SPATIAL CLUSTERING OF HIV VIREMIA AMONG PEOPLE WHO INJECT DRUGS (PWID) IN INDIA

Talia A Loeb[1], Allison M McFall[1], Michael R Desjardins[1,2], Jiban J Baishya[3], Ashwini Kedar[3], Archit Sinha[3], Aylur K Srikrishnan[3], Sunil S Solomon[4], Gregory M Lucas[4], Shruti H Mehta[1]
[1]Department of Epidemiology, Johns Hopkins Bloomberg School of Public Health (BSPH), Baltimore, MD, USA;[2]Spatial Science for Public Health Center, BSPH, Baltimore, MD, USA;
[3]YR Gaitonde Centre for AIDS Research and Education, Chennai, India; [4]Johns Hopkins University School of Medicine, Baltimore, MD, USA

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BACKGROUND

- People who inject drugs (PWID) living with HIV in India are under-engaged in treatment, with ~26% on ART and ~32% virally suppressed (Prata-Menezes, 2022).
- Identifying clusters of viremia and its correlates may help in identifying areas for intervention and preventing HIV transmission

OBJECTIVE

- Identify geospatial correlates of HIV viremia (>1000 copies/mL) in Delhi, including clustering and road network distance and travel time from treatment centers (ARTCs)

METHODS

- **Respondent-driven sampling** biobehavioral survey and rapid HIV tests done between April and August 2023 in Delhi
  - **Viremia if >1000 copies/mL**
  - **Suppressed if <1000 copies/mL or HIV-negative**
- Inclusion Criteria: ≥18 years old and reported injection drug use in the prior 2 years
- N=752 PWID; **n=743** provided up to 5 injection locations
- Mapped injection locations in ArcGIS and assessed spatial clustering of HIV viremia using SaTScan and R
- *Statistical Analyses:*
  - *Clusters:* Fisher's exact tests; K-functions for point pattern clustering
  - *Distance:* RDS-weighted logistic spatial autoregressive model with generalized estimating equations (GEE) to account for multiple locations and spatial dependence

Table 1. Sample characteristics by viremia status

n (%) / median (IQR)	Suppressed (n=505, 68.0%)	Viremia (n=238, 32.0%)	Total (n=743)
Number of injection sites	4 (1, 4)	4 (1, 4)	4 (1, 4)
Under 25 years old	162 (32.1)	98 (41.2)	260 (35.0)
At least a secondary education	231 (45.8)	96 (35.7)	316 (42.6)
Married	132 (26.1)	43 (18.1)	175 (23.6)
Unemployed	14 (2.8)	5 (2.1)	19 (2.6)
Experienced homelessness, prior 6 months	329 (65.2)	157 (66.0)	486 (65.4)
Ever incarcerated	81 (16.0)	34 (14.3)	115 (15.5)
Hepatitis C (HCV) antibody positive	286 (56.6)	228 (95.8)	514 (69.2)
Daily injection, prior 6 months	399 (79.0)	177 (74.4)	576 (77.5)
Used only clean needles, prior 6 months	103 (20.4)	75 (31.5)	178 (24.0)
Used needle-syringe exchange program, prior 6 months	42 (8.3)	26 (10.9)	68 (9.2)
Used medication for opioid use disorder (MOUD), prior 6 months	103 (20.4)	75 (31.5)	178 (24.0)

High-risk behaviors may attenuate the impact of proximity to ART clinics on HIV viremia, and identifying geospatial clusters of viremia can provide targets for field-based HIV interventions.

RESULTS

- HIV prevalence among n=743 PWID was 43.8%
- Participants injected in places a median distance of 2.4 km (IQR 2.3 – 2.6) from ARTCs
- There was clustering by viremia (Figure 1, 2), with seven clusters identified, one of which was statistically significant in Old Delhi (Figure 1, shown in orange)
  - Correlates of injecting in the Old Delhi cluster:
    - **daily injection** (94% vs. 72%)
    - missing HIV treatment **due to drug use** (75% vs 29%)
    - **larger network size** (median 60 vs 12)
    - moderate or severe **depression** (50% vs 21%)
    - injecting with **multiple persons** over half the time (72% vs 37%)

