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MSM: resurgent epidemics

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Abstract

Purpose of review—The present review discusses the recent finding on behavioral risk factors for HIV transmission from cohort studies in MSM.

Recent findings—HIV incidence among MSM has been increasing in many countries around the world. Some data support early detection and widespread use of antiretroviral treatment (ART) to decrease HIV incidence. However, suboptimal ART adherence could lead to relapse of viremia and new transmission events. Condom use for unprotected anal sex among MSM remains an important prevention tool, but use remains low in many parts of the world. Seroadaptive behaviors by MSM, such as serosorting, may also decrease condom use. However, when serosorting is practiced by MSM who receive frequent HIV testing, the risk of HIV acquisition is reduced. Serosorting and other characteristics of sexual networks, such as concurrency, may be major determinants of transmission for HIV and sexually transmitted infections among MSM. Worldwide, detailed evaluation of the factors related to rising MSM HIV incidence, as well as access to testing and care, is limited by stigma and criminalization of HIV and homosexuality.

Summary—Cohort studies of MSM remain an important strategy to characterize the behavioral factors that drive HIV transmission and how use of ART for prevention and treatment may affect both the risk of HIV transmission and acquisition by MSM.

Keywords

behavior; epidemiology; HIV; MSM; prevention

Introduction

In 1981, the report of *Pneumocystis carinii* pneumonia and mucosal candidiasis in four previously well MSM set off 40 years of scientific endeavors to characterize what was eventually named HIV [1]. Many of the epidemiologic and basic science breakthroughs related to HIV transmission and disease pathogenesis have come from systematic collection of data from well characterized study cohorts such as the Multicenter AIDS Cohort Study (MACS), North American AIDS Cohort Collaboration on Research and Design (NA-ACCORD) and the Rakai Project, a population-based cohort study in Rakai, Uganda [2–5]. Although much has been learned about the natural history of HIV, a detailed understanding of the selective factors and timing that influence HIV transmission, the determinants of

immunologic disease progression, and effective prevention interventions that can be expanded to scale within affected communities, are still not fully understood or feasible for widespread implementation. Overall, use of broader HIV testing and antiretroviral treatment (ART) worldwide in conjunction with more limited prevention intervention efforts have resulted in a decrease in incident HIV infection in many geographic regions, with the notable exception of many communities of MSM in which HIV incidence is still increasing [6•]. This review summarizes recent advances derived from cohort studies that increase our understanding of the challenges that may limit control of HIV within MSM communities. The resurgent epidemics among MSM highlight the need for additional studies to investigate the incidence of HIV globally and the factors that influence transmission, including risk behaviors and sexual network characteristics.

The prevalence and incidence of HIV/AIDS among MSM

As described in the 2009 UNAIDS Global AIDS Report, HIV prevalence is high among MSM on all continents as demonstrated by the countries of Denmark (12%), Canada (15%), Chile (20%), Myanmar (29%), Senegal (22%), and Jamaica (32%). These high rates are accompanied by rising incidence rates of HIV among MSM, as seen in the USA and France despite little change in overall population incidence [6•,7,8•,9]. A review of HIV incidence among MSM in the USA demonstrated an increase from 1.8 per 100 person-years in 1995 to 2.5 per 100 person-years in 2006 [10]. Similar increases have been observed in the Amsterdam Cohort Study, with HIV acquisition increasing from 1.0 per 100 person-years in 1992 to 2.0 per 100 person-years in 2009 [11•]. The incidence of HIV among MSM has also been estimated to be high in Thailand (7.7 per 100 person-years in 2007) and in three Chinese cities from prospective cohort studies performed in 2005–2007, with rates ranging from 2.6 to 5.6 per 100 person-years [12–15]. Worldwide, MSM are at much higher risk than non-MSM for HIV infection, with an estimated odds ratio (OR) of 10 in high prevalence countries and 60 in low prevalence countries [16]. However, despite the high risk for HIV infection in MSM around the world, many countries are not dedicating appropriate resources to HIV prevention or studies to characterize unique HIV risks in MSM populations [6•]. For example, ‘the proportion of HIV prevention expenditure devoted to programmes for sex workers and their clients, MSM and people who inject drugs, is only 1.7% in Burkina Faso, 0.4% in Côte d’Ivoire and 0.24% in Ghana, yet the percentage of new infections in these population groups is 30, 28 and 43%, respectively’ [6•]. Appropriate resources dedicated to HIV prevention can be successful, as demonstrated by a worldwide reduction in new HIV cases from 3.1 million in 1999 to 2.6 million in 2009 occurring primarily in highly effected countries in sub-Saharan Africa through behavioral changes, prevention interventions and roll-out of ART [6•]. Ecological studies in the USA and Canada have also demonstrated an association between reduction in community viral load levels and reduction in HIV incidence among MSM [17•,18•]. These data combined with provocative statistical models of the effect of universal testing and ART have led to a keen interest in evaluating early HIV treatment as a potential countermeasure to the resurgent HIV epidemic [19].

Sexual transmission of HIV

HIV cohort studies begun as early as 1983 have improved our understanding of HIV pathogenesis by evaluating and characterizing risk factors associated with disease acquisition and progression among MSM [1]. Anal sex as a mode of HIV transmission was identified as early as the first landmark publications describing unique opportunistic infections, later characterized as AIDS, among MSM [1,20]. Sexual transmission accounts for more than 90% of incident HIV in the USA [21], yet the factors that most significantly influence HIV transmission are not fully understood within populations, networks or individual sexual encounters.

