Network Formation as Determinant of Spatial Disparity

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Determinants of sexual infection transmission

- **Pathogen:**
  - Transmission probabilities (male to female, female to male, anatomical site)
  - Durations of infection (female, male, symptomatic, asymptomatic)

- **Behavioral:**
  - Rates of partner acquisition
    - Partners per year, time between partnerships ( concurrency )
  - Rates of partnership dissolution, coital frequency
    - Is partnership long enough for effective contact ( transmission ) to occur
  - (Health services seeking and utilization)
    - To shorten infection duration treatment

- **System:**
  - (Mixing patterns)

Acknowledgements

Sevgi Aral
Thomas Gift

Empirical incarceration study

- **Incarceration**
  - Associated with sexual partnership dissolution ( Khan et al. 2011 )
  - Associated with more partners per year ( Khan et al. 2008 )
  - Associated with “separational concurrency” ( Adimora et al. 2005 )
  - Alters sex ratios and thereby power dynamics ( Thomas et al. 2006, Pouget et al. 2010, Green et al. 2012 )


INCARCERATION AS A RUNNING EXAMPLE

Young black men are disproportionately incarcerated

<table>
<thead>
<tr>
<th>Age</th>
<th>Male White</th>
<th>Male Black</th>
<th>Male Hispanic</th>
<th>Male Total</th>
<th>Female White</th>
<th>Female Black</th>
<th>Female Hispanic</th>
<th>Female Total</th>
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<tbody>
<tr>
<td>18-19</td>
<td>263</td>
<td>2,615</td>
<td>1,303</td>
<td>771</td>
<td>17</td>
<td>74</td>
<td>32</td>
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<td>20-24</td>
<td>762</td>
<td>6,740</td>
<td>2,774</td>
<td>1,086</td>
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<td>113</td>
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<td>25-29</td>
<td>829</td>
<td>8,319</td>
<td>2,609</td>
<td>2,024</td>
<td>54</td>
<td>415</td>
<td>186</td>
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<td>1,845</td>
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<td>6,601</td>
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<td>1,615</td>
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<td>151</td>
<td>3</td>
<td>18</td>
<td>9</td>
<td>5</td>
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<tr>
<td>Total</td>
<td>370</td>
<td>3,098</td>
<td>1,278</td>
<td>1,099</td>
<td>23</td>
<td>188</td>
<td>78</td>
<td>51</td>
</tr>
</tbody>
</table>

Source of data: Bureau of Justice Statistics
Objective

- Explore how prison incarceration affects known STI risk factors
  - Partners per year
  - Gap length
  - Community STI levels
  - (STI network features)

- Stochastic individual based model of heterosexual Chlamydia trachomatis transmission

A simple model of incarceration

- Men are incarcerated at a constant rate (varied)
  - Men remain incarcerated for 3-4 years

- Their sexual partnerships are dissolved

- Women may form new sexual partnerships with remaining men who are not incarcerated

- No additional forced concurrency

- No altering of other behaviors (tolerance of concurrency, condom use, etc.).

Incarceration’s effects on determinants of sexual infection transmission

- Pathogen

- Behavioral
  - Shorter partnerships
  - More partners per year
  - Gap length

- System
  - Unbalanced sex ratios
  - Altered mixing patterns (measured by resulting network shape)
  - Lower effective population size

Length of short-term partnerships with variable levels of incarceration

Length of long-term partnerships with variable levels of incarceration

Gap length between partnerships with variable levels of incarceration
SO WILL GREATER INCARCERATION RESULT IN GREATER STD INFECTION RATES?
Why does incarceration not result in greater STD infection rates?

- What are we not accounting for?
- Sexual assault and transmission while in prison
- Altered power dynamics based on slight imbalance in sex ratios (concurrency tolerance, condoms, etc)
- Changes in behavior
- Greater age at long term relationship establishment (i.e. cessation of new partner acquisition)

Incarceration disrupts sexual networks

- Increases the total number of partnerships formed between people
- Unbalances sex ratios
- Removes a disproportionate number of men:
  - Remaining network more tightly connected (more contacts are made with the remaining subset of non-incarcerated men)
- Premature partnership dissolution can make partnerships too short to allow for sufficient time (number of coital acts) to transmit infection
- However, these factors alone, do not cause an increase in community STD burden.

Next steps:

- If incarceration increases STD burden in communities, it does so because factors not considered today
  - Providing a venue for sexual assault which can thereby amplify STDs back to the community
  - Altering power dynamics between the sexes potentially resulting in greater tolerance and thus prevalence of concurrency, lack of condom use, etc.

Thank you

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