SYNDEMIC SPACES AND NETWORKS CRITICAL TO THE TRANSMISSION OF HIV AND STIS IN BALTIMORE CITY: A PUBLIC HEALTH-ACADEMIC PARTNERSHIP

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This project is a part of a longstanding public health-academic partnership between the STI/HIV program of the Baltimore City Health Department (BCHD), and the Center for Child and Community Health Research (CCHR) at the Johns Hopkins School of Medicine.
Vision

Baltimore City will become a place where new HIV and STIs are rare, and when they do occur, every person regardless of age, gender, race/ethnicity, sexual orientation, gender identity or socioeconomic circumstances, will have unfettered access to high quality, life-extending care, free from stigma and discrimination.

Adapted from the National HIV/AIDS Strategy for the United States 2020
Setting

• 1 in 5 HIV positive persons in Baltimore City do not know they are infected.
• Estimates suggest that ~40% of gay, bisexual and same gender loving men are HIV infected.
• Treatment can reduce the transmission of HIV by 96%.
**HIV/STI Control**

Prevention tools are most effective if implemented at the right time, in the right space and with the most important populations.

Control strategies focus on individuals:

- a. most likely to transmit, i.e. contact tracing
- b. most at risk for acquisition, i.e. PrEP

Critical to this strategy is:

- a. identifying factors or spaces that precipitate mixing of uninfected and infectious persons and
- b. prioritizing sexual networks associated with ongoing transmission
Rationale

• HIV community viral load and new STI diagnoses may be a useful indicator of high transmission population subgroups.

• Using places helps to focus on where the disease is and may be less stigmatizing than identifying specific populations.
Rationale

The National HIV/AIDS Strategy and U.S. Centers for Disease Control and Prevention call for the use of timely, accurate, and complete surveillance data to maximize the effectiveness of HIV/STI prevention and control strategies such as HIV PrEP.
Overall Goals

1. Decrease HIV transmission in Baltimore City
2. Increase the efficiency of HIV outreach testing in Baltimore City by utilizing surveillance data (community viral load (CVL) data) and geographic information systems
HIV Outreach Testing

Objective: To develop a new protocol based on HIV hotspots to determine locations for outreach testing and to evaluate whether the protocol increased over 3 years the

1) % of time spent testing in high viral load areas (process measure)
2) HIV infections identified (outcome)
3) new HIV diagnoses identified (outcome)
4) high HIV viral load cases identified (outcome)
Development of Program

• Series of meetings between outreach team, BCHD leadership and CCHR team
• Reviewed maps and baseline data on where outreach was occurring
• GPS units placed on mobile vans to identify outreach testing locations and time spent at each location
High HIV Community Viral Load Maps

• Community viral load maps were created with viral loads (n=1,323) from testing (BCHD) and in care information (DHMH) from October 2012–June 2014
  • High viral load areas = census tracts with a geometric mean viral load of ≥1500 copies/mL

• Identified high priority high HIV CVL areas using ArcGIS, Google maps and calendar schedule of shifts

• Developed hard copy maps of high HIV CVL areas for outreach team to utilize to set monthly schedule for outreach

• Two GIS units placed on two mobile outreach testing van
Evaluation Study Design

- Time series analyses

<table>
<thead>
<tr>
<th>Baseline</th>
<th>Follow-up 1</th>
<th>Follow-up 2</th>
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<tbody>
<tr>
<td>April – June 2013</td>
<td>April-June 2014</td>
<td>April-June 2015</td>
</tr>
<tr>
<td>Night Shifts</td>
<td>Night &amp; Day Shifts</td>
<td></td>
</tr>
</tbody>
</table>
HIV CVL & Outreach Testing Locations, 2013, 2014 & 2015, Baltimore City
<table>
<thead>
<tr>
<th>Year</th>
<th>Total Hours Spent Testing</th>
<th>No Transmission Areas N = 14</th>
<th>Low Transmission Areas N = 76</th>
<th>High Transmission Areas N = 89</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>332.8</td>
<td>1%</td>
<td>30%</td>
<td>69%</td>
</tr>
<tr>
<td>2014</td>
<td>178.2</td>
<td>0%</td>
<td>28%</td>
<td>73%</td>
</tr>
<tr>
<td>2015</td>
<td>279.0</td>
<td>1%</td>
<td>15%</td>
<td>84% *</td>
</tr>
</tbody>
</table>

