Reducing Healthcare Costs in New York with Syringe Exchange Program Implementation

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Abstract

This paper explores the cost-effectiveness of New York State-approved syringe exchange programs (SEPs), and provides an estimate of the annual savings in healthcare costs due to these programs. The research utilizes the simplified circulation model that estimated cost savings in Laufer's (2001) study, however with the most recent data. The cost-effectiveness analysis used data provided by seventeen SEPs, as well as published data for the most recent 12-month period available, and treatment costs from the literature. An estimated 1,608 human immunodeficiency virus (HIV) cases are averted annually in the injection drug user (IDU) population, which translates to about $51,754,152 in treatment cost savings each year due to syringe exchange programs in New York. This research further demonstrates the cost-effectiveness of syringe exchange as prevention strategy.

Keywords: Injection drug user, syringe exchange, HIV cost-effectiveness

Reducing Healthcare Costs in New York with Syringe Exchange Program Implementation

Many studies have been conducted that demonstrate the effectiveness of syringe exchange programs in reducing HIV transmission, yet they are still controversial despite their success. SEPs provide clean syringes and collect used syringes from IDUs in an effort to reduce the spread of blood borne pathogens, such as HIV, hepatitis B virus, and hepatitis C virus. Injection drug users typically do not use sterile syringes, and through blood to blood contact, many blood pathogens are spread through them. The effects of SEPs are indeed a decrease in the spread of viruses, and even drug use. An additional effect is a decrease in healthcare costs due to SEP cost-effectiveness. For example, a clean syringe costs less than 50 cents, but the average lifetime cost of treating an HIV-positive person is around $425,000, and up to $300,000 for hepatitis C treatment (Frost, 2015). SEPs are primarily focused in prevention instead of treatment, an approach that should be prioritized, implemented, and funded more thoroughly. Further syringe exchange program implementation could greatly reduce the cost of healthcare in New York. By reviewing the published data and the reported data of each of the New York State-approved SEPs, the cost savings can be calculated.

A History of Syringe Exchange

The history of SEPs is a short one. Injection drug users can spread blood pathogens through the blood to blood contact which is involved in using un-sterile syringes. This fact was largely ignored up until the 1980s, when the AIDS epidemic was getting out of control. The Centers for Disease Control and Prevention (CDC) learned that the virus was spread through blood or sexual contact, and the realization dawned that they could potentially decrease the number of people infected by providing IDUs with clean syringes.

Affected Population: Injection Drug Users

It took a long while for the creation of a public health program idea such as SEPs, largely due to the fact that the population negatively affected is made up of drug users. In fact, many of the objections to SEPs seem to be grounded less in the effectiveness of the programs, and more in the stigmatizing of drug users and disapproval of drug use (Brownstein, 2014). Injection drug users are often treated as outcasts or untouchables by social service agencies, which is why the idea to offer them clean syringes to save their lives was such a large shift. This population is engaging in criminal acts, which reduces the opportunity for healthcare providers to offer counseling and rehabilitation services (Syringe Exchange Program, 2015). Syringe exchange programs are often the only resource in the community which is capable of engaging injection drug users in mental health or harm reduction psychotherapy services (Anderson, 2013). These programs act as a gateway for IDUs to receive help. The IDU population is large; in 2011, the number of heroin users in the U.S. was 620,000, and increasing (Delivering Harm Reduction Services Including Syringe Exchange, 2013).

Syringe Exchange Opposition

Critics of syringe exchange programs (SEPs) maintain the position that the programs encourage drug use, even though numerous studies have found that they actually reduce drug use. Individuals who support SEPs use the following scenario to argue against this statement:

> *Your county begins providing sterile syringes to injection drug users. Would this tempt you to begin using heroin? No, this would not (Ingraham, 2015**).***

Another possible opposition argument is the possible negative outcome of an increase in the number of improperly discarded used syringes. A study conducted in 2012 which compared

Miami and San Francisco answered to this argument. It was found that there were eight times more discarded used syringes on the streets of Miami, even though Miami had no SEP at the time and half as many injection drug users as San Francisco, a city which had many SEPs (Tookes, Kral, Wenger, Cardenas, Martinez, Sherman & Metsch, 2012).

Not all the arguments opposing SEPs should be dismissed. Another opposition argument is the possibility that the government issuance of injection equipment will send a message weakening efforts to combat illegal drug use, and will promote more drug use. A similar argument is the possible negative outcome that SEPs will lower the perception of risk of injection drug use, and encourage more users to inject drugs and to move to other forms of illegal drug use. Additionally, the negative outcome of increased arrests, as well as problems with the law exist (Normand, Moses & Vlahov, 1995). Many studies have shown that syringe exchange does not increase drug use or crime. These studies justify their findings by comparing the similarities between syringe exchange and providing access to condoms. In the example of condom access, individuals will not be having more sex. They will have the same amount of sex that they were having, however, they are going to have sex more safely (Delivering Harm Reduction Services Including Syringe Exchange, 2013). In the case of injection drug users, they will be injecting the same amount of drugs that they were injecting before, and they will be using a safer method.

