Estimating the Number and Characteristics of Male-Male HIV Transmissions in the US

Eli S. Rosenberg[1], Jeremy A. Grey[1], Gabriela Paz-Bailey[2], H. Irene Hall[2], Amy Lansky[2], Jonathan Mermin[2], Jacek Skarbinski[2]

[1] Department of Epidemiology, Rollins School of Public Health, Emory University, Atlanta, GA, USA; [2] Centers for Disease Control and Prevention, Atlanta, GA, USA

CROI 2015

Background

- Men who have sex with men (MSM) have represented an increasing proportion of new HIV infections in the United States. An estimated 63% of new HIV infections in 2010 were attributable to MSM.
- Estimating the number and HIV transmission and acquisition rates of transmissions to different types of male partners (main and casual) is critical to targeting HIV behavioral and biomedical prevention interventions. The relative distribution of transmissions attributable to main and casual relationships has been debated in the literature.
- National estimates of these quantities by care continuum step of transmitting partners are needed to inform intervention targeting and cost estimation.
- Models that synthesize CDC behavioral, clinical, and case surveillance systems can provide these estimates.

Methods

We constructed a static, deterministic model that utilized the synthesized primary responses from 6 years of HIV behavioral and clinical surveillance to estimate the rates and number of transmissions along the care continuum in the entire United States. The analysis was conducted in this sequence:

Data preparation: Data from national CDC HIV surveillance systems were harmonized, as summarized in Table 1.

Partner- and respondent-level transmission estimates: We computed the expected number of HIV transmissions in the previous year for each MMP and HIV-infected NHBS respondent by aggregating transmission probabilities across acts with reported sex/drug use partners, using a combination of primary data on respondents and literature-based assumptions (Figure).

Group-level transmission rates: Respondent-level transmissions were combined to estimate the mean annual per-person transmissions (i.e., transmission rate) at each continuum step overall and by respondent sex, HIV acquisition risk category, and age group, and made nationally representative through weighting and standardization procedures.

Group-level transmission estimates: Transmission rates were multiplied by population size estimates to calculate the number of HIV transmissions attributable to individuals at each continuum step.

Calibration to incidence estimates: Results were then calibrated to fit the 2009 U.S. HIV transmissions estimate of 45,000.

Outcome estimation: The final results are restricted to male-male sex and include HIV transmission rates, numbers of transmissions, total partners, total serodiscordant anal intercourse (AI) partners, and acquisition rate per serodiscordant AI partner. Results are stratified by main/casual partner type and care continuum step.

A full description of the data sources and methods has been recently published:

Skarbinski J, Rosenberg ES, Paz-Bailey G, Hall HI, Rose CE, Viall AH, Fagan JL, Lansky A, Mermin JH. Human Immunodeficiency Virus Transmission at Each Step of the Care Continuum in the United States. *JAMA Internal Med. Published online February 23, 2015*

Table 1
Data sources contributing to model

Surveillance System		Role in model
National HIV Behavioral Surveillance System		**Sexual behaviors among adults undiagnosed and those diagnosed but not retained in HIV care**
Years	**Represents**	**Sampling method**
HET-1, 2006-7	24 MSA	Venue-based and respondent-driven
MSM-2, 2008	21 MSA	Venue-based
IDU-2, 2009	20 MSA	Respondent-driven
HET-2, 2010	21 MSA	Respondent-driven
MSM-3, 2011	20 MSA	Venue-based
Medical Monitoring Project		**Sexual behaviors and viral load among adults retained in HIV care**
Year	**Represents**	**Sampling method**
2009	50 US States, DC, Puerto Rico	Probability sample of US HIV care facilities
National HIV Surveillance System		**Population size estimates used for weighting**
Year	**Represents**	**Sampling method**
2009	50 US States, DC	Mandatory case reports of HIV diagnoses, with adjustments for delayed reporting and incomplete data, with extended back-calculation to estimate total prevalence

Figure
Simplified schematic for estimating number of HIV transmissions per person in previous year

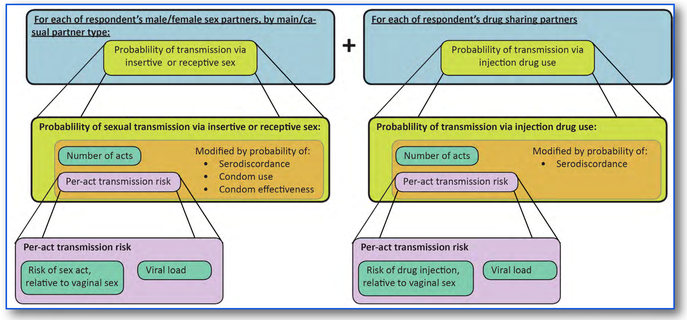

Table 2
Estimated male partners of HIV-infected individuals, by stage of HIV care. United States, 2009