* p < 0.001
HIV testing outcomes by year, April to June, Baltimore City

<table>
<thead>
<tr>
<th>Year</th>
<th>Encounters</th>
<th>HIV Positives n (%)</th>
<th>New Positives n (%)</th>
<th>High Viral Load n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>1896</td>
<td>60 (3)</td>
<td>3 (0.1)</td>
<td>5 (0.2)</td>
</tr>
<tr>
<td>2014</td>
<td>1117</td>
<td>46 (4)</td>
<td>5 (0.4)</td>
<td>6 (0.5)</td>
</tr>
<tr>
<td>2015</td>
<td>2094*</td>
<td>127 (6)*</td>
<td>6 (0.2) ^</td>
<td>9 (0.4) ^</td>
</tr>
</tbody>
</table>

*Excludes Festivals, Gay Pride, Latino Festival, African American Festival, White Party, Callow Hill Aquatics Center

* p< 0.001
^ not tested
Summary

• By using HIV CVL to determine locations for outreach testing, we were able to significantly increase the number of HIV cases identified and the number of cases identified with a higher transmission potential (i.e. higher viral load).

• HIV CVL of a geographic area may be a useful indicator of population reservoirs of HIV infection and subgroups most likely to transmit.

• This project also provides a model for translating evidence to program change.
Syphilis is on the Rise: Reported Cases of Syphilis (Primary, Secondary and Early Latent) by 6 months by Overall, Gay, Bisexual and Other Men Who Have Sex with Men (MSM) and Commercial Sex Workers (CSW), Baltimore City, 2009-2018 (N= 3530).

Data from the STI/HIV program, Baltimore City Health Dept.
Syphilis and HIV are Syndemic

Syphilis infection can facilitate the transmission and acquisition of HIV infection.

There is an estimated 2- to 5-fold increase in the risk of HIV acquisition among persons with syphilis.

Syphilis may be an indicator of ongoing sexual risk behaviors and membership in a high transmission network for both syphilis and HIV.

Syphilis can be effectively treated.

Buchacz et al., 2004; Fleming and Wasserheit, 1999; Jarzebowski et al., 2012; CDC, n.d.; Pathela et al., 2015; Tilchin et al., 2019.
Sex Partner Meeting Venues

Places where individuals congregate including bars/clubs, internet apps, social websites, chat lines, etc.

May attract individuals with incident infection

May create opportunities for interconnectedness that perpetuate incident infection

May be important places for prevention and control activities
Study Aims

To determine the

- Sex partner meeting venues and the network of sex partner meeting venues nominated by syphilis and HIV infected persons
- Degree of mixing by priority population (MSM, CSW, IDU and youth) at the venues.
Sexual networks – Venue networks

Who did you have sex with in the past 3 months?

Where did you meet sex partners in the past 3 months?
Venue-Affiliation Networks

Advantages

- More robust to some forms of bias
- Venue network reflects a latent sex network

CDC encourages collection of venue data, but a limited number of studies have used venue-based analysis

Priority Populations

National HIV/STI prevention strategies focus on priority populations based on high prevalence and incidence estimates.

- MSM
- CSW
- Injection drug users (IDU)
- Youth (ages 15-24 years)

Neglect the interconnectedness of these populations
Study Aims

To determine the
- Sex partner meeting venues and the network of sex partner meeting venues nominated by syphilis and HIV infected persons
- Degree of mixing by priority population (MSM, CSW, IDU and youth) at the venues.
Study Population

Cross-sectional study of reported new HIV diagnoses and early syphilis cases from Jan 1, 2009 to Dec 31, 2015.