HIV, Hepatitis, and Health Risks

About 20% of Acquired Immunodeficiency Syndrome (AIDS) cases and over 55% of hepatitis C cases can be attributed to injection drug use, which stresses the practicality of SEPs as a tool in the fight against these diseases (Cost-Effectiveness of Syringe Exchange Programs, 2016). Infected syringes result in 3,000-5,000 transmissions of HIV each year (Centers for

Disease Control and Prevention, 2013). As of 2013, 116,452 New Yorkers had been diagnosed with HIV or AIDS; this was a 1.3% increase in the rate of persons living with HIV/ AIDS from 2012. About 20% of those infected had injection drug use history, which is 23,290 IDUs (Paone, O'Brien & Tuazon, 2014).

SEPs were first expanded in New York during the AIDS epidemic in 1992, and this was followed by a dramatic reduction in HIV incidence among injection drug users. The HIV incidence in IDUs declined from 54% in 1990 to 13% in 2001, and hepatitis C prevalence declined from 90% to 63% **(**Des Jarlais, Perlis, Arasteh, Torian, Hagan, Beatrice & Friedman, 2005). SEPs are not only successful at reducing HIV and hepatitis viral infections, but they have been shown to be cost-effective, yielding substantial cost savings because treatment for these diseases is very expensive. By 2010, HIV/AIDS had led to the death of 600,000 Americans (Centers for Disease Control and Prevention, 2007). The loss of human lives as well as the treatment is costly to society.

Injection drug users who use un-sterile syringes are at risk for other ailments as well, ranging from collapsed veins, reduced circulation, blood clots, embolisms, infections, as well as causing scarring and permanent damage to tissues. If the IDU decides to attempt sharpening the syringe, the risk of shaved off shards of metal getting inside the syringe and in turn entering the body is high (L, 2014). Figure 1.0 in Appendix A shows a magnified view of a syringe before use, after one use, and after six uses. The syringe becomes visibly damaged, and will in turn damage the body tissue of the IDU. These are all health risks that could cause chronic disease and increase health costs. Another significant risk for IDUs is overdose. In 2014 alone there were 10,574 overdose deaths related to heroin (Castillo, 2016). Again, this loss of life is costly to society.

Politics of Syringe Exchange Over Time

The federal government has refused to fund SEPs since 1988. Funding continued to be withheld even though it was proven that SEPs have considerable benefits. While much research demonstrates that SEPs are essential, stigma is attached to the practice by those fearing promotion of risky behavior. This has made it difficult to implement programs in many places. Estimates of coverage in major metropolitan statistical areas ranged from .03% to as high as 22%, with a mean of 3.2% in 1996 (The U.S. Conference of Mayors, 1996). The uneven placement of SEPs in the U.S. involved political, socioeconomic, and organizational characteristics of areas, and these factors effected service needs, resources, opposition, and localized action (Tempalski, 2007).

Approximately 100,000 to 200,000 IDUs live in New York City, more than any other city in the United States. SEPs were established in New York in 1992 to prevent HIV transmission by distributing sterile syringes and injection equipment. These programs worked, yet gaps in syringe access continued in certain communities and areas. As of 2005, 22,000 IDUs were still living with HIV in New York (Frieden, 2006). Several New York City studies demonstrated that IDUs enrolled in SEPs decreased high-risk injection behavior such as using contaminated syringes or sharing injection equipment by more than 50% (Des Jarlais et al., 2005). The National Institute of Health reported that IDUs who have access to clean syringes reduce risky behaviors by 80%. Furthermore, these programs provide access to care for IDUs and connect them to services; studies show that participants “were five times more likely to enter drug treatment than non-participant IDUs”, and they were more likely to stay in treatment (Hagan, McGough, Thiede, Hopkins, Duchin & Alexander, 2000).

Despite such evidence, SEPs are continually caught in political conflict. The ban that was created in 1988 prevented state and local jurisdictions from spending their federal health dollars on these programs. The ban on federal funding was temporarily lifted in 2009, but was then reinstated by Congress as part of the 2010 budget negotiations. Supporters of SEPs argued that lifting the ban would not cost any additional money; it would simply allow states to spend their federally allocated dollars on SEPs. The federal government provides the majority of funding for all HIV prevention services, yet more than 200 SEPs in the U.S. were operating on small budgets from local and state governments (Frost, 2015). Congress ended the ban on federal funding for SEPs in January of 2016. The government will not fund the syringes themselves, but they will fund all the additional program elements and the other services provided to participants (Castillo, 2016).

