Making Progress in Understanding the Uneven Distribution of HIV Infection: Lessons Learned from the Priorities for Local AIDS Control Efforts "PLACE" Method

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Background

Relatively simple epidemiologic models of the HIV epidemic identify key determinants of the size and shape of HIV epidemics. However, complete and valid empiric data on these parameters at the population level have proven difficult to obtain. According to the people who model epidemics, the models have outstripped the data. We know what data would be useful-- for example, a mixing matrix of who has sex with whom, when, and how often, by HIV status-- but obtaining this sensitive information is not achievable given that many people cannot or will not accurately report specific details on sexual partnerships and HIV status. On the other hand, detailed data from population-based household surveys, HIV surveillance data, and targeted behavioral surveys have been obtained at great cost but current mathematical models cannot readily interpret trends in these data. Models are designed to explore relationships and patterns in a methodical way moving from a simple set of assumptions to a more complex scenario over time. They are not generally designed to move in the opposite direction-- to distill simple patterns from complex empiric data.

The public health response has had to grapple with mixed messages that arise from this data-model gap. The insights from conceptually pure but artificial models do not necessarily coincide with findings from "real" data with all of its complexity, errors and bias. The need for pragmatic public health action to reduce transmission has sparked efforts to close the data-model gap including efforts by modelers to identify measurable parameters that can be obtained in populations and efforts by empiric researchers to improve the measurement of the parameters most critical to the models. Closing the data-model gap should provide insights into the determinants of the current uneven spread of HIV.

In this paper, we present progress in developing a strategy to close part of the data-model gap. This method called "PLACE" was designed to improve measures of factors affecting the probability of exposure to HIV, a critical determinant of the HIV epidemic according to one model of the HIV epidemic ($R = B * c * D$). In the simplest version of this model, the likelihood that an HIV epidemic will succeed or fail is based on the average number of secondary infections generated by an index case. This reproductive number is determined by three factors: "c"-- the probability of exposure to HIV, "B"-- the probability of transmission given exposure, and "D" the length of time that an infected person remains infectious. In more complex models, determinants of each of these three factors have been identified. The determinants of the probability of exposure to infection include the age of sexual debut, the rate of new sexual partner acquisition, the extent to which partnerships are concurrent, and the extent to which sexual mixing between strata occurs.

Conceptually, the rate of new sexual partner acquisition may be more important early in an epidemic, mixing and the age of sexual debut in determining the peak of the epidemic, and concurrency to determine the level at which the endemicity is achieved.

The method most commonly used to obtain population based indicators for demographic or health outcomes at the national level are Demographic and Health Surveys (DHS). DHS surveys obtain population based indicators of many demographic and health parameters including the rate of new sexual partner acquisition, concurrency, and sexual mixing. Face to face interviews are conducted with members of a representative sample of selected households. Respondents are contacted at households with follow-up visits scheduled to obtain data from people not initially at home. The estimates are designed to be adequate at the national level for men and women and by urban and rural status but not otherwise at sub-national levels except where over-sampling of households was done to ensure a sufficient sample size.

Understanding the uneven pattern of HIV infection in a country, however, is constrained considerably if sub-national differences in factors affecting the probability of exposure and transmission are not available. Empiric evidence from surveillance data collected from antenatal clinics throughout a country suggest that multiple HIV epidemics may persist within a country and that national estimates of key parameters such as those affecting the probability of exposure to HIV may mask important differences within a country that are key to understanding the future course of HIV in the country. In addition, although an estimate of the proportion of the national population with a new sexual partner in the past year can be obtained from DHS surveys, a full description of the characteristics of those with new or concurrent partnerships is constrained because the vast majority of people interviewed in DHS surveys do not report multiple or new partnerships. In fact, DHS data may underestimate the proportion of people who have a new sexual partner as people may be unwilling to report extra-marital and non-marital partnerships when interviewed in a face to face interview at home.

Methods

The PLACE “Priorities for Local AIDS Control Efforts” Method obtains additional data on factors affecting exposure to HIV that complements data obtained from national household surveys. The method does not obtain national data but focuses on supplementing national data with local data from key areas of the country where HIV transmission is likely to be greatest. It does not obtain data from households but from people socializing at public venues where new sexual partnerships are formed. These venues are systematically identified by a process of interviewing hundreds of community informants in the area about the location of venues where people meet new sexual partners. Venues are characterized and mapped. At a sample of venues, a sample of people socializing are asked how many sexual partners they have had in the past 4 weeks and past 12 months, how many of these were new sexual partners, and whether they have met a new partner at the venue. Two estimates of new partnerships are obtained that complement national DHS findings: the proportion of respondents with a new sexual partner in the past 4 weeks and the proportion with a new partner in the past 12 months. An estimate of concurrency is obtained from the proportion reporting two or more partners in the past 4 weeks. One measure of sexual mixing is obtained by assessing the extent to which people report meeting a new sexual partner at venues and using reported venue visiting behavior to identify venues linked via sexual partnerships formed by venue patrons.

Results

Estimates of the proportion of the population socializing at PLACE venues who have either a new or concurrent sexual partnership are presented in Table 1 for 13 study locations (Table 1) where PLACE has been implemented. These figures are much higher than comparable data from national surveys (data not shown).

