Special Issue: Sexual Acquisition and Transmission of HIV Cooperative Agreement Program (SATHCAP), July 2009

Commentary

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Researchers would love to explain the HIV/AIDS epidemic, but remembering Einstein's famous dictum, "make everything as simple as possible, but not simpler", we are unlikely to be graced with a simple answer to this profoundly complex human event. For many of the explanations we seek—how the disease is transmitted, how it is propagated, how human and viral dynamics are related, what the underlying biologic and immunologic mechanisms are, what the structural features that facilitate or obstruct transmission are—"as simple as possible" is not yet in sight.

The Sexual Acquisition and Transmission of HIV Cooperative Agreement Program (SATHCAP), funded by the National Institute on Drug Abuse at the National Institutes of Health, addressed one of these fundamental issues: whether HIV among high-risk groups is diffusing to lower-risk groups, such as from men who have sex with men (MSM) or from men and women who use drugs to heterosexuals who do not use drugs. SATHCAP was conducted in three US locations with moderate to high HIV prevalence (Chicago, Los Angeles, and the Raleigh-Durham region of North Carolina) and in St. Petersburg, Russia, an area of rapidly increasing HIV transmission among injecting drug users (IDU) and their sex partners.¹ Each research site recruited drug users and MSM using Respondent Driven Sampling, a method that has been devised to produce unbiased estimates of group characteristics (see Iguchi et al. in this issue²). SATHCAP is one of the few studies to look explicitly at potential mechanisms of HIV dissemination among, and from, traditional high-risk groups.

The answer from these four study sites seems to be "Yes, but...". As the papers in this Special Issue show, each site was able to demonstrate a plausible pathway—the metaphorical "bridge"—from high- to low-risk persons, yet each pathway also took a different route that varied in complex details along the way.

Starting with the target Most studies start with the high-risk persons themselves. In St. Petersburg, Russia, where the prevalence among IDU now exceeds 40%, investigators focused not only on those at high risk but also on women diagnosed with HIV outside the usual venues for HIV care (see Toussova et al., this issue³). They found that only 33% of these women had had sexual contact with an IDU during their lifetime. The risk factors for such contact were younger age (< 26 years

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old), lower level of education, and recent alcohol use. The proportion of IDU contacts declined over the course of the study, from 43% in 2007 to 21% in 2008, suggesting to the investigators that women were increasingly at risk for heterosexually transmitted HIV. In a separate analysis (see Niccolai et al., this issue⁴), investigators examined the non-drug-using partners of IDU and found that in the previous 6 months, many reported having multiple sex partners (48%), new partners (66%), non-drug-using partners (68%), and frequent unprotected sex at last intercourse (60%). Ninety-one percent reported at least one of these risks and 15% were HIV positive. Thus, the pathways for HIV to spread from higher to lower-risk groups were clearly established and involved both injection drug use and sexual transmission, with the latter more likely occurring outside the drug-using network.

Sex acts by orientation Of the 1,044 men studied in North Carolina, 74% reported sex only with women (MSW), 17% reported sex with both men and women (MSMW), and 9% reported sex only with men (MSM; see Bobashev et al., this issue⁵). These three groups differed in several important ways. Fifty-four percent of MSMW had a history of ever injecting drugs during their lifetime, compared to 32% of MSW and 20% of MSM. Almost 30% of MSMW reported anal intercourse with female partners compared to 15% of MSW. The same proportion of MSMW had unprotected insertive anal intercourse (26.9%) with men as did MSM (26.8%), although the former reported half as much unprotected receptive anal intercourse (15.4% vs. 34%). For MSMW, the odds ratio of reporting having unprotected intercourse with women was 4.61 (95% CI, 1.72, 12.38) for those who had unprotected anal intercourse with male partners compared to those who did not. These findings established that, in Raleigh-Durham and surrounding counties, a sizable group of men, half of whom had injected drugs at some time, were having sex with both men and women, including frequent unprotected anal intercourse with both male and female partners. While details on the sexual activity of female partners are not available in the paper, it clearly establishes a pathway of HIV transmission to women by way of male-to-male sexual activity.

