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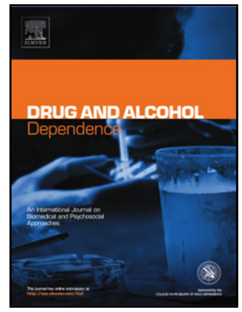

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Estimating the size of the population of persons who inject drugs in the island of Montréal, Canada, using a six-source capture-recapture model

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ABSTRACT

Background: To plan and implement services to persons who inject drugs (PWID), knowing their number is essential. For the island of Montréal, Canada, the only estimate, of 11,700 PWID, was obtained in 1996 through a capture-recapture method. Thirteen years later, this study was undertaken to produce a new estimate. **Methods**: PWID were defined as individuals aged 14-65 years, having injected recently and living on the island of Montréal. The study period was 07/01/2009 to 06/30/2010. An estimate was produced using a six-source capture-recapture log-linear regression method. The data sources were two epidemiological studies and four drug dependence treatment centres. Model selection was conducted in two steps, the first focusing on interactions between sources and the second, on age group and gender as covariates and as modulators of interactions. **Results**: A total of 1,480 PWID were identified in the six capture sources. They corresponded to 1,132 different individuals. Based on the best-fitting model, which included age group and sex as covariates and six two-source interactions (some modulated by age), the estimated population was 3,910 PWID (95% confidence intervals (CI): 3 180-4 900) which represents a prevalence of 2.8 (95% CI: 2.3-3.5) PWID per 1000 persons aged 14-65 years. **Conclusions**: The 2009-2010 estimate represents a two-thirds reduction compared to the one for 1996. The multisource capture-recapture method is useful to produce estimates of the size of the PWID population. It is of particular interest when conducted at regular intervals thus allowing for close monitoring of the injection phenomenon.

KEYWORDS: Injection drug use**,** Capture-recapture**,** Log-linear model**,** Canada

1. INTRODUCTION

For decades, persons who inject drugs (PWID) have been known to be at high risk for HIV and hepatitis C virus (HCV) infections (Des Jarlais et al., 1988; Patrick et al., 2001; Shepard et al., 2005; Mathers et al., 2008; Joint United Nations Programme on HIV/AIDS, 2012). In addition, PWID are frequently affected by other negative health outcomes such as bacterial and fungal infections and fatal and non-fatal overdoses (Ochoa et al., 2001; Gordon and Lowy, 2005; Coffin et al., 2007; Hope et al., 2008). With injection drug use being identified in 148 countries and HIV infection among PWID being reported in 120 of these countries, drug injection represents a worldwide public health problem (Mathers et al, 2008).

In Canada, PWID accounted for 14.0% of the HIV infections among adults reported in 2012 (Public Health Agency of Canada, 2013) and, based on modelled data, for 58% of the HCV cases in the country in 2007 (Remis, 2009). In the island of Montréal, the setting for the present study, HIV and HCV infection rates remain among the highest for North American cities. Data gathered from 2003 to 2010 in the island of Montréal through SurvUDI, a PWID epidemiological surveillance network, indicated that 20.4% of participating PWID were HIV-infected and 68.5% were anti-HCV positive (Leclerc et al., 2012). Amongst PWID, HIV incidence rate was estimated to be 3.1 per 100 person-years for the 1995 to 2010 period while HCV incidence rate was estimated to be 25.5 per 100 person-years for the 2003 to 2010 period. (Leclerc et al., 2012).

In order to reduce the health risks associated with drug injection, several health and social scientists promote the development of structural interventions. These interventions, exogenous to individuals, aim to modify the social, legal, economic, cultural and policy environments in which drug injection health-related harms occur (Blankenship et al., 2000; Des Jarlais, 2000). Increasing the availability of sterile injection equipment and drug treatments and accessibility to HIV and HCV screening and care are important structural interventions to reduce risks associated with drug injection. To optimize the coverage of such interventions, it is essential to have access to reliable estimates of the prevalence of injection drug use in the targeted population (Platt et al., 2004). Furthermore, as recommended by the World Health Organization, an estimate of the size of the PWID population in a given location is essential in order to provide optimal services to PWID (World Health Organization, 2009).

Estimating the size of a PWID population is complicated by the fact that drug use is stigmatized and PWID form a hidden population that has limited contacts with official agencies. Hence, data available through agencies' records or collected in the course of population surveys or epidemiological surveillance are deemed to be improper to estimate the size of the population, as they only account for the "known PWID population".

