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The Expanding Epidemics of HIV Type 1 Among Men Who Have Sex With Men in Low- and Middle-Income Countries: Diversity and Consistency

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Men who have sex with men (MSM) have borne a disproportionate burden of human immunodeficiency virus (HIV) infection and remain a markedly underresourced population globally. To better describe HIV epidemics among MSM in low- and middle-income countries, the authors conducted a systematic review of published and unpublished literature available after January 1, 2000 (2000–2009). A total of 133 HIV prevalence studies from 50 countries met the search criteria. Data were used to develop an algorithmic approach to categorize these epidemics. The authors found that the HIV epidemic in low- and middle-income countries may be described using the following 4 scenarios: 1) settings where MSM are the predominant contributor to HIV cases; 2) settings where HIV transmission among MSM occurs in the context of epidemics driven by injection drug users; 3) settings where HIV transmission among MSM occurs in the context of well-established HIV transmission among heterosexuals; and 4) settings where both sexual and parenteral modes contribute significantly to HIV transmission. The authors focused on Peru, Ukraine, Kenya, and Thailand to describe the diversity across and similarities between proposed epidemic scenarios. This scenario-based categorization of HIV epidemics among MSM may assist public health agencies and civil societies to develop and implement better-targeted HIV prevention programs and interventions.

HIV; homosexuality; review; risk factors; risk-taking; sexual behavior

Abbreviations: AIDS, acquired immunodeficiency syndrome; CI, confidence interval; HIV, human immunodeficiency virus; IDU, injection drug use/user; MSM, men who have sex with men; OR, odds ratio; UNAIDS, Joint United Nations Programme on HIV/AIDS.

INTRODUCTION

Human immunodeficiency virus (HIV)/acquired immunodeficiency syndrome (AIDS) first emerged in the early 1980s among populations of gay men and other men who have sex with men (MSM) in Western Europe, North America, and Australia. This reality shaped early responses to the epidemic and has had a lasting impact on the stigma associated with HIV/AIDS. ''MSM'' is a technical phrase intended to be less stigmatizing than culturally bound terms such as gay, bisexual, or homosexual. It describes same-sex behaviors between men rather than identities, orientations, or cultural categories. The term includes gay men, bisexuals, MSM who do not identify as gay or bisexual despite their behaviors, male sex workers, some biologically male transgendered persons, and a range of culture- and country-specific populations of MSM. More than a quarter-century later and in an increasingly broad range of countries, contexts, and development levels, data are emerging which show that epidemics of HIV among MSM are no longer limited to high-income countries. Recent evidence from a wide range of sources suggests that MSM are at marked risk for HIV infection in low- and middle-income countries in Asia, Africa, Latin America, the Caribbean, Eastern Europe, and Central Asia (1–3).

In 2007, we used a comparative pooled adjusted odds ratio approach and found that MSM in 15 Latin American countries were 33.3 times as likely (95% confidence interval (CI): 32.3, 34.2) to be HIV-positive as were reproductive-age men in the general population (2). MSM in Asia were 18.7 times as likely (95% CI: 17.7, 19.7) to have HIV infection as other men; African MSM were 3.8 times as likely (95% CI: 3.3, 4.3); and MSM in Eastern Europe, where spread by injection

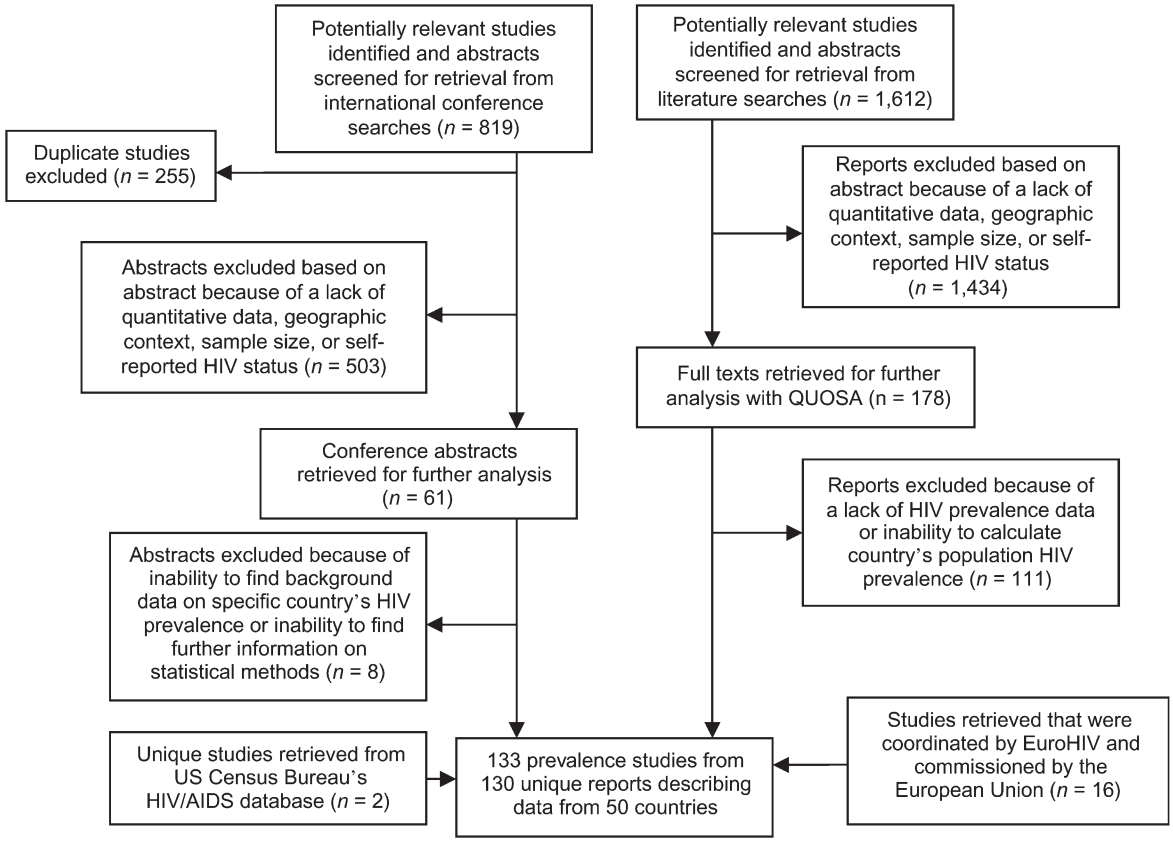

Figure 1. Search protocol used in a systematic review of published and unpublished literature on the human immunodeficiency virus (HIV) epidemic among men who have sex with men in low- and middle-income countries, 2000–2009. Articles and citations were downloaded, organized, and reviewed using the QUOSA information management software package, version 8.05 (QUOSA, Inc., Waltham, Massachusetts). AIDS, acquired immunodeficiency syndrome.

drug use (IDU) predominates, were 1.3 times as likely (95% CI: 1.1, 1.6) (2). When these data were stratified by prevalence level in the general population of reproductive-age adults, MSM in very-low-prevalence countries were 58.4 times as likely to have HIV infection—and even in medium- to high-prevalence countries, the adjusted odds ratio for MSM as compared with other men was 9.6 (95% CI: 9.0, 10.2) (2). HIV incidence data, while scarcer, generally have supported high acquisition and transmission risks among MSM in low- and middle-income countries. There is marked diversity across epidemic contexts, yet HIV rates in MSM have been consistently high.

