Cross-Sectional vs. Longitudinal HIV Incidence Estimates in People Who Inject Drugs

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Background

- Longitudinal cohorts can suffer from bias which impacts their ability to estimate HIV incidence.
- We compared HIV incidence at enrollment (baseline) and during follow-up in a cohort of people who inject drugs (PWID) in Baltimore, MD.
- We explored potential explanations for incidence differences (differential loss to follow-up or behavioral modification).

Methodology

Study Population

The AIDS Linked to the IntraVenous Experience Study[1] (ALIVE):

- Baseline survey occurred from 1988-1989
- Follow-up occurred 4-12 months after baseline
- Questionnaire administered to cover demographics, injection drug use and sexual practices

Table 1. Population Characteristics

	Baseline N=2,938	Follow-up N=1,772
STIs		
HIV	24.1% (707/2,938)	30.2% (535/1,772)
Syphilis	12.7% (371/2,925)	
Gonorrhea	51.6% (1,512/2,928)	
Drug Use		
Cocaine injection	82.4% (2,259/2,740)	62.8% (1,045/1,665)
Speed Ball use	60.0% (1,744/2,905)	51.2% (886/1,730)
Gallery use	31.6% (924/2,924)	16.2% (282/1,737)
Needle sharing	69.8% (2,020/2,894)	42.9% (739/1,721)
Sexual Practice		
Sex with IDU	83.4% (654/784)	
# Sex partners (0)	1.2% (35/2,938)	
# Sex partners (1-10)	54.4% (1,598/2,938)	
# Sex partners (>10)	44.4% (1,305/2,938)	
Race, Gender and Age		
Black	88.8% (2,605/2,935)	92.4% (1,637/1,772)
Male	80.6% (2,369/2,938)	79.0% (1,399/1,772)
Age (<30)	29.0% (852/2,938)	22.5% (399/1,772)
Age (30-40)	52.3% (1,537/2,938)	54.2% (961/1,772)
Age (>40)	18.7% (549/2,938)	23.3% (412/1,772)

Incidence Estimates and Statistical Methods

- **Cross-sectional Incidence**
  - 673/707 Baseline HIV+ had samples available for testing. Samples tested by multi-assay alsorithm.[2]
- **Longitudinal Incidence**
  - Longitudinal incidence was estimated by counting the number of individuals who seroconverted between the enrollment and first follow-up visit divided by observation time.
- Logistic regression was used to compare the characteristics between groups of individuals. Multiple imputation was used for missing data.
- Incidence was modelled to adjusted for risk factors and population characteristics. Then HIV incidence was adjusted for loss to follow-up, and behavioral change for each risk factor.

Results

Table 2. Differential Loss to Follow-up by Risk Factor Among Individuals Who Were HIV (-) at Baseline

Risk Factor*	Follow-up n =1,237	No Follow-up n =994	OR	aOR
Drug Use				
Cocaine injection	82.5%	78.4%	0.77 (0.62-0.96)†	0.78 (0.62-0.99)†
Speed Ball use	59.5%	54.3%	0.81 (0.68-0.96)†	0.98 (0.80-1.18)
Gallery use	30.2%	30.0%	0.99 (0.83-1.19)	1.24 (1.01-1.52)†
Needle sharing	70.7%	67.6%	0.86 (0.72-1.04)	0.86 (0.70-1.05)
STIs				
Syphilis	11.6%	10.9%	0.94 (0.71-1.22)	0.97 (0.73-1.30)
Gonorrhea	54.1%	46.0%	0.72 (0.61-0.85)‡	0.82 (0.68-0.99)†
Sexual Practice				
Sex with IDU	81.4%	81.7%	1.02 (0.67-1.57)	
# Sex partners (1-10)	58.8%	53.6%	1.65 (0.51-5.38)	
# Sex partners (>10)	40.4%	46.0%	2.06 (0.63-6.72)	
Race, Gender and Age				
Black	90.5%	81.4%	0.46 (0.26-0.59)‡	0.48 (0.37-0.63)‡
Female	20.3%	17.2%	0.82 (0.66-1.01)	0.77 (0.61-0.98)†
Age (30-40)	52.1%	49.5%	0.70 (0.58-0.85)‡	0.69 (0.56-0.85)‡
Age (>40)	22.2%	15.9%	0.53 (0.41-0.68)‡	0.46 (0.35-0.60)‡

*Compared to those who did not state they participated in the behavior
† p-value <0.05; ‡ p-value <0.001; OR: Odds ratio; aOR: Adjusted odds ratio

Table 3. Behavior Change Among Initially HIV (-) Subjects who Remained in Follow-up