Today, the American Academy of Pediatrics, American Bar Association, American Medical Association, American Public Health Association, International Red Cross-Red Crescent Society, National Academy of Sciences, U.S. Conference of Mayors, World Health Organization, and the World Bank all officially support SEPs (Delivering Harm Reduction Services Including Syringe Exchange, 2013). SEP**s** will likely be a vital part of the statewide plans announced by New York Governor Andrew Cuomo to "reduce new HIV infections dramatically by 2020" (Frost, 2015).

Syringe Exchange Program Details

Syringe exchange programs (SEPs) typically deliver syringes through storefront programs, peer delivery programs, and outreach programs. Peer delivery and outreach are ways to get sterile syringes to drug users who are not willing to go into the store to get them or who may not know that it exists. Outreach consists of contacting people who might benefit from harm

reduction services. Peer delivery workers are usually former or current IDUs who have connections with a large network of IDUs who are unwilling to come into the storefront to obtain sterile syringes (Anderson, 2013). Most SEPs offer more than clean syringes; many offer supplies, food and drink, preventive health and clinical services, HIV and Hepatitis C counseling and testing, sexually transmitted disease screening, tuberculosis screening, referrals to substance abuse treatment, and more. SEPs not only benefit IDUs by helping to prevent the transmission of blood borne diseases, they also benefit the communities in which they operate by keeping discarded syringes off the streets, giving homeless or unstably housed IDUs alternatives to street involvement, and serving as a gateway to engage IDUs in services such as mental health and substance use counseling, housing, and case management. Many programs have a space which allows homeless and unstably housed IDUs to get inside off the streets and get warm in the winter or cool in the summer and to have a drink or some food. Finally, it is becoming more common for SEPs to provide training in overdose prevention and reversal, and to provide overdose reversal kits containing naloxone, also known as Narcan. Naloxone is the only drug which can save a life by reversing an opioid overdose (Anderson, 2013).

Syringe exchange protocols include using harm reduction techniques that accept rather than judge participants, confidentiality, being aware of verbal and non-verbal feedback, providing referrals based on the participant's needs and choices, and assuring that services are accessible. Methods which evaluate these programs include analysis of program outcome objectives and participant surveys. Data sources used for quality improvement include quarterly reports, periodic surveys of participants, and epidemiological data in relation to drug treatment referrals, HIV, Hepatitis C and other blood borne infections (Syringe Exchange Program, 2015). Assessment of the success of a SEP may involve measuring the numbers of syringes exchanged,

the cleanliness of circulating syringes, the prevalence and incidence of HIV and other needle-borne diseases, referrals to drug treatment programs, enrollments in treatment programs, and changes in the risk behaviors of syringe exchange participants (Normand et al., 1995)**.**

Cost Effectiveness

Syringe exchange programs not only save lives, but also save millions of dollars in chronic disease treatment costs. It is estimated that a national implementation of SEPs in the late 1980s would have saved 20,000 lives and $1.1 billion in health care costs by the year 2000 **(**Frost, 2015). A 2005 Centers for Disease Control and Prevention study found that the cost to prevent one HIV infection by SEPs is only $4,000–$12,000 (HIV Cost-effectiveness, 2005). An average city would have to spend only $131,000 a year to run one SEP (about $20 per user per year), a small amount in comparison to the $120,000 in public health costs for one single case of infection (The U.S. Conference of Mayors, 1996).

HIV and AIDS

A sterile syringe costs between 10 and 50 cents, while the average lifetime cost of treating an HIV-positive person is estimated to be around $488,000. HIV-positive injection drug users are reporting higher levels of unemployment and homelessness, pushing the responsibility of cost onto public programs such as Medicaid **(**Frost, 2015). An analysis by Johns Hopkins University researchers showed that expanding the availability of SEPs to cover just 10% of all injections in the United States would prevent 500 new HIV infections among IDUs per year. This translates into $193 million in savings from prevented treatment costs; in other words, every dollar spent on syringe exchange saves between $3 and $7 in HIV treatment costs **(**Frost, 2015). Figure 2.0 in Appendix A demonstrates the relationship between additional investment in SEPs

and savings in treatment costs. SEPs in New York City alone have prevented approximately 45,000 HIV infections since the mid-1990s, saving about $1.7 billion in treatment costs (Delivering Harm Reduction Services Including Syringe Exchange, 2013).

A study conducted by Nguyen (2014) found that with an annual $10 million investment in SEPs 194 HIV infections would be averted, and result in treatment cost savings of $75.8 million. A $50 million increase in funding would avert 816 infections and save $319.1 million in treatment costs (Nguyen, Weir, Des Jarlais, Pinkerton & Holtgrave, 2014). Based on published rates of needle sharing, injection frequencies and HIV prevalence, a study by Laufer (2001) reported that SEPs decreased HIV incidence by an estimated 60.09% during the study period, resulting in about 87 HIV infections averted. The median cost of each HIV infection averted was $41,011, and when the cost of HIV infections to society is included, the 87 averted HIV infections would translate into cost savings of nearly $17 million (Laufer, 2001). The data from New York State collected in this study shows that each infection prevented by a SEP saved over $20,000 in healthcare costs (Laufer, 2001).

