

# Twenty-Five Years of HIV: Lessons for Low Prevalence Scenarios

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**Abstract:** During the initial quarter century since the discovery of HIV, international response has focused on high prevalence scenarios and concentrated epidemics. Until recently, the theoretical underpinnings of HIV prevention were largely based on these responses—the assumption that inadequate responses to concentrated epidemics within low prevalence populations could rapidly lead to generalized epidemics. The limits of these assumptions for HIV prevention in low prevalence scenarios have become evident. While examples of rapid HIV diffusion in once low prevalence scenarios exist, emergence of generalized epidemics are less likely for much of the world. This paper reviews several key issues and advances in biomedical and behavioural HIV prevention to date and highlights relevance to low prevalence scenarios.

**Key Words:** gender, HIV, HIV policy, HIV programs, HIV structural approaches, low prevalence

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## INTRODUCTION

In 1981, the peculiar diagnoses of *Pneumocystis carinii* (*Pneumocystis jiroveci*) pneumonia and Kaposi sarcoma among several gay men in San Francisco, Los Angeles, and New York<sup>1</sup> were soon linked to HIV infection and subsequently to AIDS.<sup>2</sup> Over the next 25 years, international responses cycled through a number of compartmentalized strategies of identification, treatment, or prevention. Each domain was in part driven by the underlying urgency to develop efficient responses to generalized epidemics or preventing the rapid expansion of concentrated epidemics and their diffusion to new populations. These approaches coupled with the need to garner

international support from governments and civil society lent them to a “crisis” paradigm where the threat of rapid epidemic growth of HIV/AIDS was presented as the consequence of inaction. Although the crisis paradigm was instrumental in mounting an unparalleled global public health response in the first quarter century of the epidemic, the limits of this strategy have become evident, particularly in low prevalence scenarios.

International consensus has recently shifted from viewing HIV prevention in discrete areas to a more fluid understanding that effective responses require combinations of strategies and a long-term perspective that abandons the crisis paradigm, recognizes that a diversity of factors shape local epidemics, and maintains momentum for prevention.<sup>3–5</sup> There has also been an emerging recognition that HIV/AIDS is a *social* disease that cannot be effectively controlled by relying solely on biomedical or behavioral strategies focused on individuals. Transmission of HIV is increasingly recognized as a social event that is regulated by the environments from which risks emerge.<sup>6</sup> Behavioral HIV prevention science has been slow to adopt this conceptual framework. Twenty-five years of social and cognitive research largely focused on individual behavior<sup>7</sup> and was unable to produce interventions that result in durable behavioral change to reduce incidence of HIV infection.<sup>8</sup> Focus on individual behavior change has not resulted in a comprehensive evidence base that demonstrates the ability to reduce country-level or community-level HIV incidence. This theoretical approach has several limitations, the most significant being the assumption that individuals have greater agency in minimizing their social and health risks than they in fact do. In low prevalence scenarios where the urgency of a generalized population epidemic is absent, focusing on individual behavior allows policy makers to relegate social determinants of risk to lower priority or ignore them altogether.

Biomedical science has not been much more successful in accounting for the environments in which treatment and preventative interventions operate. Behavior accounts for the vast majority of HIV transmission globally. Despite the fact that all currently available biomedical prevention and treatment technologies (and the most promising investigational technologies) significantly rely on behavior (eg, drug adherence, consistent condom use), the field’s recognition of the *biosocial* aspects of HIV disease is still in its infancy.<sup>9</sup>

Understanding the intersections of epidemiology, behavioral risk, culture, economics, governance, and gender are critical to effective HIV/AIDS prevention in low prevalence scenarios. Collectively, these factors influence behavior

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and shape individual risk. Herein we review salient issues in biomedical and behavioral HIV prevention from the first 25 years of global response. We then turn our attention to new conceptual frameworks that emphasizes multifaceted approaches and place HIV prevention, particularly for low prevalence scenarios, firmly within a broader context of addressing societal challenges.