Risk Factor*	Baseline n =1,197	1st Follow-up n =1,197	OR (95%CI)	aOR (95% CI)
Drug Use				
Cocaine injection	82.0%	61.17%	0.35 (0.29-0.43)‡	0.46 (0.37-0.57)‡
Speed Ball use	59.2%	48.3%	0.64 (0.55-0.76)‡	1.19 (0.98-1.44)
Gallery use	30.0%	16.3%	0.44 (0.36-0.54)‡	0.69 (0.55-0.87)†
Needle sharing	71.0%	45.2%	0.34 (0.28-0.40)‡	0.44 (0.36-0.54)‡

*Compared to those who did not state they participated in the behavior
† p-value <0.05; ‡ p-value <0.001; OR: Odds ratio; aOR: Adjusted odds ratio

Table 4. Comparison of HIV Recent Individuals at Baseline and HIV Non-recent at Baseline

Risk Factor*	Recent n=106	Not Recent n=567	OR (95% CI)	aOR (95% CI)
Follow-up	74.5%	77.9%	1.21 (0.75-1.95)	
Drug Use				
Cocaine injection	95.7%	87.3%	0.31 (0.11-0.87)†	0.38 (0.13-1.08)
Speed Ball use	67.9%	69.2%	1.06 (0.68-1.66)	1.11 (0.66-1.88)
Gallery use	39.0%	35.8%	0.87 (0.56-1.33)	0.82 (0.49-1.40)
Needle sharing	70.7%	71.2%	1.02 (0.65-1.62)	0.97 (0.55-1.70)
STIs				
Syphilis	11.5%	17.8%	1.67 (0.88-3.16)	1.64 (0.79-3.37)
Gonorrhea	60.9%	53.9%	0.75 (0.49-1.15)	0.84 (0.52-1.36)
Sexual Practice				
Sex with IDU	92.3%	88.3%	0.63 (0.14-2.87)	
# Sex partners (0)	2.0%	3.5%	1	
# Sex partners (1-10)	53.9%	54.2%	0.57 (0.13-2.49)	
# Sex partners (>10)	44.1%	42.3%	0.54 (0.12-2.39)	
Race, Gender and Age				
Black	96.2%	96.7%	1.13 (0.38-3.39)	1.04 (0.28-3.85)
Female	17.9%	21.5%	1.26 (0.74-2.14)	1.51 (0.79-2.89)
Age (30-40)	46.2%	58.2%	2.21 (1.41-3.47)‡	2.18 (1.32-3.61)†
Age (>40)	11.3%	17.6%	2.74 (1.38-5.44)†	2.82 (1.31-6.08)†

*Compared to those who did not state they participated in the behavior
† p-value <0.05; ‡ p-value <0.001; OR: Odds ratio; aOR: Adjusted odds ratio

Table 5. Differences in Incidence at Baseline and Follow-up by Risk Factor

	Cross-sectional Incidence at Baseline			Longitudinal Incidence 1st Follow-up 4-12 months	
	All (95% CI)	Follow-up (95% CI)	No Follow-up (95% CI)	Person years	Incidence Rate (95% CI)
Risk Factors	12.9 (10.1-15.7)	17.0 (12.8-21.2)	8.0 (4.9-11.1)	735.09	5.4 (3.9-7.4)
Drug Use					
Inject cocaine (-)	2.7 (0.03-5.4)	5.3 (0.04-10.6)	0.0 (0.0-0.0)	265.29	4.2 (2.1-4.4)
Cocaine injection	14.2 (10.9-17.6)	17.2 (12.5-21.9)	10.6 (6.4-14.7)	429.95	6.8 (4.5-9.7)
Speed Ball use (-)	9.7 (6.3-13.1)	12.2 (7.0-17.4)	7.1 (2.9-11.4)	375.63	4.3 (2.4-6.9)
Speed Ball use	15.5 (11.5-19.4)	20.4 (14.5-26.3)	8.7 (4.4-13.1)	353.79	6.8 (4.4-10.1)
Gallery use (-)	11.2 (8.2-14.2)	15.1 (10.5-19.7)	6.4 (3.1-9.6)	611.08	5.6 (3.9-7.8)
Gallery use	16.6 (11.2-22.1)	20.7 (12.6-28.7)	11.8 (5.0-18.7)	120.22	5.0 (1.8-10.9)
Needle sharing (-)	12.4 (7.8-17.0)	17.8 (10.2-25.3)	6.3 (1.6-11.1)	396.51	5.0 (3.1-7.8)
Needle sharing	13.5 (10.1-16.8)	17.0 (12.1-22.0)	8.9 (4.9-13.0)	326.42	6.1 (3.7-9.5)
Race, Gender and Age					
Male	13.10 (10.0-16.2)	16.5 (11.9-21.0)	9.3 (5.6-12.9)	586.74	4.4 (2.9-6.5)
Female	12.2 (6.5-17.9)	19.0 (9.8-28.3)	1.7 (1.6-5.1)	148.35	9.4 (5.2-15.8)
Age (<30)	18.5 (12.7-24.3)	25.9 (16.0-35.8)	11.8 (5.5-18.1)	163.01	9.2 (5.2-15.2)
Age (30-40)	11.8 (8.2-15.3)	15.7 (10.4-21.1)	6.7 (2.7-10.7)	389.66	5.9 (3.7-8.9)
Age (>40)	7.4 (3.1-11.1)	9.6 (3.5-15.8)	3.6 (1.4-8.2)	182.42	1.1 (0.1-4.0)

