Learning Objectives:

- Define what a needle exchange program is and the various tools and resources provided from their services
- Describe how common blood-borne diseases are transmitted
- Understand the dangers of reusing and sharing needles
- Explain how the needle exchange program in Albuquerque, New Mexico operates
- Discuss the opposing viewpoints of needle exchanges
- Evaluate the literature regarding needle exchange programs
I. Introduction
a. Statistics
i. Each year, 50,000 Americans are newly infected with HIV\(^1\)
ii. Injection drug use accounts for 14 percent of new HIV infections among women and 11 percent of new HIV infections among men in the United States in 2010\(^2\)
iii. Approximately 3.2 million Americans are living with hepatitis C (HCV), and deaths related to HCV have increased substantially over the last decade\(^3\)
iv. Needle sharing is a primary cause of hepatitis C infection in the U.S., with an estimated 50–80 percent of drug users becoming infected with HCV within five years of their first drug injection\(^4\)

b. Definitions\(^5,6\)
   • Needle Exchange Program (NEP) or (Syringe Exchange Program [SEP] or Needle and Syringe Program [NSP]): provide free sterile syringes and collect used syringes from injection-drug users (IVDUs) to reduce transmission of blood borne pathogens, including human immunodeficiency virus (HIV) and hepatitis C virus (HCV). \(^7\) Typically also provide supplies, services, and referrals including literature and instruction on disease prevention and safer injection techniques
   • Injection Kit: Consists of tape and sharpie for marking items, alcohol swabs, cookers, sterile water, vitamin C powder or ascorbic acid, tourniquets or ties, filters, syringes, sharps container, and cotton balls.
     o Vitamin C or ascorbic acid, (about one-quarter the size of the substance being used), is used to help dissolve brown heroin and crack. Too much vitamin C will make the solution too acidic and can cause vein problems. Vinegar and lemon juice are not recommended, as they can cause fungal infections and damage veins.
     o Cotton balls are used to filter particles from liquid drugs
   • Crack: The street name for a crystallized form of cocaine that is formed into small lumps. A lump is often referred to on the street as a “rock”
     o Crack can be either smoked or injected.
   • Smoke/Crack Kit: Consists of a Pyrex pipe, rubber mouth piece, brass screen for filtering, chopsticks, lighter, alcohol swabs, chewing gum, (to prevent lockjaw and keep mouth salivating), ascorbic acid, chapstick, and triple antibiotic ointment
     o Hepatitis transmitted through crack pipe sharing because lips dry and crack and blood is transmitted
     o Pipes made of plastic, soda cans or copper adds to the dangers of smoking crack by releasing toxic fumes when heated or burned. Thin glass pipes, such as light bulbs or syringes, break easily and can lead to cuts. Pyrex pipes are safest because they do not break down when heated and do not conduct heat as much as other materials, so burns are less frequent
     o Individual rubber mouth pieces are given so each person has their own and won’t spread infection even if sharing the same pipe
Brass screens are safer to use than steel wool or Brillo pads. In order to prevent the screens from coming loose and presenting a choking hazard when sucked into the throat, five to six screens are rolled up tightly and pushed into the glass stem with a chopstick, which will make sure they are firmly in place. Steel wool or Brillo pad screens are not as safe or effective as brass screens because they break down when heated and pieces frequently come loose when the crack vapors are inhaled. These pieces end up on the lips, (causing sores and burns), or are sucked into the throat and lungs where they cause more damage.

- **Bleach Kit**: Consists of a tube of sterile water and canister of bleach to kill most blood borne disease such as HIV
  - Hepatitis removal is controversial
- **Snorting Kit**: Consists of post-it notes, lotion with vitamin E, and straws
- **Sex Worker Kit**: May contain condoms, lubricant, and pepper spray
- **Hygiene Kit**: May contain deodorant, shampoo, condition, perfume, cotton pads, feminine products, shavers, and soap
- **Naloxone (Narcan)**: is a prescription medicine that reverses an opioid overdose, which can be caused by prescription analgesics such as oxycodone/acetaminophen (Percocet) and oxycodone (OxyContin), and illicit drugs like heroin. Naloxone will only reverse an opioid overdose; it does not prevent deaths caused by other drugs such as benzodiazepines, bath salts, cocaine, methamphetamine or alcohol.
  - Mechanism of Action: pure opioid antagonist with greatest affinity for the mu receptor. It acts by competing for the mu, kappa, and sigma opiate receptor sites in the CNS
  - Naloxone may also be effective for poly-substance overdoses such as a combined opioid and alcohol overdose.
  - Available in IV, IM, IN, and SC dosage forms
    - **IM**:
      - Wipe injection site with alcohol
      - Inject at a 90 degree angle into muscle (arm or thigh)
      - Push in plunger
    - **IN**:
      - Pull off two yellow caps
      - Screw spray device on to syringe
      - Pull red cap off vial and screw into bottom of syringe
      - Spray half of the vial up each nostril
  - It cannot be used to get high and is not addictive.
  - Naloxone is an antidote to opioid drugs. Opioids can cause respiratory depression, sedation, and hypotension. An overdose death may happen hours after taking drugs.
    - Naloxone can act as a bridge between the call to 911 and when help arrives to keep the person breathing.
  - The onset of action is 2-5 minutes. If the person doesn’t wake up in 5 minutes, a second dose should be given. Rescue breathing should be
done while waiting for the naloxone to take effect so that the person gets oxygen to their brain.