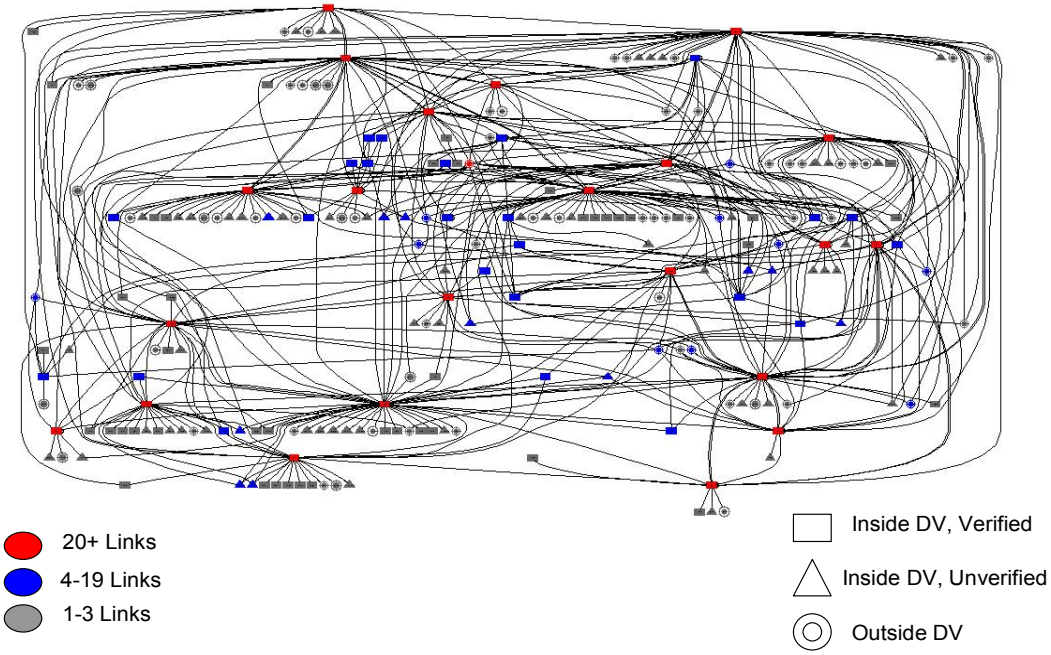
Table 1 New Partner Acquisition, Sexual Mixing, and Concurrency As Reported by People Socializing at Venues Identified as Places where New Sexual Partners are Met

	Number of Interviews at social venues	% reporting a new sexual partner in:		% reporting 2+ partners in the past 4 weeks	% reporting meeting a new partner at venue
		the past 4 weeks	in the past year		
Men					
St. Petersburg, Russia**	1019	50.8	91.5	46.1	44.1
Almaty, Kazakhstan**	1109	42.7	71.0	39.5	26.9
Karaganda, Kazakhstan**	897	42.8	72.4	42.7	29.8
Osh, Kyrgyzstan**	684	28.2	50.4	23.5	26.2
Tashkent, Uzbekistan**	1039	29.2	88.1	30.0	22.1
St. James, Jamaica***	282	18.8	51.4	23.4	19.2
Chetumal, Mexico*	432	35.0	59.0	28.0	20.1
Ciudad Hidalgo, Mexico*	162	21.6	41.4	17.3	21.6
Township in Cape Town, South Africa**	621	50.4	68.6	38.5	42.5
Township in East London, South Africa***	632	23.6	43.3	22.0	25.6
Banfora Health District, Burkina Faso*	582	--	58.8	--	29.2
Tenkodogo Health District, Burkina Faso*	374	--	71.7	--	42.0
Kampala, Uganda*	761	--	70.6		29.0
Women					
St. Petersburg, Russia**	655	31.0	81.9	23.8	27.1
Almaty, Kazakhstan**	889	32.1	47.7	30.2	30.0
Karaganda, Kazakhstan**	752	43.7	60.8	44.1	37.9
Osh, Kyrgyzstan**	643	42.8	55.4	42.0	39.8
Tashkent, Uzbekistan**	1015	27.3	75.8	26.6	25.3
St. James, Jamaica***	200	3.5	32.5	3.0	7.0
Chetumal, Mexico*	196	27.0	37.2	25.5	21.9
Ciudad Hidalgo, Mexico*	67	23.9	26.9	22.4	20.9
Township in Cape Town, South Africa**	356	47.5	68.6	39.4	41.9
Township in East London, South Africa***	424	19.8	41.3	16.9	23.8
Banfora Health District, Burkina Faso*	261	--	58.6	--	38.3
Tenkodogo Health District, Burkina Faso*	177	--	65.0	--	44.1
Kampala, Uganda*	352	--	60.8	--	30.9

* PLACE Assessment performed in 2001 ** in 2002 *** in 2003

A map showing the extent of sexual mixing in a township in South Africa by venue is presented in Figure 1. In this Figure, each dot represents a venue and a line represents a sexual link between the sites as reported by a person socializing at the site. This figure suggests extensive sexual mixing among site patrons

Individual Network



Conclusion

In which population should factors affecting exposure to HIV be measured? National population-based estimates of critical transmission parameters are essential. However, because there may be several distinct epidemics operating within a country, targeted assessment within geographic areas where incidence is likely to be highest can provide particular insight into areas where opportunities to prevent transmission may be greatest. Surveys of people socializing at public venues known to be places where people meet new sexual partners provides a more detailed description of the population of people with high rates of new sexual partnerships can be characterized and provides insights into the extent to which local populations sexually mix with mobile populations.

How should factors affecting exposure to HIV be operationally defined? The simple questions asked in the PLACE questionnaire about the number of sexual partnerships in the past year and 4 weeks appeared acceptable and were easy to administer. However it is possible that partnerships characterized by this definition of concurrency would not meet a more stringent definintion.

How can the findings improve the interpretation of population-based estimates obtained by household surveys? By providing insight into local trends which may vary substantially from national trends, the PLACE method can provide insight into why there is uneven distribution of HIV infection.