### Behavioral and Biomedical Interplay

In recent years, much attention has focused on women's ability to negotiate the terms of their own sexual protection.<sup>10–12</sup> Years of observing condom utilization and social research have established that for *those who have the ability* to decide whether or not to use a condom, individual risk perception significantly impact the decision to use them.<sup>13</sup> Several researchers have demonstrated that women's lower power in a relationship reduces condom use and the ability to decrease sexual risk.<sup>14–16</sup> Others have demonstrated that involvement in a relationship has equal, if not greater, predictive value of women's sexual risk exposure.<sup>17–19</sup> Condom use may also be inscribed with cultural constructions of masculinity and female fertility. For example, in the Middle East and North Africa (MENA) region, where religious values explicitly prohibit sex outside marriage, condom use may be interpreted as marker of deviance from cultural values.

In cultures or scenarios that limit a woman's ability to negotiate the terms of sex, female-controlled HIV prevention technologies would offer some level of protection. The search for a female-controlled HIV prevention technology has been elusive. A Phase III diaphragm and Replens gel study led by Padian et al<sup>20</sup> failed to demonstrate efficacy in reducing risk of HIV infection. Microbicides are loosely defined as vaginal or rectal gels or devices that when applied inhibit the transmission of HIV during sexual intercourse. Several compelling arguments for the development of microbicides exist. Among these, the potential for a successful microbicide to offer a female-controlled HIV prevention technology has garnered much enthusiasm. Regrettably, microbicide development has had several disappointing setbacks in the recent years. Phase III efficacy studies of nonoxynol-9 were reported to increase HIV infection.<sup>21,22</sup> Similarly, Phase III studies of *Cellulose Sulfate* and *Carraguard*, both promising microbicide candidates, were halted for either possibly increasing risk (*Cellulose Sulfate*)<sup>23,24</sup> or lack of efficacy (*Carraguard*).<sup>25</sup>

Although these results are disappointing, important shifts in microbicide research relating to gender and negotiating terms of sex have occurred. These relate primarily to widening the view of prevention to acknowledge structural factors that may limit a woman's ability to negotiate terms of sex.<sup>26</sup> Most notably, the field recognized a need to move away from coitally dependent products to longer acting products, like vaginal rings that slowly release microbicides. Unlike first-generation and second-generation products, longer acting products may increase a woman's ability to protect herself by distancing application of the technology from the coital act.<sup>27</sup> The success of an efficacious vaginal microbicide will depend on the actual ability to use it. In regions where large disparities in sexual negotiating power exist or social acceptability of

contraceptive devices and condoms are already low, even a biologically successful microbicide may not provide women the sought after protection, as it can do little if anything to encourage agency over sexuality or mitigate the social terms in which sex occurs.

By early 2007, 3 randomized controlled trials of male circumcision all reported an approximate 50% reduction in HIV transmission from female to male participants.<sup>28–30</sup> Although in the Rakai, Uganda trial, observational data suggested that circumcision might also protect against transmission from HIV-positive men to their wives, a substudy looking at just this phenomenon was stopped early for futility. The data that were available suggested that among those men who were HIV positive, circumcision did not seem to affect the rate of transmission of HIV to their wives. The effect of male circumcision on regional low prevalence may be more a complicated relationship that is dependent on multiple social factors and transmission mode (ie, heterosexual, homosexual, injecting drug users). For example, near universal circumcision may be a contributing factor to the low prevalence in the MENA but may have limited effect in Latin America where circumcision rates are low and the primary mode of transmission is not heterosexual transmission.<sup>31</sup> Amidst the enthusiasm and initial steps to make the intervention available in the most heavily HIV-burdened countries, and although women are expected to benefit indirectly at a population-level from reduced HIV and genital ulcer disease (GUD) prevalence in men, there are widespread concerns regarding new risks posed to women (risk compensation). Gruskin<sup>32</sup> aptly captures these concerns, writing, "Male circumcision having been found to be protective of the penetrating partner during vaginal sex, the potential decline in that partner's risk perception has clear implication for the receptive partner's ability to negotiate condom use."

