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Original Article

Examining the potential role of a supervised injection facility in Saskatoon, Saskatchewan, to avert HIV among people who inject drugs

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Abstract

Background: Research predicting the public health and fiscal impact of Supervised Injection Facilities (SIFs), across different cities in Canada, has reported positive results on the reduction of HIV cases among People Who Inject Drugs (PWID). Most of the existing studies have focused on the outcomes of Insite, located in the Vancouver Downtown Eastside (DTES). Previous attention has not been afforded to other affected areas of Canada. The current study seeks to address this deficiency by assessing the cost-effectiveness of opening a SIF in Saskatoon, Saskatchewan.

Methods: We used two different mathematical models commonly used in the literature, including sensitivity analyses, to estimate the number of HIV infections averted due to the establishment of a SIF in the city of Saskatoon, Saskatchewan.

Results: Based on cumulative cost-effectiveness results, SIF establishment is cost-effective. The benefit to cost ratio was conservatively estimated to be 1.35 for the first two potential facilities. The study relied on 34% and 14% needle sharing rates for sensitivity analyses. The result for both sensitivity analyses and the base line estimates indicated positive prospects for the establishment of a SIF in Saskatoon.

Conclusion: The opening of a SIF in Saskatoon, Saskatchewan is financially prudent in the reduction of tax payers' expenses and averting HIV infection rates among PWID.

Keywords: People Who Inject Drugs (PWID), HIV, Cost-Benefit Analysis, Canada

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Key Messages

Implications for policy makers

- Supervised Injection Facilities (SIFs) can be cost-effective even in small urban cities.
- SIFs are highly efficient entities that are able to reduce morbidity cases among People Who Inject Drugs (PWID).
- SIFs are also able to reduce overdose and other injection related illnesses.

Implications for public

North America's first and only Supervised Injection Facility (SIF) (Insite), has shown to be cost-effective with substantial savings to the local healthcare system relative to averting HIV, hepatitis C and overdose cases among People Who Inject Drugs (PWID). Moreover, numerous peer-reviewed research have demonstrated SIFs' cost-savings in the context of large and medium sized Canadian cities. It is important that despite the controversial nature of SIFs, they have shown to be highly cost-effective in reducing HIV even in small cities with high rates of PWID.

Background

The contraction and spread of HIV via People Who Inject Drugs (PWID) is not a problem exclusive to large cities and urban areas as small and medium sized towns have reported an increase in HIV infection (1). The Downtown Eastside (DTES) of Vancouver has historical shared similarities with many small cities in Canada in terms of HIV prevalence. Vancouver DTES has long been recognized for its composition of impoverished and dispossessed drug users and is currently home to more than 5,000 PWID (2). In the late 1990s, the DTES experienced one of the highest HIV and Hepatitis C Virus (HCV) infection in the developed world that was comparable to the epidemic in third world nations, such as Botswana (3,4). Since early 2000, the DTES has been positively transformed as a result of long standing harm reduction programs that have addressed an array of PWID needs, particularly the establishment of Insite, North America's only lawfully operated Supervised Injection Facility (SIF) (5–10).

Insite, located in the DTES of Vancouver, is a small injection facility with twelve individual booths that afford PWID with free sterile injection supplies to inject illicit drugs under the supervision of a registered nurse (11) (Figure 1).

Insite also offers its clientele access to social workers, doctors and a detoxification center located in close proximity to the facility (12). The procedural objectives of Insite have been assessed by more than 60 peer-reviewed studies offering promising results. Some of the noted effects are reduction

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Figure 1. Insite, North America's first and only SIF (photo provided by authors).

in overdose deaths, needle sharing, public injection and public discarded needles (12–14). In addition, most empirical analysis have reported cost-effectiveness of Insite in reducing HIV, HCV and overdose cases (4,15–18). More recently, a longitudinal study has suggested that the rate of needle sharing decreased substantially overtime along with a secondary effect in the reduction of HIV contractions (11). Consequently, there has been discussions among health experts and policy-makers as to the expansion of Insite in Vancouver and the implementation of the facility in other affected areas of Canada. One of the most pressing issues regarding the institution or expansion of Insite facilities is the effectiveness and cost-efficiency of SIF. This issue is of critical importance as the Canadian conservative federal government recently passed legislation Bill C-65 (now called Bill C2): *the Respect for Communities Act*, requiring that SIF operations be found economically viable within affected regions (11).

Further studies have assessed the cost-effectiveness of opening a SIF in Montreal, Ottawa and other drug affected regions in Canada. A recent study conducted in Montreal estimated the number of HIV and HCV cases averted with the opening of a potential SIF in the city (19). Expected fiscal savings amounted to more than three million Canadian dollars in HIV and HCV prevention (19). In a similar study conducted in Ottawa, the effects of opening a SIF in the city were examined (10). The sensitivity analyses at separate baseline sharing demonstrate the cost-effectiveness of SIF at a 19% needle sharing; at this baseline the cumulative annual cost model provided support for the establishment of two SIF and the marginal annual cost model for one SIF (10).

