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A Cost-benefit and Cost-effectiveness Analysis of Potential Supervised Injection Facilities in Victoria, British Columbia, Canada

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North America's first and only Supervised injection site (InSite)

- Opening date
- Control ...
- Users

Benefits

- Overdose death reduction (Marshall et al., 2011).
- Fewer risky injection (Kerr, Tyndall, Li, Montaner & Wood, 2005)
- Initiating and maintaining addiction treatment (DeBeck et al., 2011).
- No increased crime related to drug use (Wood, Tyndall, Montaner, & Kerr, 2006)
- Key venue for obtaining care for infections (Small, Wood, Lioyd-Smith, Tyndall, & Kerr, 2008).
- Safer injection education (Wood et al., 2005b).
- Refuge from dangers of the street (Fairbairn, Small, Shannon, Wood, & Kerr, 2008).

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Introduction

- The situation has been particularly bad in Montreal
  - Rate of needle sharing…(10-23%) (Ivsins et al., 2012; Stajduhar et al., 2004)
  - HIV and HCV…(21 & 63%) (Ivsins et al. 2010)
  - Rate of overdose…(Ivsins et al., 2012; Stajduhar et al., 2004)
  - 6% of population is IDU(Ivsins et al., 2012; Stajduhar et al., 2004)
- So the obvious question…

- The current study based on HIV and HCV…
  - Cost-benefit
  - Cost-effectiveness

Introduction

- A certain number of known “clean” injections as opposed to “dirty”

- IDUs who use SIFs will share needles only at a 30% rate of their non-InSite counterparts (Andresen & Boyd, 2010; Andresen & Jozaghi, 2012).

- Similar to Bayoumi and Zaric (2008), Andresen and Boyd (2010) ; Andresen and Jozaghi (2012); Jozaghi, Reid and Andresen (2013) this study employed a point estimate of 0.3.

- To err on the side of caution, this study decided to …

- Annual operational costs of InSite @ $3 million …

Assumptions

Assumptions

- The GDP per capita (CAN$33,640) in British Columbia is used (considering a discount rate of 3 percent) such that the value of lost productivity/wages is the sum of the income lost (Andresen & Boyd, 2010; Laufer, 2001).

- Because the average age of a SIF user is 35 years, (assuming the retirement at 65), there are 30 years of lost productivity/wages (Andresen & Boyd, 2010; Kerr et al, 2006).

- These values lead to a loss to society of CAN$978,924 (2013 Dollars). Despite being a large number when considering a typical SIF user, this value is a highly conservative value of life.

Assumptions

- **The range of lifetime cost-savings (in 2013 dollars) from averted cases of HIV is large in magnitude ranging from $174,410** (Gold et al., 1997)**, to US$200,000** (Chen et al., 2006; Holtgrave & Pinkerton, 1997; Pinkerton & Holtgrave, 1998), **to more than $289,970 when considering the very successful HAART program** (Werb, 2009)**.**

- **A lower bound value of $210, 555 was chosen. This value is based on the most recent research in this area by Pinkerton (2010, 2011) and Andresen and Jozaghi (2012).**

- **For HCV $35,143 (2012 Dollars) reported in the National Centre in HIV Epidemiology and Clinical Research (2010), since their study is more realistic and considers the costs for liver failure, hepatocellular carcinoma, and liver transplant cases.**

- Jacobs et al.'s (1999) mathematical model
- The number of new HIV or HCV infections avoided (A)
  - $A = INsd\,[1-(1-qt)^{m}]$
    - (*I*) is the IDU population that is HIV/HCV negative
    - (*N*) is the number of needles in circulation,
    - (*s*) is the rates of needle sharing,
    - (*d*) is the percentage of needles not cleaned before use,
    - (*q*) is the HIV/HCV prevalence in the IDU population,
    - (*t*) is the probability of HIV/HCV transmission when using an HIV infected needles
    - (*m*) is the number of sharing partners when injections are shared

Model, Methods and Data Sources

Model, Methods and Data Sources

- Kaplan & O'Keefe (1993) mathematical model
- The number of new HIV infections avoided *(A)*
  - $A = (1-\pi)\lambda(1-\theta)\beta\alpha$
    - (π) *is the prevalence of HIV infections in the neighborhood,*
    - (λ) *is the rate of needle sharing,*
    - (θ) *is the probability that a borrowed syringe is decontaminated,*
    - (β) *is the percent HIV infected needles,*
    - (α) *is the probability of acquiring HIV from a single injection with contaminated syringe.*