Research among MSM in low- and middle-income countries has been limited by the criminalization and social stigmatization of these behaviors, the hidden nature of these populations, and a lack of targeted funding (4, 5). Because these men are so hidden, there is generally marked underreporting of MSM behavior in population-based surveys, and there has been limited work on the kinds of surveillance necessary to characterize these men and the emerging epidemics affecting them (6).

MSM are a markedly underserved and underresourced population in many settings. They have limited access to HIV prevention, treatment, and care services—with estimates of access to the most basic preventive interventions ranging from less than 1 in 100 MSM in Eastern Europe and Africa to, at best, 1 in 5 MSM in Latin America (7). In epidemics categorized as generalized, where HIV prevalence rates are above 1% (or 2%) in adults, less than 0.1% of funding for HIV prevention supports prevention for MSM. In countries categorized as having concentrated epidemics (less than 1% of general-population adults but more than 5% of any at-risk group), only 3.3% of HIV prevention expenditures target the preventive needs of MSM (8). To improve low- and middle-income countries' responses to HIV/AIDS, it is essential that services expand to include MSM. A much more nuanced understanding of the diversity of epidemics among MSM in low- and middle-income countries will also be required. The current categorization of HIV epidemics into nascent, concentrated, and generalized, as used by the Joint United Nations Programme on HIV/AIDS (UNAIDS) and other monitoring agencies, has led to thinking which (incorrectly but commonly) equates "generalized" with "heterosexual" and then excludes MSM components of generalized epidemics from consideration (9, 10).

The emerging regional HIV epidemics among MSM in Africa, Asia, Latin America, and Eastern Europe are heterogeneous in themselves but are occurring in diverse contexts

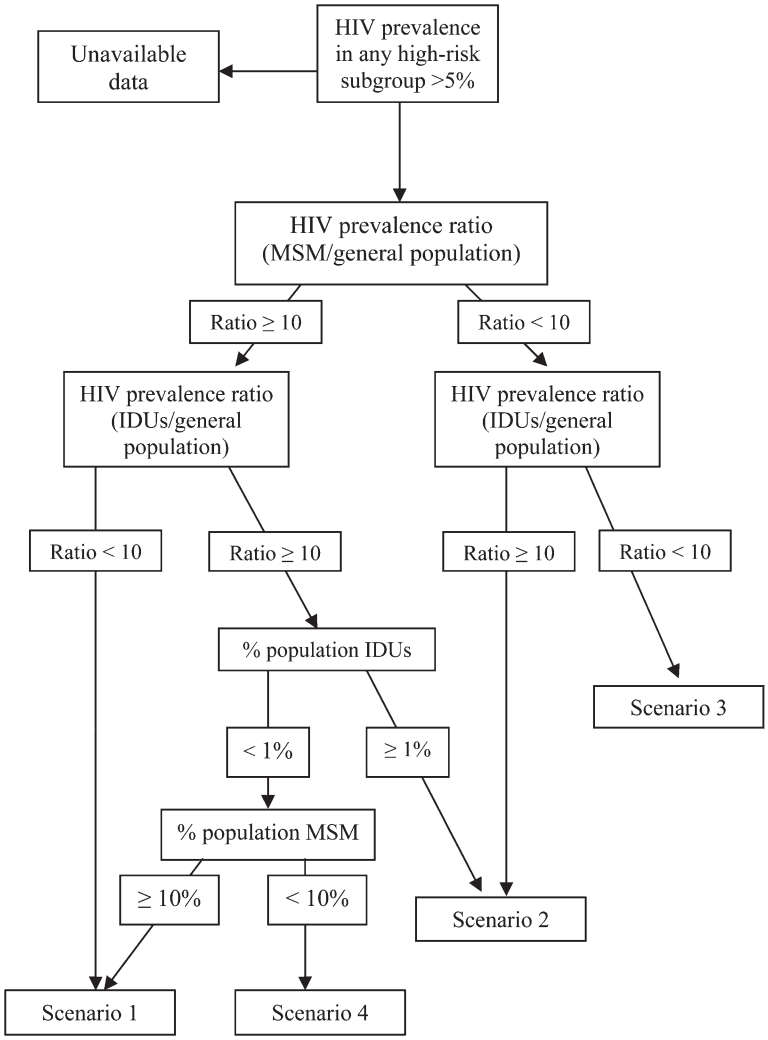

Figure 2. Development of the 4 epidemic scenarios used in a systematic review of published and unpublished literature on the human immunodeficiency virus (HIV) epidemic among men who have sex with men (MSM) in low- and middle-income countries, 2000–2009. IDUs, injection drug users.

which vary according to several factors, including predominant modes of spread, epidemic level and stage, gender and age distribution, and availability of prevention, treatment, and care services (11). We sought to advance epidemiologic specificity in characterizing MSM outbreaks in relation to the wider epidemic contexts in which they occur. To do this, we conducted a comprehensive review of the recent HIV/AIDS literature using systematic methods and developed an algorithmic approach to assist in understanding MSM epidemics and the populations in which they are occurring.

METHODS

Search strategies

The methods used in developing search strategies, abstracting data, and generating aggregate estimates of HIV disease burden among MSM and the general population have been previously described (2). In brief, we conducted systematic searches of several databases, including PubMed (US National Library of Medicine), EMBASE (Excerpta Medica, Amsterdam, the Netherlands), EBSCO (EBSCO Publishing, Ipswich, Massachusetts), and the Cochrane Database of Systematic Reviews (Cochrane Collaboration, Oxford, United Kingdom), through August 30, 2009. Articles and citations were downloaded, organized, and reviewed using the QUOSA information management software package, version 8.05 (QUOSA, Inc., Waltham, Massachusetts). PubMed Medical Subject Headings were used as keywords in searching Google Scholar (Google Inc., Mountain View, California). In addition, databases which link articles on the basis of complex algorithms, including Scopus (Elsevier B.V., Amsterdam, the Netherlands) and Web of Science (Thomson Reuters, New York, New York), were used to assess the validity of the search strategies. We also searched both online and CD-based volumes of abstracts from the

Table 1. Prevalence Rates of Human Immunodeficiency Virus Infection in Men Who Have Sex With Men and the General Population for 50 Countries Categorized According to Epidemic Scenario, 2000–2009[a]