A recent cost-benefit ratio study suggests that supervised inhalation rooms, where drug users could smoke crack and crystal methamphetamine under supervision, has a saving potential of Can$1.45 per year for each facility (20). The cost-benefit/cost-effectiveness analysis focused on HCV cases and the rate of transmission via a contaminated crack pipe. The results infer that the expansion of the facility would be of great utility to other affected regions in Canada (20). The current study focuses on the densely affected city of Saskatoon, Saskatchewan. Scant attention has been paid to the possibility of a SIF in the city and the benefits that such establishment may accrue. Saskatoon has an estimated population of 2,000 PWIDs, concentrated in the poorest neighborhoods in the city, most of whom are affected by poverty, low educational attainment and have meager access to job opportunities (21). Morphine and powdered cocaine are the two most preferred drugs of choice among PWIDs. And, most users utilizes an average of 1,000 needles per year (21).

Since 1993, the government of Saskatoon has made attempts to reduce the incidence of HIV through needle exchange outreach programs and has increased funding toward related programs. Nonetheless, most of these endeavors have been unsuccessful in curtailing needle sharing practices among PWIDs. As a result, the incidence of HIV cases has sharply increased and is felt most acutely within the Indigenous population of Saskatoon where 9.2% of the Indigenous population accounts for 88.1% of PWID and 77.4% of the PWID Indigenous population has tested positive for HIV (3). The increase incidence of HIV among the Indigenous PWID population has been attributed to a history of colonization, residential school programs and lack of available non-judgmental services tailored specifically toward this group (3). In addition, many of Indigenous population of Saskatoon reside in area of the city that has "*higher rates of unemployment, lower education levels, a higher proportion of residents living below the low income cut-off (47% in 2006), higher rates of inadequate housing and limited access to nutritious and affordable food*" (22) (p. 10). Subsequently, it is not surprising that these areas have also shown higher rates of health disparities (23,24).

The authors elected Saskatoon as the study site due to its high HIV prevalence. With miniscule attention previously afforded to Saskatoon's PWID population, the authors hope to simulate the economic possibilities of SIF in reducing morbidity related diseases in this region. The study utilizes a cost-benefit and cost-effectiveness analysis employing HIV data and sharing needle cases in Saskatoon to determine the prospects of a SIF within the city. The analysis project the new HIV cases prevented as a result of establishing SIF and the possible benefits and costs of scaling up additional facilities. Subsequently, the avoided monetary costs of HIV cases are compared to the operating costs of potential facilities. Due to the unavailability of key parameters, HCV cases were excluded from the analysis, which made the costing study more conservative in reporting the benefits of SIF in Saskatoon.

Methods

Models

The current study focuses on two different mathematical models to estimate the number of HIV prevented as a result of establishing a SIF in Saskatoon. The first model was initially used in Edmonton, Alberta's evaluation of a needle exchange program in 1999. Later, the model was used in an economic evaluation of Insite (14–18,25,26). In addition, the model has been used to estimate the cost-benefit/cost-effectiveness of a SIF potential in Montreal, Quebec, and Ottawa, Ontario (10,19). The model has been employed to assess the economic viability of a supervised smoking facility in the DTES of Vancouver (20).

For the current model, the number of new HIV infections averted, (A), is calculated as follows:

$$\text{New HIV infections } (A) = 1Nsd[1-(1-qt)^m] \quad (1)$$

where (d) is the percentage of needles not cleaned before use, (N) is the number of needles in circulation, (q) is the HIV prevalence in the PWID population, (I) is the PWID population that is HIV positive, (s) is the rates of needle sharing, (t) is the probability of HIV transmission when using an HIV infected needles, and (m) is the number of sharing partners when injections are shared.

This study also relied on a second model to estimate the number of HIV prevented. The second model was originally used in the evaluation of New Haven, Connecticut needle depot in 1993 (27). The model was later utilized in the economic evaluation of North America's first supervised injection facility and in predicating the cost-effectiveness of a potential SIF in Ottawa, Ontario. The number of new HIV infections avoided, (A), is calculated as follows:

$$\text{New HIV infection } (A) = (1-\pi)\,\lambda(1-\theta)\beta\alpha$$

where (β) is the percent of HIV infected needles, (λ) is the rate of needle sharing, (π) is the prevalence of HIV within the PWID population, (α) is the probability of acquiring HIV from a single injection with contaminated syringe, and (θ) is the probability that a borrowed syringe is decontaminated (27). The data for both mathematical models were collected from published and peer-reviewed articles (see Table 1). To reduce selection bias, the values and parameters that were the most conservative in their reporting were selected (10,17,19, 20,26). In addition, preferences were given to peer-reviewed studies when other sources were available.