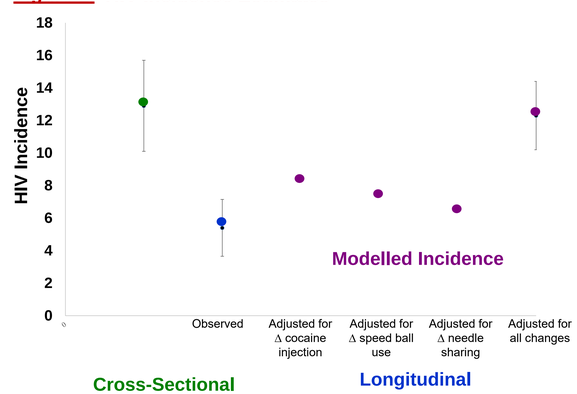
(-) Did not have the given risk factor

Table 6. Differences Between those Recently Infected at Baseline to Those Who Seroconverted During Follow-up

Risk Factor*	Recent at Baseline n=106	SC at Follow-up N=40	OR	aOR
Drug Use				
Cocaine injection	95.7%	72.5%	0.12 (0.04-0.40)‡	0.14 (0.04-0.55)†
Speed Ball use	67.9%	60.0%	0.71 (0.33-1.50)	1.30 (0.49-3.40)
Gallery use	39.0%	15.0%	0.28 (0.11-0.71)†	0.50 (0.16-1.59)
Needle sharing	70.7%	50.0%	0.41 (0.20-0.87)†	0.57 (0.22-1.51)
Gender and Age				
Male	82.1%	65.0%	1	1
Female	17.9%	35.0%	2.47 (1.09-5.58)†	2.19 (0.81-5.91)
Age (<30)	42.5%	37.5%	1	1
Age (30-40)	46.2%	57.5%	1.41 (0.65-3.03)	1.35 (0.55-3.30)
Age (>40)	11.3%	5.0%	0.50 (0.10-2.49)	0.45 (0.07-2.92)

*Compared to those who did not state they participated in the behavior; SC -Seroconverted
† p-value <0.05; ‡ p-value <0.001; OR: Odds ratio; aOR: Adjusted odds ratio

Figure 1. HIV Incidence Estimates



Results

Table 7. Adjustment of Incidence Estimates for Differential Loss to Follow-Up and Behavior Change

	Differential Lost to Follow-up		Behavior Change	
Risk Factors	Adjustment Factor	Adjusted Incidence	Adjustment Factor	Adjusted Incidence
Drug Use				
Inject cocaine	0.99	5.35	1.51	8.17
Speed Ball	0.99	5.35	1.35	7.29
Used Gallery	1.00	5.40	0.97	5.23
Share needles	1.00	5.40	1.15	6.23
Gender and Age				
Sex	0.99	5.35		
Age	1.05	5.65		

- At baseline, 82% (87/106) of the recent group in contrast 65% (14/40) of those you seroconverted during follow-up group were male (p= 0.04).
- Seroconverts were less likely to inject cocaine than the recently infected individuals at baseline adjusted odds ratio 0.14 (95% CI: 0.04, 0.55, P < 0.05).
- No impact of loss to follow-up on HIV incidence estimates.
- Incidence needed to be adjusted:
  51% for the decrease in injecting cocaine behavior
  31% for the observed decrease in speed ball usage
  15% for decrease in sharing of needles.

Conclusions

- Annual HIV incidence in this cohort of PWID was much higher in the months before enrollment than in the first year of the study (12.9% vs. 5.4%).
- Fewer men who seroconverted at follow-up than females.
- The difference in HIV incidence at enrollment vs. after enrollment was not explained by differential loss-to-follow-up, but may have been explained by a decline in drug use practices after study enrollment.

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References

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[2] Laeyendecker et al. *J Infect Dis.* 2013 15;207:232-9.