Sexual transmission of HIV is also known to be higher in the presence of sexually transmitted infections (STIs).<sup>33,34</sup> The most significant STIs related to higher transmission rates of HIV are genital ulcerative diseases such as syphilis, chancroid, and herpes simplex virus-2 (HSV-2). The World Health Organization estimates that low-income and middle-income countries carry the heaviest burden, particularly those in sub-Saharan Africa and Asia. One meta-analysis estimated that HSV-2 is associated with a 3-fold increase in risk of HIV transmission, and that in Southern Africa between 38%–60% of new HIV infection in women and 8%–49% in men could be attributable to HSV-2.<sup>35</sup> Two Phase III trials testing the impact of HSV-2 suppression with acyclovir on HIV infection also unfortunately showed no effect.<sup>36,37</sup> In the United States—a low prevalence country—STIs have made a resurgence in recent years among communities experiencing concentrated HIV epidemics.<sup>38</sup>

Knowledge of one's serostatus is the cornerstone of providing antiretroviral (ARV) prophylaxis. Voluntary counseling and testing (VCT) is widely recognized as a critical entry point to HIV prevention services, treatment, and linkage to care. In settings where ARV therapy is available, early diagnosis of HIV infection and rapid linkage to care results in significantly reduced morbidities and mortality. Where ARV therapy is unavailable, early diagnosis still provides both

medical and behavioral advantages in reducing HIV transmission. A 2007 report jointly commissioned by the World Health Organization, The Joint United Nations Programme on HIV/AIDS, and United Nations Children's Fund indicates that in high prevalence countries, just 12% of men and 10% of women know their HIV status and globally an estimated 80% of people living with HIV are unaware of their status.<sup>39</sup> Even in low prevalence settings like the United States, approximately one quarter of HIV-infected individuals do not know their serostatus.<sup>40</sup> In more than 70 surveyed low-income and middle-income countries that reported data for 2005, only 10% of pregnant woman had received an HIV test.<sup>39</sup> Not only do those who are unaware that they are HIV infected benefit from early treatment but they may also be inadvertently infecting others.<sup>41,42</sup>

VCT is a behavioral modification strategy that assumes high-risk HIV transmission behavior can be reduced by informing individuals of their HIV serostatus in the context of specialized counseling, then linking them to ongoing support services and care. VCT is internationally accepted in both high and low prevalence regions as an important component of HIV prevention and is almost universally accepted as an entry to treatment and care, and this point tends to overshadow the intervention's actual efficacy in behavioral risk reduction.<sup>43</sup>

Much is still unknown about VCT's ability to achieve the goal of sustained behavioral risk reduction in a variety of epidemiologic contexts in which it is employed. Many of the early assumptions about VCT's ability to change behavior came from developed countries with concentrated epidemics. As previously mentioned, sustained behavior change is difficult to achieve. Meta-analysis in developing countries shows limited sustainable impact in most groups, the notable exception being serodiscordant couples.<sup>43</sup> Traditional VCT is resource intensive, and provider-initiated "opt out" counseling and testing is yet unproven and adds additional burden on health providers, an effect which may be considerably more pronounced in resource-limited settings.<sup>43</sup> The strategy's ability to connect individuals to treatment and reduce risk behavior depends, "... in large part on the extent to which fears of testing are overcome, adverse consequences of disclosure are avoided, and providers can connect clients to appropriate treatment and prevention services."<sup>44</sup> Reducing these barriers are all functions of the local environments that give rise to stigma and the structures that support or limit human rights.

Mahajan et al<sup>45</sup> have highlighted that HIV-related stigma is linked to higher risk behaviors in a range of low and high prevalence scenarios.<sup>46</sup> Only 6 of 10 countries in the world have laws and regulations that prohibit discrimination against people living with HIV, and even for the states that have antidiscrimination laws, major obstacles persist in implementation. Equally troubling is the United States—the largest governmental contributor to international HIV/AIDS prevention and care—which has persistently lobbied to drop the term "human rights" from international consensus documents about HIV/AIDS.<sup>47,48</sup> In most countries, health professionals are taught neither about human rights nor about meaningful understanding of how stigma contributes to elevated population health risks.<sup>49</sup> In the absence of basic tenants of human rights, instruments to enforce them, and training of health

professionals, stigma gives rise to discrimination, further isolating populations most burdened.