- Oxygen is the key to survival for someone experiencing an overdose

- People who are dependent on opioids may wake up with acute withdrawal symptoms. Acute withdrawal is a horrible experience, but the overdose victim is alive and can seek further medical care.

- Duration of action is about 30-90 minutes and the person can stop breathing again unless more naloxone is available.
  - For this reason, it is safest to call 911 and have the person taken in for medical care.

- A complete intra-nasal or intra-muscular kit costs about $65, and some of that cost is usually reimbursable by insurance. In some states, there are programs providing naloxone to those who need it for free or for a small donation.

c. Background

i. The first legal NEPs in the United States started in the 1980’s in Boston, MA and Tacoma, WA. 9

ii. There are more than 200 NEPs currently operating in 34 states, the District of Columbia, and Puerto Rico. 10 (See Appendix A, Figure 1, Page 17)

d. NEP Statistics 11, 12, 13, 14

i. In 2002, NEPs reported removing nearly 25 million used syringes from communities.

ii. NEP participants have been found five times more likely to enter drug treatment than those who had never used an exchange.

iii. NEPs throughout the country have reduced HIV transmission rates by one-third to two-fifths.

II. Blood-borne Disease Transmission 15, 16

a. How infections are spread

i. **Direct contact:** Infected blood or body fluid from one person enters another person’s body at a correct entry site, such as infected blood splashing in the eye.

ii. **Indirect contact:** A person’s skin touches an object that contains the blood or body fluid of an infected person, such as picking up soiled dressings contaminated with an infected person’s blood or body fluid.

iii. **Respiratory droplet transmission:** A person inhales droplets from an infected person, such as through a cough or sneeze.

iv. **Vector-borne transmission:** A person’s skin is penetrated by an infectious source, such as an insect bite.

b. Most common diseases spread: HIV and Hepatitis C

i. HIV (See Appendix B, Figure 2, Page 18)

   1. It starts with an exposure. Bodily fluids from an HIV-positive person need to come into contact with specific body parts of an HIV-negative person’s mucous membrane.
a. Most of the skin on the body is covered with a protective layer of fibers that makes the skin “dry” and that HIV cannot cross unless there is a cut or sore. The mucous membranes are not covered with this protective layer because it would impede their function.

2. Mucous membranes are more vulnerable and often the main “routes” that germs can enter the body.
   a. These membranes are covered with a layer of cells (called epithelial cells) that are tightly joined together. This helps to prevent germs from entering the body and causing an infection. Some mucous membranes (such as the rectum) have a single layer of cells while others (such as the foreskin, urethra, mouth and vagina) have multiple layers.

3. Under the cell layer, large concentrations of immune cells are responsible for attacking and killing germs that get past the cell layer
   a. To cause an infection after an exposure, HIV first needs to cross the cell layer and then avoid being destroyed by the immune cells below. HIV may not be able to either cross the cell layer or win its battle against the immune cells. This explains why some exposures to HIV do not lead to infection.

4. If the virus overcomes these defenses, it can enter the body and then spread past the site of infection to other parts of the body by entering the blood and lymphatic vessels
   a. Once HIV has spread throughout the body, the infection becomes permanent
   b. HIV can survive up to 30 days in blood within syringes

ii. Hepatitis C
   1. It is spread when the blood of a person with hepatitis C comes in contact with the bloodstream of someone else
      a. It only takes a small amount of blood to transmit hepatitis C
   2. Other modes of transmission include needle-stick, woman to baby, sharing drug equipment, unprotected sex, sharing hygiene and grooming supplies, and blood transfusions
   3. The virus can live outside of the body in open air for at least four days. In certain conditions, such as the inside of a syringe, the virus can live for many weeks

   c. Nasal transmission
      i. When a drug is snorted, it comes into contact with the lining of the nasal cavity
      ii. The drug itself can cause the blood vessels to dilate and rupture, allowing tiny amounts of blood to leak out onto the snorting device
iii. Sometimes, drugs are mixed with materials like laundry detergent or ground glass that cause tiny cuts and tears in the nasal passages
   1. These tiny cuts or tears allow the drug to be absorbed faster into the body, but they also allow for the transfer of blood to the device
iv. Once another person reuses a snorting device, blood from the previous person can be passed on. When this blood is infected with Hepatitis C, there is a risk of transmission
v. This risk increases with greater damage on the inside of the nose and the more a person uses. Recurring and frequent snorting can lead to nosebleeds, excessive mucous production and the destruction of the septum

