathogens such as CMV, HBV, and KSHV precludes our ability to directly establish that these organisms can be transmitted by the use of the saliva as a lubricant in anal sexual acts. Indeed, there are reasons to believe that transmission via saliva is not a foregone conclusion. For example, presence of neutralizing Immunoglobulin A, as has been reported for HIV,²⁹ may counterbalance infectiousness. Establishing an independent relationship between the use of saliva as a lubricant in anal-based sexual acts and acquisition of saliva-borne pathogens will be complex, given the close correlation in practice of various sexual acts (eg, penile–anal, oral–anal, and penile–oral contact) among MSM, which all could conceivably transmit these pathogens.³⁰ It is likely that only longitudinal studies of very young MSM, initially uninfected with these organisms, will be able to tease out the independent contribution of saliva used as a lubricant.

Our findings provide the rationale for formal investigation of whether saliva used as a lubricant in anal sex may contribute to the transmission of saliva-borne pathogens in MSM. Until it can be disproved that saliva-borne pathogens are transmitted through this route, there now needs to be debated as to whether prevention guidelines should be expanded to include avoidance of saliva exposure via this route. In opposition of this expansion is that nonsaliva lubricants may not be affordable to everyone, and a premature call to avoid use of saliva as a lubricant could have unintended consequences of limiting sexual contact and its attendant benefits to well-being. In support of this expansion is the view that avoidance of saliva use as a lubricant would seem to be feasible especially because the avoidance of sexual contact per se is not the issue. Education alone regarding the risks of saliva use in this manner may be all that is needed to facilitate behavior change. Structural interventions, such as the copackaging of condoms with packets of sterile jelly lubricants, might also be useful in sustaining the message. This debate will likely only be settled through collection of more epidemiologic data directly examining the infectivity of saliva when used as a lubricant and novel data from the community on the perceived consequences among MSM of a message that suggested avoidance of the use of saliva in this way.

ACKNOWLEDGMENT

We gratefully acknowledge Amber Cheng for data management.

REFERENCES

1. Drew WL, Mintz L, Miner RC, et al. Prevalence of cytomegalovirus infection in homosexual men. *J Infect Dis.* 1981;143:188–192.
2. Dietzman DE, Harnisch JP, Ray CG, et al. Hepatitis B surface antigen (HBsAg) and antibody to HBsAg. Prevalence in homosexual and heterosexual men. *JAMA.* 1977;238:2625–2626.

