

# Engagement of Gay Men and Other Men Who Have Sex with Men (MSM) in the Response to HIV: A Critical Step in Achieving an AIDS-Free Generation

Shauna Stahlman<sup>1</sup> · Chris Beyrer<sup>1</sup> · Patrick S. Sullivan<sup>2</sup> · Kenneth H. Mayer<sup>3,4</sup> · Stefan D. Baral<sup>1</sup>

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**Abstract** Men who have sex with men (MSM) continue to be at elevated risk for HIV acquisition and transmission secondary to biological and behavioral characteristics, social and sexual network characteristics, community environmental factors, and structural factors. HIV incidence rates remain high among MSM in both low- and high-income settings, and in both concentrated and more generalized HIV epidemic settings. While data quality tends to be poorer, the best estimates collectively suggest that MSM have up to 20 times the odds of living with HIV as compared to other reproductive aged adults across low- and middle-income countries. Recent prevention strategies to lower biological HIV transmission and acquisition risks, including the early use of antiretrovirals to decrease infectiousness for those living with HIV, and pre-exposure prophylaxis for those at significant risk of HIV acquisition, have demonstrated the potential to change the trajectory of the HIV epidemics among MSM. However, the coverage and effectiveness of these approaches is limited by structural factors including the punitive legal frameworks and institutional discrimination that contribute to limited uptake, challenges to

adherence, and suboptimal health-seeking behaviors among MSM. More intensive efforts will be required to reach MSM who do not currently have access to relevant and effective prevention and treatment services or elect not to access these services given enacted and/or perceived stigma. Respect for human rights, including efforts to aggressively confront and combat the forms of stigma that are preventing us from achieving an AIDS-Free generation, are needed for all people including gay men and other MSM.

**Keywords** Men who have sex with men · MSM · HIV · Epidemic · Risk factors

## Introduction

Men who have sex with men (MSM) include gay and bisexual men, MSM who do not identify as gay or bisexual despite their behaviors, male sex workers, and transgender men who have sex with men who identify as gay or have sex with other men. The term “MSM” was originally intended to describe same sex behaviors between men rather than identities, orientations, or cultural categories. It was designed to be less stigmatizing than culturally-bound terms such as gay, bisexual, or homosexual, and has been useful as an epidemiologic tool to help characterize the HIV pandemic in challenging contexts. However, in the era of HIV, there are a growing number of men in many low- and middle-income countries who now identify as MSM and feel a sense of connection with what is often referred to as a MSM community, thereby confounding the initial intention of the term. Moreover, the term MSM in 2016 has evolved into one that is often used interchangeably with the term gay, which is dehumanizing to those who identify as members of the lesbian, gay, bisexual, and transgender

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✉ Shauna Stahlman  
sstahml1@jhu.edu

<sup>1</sup> Department of Epidemiology, Center for Public Health and Human Rights, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, USA

<sup>2</sup> Department of Epidemiology, Rollins School of Public Health, Emory University, Atlanta, USA

<sup>3</sup> Fenway Health, The Fenway Institute, Boston, MA, USA

<sup>4</sup> Division of Infectious Diseases, Department of Medicine, Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA, USA

(LGBT) community [1]. And given the dynamic nature of people, these definitions may further evolve in the years to come. However, for this paper, we will use the term MSM as a broad epidemiologic characterization in the context of the HIV pandemic.

Despite recent advances in HIV prevention and treatment approaches [2, 3], MSM are among those at highest risk of acquiring and transmitting HIV (Fig. 1) [4]. The reasons for the high burden of HIV among MSM are multifaceted and may be manifested in diverse ways for different individuals. In addition to individual biological factors (e.g., the increased susceptibility of anal mucosa to HIV infection) or behavioral characteristics (e.g., increased number or frequency of sexual contacts or condomless sex among some MSM), social and sexual networks, community environments, law and policies, and the stage of epidemic in the area in which an individual resides may also play a role in potentiating HIV spread [4–9].

The objective of this paper is to demonstrate that engaging and retaining gay men and other MSM in treatment and prevention services is critical to controlling the HIV epidemic worldwide. We will provide an overview of the drivers of HIV risk and will then focus on how these findings relate to the global and local epidemics, including concentrated and generalized epidemics in high- and low-income settings.

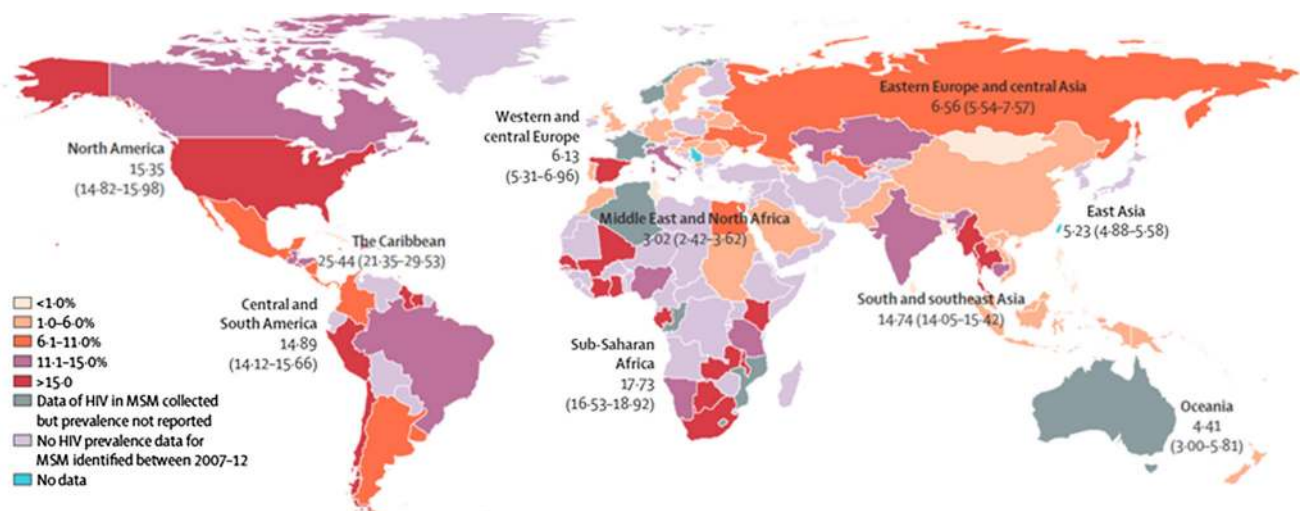
### Individual-Level Risks

Individual-level risks for HIV acquisition in MSM include condomless insertive and receptive anal intercourse with serodiscordant and viremic sexual partners, high frequency of casual male partners, high number of lifetime male

partners, high viral burden in the index partner, injection drug use, and non-injection drug use, including use of amphetamines and other drugs before and during sex [10]. In addition, MSM may be at risk for a wide variety of other sexually transmitted infections, which can facilitate HIV transmission and acquisition through genital tract inflammation involving increased local density of immune cells that are at risk for acquiring HIV, ulcerations, and abrasions [11–13]. However, one of the primary driving forces behind the disproportionate HIV disease burden among MSM globally is the high per-act and per-partner transmission probability of HIV from receptive anal sex compared to vaginal sex with a non-virally suppressed sexual partner living with HIV [4, 14–16]. Rectal exposure to HIV infection is biologically different from vaginal exposure: the gut has a huge potential transmission space, contains a large number of CD4 expressing cells in the proximal submucosa, and is more susceptible to HIV infection [6–8]. These factors result in a high HIV transmission probability per act during condomless anal sex with a non-virally suppressed partner living with HIV—almost 20 times higher than during vaginal sex (1.4 vs. 0.08 %) [6].