## Framing Structural Issues and Interventions in Low Prevalence Scenarios

Why is it so imperative that we address structural factors and embrace the long-wave effect of HIV in a low prevalence scenario? Until recently, the response to this question has focused on the threat of epidemic explosion: emerging HIV epidemics have long latency periods, and as is often the case during this latency, the unaddressed epidemic of HIV has cascading negative effects as the virus grows within concentrated risk groups or disperses from risk groups to the general population.<sup>50</sup> Research and prevention efforts emerging from this paradigm have focused largely on immediate behavioral and biomedical risk factors while ignoring the social determinants of risk. Although examples exist of countries or no populations with early perceived low risk that were slow to respond to the long-wave nature of HIV—China and India, for example—which now find themselves in burgeoning epidemics, emergence of generalized population epidemics are less likely for much of the world. It is now clear that a range of epidemiological possibilities other than generalized epidemics can emerge from low prevalence scenarios.

Although several social scientific fields have explored the influence of structural factors on individuals and communities for some time,<sup>51–55</sup> the field of HIV prevention has only recently began to employ structural framing into its understanding, analysis, and interventions. As the field's acceptance that health risks are a function of the context in which they emerge widens, reference to "structural factors" or "structural interventions" is increasingly common in scientific literature. Yet the usage is frequently loose and employed as a proxy for a range of undefined issues. Often the term "structural" is used as a method of acknowledging factors with greater scope than individual failings without substantive discussion of what these factors are and how they operate.

Simply stated, HIV/AIDS structural interventions attribute the production of sexual and drug risk to contextual factors—social, political, and economic—rather than to individuals engaged in risk behaviors. Blankenship et al<sup>52</sup> explain that, "individual-focused approaches assume that the relationship between individuals and society is one in which individuals have considerable autonomy to make and act on their choices, but structural approaches view individual agency as constrained or shaped by structures." Interventions focusing on individual behavior, although possibly resulting in immediate individual change, have limited population-level impact because they do not address the underlying social production of risk and how it is reproduced generationally through populations. Although individual-based interventions can be implemented relatively easily, this is not the case with structural interventions, which often require major changes in law, policy, or complex social processes.

The processes that put some groups at greater risk while conferring privilege on others are often invisible both to those to whom that privilege is conferred<sup>56</sup> and to those who shoulder the burden of risk. Garnering support for structural

interventions is often difficult because those privileged by the inequity have the luxury not to think about it and those burdened are influenced by a number of social forces that often render them complicit in their own subordination. For example, one of the social dividends men gain from their positions is not having to think about gender.<sup>56</sup> The difficulty in characterizing social determinants and designing interventions that address them is that they operate *invisibly* and have pervasive influence. This is particularly relevant in low prevalence scenarios where allocating resources to intervention focusing on immediately visible HIV/AIDS risk factors may be less convincing than other public health and social needs. Structural models characterize HIV vulnerability as a product of a web of normative social forces—and it is because these forces are normative components of a culture, their impact on elevating HIV risk is difficult to change.

Social scientists have developed models explaining the mechanisms in which inequalities become ingrained in the political and cultural structures of societies and become resistant to change. In discussing racial disparities, Roithmayr<sup>57</sup> describes a “lock-in” model in terms of persistent monopoly power that continues long after the original anticompetitive behavior has ceased. Roithmayr<sup>57</sup> explains that once early asset advantage becomes locked in through self-reinforcing institutional processes it becomes resistant to change even after the institutional advantages are formally removed. For example, in societies that have had long-standing political and legal structures supporting the dominance of men, these dividends get ingrained into normative culture and males continue to reap dividends of their gender long after the legal or political structures that granted them are removed. In these scenarios, elimination of a visible barrier may be insufficient to ameliorate larger inequities. For example, removing barriers that prevent girls from receiving education and the relationship to women’s labor force access can illustrate how locked-in structural forces can continue disparities.