Hepatitis

Hepatitis causes cirrhosis of the liver, which results in about 1,000 liver transplants each year, costing $500,000 for each procedure. Currently in the U.S. we are spending about $20 million a year on SEPs. Given that the medical cost of a single infection is a half million dollars, we are saving money if we prevent more than 40 new infections a year (Delivering Harm Reduction Services Including Syringe Exchange, 2013). In 2014, the cost to provide hepatitis C treatment was anywhere between $84,000 and $300,000. The cost of preventing a drug-related infection is 150 times more cost efficient than the cost efficiency of transfusion-related infection (Ruiz, Gable, Kaplan, Stoto, Fineberg & Trussell, 2002).

Methodology

The effects of syringe exchange programs are decreases in the spread of viruses, drug use, and healthcare costs. The AIDS Institute of the New York State Department of Health estimates that the twenty-four state-approved syringe exchange programs may be responsible for a 50% to 75% decline in rates of new HIV infection (New York State Department of Health, 2014). The cost of a clean syringe is barely one dollar, and it only takes a few thousand dollars in SEP services to prevent a case of HIV. However, it can cost hundreds of thousands of dollars to treat someone with HIV. If the facts point significantly to the fact that SEPs dramatically reduce healthcare costs, which is a growing problem in our country, they may be more widely implemented.

The annual cost savings of New York has been determined by multiplying the number of HIV cases averted annually by SEPs by the average annual cost of treating an HIV infection. Existing data was collected and analyzed to use as secondary sources. Additionally, data from syringe exchange programs in New York were utilized as primary sources. Data was collected from the programs through their websites, email, and annual reports, and include the number of syringes distributed annually, the number of estimated cases prevented in one year, and the program's number of participants.

Each of the 24 syringe exchange programs in New York were asked to provide information from the most recent 12-month period. They were asked to provide the number of syringes distributed annually, and the number of annual participants. 17 of the 24 programs in operation participated in the study. The number of HIV infections averted annually was estimated using a simplified circulation model. This model uses the equation $E / (E + S)$ to estimate the decrease in HIV incidence through SEP participation, where E is the number of

syringes exchanged per client year, and *S* is the number of shared injections per IDU per year (Laufer, 2001). This decrease in HIV incidence is then applied to *N*, the projected number of SEP participants who would contract HIV in the absence of the SEP (Laufer, 2001). Multiplying these can be used to estimate the number of HIV infections averted annually, a number necessary to determine cost savings.

Results

The number of HIV infections averted was estimated using the simplified circulation model. Calculations were based on averaged data collected from each of the participating syringe exchange programs in New York. The results of these calculations resulted in an estimated 1,608 HIV infections averted each year due to SEP participation. Estimated HIV infections averted were rounded to the nearest whole number.

The parameters of the simplified circulation model can be viewed in Table B2 in the Appendix. The syringe exchange rate (*E*) was obtained by dividing the reported number of annually distributed syringes (*b)* by the estimated client-years of participation. Client-years of participation was determined by multiplying the reported number of annual participants (*c*) by 0.483, the SEP participant attendance rate (*a*) (Paone, Des Jarlais, Caloir, Freidmann & Ness, 1994). Therefore, $E = 326{,}757 / (2{,}310 * .483)$, or $E = 292.864$. The number of shared injections per year (*S*) was obtained by multiplying the IDUs' injection frequency (*d*) of 780 injections per year (Des Jarlais, Marmor, Paone, Titus, Shi, Perlis & Friedman, 1996) by the needle sharing rate (*f*) of 24.6% (Jenness, Hagan, Liu, Wendel & Murrill, 2011). Therefore, $S = 780 * .246$, or $S = 191.88$. The equation $E / (E + S)$ was then used to estimate the decrease in HIV incidence through SEP participation (292.864 / 292.864 + 191.88). The estimated decrease in HIV incidence was calculated to be 60.4%. This is a slight increase from the estimated 60.09%

decrease in HIV incidence found in Laufer's (2001) study. The number of SEP participants who would contract HIV in the absence of SEPs (*N*) is calculated by multiplying the reported number of HIV-negative participants (*g*) by the estimated HIV incidence among non-SEP users (*i*) of 0.0526 (Des Jarlais et al., 1996). Therefore, $N = 2{,}102 * .0526$, or $N = 110.5652$. Applying the decrease in HIV incidence of 60.4% to the estimated 110.5652 SEP participants who would contract HIV in the absence of the SEP results in about 67 HIV infections averted. If each SEP averts 67 HIV infections on average each year, then the total number of HIV infections averted annually by New York State-approved SEPs is about 1,608.