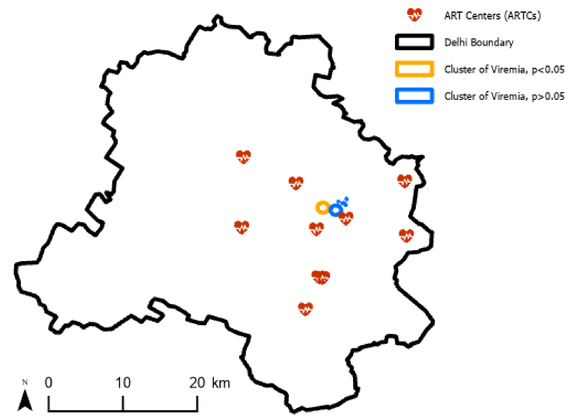

Figure 1. Unweighted clusters of HIV viremia

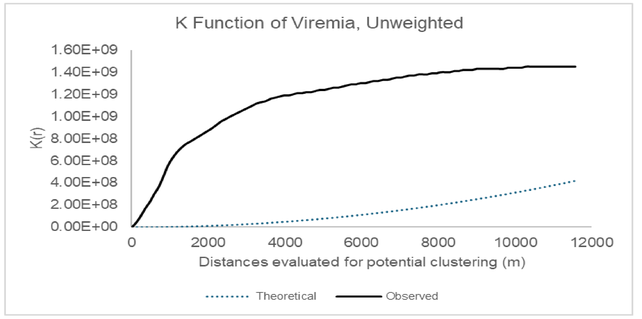

Figure 2. Unweighted K Function. The observed point pattern suggests that viremic participants cluster in space since the observed line is above the theoretical complete spatial randomness baseline at all given distances

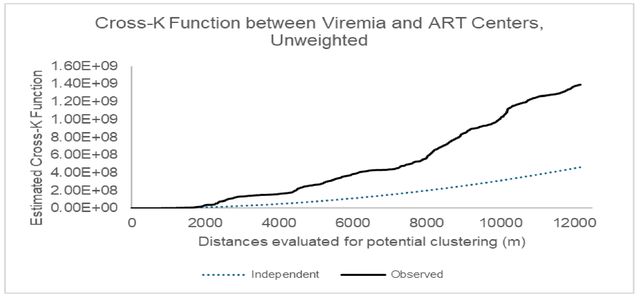

Figure 3. Unweighted Cross-K Function with ARTCs. When farther than 2.0 km from ARTCs, participants with viremia tended to cluster geographically

Table 2. Results from the RDS-weighted adjusted spatial autoregressive model with GEE

Associations with HIV Viremia		aOR* (95% CI)
Proximity to the closest ARTC (ref: 0-to-30-minute)		
Over 30-minute walk**		1.27 (1.08, 1.49)
HCV (ref: Treated HCV)		
HCV-negative		0.99 (0.81, 1.24)
Untreated HCV**		1.40 (1.18, 1.67)
Resilient coping (ref: Low)		
High**		0.91 (0.85, 0.98)
Medium**		0.87 (0.82, 0.93)
Hazardous alcohol use		1.15 (0.99, 1.33)
MOUD (ref: Never used)		
Used in prior 6 months		1.03 (0.96, 1.10)
Used more than 6 months ago		0.95 (0.83, 1.08)
Interaction Terms	**Interaction Coefficient***	**aOR⁺⁺ (95% CI)**
Proximity x HCV-negative	-0.29**	0.95 (0.80, 1.12)
Proximity x Untreated HCV	-0.37**	1.23 (1.08, 1.49)**
Proximity x Hazardous alcohol use	-0.20**	1.19 (1.01, 1.41)**

*adjusted for age, employment, and other covariates in the model and RDSII-weighted, **p<0.05
⁺Odds ratios are the effect of proximity within the subgroups represented by the interactions

CONCLUSIONS

- There was a geospatial cluster of PWID with untreated HIV associated with higher levels of risk behaviors – potentially facilitating transmission
- Longer walking distance from the closest ART center was associated with higher odds of HIV viremia, as was untreated Hepatitis C infection
- Alcohol use and untreated Hepatitis C attenuated the effect of proximity on viremia, so factors other than proximity may be more important in accessing treatment and ARTCs
- Identifying distinct geographic areas characterized by high viremia can provide targets for field-based strategies to interrupt HIV transmission

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