Syringe type and HIV risk: current knowledge and future directions

Presented by
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Along with
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Background
Injecting Drug Users and HIV*

- Injecting drug use reported in 148 countries
- HIV reported among IDUs in 120 countries
- Estimated 15.9 million IDUs worldwide
- HIV prevalence ranges from < 1% to > 70%
- 1 in 10 new HIV infections occur in IDUs
- 30% of new HIV infections outside of Sub-Saharan Africa occur among IDUs

*Mathers et. al 2008, *Lancet*
Factors Influencing Transmission

- Individual risk behavior
  - Injection risk
  - Unprotected sex

- Environmental, social, biological
  - Laws restricting syringe access and possession
  - Community HIV prevalence
  - Types of drugs used
  - Network structure and location within network
  - Acute infection, STDs, circumcision
  - Overlap among IDUs, MSM, sex workers

- Associations between risk and HIV prevalence are inconsistent
What’s Missing?

- Most HIV transmission among IDUs has been attributed to sharing needles and syringes.
- Researchers rarely collect information of the types of syringes used.
- This suggests that either all IDUs use the same types of syringes or that the type of syringe is irrelevant.
Syringes Used by IDUs
Early Observations

- IDUs across Texas other southwestern states in the US used syringes with detachable needles in the 1960s.
- Around 1970 insulin syringes with permanently attached needles were introduced.
- In the early 1980s insulin syringes with detachable needles were almost completely phased out.

\(^a\)Zule, 1992. J. Psychoactive Drugs.
Fact: Some syringes retain more fluid and blood than other syringes retain.

Hypothesis: Injection-related HIV epidemics cannot occur in cities where all (>95%) of IDUs use syringes that retain less blood.
Testing the Hypothesis

- Laboratory Experiments
- Cross-sectional Epidemiological Data
- Mathematical Models
- Ecological Data from cities across Europe and Asia (in progress)
# Experimental Observations*

<table>
<thead>
<tr>
<th>Syringe type</th>
<th>2\textsuperscript{nd} rinse</th>
</tr>
</thead>
<tbody>
<tr>
<td>LDSS</td>
<td>&lt; 0.001 µl</td>
</tr>
<tr>
<td>HDSS</td>
<td>1.01 µl</td>
</tr>
</tbody>
</table>

Ratio of blood retained in HDSS/LDSS

- Involved registering with 0.1 ml, booting with 0.1 ml of blood and 2 water rinses with 0.5 ml of water

*Zule et al, 1997. JAIDS
Why It Matters
Viral Burden

- The probability of infection associated with an exposure is influenced by the “viral burden” in the exposure.

- **Viral Burden** = \( \text{viral load} \times \text{volume of inoculum} \)

- **Examples of high viral burden**
  - Acute HIV infection
  - Blood transfusions

- **Examples of low viral burden**
  - Needlestick
  - Antiretroviral therapy and low viral load
# How Syringe Type Influences Viral Burden

<table>
<thead>
<tr>
<th>Stage of Infection</th>
<th>Viral load copies/ ml</th>
<th>HDSS (1 μl of blood)</th>
<th>LDSS (0.001 μl of blood)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute (very high)</td>
<td>100,000,000</td>
<td>100,000</td>
<td>100</td>
</tr>
<tr>
<td>Acute</td>
<td>10,000,000</td>
<td>10,000</td>
<td>10</td>
</tr>
<tr>
<td>Latent (moderately high)</td>
<td>100,000</td>
<td>100</td>
<td>1 copy in 10 exposures</td>
</tr>
<tr>
<td>Latent</td>
<td>10,000</td>
<td>10</td>
<td>1 copy in 100 exposures</td>
</tr>
<tr>
<td>End stage (AIDS)</td>
<td>1,000,000</td>
<td>1,000</td>
<td>1</td>
</tr>
</tbody>
</table>
Linking Prevalent HIV Infection to a History of Sharing HDSS
Sample Characteristics

Sample Size and Location
- 822 participants were recruited through street outreach and peer referral in Raleigh-Durham, North Carolina between July 2003 and December 2006.