Conclusions

Using the simplified circulation model, an estimated 1,608 HIV cases are averted each year by the 24 syringe exchange programs in New York. According to the New York State Department of Health (2014), each HIV infection costs New York State $37,969 each year in healthcare costs (New York State Department of Health, 2014). If each of the 1,608 HIV infections averted saves $37,969, the total savings each year is about $61,054,152. In fiscal year 2013/2014, total funding for New York State SEPs totaled $9.3 million (New York State Department of Health, 2014). If the annual cost to run the SEPs is subtracted from the estimated total annual savings, New York State is left with $51,754,152 in healthcare cost savings each year. These calculations further demonstrate the cost-effectiveness of syringe exchange as prevention strategy. Prevention should be the primary focus for aiding the IDU population, and as an added benefit treatment costs can be avoided entirely in some cases. SEPs should no longer be viewed as controversial, and the government should encourage the implementation of more state-approved programs. With more comprehensive and up-to-date evaluation of SEPs to

provide evidence of the full range of benefits of these programs as a prevention strategy, these programs will gain wider acceptance and more funding.

It should be noted that the results estimate the number of primary HIV infections averted. No attempt was made to estimate the number of secondary infections resulting from already infected participants. Additionally, no attempt was made to calculate the cost savings from hepatitis infections averted, or any other infection resulting from injection drug use. It should also be noted that the results used were based on reported data that was averaged together. This data does not reflect the size differences between syringe exchange programs throughout New York. Several programs are very large, and almost certainly avert more than 67 HIV infections each year. Future studies are needed to calculate the total cost savings when secondary infections, as well other infections, are considered. Additionally, future studies should be conducted which gather data from all of the New York State-approved SEPs, so that HIV infections averted may be calculated for each program and SEP size may be considered.

References

Access Care and Resources Health. (2017). *2015-2016 Annual Report*. Retrieved from http://acrhealth.org/docs/pdfs/1483716879.pdf

Anderson, K. (2013, July 19). Why Needle Exchange Is Good for Your Community. Retrieved February 23, 2016, from http://www.psychologytoday.com/blog/overcoming-addiction/201307/why-needle-exchange-is-good-your-community

BOOM!Health. (2014). *The BOOM!Health 2014 Annual Report* (Our Impact in Fiscal Year 2014). Retrieved from https://www.boomhealth.org/2014/

Brownstein, J. (2014, April 18). Opposition to Clean Needles for Addicts: Symbolism Over Science? Retrieved March 31, 2016, from http://america.aljazeera.com/articles/2014/4/18/needle-exchange-programs.html

Castillo, T. (2016, January 20). Congress Lifts Ban on Federal Funding for Syringe Exchange Programs. Retrieved March 31, 2016, from http://www.huffingtonpost.com/tessie-castillo/congress-lifts-the-ban-on_b_9032362.html

Centers for Disease Control and Prevention. (2012). *HIV Infection and HIV-Associated Behaviors Among Injecting Drug Users — 20 Cities, United States, 2009* (Weekly Report). Atlanta, Georgia. Retrieved from https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6108a1.htm

Centers for Disease Control and Prevention. *HIV/AIDS Surveillance Report, 2007*. Vol. 19. Atlanta: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention; 2009. http://www.cdc.gov/hiv/topics/surveillance/resources/reports/.

Centers for Disease Control and Prevention. *HIV Surveillance Report, 201l.* Vol. 23. Atlanta: US. Department of Health and Human Services, Centers for Disease Control and

Prevention; 2013. http://www.cdc.gov/hiv/topics/surveillance/resources/reports/.

Cost-Effectiveness of Syringe Exchange Programs. (n.d.). Retrieved March 31, 2016, from http://harmreduction.org/wp-content/uploads/2012/01/CostEffectivenessofSyringeExchangePrograms.pdf

Delivering Harm Reduction Services Including Syringe Exchange. (2013). Retrieved March 31, 2016, from http://www.amfar.org/endtheban/

Des Jarlais, D. C., Marmor, M., Paone, D., Titus, S., Shi, Q., Perlis, T., … Friedman, S. R. (1996). HIV incidence among injecting drug users in New York City syringe-exchange programmes. *The Lancet, 348*(9033), 987–991. https://doi.org/10.1016/S0140-6736(96)02536-6

Des Jarlais, D. C., Perlis, T., Arasteh, K., Torian, L. V., Hagan, H., Beatrice, S., … Friedman, S. R. (2005). Reductions in Hepatitis C Virus and HIV Infections Among Injecting Drug Users in New York City, 1990–2001. *AIDS, 19*. Retrieved from http://journals.lww.com/aidsonline/Fulltext/2005/10003/Reductions_in_hepatitis_C_virus_and_HIV_infections.5.aspx

Dewey, J. (2017, April 28). Syringe Exchange Program Question.