Providing girls with primary and secondary education has received considerable international attention as a means of reducing a range of gender disparities by increasing social mobility and labor force participation; reducing fertility rates and child mortality; and reducing vulnerability to HIV, STIs, and a host of negative health outcomes.<sup>58</sup> Most countries in the Middle East have made significant progress in closing the gender gap in primary and secondary education, and 9 countries have eliminated the gap.<sup>59</sup> Nevertheless, eliminating disparities in educating girls in the MENA region not resulted in reducing gender disparities in labor market access as it has in other regions. The World Bank reports that between 2000 and 2006, women’s labor force participation in the MENA region only increased from 28% to 32% and remains the lowest region in the world.<sup>59</sup> Despite the elimination of formal barriers to girl’s education, limited social mobility and devaluation of women in the MENA region diminishes the beneficial effect of education on labor market access. In the case of labor market access, coupling multiple structural interventions that work in concert may be required to achieve a range of benefits any single intervention could not accomplish alone.

Microfinancing interventions for women in societies with persistent gender disparities may be one example of

a structural intervention that coupled with education could catalyze a range of benefits including access to labor markets, increased social mobility, and wider health benefits.<sup>60</sup> These strategies would link interventions over a life course—primary and secondary education for girls, credit programs, and tertiary or skills education for women—that place HIV/AIDS risk reduction in low prevalence regions firmly within a wide range of societal benefits.

A lock-in model suggests that because risk behaviors are rooted in a web of long-standing sociocultural structural factors, they become resistant to modification and require a considerable amount of corrective intervention even in the *absence* of immediate factors contributing to risk environment. Low prevalence is an unreliable marker of risk. Reducing HIV transmission risk in low prevalence scenarios may be part of a larger project of societal transformation in which the targets of interventions are not limited to immediate risk behaviors. Epidemiologically, because latency period of burgeoning epidemics is long and can go undetected at a population level for years, by the time undeniable signs of the epidemic become visible, the consequences of having more people infected reach well beyond a simple biomedical treatment model.

Similarly, Barnett<sup>50</sup> has described HIV in terms of a *long-wave event*, one in which the large-scale effects emerge gradually over time. Short-wave events, Barnett explains, reveal what is happening soon after the event begins. Although short-wave events may have some long-term implications, the event itself has short-wave form (eg, a life-taking natural disaster in which survivors are left to bereave and reconstruct their lives without those killed). In contrast, long-wave events characterize themselves by their early invisibility. We are often unaware of their starting points, and by the time we become aware of their presence, the event has become *structured* within normative societal conventions and institutional practices. The extent to which a long-wave event—in this case HIV transmission—can operate invisibly within a society, its pervasiveness and population impact is dictated by existing social conventions, local economies, and governance (ie, structural factors). The early invisibility of HIV among marginalized segments of a society and the fact that population-level impacts are not immediately felt made it very difficult to garner support and resources to combat HIV. Nevertheless, the slower moving spread among low-risk groups may lead to large numbers of infected people 5, 10, or 15 years in the future.<sup>61</sup> In low prevalence scenarios, specifically ones in which epidemic thresholds will likely not be reached, the long-wave model is useful for understanding the way in which social determinants of health get entrenched over generations rather than predicting large numbers of new HIV infections. In the case of an infectious disease like HIV, in which transmission is a social phenomenon, the medical and governmental establishments may lack the analytic tools or will to address long-term societal ills that give rise to public health risks. The fact that individuals and community normative behaviors may sanction and often *encourage* these health risks, often mislead policy-makers to support individual-focused responses that have limited population impact. Addressing structural factors that give rise to health risks requires the identification and dismantling of the

institutions that bestow invisible privileges to some and posit dominant groups in positions of power—a difficult process in any societal transformation with progress more likely measured in generations rather than years.