III. Reusing and Sharing Needles
   a. Needles can start shedding and become duller when reused (See Appendix C, Figure 3, Page 19)
   b. Increased risk of bacterial growth on needle, increased pain when injecting, and increased risk of needle tip breaking off
   c. In the absence of syringe exchange programs, IV drug users (IVDUs) report reusing their needles an average of seven times

IV. Personal Experience: Albuquerque, New Mexico
   a. Needle Exchange Program Services
      i. New Mexico Harm Reduction Act of 1976
         1. NM Department of Health established and administered a harm reduction program for the purpose of sterile syringe and needle exchange
         2. Exchange or possession of syringes in compliance with the program does not constitute violation of the Controlled Substances Act
         3. Participants must be 18 years of age or older, current injection drug user, and given a yellow card with a unique identifier code that expires one year after issuance
      ii. Facts
         1. Starting date: February 2, 1998
         2. 24 initial participants
         3. Over 14,500 participants as of 2012
         4. Over five million needles exchanged from 2008-2010
         5. In 2012, the program distributed more than 3.1 million clean needles and collected nearly as many.
      iii. Mobile outreach:
         1. Van operates 3-5 days a week. The full schedule is available online with mapped locations
         2. Supplies given: Injection kits, smoke/crack kits, sex workers kits, food, hygiene kits, naloxone
            a. Pharmacists in New Mexico can prescribe and distribute naloxone with special training and under a protocol
3. Services offered: Free HIV testing/counseling on site, drug rehabilitation referrals, domestic violence resources, homeless shelter referrals, medical doctor available for short appointments/procedures, pharmacist for counseling and vaccinations

4. Patient tracking: Yellow ID card valid for one year which allows participants to obtain the items and not be criminalized for possession

iv. Home site: Albuquerque Healthcare for the Homeless\(^5,\,20\)
   1. Free healthcare clinic open Monday-Friday
   2. Fully staffed, non-profit
   3. Interprofessional staff consisting of medical doctors, nurse practitioners, physician assistants, registered nurses, pharmacists, social workers, dentists, physical therapists, and healthcare students

b. Funding
   i. It is a Federally Qualified Health Care Clinic (FQHCC) that is funded by the federal government. FQHCs are community-based organizations that provide comprehensive primary care and preventive care, including health, oral, and mental health/substance abuse services to persons of all ages, regardless of their ability to pay or health insurance status.\(^20\)
   ii. Donations
   iii. Healthcare students
   iv. Volunteers

V. Pharmacist’s Role\(^21,\,22\)
   a. Selling syringes at a retail pharmacy
      i. Pharmacist’s discretion
      ii. Illegal/Against Policy
         1. Depends on state you practice in and/or company policy
   b. Pharmacist’s opinions
      i. 65% of pharmacists surveyed were willing to sell syringes to suspected IVDUs without a prescription
      ii. 35% of pharmacists surveyed refused to sell without a prescription unless diabetic status was proven
      iii. 68% of pharmacists surveyed favored providing free sharps containers to suspected IVDUs
      iv. 88% of pharmacists surveyed were willing to provide safer injection practices and drug treatment resources to suspected IVDUs
      v. 96% of pharmacists surveyed supported syringe exchange programs
      vi. Major concern was the effect of sales of syringes on other customers and the possibility of increased of syringe disposal/selling in or around their business

VI. Opposing Views
   a. Top two reasons against NEPs:
i. Encouraging or promoting drug use
   1. NEPS serve as critical entry points for drug users, and link individuals to comprehensive treatment and care, such as in New Jersey, where more than 22 percent (998 individuals) of the 4,482 people served by New Jersey’s five NEPs from 2007 to 2009 entered a drug treatment program.23
   2. Employment increased 44.8 percent within six months among clients of SEPs who received certain federal funding while the funding ban was removed.1

ii. Increased amounts of discarded, contaminated needles on the streets
   1. In Baltimore, a carefully designed systematic street survey showed no increase in discarded needles following the opening of an NEP.24
   2. Decrease seen in city with versus without NEPs.25