Inclusion:

- Partner services interview
- Nominated at least one sex partner meeting in the last 12 months
### Study Population Characteristics (N = 927)

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
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</thead>
<tbody>
<tr>
<td>Age Category</td>
<td></td>
</tr>
<tr>
<td>&lt; 25</td>
<td>34.6%</td>
</tr>
<tr>
<td>25 – 49</td>
<td>57.4%</td>
</tr>
<tr>
<td>&gt; 50</td>
<td>8.0%</td>
</tr>
<tr>
<td>Male</td>
<td>82.0%</td>
</tr>
<tr>
<td>Race</td>
<td></td>
</tr>
<tr>
<td>Black/African American</td>
<td>72.6%</td>
</tr>
<tr>
<td>White</td>
<td>10.9%</td>
</tr>
<tr>
<td>Other/Unknown</td>
<td>16.5%</td>
</tr>
<tr>
<td>Diagnosis</td>
<td></td>
</tr>
<tr>
<td>HIV</td>
<td>31.7%</td>
</tr>
<tr>
<td>Syphilis</td>
<td>64.9%</td>
</tr>
<tr>
<td>Both</td>
<td>3.3%</td>
</tr>
<tr>
<td>MSM</td>
<td>72.5%</td>
</tr>
<tr>
<td>IDU</td>
<td>4.4%</td>
</tr>
<tr>
<td>CSW</td>
<td>12.1%</td>
</tr>
<tr>
<td>Number of sex partners in the preceding 12 months, median (IQR)</td>
<td>2.0 [1.0, 4.0]</td>
</tr>
</tbody>
</table>

### Venue Types (N = 420)

- **Street Corner / Park / Neighborhood**: 54%
- **Bar / Club**: 7%
- **Internet site / App**: 13%
- **Public Market / Mall**: 13%
Process Steps

- **Original (2-mode)**
- **Jaccard Similarity (1-mode)**
- **Backbone $\gamma=0.15$ (1-mode)**

![Graphs showing process steps](image)
Complexity Reduction

Original Data \[\xrightarrow{\text{Jaccard Similarity}}\] Irreducible Network Backbone

\[J(A, B) = \frac{|A \cap B|}{|A \cup B|}\]

Irreducible backbone *

- Complexity reduction on the edges
- Objective is to only keep edges that would not appear randomly.
- P-value for the null hypothesis on each edge is \(\gamma\) which we pick.
- Sensitivity analyses with \(\gamma = 0.25, 0.2, 0.15, 0.1,\) and 0.05

Sex partner meeting venues reported by new HIV diagnoses and early syphilis cases by type of venue and number nominating each venue in the irreducible backbone network (gamma = 0.1), Baltimore City, 2009-2015.
Sex partner meeting venues reported by new HIV diagnoses and early syphilis cases by the number of different priority populations nominating each venue in the irreducible backbone network (\(\gamma = 0.1\)), Baltimore City, 2009-2015.

Count for each high risk group present at the venue:
- None present
- 1 present (e.g., MSM only)
- 2 present (e.g., MSM and IDU)
- 3 present
- All four groups present

Note: Small nodes are single nomination, large nodes are more than one.
Venn Diagram of the proportion of venues in the irreducible backbone network that demonstrated different mixing combinations between priority populations, Baltimore City, 2009-2015.

In Baltimore, 12% of venues were only nominated by youth, 21% were only nominated by MSM, and 30% were nominated by both youth and MSM. In contrast, no venues were nominated by a combination of youth and IDU, nor by a combination of youth, IDU, and CSW.
Conclusions

Mixing between priority populations occurred at most (56%) venues.

Social evidence that mixing between priority populations is common.

We identified specific venues where mixing occurred between priority populations.

These projects provide excellent examples of the power of using data to drive decision-making about how to improve the public health of Baltimore City residents and create a better future for Baltimore.
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