Frieden, T. (2006). *HIV Epidemiology Program* (1st Quarter Report No. 1). New York City: The New York City Department of Health and Mental Hygiene. Retrieved from http://www1.nyc.gov/assets/doh/downloads/pdf/dires/dires-2006-report-qtr1.pdf

Frost, K. R. (2015, April 17). Why Congress Should Rethink Syringe Issue. Retrieved March 31, 2016, from http://www.cnn.com/2015/04/17/opinions/frost-congress-rethink-syringe-issue/index.html

Gibbons, T. (2017, April 24). Syringe Exchange Program Numbers.

Hagan, H., McGough, J. P., Thiede, H., Hopkins, S., Duchin, J., & Alexander, E. R. (2000). Reduced injection frequency and increased entry and retention in drug treatment associated with needle-exchange participation in Seattle drug injectors. *Journal of Substance Abuse Treatment*, *19*(3), 247–252. https://doi.org/10.1016/S0740-5472(00)00104-5

Harlem United. (2014). *Harlem United 2014 Annual Report* (Annual Report) (pp. 2, 9). Retrieved from https://www.harlemunited.org/wp-content/uploads/2014/10/Harlem-United-2014-Annual-Report.pdf

HIV Cost-effectiveness. (2005). Retrieved April 28, 2017, from https://www.cdc.gov/hiv/programresources/guidance/costeffectiveness/index.html

Housing Works. (2015). *Housing Works 2015 Annual Report* (Annual Report). Retrieved from http://www.housingworks.org/i/page-media/HW_Inc_AnnualReport_2015_v4.pdf

Ingraham, C. (2015, March 31). Politicians Need to Get Over Their Squeamishness About Needle Exchange Programs. *The Washington Post*. Retrieved from https://www.washingtonpost.com/news/wonk/wp/2015/03/31/politicians-need-to-get-over-their-squeamishness-about-needle-exchange-programs/

Jenness, S. M., Hagan, H., Liu, K.-L., Wendel, T., & Murrill, C. S. (2011). Continuing HIV Risk in New York City Injection Drug Users: The Association of Syringe Source and Syringe Sharing. *Substance Use & Misuse*, *46*(2-3), 192–200. https://doi.org/10.3109/10826084.2011.521467

L, S. (2014, April 19). The Importance of Single Use Sterile Syringes for IV Drug Users. Retrieved March 31, 2016, from http://crosstalk.kinja.com/the-importance-of-single-use-sterile-syringes-for-iv-dr-1565090773

Laufer, F. N. (2001). Cost-effectiveness of syringe exchange as an HIV prevention strategy. *Journal of Acquired Immune Deficiency Syndromes* (1999), 28(3), 273–278.

Needle Exchange Programs: Counter-Productive? (2001, December 21). Retrieved March 31, 2016, from http://aras.ab.ca/articles/popular/alive-nep.html

New York State Department of Health, AIDS Institute. (2014). *Comprehensive Harm Reduction Reverses the Trend in New HIV Infections* (pp. 1–30). Retrieved from https://www.health.ny.gov/diseases/aids/providers/reports/docs/sep_report.pdf

New York Syringe Exchange Programs. (2017). Retrieved April 2, 2017, from https://nasen.org/directory/ny/

Nguyen, T. Q., Weir, B. W., Pinkerton, S. D., Des Jarlais, D. C., & Holtgrave, D. R. (2012). Increasing investment in syringe exchange is cost-saving HIV prevention: modeling hypothetical syringe coverage levels in the United States. *Johns Hopkins Bloomberg School of Public Health*. Retrieved from http://pag.aids2012.org/Abstracts.aspx?AID=17268

Nguyen, T. Q., Weir, B. W., Des Jarlais, D. C., Pinkerton, S. D., & Holtgrave, D. R. (2014). Syringe Exchange in the United States: A National Level Economic Evaluation of Hypothetical Increases in Investment. *AIDS and Behavior*, *18*(11), 2144–2155. https://doi.org/10.1007/s10461-014-0789-9

Normand, J., Moses, L. E., & Vlahov, D. (1995). The Effects of Needle Exchange Programs. Retrieved from http://www.ncbi.nlm.nih.gov/books/NBK232343/

NYS-Authorized Syringe Exchange Programs. (2016, June). NYSDOH/AIDS Institute - Harm Reduction Unit. Retrieved from https://www.health.ny.gov/diseases/aids/consumers/prevention/needles_syringes/docs/se

p_hours_sites.pdf

O'Connor, K. (2015, February 20). Used syringes: A growing health risk to Tier residents. Retrieved April 5, 2017, from http://www.ithacajournal.com/story/news/local/2015/02/20/syringes-needles-heroin-drug-use-addict/23731017/

Paone, D., Des Jarlais, D. C., Caloir, S., Freidmann, P., & Ness, I. (1994). New York City Syringe Exchange: An Overview. *National Research Council and Institute of Medicine Panel on Needle Exchange and Bleach Distribution*. Retrieved from https://www.ncbi.nlm.nih.gov/books/NBK236642/