Marginal or cumulative benefits and costs are a critical part of any economical evaluation as they provide the relevant measurement of cost/benefits at a specific level of production and consumption (28,29). In simpler terms, marginal benefit and cost are the measurement of benefits or cost of producing one more unit. However, the cumulative benefits and cost accounts for the total measurement.

Infectious disease cases prevented

Previous costing studies have illustrated that SIF prevent shared or 'dirty' injections (10,15–19,28,29). Behavioral changes for those who attend SIF has been highlighted as an important factor in previous literature as well (30,31). Similar to previous costing studies, the current study employs Odds Ratio (OR) of 0.3 for behavioral change (10,17,19,20). Since we cannot expect all PWID to start utilizing SIF and eventually alter their injecting behavior, OR of 0.3 was only employed twice (for the first and second SIF only) (10,17,19,20). Ultimately, we limit the number of new users to Saskatoon's SIF by using the 0.3 OR. The total number of illicit drug injections per year in the city of Saskatoon was calculated by multiplying the number of PWID by number of injection per year estimated in a number of peer-reviewed studies [e.g. 2,000 PWID × 913 injections per year] (6,25,28,32,33). This number called G [estimated to be 1,826,000 injections per year] was later multiplied by the initial sharing rate to determine the number of shared injections in the city of Saskatoon.

The total number of injections at a SIF in Saskatoon was estimated to be 315,360 injections per year [V] [e.g. 3 injection per hour × 24 hours × 365 days × 12 booths]. V was estimated based on the reported injection that takes place on daily basis at Insite (34). For instance, 600 [T] injections take place at Insite in Vancouver (34). Subsequently, a ratio of 3 injection per 60 minutes is derived when T is divided by 216 [18 hours of operation at Insite × 12 booths operating]. Averted shared injections [Z] is derived when V is multiplied by the sharing rate [0.24]. After considering the OR [0.30], G is added to Z to determine the total potential prevented cases of needle sharing in the city of Saskatoon. The rate with a SIF, and the rate without a SIF is subsequently estimated and the difference is calculated. This method is repeated with increased numbers of SIFs.

The medical cost of new HIV

A 1996 New York data estimated the cost-effectiveness of needle exchange between $90,000 to $200,000 from HIV

Table 1. Sources for variables used in the first and second models

Variable	Value	Source
Proportion of IDUs HIV- (I)	85.00%	Laurence Thompson Strategic Consulting (21)
Rate of needle sharing (s) or (λ)	24.00%	Laurie and Green (36)
Number of needles in circulation (N)	1,000,000	Warren (37)
Percentage of needles not cleaned (d)	17.00%	Kaplan and O'Keefe (27); Jacobs *et al*. (25)
Probability of HIV infections from a single injection (t) or (α)	0.67%	Kaplan and O'Keefe (27)
Number of sharing partners (m)	1.38	Jacobs *et al*. (25)
Proportion of IDUs HIV+ (q) or (π)	15.00%	Laurence Thompson Strategic Consulting (21)
Proportion of HIV infected needles (β)	40.50%	Kaplan and O'Keefe (27)
Probability of needles cleaned (θ)	83.00%	Kaplan and O'Keefe (27); Jacobs *et al*. (25)

IDUs= Injection Drug Users.

cases averted (33,35). A similar costing study in Hamilton, Ontario estimated the life time treatment of HIV at $150,000 (38). In Edmonton, a costing study of needle exchange estimated the lifetime cost of treating HIV to be $94,000 (39). A comprehensive review of needle exchange program in Saskatchewan estimated the cost of treating a person with HIV to be $120,000 (21). In the United States, the lifetime cost of HIV care is approximately $395,000 (38) while the Canadian cost is slightly lower at Can$210,555. The value of Can$210, 555 or $169,100 is chosen for its conservative estimate, assuming a lower cost-savings for HIV infections among PWID [to convert the Canadian to American dollar simply multiply by 0.81]. This lower cost assumption is based on the most recent literature that recognizes certain self-imposed barriers that make treatment less likely within the PWID population (4,10,19,26).

Cost of Supervised Injection Facility (SIF)

The only available comparison facility in North America is Insite in Vancouver. As a result we draw upon the most recent data from Insite's operational cost which is estimated to be Can$3 million (10,18,19,26,39). The Can$3 million or $2.40 million figure includes additional services, such as addiction counseling, primary healthcare, public health screening, immunization, diagnostic peer counseling, case management, education, and housing services (10,18,19,26,39). The estimated cost will be lower (Can$1.53 million or $1.23 million) if the annual operating cost of Insite only considers ancillary equipment, staff salaries, property rental, and equipment purchases (37). An Insite expansion from 18 to 24 hours adds an additional Can$0.652 million or $0.525 million to the annual operating cost of Insite where the operational cost of Insite reaches Can$2.182 million or $1.757 million (10,18,19,26). For simplicity, we assume that the Saskatoon SIF would provide comparable costs associated with staff salaries, equipment purchases, and property rental as the SIF in Vancouver.