Country	Aggregate HIV Prevalence Among MSM		Population Prevalence of HIV (Ages ≥15 Years), %	HIV Prevalence Among MSM vs. General Population	Country Prevalence of IDU, %	HIV Prevalence Among IDUs, %	HIV Prevalence Among IDUs vs. General Population
	%	95% CI					
Scenario 1: MSM Risks Are the Predominant Mode of Exposure for HIV Infection in the Population							
Ecuador	15.1	12.8–17.4	0.27	55.9	0.59	28.77	106.6
Peru[b]	13.8	13.4–14.3	0.37	37.3	0.59	13	35.1
Bolivia	21.2	17.6–24.7	0.13	163.1	0.59	28.77	221.3
Uruguay	18.9	16.1–21.7	0.38	49.7	0.59	28.77	75.7
Argentina	12.1	10.8–13.4	0.40	30.3	0.29	49.7	124.3
Colombia	19.4	17.2–21.6	0.51	38.0	0.59	1	2.0
Paraguay	13	6.2–19.9	0.48	27.1	0.59	9.35	19.5
Brazil	8.2	6.9–9.4	0.50	16.4	0.67	48	96.0
Honduras	9.8	8.1–11.5	0.57	17.2	0.59	28.77	50.5
Panama	10.6	6.7–14.6	0.83	12.8	0.59	28.77	34.7
Guatemala	11.5	6.7–16.4	0.70	16.4	0.59	28.77	41.1
El Salvador	7.9	4.8–10.9	0.77	10.3	0.59	28.77	37.4
Nicaragua	9.3	4.8–13.7	0.20	46.5	0.59	6	30.0
Mexico	25.6	24.8–26.5	0.26	98.5	0.59	3	11.5
Jamaica	31.8	25.4–38.3	1.38	23.0	0.73	12.9	9.3
Ghana	25	20.5–29.5	1.67	15.0	0.43	12.43	7.4
Scenario 2: MSM Risks Occur Within Established HIV Epidemics Driven by IDU							
Poland	5.4	3.3–7.6	0.06	90.0	1.50	8.9	148.3
Serbia	8.7	5.4–12.0	0.08	108.8	1.50	27.04	338.0
Armenia	0.9	0.0–2.7	0.10	9.0	0.10	13.4	134.0
Georgia	5.3	1.2–9.4	0.07	75.7	4.19	1.63	23.3
Moldova	1.7	0.0–4.0	0.24	7.1	0.14	17	70.8
Russia	3.4	2.6–4.2	0.78	4.4	1.78	37.15	47.6
East Timor (Timor Leste)	1	0.0–2.6	0.20	5.0	0.27	16.7	83.5
Ukraine[b]	10.6	7.8–14.2	1.09	9.7	1.16	41.8	38.3

Table continues

International AIDS Conference, the Conference on HIV Pathogenesis, Treatment, and Prevention, and the Conference on Retroviruses and Opportunistic Infections, with similar restrictions using Boolean logic (Figure 1).

An algorithmic approach for characterizing MSM epidemics

The development of the algorithm begins with the standard UNAIDS definition of a concentrated HIV epidemic, defined as greater than 5% HIV prevalence in any high-risk group (MSM, IDUs, or sex workers, female or male) (9). The algorithm proceeds to the ratio of HIV prevalence among MSM to that in the general population and dichotomizes this categorization into a ratio of less than 10 or greater than or equal to 10. The basis for the selection of a ratio of 10 as the cutoff value builds on prior work (2), which indicated that the adjusted odds ratio for MSM as compared with other men in countries with medium HIV prevalence was 9.6 (95% CI: 9.0, 10.2). Assuming that the prevalence ratio will approximate the odds ratio, we used the upper level of that interval to differentiate countries whose MSM HIV prevalence is substantial in comparison with the general population. The algorithm then takes into account the ratio of HIV infection prevalence among IDUs to that in the general population, again dichotomized into ratios of less than 10 or greater than or equal to 10. Using a rationale parallel to that regarding MSM above and because of a lack of a similar analysis for IDUs, we use the same cutoff value of 10 for the ratio of HIV prevalence among IDUs to that in the general population. The final step is the categorization by proportion of the adult male population engaging in IDU behavior, dichotomized as less than 1% and greater than or equal to 1%, and categorization by proportion of the adult male population with a history of ever engaging in MSM behavior, again

Table 1. Continued

Country	Aggregate HIV Prevalence Among MSM		Population Prevalence of HIV (Ages ≥15 Years), %	HIV Prevalence Among MSM vs. General Population	Country Prevalence of IDU, %	HIV Prevalence Among IDUs, %	HIV Prevalence Among IDUs vs. General Population
	%	95% CI					
Scenario 3: MSM Risks Occur in the Context of Mature and Widespread HIV Epidemics Among Heterosexuals							
Namibia	12.4	8.1–16.8	13.32	0.9	0.43	12.43	0.9
Botswana	19.7	12.5–26.9	21.56	0.9	0.43	12.43	0.6
South Africa	15.3	12.4–18.3	15.89	1.0	0.87	12.4	0.8
Zambia	32.9	29.3–36.6	15.72	2.1	0.43	12.43	0.8
Kenya[b]	15.2	13.3–17.2	7.49	2.0	0.73	42.9	5.7
Tanzania	12.4	9.5–15.2	5.88	2.1	0.43	12.43	2.1
Malawi	21.4	15.7–27.1	11.46	1.9	0.43	12.43	1.1
Nigeria	13.5	12.0–15.0	2.88	4.7	0.43	12.43	4.3
Sudan	8.8	7.1–10.4	1.26	7.0	0.05	2.94	2.3
Scenario 4: MSM, IDU, and Heterosexual Transmission All Contribute Significantly to the HIV Epidemic							
Thailand[b]	23	20.1–25.4	1.18	19.5	0.38	42.5	36.0
Vietnam	6.2	5.1–7.3	0.42	14.8	0.25	33.85	80.6
Laos	5.4	3.5–7.2	0.14	38.6	0.27	16.7	119.3
Cambodia	7.8	5.9–9.7	0.76	10.3	0.02	22.8	30.0
China	4.3	4.0–4.7	0.07	61.4	0.19	12.3	175.7
Indonesia	9	6.9–11.0	0.16	56.3	0.13	42.5	265.6
India	14.5	13.3–15.6	0.30	48.3	0.02	11.15	37.2
Nepal	4.8	2.6–7.0	0.38	12.6	0.15	41.39	108.9
Pakistan	1.8	1.1–2.6	0.09	20.0	0.14	10.8	120.0
Senegal	24.3	21.9–26.7	0.88	27.6	0.43	12.43	14.1
Egypt	5.3	2.9–7.7	0.02	265.0	0.05	2.94	147.0
Unavailable Data							
Belarus	0	0.0–0.0	0.16	0.0	0.09	16.6	103.8
Kazakhstan	0	0.0–0.0	0.10	0.0	0.96	9.2	92.0
Kyrgyzstan	0	0.0–0.0	0.11	0.0	0.74	8	72.7
Azerbaijan	42.9	6.2–79.5	0.12	357.5	5.21	13	108.3

Abbreviations: CI, confidence interval; HIV, human immunodeficiency virus; IDU, injection drug use/user; MSM, men who have sex with men.

[a] High-income countries/territories excluded from the analysis: Andorra, Antigua and Barbuda, Aruba, Australia, Austria, Bahamas, Bahrain, Barbados, Belgium, Bermuda, Brunei Darussalam, Canada, Cayman Islands, Channel Islands, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Equatorial Guinea, Faeroe Islands, Finland, France, French Polynesia, Germany, Greece, Greenland, Guam, Hong Kong, Hungary, Iceland, Ireland, Isle of Man, Israel, Italy, Japan, Korea, Kuwait, Liechtenstein, Luxembourg, Macao, Malta, Monaco, Netherlands, Netherlands Antilles, New Caledonia, New Zealand, Northern Mariana Islands, Norway, Oman, Portugal, Puerto Rico, Qatar, San Marino, Saudi Arabia, Singapore, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Trinidad and Tobago, United Arab Emirates, United Kingdom, United States, and US Virgin Islands.