### Network-Level Risks

Among MSM, sexual-network-level risks can also facilitate HIV spread [17, 18]. Although individual-level risks are similar for men and women for receptive anal sex with an HIV-infected and viremic sexual partner, male–male sexual partnerships differ since each partner can engage in either insertive or receptive sexual positioning. This sex role versatility, coupled with the high per act risk of HIV transmission during rectal exposure, leads to high



**Fig. 1** Global HIV prevalence in MSM, from studies published 2007–2011. Data are prevalence (95 % CIs). Reprinted from The Lancet, Volume 380, Beyrer C, Baral SD, van Griensven F, Goodreau

SM, Chariyalertsak S, Wirtz AL, and Brookmeyer R. Global epidemiology of HIV infection in men who have sex with men, pages 367–77, Copyright (2012), with permission from Elsevier

individual, couple-based, and network-level HIV transmission risks [19–21]. Social and peer-group norms, as well as availability of condoms and high HIV/STI prevalence within networks can also accelerate the spread of HIV [22, 23]. Molecular epidemiological studies of HIV conducted among MSM demonstrate substantial clustering of HIV infection within MSM networks, a high frequency of multiple transmitted viral variants, and more rapid HIV spread through sexual networks [4]. In addition, larger sexual networks provide increased opportunities for exposure to HIV-infected partners and consequently higher risk of HIV acquisition among MSM. In the era of increasing use of digital spaces to find sexual partners, sexual networks may be increasingly large where people are less likely to know the status of their partner.

However, social network characteristics such as the provision of social support within communities of gay men and other MSM can help to reduce the spread of HIV [24–26]. Social factors such as trust or the ability to work together towards a common goal with other MSM, deriving a sense of pleasure or value from participating in same-sex oriented public events, and reporting comfort with one's sexual identity or behaviors can encourage consistent condom use and participation in HIV prevention and health care programs, and they have been associated with decreased HIV infection, better HIV treatment outcomes, and reduced depression [26–31].

### Community-Level Risks

Societal and internalized homophobia can limit the provision and uptake of HIV prevention, treatment, and care services [32, 33]. For example, culturally-insensitive health workers may result in MSM avoiding HIV prevention services; or even more problematically, MSM living with HIV may avoid HIV treatment services. Reduced utilization of health and HIV services by MSM, due to enacted or perceived discrimination, may limit knowledge of the risks of unprotected anal intercourse and opportunities for access to prevention services [34, 35]. Stigma and discrimination, such as exposure to homophobic abuse, homophobia, or homonegativity; a lack of social support; shame, blame, and social isolation; and victimization at school or work, have all been associated with poor HIV-related health outcomes. These adverse outcomes include reduced rates of HIV testing, increased risk for HIV infection, lower likelihood of discussing or disclosing HIV/AIDS status with male partners, increased condomless anal sex, and reduced engagement in HIV treatment for those living with HIV [36–39]. However, community support such as MSM-specific health promotion can have positive impacts such as encouraging condom use through education and self-affirming and sex-positive messaging [27, 40].

### Structural-Level Risks

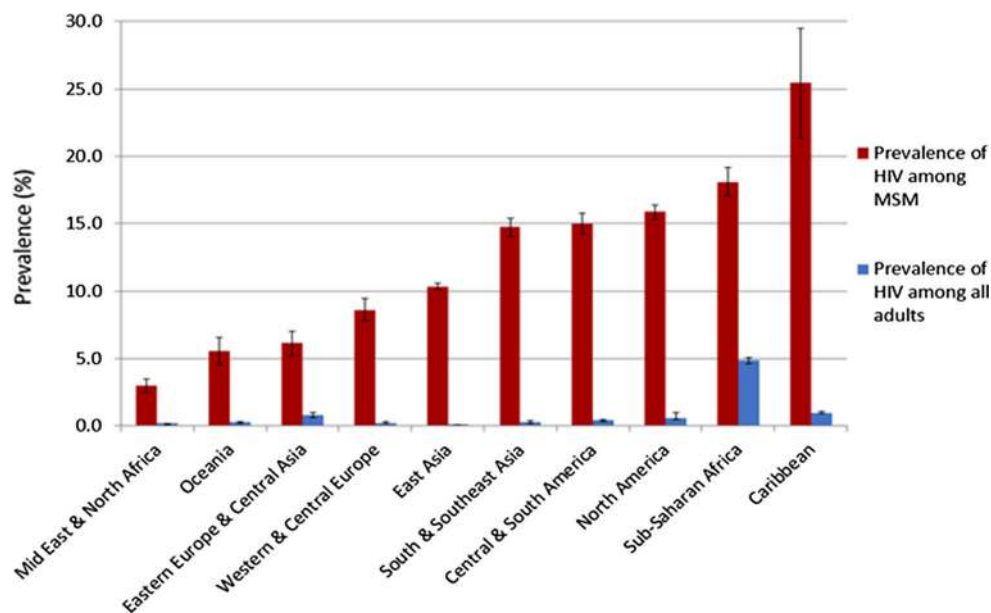
Administrative policies such as the criminalization of same-sex practices in many countries and exclusion of MSM from national surveillance programs and HIV responses have contributed to the lack of focused, accessible prevention strategies for MSM [33]. These punitive policies present significant barriers to HIV prevention and meaningful engagement in treatment. Moreover, they have been associated with higher levels of violence and stigma against MSM, decreased funding for programs for MSM, increased fear of seeking health care leading to reduced engagement in health care, and ultimately higher HIV incidence, prevalence, and mortality [41, 42]. Criminalization promotes multiple forms of stigma as well as structural and cultural violence, which in turn worsen health conditions for MSM and the broader communities [27]. In many settings, uniformed officers are among those perpetuating physical and psychological abuse towards MSM, and particularly in regions where same-sex behaviors are criminalized [43].

### Epidemic Stage

The individual-, network-, community, and law and policy-level risks discussed previously cannot create HIV infections and moreover, there is nothing inherently harmful about condomless anal sex. These factors can only increase or decrease the probability of transmission of an infection that is currently prevalent. Consequently, it is the stage of the epidemic within the social and sexual network, community, and country that primarily determines the risk for HIV acquisition in the individual. For example, an individual living in an area of high HIV prevalence will have a greater chance of a shared sexual network with someone who is living with HIV and not virally suppressed than someone living in an area of low prevalence [5].

### MSM in Concentrated Epidemics

A concentrated epidemic has traditionally been defined as a country with an HIV prevalence of less than 1 % among all reproductive aged adults but more than 5 % in any key population including MSM [44]. Outside Eastern and Southern Africa, the epidemiology of HIV is primarily represented by concentrated epidemics among key populations including MSM, sex workers, people who inject drugs, and transgender women. In many regions, the HIV prevalence among MSM is over 10 % and the ratio of HIV prevalence in MSM to that of the others in the population is disproportionately high [45] (Fig. 2).