Results

The number of HIV prevented was predicted based on needle sharing. Table 2 and 3 demonstrated that increasing the scope of SIF in Saskatoon also increases the number of HIV prevented. Based on Table 2, cost-saving does not disappear for SIF in Saskatoon when the cumulative data is taken into consideration. In fact, the cost-saving ranges from $1,529,940 for the second SIF to a low value of $533,220 for the fourth potential SIF. Based on cumulative cost-effectiveness results, SIF establishment is cost-effective up to four facilities in Saskatoon. For example, the cumulative cost-effectiveness ranges from $198,436 to $145,520. The cumulative benefit-cost ratio is also above unity for the first four facilities. For instance, the cumulative benefit-cost ratios for HIV range from 1.44 to 1.06.

According to Table 3, the marginal cost savings are more modest. In fact, after the second facility, cost savings diminishes. Similarly, the marginal cost-effectiveness shown in Table 3 indicates that after the second facility, the expansion will not be cost-effective. For example, the marginal cost-effectiveness ratios for HIV range from $145,520 to $272,850. Based on Table 3, the marginal benefit-cost ratio for HIV is above unity for the first two facilities. For instance, the marginal benefit-cost ratios according to Table 3 range from 1.44 to 0.77 for HIV cases.

Moreover, the cost-savings diminishes after the second facility. For example, the cost-saving of $975,525 diminishes to a loss of $498,360. Sensitivity analyses conducted at different baseline sharing rates also demonstrated that establishing SIF based on HIV averted may save tax payers' dollars (see Table 2 and 3). The current analysis used 14% and 34% initial needle-sharing for the sensitivity analysis. The second model also demonstrated that establishing more than one SIF in Saskatoon may save tax payers money. As shown in Table 4, the cumulative cost-effectiveness ratios range from $155,914 to $207,886 and the cumulative benefit to cost ratios are again above unity for the first four potential SIF. Based on Table 4, the marginal values of the second model are also similar to the cumulative values, thereby supporting the establishment of SIF in Saskatoon. To illustrate, the cost-effectiveness ratios range from $155,914 to $272,850 and benefit-cost ratios are above unity for the first two potential SIF. On average, benefit-to-cost ratios are never below unity for the first two facilities with an average of 1.32.

Discussion

Based on the first two models and subsequent sensitivity analysis, establishing at least two SIF in Saskatoon is cost-effective. The SIF is warranted as there is still a high incidence of HIV among Saskatoon PWID despite success of current

Table 2. The cumulative annual cost-effectiveness and cost-benefit of SIF in Saskatoon using the first model

Variables	Annual cost of operation	Sharing rate	Number of HIV averted	HIV Cost saved	Cost-effectiveness ratio HIV	Cost-benefit ratio HIV
First SIF	$2,182,800	17%	15	$975,525	$145,520	1.44
		(24%, 10%)	(21, 9)	($2,238,855, **-$287,805**)	($103,943, $242,533)	(2.03, 0.87)
Two SIFs	$4,365,600	10%	28	$1,529,940	$155,914	1.35
		(14%, 6%)	(39, 16)	($3,846,045, **-$996,720**)	($272,850, $272,850)	(1.90, 0.77)
Three SIFs	$6,548,400	6%	36	$1,031,580	$181,900	1.16
		(9%, 4%)	(51, 21)	($4,189,905, **-$2,126,745**)	($128,400, $311,829)	(1.60, 0.68)
Four SIFs	$8,731,200	2%	44	$533,220	$198,436	1.06
		(3%, 1%)	(63, 26)	(4,533,765, **-$3,256,770**)	($138,590, $335,815)	(1.50, 0.63)

SIF= Supervised Injection Facility.
Note: The numbers in parentheses represent the results of the sensitivity analysis: (34% sharing, 14% sharing). Numbers in bold represent the loss.

Table 3. The marginal annual cost-effectiveness and cost-benefit of SIF in Saskatoon using the first model

Variables	Annual cost of operation	Sharing rate	Number of HIV averted	HIV Cost-saved	Cost-effectiveness ratio HIV	Cost-benefit ratio HIV
First SIF	$2,182,800	17%	15	$975,525	$145,520	1.44
		(24%, 10%)	(21, 9)	($2,238,855, **-$287,805**)	($103,943, $242,533)	(2.03, 0.87)
Two SIFs	$2,182,800	10%	13	$554,415	$167,908	1.25
		(14%, 6%)	(18, 8)	($1,607,190, **-$498,360**)	($121,267, $272,850)	(1.74, 0.77)
Three SIFs	$2,182,800	6%	8	**-$498,360**	$272,850	0.77
		(9%, 4%)	(12, 5)	($343,860, **-$1,130,025**)	($181,900, $436,560)	(1.16, 0.48)
Four SIFs	$2,182,800	2%	8	-$498,360	$272,850	0.77
		(3%, 1%)	(12, 5)	($343,860, **-$1,130,025**)	($181,900, $436,560)	(1.16, 0.48)

SIF= Supervised Injection Facility.
Note: The numbers in parentheses represent the results of the sensitivity analysis: (34% sharing, 14% sharing). Numbers in bold represent the loss.