[b] Example country used to describe that particular scenario.

dichotomized (12). Incorporation of denominator estimates for MSM and IDU point to the extent of the HIV burden in a given country. Figure 2 illustrates the algorithm, while a detailed explanation for the algorithms which yielded each of the 4 scenarios is available in the Web Appendix (posted on the *Epidemiologic Reviews* Web site (http://epirev.oxfordjournals.org/)).

Definitions of low- and middle-income countries

Economies were divided by the World Bank according to their 2008 gross national income per capita, calculated using the Atlas method (13). The groups are: low-income, $975 or less; lower middle-income, $976–$3,855; upper middle-income, $3,856–$11,905; and high-income, $11,906 or more (13).

RESULTS

Search findings

In all, 1,612 citations were identified from reports published after January 1, 2000, and 819 were identified from international conferences held after January 1, 2000 (Figure

1). After exclusions due to duplicate publication and lack of data, including biologic measures of HIV, 178 published citations and 61 conference reports were retrieved and reviewed. A total of 133 prevalence studies from 130 unique reports met all of the inclusion criteria. These data describe HIV prevalence among MSM in 50 low- and middle-income countries.

Epidemic scenarios and representative countries

Table 1 shows HIV prevalence rates in MSM and the general population for the 50 countries included. Figure 3 maps those countries in each of the regions where the available data suggest that MSM epidemics can be best characterized by one of the scenarios generated through use of the algorithm.

Use of the algorithm with available country-level data yields 4 epidemic scenarios, as follows.

Scenario 1. In scenario 1, MSM risks are the predominant mode of exposure for HIV infection in the population. This scenario is seen across most of South America and in multiple settings in high-income countries. Here HIV prevalence among MSM is generally over 10%, the ratio of HIV prevalence in MSM to that in the general population is very high (odds ratio (OR) = 33.5 in the review by Baral et al. (2)), the prevalence among IDUs is variable but the population prevalence of IDU risks is well under 1% of adults, and the proportion of men reporting a lifetime history of sex with another man is well under 10% of adults.

Scenario 2. In scenario 2, MSM risks occur within established HIV epidemics driven by IDU. This is the predominant epidemic context in Eastern Europe and Central Asia. Here the HIV rate is highest among IDUs, the prevalence ratio for HIV infection among MSM as compared with the general population is less than 10 but the same ratio for IDUs compared with the general population is well over 10, and the proportion of the adult population with a lifetime history of ever injecting drugs is over 1%, the highest categorization stratum used by Mathers et al. (12).

Scenario 3. In scenario 3, MSM risks occur in the context of mature and widespread HIV epidemics among heterosexuals. This is the prevailing context across sub-Saharan Africa, with particular relevance for the high-prevalence zones of East Africa and Southern Africa. Here rates in heterosexuals are high, so the ratio of HIV prevalence in MSM to that in general-population samples is well under 10, and this is also true of the ratio among IDUs compared with heterosexuals.

Scenario 4. In scenario 4, MSM transmission, IDU transmission, and heterosexual transmission all contribute significantly to the HIV epidemic. This is the complex context of much of South, Southeast, and Northeast Asia. In this algorithm, the same conditions prevail as in scenario 1 (Latin America), but the proportion of men with a history of same-sex behavior is markedly higher.

The 4 scenarios, for the most part, followed geographic groupings by continent; however, there were some exceptions: Ghana was categorized as a scenario 1 country, along with Latin American countries; Senegal and Egypt joined Asian countries in scenario 4; and East Timor and Vietnam joined countries in Eastern Europe and Central Asia in scenario 2. Finally, Belarus, Kazakhstan, Kyrgyzstan, and Azerbaijan lacked dependable data on HIV prevalence among MSM, so these countries were assigned to a default category with ''unavailable data.''

The HIV pandemic is marked by enormous regional diversity, and this is true of MSM epidemics as well (11). Generally, sub-Saharan Africa remains by far the most affected region and the only part of the world where generalized epidemics have affected more than 10% of all reproductive-age adults (14). The MSM component of Africa's epidemics is arguably the least studied, most hidden, and least understood of any region, and it is not surprising that we found the fewest number of reports for this region. Asia has had several quite severe HIV epidemics, with high rates in several subgroups, including MSM—most notably in Thailand, Cambodia, and Burma—and a mixed picture with substantial MSM, IDU, and heterosexual spread. Additionally, South America has multiple HIV epidemics which are highly concentrated among MSM. This great diversity suggests that approaches to MSM epidemics must be clearly situated in their wider national and regional epidemic contexts to be understood.

To explore these regional scenarios in some detail, we describe here 1 representative country for each scenario. Selection of the countries was based on several criteria: Data were available on MSM; the countries were of significant size and regional importance that findings would have relevance for their wider region; and HIV/AIDS epidemics and responses to those epidemics were substantial enough in 2009 to make evaluation possible. For scenario 1, we investigated Peru; for scenario 2, Ukraine; for scenario 3, Kenya; and for scenario 4, Thailand. Table 2 shows HIV prevalence rates calculated from community-based samples of MSM in the 4 representative countries.

Because the taxonomy of male sexual orientation and gender identity is culturally bound, can be complex, and has implications for HIV programming, we have attempted to characterize the MSM/transgender typologies used in epidemiologic studies for each representative country. We reviewed the evidence for the various populations of MSM and attempted to ascertain differential risks of HIV. We also explored the intersection of MSM HIV epidemics and substance use—both IDU risk and noninjection risks, such as those associated with non-IDU use of methamphetamine and cocaine. Because sexual behaviors with female sex partners are also diverse, complex, and important for understanding HIV spread among these men, we also investigated these domains.

Scenarios and representative countries

Scenario 1—Peru: MSM risks predominate in HIV exposures. The first case of AIDS in Peru was reported in 1983. An estimated 20,000–79,000 Peruvian adults are currently living with HIV (15–17). HIV infection rates in