Unprotected anal intercourse (UAI) is the main risk factor for HIV among MSM as demonstrated by a 20-fold increased risk of HIV seroconversion over 6 months among MSM who reported UAI compared with those who did not [22]. Estimating the per contact risk of HIV acquisition associated with different behaviors and practices remains a major challenge, particularly when attempting to adequately control for potential confounding influences from host, viral and biological determinants [23]. A recent meta-analysis of multiple cohort studies provided a summary estimate of 1.4% [95% confidence interval (CI) 0.2–3.5] risk of HIV acquisition per episode of unprotected receptive anal intercourse (URAI) with no difference between MSM and heterosexuals (HET) [24•]. As with HET studies, there was considerable variability in the estimates provided by available studies leading the authors to conclude that individual factors may influence transmission rates and future studies will need to be more judicious in collecting the characteristics of the sexual behavior for both the source partner and the HIV-infected individual [23,24•].

Although circumcision has been well documented to reduce the risk of HET transmission, recent studies have failed to show a reduced risk of acquiring HIV related to circumcision among MSM [25–27]. When analyses are restricted to MSM who engage only in insertive anal sex (being the ‘top’ with an HIV-positive partner), circumcision was associated with a possible modest protection from acquisition of HIV [28,29]. These data are suggestive, but not necessarily conclusive, that circumcision does not provide the same significant risk reduction for HIV transmission among MSM that has been observed among HET partnerships [30–32]. However, available studies evaluating the effect of male circumcision on HIV transmission among MSM are limited by relatively small sample sizes and difficulty in controlling for versatility of sexual positioning (being both a top and bottom for anal sex) among MSM, and thus, further studies are warranted before definitive recommendations on circumcision for prevention among MSM can be provided [33•].

ART use by the infected partner in HIV discordant HET relationships is associated with a significant reduction in HIV transmission and ART used by uninfected MSM for preexposure prophylaxis (PrEP) is associated with a 42% reduction in HIV acquisition [34•, 35]. Long-term adherence to ART for HIV-infected and PrEP for HIV-uninfected persons, will remain key challenges treatment interventions used to reduce HIV incidence [36]. Expanding novel treatment interventions to scale in MSM will also require dedicated resources and community education. Knowledge of PrEP or post-exposure prophylaxis (PEP) among MSM in New York to prevent HIV transmission was reported by only 46%,

implying a need to educate communities on prevention options [37]. In addition, despite widespread use and potent in-vivo efficacy, ART use is not universally associated with complete and durable virological suppression, which could limit its effectiveness as a prevention intervention. The Swiss HIV cohort followed 6909 participants for a median of 4.5 years for self-reported ART adherence and found that although 78% of all visits were characterized by no missed doses, only 51% of MSM maintained 100% adherence in long-term follow-up [38••]. In this large group of study participants, 13% consistently reported missing doses of ART in the previous 3 months and the remaining patients had missed doses during further follow-up. It was not evident that any of the nonadherence led to breakthrough viremia. In another Swiss cohort analysis, HIV transmissions in phylogenetically linked transmission clusters (groups of individuals with nearly identical HIV genetic sequences) were linked to individuals who discontinued ART after early treatment for primary infection [39••]. Treatment of HIV that results in CD4 cell recovery and improved wellness has also been associated with increased sexual activity in a cohort of US MSM [40]. Therefore, as individuals are identified and treated earlier in the course of disease, sexual activity is likely to increase and failure to maintain viral suppression in HIV-infected individuals through ART may lead to increased HIV transmission risk. To adequately understand the implications of earlier and more widespread ART on HIV transmission risks, well designed studies are needed, especially among MSM populations.

Sexual risk behavior

A recent report summarizing condom use with the last anal sex act among MSM from 78 countries showed that use ranged from 11% in Greece to 89% in Suriname [6•]. In 31% of the 78 countries reporting results in 2009, condom use with the last anal sex partner was reported by less than half of MSM. Among recently infected MSM from Seattle, 69% reported UAI with a HIV-positive or unknown status partner compared with 32% in HIV-uninfected controls ($P<0.01$) [41]. The longitudinal Swiss HIV cohort analysis of 2840 HIV-infected MSM examined predictors of unprotected sex [42••]. This study identified HIV infection status of sexual partners as the strongest predictor of UAI with 89% of HIV-infected MSM reporting consistent condom use with a stable HIV-negative partner, whereas 48% reporting condom use with HIV-infected partners [42••]. In further analyses, the authors found that the use of condoms was lower among MSM with complete virologic suppression related to ART (OR 2.41; 95% CI 1.35–4.30) [42••]. Other predictors of decreased condom use included use of illicit drugs (OR 1.71; 95% CI 1.05–2.78) and older age (OR per 10 years older, 0.86; 95% CI 0.75–0.99) [42••]. A decline in condom use in the MACS cohort (MSM and bisexual men) was associated with ‘safe sex’ message fatigue and a reduced concern about HIV [43]. As ART use is expanded in response to expert panel recommendations to start ART at earlier stages of HIV disease [44], monitoring of potential ‘risk compensation’, an increase in risk behavior related to perception that the absolute risk of HIV transmission is less, is critical. Significant changes in risk behavior among those receiving ART could potentially offset the benefits of earlier ART initiation [45].

Drug use

Substance use, particularly methamphetamine, remains a major predictor of incident HIV in some MSM populations in the USA [41,46–48]. Methamphetamine use is associated with two-fold to three-fold increase in risk of both HIV acquisition and UAI for HIV-infected MSM with partners of negative or unknown status [42•,49]. Although data are scarce for other parts of the world, methamphetamine use has been reported in 110 countries [50], with use associated with recent HIV infection in Australia [51]. Increasing methamphetamine use among MSM in Thailand in addition to current widespread international use suggests the potential for a globally expanding syndemic of methamphetamine use and HIV [12,51]. However, despite the recognized increased HIV risk with methamphetamine use, effective behavioral interventions are limited. Project Mix, a randomized controlled trial of a group-based cognitive behavior intervention, showed no additional risk reduction compared with routine testing and counseling [52].