**Fig. 2** Pooled HIV prevalence among MSM, and among all men of reproductive age, by region, 2012. Data from *UNAIDS report on the global AIDS Epidemic: 2012*. Joint United Nations Programme on HIV/AIDS (UNAIDS). Geneva: 2012. Adapted from The Lancet,

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### High-Income Settings

The burden of HIV among MSM in many high-income settings can be characterized as a predominantly male concentrated epidemic, with a median male:female case ratio of 2.5:1 and men making up more than 75 % of the prevalent HIV infections [46]. Even as the HIV epidemic among adults is primarily stable or decreasing in most settings, the HIV epidemic among MSM continues to increase in many high-income countries, including the United States [47]. The US accounts for over 30 % of total infections in high income countries with significant disparities across income levels of MSM [46], with ethnic and racial minority MSM carrying a disproportionate local HIV burden [48].

High-income countries exhibit greater coverage of antiretroviral therapy (ART), larger extent of HIV diagnosis among people living with HIV, and greater access to healthcare services and social structures that facilitate accurate reporting of male-to-male sex risks [46, 49]. However, there have been re-emergent epidemics in MSM in many high-income settings where the overall HIV epidemic is otherwise in decline—including Australia, France, the UK, and the US [46]. In the US, HIV infections among MSM overall remained relatively stable between 2002 and 2011 though this average omits the increasing disparities in the burden of HIV observed in the US among MSM generally attributed to socioeconomic determinants [50, 51].

HIV infections in MSM aged 13–24 years are estimated to be increasing at roughly 10 % per year since 2002 [50]. Similar trends have been reported among gay and other MSM in the UK, where treatment coverage is higher than in the US [52]. Biological, couple, network-level, and community-level influences are likely crucial to understanding why HIV transmission rates remain so high in these populations of MSM.

Given the rapid transmission that appears to take place within sexual networks of MSM when someone is acutely HIV infected, the bar for preventing HIV infection within these sexual networks is very high. In addition, breaking chains of HIV transmission necessitates not just coverage of HIV testing, but the diagnosis of people during the acute infection stage followed by an effective intervention. Thus, we do not know yet whether universal treatment approaches will work for MSM since so many of these men are often diagnosed too late to prevent HIV transmission events or to positively influence health outcomes [46]. Novel HIV testing approaches or the optimized implementation of existing HIV testing approaches may improve the current trends of HIV infections being diagnosed too late among MSM.

### Low- and Middle-Income Settings

The concentrated HIV epidemic among MSM transcends country income level. In low- and middle-income countries,

MSM are estimated to have 19 times the odds of living with HIV compared with other people [53]. According to a meta-analysis of 15 South American countries, the HIV prevalence among MSM is generally greater than 10 % and the odds of having HIV in MSM is almost 34 times that of the general population [53]. In the Middle East and North African countries, HIV prevalence among MSM appears to be low, but emerging HIV epidemics have been documented among MSM in Egypt, Jordan, Lebanon, Oman, and Syria [54]. In Eastern Europe and Central Asia, HIV incidence is highest among dual risk people who inject drugs (PWID) and are MSM, expanding the established local HIV epidemics driven by PWID combined with limited coverage of effective tools to decrease parenteral transmission of HIV. In South, Southeast, and Northeast Asia, MSM transmission, PWID transmission, and heterosexual transmission all contribute significantly to the HIV epidemic [55]. In Sub-Saharan Africa, the prevalence of HIV among MSM is higher than that of age-matched men in all settings (Fig. 3) [56, 57].

For several years, the HIV epidemic among MSM in low- and middle-income countries was ignored by many governments, donors, and societies. Although attitudes have steadily shifted to address the needs of MSM, in many parts of the world a hidden epidemic remains that is exacerbated by persistent stigma, discrimination, and violence. Same-sex sexual practices are punished as crimes in roughly 75 countries, with penalties ranging from fines to imprisonment, and in some cases even death [42]. In much of the world, national HIV epidemiological surveys do not assess the impact of HIV on MSM. Unfortunately, this willful ignorance results in a data paradox where the lack of usable data regarding HIV risk among MSM is used in turn to justify the limited specific investment in HIV prevention and treatment needs [33].

To improve low- and middle-income countries' responses to HIV/AIDS, it is essential that services expand to include MSM as a key population in line with the attributable proportion of HIV infections. To accomplish this, a more informed understanding of the diversity of epidemics among MSM in low- and middle-income countries is needed. Because these men often are hidden from the broader community, there is notable underreporting of same-sex behavior in population-based surveys resulting in risk misclassification among those living with HIV. Moreover, there are many questions left to be answered on optimal surveillance approaches for MSM given the safety issues that exist when collecting these data. Correlates of prevalent HIV infection in low- and middle-income countries also should not just focus on the most proximal individual-level HIV risk factors but should include assessment of community-level determinants including social isolation, limited healthcare access, and social stigma [55, 58].