VII. Literature Review

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objective</strong></td>
<td>To compare the IV risk for HIV, HBV, and HCV infection among IVDUs in a city where syringe distribution is illegal versus a city where they are legal.</td>
</tr>
<tr>
<td><strong>Study Design</strong></td>
<td>Structured, qualitative interview and objective laboratory analysis</td>
</tr>
<tr>
<td><strong>Study Site(s)</strong></td>
<td>New York City, NY and Newark, NJ</td>
</tr>
</tbody>
</table>
| **Subjects** | • Recruited via street outreach  
• 18 years +  
• Injected drugs within past 30 days (heroin, cocaine, methamphetamines); confirmed via urine test and visual inspection  
• Ability to give consent  
• 526 participants (214 in Newark and 312 in NYC) |
| **Methods** | • IVDUs were interviewed about syringe sources and injecting risk behaviors in the past 30 days  
• Blood specimens were tested for HIV-1 antibody (via enzyme immunoassay with Western Blot confirmation), antibody to the hepatitis B core antigen or HBVcAb (using CORZYME immunoassay), and HCV antibody (via Abbott HCV immunoassay) |
| **Results (See Appendix D, Table 1, Page 19)** | • The risk of having been infected with one of the three diseases tested for was greater in Newark versus NYC  
• IVDUs in Newark had 26% of those tested test positive for HIV versus 5% in NYC  
• IVDUs in Newark had 70% of those tested test positive for the antibody to HBV core antigen versus 27% in NYC |
- IVDUs in Newark had 82% of those tested test positive for the antibody to HCV versus 53% in NYC
- IVDUs in Newark were more likely to obtain syringes illegally (93%) whereas NYC IVDUs were more likely to utilize pharmacies and NEPs (93%) (See Appendix D, Table 2, Page 20)
- IVDUs in Newark were more likely to inject with used needles (twice as likely), obtain needles from “street sellers,” (three times as likely) and to not always inject only once with a new, sterile syringe that had been sealed in a wrapper (See Appendix D, Table 3, Page 20)

### Authors’ Conclusions
- The implementation of legal sterile syringe distribution programs at the state and local level can prevent avoidable infections with HIV and hepatitis among IVDUs
- In states where NEPs are illegal, IVDUs are more likely to obtain syringes from unsafe places and engage in risky injecting behaviors

### Presenter’s Conclusions
Although there is always bias when using self reports, the laboratory data backs up the evidence that NEPs can assist in decreasing disease transmission amongst IVDUs

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Chose cities that were next to each other</td>
<td></td>
</tr>
<tr>
<td>• Physically collected blood samples</td>
<td>• Major population size differences (8 million in NYC versus 450,000 in Newark)</td>
</tr>
<tr>
<td></td>
<td>• Self-reported data used</td>
</tr>
<tr>
<td></td>
<td>• Unable to generalize information since only two cities looked at</td>
</tr>
</tbody>
</table>

### Study 225

### Objective
To compare syringe disposal practices in a US city with NSPs to a US city without NSPs by examining the prevalence of improperly discarded syringes in public places and the self-reported syringe disposal practices among IVDUs in the two cities

### Study Design
Observational and quantitative interview

### Study Site(s)
San Francisco, California and Miami, Florida

### Subjects
- IVDUs from neighborhoods known to have high levels of IV drug use
- Recently injected illicit drugs; confirmed via visual track marks and knowledge of IV drug use
- 18 years and older
• Ability to provide informed consent  
• 1,050 participants: 602 San Francisco & 448 in Miami

### Methods

• Visual inspection walkthroughs done in a random sample of the top-quartile of drug-affected neighborhoods in San Francisco, California (a city with NEPs) and Miami, Florida (a city without NEPs).
  • Recorded geographical location of each syringe (See Appendix E, Figure 4, Page 21)
  • The number of syringes was normalized to syringe density (number of syringes per 1000 inspected blocks) and syringe prevalence (number of syringes per 1000 population living in inspected blocks)
  • Conducted quantitative interviews with adult IVDUs in both cities regarding disposal in the past 30 days (See Appendix E, Table 4, Page 22)

### Results

• 11 syringes found in San Francisco  
• 328 syringes found in Miami  
• Syringe density in San Francisco was 44/1000 blocks and 371/1000 blocks for Miami  
• Proper disposal reported better in San Francisco versus Miami (See Appendix E, Table 5, Page 22)  
• There were eight times as many syringes found in public places in Miami versus San Francisco

### Authors’ Conclusions

• The data demonstrates that NSPs provide a venue for safe syringe disposal for IVDUs without an increase in public disposal  
• These findings also show that implementation of NSPs reduce the transmission of blood-borne diseases to IVDUs and other community members

### Presenter’s Conclusions

Although there are some factors that may limit the results generalizability, the huge difference in syringes found in a city with versus without NEPs shows that these programs really can make a difference. The self-reports, although subject to bias, clearly show that having a safe place for disposal decreases improper disposal. The safety of the communities that these are implemented in is increased.