In addition to HIV transmission risks associated with methamphetamine use, a growing body of evidence indicates that use of erectile dysfunction drugs (EDDs) among MSM is a risk factor for recent HIV infection [43,48,51]. Use of EDD by MSM has been associated with UAI and with high-risk activities such as sex marathons [53,54]. These data do not suggest that appropriately used EDD will increase the risk of HIV transmission as documented by a lack of ‘high-risk’ sexual behavior among men with EDD prescriptions [55•]. However, EDD use may be more frequent among MSM with chronic HIV infection because of sexual dysfunction rates as high as 21% and these same individuals may have lower adherence to ART due to perceived side-effects and pill burden [56]. The role of EDD in HIV transmission is complex, but may represent a significant transmission risk both within groups of high-risk methamphetamine sensation-seeking individuals and networks of mixed serostatus.

Seroadaptation

The selection of sexual partners by HIV status within the MSM community has been called seroadaptation and includes risk reduction strategies such as condom use and strategic positioning [57,58]. Longitudinal data for HIV-infected MSM from San Francisco showed that the relative risk (RR) for individual partnerships of having UAI with a perceived same status partner was 5.11 (95% CI 3.22–8.18) compared with a discordant status partner [58]. However, it remains unclear whether serosorting by HIV status is an effective method to reduce HIV transmission [59,60]. HIV-uninfected MSM in Australia who serosorted by HIV-negative status and developed stable partnerships had a risk of acquiring HIV not significantly different from those without UAI over 1000 person-years of follow-up [61]. Serosorting was found to reduce the risk of HIV acquisition in the Project EXPLORE cohort of HIV-negative MSM enrolled in six US cities, with an OR of 0.88 (95% CI 0.81–0.95) [62•]. Individuals in the EXPLORE study underwent regular HIV testing, suggesting that these individuals knew their HIV status. These studies suggest that serosorting could be effective, conditional on regular HIV testing and development of stable partnerships. Further cohort studies are needed to adequately determine whether optimization of serosorting can be achieved through routine testing and facilitated status disclosure.

Sexual networks

Seroadaptive behaviors have the potential to create sexual networks that are enriched for persons with HIV infection, providing the potential for greater HIV transmission risk from these networks. Evidence of higher risk sexual networks can be found in phylogenetic analyses of HIV transmission clusters from San Diego, USA and in Brighton, UK [63,64]. Clusters of HIV infections are also associated with internet and bathhouse use among those seeking sexual partnerships in Hong Kong [65] and these venues were both associated with recent HIV infection in Seattle, USA [41]. Recent HIV infection in the source partner was identified as the most significant factor associated with HIV transmission in a UK study ($P=0.0008$).

Sexual concurrency, or the practice of having sexual partners that overlap in time, represents another behavioral risk that may increase the rate of HIV transmission [66]. Fifty percent of MSM from Shenzhen, China reported a concurrent sexual partner, whereas studies from South Africa show that 16% of MSM also had a concurrent female partner; however, these studies did not evaluate HIV transmission rates [67,68]. Surprisingly, few studies have evaluated concurrency among MSM from resource-rich countries. In the USA Blacks and other racial minority groups demonstrate higher rates of HIV infection than Whites and there is some evidence that increased concurrency and partner-related risk reduction among persons of color may explain some of the race-related HIV transmission disparities among MSM [69–71]. Compared with other races, Black MSM were three times more likely to have concurrent partnerships in the previous 6 months and these partners were more likely to belong to the Black racial group and intergenerational [71]. Residential geography among MSM may also account for some disparity in HIV risk. The Young Men's Survey analysis of neighborhood characteristics suggested that URAI among Black and Latino MSM was less among those in neighborhoods with high gay presence [72]. These data suggest that evaluation of contextual factors, sexual network structure and partnerships are important for developing prevention strategies, though further research is needed to develop effective network level interventions.

Sexual transmitted infections

Sexually transmitted infections (STIs) have been used as a surrogate for high-risk sexual behavior among MSM and are recognized as an independent biological risk factor for HIV infection [73]. Anal gonorrhea among MSM from the Australian HIM cohort was the strongest predictor of HIV with an adjusted hazard ratio of 7.1 (95% CI 1.62–8.14) [61]. Although the pharynx may not represent a significant source of HIV transmission risk, it may serve as a reservoir for gonorrhea, wherein incidence can be as high as 11% per year for MSM [74,75]. In contrast, the potential for the pharynx to act as a reservoir for chlamydia infection is less likely, with infrequent recovery of chlamydia from the pharynx of MSM compared with the rectum [74,76,77]. Although rates of STI appear to be high among MSM, serosorting sexual networks can be associated with a paradoxical increase in STI frequency without increasing HIV transmission rates [78]. For example, a resurgence of syphilis among MSM has been observed around the world without a concurrent increase in HIV transmission rates [79–81]. STIs still remain an important co-factor for HIV infection and

annual screening for syphilis, gonorrhea and chlamydia at exposed sites among MSM is highly recommended by the Center for Disease Control with more frequent screening for those at highest risk [82].