Sex with both The heterogeneity of sexual orientation was fully apparent in Chicago, where over 70% of MSM also reported having recent sex with women. In the past 30 days, MSMW were less likely to have had sex with a female partner than were MSW and less likely than MSM to have had sex with a male partner. Yet, among those who were sexually active with a female partner in the past 30 days, MSMW were more likely to have had anal sex and less likely to have had vaginal sex with their female partners compared with MSW. Among those sexually active with men in the past 30 days, MSMW were less likely than MSM to have had receptive anal sex, but there was no difference in likelihood of insertive anal sex between MSM and MSMW. MSMW reported considerable concurrency of male and female partners. In addition, over 50% reported that they have anal sex with other men, and 70% reported that they have unprotected anal and vaginal sex with women. Most (70%) MSMW had not told their female partners about their bisexual behaviors. There was a notable discordance between the use of heroin, cocaine, or amphetamine in the past 30 days reported by MSMW (88%) compared to the 71% of their sex partners who reported ever having used these drugs. The heterogeneity of sexual orientation, sexual risks, and drug use behaviors found among these respondents demonstrates how the pathways for HIV transmission from higher- to lower-risk groups appear to be increasingly complex and multidimensional.

Not everywhere Of the 1,125 men recruited into the study from Los Angeles County, 41% were MSMW and 21% were MSW. The investigators describe a group of impoverished, largely minority, frequently homeless men whose male and female sex partners were also impoverished, used drugs, and engaged in risky sex. The extensive drug and sex interconnections among members of these groups appeared to be socially, behaviorally, and geographically bounded, with few if any outward connections to lower-risk groups. The insularity of these groups, coupled with their high levels of drug use and sexual risk behaviors, may explain their high observed prevalence of HIV yet also suggest why so little evidence was found for HIV dispersion to lower-risk persons.

For HIV to be transmitted from higher- to low-risk groups, those at high risk must have effective contact with those at low risk, who in turn must have effective contact with others at low risk. SATHCAP focused on MSM and drug users, including non-IDU (high risk), their sexual contact with women who do not use drugs, and the contact of those women with other men who are outside the MSM/drug-using nexus. Bridging, the most commonly used metaphor for this phenomenon,⁶⁻¹⁸ may well be a misnomer since it is a sequence of social contacts and interactions rather than an act. That is, a complex set of events must occur, as was shown by three of the four SATHCAP research sites. At the fourth project site, Los Angeles, the sequence of events is no less complex but the pathways appear to be, at least for this participant population, recursive.

Although the SATHCAP was not designed to demonstrate actual transmission along pathways from high to low risk, its findings do accord with those reported in recent years by the Centers for Disease Control and Prevention on the proportion of transmission that may be attributed to heterosexual HIV exposure. The “high-risk heterosexual contact” transmission includes sex with an IDU, sex with a bisexual male, sex with a person with hemophilia, sex with an HIV-infected transfusion recipient, and sex with an HIV-infected person, risk factor not specified.¹⁹ From 2004 to 2007, there was a 9% increase in annual HIV diagnoses attributed to high-risk heterosexual contact among males and a 14% increase among females.¹⁹ Commentary provided by the CDC observes the uncertainty with some of these estimates, yet it is not possible to rule out an actual increase in numbers of new infections. Such would be consistent with the findings from at least three of the four SATHCAP sites on high-risk heterosexual contact as a major pathway from higher risk groups to lower-risk women. That the fourth site (Los Angeles) did not find such a pathway may be revealing: The most intractable endemicity in that city may not be the source of the wider epidemic there. The papers by Shoptaw et al.²⁰ and Gorbach et al. in this issue²¹ are vital for understanding the Los Angeles findings, and like others, they show how HIV/AIDS propagation depends on a complex mix of heterogeneous communities.²²⁻²³ An overarching theory of HIV transmission would be a boon—as Kurt Lewin remarked, “There is nothing so practical as good theory”²⁴—but until we have one, we should remain wary of making things simpler than possible.

REFERENCES

1. Burchell AN, Calzavara LM, Orekhovsky V, Ladnaya NN. Characterization of an emerging heterosexual HIV epidemic in Russia. *Sex Transm Dis*. 2008; 35(9): 807–813.
2. Iguchi MY, Ober AJ, Berry SH, et al. Simultaneous recruitment of drug users and men who have sex with men in the United States and Russia using respondent driven sampling: sampling methods and implications. *J Urban Health*. 2009; doi:[10.1007/s11524-009-9365-4](https://doi.org/10.1007/s11524-009-9365-4).