Variable	Value	Source
Proportion of IDUs HIV- (I)	79%	Ivsins et al. (2012); VIHA. (2010); Stajduhar et al. (2004)
Rate of Needle sharing (s) or (b)	23%	Ivsin et al. (2010); Ivsin et al. (2012)
Number of needles in circulation (N)	30,000	Ivsin et al. (2010)
Percentage of needles not cleaned (d)	17.00%	Kaplan and O'Keefe (1993); Jacobs et al. (1999)
Probability of HIV infections from a single injection (t) or (α)	0.67%	Kaplan and O'Keefe (1993)
Number of sharing partners (m)	1.38	Jacobs et al. (1999)
Proportion of IDUs HIV+ (q)	21%	Ivsins et al. (2012); VIHA. (2010); Stajduhar et al. (2004)
Proportion IDUs HCV- (I)	36.9%	Ivsins et al. (2012); VIHA. (2010)
Proportion of IDUs HCV+ (q)	63.1%	Ivsins et al. (2012); VIHA. (2010)
Probability of HCV infection from single injection(t)	3%	Gore & Bird (1998)
Proportion of HIV infected needles (c)	40.50%	Kaplan and O'Keefe (1993)
Probability of needles cleaned (θ)	83%	Kaplan and O'Keefe (1993); Jacobs et al. (1999)

Model, Methods and Data Sources

Table 2. The Cumulative Annual Cost Saving, Cost - Effectiveness and Cost – Benefit of SIF in Victoria using Jacobs et al.'s (1999) model.

Variables	Annual cost of operation	Sharing rate	#of HIV averted	#of HCV averted	Cost-effectiveness ratio HCV	Cost-effectiveness ratio HIV	Cost-benefit ratio HCV	Cost-benefit ratio HIV
Post SIF	$2,182,800	16%	0.5	3	$727,600	$4,365,600	0.05	0.05
Two SIF	$4,365,600	10%	1	7	$623,657	$4,365,600	0.06	0.05
Three SIF	$6,548,400	6%	1	8	$818,550	$6,548,400	0.04	0.03
Four SIF	$8,731,200	2%	2	10	$873,120	$4,365,600	0.04	0.05
Five SIF	$10,914,000	-2%	2	13	$839,538	$5,457,000	0.04	0.04
Six SIF	$13,096,800	-6%	3	15	$873,120	$4,365,600	0.04	0.05

Results

Table 3. The Marginal Annual Cost Saving, Cost - Effectiveness and Cost – Benefit of SIF in Victoria using Jacobs et al.'s (1999) model.

Variables	Annual cost of operation	Sharing rate	#of HIV averted	#of HCV averted	Cost-effectiveness ratio HCV	Cost-effectiveness ratio HIV	Cost-benefit ratio HCV	Cost-benefit ratio HIV
Post SIF	$2,182,800	16%	0.5	3	$727,600	$4,365,600	0.05	0.05
Two SIF	$2,182,800	10%	0.5	3	$727,600	$4,365,600	0.05	0.05
Three SIF	$2,182,800	6%	0.3	2	$1,091,400	$7,276,000	0.03	0.03
Four SIF	$2,182,800	2%	0.3	2	$1,091,400	$7,276,000	0.03	0.03
Five SIF	$2,182,800	-2%	0.3	2	$1,091,400	$7,276,000	0.03	0.03
Six SIF	$2,182,800	-6%	0.3	2	$1,091,400	$7,276,000	0.03	0.03

Results

Table 4. The Sensitivity Analysis at 33% Sharing Rate for Cumulative Annual Cost Saving, Cost - Effectiveness and Cost – Benefit of SIF in Victoria.