Stigma and criminalization of homosexuality

In many countries of the world, stigma related to both HIV infection and homosexuality has limited social acceptance and access to care [83]. Stigma in the most general terms refers to a 'dynamic process of devaluation that significantly discredits an individual in the eyes of others' [83]. Research to evaluate predictors of HIV infection has been limited in communities in which significant HIV stigma is reported [6,84,85]. This may be a result of insufficient resources, unwillingness to consider HIV transmission a problem among MSM communities and the frequent social discomfort that is associated with MSM sexual behaviors, resulting in an outright criminalization of same sex partnerships in 85 countries (as of 2007) around the world [16,83,86]. Criminalization of HIV transmission from all risk groups is prominent around the world, despite strong arguments against the use of legal means to deter risk behavior and HIV transmission [87,88]. Limiting the criminalization of homosexuality and HIV transmission in general is recommended by UNAIDS and is critical to improved studies of HIV among MSM [89,90].

Conclusion

HIV incidence remains higher among MSM compared with all other risk groups in almost every part of the world [16]. There is hope that increased access and use of ART may be effective in reducing HIV transmission rates [19]. Future studies to evaluate the impact of intensified HIV testing, linkage to care and ART initiation, the 'test and treat' paradigm, are needed to evaluate both the limitations of this strategy and the potential benefits [3,64,91,92]. The success of the 'test and treat' strategy will be greatly influenced by how much transmission is perpetuated from the earliest stages of infection, something that is not known at this time with certainty [93]. It is important to note that population level ecological studies are subject to bias (i.e. ecological fallacy) and evidence of HIV prevention efficacy resulting from either ART, behavior modification, or both, will ideally require validation in well characterized study cohorts [94]. Achieving a reduction in prevalent HIV infections with currently available prevention efforts remains a challenge. It is estimated that a 50% reduction in incident HIV in the USA would be associated with a 20% increase in HIV prevalence for those living with HIV over 10 years [95]. To achieve a significant reduction in HIV transmission among MSM, multilevel prevention approaches are needed that include not only individual level interventions, such as ART and behavioral modification, but also effective targeted prevention interventions for both high-risk communities and sexual networks.

References and recommended reading

Papers of particular interest, published within the annual period of review, have been highlighted as:

- of special interest

•• of outstanding interest

Additional references related to this topic can also be found in the Current World Literature section in this issue (pp. 338–339).

1. Gottlieb MS, Schroff R, Schanker HM, et al. Pneumocystis carinii pneumonia and mucosal candidiasis in previously healthy homosexual men: evidence of a new acquired cellular immunodeficiency. *N Engl J Med.* 1981; 305:1425–1431. [PubMed: 6272109]
2. Gange SJ, Kitahata MM, Saag MS, et al. Cohort profile: the North American AIDS Cohort Collaboration on Research and Design (NA-ACCORD). *Int J Epidemiol.* 2007; 36:294–301. [PubMed: 17213214]
3. Wawer MJ, Gray RH, Sewankambo NK, et al. Rates of HIV-1 transmission per coital act, by stage of HIV-1 infection, in Rakai, Uganda. *J Infect Dis.* 2005; 191:1403–1409. [PubMed: 15809897]
4. Quinn TC, Wawer MJ, Sewankambo N, et al. Viral load and heterosexual transmission of human immunodeficiency virus type 1. Rakai Project Study Group. *N Engl J Med.* 2000; 342:921–929. [PubMed: 10738050]
5. Mellors JW, Rinaldo CR Jr, Gupta P, et al. Prognosis in HIV-1 infection predicted by the quantity of virus in plasma. *Science.* 1996; 272:1167–1170. [PubMed: 8638160]
- 6•. UNAIDS Report on the Global AIDS Epidemic, 2010. Joint United Nations Programme on HIV/AIDS. 2010 This paper gives an excellent global view of HIV.
7. Semaille C, Cazein F, Lot F, et al. Recently acquired HIV infection in men who have sex with men (MSM) in France, 2003–2008. *Euro Surveill.* 2009; 14:14.
- 8•. Le Vu S, Le Strat Y, Barin F, et al. Population-based HIV-1 incidence in France, 2003–08: a modelling analysis. *Lancet Infect Dis.* 2010; 10:682–687. The most recent paper with incidence estimates in a resource-rich country. [PubMed: 20832367]
9. Hall HI, Song R, Rhodes P, et al. Estimation of HIV incidence in the United States. *JAMA.* 2008; 300:520–529. [PubMed: 18677024]
10. Stall R, Duran L, Wisniewski SR, et al. Running in place: implications of HIV incidence estimates among urban men who have sex with men in the United States and other industrialized countries. *AIDS Behav.* 2009; 13:615–629. [PubMed: 19205867]
- 11•. Jansen IA, Geskus RB, Davidovich U, et al. Ongoing HIV-1 transmission among men who have sex with men in Amsterdam: a 25-year prospective cohort study. *AIDS.* 2011; 25:493–501. A long-term cohort study with detailed analysis of HIV transmission among MSM. [PubMed: 21192230]
12. van Griensven F, Varangrat A, Wimonasate W, et al. Trends in HIV prevalence, estimated HIV incidence, and risk behavior among men who have sex with men in Bangkok, Thailand, 2003–2007. *J Acquir Immune Defic Syndr.* 2009; 53:234–239.
13. Ruan Y, Jia Y, Zhang X, et al. Incidence of HIV-1, syphilis, hepatitis B, hepatitis C virus infections and predictors associated with retention in a 12-month follow-up study among men who have sex with men in Beijing, China. *J Acquir Immune Defic Syndr.* 2009; 52:604–610. [PubMed: 19710617]
14. Yang H, Hao C, Huan X, et al. HIV incidence and associated factors in a cohort of men who have sex with men in Nanjing, China. *Sex Transm Dis.* 2010; 37:208–213. [PubMed: 20182406]
15. Xu JJ, Zhang M, Brown K, et al. Syphilis and HIV seroconversion among a 12-month prospective cohort of men who have sex with men in Shenyang, China. *Sex Transm Dis.* 2010; 37:432–439. [PubMed: 20375928]
16. Baral S, Sifakis F, Cleghorn F, Beyrer C. 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.* 2007; 4:e339. [PubMed: 18052602]
- 17••. Das M, Chu PL, Santos GM, et al. Decreases in community viral load are accompanied by reductions in new HIV infections in San Francisco. *PLoS One.* 2010; 5:e11068. The paper by Das *et al.* demonstrated an ecological association of a reduction in total population level viral load with declining numbers of new HIV diagnoses. These data were from San Francisco where the vast majority of HIV cases followed was MSM. These provocative data suggest that