Paone, D., O'Brien, D. B., & Tuazon, E. (2014, June). Drug Use Trends in New York City: 2013. Retrieved April 6, 2016, from https://www.drugabuse.gov/sites/default/files/newyorkcity2014.pdf

Ruiz, M., Gable, A., Kaplan, E., Stoto, M., Fineberg, H., & Trussell, J. (2002). *No Time to Lose: Getting More from HIV Prevention*. Washington, D.C.: Institute of Medicine, National Academy of Sciences. Retrieved from https://www.nap.edu/read/9964/chapter/1

St. Ann's Corner of Harm Reduction. (2016, November 29). Retrieved April 30, 2017, from http://www.sachr.org/

Syringe Exchange. (2015, October 10). Retrieved April 3, 2017, from http://nyhre.org/programs-services/syringe-exchange/

Syringe Exchange Program. (2015, June 1). Retrieved March 31, 2016, from https://louisvilleky.gov/sites/default/files/health_and_wellness/clinics/lmsapoperatingguidlines060915.pdf

Tempalski, B. (2007). Placing the Dynamics of Syringe Exchange Programs in the United States. *Health & Place*, *13*(2), 417–431. http://doi.org/10.1016/j.healthplace.2006.05.004

The U.S. Conference of Mayors. (1996). *Syringe Exchange in the United States: 1995 Update* (HIV Capsule Report No. 1).

Tookes, H. E., Kral, A. H., Wenger, L. D., Cardenas, G. A., Martinez, A. N., Sherman, R. L., … Metsch, L. R. (2012). A comparison of syringe disposal practices among injection drug users in a city with versus a city without needle and syringe programs. *Drug and Alcohol Dependence*, *123*(1-3), 255–259. https://doi.org/10.1016/j.drugalcdep.2011.12.001

Trillium Health & Pleasant Street Apothecary. (2014). *2013-2014 Annual Report* (p. 3). Retrieved from https://www.trilliumhealth.org/uploads/pdfs/Trillium%20Health%20Annual%20Report%202013-2014l.pdf

Vieira, G. (2014, January 10). How Many Times Can You Reuse a Syringe? Retrieved April 30, 2017, from http://www.diabetesdaily.com/blog/2014/01/how-many-times-can-you-reuse-a-syringe/

Washington Heights Corner Project. (2016). *A year of Care for Each and Every Participant*. Retrieved from http://www.cornerproject.org/

Zagari, C. (2017). New York State-Approved Syringe Exchange Program Locations [Map]. NY.

Appendix A

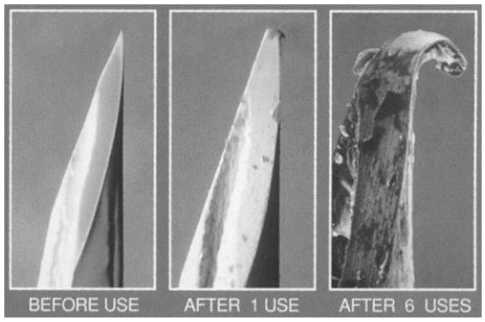

Figure 1.0: Syringe Use (Vieira, 2014)

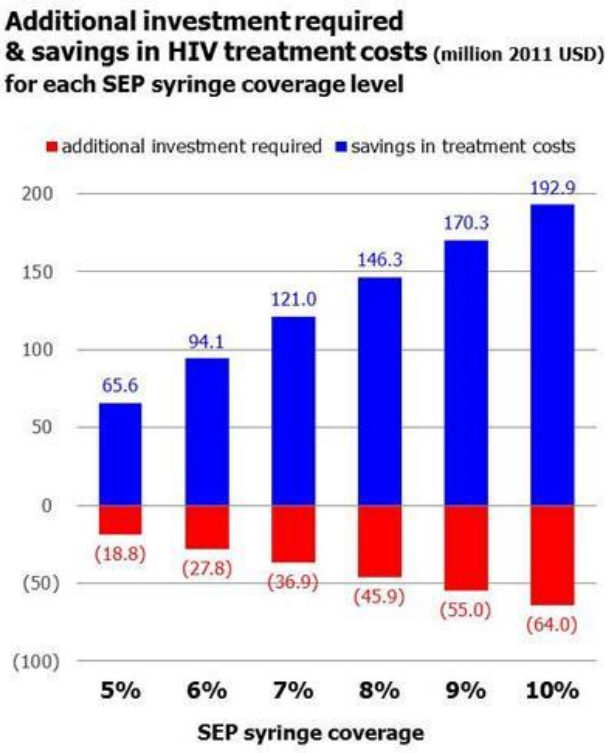

Figure 2.0: Relationship Between Investment in SEPs and Savings in Treatment Costs (Nguyen, Weir, Pinkerton, Des Jarlais & Holtgrave, 2012)