	Male partners			Male HIV serodiscordant anal intercourse partners		
	Number	*Within group %*	*Overall %*	*Number*	*Within group %*	*Overall %*
Undiagnosed						
Main partnerships	124,627	11.1%	2.7%	55,805	16.1%	4.4%
Casual partnerships	1,001,080	88.9%	22.0%	291,838	83.9%	22.8%
Total	1,125,707	100.0%	24.7%	347,643	100.0%	27.1%
Diagnosed, not on antiretroviral therapy						
Main partnerships	236,602	8.4%	5.2%	103,152	13.4%	8.0%
Casual partnerships	2,582,720	91.6%	56.7%	665,781	86.6%	51.9%
Total	2,819,322	100.0%	61.9%	768,933	100.0%	60.0%
On antiretroviral therapy						
Main partnerships	111,507	18.3%	2.4%	45,409	27.5%	3.5%
Casual partnerships	496,529	81.7%	10.9%	119,836	72.5%	9.3%
Total	608,036	100.0%	13.4%	165,245	100.0%	12.9%
TOTAL	4,553,065	---	100.0%	1,281,821		100.0%

Table 3
Estimated male-male HIV transmissions. United States, 2009

	HIV Transmissions			HIV transmission rate, per respondent	HIV acquisition rate, per-serodiscordant anal intercourse partner
	Number	*Within group %*	*Overall %*	*Rate, per 100*	*Rate, per 100*
Undiagnosed					
Main partnerships	6,350	78.6%	24.1%	4.92	11.38
Casual partnerships	1,726	21.4%	6.5%	1.34	0.59
Total	8,076	100.0%	30.6%	6.26	2.32
Diagnosed, not on antiretroviral therapy					
Main partnerships	12,145	74.0%	46.0%	3.92	11.77
Casual partnerships	4,277	26.0%	16.2%	1.38	0.64
Total	16,422	100.0%	62.2%	5.30	2.14
On antiretroviral therapy					
Main partnerships	1,608	84.5%	6.1%	0.75	3.54
Casual partnerships	294	15.5%	1.1%	0.14	0.25
Total	1,902	100.0%	7.2%	0.89	1.15
TOTAL	26,400	---	100.0%	4.05	2.06

Results

- We estimate that in 2009, 652,300 men who acquired HIV by MSM or MSM-IDU behavior had 4,553,065 male and 1,281,281 serodiscordant male anal intercourse partnerships.
- In these serodiscordant partnerships, 26,400 HIV transmissions occurred, yielding a rate of 4.05 per 100 persons living with HIV, with the highest rate of 6.26 per 100 for those undiagnosed.
- Although casual partners comprised the large majority of partners, three-quarters of transmissions were to main partners, due to higher per-partner acquisition rates.
- 70.1% of all transmissions were from men not on ART to main partners, who represented only 12.4% of serodiscordant AI partners. Nearly two-thirds of these transmissions were from men who had been diagnosed.

Limitations

- Partner totals, particularly casual partners, are an upper bound, as they do not account for repetition of individuals who had sex with >1 HIV-positive man in the previous year.
- Further model improvements are needed to better represent transmission during acute HIV infection and transmission dynamics.

Conclusions

- Large reductions in HIV transmissions may result from focusing efforts to increase the number of HIV-infected MSM who are on ART.
- Focusing PrEP on HIV-negative MSM in serodiscordant main AI partnerships may be a particularly efficient prevention strategy, with the highest benefits seen among men whose partners are not on ART.
- Main partners represented 204,366 of 1,281,821 serodiscordant AI partners in 2009, yielding estimates for the men and relationships who would benefit most from focused PrEP, care-continuum, and behavioral HIV prevention efforts.

Acknowledgements

We would like to thank the MMP, NHBS, and NHSS staff, as well as the MMP and NHBS participants.

Poster #1115

Eli S. Rosenberg, PhD
Department of Epidemiology
Emory University Rollins School of Public Health

1518 Clifton Rd.
Atlanta, GA 30322
esrose2@emory.edu