expanding HIV treatment will reduce HIV incidence. However, these studies do not count people not in care and the relationship could be confounded by other factors. [PubMed: 20548786]

- 18•. Montaner JS, Lima VD, Barrios R, et al. Association of highly active antiretroviral therapy coverage, population viral load, and yearly new HIV diagnoses in British Columbia, Canada: a population-based study. *Lancet*. 2010; 376:532–539. Motaner *et al.* also show an ecological association of population level viral load with declining numbers of new HIV diagnoses. The effect observed was driven primarily by the reduction in HIV incident cases in intravenous drug users. [PubMed: 20638713]
19. Granich RM, Gilks CF, Dye C, et al. Universal voluntary HIV testing with immediate antiretroviral therapy as a strategy for elimination of HIV transmission: a mathematical model. *Lancet*. 2009; 373:48–57. [PubMed: 19038438]
20. A cluster of Kaposi's sarcoma and *Pneumocystis carinii* pneumonia among homosexual male residents of Los Angeles and Orange Counties, California. *MMWR Morb Mortal Wkly Rep*. 1982; 31:305–307. [PubMed: 6811844]
21. Subpopulation estimates from the HIV incidence surveillance system – United States, 2006. *MMWR Morb Mortal Wkly Rep*. 2008; 57:985–989. [PubMed: 18784639]
22. Kingsley LA, Detels R, Kaslow R, et al. Risk factors for seroconversion to human immunodeficiency virus among male homosexuals. Results from the Multicenter AIDS Cohort Study. *Lancet*. 1987; 1:345–349. [PubMed: 2880160]
23. Powers KA, Poole C, Pettifor AE, Cohen MS. Rethinking the heterosexual infectivity of HIV-1: a systematic review and meta-analysis. *Lancet Infect Dis*. 2008; 8:553–563. [PubMed: 18684670]
- 24•. Baggaley RF, White RG, Boily MC. HIV transmission risk through anal intercourse: systematic review, meta-analysis and implications for HIV prevention. *Int J Epidemiol*. 2010; 39:1048–1063. This paper is the most complete review of the risk of HIV transmission from anal sex. [PubMed: 20406794]
25. Jameson DR, Celum CL, Manhart L, et al. The association between lack of circumcision and HIV, HSV-2, and other sexually transmitted infections among men who have sex with men. *Sex Transm Dis*. 2010; 37:147–152. [PubMed: 19901865]
26. McDaid LM, Weiss HA, Hart GJ. Circumcision among men who have sex with men in Scotland: limited potential for HIV prevention. *Sex Transm Infect*. 2010; 86:404–406. [PubMed: 20595141]
27. Sanchez J, Sal YRVG, Hughes JP, et al. Male circumcision and risk of HIV acquisition among MSM. *AIDS*. 2010; 25:519–523.
28. Templeton DJ, Millett GA, Grulich AE. Male circumcision to reduce the risk of HIV and sexually transmitted infections among men who have sex with men. *Curr Opin Infect Dis*. 2010; 23:45–52. [PubMed: 19935420]
29. Gust DA, Wiegand RE, Kretsinger K, et al. Circumcision status and HIV infection among MSM: reanalysis of a phase III HIV vaccine clinical trial. *AIDS*. 2010; 24:1135–1143. [PubMed: 20168206]
30. Auvert B, Taljaard D, Lagarde E, et al. Randomized, controlled intervention trial of male circumcision for reduction of HIV infection risk: the ANRS 1265 trial. *PLoS Med*. 2005; 2:e298. [PubMed: 16231970]
31. Bailey RC, Moses S, Parker CB, et al. Male circumcision for HIV prevention in young men in Kisumu, Kenya: a randomised controlled trial. *Lancet*. 2007; 369:643–656. [PubMed: 17321310]
32. Gray RH, Kigozi G, Serwadda D, et al. Male circumcision for HIV prevention in men in Rakai, Uganda: a randomised trial. *Lancet*. 2007; 369:657–666. [PubMed: 17321311]
- 33•. Smith DK, Taylor A, Kilmarx PH, et al. Male circumcision in the United States for the prevention of HIV infection and other adverse health outcomes: report from a CDC consultation. *Public Health Rep*. 2010; 125(Suppl 1):72–82. A report on the status of circumcision for MSM on HIV transmission. [PubMed: 20408390]
- 34•. Grant RM, Lama JR, Anderson PL, et al. Preexposure chemoprophylaxis for HIV prevention in men who have sex with men. *N Engl J Med*. 2010; 363:2587–2599. The paper by Grant *et al.* demonstrates that ART is effective in prevention of HIV acquisition but does not begin to answer how this could be implemented or how real world effectiveness will be. [PubMed: 21091279]