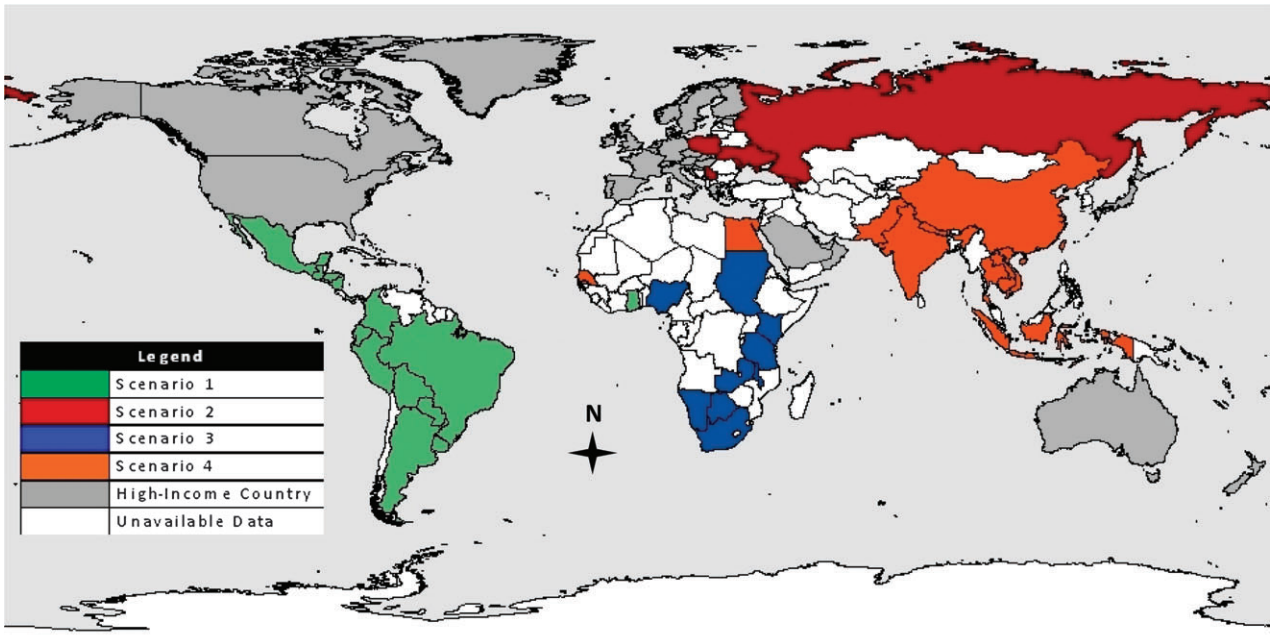

Figure 3. Map of the 4 algorithm-generated scenarios of global human immunodeficiency virus prevalence among men who have sex with men in low- and middle-income countries, 2000–2009.

Peru are markedly higher among MSM, ranging from 13.9% to 22.3% in Lima (18–21), and are estimated nationwide at 13.8% (95% CI: 13.4, 14.3; $n = 22{,}284$) among MSM as compared with approximately 0.5% of reproductive-age adults in the general population (17). Surveillance data from Lima in 2006 showed that the epidemic is more concentrated among MSM than in any of the other high-risk groups, such as female sex workers (prevalence of 0.5%) (17). One UNAIDS estimate suggested that by the end of 2010, 55% of HIV incidence in Peru will be accounted for by transmission among MSM, 6% by female partners of MSM, and 6% by partners of clients of female sex workers (22).

MSM/transgender typologies used in epidemiologic studies. Research reports from Peru generally classify MSM into categories based on sexual identity and include heterosexual, bisexual, homosexual/gay, and transvestite/transgendered. Data from Lima from 2002 suggest differential risks between subpopulations of MSM, with the highest prevalence rates being found among self-identified gay (26.2%) and transgendered (32.2%) MSM and lower rates being observed among bisexual (13.3%) and heterosexual-identified (12.1%) MSM (20).

High-risk activity, including low levels of condom use, compensated or transactional sex, forced sex, and high numbers of sexual partners, are commonly reported among MSM (20, 23–26). In a study of HIV-infected MSM in Lima, Clark et al. (27) found that 34% of infected MSM had been compensated for sex in the last 6 months, and this rate remained consistent among those who were aware of their HIV status (31%).

In a study carried out in 1996, Tabet et al. (21) found that among more than 400 MSM, prevalences of HIV and syphilis were 32% and 51%, respectively, for transgendered persons (''cross-dressers''), and transgendered persons were more likely to be HIV-positive than homosexuals (OR = 2.3, 95% CI: 1.0, 4.8) and bisexuals (OR = 2.7, 95% CI: 1.1, 6.5). Second-generation sentinel surveillance conducted among MSM in Lima found that rates of sexually transmitted infection were greatest among the 7.4%–19.2% (1996–2002) who self-identified as ''transvestites'' (80% for herpes simplex virus type 2 and 51% for syphilis in 1996) when they were compared with the other subpopulations (20, 28). Receptive anal intercourse (reported by 100% in 1 study) and low levels of condom use are also frequently reported by transgendered persons (20, 21, 23).

MSM and drug use. Risks associated with IDU have been little investigated among MSM in Peru, since IDU is rare in Peru (29), although clean injecting equipment is available as a means for prevention of transmissible diseases (30). Because IDU is not considered a critical issue in the HIV epidemic in Peru, drug use in general (IDU and non-IDU) has not historically been a priority in Peruvian HIV research and has begun to be assessed only recently, often in studies conducted among lower-income communities (23, 24, 26, 31, 32).

These findings make clear that Peru has a low prevalence of HIV infection in the general population, and low rates are seen among high-risk heterosexuals, such as female sex workers. MSM are the predominant risk group for HIV infection and account for the majority of estimated incident infections. Most of the transmission

Table 2. Prevalence of Human Immunodeficiency Virus Infection in Community-based Samples of Men Who Have Sex With Men in the 4 Countries Representing the 4 Epidemic Scenarios, 2000–2009

Country and First Author (Reference No.)	Location	Type of Sample	Year(s)	No. of Men in Sample	No. HIV-Positive	Prevalence, %	95% Confidence Interval
Peru (scenario 1)							
Sanchez (20), Tabet (21)	Lima	Convenience	1996	444	82	18.5	
Hierholzer (18)	Lima	Convenience	1998–2000	7,041	982	13.9	
Hierholzer (18)	Other cities	Convenience	1998–2000	4,514	241	5.3	
Sanchez (20)	Lima	Convenience	1998–1999	1,211	215	17.8	
Sanchez (20)	Lima	Convenience	2000	3,200	528	16.5	
Sanchez (20)	Lima	Convenience	2000	1,357	268	19.7	
Sanchez (20)	Lima	Convenience	2002	1,358	303	22.3	
UNAIDS (17), La Rosa (19)	Lima	Convenience	2002	893	198	22.2	
UNAIDS (17), La Rosa (19)	Sullana, Piura	Convenience	2002	732	59	8.1	
UNAIDS (17), La Rosa (19)	Arequipa	Convenience	2002	424	28	6.6	
UNAIDS (17), La Rosa (19)	Iquitos	Convenience	2002	285	34	11.9	
UNAIDS (17), La Rosa (19)	Pucallpa	Convenience	2002	266	18	6.8	
Clark (27)	Lima	Convenience	2007	559	124	22.2	
Total				22,284	3,080	13.8	13.4, 14.3
Ukraine (scenario 2)							
UNAIDS/MOH (34), Balakiryeva (43)	Kiev	RDS	2007	90	4	4.4	
UNAIDS/MOH (34), Balakiryeva (43)	Kryviy Rig	RDS	2007	100	8	8.0	
UNAIDS/MOH (34), Balakiryeva (43)	Mykolayiv	RDS	2007	100	10	10.0	
UNAIDS/MOH (34), Balakiryeva (43)	Odessa	RDS	2007	69	16	23.2	
Total				359	38	10.6	7.8, 14.2
Kenya (scenario 3)							
Angala (81)	National VCT centers	VCT-based	2006	780	83	10.6	
Sanders (58)	Mombasa, Kilifi	Convenience	2009	553	120	21.7	
Total				1,333	203	15.2	13.3, 17.2
Thailand (scenario 4)							
van Griensven (76)	Bangkok	TLS	2007	400	123	30.8	
CDC (78)	Bangkok	TLS	2005	399	113	28.3	
CDC (78)	Chang Mai	TLS	2005	222	34	15.3	
CDC (78)	Phuket	TLS	2005	200	11	5.5	
Total				1,221	281	23.0	20.1, 25.4

Abbreviations: CDC, Centers for Disease Control and Prevention; HIV, human immunodeficiency virus; MOH, Ministry of Health; RDS, respondent-driven sampling; TLS, time-location sampling; UNAIDS, Joint United Nations Programme on HIV/AIDS; VCT, voluntary counseling and testing.

among MSM appears to be due to sexual and not parenteral exposure. The public health implications of this epidemiology are many. First, a response to reducing HIV infection rates in Peru must concentrate on MSM. Second, the diversity of MSM taxonomies in the population suggests that a diverse and targeted set of responses may be required. And finally, prevention strategies for the female partners of MSM are a clear public health priority, since they account for a substantial proportion of HIV infections among women in this highly concentrated

epidemic. These programs will probably require the active participation of male partners.