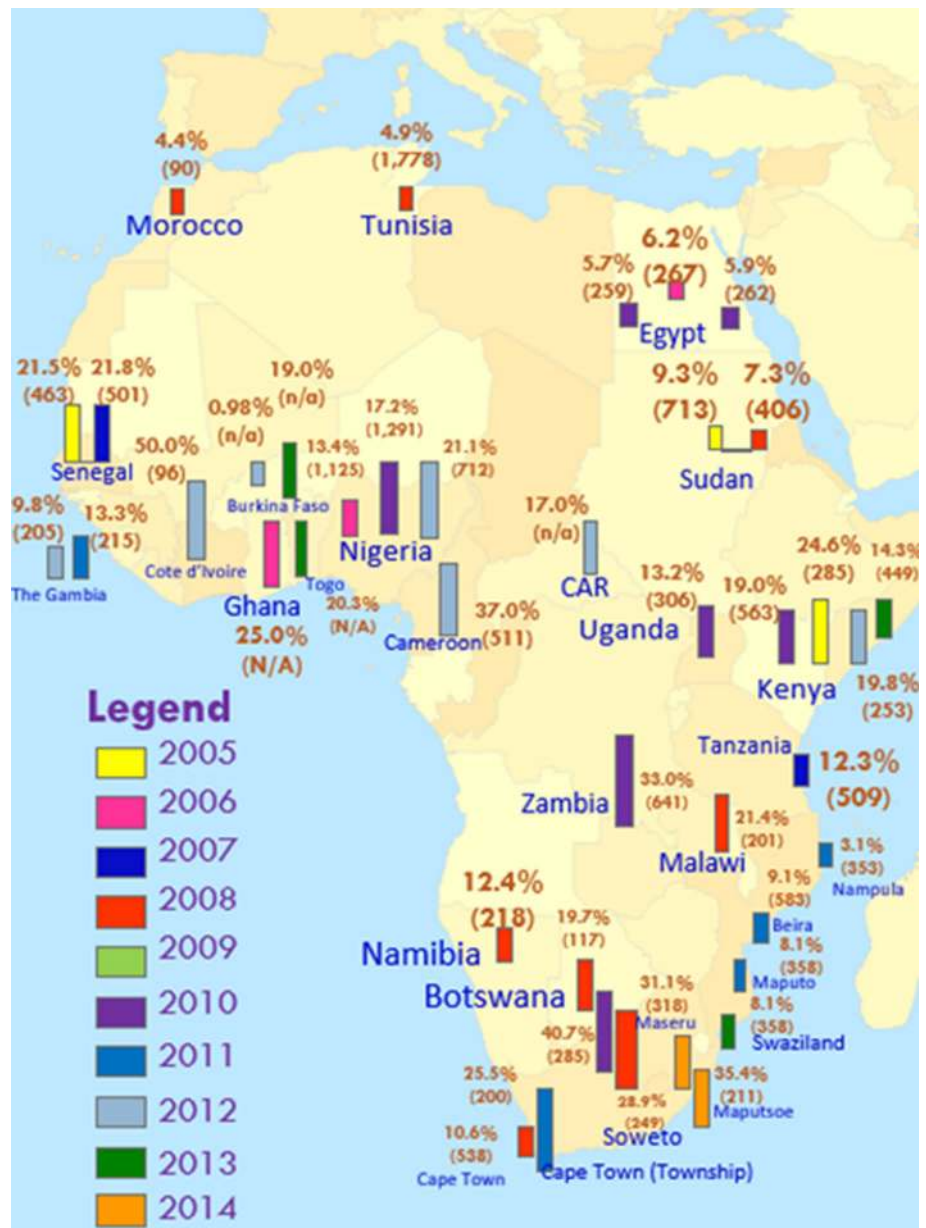
Overall, the odds of having HIV infection are markedly and consistently higher among MSM in each geographic locale than among the adult populations across Asia, Africa, and the Americas. Moreover, MSM from low- and middle-income countries historically have been understudied and underserved, and are in urgent need of prevention services and access to appropriate care [59]. Factors contributing to the lack of sufficient knowledge include a dearth of studies and concomitant limited data regarding adolescent MSM, and MSM from specific regions such as North Africa and the Middle East. Prevention strategies that lower biological transmission and acquisition risks, such as access to early treatment and the availability of and consistent use of pre-exposure prophylaxis (PrEP), offer promise for controlling the expanding epidemic in MSM in these settings [3, 60, 61]; however, their potential effectiveness often is limited by structural factors that discourage health-seeking behaviors among MSM, and by the refusal of governments to address regulatory and other structural barriers that block or limit the availability of PrEP. More intensive efforts will be required to reach younger MSM, expand testing and treatment, and implement effective prevention tools such as PrEP in diverse geographic settings, particularly in rights-constrained contexts [2, 20, 62]. In addition, these efforts will have to be coupled with community efforts around safe sex practices and condom use. Ultimately, the challenge will be not just linking people to these programs, but about securing long term retention—and this will require significant study to identify the best implementation research approaches.

### MSM in Generalized Epidemics

Generalized HIV epidemics are commonly categorized as regions with HIV prevalence rates above 1 % in adults or in antenatal clinics. With few exceptions, generalized HIV epidemics are limited to Southern and Eastern Sub-Saharan Africa. In the context of generalized epidemics, it is often proposed that MSM do not constitute a significant component of the epidemic, and that resources should not be diverted from addressing other populations deemed to have higher priority. As a result, in countries categorized as having generalized epidemics, only a small proportion of HIV prevention expenditures support the needs of MSM. However, a number of studies and a growing body of data highlight the disproportionate burden of HIV among MSM that exists when compared with other men of reproductive age across countries with generalized epidemics [45, 58, 63, 64].

Fortunately, there have been recent, notable decreases in HIV incidence among several countries with generalized epidemics, including Malawi, Namibia, Botswana, and Zambia [65]. However, in a review of 51 countries with

**Fig. 3** HIV Prevalence among MSM in Africa. Modified from van Griensven F, de Lind van Wijngaarden JW, Baral S, Grulich A. The global epidemic of HIV infection among men who have sex with men. Current opinion in HIV and AIDS. 2009;4 [4]:300–307 [57]



generalized epidemics, the burden of HIV was found to be consistently higher among MSM [58]. For example, in Kenya, the HIV prevalence among MSM ranged from 12.3 to 43.0 % compared with 6.1 % among the reproductive-age population [66]. Similarly in South Africa, HIV prevalence among MSM ranged 10.0–40.7 % compared with 17.9 % among reproductive-age adults [67, 68]. In Thailand, one of the few countries outside of Eastern and Southern Sub-Saharan Africa which has had a generalized epidemic, HIV prevalence among MSM ranged 8.2–68.2 % compared with 1.1 % among adults of reproductive age [69–73]. These data are notable as the HIV epidemics in these settings have traditionally focused on the “general

population” which is assumed to be group of reproductive age adults with average risks for the acquisition and transmission of HIV. And indeed, in the countries with the most broadly generalized HIV epidemics, the responses appear to have been developed with the assumption that risk is evenly distributed. However, data such as what is shown here suggest that risk of HIV is not evenly distributed and that specifically addressing the specific HIV prevention needs of gay men and other MSM in these settings is crucial [74].

The HIV prevention needs of MSM within generalized epidemics may be different from those in concentrated epidemics. In generalized epidemics, HIV prevalence is high in the population as a whole and these are the only

settings where women are still disproportionately affected by HIV. Thus, in generalized epidemics, some of the HIV risk among MSM may be attributed to their ability to acquire or transmit HIV in both heterosexual and same-sex relationships [75]. Decriminalization of same-sex sexual practices is important in terms of removing barriers which can improve relationship stability within same-sex couples and also improve the environment for the effective provision and uptake of services. However in 2016, decriminalization alone cannot achieve stigma reductions to support improved quality of life and improved programmatic reach [43]. Combining evidence-informed stigma mitigation programs in the context of society as well as in health care are also needed to change both experiences and eventually perceptions.

## Other Key Issues

### Role of Community Organizations

Gay men and other MSM have historically led and participated in HIV intervention efforts through advocacy, education, research, and design and delivery of prevention, treatment, and care programs that have been a benefit to everyone affected by HIV. In stigmatizing environments, MSM and LGBT community groups often are the only members of the community who are willing to advocate for the right to provide HIV-related services to gay men and other MSM. Gay and MSM advocates have achieved important successes in locally-based responses to HIV, but they have often faced enormous challenges, including stigma and threats of violence and blackmail, limited funding, and the need to represent highly diverse populations. Protecting and improving the personal health of everyone requires inclusive community-level action and this will continue to be essential in the response to AIDS worldwide. Community-based service providers will require increased resources, developmental support, and expanded opportunities to serve and lead the fight against the growing HIV epidemic in MSM [1, 76].

### Transgender Women

Transgender women represent a separate and distinct population from MSM; they were assigned the male sex at birth but identify as women and are well known to be at exceptionally high risk for HIV acquisition and transmission. Worldwide, the odds for transgender women being infected with HIV is almost 50 times that of other reproductive age adults, with an estimated overall HIV prevalence of around 19 % [77]. There are some shared determinants of risk between transgender women and

MSM including the high transmission probability of unprotected anal sex. In addition, network-level (e.g., HIV prevalence in subgroups), community-level (e.g., stigma, social exclusion) and structural-level (e.g., discriminatory laws, economic marginalization) factors contribute to the high burden of HIV among transgender women [78, 79].