35. Donnell D, Baeten JM, Kiarie J, et al. Heterosexual HIV-1 transmission after initiation of antiretroviral therapy: a prospective cohort analysis. *Lancet*. 2010; 375:2092–2098. [PubMed: 20537376]
36. Christopoulos KA, Das M, Colfax GN. Linkage and retention in HIV care among men who have sex with men in the United States. *Clin Infect Dis*. 2011; 52(Suppl 2):S214–S222. [PubMed: 21342910]
37. Mehta SA, Silvera R, Bernstein K, et al. Awareness of postexposure HIV prophylaxis in high-risk men who have sex with men in New York City. *Sex Transm Infect*. 2011 [Epub ahead of print].
- 38••. Glass TR, Battegay M, Cavassini M, et al. Longitudinal analysis of patterns and predictors of changes in self-reported adherence to antiretroviral therapy: Swiss HIV Cohort Study. *J Acquir Immune Defic Syndr*. 2010; 54:197–203. The paper by Glass *et al* is important in that it shows the long-term ART adherence reported by a large cohort of HIV-infected individuals and that 100% adherence was not the norm. However, the number of missed doses is not well quantified and, therefore, is uncertain whether there was significant viral breakthrough. [PubMed: 20035231]
- 39••. Rieder P, Joos B, von Wyl V, et al. HIV-1 transmission after cessation of early antiretroviral therapy among men having sex with men. *AIDS*. 2010; 24:1177–1183. The paper by Rieder *et al* shows that transmission of HIV could be traced to individuals who had discontinued ART in the Swiss Cohort after early treatment for primary infection. This suggests that continued use of ART could have prevented these transmissions. [PubMed: 20386427]
40. Jeffries WL, Zsembik BA, Peek CW, Uphold CR. A longitudinal analysis of sociodemographic and health correlates of sexual health among HIV-infected men in the USA. *Sex Health*. 2009; 6:285–292. [PubMed: 19917196]
41. Thiede H, Jenkins RA, Carey JW, et al. Determinants of recent HIV infection among Seattle-area men who have sex with men. *Am J Public Health*. 2009; 99(Suppl 1):S157–S164. [PubMed: 18445808]
- 42••. Hasse B, Ledergerber B, Hirschel B, et al. Frequency and determinants of unprotected sex among HIV-infected persons: the Swiss HIV cohort study. *Clin Infect Dis*. 2010; 51:1314–1322. The paper by Hasse *et al* reported reasons for condom use among a large cohort of HIV-infected men. In particular, MSM were less likely to use a condom with a seroconcordant partner and if they were on ART. This suggests MSM make decisions on condom use based on a perception of lower transmission risk. [PubMed: 21034200]
43. Ostrow DG, Plankey MW, Cox C, et al. Specific sex drug combinations contribute to the majority of recent HIV seroconversions among MSM in the MACS. *J Acquir Immune Defic Syndr*. 2009; 51:349–355. [PubMed: 19387357]
44. Thompson MA, Aberg JA, Cahn P, et al. Antiretroviral treatment of adult HIV infection: 2010 recommendations of the International AIDS Society-USA panel. *JAMA*. 2010; 304:321–333. [PubMed: 20639566]
45. Eaton LA, Kalichman S. Risk compensation in HIV prevention: implications for vaccines, microbicides, and other biomedical HIV prevention technologies. *Curr HIV/AIDS Rep*. 2007; 4:165–172. [PubMed: 18366947]
46. Rudy ET, Shoptaw S, Lazzar M, et al. Methamphetamine use and other club drug use differ in relation to HIV status and risk behavior among gay and bisexual men. *Sex Transm Dis*. 2009; 36:693–695. [PubMed: 19704399]
47. Carey JW, Mejia R, Bingham T, et al. Drug use, high-risk sex behaviors, and increased risk for recent HIV infection among men who have sex with men in Chicago and Los Angeles. *AIDS Behav*. 2009; 13:1084–1096. [PubMed: 18498049]
48. Drumright LN, Gorbach PM, Little SJ, Strathdee SA. Associations between substance use, erectile dysfunction medication and recent HIV infection among men who have sex with men. *AIDS Behav*. 2009; 13:328–336. [PubMed: 18064558]
49. Gorbach PM, Weiss RE, Jeffries R, et al. Behaviors of recently HIV-infected men who have sex with men in the year postdiagnosis: effects of drug use and partner types. *J Acquir Immune Defic Syndr*. 2011; 56:176–182. [PubMed: 21119524]

