



Article Literature Review

Does per-act HIV-1 transmission risk through anal sex vary by gender? An updated systematic review and meta-analysis

September 2018 · *American Journal Of Reproductive Immunology*, 80(7):e13039DOI: [10.1111/aji.13039](https://doi.org/10.1111/aji.13039)

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## Abstract

Quantifying HIV-1 transmission risk per-act of anal intercourse (AI) is important for HIV-1 prevention. We updated previous reviews by searching Medline and Embase to 02/2018. We derived pooled estimates of receptive AI (URAI) and insertive AI (UIAI) risk unprotected by condoms using random-effects models. Subgroup analyses were conducted by gender, study design, and whether antiretroviral treatment (ART) had been introduced by the time of the study. Two new relevant studies were identified, one of which met inclusion criteria, adding three new cohorts and increasing number of individuals/partnerships included from 1869 to 14 277. Four studies, all from high-income countries, were included. Pooled HIV-1 risk was higher for URAI (1.25%, 95% CI 0.55%-2.23%, N = 5, I<sup>2</sup> = 87%) than UIAI (0.17%, 95% CI 0.09%-0.26%, N = 3, I<sup>2</sup> = 0%). The sole heterosexual URAI estimate (3.38%, 95% CI 1.85%-4.91%), from a study of 72 women published in a peer-reviewed journal, was significantly higher than the men-who-have-sex-with-men (MSM) pooled estimate (0.75%, 95% CI 0.56%-0.98%, N = 4, P < 0.0001) and higher than the only other heterosexual estimate identified (0.4%, 95% CI 0.08%-2.0%, based on 59 women, excluded for being a pre-2013 abstract). Pooled per-act URAI risk varied by study design (retrospective-partner studies: 2.56%, 95% CI 1.20%-4.42%, N = 2 (one MSM, one heterosexual); prospective studies: 0.71%, 95% CI 0.51%-0.93%, N = 3 MSM, P < 0.0001). URAI risk was lower for studies conducted in the ART era (0.75%, 95% CI 0.52%-1.03%) than pre-ART (1.67%, 95% CI 0.44%-3.67%) but not significantly so (P = 0.537). Prevention messages must emphasize that HIV-1 infectiousness through AI remains high, even in the ART era. Further studies, particularly among heterosexual populations and in resource-limited settings, are required to elucidate whether AI risk differs by gender, region and following population-level ART scale-up.

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... HIV acquisition risk during one receptive anal intercourse (RAI) act unprotected by pre-exposure prophylaxis (PrEP) or condoms (URAI) is higher than during receptive vaginal intercourse (RVI) unprotected by PrEP or condoms (URVI), with pooled estimates from previous systematic reviews of 1.25% (95% confidence interval (CI) 0.55-2.23) and 0.08% (0.06-0.11) per URAI and URVI act, respectively [1][2] [3]. Heterosexual URAI practice could increase HIV incidence among women and impact HIV spread at the population level if practised sufficiently often by a sufficient fraction of women [4]. Current evidence from three systematic reviews among young women, South African women, and female sex workers (FSWs) suggests that RAI is common, with pooled estimates of the proportions practising RAI ranging from 12 to 21% in the past 3 months and from 15 to 22% in their lifetimes across these three risk populations [5][6][7]. ...

... Overall, HIV incidence was approximately twice as high (pooled crude RR = 1.56, pooled adjusted RR = 2.23) among women reporting RAI than women reporting RVI only. Since women do not typically practise RAI in all sex acts, our pooled estimate is consistent with current evidence suggesting that HIV risk per URAI act is up to 10-20 times higher than per URVI act [1][2] [3]. ...

... It is surprising that after so many years and with the recognition of RAI as an important risk factor for HIV that RAI has not been more systematically investigated. Furthermore, with the knowledge that URAI is important for HIV transmission [3], the lack of data on URAI and condom use during RAI is disappointing. More longitudinal studies are urgently needed to evaluate whether the variation in RR by world region and risk population that we found is real and to provide further measures of RAI and condomless RAI. ...

### Increases in HIV Incidence Following Receptive Anal Intercourse Among Women: A Systematic Review and Meta-analysis

Article [Full-text available](#)

Sep 2019 · *AIDS BEHAV*

James Stannah · Romain Silhol · Jocelyn Elmes · Marie-Claude Boily

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... HIV is primarily a sexually transmitted infection (STI) [1]. A single sexual encounter between an HIV-positive partner and an HIV-negative partner (a serodifferent/serodiscordant couple) has a low probability of HIV transmission [2][3] [4] [5]. When transmission occurs, a single viral variant (the transmitted founder virus) is detected 80% of the time, and usually only a maximum of two or three viral variants are transmitted [6,7]. ...

... When transmission occurs, a single viral variant (the transmitted founder virus) is detected 80% of the time, and usually only a maximum of two or three viral variants are transmitted [6,7]. The transmission of HIV is generally relatively inefficient, and predicted to require hundreds of exposures in the case of penilevaginal intercourse [2,3] and dozens of exposures for penile-rectal exposure [4, 5]. ...