### Strengths

• Addressed street sweeping and cleanup in both cities  
• Investigators physically gathered data  
• Sufficient way to compare the impact of NEPs

### Weaknesses

• No exclusion criteria given  
• Self-reported data used  
• Study done in two cities (generalizability), in two different years  
• Amount of area observed was not equal  
• Randomization of street blocks not explained

**Objective**
To analyze the cost-effectiveness of New York State-approved syringe exchange programs (SEPs) and estimate the cost-saving potential of these programs

**Study Design**
Cost-effectiveness analysis using cost and process data from seven SEPs

**Study Site(s)**
New York: Six sites in New York City and one site in Rochester

**Methods**
- Information collected from 1996 or most recent 12-month period
- Reported number of unduplicated patients participating
- Reported number of syringes distributed and returned
- HIV infections averted equation: \( A = c \times (1-p) \times a \times r \)  
  (See Appendix F, Table 6, Page 23)
  - HIV infections averted using simplified circulation model. This model uses the number of needles exchanged per client year and the number of shared injections per IVDU per year to estimate the decrease in HIV incidence through SEP participation
  - Self-reported cost information (regardless of source)
  - Estimated cost of HIV treatment was considered. The intermediate level of care was used in calculations, which is combination therapy with a pair of nucleoside analog reverse transcriptase inhibitors on detection of infection and adding a protease inhibitor when CD4 count drops below 500mm³. The total average cost is estimated at $195,188²⁷
  - Sensitivity analyses were done for estimated number of shared injections per IVDU per year and HIV incidence among non-SEP users. A sensitivity analysis is used to determine how different values of an independent variable will impact a dependent variable under a given set of assumptions.

**Results**
- The seven programs incurred costs of $1,822,426 for all-program costs which includes expenses related to supplies, materials, travel, and ancillary services (counseling and support groups)
- Estimated decrease of 60.09% in HIV incidence
- 92 HIV infections averted based on the equation above
- 87 HIV infections averted based on the simplified circulation model
- Cost effectiveness ratio of $20,947 per HIV infection averted calculated based on 87 HIV infections averted from the seven programs
- Median cost per HIV infection averted was $41,011
- Based on sensitivity analysis, low shooters (injecting once daily) and high shooters (injecting eight times daily) resulted in cost-effectiveness ratios of $18,596 and $21,957 per HIV infection averted, respectively.
- Using another sensitivity analysis, it was calculated that 40 HIV
infections might be averted at a program cost of $45,561 per HIV infection averted with an HIV infection rate of 2.41%. 189 infections could be averted at a program cost of $9,624 per infection with an HIV infection rate of 11.49%.

* Averting 87 HIV infections though IVDUs participation in SEPs would save almost $17 million in treatment costs. Even applying a low-level of care for treatment, it would still save $7.6 million in HIV treatment costs.

**Authors’ Conclusions**

* This research demonstrates that syringe exchange is a cost-effective and cost-saving strategy for reducing HIV transmission.
* Using imputed costs for donated services and estimates of lifetime costs to treat HIV, syringe exchange is cost-saving from a societal perspective.

**Presenter’s Conclusions**

Although the data comes from formulas and estimations, there seems to be definitive information that shows that syringe exchange programs are cost-effective in the long run especially when comparing the cost of treatment for infected individuals.

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Included all costs in calculations</td>
<td>• No data on other blood borne diseases</td>
</tr>
<tr>
<td>• Used formulas that are credible and have worked in previous studies</td>
<td>• Number of infections averted based on formulas rather than biologically measured</td>
</tr>
<tr>
<td>• References several other studies as supporting evidence</td>
<td>• Program costs were self-reported</td>
</tr>
<tr>
<td>• Gathered a sufficient amount of data</td>
<td>• No consideration for drug treatment cost or other program referrals</td>
</tr>
</tbody>
</table>

**VIII. Summary/Conclusion**

a. Needle exchange programs (NEPs) are a crucial component of a harm-reduction. Injection drug users often share needles and syringes, which in turn increases the risk of transmission of HIV and hepatitis C (HCV). If injection drug users are provided with new, sterile syringes and needles, this will reduce the sharing of drug equipment and thus decrease the transmission of blood borne diseases such as HIV and HCV.29

b. In addition to distributing sterile injection equipment, NEPs are a useful way of getting in touch with injection drug users in order to provide education and counseling and to connect them to health-care services and drug treatment programs.
c. Not all NEP participants are using illicit drugs. Many patients cannot afford needles for insulin or testosterone for example.
d. The lifetime cost of treating an HIV-positive person is estimated to be between $385,200 and $618,900. HCV costs hundreds of millions of dollars annually to treat. Many infected IVDUs are often uninsured or reliant on public sector programs (such as Medicaid) for their care, making taxpayers endure the burden of treatment costs.
e. With individual needles and syringes costing less than 99 cents, it is far cheaper to prevent a new case of HIV than to assume many years of treatment costs.
f. Final Recommendation
   i. I am in favor of NEPs because they assist in preventing disease transmission, increases public education, offers help to those who may need it, and can save lives

g. “Needle exchange offers us a way to say that drug addicts are people and they have an illness that merits concern and love. Needle exchanges are necessary. Until we get people in drug treatment, then this is a great way to take care of them”
References