50. Degenhardt L, Mathers B, Guarinieri M, et al. Meth/amphetamine use and associated HIV: implications for global policy and public health. *Int J Drug Policy*. 2010; 21:347–358. [PubMed: 20117923]
51. Prestage G, Jin F, Kippax S, et al. Use of illicit drugs and erectile dysfunction medications and subsequent HIV infection among gay men in Sydney, Australia. *J Sex Med*. 2009; 6:2311–2320. [PubMed: 19493293]
52. Mansergh G, Koblin BA, McKirnan DJ, et al. An intervention to reduce HIV risk behavior of substance-using men who have sex with men: a two-group randomized trial with a nonrandomized third group. *PLoS Med*. 2010; 7:e1000329. [PubMed: 20811491]
53. Fisher DG, Reynolds GL, Ware MR, Napper LE. Methamphetamine and Viagra use: relationship to sexual risk behaviors. *Arch Sex Behav*. 2009; 40:273–279. [PubMed: 19330436]
54. Semple SJ, Zians J, Strathdee SA, Patterson TL. Sexual marathons and methamphetamine use among HIV-positive men who have sex with men. *Arch Sex Behav*. 2009; 38:583–590. [PubMed: 18185990]
55. Cook RL, McGinnis KA, Samet JH, et al. Erectile dysfunction drug receipt, risky sexual behavior and sexually transmitted diseases in HIV-infected and HIV-uninfected men. *J Gen Intern Med*. 2010; 25:115–121. This study shows that men receiving prescription of EDDs did not have higher sexual risk behaviors. [PubMed: 19921112]
56. Trotta MP, Ammassari A, Murri R, et al. Self-reported sexual dysfunction is frequent among HIV-infected persons and is associated with suboptimal adherence to antiretrovirals. *AIDS Patient Care STDS*. 2008; 22:291–299. [PubMed: 18422461]
57. McFarland W, Chen YH, Raymond HF, et al. HIV seroadaptation among individuals, within sexual dyads, and by sexual episodes, men who have sex with men, San Francisco, 2008. *AIDS Care*. 2010; 23:261–268.
58. McConnell JJ, Bragg L, Shiboski S, Grant RM. Sexual seroadaptation: lessons for prevention and sex research from a cohort of HIV-positive men who have sex with men. *PLoS One*. 2010; 5:e8831. [PubMed: 20098616]
59. Butler DM, Smith DM. Serosorting can potentially increase HIV transmissions. *AIDS*. 2007; 21:1218–1220. [PubMed: 17502737]
60. Golden MR, Stekler J, Hughes JP, Wood RW. HIV serosorting in men who have sex with men: is it safe? *J Acquir Immune Defic Syndr*. 2008; 49:212–218. [PubMed: 18769346]
61. Jin F, Crawford J, Prestage GP, et al. Unprotected anal intercourse, risk reduction behaviours, and subsequent HIV infection in a cohort of homosexual men. *AIDS*. 2009; 23:243–252. [PubMed: 19098494]
62. Philip SS, Yu X, Donnell D, et al. Serosorting is associated with a decreased risk of HIV seroconversion in the EXPLORE Study Cohort. *PLoS One*. 2010; 9:e12662. In the paper by Philip *et al.*, a well characterized cohort of MSM who were in a behavioral intervention trial and had frequent HIV testing demonstrated a reduction in HIV acquisition risk if they reported serosorting. This suggests that regular HIV testing combined with serosorting could reduce HIV transmission.
63. Smith DM, May SJ, Tweeten S, et al. A public health model for the molecular surveillance of HIV transmission in San Diego, California. *AIDS*. 2009; 23:225–232. [PubMed: 19098493]
64. Fisher M, Pao D, Brown AE, et al. Determinants of HIV-1 transmission in men who have sex with men: a combined clinical, epidemiological and phylogenetic approach. *AIDS*. 2010; 24:1739–1747. An excellent analysis of determinants of HVI transmission among MSM. [PubMed: 20588173]
65. Lee SS, Tam DK, Tan Y, et al. An exploratory study on the social and genotypic clustering of HIV infection in men having sex with men. *AIDS*. 2009; 23:1755–1764. [PubMed: 19609202]
66. Morris M, Kretzschmar M. Concurrent partnerships and the spread of HIV. *AIDS*. 1997; 11:641–648. [PubMed: 9108946]
67. Beyrer C, Trapence G, Motimedi F, et al. Bisexual concurrency, bisexual partnerships, and HIV among southern African men who have sex with men. *Sex Transm Infect*. 2010; 86:323–327. [PubMed: 20410078]