In contrast, transgender men, who were assigned the male sex at birth, have traditionally been considered low-risk for HIV. However, some of these men, sometimes termed trans MSM, identify as gay and have sex with other men. Trans men and trans MSM report a range of sexual practices including vaginal or receptive anal sex with other men, which could put them at substantial risk in the context of HIV-infected and viremic sexual partners. HIV prevalence in transgender men ranges from 0 to 2.9 % based on two studies conducted in the US [80–82]. However, there has been such limited programmatic investment and study, ultimately greatly limiting our knowledge of HIV-related risk behaviors, social and structural factors, and sexual health needs of transgender men [83].

### Male Sex Workers

The global burden of HIV among male sex workers (MSW) is high and in some cases increasing [84]. Male sex workers tend to have high numbers of male partnerships with less awareness of the HIV status of their partners which may potentiate risks for HIV acquisition. Other risks include economic incentives to have condomless anal sex with clients, sexual and physical abuse, and substance use. In addition, criminalization and stigma of same sex practices and commercial sex can lead to avoidance and delay of seeking health care including testing, treatment, and prevention services. However, prevalence of HIV among male sex workers is not universally higher than that of other men potentially because increased awareness and use of preventive measures. Ultimately, the dynamics of male sex work are complex and little understood because of the nearly universal criminalization of this occupation either through the criminalization of sex work or that of same-sex practices [85, 86]. Dedicated advocacy, funding, surveillance, research initiatives, and diverse preventive options are needed to reduce the burden of HIV among male sex workers.

### Internet Use for Finding Sex Partners

Among MSM, the Internet and mobile-applications are popular platforms for meeting new sexual partners. Recent data suggest that MSM in low- and middle-income settings utilize the Internet for seeking sex at rates equivalent to MSM in high-income settings such as North America and Europe [87–89]. Given the pervasive stigma that exists

affecting same-sex relationships, it is not surprising that people are turning to the Internet to discreetly be part of a network, derive support, and meet partners. In some settings, the use of the Internet to find partners is being heavily scrutinized and websites being shut down. The trend is concerning, and the response not based in evidence as this medium also represents a potential tool to reach the unreached, as well as to support those men with linkage and retention services [87, 90–93]. Indeed, the evidence continues to support the need to turn to Internet and mobile-applications as the future of feasible HIV intervention mechanisms to reach MSM worldwide [94].

### Biomedical Improvements in HIV Prevention

Daily oral use of PrEP is an effective HIV prevention intervention for MSM [95]. In 2010, the iPrEx (Pre-exposure prophylaxis initiative) trial demonstrated a 44 % reduced HIV infection rate among MSM in the PrEP arm compared to the placebo arm [3], but on average medication adherence was around 50 %. In 2015, an open-label randomized trial (the PROUD study) conducted among gay men and other MSM in England successfully addressed concerns about real world effectiveness and risk compensation for PrEP by demonstrating 86 % efficacy among MSM who accessed STD clinics who initiated PrEP right away [60]. Further, the French and Canadian Ipergay study found that peri-coital dosing before and after sex was found to be similarly effective (86 %) [96]. Subsequent studies in real world settings of STD clinics and in a private health maintenance organization found PrEP to be effective in decreasing HIV incidence in high risk MSM in the US, even while STD incidence remained high [61, 97]. Overall, the findings of these studies strongly support the further scaling up of PrEP for MSM as part of package of comprehensive sexual health services that include behavioral, structural, and biological intervention components.

However, the slow and highly limited implementation of PrEP, the only new biomedical intervention with evidence for efficacy of HIV prevention in MSM, is another example of an important structural-level risk. Despite a series of successful efficacy trials and effectiveness evaluations demonstrating the potential impact of PrEP among MSM, at the time of writing PrEP is being implemented and recommended for MSM only in the United States, South Africa, France, and Kenya—a remarkably slow rollout and missed opportunity for an intervention with 6 years of efficacy data [98]. Even the U.K., where the PROUD study demonstrated high effectiveness [60], has not implemented PrEP through the U.K.'s National Health System, thereby sustaining an enhanced risk environment for MSM. And indeed, this slow rollout may be further indicative of the

limited support for interventions where the primary efficacy data for HIV prevention is among MSM. The coming years will likely introduce new formulations of oral PrEP and even long acting injectable PrEP which may ultimately represent important components of the package of services for MSM.

### Conclusions

There is an HIV pandemic among MSM—it is a global epidemic with more similarities than differences across income levels, HIV epidemic types, and geography. Improved HIV surveillance mechanisms leveraging mathematical modeling, phylodynamics, and meaningful indicators can inform the population attributable fraction of HIV among MSM across countries and will be needed to passively evaluate the success of intervention efforts. Among MSM, individual- and network-level HIV risks are compounded by structural-level risks such as community environments, laws, policies, and program failures. Universal HIV treatment, fourth generation HIV tests, HIV self-testing, and daily oral PrEP using tenofovir-emtricitabine have emerged as integral to the prevention of HIV transmission, and such efforts should be immediately expanded for MSM and other populations disproportionately affected by HIV. Indeed, the bar for HIV prevention among MSM is extremely high. Only with true respect for human rights and efforts to combat stigma, discrimination, and social exclusion can the levels of coverage needed to change the trajectory of the HIV pandemic among MSM be achieved.

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**Conflict of Interest** Chris Beyrer is receiving a donation of Tenofovir/Emtricitabine (Truvada) from Gilead, Inc. for an effectiveness study of a multi-level combination HIV preventive intervention with and without daily oral Truvada pre-exposure prophylaxis among young men who have sex with men in Bangkok, Thailand (R01AI118505; PI: Beyrer). Kenneth H. Mayer has received unrestricted research grants from Gilead Sciences and ViiV Healthcare. Shauna Stahlman, Patrick S. Sullivan, and Stefan D. Baral declare that they have no conflict of interest.

**Ethical Approval** This article does not contain any studies with human participants or animals performed by any of the authors.