### Governance and National-Level Response

Structural forces that influence health risk emerge from complex webs of sociohistorical processes. Structural processes influencing population-level HIV risks (and those of all epidemics) are intimately related to governance. Indeed, the links between governance and infectious disease has been well documented.<sup>62</sup> Good governance can be a critical facilitator of progressive biosocial responses to public health risks.<sup>9</sup> Governance can also establish or concretize structural forces that not only put populations at immediate social and health risks but also ensure these risks are reproduced generationally by establishing policies that ingrain risk into normative behavior within the most burdened groups.

Uganda is a frequently cited example of the importance of political commitment in addressing the HIV/AIDS epidemic. As early as 1992, Uganda registered a decrease in HIV prevalence, which was attributed to a comprehensive multisectoral HIV campaign that included government at the highest levels.<sup>63–66</sup> Leadership from governmental figures like President Yoweri Museveni and other national stakeholders led to policies encouraging openness about the epidemic and sexual behaviors, policies reducing stigma, and effective identification and treatment programming.

In Thailand, the epidemic became prominent only at the end of the 1980s and then spread rapidly. The early prevention programs in the 1980s were small in scale, disorganized, and in part driven by fear.<sup>66,67</sup> Mandatory reporting of HIV infection gave rise to stigma and breached human rights, until it was finally abandoned in 1991.<sup>68</sup> In the late 1980s, the evidence that the epidemic was growing at explosive rates begin to draw national concern. During this time, prevalence among drug users rose by more than 40% in a single year<sup>69</sup> and sentinel surveys among commercial sex workers in Northern Thailand indicated prevalence rates of around 44%.<sup>70</sup> To the government's credit, top-level political commitment and multisectoral strategies mobilized funds and human resources to implement the control program at all levels.<sup>68</sup> Intensive media campaigns, peer education, workplace programs, lifeskills training for youth, nondiscrimination campaigns, and a 100% condom distribution program in all commercial sex establishments resulted in nearly a 90% decrease in rates of sexually transmitted diseases and nearly an 80% decrease in HIV incidence between the epidemic's peak in the early 1990s and 2001.<sup>66,68,71</sup> Thailand's experience demonstrated that well-coordinated structural HIV interventions could have enormous impact on reducing population risk.

The Brazilian government's HIV/AIDS response is best known for spearheading universal drug access and its comprehensive support of prevention. In 1982, when HIV was first detected in Brazil, the epidemic initially spread rapidly among men who have sex with men and then among injecting drug users after which a wave of heterosexual transmission exploded.<sup>72</sup>

Since 1996, the Brazilian government has provided free and universal access to highly active ARV treatment for all its citizens. The model has led to sharp declines in AIDS-related mortality since first introduced<sup>73,74</sup> and has improved the health of tens of thousands of Brazilians. The program is estimated to have saved the country an estimated \$2.2 billion in hospital costs between 1996 and 2004.<sup>75</sup> Brazil's model has affected ARV prices around the globe by setting important precedents for price negotiations and tiered pricing schemes for other developing countries.<sup>76</sup> Brazil has also had an aggressive and candid emphasis on prevention from early in the epidemic. Okie<sup>75</sup> best captures the magnitude of Brazil's prevention effort, writing: "At the beginning of the 1990's, the epidemics in Brazil and South Africa, both ranked middle-income countries, were at a similar stage, with prevalence of HIV infection of about 1.5% among adults of reproductive age. But by 1995, the year before Brazil's treatment program was established, the HIV epidemic in South Africa had begun to explode, with prevalence already greater than 10%, whereas the infection rate in Brazil had declined by half."