Scenario 2—Ukraine: high HIV prevalence among MSM in the context of an IDU-driven HIV epidemic. The first case of HIV in Ukraine was reported in 1987 (33). In 1995, there was an explosive outbreak among Ukrainian IDUs. The proportion of IDU among all newly reported HIV infections was 68.5% in 1995 and 83.6% in 1997, and has shown a decreasing trend since, reaching 40.1% by the end of 2007 (34). By the end of 2007, there were 81,741 officially registered cases of HIV in Ukraine (34), and the Ukrainian AIDS Centre of the Ministry of Health estimated that there were 395,000 (range, 230,000–573,000) HIV-infected persons aged 15–49 years in the country, or 1.63% of the adult population of Ukraine—the highest adult HIV prevalence in the region (34–38).

Surveillance data on HIV among MSM in Ukraine are very limited and are not reflected in Ukraine's official statistics, since the routine HIV surveillance system does not differentiate between heterosexual and homosexual transmission. Data from sentinel surveillance activities indicate a total of 158 HIV cases being diagnosed among MSM (or 0.13% of all HIV cases reported) between 1987 and 1997; in 1997, among the 17,669 newly reported HIV cases, only 43 (0.24%) were reportedly among MSM. These estimates are probably a gross underestimation of HIV among MSM and highlight that MSM may not seek voluntary counseling and testing or may not report their behaviors because of the social stigma attached to same-sex behavior.

MSM/transgender typologies used in epidemiologic studies. Ukraine was the first former Soviet republic to decriminalize homosexuality (34). However, the Ministry of Health of Ukraine, in its 2008 United Nations General Assembly Special Session on HIV/AIDS report, indicated that there is no ''normative or legal basis that would protect the rights of vulnerable populations, namely injecting drug users, female sex workers, men who have sex with men and others'' (34, p. 126). Stigma and discrimination against MSM are widespread, and ''MSM are generally treated as people with pathological mental deviations'' (34, p. 122). In a 2004 6-city behavioral survey, 57% of MSM reported nondisclosure of their sexual identity to others because of fear of stigma and discrimination (39), whereas in 2005, approximately 57% of MSM reported experiencing discrimination or abuse of their rights, especially regarding employment (40).

The Ukrainian AIDS Center has estimated the number of MSM in Ukraine to be 177,000–430,000 (36). The lower estimate was derived from triangulation from different sources of estimates (36). The higher estimate corroborates the Cáceres et al. (26) estimate of the prevalence of lifetime same-sex experience among men in Eastern Europe and Central Asia: approximately 3% of the male population.

HIV among MSM. Seroprevalence studies among Ukrainian MSM recruited via peer-referral convenience sampling or respondent-driven sampling have found a considerably high HIV prevalence among MSM (aggregate = 11.0%, 95% CI: 8.0, 14.1). If these prevalence estimates are applied to the MSM population estimates (36), the expected number of HIV-positive MSM in Ukraine is between 19,470 and 47,300 (range, 14,160–60,630).

Male sex work and transactional sex. Engaging in transactional sex with other males is a common practice among Ukrainian MSM. In 2002, 21% of 227 MSM survey participants reported having engaged in transactional sex with males in the prior 6 months (41). In a peer-referral convenience sample of 886 MSM in 6 cities selected by the International HIV/AIDS Alliance in Ukraine in 2004, 22% of respondents reported engaging in transactional sex with males in the prior 12 months (42). Finally, second-generation surveillance data indicate that 8% of 359 MSM sampled via respondent-driven sampling in 2007 had engaged in transactional sex with males during the month prior to their participation in the survey (43).

MSM and drug use. Behavioral evidence suggests that the proportion of MSM who also inject illicit drugs is relatively small. Two reports from 2004 and 2008 (38, 43) indicate that 6% of MSM are also IDUs, which results in an estimate of that dual-risk group of 10,620–25,800 persons, if that proportion is applied to the estimated number of MSM in Ukraine. Considering that HIV prevalence among IDUs exceeded 40% in 2007, this subset of MSM, albeit small, is at very high risk for HIV infection. There exists scant corroborative evidence that approximately 33% of MSM/IDUs self-report being HIV-infected (38), while the majority indicate that they are bisexual and that they inject drugs occasionally but in concordance with same-sex behaviors (39).

Stigma and discrimination play a substantial role in limiting HIV testing, disclosure, and use of HIV services by MSM in Ukraine. While HIV rates are above 1% of reproductive-age adults, making this a generalized epidemic by the UNAIDS definition, this remains an epidemic that is substantially driven by IDU risks. While MSM who are also IDUs are probably a relatively small subset of both the MSM and IDU populations, they appear to be at very high risk for HIV infection. Ukraine is an example of a country where efforts to decrease stigma in health-care settings and to provide truly confidential or anonymous HIV testing services, with staff trained in working with MSM, will probably be required in order to understand HIV among MSM and to respond. Services for IDUs need to take greater account of prevention services for sexual risks. And finally, the surveillance system will probably need to assess not simply sexual versus parenteral exposures but also homosexual and heterosexual risks for Ukrainian men.

Scenario 3—Kenya: HIV among MSM in a mature East African epidemic. HIV spread in Kenya has long been characterized as driven by heterosexual and vertical (perinatal) transmission. However, the last 4–5 years have demonstrated increased risk among other vulnerable populations, including sex workers, IDUs, and MSM (5). The Kenyan government has made great strides in accepting the reality that MSM are at risk for HIV in Kenya. In 1998, then-Kenyan president Daniel Arap Moi told Kenya's *Daily Nation* newspaper that ''Kenya has no room for homosexuals and lesbians. Homosexuality is against African norms and traditions, and even in religion it is considered a great sin'' (44, pp. 9–10). Similarly, in 1998, Maina Kahindo of the Kenyan Ministry of Health was quoted as saying that ''taking into

account other modes of transmission of HIV/AIDS, homosexuality is negligible and should not take up our resources and time'' (45, p. 48). In October 2009, the Kenyan government indicated that it was vital for the government to reach out to the gay community in the form of a multicity study using respondent-driven sampling, including population size estimations and needs assessment (46).

As of 2007, Kenya had 1.4–1.8 million reproductive-age adults living with HIV, of whom approximately 68% were women (37). IDUs have also been increasingly recognized as an at-risk population in Kenya (47). A 2004 study by the United Nations Office of Drugs and Crime found that 80% of IDUs in 3 Kenyan urban centers reported sharing injection devices, with 50% prevalence in Mombasa (48). In a World Health Organization study carried out in Nairobi, HIV prevalence was 53% among IDUs, with two-thirds also reporting sexual risk factors (49).