## References

1. Trapence G, Collins C, Avrett S, et al. From personal survival to public health: community leadership by men who have sex with men in the response to HIV. *Lancet*. 2012;380(9839):400–10 **Epub 2012/07/24**.
2. Cohen MS, Chen YQ, McCauley M, et al. Prevention of HIV-1 infection with early antiretroviral therapy. *N Engl J Med*. 2011;365(6):493–505 **Epub 2011/07/20**.
3. 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(27):2587–99.
4. Beyrer C, Baral SD, van Griensven F, et al. Global epidemiology of HIV infection in men who have sex with men. *Lancet*. 2012;380(9839):367–77 **Epub 2012/07/24**.
5. Baral S, Logie CH, Grosso A, Wirtz AL, Beyrer C. Modified social ecological model: a tool to guide the assessment of the risks and risk contexts of HIV epidemics. *BMC Public Health*. 2013;13:482 **Epub 2013/05/18**.
6. Baggeley 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(4):1048–63 **Epub 2010/04/22**.
7. Levy JA. The transmission of HIV and factors influencing progression to AIDS. *Am J Med*. 1993;95(1):86–100 **Epub 1993/07/01**.
8. Belec L, Dupre T, Prazuck T, et al. Cervicovaginal overproduction of specific IgG to human immunodeficiency virus (HIV) contrasts with normal or impaired IgA local response in HIV infection. *J Infect Dis*. 1995;172(3):691–7 **Epub 1995/09/01**.
9. Sullivan PS, Carballo-Diequez A, Coates T, et al. Successes and challenges of HIV prevention in men who have sex with men. *Lancet*. 2012;380(9839):388–99 **Epub 2012/07/24**.
10. Beyrer C. HIV epidemiology update and transmission factors: risks and risk contexts—16th International AIDS Conference epidemiology plenary. *Clin Infect Dis*. 2007;44(7):981–7 **Epub 2007/03/08**.
11. Mayer KH, Bekker LG, Stall R, Grulich AE, Colfax G, Lama JR. Comprehensive clinical care for men who have sex with men: an integrated approach. *Lancet*. 2012;380(9839):378–87 **Epub 2012/07/24**.
12. Mayer KH, Venkatesh KK. Interactions of HIV, other sexually transmitted diseases, and genital tract inflammation facilitating local pathogen transmission and acquisition. *Am J Reprod Immunol*. 2011;65(3):308–16 **Epub 2011/01/11**.
13. Kelley CF, Vaughan AS, Luisi N, et al. The effect of high rates of bacterial sexually transmitted infections on HIV incidence in a cohort of black and white men who have sex with men in Atlanta, Georgia. *AIDS Res Hum Retrovir*. 2015;31(6):587–92 **Epub 2015/02/27**.
14. Smith AM, Grierson J, Wain D, Pitts M, Pattison P. Associations between the sexual behaviour of men who have sex with men and the structure and composition of their social networks. *Sex Transm Infect*. 2004;80(6):455–8 **Epub 2004/12/02**.
15. Johnson WD, Diaz RM, Flanders WD, et al. Behavioral interventions to reduce risk for sexual transmission of HIV among men who have sex with men. *Cochrane Database Syst Rev*. 2008;3:CD001230 **Epub 2008/07/23**.
16. Kelly JA, Amirkhanian YA, McAuliffe TL, et al. HIV risk characteristics and prevention needs in a community sample of bisexual men in St. Petersburg, Russia. *AIDS Care*. 2002;14(1):63–76 **Epub 2002/01/19**.
17. Poundstone KE, Strathdee SA, Celentano DD. The social epidemiology of human immunodeficiency virus/acquired immunodeficiency syndrome. *Epidemiol Rev*. 2004;26:22–35 **Epub 2004/07/06**.
18. McLeroy KR, Bibeau D, Steckler A, Glanz K. An ecological perspective on health promotion programs. *Health Educ Q*. 1988;15(4):351–77 **Epub 1988/01/01**.
19. Tieu HV, Li X, Donnell D, et al. Anal sex role segregation and versatility among men who have sex with men: EXPLORE study. *J Acquir Immune Defic Syndr*. 2013;64(1):121–5 **Epub 2013/08/16**.
20. Mayer KH, Wheeler DP, Bekker LG, et al. Overcoming biological, behavioral, and structural vulnerabilities: new directions in research to decrease HIV transmission in men who have sex with men. *J Acquir Immune Defic Syndr*. 2013;63(Suppl 2):S161–7 **Epub 2013/08/07**.
21. Goodreau SM, Peinado J, Goicochea P, et al. Role versatility among men who have sex with men in urban Peru. *J Sex Res*. 2007;44(3):233–9 **Epub 2007/09/20**.
22. Wohlfeiler D, Potterat JJ. Using gay men's sexual networks to reduce sexually transmitted disease (STD)/human immunodeficiency virus (HIV) transmission. *Sex Transm Dis*. 2005;32(10 Suppl):S48–52 **Epub 2005/10/06**.
23. Rothenberg R. How a net works: implications of network structure for the persistence and control of sexually transmitted diseases and HIV. *Sex Transm Dis*. 2001;28(2):63–8 **Epub 2001/03/10**.
24. Vogel DL, Wade NG, Wester SR, Larson L, Hackler AH. Seeking help from a mental health professional: the influence of one's social network. *J Clin Psychol*. 2007;63(3):233–45 **Epub 2007/01/11**.
25. Pronyk PM, Harpham T, Morison LA, et al. Is social capital associated with HIV risk in rural South Africa? *Soc Sci Med*. 2008;66(9):1999–2010 **Epub 2008/02/27**.
26. Stahlman S, Bechtold K, Sweitzer S, et al. Sexual identity stigma and social support among men who have sex with men in Lesotho: a qualitative analysis. *Reprod Health Matters*. 2015;23(46):127–35 **Epub 2016/01/01**.
27. Baral S, Holland CE, Shannon K, et al. Enhancing benefits or increasing harms: community responses for HIV among men who have sex with men, transgender women, female sex workers, and people who inject drugs. *J Acquir Immune Defic Syndr*. 2014;66(Suppl 3):S319–28 **Epub 2014/07/10**.
28. Afzali M, Shahhosseini Z, Hamzeshghardeshi Z. Social capital role in managing high risk behavior: a narrative review. *Materia Soc-Med*. 2015;27(4):280–5 **Epub 2015/11/07**.
29. Frumence G, Emmelin M, Eriksson M, et al. Access to social capital and risk of HIV infection in Bukoba urban district, Kagera region, Tanzania. *Arch Public Health = Archives belges de sante publique*. 2014;72(1):38 **Epub 2015/02/12**.
30. Stahlman S, Grosso A, Ketende S, et al. Depression and social stigma among MSM in lesotho: implications for HIV and sexually transmitted infection prevention. *AIDS Behav*. 2015;19(8):1460–9 **Epub 2015/05/15**.
31. Amirkhanian YA. Social networks, sexual networks and HIV risk in men who have sex with men. *Curr HIV/AIDS Rep*. 2014;11(1):81–92.
32. Baral SD, Ketende S, Mnisi Z, et al. A cross-sectional assessment of the burden of HIV and associated individual- and structural-level characteristics among men who have sex with men in Swaziland. *J Int AIDS Soc*. 2013;16(Suppl 3):18768 **Epub 2014/01/01**.
33. The Foundation for AIDS Research and Johns Hopkins Bloomberg School of Public Health. Achieving an AIDS-Free Generation for Gay Men and Other MSM: Financing and implementation of HIV programs targeting MSM. 2012.
34. Pachankis JE, Hatzenbuehler ML, Hickson F, et al. Hidden from health: structural stigma, sexual orientation concealment, In: HIV across 38 countries in the European MSM Internet Survey. *AIDS (London, England)*. 2015;29(10):1239–1246 **Epub 2015/06/04**.