Table 4. The cumulative and marginal cost-effectiveness and cost-benefit of SIF in Saskatoon using the second model

Variables	Annual cost of operation	Sharing rate	#of HIV averted	Cost-effectiveness ratio HIV	Cost-benefit ratio HIV
First SIF	$2,182,800	17%	14	$155,914	1.40
	($2,182,800)	(17%)	(14)	($155,914)	(1.40)
Two SIFs	$4,365,600	10%	26	$167,908	1.30
	($2,182,800)	(10%)	(12)	($181,900)	(1.20)
Three SIFs	$6,548,400	6%	34	$192,600	1.10
	($2,182,800)	(6%)	(8)	($272,850)	(0.77)
Four SIFs	$8,731,200	2%	42	$207,886	1.01
	($2,182,800)	(2%)	(8)	($272,850)	(0.77)

SIF= Supervised Injection Facility.
Note: The numbers in parentheses represent the marginal results.

needle exchange programs (21). In Saskatoon, HIV reports were more than three times that of the national average (40,41). The annual incidence report for Saskatoon was 31.3 per 100,000 persons in comparison to the national average of 9.3 per 100,000 persons (2,21). Additionally, the majority of Saskatoon's HIV reports were attributed to PWID (76.9%), while the nation's average of PWID contribution to HIV was 18.9% (2).

Current drug policy strategies in Saskatoon are inept at reducing the co-morbidity cases among the disadvantaged Indigenous group. A recent study conducted in Saskatoon demonstrated that PWID encounter multiple barriers when attempting to access harm reduction services which include but not limited to system deficiencies, poor communication, discrimination by healthcare providers and police and insufficient financial resources (42–44). Consequently, the health authority needs to take a paradigm shift toward more effective harm reduction programs in addition to the services that are being already provided. We suggest that harm reduction services in Saskatoon should include SIF as part of healthcare delivery to this vulnerable population.

The results of the current study suggest that establishment of at least two SIF in Saskatoon will on average prevent at least 14 new HIV cases. This translates into cost savings of $764,970 for the first two facilities. Moreover, the establishment of SIF in Saskatchewan's largest city appears to be cost-effective. In fact, cost-effective and cost-benefit ratios suggest that the establishment of at least two SIF in Saskatoon will increase taxpayer's revenue. It is important to emphasize that Vancouver once paralleled Saskatoon morbidity cases during the late 1990s (45). But, peer-driven harm reduction programs were able to successfully decrease morbidity and mortality cases in the DTES (9). The primary difference between both cities is the higher concentration and greater size of the PWID population in Saskatoon, which fosters a greater need for the implementation of harm reduction programs as evinced in Vancouver.

Recent qualitative studies conducted in Saskatoon suggests that the city could benefit from experimenting with smaller scale harm reduction approaches that rely on peer drug users to disseminate information and skills to the most marginalized PWID (42,43). Accordingly, the study suggests that this type of "*program is ideal for smaller urban centers where social networks may be closer than in a larger city …. Additionally, such a program would take advantage of the fact that IDUs in Saskatoon receive a large proportion of drug use safety information from their peers*" (42) (p. 9).

SIF that have been operating in Vancouver have been effective in reducing HIV, lethal overdoses, needle sharing and publicly discarded syringes. These facilities have been successful in improving service uptake, improved public order, and increasing the probability of initiating and maintaining addiction treatment (9,12–14,34,46–51). SIFs have the potential to "*reduce viral and bacterial infections and overdose mortality among those who engage in high-risk injection behaviors by offering unique public health services that are complementary to other interventions*" (52) (p. 100). Additionally, SIF in Vancouver has been a key venue for obtaining care for infections and encouraging safer injection methods (12,48).

Theoretical possibilities of SIF expansion needs to be decided on by the local health authorities on the basis of scientific evidence supporting such expansion (17). Public awareness by the local health policy-makers and doctors regarding SIF will allow the community to be better educated about the benefits of these harm reduction programs and the role they play in reducing crime, drug dealing, public injection, and a host of other social maladies (9,12–14,34,46–51). Community support is a fundamental part of sustaining the program and it will ultimately help in conceptualizing injection drug use as a health issue, rather than a moral one (11,16,53). There are numerous example of activism by peer drug user organization in Canada. Vancouver Area Network of Drug Users (VANDU) and the Sandy Hill community center in Ottawa, are some examples of where drug users have been able to successfully advocate for their rights and a SIF in their respected cities (8,10,54).