MSM/transgender typologies used in epidemiologic studies. Studies of MSM in Nairobi have revealed that many of these men use the English-language terms gay, bisexual, and homosexual to describe their sexual orientation. In Nairobi, a study of 500 MSM revealed 46% self-identifying as gay, 23% as bisexual, and 16% as homosexual. Of the men studied, 12% identified themselves using the Kiswahili term *shoga*, which means gay or homosexual (50). *Basha* is a term often associated with men who play a masculine or insertive role during sex, while *shoga* have been described as predominantly receptive partners during anal intercourse in Kenya. The word *basha* is derived from ''pasha,'' which means a high-ranking official, in addition to being the local term for the king in packs of playing cards (51). Few Kenyan MSM report being transgendered, which is congruent with many studies across Africa (52).

While there is an emerging community of Kenyan MSM willing to advocate for their needs, there remains a significant proportion of Kenya's MSM who meet cultural norms by marrying and having children (53). Population-based estimates of the prevalence of same-sex practices among MSM are elusive, though a few estimates have been proposed (54). Cáceres et al. (26) proposed that the lifetime prevalence of MSM practices in East Africa is 1%–4%, which is congruent with self-reported same-sex practices among 486 men sampled in Nairobi (53).

MSM carry a disproportionate burden of HIV in Kenya, with an average prevalence of approximately 15.2% (95% CI: 13.1, 17.3) as compared with an HIV prevalence among all Kenyan men of approximately 6.1%. Higher prevalence estimates tend to be found along the coast, where Muhaari (55) has observed an overall prevalence of 22% (120/553) in a cohort study over 5 years of accrual, with an incidence rate of 8.8 per 100 person-years.

There have been numerous estimates of the component of Kenya's HIV epidemic that is attributable to MSM practices and prison experiences. In an early model, van Griensven (56) estimated that MSM contributed approximately 4.5% of Kenya's HIV epidemic. More recent estimates have been higher, including an estimate of 9.8%, based on an assumption of 3% of men engaging in male-to-male sex (56). In the 2009 Kenya HIV Prevention Response and Modes of Transmission Analysis, researchers estimated that 15.2% of incident infections in Kenya were attributable to MSM (57). There was significant variation based on region, ranging from 6.0% in Nyanza to 16.4% in Nairobi and 20.5% along the coast (57). The Modes of Transmission study further estimated that HIV incidence was approximately 6.7% per 100 person-years among all MSM and 12.6% per 100 person-years among incarcerated MSM.

Male sex work and transactional sex. In an initial exploratory study of Kenyan MSM, 14% reported sex work as their primary occupation (50). In a sample of 285 MSM, 74% reported selling sex for money or goods in the previous 3 months, and 40% of these men reported buying sex during this same time frame. Only 17% of the sample reported not having bought or sold sex during the preceding 3 months (58). In a baseline behavioral study of 425 men who reported selling sex, levels of HIV knowledge were very low, and alcohol consumption was associated with lower rates of condom use during transactional sex (59–62).

Bisexual MSM and relationships with women. Multiple studies have demonstrated high rates of active bisexuality and bisexual concurrent partnerships among MSM in Kenya. Notably, men practicing bisexuality tend to have lower rates of HIV than those practicing exclusively sex with men. Even in the female-predominant epidemics of sub-Saharan Africa, this tends to be a common finding and probably relates to sexual positioning—namely, persons who self-identify as homosexual and have only male partners tend to be the receptive partner (58, 63). In contrast, MSM who self-identify as heterosexual tend to have higher insertivity ratios (the proportion of sex acts with men in which the index partner is insertive), which potentially explains the lower HIV prevalence rates among these men.

In 1 study of 500 MSM in Nairobi, 23% reported being bisexual, though 69% reported ever having sex with a woman, and 14% were either currently married or had ever been married to a woman. In a more recent study by Sanders et al. (58), 60% of 285 MSM reported having female sexual partners. Finally, a study of male sex workers showed that 8% were currently married to a woman, and another 9% were currently living with a woman but not married (61).

MSM and drug use. There are few available data describing dual-risk MSM IDU in Kenya. In the study by Sanders et al. (58), only 1.4% of MSM reported IDU, of whom 2 were HIV-positive. Even with this small sample size, the HIV risk associated with IDU nearly met statistical significance (OR = 13.1, 95% CI: 0.95, 180) (58).

HIV infection rates among MSM in Kenya are considerable and rising. The mature and widespread epidemic of HIV among all Kenyans means that while MSM are at risk, the epidemic among them is part of a much larger and wider epidemic of HIV. While risks from female partners are probably significant, Kenyan MSM who report having female partners are at lower risk for HIV than MSM who report having only male partners—a finding consistent with other recent African reports (4, 64–66). IDU risks are emerging in Kenya, but the overlap of MSM and IDU appears to be small and probably contributes little to wider prevalence estimates. Responses to the HIV epidemic in Kenya will probably need to emphasize targeted HIV prevention services for

Table 3. Prevalence of Human Immunodeficiency Virus Infection (%) Among Men Who Have Sex With Men in 3 Cities, Thailand, 2005[a]

	No. of Men	City			*P* Value[b]
		Bangkok	Chiang Mai	Phuket	
All men who have sex with men	821	28.3	15.3	5.5	<0.001
Male sex workers	754	18.9	11.4	11.5	NS
Transgendered persons	474	11.5	17.6	11.9	NS

Abbreviation: NS, not significant.
[a] Adapted from *Morbidity and Mortality Weekly Report* (78).
[b] *P* for variance by site.

MSM, community engagement with these men, and sex worker outreach for non-gay-identified male sex workers.

Scenario 4—Thailand: high HIV prevalence and incidence among gay men, other MSM, and transgendered persons (katoey) in a complex epidemic context. Thailand has justly been heralded for a number of achievements in HIV prevention, treatment, and care (67). Thailand was among the first Asian states to develop a national plan for HIV/AIDS and the first to commit to universal access to antiretroviral agents. Despite these successes, the Thai response has also been marked by the long-standing exclusion of MSM (68). MSM were not included in the national HIV surveillance system until 2007.

The Thai HIV epidemic has been marked by several phases of spread. The first wave, described by Weniger et al. (69), occurred among MSM and male sex workers in 1985–1988. In 1988–1989, an explosive epidemic was detected among IDUs (70). Asia's most severe heterosexual epidemic followed shortly thereafter. This was an epidemic driven by high rates of commercial sex-worker patronage by young Thai men (71). By 1992–1993, Thailand had a generalized epidemic of type 1 HIV. MSM, since they were not included in the national HIV/AIDS plan until 2007–2011, cannot be readily studied through the sentinel system (72). Nevertheless, data from multiple studies demonstrate a severe and expanding epidemic of HIV among MSM across the country (73–75). HIV rates in Bangkok MSM evaluated through venue time sampling increased from an estimated 17.3% in 2003 to 28.3% in 2005 and to 30.7% in 2007, the highest in the region (76). The overall increase in prevalence from 2003 to 2007 was significant (*P* for trend < 0.001). Among young MSM (aged 15–22 years), estimated incidence rose from 4.1% in 2003 to 6.4% in 2005 and an extraordinarily high rate of 7.7% in 2007 (*P* for trend > 0.02) (76).