35. Ayala G, Makofane K, Santos GM, et al. Access to basic HIV-related services and PrEP acceptability among men who have sex with men worldwide: barriers, facilitators, and implications for combination prevention. *J Sex Transm Dis.* 2013;2013:953123 **Epub 2013/01/01.**
36. Knox J, Sandfort T, Yi H, Reddy V, Maimane S. Social vulnerability and HIV testing among South African men who have sex with men. *Int J STD AIDS.* 2011;22(12):709–13 **Epub 2011/12/17.**
37. Hladik W, Barker J, Ssenkusu JM, et al. HIV infection among men who have sex with men in Kampala, Uganda—a respondent driven sampling survey. *PloS One.* 2012;7(5):e38143 **Epub 2012/06/14.**
38. Hu Y, Lu H, Raymond HF, et al. Measures of condom and safer sex social norms and stigma towards HIV/AIDS among Beijing MSM. *AIDS Behav.* 2014;18(6):1068–74 **Epub 2013/09/24.**
39. Choi KH, Hudes ES, Steward WT. Social discrimination, concurrent sexual partnerships, and HIV risk among men who have sex with men in Shanghai, China. *AIDS Behav.* 2008;12(4 Suppl):S71–7 **Epub 2008/04/23.**
40. Wang K, Brown K, Shen SY, Tucker J. Social network-based interventions to promote condom use: a systematic review. *AIDS Behav.* 2011;15(7):1298–308 **Epub 2011/08/04.**
41. Schwartz SR, Nowak RG, Orazulike I, et al. The immediate effect of the same-sex marriage prohibition act on stigma, discrimination, and engagement on HIV prevention and treatment services in men who have sex with men in Nigeria: analysis of prospective data from the TRUST cohort. *The Lancet HIV.* 2015;2(7):e299–e306 **Epub June 2, 2015.**
42. International Lesbian Gay Bisexual Trans and Intersex Association. *State Sponsored Homophobia Report.* 2015. <http://ilga.org/what-we-do/state-sponsored-homophobia-report/>. Accessed 3 Apr 2016.
43. Zahn R, Grosso A, Scheibe A, et al. Human rights violations among men who have sex with Men in Southern Africa: comparisons between legal contexts. *PloS One.* 2016;11(1):e0147156 **Epub 2016/01/15.**
44. WHO, UNAIDS. Second generation surveillance for HIV: the next decade. 2000. [http://www.who.int/hiv/pub/surveillance/en/cds\\_edc\\_2000\\_5.pdf](http://www.who.int/hiv/pub/surveillance/en/cds_edc_2000_5.pdf). Accessed 3 Apr 2016.
45. Beyrer C, Sullivan P, Sanchez J, et al. The increase in global HIV epidemics in MSM. *AIDS (London, England).* 2013;27(17):2665–2678 **Epub 2013/07/12.**
46. Sullivan PS, Jones JS, Baral SD. The global north: HIV epidemiology in high-income countries. *Curr Opin HIV AIDS.* 2014;9(2):199–205 **Epub 2014/01/22.**
47. Centers for Disease Control and Prevention. Prevalence and awareness of HIV infection among men who have sex with men—21 Cities, United States, 2008. *Morb Mortal Wkly Rep (MMWR).* 2010;59(37):1201–7.
48. Millett GA, Peterson JL, Flores SA, et al. Comparisons of disparities and risks of HIV infection in black and other men who have sex with men in Canada, UK, and USA: a meta-analysis. *Lancet.* 2012;380(9839):341–8 **Epub 2012/07/24.**
49. World Health Organization. Global update on the health sector response to HIV. July 2014. <http://www.who.int/hiv/pub/progressreports/update2014-executive-summary/en/>. Accessed 13 Jan 2016.
50. Johnson AS, Hall HI, Hu X, Lansky A, Holtgrave DR, Mermin J. Trends in diagnoses of HIV infection in the United States, 2002–2011. *JAMA.* 2014;312(4):432–4.
51. Rosenberg ES, Millett GA, Sullivan PS, Del Rio C, Curran JW. Understanding the HIV disparities between black and white men who have sex with men in the USA using the HIV care continuum: a modeling study. *Lancet HIV.* 2014;1(3):e112–8 **Epub 2014/12/23.**
52. Yin Z, Brown A, Hughes G, et al. HIV in the United Kingdom 2014 Report: data to end 2013. November 2014. Public Health England, London.
53. 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(12):e339 **Epub 2007/12/07.**
54. Mumtaz G, Hilmi N, McFarland W, et al. Are HIV epidemics among men who have sex with men emerging in the Middle East and North Africa?: a systematic review and data synthesis. *PLoS Med.* 2010;8(8):e1000444 **Epub 2011/08/11.**
55. Beyrer C, Baral SD, Walker D, Wirtz AL, Johns B, Sifakis F. 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;32:137–51 **Epub 2010/06/25.**
56. Baral S, editor. *HIV Risks and vulnerabilities among men who have sex with men across Sub-Saharan Africa.* In: Conference on Retroviruses and Opportunistic Infections (CROI); 2015 February 23–26, 2015; Seattle, Washington.
57. van Griensven F, de Lind van Wijngaarden JW, Baral S, Grulich A. The global epidemic of HIV infection among men who have sex with men. *Curr Opin HIV AIDS.* 2009;4(4):300–7 **Epub 2009/06/18.**
58. Baral SD, Grosso A, Holland C, Papworth E. The epidemiology of HIV among men who have sex with men in countries with generalized HIV epidemics. *Curr Opin HIV AIDS.* 2014;9(2):156–67 **Epub 2014/01/22.**
59. Beyrer C, Sullivan PS, Sanchez J, et al. A call to action for comprehensive HIV services for men who have sex with men. *Lancet.* 2012;380(9839):424–38 **Epub 2012/07/24.**
60. McCormack S, Dunn DT, Desai M, et al. Pre-exposure prophylaxis to prevent the acquisition of HIV-1 infection (PROUD): effectiveness results from the pilot phase of a pragmatic open-label randomised trial. *Lancet.* 2016;387:53–60 **Epub 2015/09/14.**
61. Volk JE, Marcus JL, Phengrasamy T, et al. No new HIV infections with increasing use of HIV preexposure prophylaxis in a clinical practice setting. *Clin Infect Dis.* 2015;61(10):1601–3 **Epub 2015/09/04.**
62. Hoots BE, Finlayson TJ, Wejnert C, Paz-Bailey G, Group NS. Early linkage to HIV care and antiretroviral treatment among men who have sex with men—20 cities, United States, 2008 and 2011. *PLoS One.* 2015;10(7):e0132962.
63. Baral S, Trapence G, Motimedi F, et al. HIV prevalence, risks for HIV infection, and human rights among men who have sex with men (MSM) in Malawi, Namibia, and Botswana. *PloS One.* 2009;4(3):e4997 **Epub 2009/03/28.**
64. Stahlman S, Johnston LG, Yah C, et al. Respondent-driven sampling as a recruitment method for men who have sex with men in southern sub-Saharan Africa: a cross-sectional analysis by wave. *Sex Transm Infect.* 2015. doi:10.1136/sextrans-2015-052184 **Epub 2015/10/02.**
65. UNAIDS. *Global report: UNAIDS report on the global AIDS epidemic 2013.* Joint United Nations Programme on HIV/AIDS (UNAIDS). Geneva; 2013.
66. Sanders EJ, Okuku HS, Smith AD, et al. High HIV-1 incidence, correlates of HIV-1 acquisition, and high viral loads following seroconversion among MSM. *AIDS (London, England).* 2013;27(3):437–446 **Epub 2012/10/20.**
67. Needle R, Kroeger K, Belani H, Achrekar A, Parry CD, Dewing S. Sex, drugs, and HIV: rapid assessment of HIV risk behaviors among street-based drug using sex workers in Durban, South Africa. *Soc Sci Med.* 2008;67(9):1447–55 **Epub 2008/08/06.**
68. Rispe LC, Metcalf CA, Cloete A, Reddy V, Lombard C. HIV prevalence and risk practices among men who have sex with men in two South African cities. *J Acquir Immune Defic Syndr.* 2011;57(1):69–76 **Epub 2011/02/08.**