6. Personal communication, Texas harm reduction officials. October 2014.


34. Father Errol Harvey, formerly of Manhattan’s St. Augustine Church. In Achieve: A quarterly journal on HIV prevention, treatment, and politics (Winter 2010)
Appendices

Appendix A

Figure 1
Appendix B

Figure 2
Appendix C\textsuperscript{18}

egin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure3.png}
\caption{Figure 3}
\end{figure}

Appendix D\textsuperscript{28}

Table 1

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|c|c|c|}
\hline
 & \textbf{Total, \(n\)} & \textbf{Newark, \(n\)} & \textbf{NYC, \(n\)} & \textbf{OR (95\% CI)} & \textbf{AOR (95\% CI)} & \textbf{\(p\) value} \\
 & \textbf{positive/n} & \textbf{positive/n} & \textbf{positive/n} & & & \\
 & \textbf{tested} & \textbf{tested} & \textbf{tested} & & & \\
 & \textbf{(% positive)} & \textbf{(% positive)} & \textbf{(% positive)} & & & \\
\hline
\textbf{All participants\textsuperscript{a}} & & & & & & \\
HIV+ & 67/487 (13.7) & 52/199 (26.1) & 15/288 (5.2) & 6.5 (3.5–11.9) & 3.2 (1.6–6.1) & 0.0007 \\
HBV+ & 214/469 (45.5) & 142/204 (69.6) & 72/265 (27.1) & 6.2 (4.1–9.2) & 4.4 (2.8–6.9) & <0.0001 \\
HCV+ & 320/487 (65.6) & 169/205 (82.4) & 151/282 (53.4) & 4.1 (2.7–6.3) & 3.0 (1.8–4.9) & <0.0001 \\
\hline
\textbf{African American/Black or Hispanic\textsuperscript{b}} & & & & & & \\
HIV+ & 58/266 (21.8) & 49/159 (30.8) & 9/107 (8.4) & 4.9 (2.3–10.4) & 4.0 (1.8–8.6) & 0.0006 \\
HBV+ & 154/267 (57.7) & 114/165 (69.1) & 40/102 (39.2) & 3.5 (2.1–5.8) & 3.0 (1.8–5.2) & <0.0001 \\
HCV+ & 197/269 (73.2) & 132/165 (80.0) & 65/104 (62.5) & 2.4 (1.4–4.2) & 1.8 (1.02–3.3) & 0.0414 \\
\hline
\end{tabular}
\caption{HIV, HBV, and HCV seroprevalence among drug injectors in Newark, NJ, and New York City, by city of recruitment, 2004–2006}
\end{table}

\textsuperscript{a}AOR adjusted by race/ethnicity and years since initiated injecting
\textsuperscript{b}AOR adjusted by years since initiated injecting
Table 2