68. Ha TH, Liu H, Cai Y, Feng T. Concurrent sexual partnerships among men who have sex with men in Shenzhen, China. *Sex Transm Dis.* 2010; 37:506–511. [PubMed: 20453721]
69. Eaton LA, Kalichman SC, Cherry C. Sexual partner selection and HIV risk reduction among Black and White men who have sex with men. *Am J Public Health.* 2010; 100:503–509. [PubMed: 20075328]
70. Cassels S, Pearson CR, Walters K, et al. Sexual partner concurrency and sexual risk among gay, lesbian, bisexual, and transgender American Indian/ Alaska natives. *Sex Transm Dis.* 2010; 37:272–278. [PubMed: 20051930]
71. Bohl DD, Raymond HF, Arnold M, McFarland W. Concurrent sexual partnerships and racial disparities in HIV infection among men who have sex with men. *Sex Transm Infect.* 2009; 85:367–369. [PubMed: 19773457]
72. Frye V, Koblin B, Chin J, et al. Neighborhood-level correlates of consistent condom use among men who have sex with men: a multilevel analysis. *AIDS Behav.* 2010; 14:974–985. [PubMed: 18712593]
73. Rottingen JA, Cameron DW, Garnett GP. A systematic review of the epidemiologic interactions between classic sexually transmitted diseases and HIV: how much really is known? *Sex Transm Dis.* 2001; 28:579–597. [PubMed: 11689757]
74. Templeton DJ, Jin F, Imrie J, et al. Prevalence, incidence and risk factors for pharyngeal chlamydia in the community based Health in Men (HIM) cohort of homosexual men in Sydney, Australia. *Sex Transm Infect.* 2008; 84:361–363. [PubMed: 18596068]
75. Morris SR, Klausner JD, Buchbinder SP, et al. Prevalence and incidence of pharyngeal gonorrhea in a longitudinal sample of men who have sex with men: the EXPLORE study. *Clin Infect Dis.* 2006; 43:1284–1289. [PubMed: 17051493]
76. Kent CK, Chaw JK, Wong W, et al. Prevalence of rectal, urethral, and pharyngeal chlamydia and gonorrhea detected in 2 clinical settings among men who have sex with men: San Francisco, California, 2003. *Clin Infect Dis.* 2005; 41:67–74. [PubMed: 15937765]
77. Dang T, Jatton-Ogay K, Flepp M, et al. High prevalence of anorectal chlamydial infection in HIV-infected men who have sex with men in Switzerland. *Clin Infect Dis.* 2009; 49:1532–1535. [PubMed: 19848599]
78. Truong HM, Kellogg T, Klausner JD, et al. Increases in sexually transmitted infections and sexual risk behaviour without a concurrent increase in HIV incidence among men who have sex with men in San Francisco: a suggestion of HIV serosorting? *Sex Transm Infect.* 2006; 82:461–466. [PubMed: 17151031]
79. Spielmann N, Munstermann D, Hagedorn HJ, et al. Time trends of syphilis and HSV-2 co-infection among men who have sex with men in the German HIV-1 seroconverter cohort from 1996–2007. *Sex Transm Infect.* 2010; 86:331–336. [PubMed: 20876750]
80. Baral S, Kizub D, Masenior NF, et al. Male sex workers in Moscow, Russia: a pilot study of demographics, substance use patterns, and prevalence of HIV-1 and sexually transmitted infections. *AIDS Care.* 2010; 22:112–118. [PubMed: 20390488]
81. Mayer KH, O’Cleirigh C, Skeer M, et al. Which HIV-infected men who have sex with men in care are engaging in risky sex and acquiring sexually transmitted infections: findings from a Boston community health centre. *Sex Transm Infect.* 2010; 86:66–70. [PubMed: 19720603]
82. Workowski KA, Berman S. Sexually transmitted diseases treatment guidelines, 2010. *MMWR Recomm Rep.* 2010; 59:1–110.
83. Ayala G, Beck J, Lauer K, et al. Social discrimination against men who have sex with men (MSM): implications for HIV policy and programs. *The Global Forum on MSM and HIV 2010 Policy Brief.*
- 84•. Beyrer C, Baral SD, Walker D, et al. The expanding epidemics of HIV type 1 among men who have sex with men in low- and middle-income countries: diversity and consistency. *Epidemiol Rev.* 2010; 32:137–151. This paper is the best overall description of the state of HIV in resource-limited countries. [PubMed: 20573756]
85. Sayles JN, Wong MD, Kinsler JJ, et al. The association of stigma with self-reported access to medical care and antiretroviral therapy adherence in persons living with HIV/AIDS. *J Gen Intern Med.* 2009; 24:1101–1108. [PubMed: 19653047]

86. Smith AD, Tapsoba P, Peshu N, et al. Men who have sex with men and HIV/AIDS in sub-Saharan Africa. *Lancet*. 2009; 374:416–422. [PubMed: 19616840]
87. Csete J, Dube S. An inappropriate tool: criminal law and HIV in Asia. *AIDS*. 2010; 24(Suppl 3):S80–S85. [PubMed: 20926932]
88. Jurgens R, Cohen J, Cameron E, et al. Ten reasons to oppose the criminalization of HIV exposure or transmission. *Reprod Health Matters*. 2009; 17:163–172. [PubMed: 19962650]
89. UNAIDS. Criminal Law, Public Health and HIV Transmission: a Policy Options Paper. 2002
90. International consultation on the criminalization of HIV transmission: 31 October 2 November 2007, Geneva, Switzerland. Vol. 17. Joint United Nations Programme on HIV/AIDS (UNAIDS); Geneva: United Nations Development Programme (UNDP); New York: 2007. 180–186. *Reprod Health Matters* 2009
91. Lewis F, Hughes GJ, Rambaut A, et al. Episodic sexual transmission of HIV revealed by molecular phylodynamics. *PLoS Med*. 2008; 5:e50. [PubMed: 18351795]
92. Brenner BG, Roger M, Moisi DD, et al. Transmission networks of drug resistance acquired in primary/early stage HIV infection. *AIDS*. 2008; 22:2509–2515. [PubMed: 19005274]
93. Miller WC, Rosenberg NE, Rutstein SE, Powers KA. Role of acute and early HIV infection in the sexual transmission of HIV. *Curr Opin HIV AIDS*. 2010; 5:277–282. [PubMed: 20543601]
94. Rutherford GW, McFarland W, Spindler H, et al. Public health triangulation: approach and application to synthesizing data to understand national and local HIV epidemics. *BMC Public Health*. 2010; 10:447. [PubMed: 20670448]
- 95••. Hall HI, Green TA, Wolitski RJ, et al. Estimated future HIV prevalence, incidence, and potential infections averted in the United States: a multiple scenario analysis. *J Acquir Immune Defic Syndr*. 2010; 55:271–276. Using methods for calculating HIV incidence, this modeling exercise demonstrates that declines of more than 50% will be needed to see leveling of HIV prevalence. This supports the need for an ongoing multilevel HIV control strategy. [PubMed: 20634702]

Key points

- HIV incidence among MSM is high around the world but early detection and treatment may be part of a strategy to reduce transmission.
- MSM are selective in condom use with anal sex based on perceived lower risk of HIV transmission with serosorted partners or when the HIV-infected person is on antiretroviral treatment (ART).
- Serosorting among MSM may prevent HIV transmission if they have accurate and routinely updated assessment of HIV status.
- HIV and other sexually transmitted infections occur through sexual networks. Important network characteristics include serosorting practices, wherein partners are met, and concurrency.
- Stigma and criminalization of HIV and homosexuality are counterproductive to the study and control of the HIV epidemic among MSM.