MSM/transgender typologies used in epidemiologic studies. Thai culture has a long-standing traditional third gender category: *katoey*, who are transgendered biologic males who take on female identities and roles (77). Male partners of *katoey* were traditionally considered "*puchai*," that is, men, if they maintained masculine behavior and appearance. In a study carried out among 2,005 Thai men admitted to drug detoxification programs in northern Thailand, 3.8% reported a lifetime history of sex with another male; 84.8% of these MSM had only ever had a *katoey* sex partner; and only 10.6% reported ever having had sex with a male-identified man (73).

Contemporary Thai culture has seen the emergence of openly gay men who are male-identified and no longer fit the *katoey/puchai* paradigm. Male sex workers, a considerable population in some commercial sex areas—principally Bangkok, Chiang Mai, Pattaya, and Phuket and in virtual online domains—may be heterosexually identified, bisexual, homosexual, or *katoey*, though the majority (62.9% in a 3-city 2005 study (77)) report heterosexual orientation.

HIV among MSM. A 2005 *Morbidity and Mortality Weekly Report* article on 3 categories of Thai MSM (MSM, male sex workers, and transgendered persons) identified differential HIV risks and rates across sampling sites (78). These were venue time-sampled populations in Bangkok, Chiang Mai, and Phuket, all major MSM and commercial sex centers (Table 3).

A significant concern in both the Centers for Disease Control and Prevention study (78) and the 2009 report by van Griensven et al. (76) was the lack of awareness of current HIV status among Thai MSM. In the 2005 data, from a total of 340 HIV-positive men, 274 (80.6%) reported that they were HIV-uninfected (78). Reports of ever having sex with a woman were stable from 2003 to 2007; sex with a woman was reported by approximately one-third (37%) of all MSM.

MSM and drug use. Most studies of MSM in Thailand have found relatively low rates of reporting of active IDU. Drug use was associated with HIV infection in the Centers for Disease Control and Prevention study only among MSM, and this was largely a history of methamphetamine smoking rather than IDU (78). Rates of use of noninjected drugs, mostly methamphetamine, were high across the populations, however; in 2005, use of noninjected drugs was reported by 38.5% of male sex workers, 24.1% of transgendered persons, and 15.5% of MSM (78). Trend analysis in the study by van Griensven et al. (76) showed a marked and statistically significant increase in reported drug use (amphetamine-like substances, amphetamine-type stimulants, and benzodiazepines) during the previous 3 months, from 3.6% of MSM in 2003 to 17.5% in 2005 and 20.8% in 2007 (*P* for trend < 0.001). Drug use during the most recent sexual encounter, another measure of risk used in that study, also increased significantly and was reported by 5.5% of MSM in 2007 (76).

The Thai HIV epidemic is complex, with substantial HIV rates among IDUs and at-risk heterosexuals and a high prevalence and incidence among MSM. While overall HIV infection rates are stable or declining in the general population, a trend now being seen across Asia, the MSM epidemic appears to be "dislinked" and on an expanding trajectory, suggesting that current responses are inadequate. A vigorous targeted response among MSM is clearly called for—one that includes interventions focused on the rising use of noninjection drugs and related sexual risk factors among these men.

DISCUSSION

We have presented an algorithmic approach for generating epidemic scenarios to assist in understanding MSM

epidemics and the populations in which they are occurring. Based on a systematic review of the literature and the use of an algorithm derived from that literature, 4 distinct scenarios emerged which characterize the majority of MSM epidemics in low- and middle-income countries: 1) MSM risks are the predominant exposure mode for HIV infection in the population; 2) MSM risks occur within established HIV epidemics driven by IDU; 3) MSM risks occur in the context of mature and widespread HIV epidemics among heterosexuals; and 4) MSM, IDU, and heterosexual transmission all contribute significantly to the HIV epidemic. We highlighted Peru, Ukraine, Kenya, and Thailand, respectively, as countries that are representative of each of these scenarios.

This algorithmic approach should be treated as a dynamic process, whereby countries are assigned to a scenario on the basis of current data available; however, as the epidemic changes or as data become available, scenario assignment may certainly change. In fact, a major limitation of this approach is the scarcity of data across countries. However, our framework suggests that the current description of HIV among MSM in terms of concentrated or generalized epidemics fails to capture the diversity of the epidemic. Failure to recognize such diversity will probably lead to a failure to identify appropriate strategies for prevention, treatment, and care. Even within these scenarios, there is a large amount of diversity, but our epidemic scenario-based approach could facilitate discussions regarding appropriate responses. This may be particularly true for countries like Ghana, which an algorithmic approach suggests will fall into scenario 1 (MSM predominance), outside of its geographic region (most of Africa falls into scenario 3, with MSM spread occurring in contexts of high heterosexual prevalence). If a country's profile meets our scenario 1 criteria, its prevention efforts should have a major focus on MSM in order to be responsive. This will be a challenge in many geopolitical contexts and for many national-level AIDS programs.

To respond to multiple levels of HIV risk among MSM, combination HIV prevention interventions must be multileveled and multimodal to maximize their potential effectiveness (79). Our scenarios suggest that structural-level interventions will probably be required in order to provide services for MSM, most especially in scenario 2 (Eastern Europe and Central Asia) and scenario 3 (much of Africa). For scenario 2, where many prevention programs for drug users do not currently include adequate access to substitution therapy, as in Russia and several other countries, structural interventions will probably require policy changes to allow the use of methadone and other agents with known efficacy for treatment of opiate dependence. For scenario 3, structural interventions may include decriminalization of same-sex behavior between consenting adults to allow implementation of HIV prevention services for these men. An important question that should to be addressed in each epidemic scenario is whether preventive services for MSM should be mainstreamed with HIV prevention programs targeting the general population or should be designed as parallel to these existing structures. While mainstreaming would probably increase the cost-efficacy of these interventions, significant social stigma and criminalization would limit their efficacy, as men in such settings are quite justified in not seeking care.

Preventive interventions for MSM will probably vary markedly by scenario and by risk group; for example, promotion of condom use in stable sexual partnerships is a challenge across gender and sexual orientation categories, while increasing condom use in casual sexual partnerships will be a key goal across risk groups and may require the creation of environments for condom distribution in MSM venues. Other interventions, such as increasing uptake of water-based lubricants, will probably be relevant across all risk categories and will require changes in policy and programming to support lubricant access in low-resource settings, particularly in Africa and Asia.

It is important to recognize the relation between human rights contexts and HIV risk status among MSM and other sexual minorities. Homosexuality remains criminalized in over 80 member states of the United Nations, with punishments ranging from jail time to the death penalty. Repressive legal contexts and pervasive social stigma can limit access for these men to appropriate services for sexually transmitted infections and HIV, including prevention, treatment, and care. South America, predominantly captured by scenario 1, has gone far in decriminalizing same-sex relations and in affirming the human rights of sexual minorities. Targeted HIV prevention services, as in the Peru example, are both legal and publicly supported. In many African settings, including the example of Kenya, homosexuality remains criminalized and stigmatized, and the rights of sexual minorities are not protected by the state (80). Openly aiming HIV services at MSM populations in these areas may be unfeasible, and more community-based and externally funded approaches may be the only viable alternatives across many scenario 3 countries.

The starting point for a concerted global effort to tackle the HIV epidemic among MSM is a better understanding of the diversity of MSM epidemics and the populations in which they are occurring. An epidemic scenario-based approach provides a greater understanding beyond the traditional generalized-or-concentrated paradigm.

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