Variables	Annual cost of operation	Sharing rate	#of HIV averted	#of HCV averted	Cost-effectiveness ratio HCV	Cost-effectiveness ratio HIV	Cost-benefit ratio HCV	Cost-benefit ratio HIV
Post SIF	$2,182,800	23%	1	5	$436,560	$2,182,800	0.08	0.1
Two SIF	$4,365,600	14%	1.5	9	$485,067	$2,910,400	0.07	0.07
Three SIF	$6,548,400	8%	2	12	$545,700	$3,274,200	0.06	0.06
Four SIF	$8,731,200	3%	2	15	$582,080	$4,365,600	0.06	0.05
Five SIF	$10,914,000	-3%	3	18	$606,333	$3,638,000	0.06	0.06
Six SIF	$13,096,800	-9%	3	21	$623,657	$4,365,600	0.06	0.05

Results

Table 5. The Sensitivity Analysis at 13% Sharing Rate for Cumulative Annual Cost Saving, Cost - Effectiveness and Cost – Benefit of SIF in Victoria.

Variables	Annual cost of operation	Sharing rate	#of HIV averted	#of HCV averted	Cost-effectiveness ratio HCV	Cost-effectiveness ratio HIV	Cost-benefit ratio HCV	Cost-benefit ratio HIV
Post SIF	$2,182,800	9%	0.3	2	$1,091,400	$7,276,000	0.03	0.03
Two SIF	$4,365,600	6%	0.6	4	$1,091,400	$7,276,000	0.03	0.03
Three SIF	$6,548,400	3%	0.7	5	$1,309,680	$9,354,857	0.03	0.02
Four SIF	$8,731,200	1%	0.9	6	$1,455,200	$9,701,333	0.02	0.02
Five SIF	$10,914,000	-1%	1	7	$1,559,143	$10,914,000	0.02	0.02
Six SIF	$13,096,800	-3%	1.2	8	$1,637,100	$10,914,000	0.02	0.02

Results

Table 6. The Cumulative Cost - Effectiveness and Cost – Benefit of SIF in Victoria using Kaplan and O'Keefe (1993) model.

Variables	Annual cost of operation	Sharing rate	#of HIV averted	Cost-effectiveness ratio HIV	Cost-benefit ratio HIV
Post SIF	$2,182,800	23%	13	$167,908	1.3
Two SIF	$4,365,600	16%	24	$181,900	1.2
Three SIF	$6,548,400	10%	31	$211,239	1
Four SIF	$8,731,200	6%	38	$229,768	0.9
Five SIF	$10,914,000	2%	45	$242,533	0.9
Six SIF	$13,096,800	-2%	52	$251,861	0.8
Average	$7,639,800	9%	34	$214,202	1

Results

Table 7. The Marginal Cost - Effectiveness and Cost – Benefit of SIF in Victoria using Kaplan and O'Keefe (1993) model.

Variables	Annual cost of operation	Sharing rate	#of HIV averted	Cost-effectiveness ratio HIV	Cost-benefit ratio HIV
Post SIF	$2,182,800	23%	13	$167,908	1.3
Two SIF	$2,182,800	16%	11	$198,436	1.1
Three SIF	$2,182,800	10%	7	$311,829	0.7
Four SIF	$2,182,800	6%	7	$311,829	0.7
Five SIF	$2,182,800	2%	8	$272,850	0.8
Six SIF	$2,182,800	-2%	7	$311,829	0.7
Average	$2,182,800	9%	9	$262,447	0.9

- **Table 8. Cost-savings, Cost-effectiveness and Cost-benefit Ratio of Estimated Annual Death Prevented as a result of a SIF in Victoria.**

Variables	Annual cost of operation	#of overdose death averted	Cost-saving	Cost-effectiveness ratio death prevented	Cost-benefit ratio death prevented
Post SIF	$2,182,800	2.3	$2,251,525	$949,044	1.03

Results

- Based on the number of HIV and HCV cases averted owing to the provision of clean injecting equipment, safer injecting behaviours and overdose deaths …

- The addition of more SIFs beyond the second locations may still be considered cost-effective even if it is not cost saving (e.g. break-even) …

- Not included in this calculation was the potential for cost-savings in terms of cellulitis, subcutaneous abscesses, endocarditis, and incidence of soft-tissue infections averted.

- For HIV, this paper omitted the expensive HAART program and relied on the lower cost estimates of HIV and HCV.

Disscussion

Future Studies and Limitations

- More economical evaluation in other major North American cities need to be conducted.
- Any actual establishment needs to be conducted through community consultation.
- Although ‘dynamic’ in the sense that this paper’s method considers the establishment of successive SIFs, the mathematical model is static.
- Other more complex models, such as Laufer (2001) should be used

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