<table>
<thead>
<tr>
<th>Source of Syringes</th>
<th>Total, N (%)</th>
<th>Newark, N (%)</th>
<th>NYC, N (%)</th>
<th>OR (95% CI)</th>
<th>AOR (95% CI)*</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Legal new sterile syringes</td>
<td>526 (100)</td>
<td>214 (40.7)</td>
<td>312 (59.3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>By going to SEP yourself</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>311 (62.9)</td>
<td>212 (99.1)</td>
<td>119 (38.1)</td>
<td>0.01</td>
<td>0.01</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Yes</td>
<td>155 (37.1)</td>
<td>2 (0.9)</td>
<td>193 (61.9)</td>
<td>(0.001–0.02)</td>
<td>(0.001–0.03)</td>
<td></td>
</tr>
<tr>
<td>From someone else who went to SEP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>482 (91.6)</td>
<td>212 (99.1)</td>
<td>270 (85.5)</td>
<td>0.06</td>
<td>0.11</td>
<td>0.0072</td>
</tr>
<tr>
<td>Yes</td>
<td>44 (8.4)</td>
<td>2 (0.9)</td>
<td>42 (13.5)</td>
<td>(0.01–0.25)</td>
<td>(0.02–0.55)</td>
<td></td>
</tr>
<tr>
<td>From SEP by yourself or others</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>316 (60.1)</td>
<td>210 (98.1)</td>
<td>106 (34.0)</td>
<td>0.01</td>
<td>0.01</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Yes</td>
<td>210 (39.9)</td>
<td>4 (1.9)</td>
<td>206 (66.0)</td>
<td>(0.004–0.03)</td>
<td>(0.004–0.04)</td>
<td></td>
</tr>
<tr>
<td>From a pharmacy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>369 (70.2)</td>
<td>207 (96.7)</td>
<td>162 (51.9)</td>
<td>0.04</td>
<td>0.03</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Yes</td>
<td>157 (29.8)</td>
<td>7 (3.3)</td>
<td>150 (48.1)</td>
<td>(0.02–0.06)</td>
<td>(0.01–0.07)</td>
<td></td>
</tr>
<tr>
<td>From SEP or pharmacy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>227 (43.2)</td>
<td>204 (95.3)</td>
<td>23 (7.4)</td>
<td>0.004</td>
<td>0.004</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Yes</td>
<td>299 (56.8)</td>
<td>10 (4.7)</td>
<td>289 (92.6)</td>
<td>(0.002–0.01)</td>
<td>(0.001–0.01)</td>
<td></td>
</tr>
<tr>
<td>Illegal &quot;new&quot; syringe acquisition sources</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>From a person selling syringes on the street</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>361 (68.6)</td>
<td>59 (27.6)</td>
<td>302 (96.8)</td>
<td>79.31</td>
<td>74.02</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Yes</td>
<td>165 (16.4)</td>
<td>155 (72.4)</td>
<td>10 (3.2)</td>
<td>(39.48–159.3)</td>
<td>(29.9–183.2)</td>
<td></td>
</tr>
<tr>
<td>From a friend or relative with syringes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>469 (89.2)</td>
<td>169 (79.0)</td>
<td>300 (96.2)</td>
<td>6.66</td>
<td>5.44</td>
<td>0.0001</td>
</tr>
<tr>
<td>Yes</td>
<td>57 (10.8)</td>
<td>45 (21.0)</td>
<td>12 (3.8)</td>
<td>(3.43–12.93)</td>
<td>(2.31–12.85)</td>
<td></td>
</tr>
<tr>
<td>From other sources</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>903 (95.6)</td>
<td>203 (94.9)</td>
<td>300 (96.2)</td>
<td>1.35</td>
<td>1.96</td>
<td>0.2576</td>
</tr>
<tr>
<td>Yes</td>
<td>23 (4.4)</td>
<td>11 (5.1)</td>
<td>12 (3.8)</td>
<td>(0.59–3.13)</td>
<td>(0.61–6.31)</td>
<td></td>
</tr>
<tr>
<td>Any illegal new syringes acquisition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>286 (56.3)</td>
<td>15 (7.0)</td>
<td>281 (90.1)</td>
<td>120.3</td>
<td>117.1</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Yes</td>
<td>230 (43.7)</td>
<td>199 (93.0)</td>
<td>31 (9.9)</td>
<td>(63.24–228.7)</td>
<td>(47.88–286.33)</td>
<td></td>
</tr>
</tbody>
</table>

Table 3

<table>
<thead>
<tr>
<th>Risk Behaviors</th>
<th>Total, N (%)</th>
<th>Newark, N (%)</th>
<th>NYC, N (%)</th>
<th>OR (95% CI)</th>
<th>AOR (95% CI)*</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Injected with a used syringe from another injector</td>
<td>526 (100)</td>
<td>214 (40.7)</td>
<td>312 (59.3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>460 (87.5)</td>
<td>173 (80.8)</td>
<td>287 (92.0)</td>
<td>2.72</td>
<td>2.32</td>
<td>0.0337</td>
</tr>
<tr>
<td>Yes</td>
<td>66 (12.5)</td>
<td>41 (19.2)</td>
<td>25 (8.0)</td>
<td>(1.60–4.63)</td>
<td>(1.07–5.04)</td>
<td></td>
</tr>
<tr>
<td>Reused own syringe</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>403 (76.6)</td>
<td>133 (62.1)</td>
<td>270 (86.5)</td>
<td>3.91</td>
<td>2.99</td>
<td>0.0004</td>
</tr>
<tr>
<td>Yes</td>
<td>123 (23.4)</td>
<td>81 (37.9)</td>
<td>42 (13.5)</td>
<td>(2.56–6.00)</td>
<td>(1.63–5.50)</td>
<td></td>
</tr>
<tr>
<td>Did not always inject once only with a new, sterile syringe that had been sealed in a wrapper</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>147 (27.9)</td>
<td>22 (10.3)</td>
<td>125 (40.1)</td>
<td>5.79</td>
<td>5.43</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Yes</td>
<td>379 (72.1)</td>
<td>192 (89.7)</td>
<td>187 (59.9)</td>
<td>(3.52–9.50)</td>
<td>(2.86–10.30)</td>
<td></td>
</tr>
</tbody>
</table>
Appendix E

Figure 4

Fig. 1. (A) Locations of found syringes, San Francisco, CA. (B) Locations of found syringes, Miami, FL.
### Table 4

Demographic characteristics of injection drug users in San Francisco (2008) and Miami (2009) and self-reported syringe disposal locations.