The current study has several limitations. The first limitation pertains to the exclusive focus on HIV cases. Other costing studies, that have considered Insite and its potential role for expansion in other cities, have included HCV in the cost-benefit analysis (10,18–20). However, the current study due to unavailability of key parameters had to rely on HIV cases alone which made the costing study more conservative in reporting the benefits of SIF in Saskatoon. However, the most noteworthy limitation of this study concerns the static mathematical models used in the analysis. Such models omit Quality-Adjusted Life Years (QALYs). In fact, our models may be considered simple in comparison to other more complex models that consider the dynamics of the social system and a score of parameters, such as secondary sexual transmission, effects of attending methadone therapy and increase in the population of drug users.

Conclusion

Through the use of two mathematical models this study has shown that SIF in Saskatoon are indeed cost-saving. The models in this paper are similar to that used by five other costing studies that also show economic viability of SIF and other harm reduction programs (10,17,19,20,26). This paper shows that the associated cost-savings related to the number of new HIV infections averted is large enough to cover the cost of operating more than one SIF in Saskatoon. It is our hope that the results of the study will encourage community activists and government officials to make a paradigm shift toward harm reduction programs that will aid and protect at risk PWID population.

Ethical Issues

The authors received no funding or financial support for this research. The data for this research was retrieved from the secondary data available to public.

Competing interests

Authors declare that they have no competing interests.

Authors' contributions

EJ, collected the data, conducted the analysis, wrote the results, methods and discussion. AJ, wrote the introduction, results, methods, conclusion and references. AJ also edited the paper.

References

1. Jozaghi E, Andresen MA. Should North America's first and only supervised injection facility (InSite) be expanded in British Columbia, Canada? *Harm Reduct J* 2013; 10: 1. doi: 10.1186/1477-7517-10-1
2. Lemstra M, Rogers M, Thompson A, Moraros J, Buckingham R. Risk indicators associated with injection drug use in the Aboriginal population. *AIDS Care* 2012; 24: 1416-24. doi: 10.1080/09540121.2011.650678
3. Lemstra M, Rogers M, Thompson A, Moraros J, Buckingham R. Risk indicators of depressive symptomatology among injection drug users and increased HIV risk behaviour. *Can J Psychiatry* 2011; 56: 358-65.
4. Pinkerton SD. How many HIV infections are prevented by Vancouver's Canada supervised injection facility? *Int J Drug Policy* 2011; 22: 179-83. doi: 10.1016/j.drugpo.2011.03.003
5. Challacombe L. The epidemiology of HIV in people who inject drugs in Canada. *CATIE* 2014. Available from: http://www.catie.ca/fact-sheets/epidemiology/injection-drug-use-and-hiv-canada
6. Holtgrave DR, Pinkerton SD, Jones TS, Lurie P, Vlahov D. Cost and cost effectiveness of increasing access to sterile syringes and needles as an HIV prevention intervention in the United States. *J Acquir Immune Defic Syndr Hum Retrovirol* 1998; 18: 133-8. doi: 10.1097/00042560-199802001-00022
7. Jozaghi E. "A little heaven in hell": The role of a supervised injection facility in transforming place. *Urban Geogr* 2012; 33: 1144-62. doi: 10.2747/0272-3638.33.8.1144
8. Jozaghi E. The role of drug users' advocacy group in changing the dynamics of life in the Downtown Eastside of Vancouver, Canada. *J Subst Use* 2014; 19: 213-8. doi: 10.3109/14659891.2013.775608
9. Ti L, Kerr T, Wood E, Werb D, DeBeck K, Graham D, *et al*. *Drug Situation in Vancouver*. Vancouver: Urban Health Research Initiative of the British Columbia Centre for Excellence in HIV/AIDS; 2013.
10. Jozaghi E, Reid AA, Andresen MA, Juneau A. A cost-benefit/cost-effectiveness analysis of proposed supervised injection facilities in Ottawa, Canada. *Subst Abuse Treat Prev Policy* 2014; 9: 31. doi: 10.1186/1747-597X-9-31
11. Jozaghi E. Morality versus the scientific evidence: The story behind Bill C-2. *J Subst Use* 2015; forthcoming. doi: 10.3109/14659891.2014.987837
12. Wood E, Tyndall MW, Stoltz J, Small W, Zhang R, O'Connell J. Safer injection education for HIV prevention within a medical supervised safer injection facility. *Int J Drug Policy* 2005; 16: 281-4. doi: 10.1016/j.drugpo.2005.07.004
13. DeBeck K, Kerr T, Bird L, Zhang R, Marsh D, Tyndall M, *et al.* Injection drug use cessation and use of North America's first medically supervised safer injecting facility. *Drug Alcohol Depend* 2011; 113: 172-6. doi: 10.1016/j.drugalcdep.2010.07.023
14. Marshall BD, Milloy MJ, Wood E, Montaner JS, Kerr T. Reduction in overdose mortality after the opening of North America's first medically supervised safer injection facility: A retrospective population-based study. *Lancet* 2011; 377: 1429-37. doi: 10.1016/s0140-6736(10)62353-7
15. Pinkerton SD. Is Vancouver Canada's supervised injection facility cost-saving? *Addiction* 2010; 105: 1429-36. doi: 10.1111/j.1360-0443.2010.02977.x
16. Des Jarlais DC, Arasteh K, Hagan H. Commentary: Evaluating Vancouver's supervised injection facility: Data and dollars, symbols and ethics. *CMAJ* 2008; 179: 1105-6. doi: 10.1503/cmaj.081678
17. Andresen MA, Boyd NT. A cost–benefit and cost-effectiveness analysis of Vancouver's supervised injection facility. *Int J Drug Policy* 2010; 21: 70-6. doi: 10.1016/j.drugpo.2009.03.004
18. Bayoumi AM, Zaric GS. The cost-effectiveness of Vancouver's supervised injection facility. *CMAJ*, 2008; 179: 1143-51. doi: 10.1503/cmaj.080808
19. Jozaghi E, Reid AA, Andresen MA. A cost-benefit/cost-effectiveness analysis of proposed supervised injection facilities in Montreal, Canada. *Subst Abuse Treat Prev Policy* 2013; 8: 25.