3. Toussova OV, Shcherbakova IS, Volkova GV, et al. Potential bridges of heterosexual HIV transmission from drug users to the general population in St. Petersburg, Russia: is it easy to be a female? *J Urban Health*. 2009; doi:[10.1007/s11524-009-9364-5](https://doi.org/10.1007/s11524-009-9364-5).
4. Niccolai LM, Shcherbakova IS, Toussova OV, et al. The potential for bridging HIV transmission in Russian Federation: sex risk behaviors and HIV prevalence among drug users (DUs) and their non-DU sex partners. *J Urban Health*. 2009; doi:[10.1007/s11524-009-9369-0](https://doi.org/10.1007/s11524-009-9369-0).
5. Bobashev GV, Zule WA, Osilla KC, et al. Transactional sex among men and women in the South at high risk for HIV and other STIs. *J Urban Health*. 2009; doi:[10.1007/s11524-009-9368-1](https://doi.org/10.1007/s11524-009-9368-1).
6. Lau JT, Tsui HY, Zhang Y, et al. Comparing HIV-related syringe-sharing behaviors among female IDU engaging versus not engaging in commercial sex. *Drug Alcohol Depend*. 2008; 97(1–2): 54–63.
7. Lau JT, Wang M, Wong HN, et al. Prevalence of bisexual behaviors among men who have sex with men (MSM) in China and associations between condom use in MSM and heterosexual behaviors. *Sex Transm Dis*. 2008; 35(4): 406–413.
8. Xu JJ, Wang N, Lu L, et al. HIV and STIs in clients and female sex workers in mining regions of Gejiu City, China. *Sex Transm Dis*. 2008; 35(6): 558–565.
9. Duong CT, Nguyen TH, Hoang TT, et al. Sexual risk and bridging behaviors among young people in Hai Phong, Vietnam. *AIDS Behav*. 2008; 12(4): 643–651.
10. Adimora AA, Schoenbach VJ, Doherty IA. HIV and African Americans in the southern United States: sexual networks and social context. *Sex Transm Dis*. 2006; 33(7 Suppl): S39–S45.
11. Hesketh T, Zhang J, Qiang DJ. HIV knowledge and risk behaviour of female sex workers in Yunnan Province, China: potential as bridging groups to the general population. *AIDS Care*. 2005; 17(8): 958–966.
12. Tucker JD, Henderson GE, Wang TF, et al. Surplus men, sex work, and the spread of HIV in China. *AIDS*. 2005; 19(6): 539–547.
13. Miller GA, Mendoza W, Krone MR, et al. Clients of female sex workers in Lima, Peru: a bridge population for sexually transmitted disease/HIV transmission? *Sex Transm Dis*. 2004; 31(6): 337–342.
14. Lowndes CM, Alary M, Meda H, et al. Role of core and bridging groups in the transmission dynamics of HIV and STIs in Cotonou, Benin, West Africa. *Sex Transm Infect*. 2002; 78(Suppl 1): i69–i77.
15. Tabet S, Sanchez J, Lama J, et al. HIV, syphilis and heterosexual bridging among Peruvian men who have sex with men. *AIDS*. 2002; 16(9): 1271–1277.
16. Gorbach PM, Sopheab H, Phalla T, et al. Sexual bridging by Cambodian men: potential importance for general population spread of STD and HIV epidemics. *Sex Transm Dis*. 2000; 27(6): 320–326.
17. Lowndes CM, Alary M, Gnintoungbe CA, et al. Management of sexually transmitted diseases and HIV prevention in men at high risk: targeting clients and non-paying sexual partners of female sex workers in Benin. *AIDS*. 2000; 14(16): 2523–2534.
18. Morris M, Podhisita C, Wawer MJ, Handcock MS. Bridge populations in the spread of HIV/AIDS in Thailand. *AIDS*. 1996; 10(11): 1265–1271.
19. Centers for Disease Control and Prevention. HIV/AIDS Surveillance Report, 2007. Vol. 19. Atlanta: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention; 2009.
20. Shoptaw S, Weiss RE, Munjas B, et al. Homonegativity, substance use, sexual risk behaviors and HIV-status in poor and ethnic men who have sex with men in Los Angeles. *J Urban Health*. 2009; doi:[10.1007/s11524-009-9372-5](https://doi.org/10.1007/s11524-009-9372-5).
21. Gorbach PM, Murphy R, Weiss RE, et al. Bridging sexual boundaries: men who have sex with men and women in a street-based sample in Los Angeles. *J Urban Health*. 2009; doi:[10.1007/s11524-009-9370-7](https://doi.org/10.1007/s11524-009-9370-7).
22. Holmberg S. The estimated prevalence and incidence of HIV in 96 large US metropolitan areas. *Am J Public Health*. 1996; 86: 642–654.

23. Cooper HLF, Brady JE, Friedman SR, Tempalski B, Gostnell K, Flom PL. Estimating the prevalence of injection drug use among black and white adults in large U.S. metropolitan areas over time (1992–2002): estimation methods and prevalence trends. *J Urban Health*. 2008; 85(6): 826–856.
24. Lewin K. Field theory in social science: selected theoretical papers. New York: Harper; 1951.