<table>
<thead>
<tr>
<th></th>
<th>San Francisco (N=602) (%)</th>
<th>Miami (N=488) (%)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>73</td>
<td>79</td>
<td>0.045</td>
</tr>
<tr>
<td>Female</td>
<td>26</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>Intersex</td>
<td>&lt;1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Race/ethnicity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White (Non-Hispanic)</td>
<td>44</td>
<td>23</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Black (Non-Hispanic)</td>
<td>37</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>10</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Native American</td>
<td>4</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Asian or Pacific Islander</td>
<td>&lt;1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Multiple Races/Other</td>
<td>5</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18–29</td>
<td>6</td>
<td>8</td>
<td>0.009</td>
</tr>
<tr>
<td>30–39</td>
<td>18</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>40–49</td>
<td>41</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>50+</td>
<td>35</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>Currently homeless</td>
<td>69</td>
<td>50</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>HIV-positive (self report)</td>
<td>15</td>
<td>10</td>
<td>0.014</td>
</tr>
<tr>
<td>Syringe disposal locations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public place</td>
<td>11.0</td>
<td>68.7</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Selling/giving away</td>
<td>12.7</td>
<td>12.6</td>
<td>0.979</td>
</tr>
<tr>
<td>Trash</td>
<td>52.5</td>
<td>66.2</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>NSP</td>
<td>61.5</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Hospital or clinic</td>
<td>11.5</td>
<td>1.6</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Pharmacy</td>
<td>1.2</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Sharps container</td>
<td>2.3</td>
<td>3.8</td>
<td>&lt;0.077</td>
</tr>
<tr>
<td>Flush down the toilet</td>
<td>15.0</td>
<td>2.0</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Public disposal box</td>
<td>7.0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Sewer/manhole</td>
<td>3.3</td>
<td>4.5</td>
<td>0.496</td>
</tr>
<tr>
<td>Any improper disposal</td>
<td>64.8</td>
<td>96.6</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

### Table 5

Number of syringes disposed in the past 30 days as reported by injection drug users in San Francisco (2008) and Miami (2009).

<table>
<thead>
<tr>
<th></th>
<th>San Francisco (%)</th>
<th>Miami (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public place</td>
<td>718 (1.1)</td>
<td>4689 (45.2)</td>
</tr>
<tr>
<td>Selling/giving away</td>
<td>680 (1.1)</td>
<td>675 (6.5)</td>
</tr>
<tr>
<td>Trash</td>
<td>5865 (9.1)</td>
<td>4004 (38.6)</td>
</tr>
<tr>
<td>NSP</td>
<td>53,143 (82.7)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Hospital or clinic</td>
<td>1049 (1.6)</td>
<td>200 (1.9)</td>
</tr>
<tr>
<td>Pharmacy</td>
<td>220 (0.3)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Sharps container</td>
<td>238 (0.4)</td>
<td>334 (3.2)</td>
</tr>
<tr>
<td>Public disposal box</td>
<td>1135 (1.8)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Sewer/manhole</td>
<td>136 (0.2)</td>
<td>234 (2.2)</td>
</tr>
<tr>
<td>Flush down the toilet</td>
<td>1026 (1.6)</td>
<td>163 (1.6)</td>
</tr>
<tr>
<td>Other</td>
<td>49 (0.1)</td>
<td>80 (0.8)</td>
</tr>
<tr>
<td>Total syringes improperly disposed</td>
<td>8474 (13.2)</td>
<td>9845 (94.9)</td>
</tr>
<tr>
<td>Total syringes disposed</td>
<td>64,259</td>
<td>10,379</td>
</tr>
</tbody>
</table>
Appendix F

Table 6

**COST-EFFECTIVENESS OF SYRINGE EXCHANGE**

<table>
<thead>
<tr>
<th>TABLE 1. Cost effectiveness analysis of syringe exchange; parameters to estimate number of HIV infections averted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter (symbol)</td>
</tr>
<tr>
<td>-------------------</td>
</tr>
<tr>
<td>Number of unduplicated clients</td>
</tr>
<tr>
<td>New York City ($c_{NYC}$)</td>
</tr>
<tr>
<td>Rochester ($c_{ROCH}$)</td>
</tr>
<tr>
<td>HIV seroprevalence in IDU population</td>
</tr>
<tr>
<td>New York City ($p_{NYC}$)</td>
</tr>
<tr>
<td>Rochester ($p_{ROCH}$)</td>
</tr>
<tr>
<td>SEP client attendance rate (a)</td>
</tr>
<tr>
<td>Reduction in HIV incidence (r)</td>
</tr>
<tr>
<td>(per 100 person-years at risk)</td>
</tr>
</tbody>
</table>

<sup>a</sup> The source of the information is data collected by the SEPs.

<sup>b</sup> The source of the information is Q. Shi, Beth Israel Medical Center’s Chemical Dependency Institute.

IDU, injection drug user; SEP, syringe exchange program; NYSDOH, New York State Department of Health.