doi: 10.1186/1747-597X-8-25
20. Jozaghi E. A cost-benefit/cost-effectiveness analysis of an unsanctioned supervised smoking facility in the Downtown Eastside of Vancouver, Canada. *Harm Reduct J* 2014; 11: 30. doi: 10.1186/1477-7517-11-30
21. Laurence Thompson Strategic Consulting. A review of needle exchange program in Saskatchewan: Final report, 2008. [cited July 29, 2013]. Available from: http://www.health.gov.sk.ca/needle-exchange-review-report
22. HIV Strategy for Saskatchewan. A comprehensive provincial strategy of HIV in Saskatchewan and to improve the quality of life for HIV positive people. 2014. Saskatoon: Saskatchewan Ministry of Health, Population Health Branch; 2014. Available from: http://www.health.gov.sk.ca/hiv-strategy-2010-2014
23. Strathdee S, Patrick D, Currie S, Cornelisse P, Rekart M, Montaner J, *et al*. Needle exchange is not enough: lessons from the Vancouver injecting use study. *AIDS* 1997; 11: F59-65. doi: 10.1097/00002030-199708000-00001
24. Fisher D, Fenaughty A, Cagle H, Wells R. Needle exchange and injection drug use frequency: a random controlled trial. *J Acquir Immune Defic Syndr* 2003; 33: 199-205. doi: 10.1097/00126334-200306010-00014
25. Jacobs P, Calder P, Taylor M, Houston S, Saunders LD, Albert T. Cost effectiveness of streetworks' needle exchange program of Edmonton. *Can J Public Health* 1999; 90: 168-71.
26. Andresen MA, Jozaghi E. The point of diminishing returns: an examination of expanding Vancouver's Insite. *Urban Stud* 2012; 49: 3531-44. doi: 10.1177/0042098012443865
27. Kaplan EH, O'Keefe E. Let the needles do the talking! Evaluating the New Haven needle exchange. *Interfaces* 1993; 23: 7-26. doi: 10.1287/inte.23.1.7
28. Laufer FN. Cost-effectiveness of syringe exchange as an HIV prevention strategy. *J Acquir Immune Defic Syndr* 2001; 28: 273-8. doi: 10.1097/00042560-200111010-00012
29. MSIC Evaluation Committee. Final report on the evaluation of the Sydney Medically supervised injection centre. Sydney, Australia; 2003. [cited October 23, 2013]. Available from: http://www.indro-online.de/sydneyfinalreport.pdf
30. Kerr T, Tyndall M, Li K, Montaner J, Wood E. Safer injection facility use and syringe sharing in injection drug users. *Lancet* 2005; 366: 316-8. doi: 10.1016/s0140-6736(05)66475-6
31. Bravo MJ, Royuela L, Fuente DL, Brugal MT, Barrio G, Salvany D. Use of supervised injection facilities and injection risk behaviours among young drug injectors. *Addiction* 2009; 104: 614-9. doi: 10.1111/j.1360-0443.2008.02474.x
32. McClean ME. *Vancouver drug use epidemiology-2001: Vancouver and BC site report for the Canadian community epidemiology network on drug use*. Vancouver, BC: Vancouver-Richmond Health Board; 2002.
33. Lurie P, Drucker E. An opportunity lost: HIV infections associated with lack of a national needle-exchange programme in the USA. *Lancet* 1997; 349: 604-8. doi: 10.1016/s0140-6736(96)05439-6
34. Tyndall MW, Kerr T, Zhang R, King E, Montaner JG, Wood E. Attendance, drug use patterns, and referrals made from North America's first supervised injection facility. *Drug Alcohol Depend* 2006; 83: 193-8. doi: 10.1016/j.drugalcdep.2005.11.011
35. Gold M, Gafni A, Nelligan P, Millson P. Needle exchange programs: An economic evaluation of a local experience. *CMAJ* 1997; 157: 255-62.
36. Laurie ML, Green KL. Health risks and opportunities for harm reduction among injection-drug-using clients of Saskatoon's needle exchange program. *Can J Public Health* 2000; 91: 350-2.
37. Warren J. Fewer needles found during annual cleanup. The Star Phoenix, 2010. [cited August 05, 2013]. Available from: http://www2.canada.com/saskatoonstarphoenix/news/third_page/story.html?id=033c537d-d7e1-4950-b2ec-ce6a015c798c&p=1