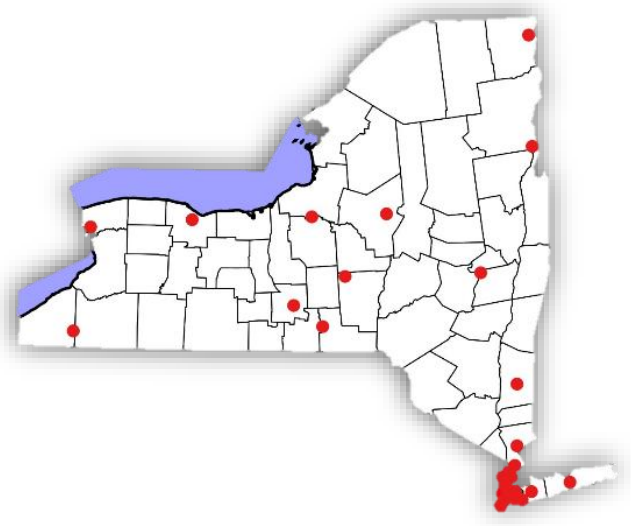

Figure 3.0: New York State-Approved Syringe Exchange Program Locations (Zagari, 2017)

Appendix B

Table B1: Averaged SEP Data Reported

Syringe Exchange Program	**Locations**	**Average Annual Client # (*c*)**	**Average Annual Syringes Distributed # (*b*)**	**Sources**
ACR Health	Syracuse Utica	2,083		Access Care and Resources Health, 2017
After Hours Project	Brooklyn	4,497		New York State Department of Health, 2014
AIDS Center of Queens County	Woodside Far Rockaway Jamaica Long Island City	2,823		New York State Department of Health, 2014
Alliance for Positive Health	Plattsburgh Ticonderoga	275	456,108	Gibbons, 2017
BOOM!Health	Bronx	8,285	256,288	New York State Department of Health, 2014 BOOM!Health, 2014
Catholic Charities AIDS Services	Albany Schenectady Troy	707		New York State Department of Health, 2014
Community Action for Social Justice	Long Island			
Community Health Action of Staten Island	Staten Island	1,182		New York State Department of Health, 2014
Evergreen Health Services	West Buffalo Jamestown			
Family Services Network of NY	Brooklyn			
Harlem United Community AIDS Center	Bronx		200,000	Harlem United, 2014
Housing Works	Manhattan	822	85,525	Housing Works, 2015

Hudson Valley Community Services Inc.	Newburgh Poughkeepsie	461	126,200	Dewey, 2017
Long Island Minority AIDS Coalition	Hempstead	675		New York State Department of Health, 2014
Lower East Side Harm Reduction Center	Manhattan			
NY Harm Reduction Educators	Bronx	3,257	776,944	Syringe Exchange, 2015
Positive Health Project	Manhattan			
Safe Horizon	NYC	1,339		New York State Department of Health, 2014
Southern Tier AIDS Program	Ithaca Johnson City	600	541,116	O'Connor, 2015
St. Ann's Corner of Harm Reduction	Bronx	8,600		St. Ann's Corner of Harm Reduction, 2016
Trillium Health	Rochester	762		Trillium Health & Pleasant Street Apothecary, 2014
Urban League of Westchester	Mount Vernon			
VOCAL-NY	Brooklyn	375		New York State Department of Health, 2014
Washington Heights Corner Project	Washington Heights	2,525	171,878	Washington Heights Corner Project, 2016
Averages		**2,310**	**326,757**	

Table B2: Simplified Circulation Model Parameters

Variable	Value	Source
E (number of syringes exchanged annually)	***E* = *b* / (*c* * *a*)**	Laufer, 2001
a (client attendance rate)	.483	Laufer, 2001 Paone et al., 1994
b (syringes distributed annually)	326,757	SEP data
c (number of clients annually)	2,310	SEP data
S (number of shared injections per IDU annually)	***S* = *d* * *f*** *S* = 191.88	Laufer, 2001
d (IDU injection frequency)	780 injections per year	Des Jarlais et al., 1996
f (rate of injection sharing among IDUs)	.246	Jenness et al., 2011
g (number of HIV-negative clients)	*g* = *c* * *h* 2,102	SEP data
h (percent of IDUs who are HIV-positive)	.09	Centers for Disease Control and Prevention, 2012
i (HIV incidence among non-SEP users)	.0526	Des Jarlais et al., 1996
N (Estimated number of IDUs who would contract HIV)	***N* = *g* * *i***	Laufer, 2001

**E* / *E* + *S* is the estimated decrease in HIV incidence
**N* is the estimated number of IDU's who would contract HIV
*(*E* / *E* + *S*) * *N* is the estimated annual number of HIV cases averted by SEPs