3. Smith NA, Sabin CA, Gopal R, et al. Serologic evidence of human herpesvirus 8 transmission by homosexual but not heterosexual sex. *J Infect Dis.* 1999;180:600–606.
4. Martin JN, Ganem DE, Osmond DH, et al. Sexual transmission and the natural history of human herpesvirus 8 infection. *N Engl J Med.* 1998;338:948–954.
5. Pauk J, Huang ML, Brodie SJ, et al. Mucosal shedding of human herpesvirus 8 in men. *N Engl J Med.* 2000;343:1369–1377.
6. Koelle DM, Huang ML, Chandran B, et al. Frequent detection of Kaposi's sarcoma-associated herpesvirus (human herpesvirus 8) DNA in saliva of human immunodeficiency virus-infected men: clinical and immunologic correlates. *J Infect Dis.* 1997;176:94–102.
7. Fidouh-Houhou N, Duval X, Bissuel F, et al. Salivary cytomegalovirus (CMV) shedding, glycoprotein B genotype distribution, and CMV disease in human immunodeficiency virus-seropositive patients. *Clin Infect Dis.* 2001;33:1406–1411.
8. Lucht E, Brytting M, Bjerregaard L, et al. Shedding of cytomegalovirus and herpesviruses 6, 7, and 8 in saliva of human immunodeficiency virus type 1-infected patients and healthy controls. *Clin Infect Dis.* 1998;27:137–141.
9. Lucht E, Albert J, Linde A, et al. Human immunodeficiency virus type 1 and cytomegalovirus in saliva. *J Med Virol.* 1993;39:156–162.
10. Karayiannis P, Novick DM, Lok AS, et al. Hepatitis B virus DNA in saliva, urine, and seminal fluid of carriers of hepatitis B e antigen. *Br Med J (Clin Res Ed).* 1985;290:1853–1855.
11. Jenison SA, Lemon SM, Baker LN, et al. Quantitative analysis of hepatitis B virus DNA in saliva and semen of chronically infected homosexual men. *J Infect Dis.* 1987;156:299–307.
12. Davison F, Alexander GJ, Trowbridge R, et al. Detection of hepatitis B virus DNA in spermatozoa, urine, saliva and leucocytes, of chronic HBsAg carriers. A lack of relationship with serum markers of replication. *J Hepatol.* 1987;4:37–44.
13. van der Eijk AA, Niesters HG, Hansen BE, et al. Paired, quantitative measurements of hepatitis B virus DNA in saliva, urine and serum of chronic hepatitis B patients. *Eur J Gastroenterol Hepatol.* 2005;17:1173–1179.
14. Zhevachevsky NG, Nomokonova NY, Beklemishev AB, et al. Dynamic study of HBsAg and HBeAg in saliva samples from patients with hepatitis B infection: diagnostic and epidemiological significance. *J Med Virol.* 2000;61:433–438.
15. Martinson FE, Weigle KA, Royce RA, et al. Risk factors for horizontal transmission of hepatitis B virus in a rural district in Ghana. *Am J Epidemiol.* 1998;147:478–487.
16. Scott RM, Snitbhan R, Bancroft WH, et al. Experimental transmission of hepatitis B virus by semen and saliva. *J Infect Dis.* 1980;142:67–71.
17. Dedicoat M, Newton R, Alkharsah KR, et al. Mother-to-child transmission of human herpesvirus-8 in South Africa. *J Infect Dis.* 2004;190:1068–1075.
18. CDC. Guidelines for preventing opportunistic infections among HIV-infected persons. *MMWR Recomm Rep.* 2002;51(RR08):1–46.
19. Winkelstein W Jr, Lyman DM, Padian N, et al. Sexual practices and risk of infection by the human immunodeficiency virus. The San Francisco Men's Health Study. *JAMA.* 1987;257:321–325.
20. Smith AM, Jolley D, Hocking J, et al. Does additional lubrication affect condom slippage and breakage? *Int J STD AIDS.* 1998;9:330–335.
21. Golombok S, Harding R, Sheldon J. An evaluation of a thicker versus a standard condom with gay men. *AIDS.* 2001;15:245–250.
22. Ask the Experts About Safe Sex and HIV Prevention: Saliva as Lubricant. September 8, 2000. Available at: <http://www.thebody.com/Forums/AIDS/SafeSex/Archive/PreventionSexual/09685.html>. Accessed on March 15, 2008.
23. Casper C, Carrell D, Miller KG, et al. HIV serodiscordant sex partners and the prevalence of human herpesvirus 8 infection among HIV negative men who have sex with men: baseline data from the EXPLORE Study. *Sex Transm Infect.* 2006;82:229–235.
24. Nguyen TA, Nguyen HT, Le GT, Detels R. Prevalence and risk factors associated With HIV infection among men having sex with men in Ho Chi Minh City, Vietnam. *AIDS Behav.* 2008;12:476–482.
25. Osmond DH, Page K, Wiley J, et al. HIV infection in homosexual and bisexual men 18 to 29 years of age: the San Francisco Young Men's Health Study. *Am J Public Health.* 1994;84:1933–1937.
26. Vittinghoff E, Glidden DV, Shiboski SC, et al. *Regression Methods in Biostatistics.* New York, NY: Springer; 2005.
27. Miller CS, Berger JR, Mootoor Y, et al. High prevalence of multiple human herpesviruses in saliva from human immunodeficiency virus-infected persons in the era of highly active antiretroviral therapy. *J Clin Microbiol.* 2006;44:2409–2415.
28. Phillips AM, Graves Jones A, Osmond DH, Pollack LM, Catania J, Martin JN. Awareness of Kaposi's sarcoma-associated herpesvirus among men who have sex with men. *Sex Transm Dis.* 2008;35:1011–1014.
29. Devito C, Hinkula J, Kaul R, et al. Cross-clade HIV-1-specific neutralizing IgA in mucosal and systemic compartments of HIV-1-exposed, persistently seronegative subjects. *J Acquir Immune Defic Syndr.* 2002;30:413–420.
30. Martin JN, Osmond DH. Invited commentary: determining specific sexual practices associated with human herpesvirus 8 transmission. *Am J Epidemiol.* 2000;151:225–229. Discussion 230.