... Rectal mucosa is a vulnerable tissue and unprotected anal intercourse has the greatest risk for HIV acquisition [3] [4] [5][50]. Rectal mucosa is thin and friable and heavily defended against infection, thereby enriched with cells receptive to HIV. Bernstein et al, reported that in men who have sex with men (MSM) with a history of syphilis and two rectal gonorrhoea or chlamydia infections in the past two years, there was an eightfold risk of HIV acquisition [51]. ...

### Sexually transmitted infections and HIV in the era of antiretroviral treatment and prevention: the biologic basis for epidemiologic synergy

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Aug 2019

Myron S Cohen · Olivia D. Council · Jane S Chen

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... The likelihood of HIV transmission during condomless receptive anal intercourse (AI) may be up to 18-fold higher than that during condomless receptive vaginal intercourse (VI) (1). Cross-sectional studies consistently suggest that AI is commonly practised among US cisgender women (referred to here as women), with a systematic review on AI among young people estimating that 25% (95% confidence interval [CI]: 20-29%) of sexually active young women and girls (aged <25 years) in North America had ever practised AI (2). ...

... Table 4. Multivariable analysis of baseline characteristics associated with trajectory group membership among HIV-seronegative women in the WIHS cohort, using Group 3 (VI persistors) as reference group. 1 Non-Hispanic White. 2 Ever having been raped and ever having been severely beaten were highly correlated with one another. The two variables were therefore combined into one in order to reduce multicollinearity in the models. ...

### Patterns and trajectories of anal intercourse practice over the life course among US women at risk of HIV

Preprint [Full-text available](#)

Feb 2020

Branwen Nia Owen · Rebecca F Baggaley · Mathieu Maheu-Giroux · Marie-Claude Boily

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... Possible mechanisms underlying the difference observed here include: 1) higher type I interferon response to the SHIV challenge inoculum TLR7 stimulation in females limiting early viral replication [27], 2) greater propensity among males to produce TNF upon TLR4 stimulation (via the MPLA in ALFA) increasing viral transcription [43], and 3) estradiol-mediated inhibition of viral transcription in females via the repressive estrogen receptor in the LTR [44]. In humans, by contrast, a recent meta-analysis showed intrarectal HIV-1 acquisition risk to be higher in women than men [45], though only one study assessing intrarectal transmission risk in women was available. Taken together, there are limited and inconsistent findings regarding the impact of sex on mucosal transmission rates in humans and NHP and more studies involving females are needed. ...

#### Adjuvanted HIV-1 vaccine promotes antibody-dependent phagocytic responses and protects against heterologous SHIV challenge

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Sep 2020

Kier Om · Dominic Paquin Proulx · Maria Montero · Diane L Bolton

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... In 2016, women accounted for approximately 20% of new HIV cases in the country; about 80% of these were attributed to heterosexual sexual contact. 1 Receptive intercourse, both vaginal and anal, results in a higher risk of HIV infection than does insertive intercourse, and receptive anal intercourse (RAI) confers the greatest risk 2 on the male or female receptive partner. 3 Compared with the vagina, the anus is more vulnerable to abrasions during sex, which facilitates infection transmission, 4 and anal mucosa lacks immune barriers to protect against infection. 5 Evidence supports the role that RAI plays in HIV risk among gay and bisexual men, 6 but it may also play a crucial role in driving the heterosexual HIV epidemic, including among women. ...

#### Childhood Traumatic Experiences and Receptive Anal Intercourse Among Women: Childhood Trauma and Anal Intercourse among Women

Article

Feb 2020

Joy Scheidell · Typhany Penniman Dyer · MacRegga Severe · Maria R Khan

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... The global HIV epidemic continues to significantly impact lives, in 2017 approximately 1.8 million new cases, 1 million AIDS deaths, and 37 million HIV infected individuals were reported 1 . The main mode of HIV transmission is through sexual contact with a significantly higher transmission rate for receptive and insertive anal versus vaginal sexual intercourse [2][3][4] . While the vaginal epithelium is multi-stratified, the rectal epithelium is single-layered and thus more vulnerable with underlying HIV target cells easily reachable for penetrating viral particles. ...

#### Impact of Q-Griffithsin anti-HIV microbicide gel in non-human primates: In situ analyses of epithelial and immune cell markers in rectal mucosa

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Dec 2019

Gökçe Günaydın · Gabriella Edfeldt · David A. Garber · Kristina Broiden

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... Baggaley et al., (2008) in a systematic review and meta-analysis of HIV transmission risks in anal sex, reported a 1.4% transmission probability per-act of unprotective receptive anal intercourse (URAI) and 40.4% (6.0-74.9) per-partner probability, with no difference between MSM and heterosexual anal intercourse [29]. The 1.4% per-act probability for URAI has been estimated to be roughly 18-times greater than that of vaginal intercourse [1, 30]. An updated review in 2018, showed a pooled HIV-1 risk of 1.3% for URAI with no difference between the pre-ART and ART era (1.7% vs. 0.8%;  $p = 0.537$ ) [31]. ...