38. Schackman BR, Gebo KA, Walensky RP, Losina E, Muccio T, Sax PE, *et al*. The lifetime cost of current human immunodeficiency virus care in the United States. *Med Care* 2006; 44: 990-7. doi: 10.1097/01.mlr.0000228021.89490.2a
39. Health Canada. Vancouver's INSITE service and other Supervised injection sites: What has been learned from research? Final report of the Expert Advisory Committee. 2008. [cited July 9, 2013]. Available from: http://www.hc-sc.gc.ca/ahc-asc/pubs/_sites-lieux/insite/index-eng.php
40. Iskandar S, Kamal R, De Jong CA. Psychiatric comorbidity in injecting drug users in Asia and Africa. *Curr Opin Psychiatry* 2012; 25: 213. doi: 10.1097/yco.0b013e3283523d66
41. De Bruin P, Gibson S, Trischuk H. *Saskatoon Health Region HIV Prevention, Treatment & Support Strategy.* Saskatoon: Saskatoon Health Region; 2010
42. Lang K, El-Aneed A, Berenbaum S, Dell CA, Wright J, McKay ZT. Qualitative assessment of crisis services among persons using injection drugs in the city of Saskatoon. *J Subst Use* 2013; 18: 3-11. doi: 10.3109/14659891.2011.606350
43. Lang K, Neil J, Wright J, Dell CA, Berenbaum S, El-Aneed A. Qualitative investigation of barriers to accessing care by people who inject drugs in Saskatoon, Canada: perspectives of service providers. *Subst Abuse Treat Prev Policy* 2013; 8: 35. doi: 10.1186/1747-597X-8-35
44. Laurie ML, Green KL. Health risks and opportunities for harm reduction among injection-drug-using clients of Saskatoon's needle exchange program. *Can J Public Health* 2000; 91: 350-2.
45. Kerr T, Wood E, Palepu A, Wilson D, Schechter MT, Tyndall MW. Responding to an explosive HIV epidemic driven by frequent cocaine injection: Is there a role for safe injection facilities? *J Drug Issues* 2003; 33: 579-608. doi: 10.1177/002204260303300303
46. Wood E, Kerr T, Small W, Li K, Marsh DC, Montaner JS, *et al*. Changes in public order after the opening of a medically supervised safer injection facility for drug users. *CMAJ* 2004; 171: 731-4. doi: 10.1503/cmaj.1040774
47. Kerr T, Tyndall M, Li K, Montaner J, Wood E. Safer injection facility use and syringe sharing in injection drug users. *Lancet* 2005; 366: 316-8. doi: 10.1016/s0140-6736(05)66475-6
48. Small W, Wood E, Lioyd-Smith E, Tyndall M, Kerr T. Accessing care for injection-related infections through a medically supervised injection facility: A Qualitative study. *Drug Alcohol Depend* 2008; 98: 159-62. doi: 10.1016/j.drugalcdep.2008.05.014
49. Wood E, Tyndall MW, Zhang R, Stoltz JA, Lai C, Montaner JS, *et al*. Attendance at supervised injecting facilities and use of detoxification services. *N Engl J Med* 2006; 354: 2512-4. doi: 10.1056/nejmc052939
50. Kerr T, Small W, Moore D, Wood E. A micro-environmental intervention to reduce the harms associated with drug-related overdose: Evidence from the evaluation of Vancouver's safer injection facility. *Int J Drug Policy* 2007; 18: 37-45.
51. Kerr T, Wood E, Small D, Palepu A, Tyndall MW. Potential use of safer injecting facilities among injection drug users in Vancouver's Downtown Eastside. *CMAJ* 2003; 169: 759-63.
52. Semaan S, Fleming P, Worrell C, Stolp H, Baack B, Miller M. Potential role of safer injection facilities in reducing HIV and hepatitis C infections and overdose mortality in the United States. *Drug Alcohol Depend* 2011; 118: 100-10. doi: 10.1016/j.drugalcdep.2011.03.006
53. Hyshka E, Bubela T, Wild TC. Prospects for scaling-up supervised injection facilities in Canada: the role of evidence in legal and political decision-making. *Addiction* 2013; 108: 468-76.
54. Jozaghi E, Reid AA. A case study in transformation in the Downtown Eastside of Vancouver, Canada by peer injection drug users. *Canadian Journal of Criminology and Criminal Justice* 2014; 56: 563-94. doi: 10.3138/cjccj.2013.e30