69. US Centers for Disease Control and Prevention. HIV, and syphilis infection among men who have sex with men: Bangkok, Thailand, 2005–2011. *MMWR Morb Mortal Wkly Rep* 2013; 62:518–520. 2013. <http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6225a2.htm>. Accessed 3 Apr 2016.
70. 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*. 2010;53(2):234–9 **Epub 2009/11/11**.
71. van Griensven F, Thienkrua W, McNicholl J, et al. Evidence of an explosive epidemic of HIV infection in a cohort of men who have sex with men in Thailand. *AIDS (London, England)*. 2013;27(5):825–832 **Epub 2012/11/22**.
72. Li A, Varangrat A, Wimonasate W, et al. Sexual behavior and risk factors for HIV infection among homosexual and bisexual men in Thailand. *AIDS Behav*. 2009;13(2):318–27 **Epub 2008/09/02**.
73. Phanuphak N, Teeratakulpisarn N, Lim C, et al. Comparable performance of conventional and liquid-based cytology in diagnosing anal intraepithelial neoplasia in HIV-infected and -uninfected Thai men who have sex with men. *J Acquir Immune Defic Syndr*. 2013;63(4):464–71 **Epub 2013/03/29**.
74. Baral S, Phaswana-Mafuya N. Rewriting the narrative of the epidemiology of HIV in sub-Saharan Africa. *SAHARA J*. 2012;9(3):127–30 **Epub 2012/12/15**.
75. 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(4):323–7 **Epub 2010/04/23**.
76. Holland CE, Papworth E, Billong SC, et al. Antiretroviral treatment coverage for men who have sex with men and female sex workers living with HIV in Cameroon. *J Acquir Immune Defic Syndr*. 2015;68(Suppl 2):S232–40 **Epub 2015/02/28**.
77. Baral SD, Poteat T, Stromdahl S, Wirtz AL, Guadamuz TE, Beyrer C. Worldwide burden of HIV in transgender women: a systematic review and meta-analysis. *Lancet Infect Dis*. 2013;13(3):214–22 **Epub 2012/12/25**.
78. Poteat T, Reisner SL, Radix A. HIV epidemics among transgender women. *Curr Opin HIV AIDS*. 2014;9(2):168–73 **Epub 2013/12/11**.
79. De Santis JP. HIV infection risk factors among male-to-female transgender persons: a review of the literature. *J Assoc Nurses AIDS Care*. 2009;20(5):362–72.
80. Clements-Nolle K, Marx R, Guzman R, Katz M. HIV prevalence, risk behaviors, health care use, and mental health status of transgender persons: implications for public health intervention. *Am J Public Health*. 2001;91(6):915–21 **Epub 2001/06/08**.
81. Schulden JD, Song B, Barros A, et al. Rapid HIV testing in transgender communities by community-based organizations in three cities. *Public health reports (Washington, DC: 1974)*. 2008;123(Suppl 3):101–114 **Epub 2009/01/27**.
82. Stephens SC, Bernstein KT, Philip SS. Male to female and female to male transgender persons have different sexual risk behaviors yet similar rates of STDs and HIV. *AIDS Behav*. 2011;15(3):683–6 **Epub 2010/08/10**.
83. Reisner S, Lloyd J, Baral S. Technical Report: The Global Health Needs of Transgender Populations. USAID's AIDS Support and Technical Assistance Resources, AIDSTAR-Two, Task Order 2, Arlington, VA; 2013.
84. Baral SD, Friedman MR, Geibel S, et al. Male sex workers: practices, contexts, and vulnerabilities for HIV acquisition and transmission. *Lancet*. 2015;385(9964):260–73 **Epub 2014/07/26**.
85. Weber AE, Craib KJ, Chan K, et al. Sex trade involvement and rates of human immunodeficiency virus positivity among young gay and bisexual men. *Int J Epidemiol*. 2001;30(6):1449–1454; discussion 55–6 **Epub 2002/02/01**.
86. Poteat T, Wirtz AL, Radix A, et al. HIV risk and preventive interventions in transgender women sex workers. *Lancet*. 2015;385(9964):274–86 **Epub 2014/07/26**.
87. Stahlman S, Grosso A, Ketende S, et al. Characteristics of men who have sex with men in southern Africa who seek sex online: a cross-sectional study. *Journal of medical Internet research*. 2015;17(5):e129 **Epub 2015/05/27**.
88. Wu Z, Xu J, Liu E, et al. HIV and syphilis prevalence among men who have sex with men: a cross-sectional survey of 61 cities in China. *Clin. Infect. Dis*. 2013;57(2):298–309 **Epub 2013/04/13**.
89. Liao A, Millett G, Marks G. Meta-analytic examination of online sex-seeking and sexual risk behavior among men who have sex with men. *Sex Transm Dis*. 2006;33(9):576–84 **Epub 2006/03/17**.
90. Lewnard JA, Berrang-Ford L. Internet-based partner selection and risk for unprotected anal intercourse in sexual encounters among men who have sex with men: a meta-analysis of observational studies. *Sex Transm. Infect*. 2014;90(4):290–6 **Epub 2014/02/13**.
91. Bien CH, Best JM, Muessig KE, Wei C, Han L, Tucker JD. Gay apps for seeking sex partners in china: implications for MSM sexual health. *AIDS Behav*. 2015;19(6):941–6 **Epub 2015/01/13**.
92. Young SD, Szekeres G, Coates T. The relationship between online social networking and sexual risk behaviors among men who have sex with men (MSM). *PloS One*. 2013;8(5):e62271 **Epub 2013/05/10**.
93. Melendez-Torres GJ, Nye E, Bonell C. Internet sex-seeking is inconsistently linked with sexual risk in men who have sex with men: systematic review of within-subjects comparisons. *Sex Health*. 2015;12(3):183–7 **Epub 2015/04/07**.
94. Muessig KE, Nekkanti M, Bauermeister J, Bull S, Hightow-Weidman LB. A systematic review of recent smartphone, Internet and Web 2.0 interventions to address the HIV continuum of care. *Current HIV/AIDS reports*. 2015;12(1):173–190 **Epub 2015/01/30**.
95. Spinner CD, Boesecke C, Zink A, et al. HIV pre-exposure prophylaxis (PrEP): a review of current knowledge of oral systemic HIV PrEP in humans. *Infection*. 2016;44(2):151–8. doi:10.1007/s15010-015-0850-2 **Epub 2015/10/17**.
96. Molina JM, Capitant C, Spire B, et al. On-demand preexposure prophylaxis in men at high risk for HIV-1 infection. *N Engl J Med*. 2015;373(23):2237–46 **Epub 2015/12/02**.
97. Liu AY, Cohen SE, Vittinghoff E, et al. Preexposure prophylaxis for HIV infection integrated with municipal- and community-based sexual health services. *JAMA Internal Med*. 2016;176(1):75–84 **Epub 2015/11/17**.
98. AVAC. PrEPWatch: Country Updates. <http://www.prepwatch.org/advocacy/country-updates/>. Accessed 4 Jan 2016