#### Rising HIV prevalence among men who have sex with men in Nigeria: a trend analysis

Article [Full-text available](#)

Sep 2019 · **BMC PUBLIC HEALTH**

George I Eluwa · Sylvia Adebajo · Titilope Eluwa · Charles Nzeju

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... These results reflect both biology and behavior. Overall, receptive anal sex has a higher probability of infection than insertive anal sex (Baggaley et al., 2018; Baggaley, White, & Boily, 2010; Meng et al., 2015). Beyrer et al. (2012, p. 368) succinctly outlined the consequences of this differential for versatility, "Role reversal in MSMs, whereby individuals practice both insertive and receptive roles, helps HIV spread by overcoming the low transmission rates from receptive to insertive partners". ...

**Longitudinal Event-Level Analysis of Gay and Bisexual Men's Anal Sex Versatility: Behavior, Roles, and Substance Use**

Article

Aug 2019 · [J SEX RES](#)

Lindsay Shaw · Lu Wang · Zishan Cui · Eric Abella Roth

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... Key populations influence the evolution of these epidemics in four ways: First, if no protective steps are taken, HIV transmission among key population members is highly efficient. Transmission risk in key populations is elevated for several reasons: the high-efficiency of anal sex in transmitting HIV for MSM and transgendered populations [15]; high-frequency of needle sharing acts among many PWID; substantial partner exchange rates and the facilitating role of other sexually transmitted infections and primary HIV infection for sex workers and clients. Vaginal sex, especially with much lower rates of facilitating sexually transmitted infections outside certain key populations, transmits HIV at significantly lower rates and over a much longer time span [16]. ...

**Evolving HIV epidemics: The urgent need to refocus on populations with risk**Article [Full-text available](#)Jun 2019 · [Curr Opin HIV AIDS](#)

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**Receptive anal sex contributes substantially to heterosexually-acquired HIV infections among at-risk women in Twenty US Cities: results from a modelling analysis**Article [Full-text available](#)May 2020 · [AM J REPROD IMMUNOL](#)

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Apr 2020 · [HIV MED](#)

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**Anal intercourse, HIV-1 risk, and efficacy in a trial of a dapivirine-containing vaginal ring for HIV-1 prevention**

Article

Dec 2019 · [JAIDS-J ACQ IMM DEF](#)

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February 2014 · Sexually transmitted infections

**Amy Matser · Martlies Heiligenberg · Ronald B Geskus · [...] · Maarten Schim van der Loeff**

Decisions to use condoms are made within partnerships. We examined the associations between inconsistent or no condom use and individual and partnership characteristics. We also examined the relative importance of individual versus partnership factors. Cross-sectional study of heterosexual individuals enrolled from the sexually transmitted infections (STI) outpatient clinic in Amsterdam, the ... [\[Show full abstract\]](#)

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**Article**

### P4.031 Differences in Condom Use Consistency During Vaginal and Heterosexual Anal Sex: Findings from...

July 2013 · Sexually Transmitted Infections

**Laura Hoyt D'Anna · Olga Korosteleva · D. Perez · [...] · Kevin Malotte**

Background Condom use consistency is influenced by factors including participant and partnership characteristics, sex acts and cognitive mediators. We aimed to: (1) assess condom use consistency among urban U.S. STD clinic users; (2) examine condom use patterns for anal and vaginal sex within partnerships, and (3) identify characteristics and cognitive factors associated with condom use ... [\[Show full abstract\]](#)

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**Article**

### The potential impact of an HIV vaccine with rapidly waning protection on the epidemic in Southern Af...

August 2011 · Vaccine

**Kyeen M Andersson · A David Paltiel · Douglas K. Owens**

The prime-boost HIV vaccine regimen used in the recent RV144 trial resulted in modest efficacy of 31% over 3.5 years, but was

substantially higher in the first year post-vaccination. We sought to explore the potential impact of a vaccine with rapidly waning efficacy in a South African population. We explored two strategies using a dynamic compartmental epidemic model for heterosexual transmission ... [Show full abstract]

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### Couples HIV testing and immediate antiretroviral therapy for serodiscordant HIV-positive partners: T...

May 2019 · International Journal of STD & AIDS

Duong Bui Duc · Nhan T Do · Linh TT Pham · [...] · Masaya Kato

Injection drug use and heterosexual transmission from male key populations to their female partners have been the dominant modes of HIV transmission in Vietnam. A demonstration project was conducted to offer immediate antiretroviral therapy (ART) (regardless of CD4 cell count) to HIV-seropositive partners in serodiscordant couples. During March–December 2013, couples HIV testing and counselling ... [Show full abstract]

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