What has been learned from the most successful national responses? Effective responses have occurred in comprehensive frameworks that include partnerships between government, nongovernment organizations, business, and importantly, active participation from civil society and affected communities that are sufficiently empowered to hold all sectors accountable for commitments to public health and risk reduction. All successful responses that respect human rights have centered on community involvement in prevention, treatment, and scale-up. Successful responses form synergies between researchers, educators, and communities. Finally, critical to achieving sustained effectiveness in HIV prevention is the recognition of the fluidity and disparate patterning of behavior.<sup>77</sup>

### LOCAL DETERMINANTS, LOCAL EPIDEMICS

The first wave of responses to the global HIV epidemic repeatedly stumbled as the field of prevention science relied heavily on models for transmission derived from developed countries. Chris Beyrer summarized the shortcomings of this approach when asked to generalize what populations are most at risk, "The focus has often been on high-risk groups. That is an unfortunate outcome of the way the epidemic looked in the West. For example, in central southern Africa—who is at high risk? Young women of childbearing age and all heterosexual men, and we put those 2 pools together and you have a tremendous percentage of the population. Are they at high risk? Yes! They don't have to be sex workers or to have had a blood transfusion. That is a function of the fact that once this virus gets out of high-risk population, and begins to spread in general populations, the risk for everybody who is sexually active goes up in a heterosexual epidemic."<sup>78</sup> Simply, Beyer is emphasizing that every sexually active person is at risk—not just drug users, prostitutes, men who have sex with men, and promiscuous people. The limits of relying on models developed outside the context of a specific epidemic—even when local epidemiological data are used—is further demonstrated by considering the Ugandan and Thai experiences.

Having comprehensive HIV surveillance data is the foundation of good prevention, but understanding *local*

context that gives rise to this data is of equal, if not greater, importance. A prime example is the process by which the Ugandan epidemic came to be understood. In her book, *The Invisible Cure: Africa, the West, and the Fight Against AIDS*, Epstein<sup>79</sup> explains how transposing Western assumptions about sexual behavior and risk onto the Ugandan and Thai epidemics confounded investigators and delayed some of the most locally relevant effective prevention strategies. The key difference between Uganda and the United States, Epstein<sup>79</sup> explains, is that heterosexual Americans tend to have several long-term sequential relationships over a lifetime. Ugandans—although not having more overall lifetime partners or behaving more promiscuously than their American counterparts—participated in sexual *concurrency* that involves overlapping relationships. The biological phenomenon of heightened infectivity (acute infection) shortly after a person is infected allows concurrency to function as a superhighway for HIV transmission. Serial monogamy on the other hand has a lower risk of transmission insofar as the time elapsed between the start of one relationship and the next allows the virus time to cycle through its acute infectivity period before a new relationship is initiated.

The Thai experience as well did not fit the Western model for transmission, but concurrency was also not an explanation. Most Thai men who were married had only one long-term relationship with their wives. However, many Thai men indicated that they had routine sex with prostitutes. Before Thailand's policy of 100% condom coverage in brothels, this put commercial sex workers, men, and the wives they returned to at great risk.

Mismatched risk models and epidemiological data do not just occur between developed and developing countries, as often they occur within a country or region; the United States serves as a prime example. In recent years, the US domestic policy about undocumented labor migrants from its border state Mexico has, among many arguments, cited infectious disease threats posed to the United States. Not surprisingly, a growing body of research on the Mexican states, from which the greatest numbers of people migrate illegally to the United States, suggests that these populations are at greatest risk for HIV infection and other sexually transmitted diseases while in the United States and that they are in fact adding to the burden of disease in Mexico when they return to their families.<sup>75,76</sup>

## CONCLUSIONS

In low prevalence scenarios and concentrated epidemics, the limits of compartmentalized behavioral and biomedical approaches to HIV prevention are apparent. Transmission and prevention are no more functions of viral pathogenesis than the context in which local epidemiologies are shaped. Gender disparities, culture, economics, governance, and other social phenomena form the environment from which HIV vulnerability emerges. These factors function in concert with one another, intertwined and simultaneously shaping one another. Despite a convincing body of evidence accumulated over the past 2 decades indicating behavioral and health risks are shaped by collective structural factors, until recently, most interventions have focused on individual behavior

modification. Not surprisingly, public health strategies that do not account for the context in which risk emerges, have had limited sustainable success.<sup>77,80,81</sup>

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