Eligibility Criteria
- At least 18 years of age
- No formal substance abuse treatment last 30 days
- Self-reported injecting drug use in the last 30 days
- Visible track marks or urine positive for morphine, cocaine, or methamphetamine

<table>
<thead>
<tr>
<th>Background characteristics</th>
<th>Ever Used HDSS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No (n=477)</td>
</tr>
<tr>
<td>Mean Age (S.D.)***</td>
<td>38.3 (9.3)</td>
</tr>
<tr>
<td>% Male</td>
<td>71.7</td>
</tr>
<tr>
<td>Ever in substance abuse treatment***</td>
<td>71.8</td>
</tr>
<tr>
<td>Ever in prison**</td>
<td>51.7</td>
</tr>
</tbody>
</table>

*** p < 0.001
Infection Prevalence by HDSS Use

- **History of sexually transmitted infection***
- **HIV positive***
- **HCV positive***

**Percent**

***p < 0.001
## Syringe Type and HIV Model

<table>
<thead>
<tr>
<th></th>
<th>Logistic Regression</th>
<th>Multiple Logistic Regression</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predicted probability of using an HDSS (propensity score)</td>
<td>Odds Ratio (95% CI)</td>
<td>Adjusted Odds Ratio (95% CI)</td>
</tr>
<tr>
<td></td>
<td>10.37 (2.80, 38.34)</td>
<td>4.76 (1.04, 21.81)</td>
</tr>
<tr>
<td>Use and sharing of LDSSs and HDSSs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never shared syringes and never used an HDSS</td>
<td>Ref</td>
<td>Ref</td>
</tr>
<tr>
<td>Shared LDSS but never used an HDSS</td>
<td>1.08 (0.44, 2.66)</td>
<td>0.89 (0.34, 2.33)</td>
</tr>
<tr>
<td>Used an HDSS but never shared any type of syringe</td>
<td>1.92 (0.82, 4.51)</td>
<td>1.50 (0.60, 3.77)</td>
</tr>
<tr>
<td>Used an HDSS and shared an LDSS</td>
<td>2.44 (1.06, 5.63)</td>
<td>1.40 (0.53, 3.73)</td>
</tr>
<tr>
<td><strong>Used and shared HDSS</strong></td>
<td><strong>4.02 (1.88, 8.61)</strong></td>
<td><strong>2.50 (1.01, 6.15)</strong></td>
</tr>
</tbody>
</table>

Zule and Bobashev, 2009. Drug & Alcohol Dependence
Modeling the Effects of Syringe Type on HIV Prevalence among IDUs
HIV prevalence in the high-risk IDU networks, assuming 15% initial prevalence

Note. Solid, dashed, dotted, and long-dashed lines correspond to 100%, 50%, 10%, and 0% of HDSS, respectively. Thin lines correspond to 95% bounds of simulated trajectories.

Ecological Data on Syringe Type and HIV Prevalence among IDUs

(Dead Space Syringe Project)
Methods

- Review of peer-reviewed and gray literature on HIV prevalence and potential confounders among IDUs in cities across Europe and Asia.

- Contact syringe exchange operators to obtain syringes, information on types of syringes used and on potential confounders.
Preliminary Results

Search Results
- Identified 2449 articles, reports, abstracts, etc.
- 191 cities with multi-year HIV IDU prevalence data in 51 countries

Survey Results
- Received information on the types of syringes used in more than 75 cities in over 25 countries

HIV prevalence in 70 HDSS cities ranged from <1% to >70%

HIV prevalence in 5 LDSS cities ranged from <1% to 6%
Syringes from Around the World

Low Dead Space

High Dead Space

Budapest
Bratislava
Vienna
Dnipropetrovsk
Hanoi
Sevastopol
Dhaka
Kiev
Conclusions

- Results of laboratory experiments, cross-sectional studies, mathematical models, city level ecological data on syringe type and HIV prevalence among IDUs are consistent with the biologically plausible hypothesis that LDSS may prevent HIV epidemics among IDUs.
Next Steps

- **Add to existing evidence**
  - Link HDSS use to incident HIV infections
  - Persuade other IDU researchers to collect data on syringe type

- **Reduce Use of HDSS**
  - Convince policy makers and syringe exchange funders to reduce the availability of HDSS
  - Increase acceptance of LDSS among IDUs
  - Insure availability of LDSS that meet IDUs needs
Acknowledgements

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  - Georgiy Bobashev for developing mathematical models illustrating the impact of syringe type on HIV epidemics.

- Dead Space Syringe Project Staff and Consultants
  - Staff: Curtis Coomes and Winona Poulton
  - Consultants: David Otiashvili, Sam Friedman, Don Des Jarlais, Anna Gyarmathy