Indirect methods were developed to adjust for the under-ascertainment of such data sources. Among these methods, capture-recapture (CRC) is increasingly used to estimate the size of hard-to-reach populations. CRC was initially developed in animal ecology and introduced in epidemiology in the 1970s by Wittes (Wittes et al., 1974; Wittes and Sidel, 1968). It has been widely used to estimate the prevalence of problematic drug use around the world (Hser, 1993; Domingo-Salvany et al., 1998; Platt et al., 2004; Hickman et al., 2004; Böhning et al., 2004; Chiang et al., 2007; Khazaei et al., 2012; Pérez et al., 2013; Uuskula et al., 2013).

Estimates of the island of Montréal's PWID population are scarce. In 1996, the PWID population was estimated in three Canadian cities (Montréal, Toronto and Vancouver). Using a three-source CRC method, the total estimated population of PWID for the island of Montréal was 11,700 [95% confidence interval (CI): 8 500 – 16 500] (Remis et al., 1998). More than a decade later, an updated estimate was essential. This study was undertaken to estimate the number of PWID in the island of Montréal between July 1, 2009 and June 30, 2010 using a CRC method.

2. METHODS

2.1 Overview

This study was carried out using a six-source CRC method. Based on the number of individuals identified in each source and the number of individuals present in more than one source, the CRC method allows estimating the number of individuals who have not been observed in any of the sources and, consequently, the total number of individuals in the study population (Hook and Regal, 1995; 2000; Chao et al., 2001).

In order to obtain asymptotically unbiased and efficient CRC estimates, four assumptions (or conditions) must be satisfied (Hook and Regal, 1995): 1- All identified individuals meet the definition of PWID, 2- All identified PWID are observed during the study period and in the targeted geographic region, 3- The studied population is closed and 4- All PWID matches (PWID present in more than one data source) and only true PWID matches are identified.

When only two sources are available, two additional assumptions have to be satisfied, namely homogeneity of the capture probabilities (all individuals have the same probability of ascertainment within each source) and independence between the sources (presence of an individual in one source provides no information regarding her/his presence in the other). When more than two sources are available, log-linear regression models can account for these two types of potential dependencies by including interaction terms, as appropriate, between sources (Cormack, 1989; Hook and Regal, 1995; Chao et al., 2001).

2.2 Data sources and selection criteria

Data for the estimation were obtained from the following sources: (1) SurvUDI, a PWID epidemiological surveillance network implemented in 1995 (Hankins et al., 2002; Leclerc et al., 2012), (2) the Saint-Luc Cohort, a PWID cohort study initiated in 1988 (Bruneau et al., 2011, 2012), and from four drug treatment centres (3) *Service de médecine et de psychiatrie des toxicomanies du Centre Hospitalier de l'Université de Montréal* (CHUM), a university hospital-based program offering medical and psychiatric integrated inpatient and outpatient services for patients with drug-related problems, (4) the *Centre Dollard-Cormier Institut universitaire sur les dépendances* (CDC-IUD, now called "*Centre de réadaptation en dépendance de Montréal-Institut universitaire*") a centre offering detoxification and treatment in various settings including homeless and emergency clinics and inpatient services and evaluating individuals referred by the justice system, (5) the *Centre de recherche et d'aide pour les narcomanes* (Cran), a centre targeting opioid dependent individuals offering opioid-substitution treatment (OST), including a low-threshold clinic, and (6) the Foster Addiction Rehabilitation Centre (Foster-ARC), a centre with inpatient and outpatient facilities offering services mainly to the English-speaking population.

Selection criteria were similar for all sources: being between 14 and 65 years of age; being a person who injects drugs (defined as having injected drugs at least once in the preceding 6 months); residing in the island of Montréal (including the homeless population); and appearing in a data source between July 1, 2009 and June 30, 2010.

2.3 Data collection

SurvUDI and the Saint-Luc Cohort have electronic databases allowing for computerized identification of eligible participants. For the four treatment data sources, the preliminary identification of eligible patients was computerized but the final identification required manual review of patients' files. To protect participant and patient confidentiality, identification of eligible subjects and data extraction were conducted by staff from each research project or treatment centre.

2.4 Matching

Routinely in the SurvUDI database, participants are identified by an encrypted code, based on their initials, date of birth and gender, generated at recruitment by a unidirectional encryption algorithm developed for the SurvUDI project. To match individuals between the six databases, the SurvUDI encryption algorithm was applied in the other five data sources. Only individuals with identical encrypted codes were considered matches.

2.5 Analyses

2.5.1 Inferential framework: In capture-recapture analyses with more than 2 sources, log-linear models are used to estimate the number of "unobserved" individuals based on those observed (Cormack, 1989). For our analyses, the observed individuals were distributed in a contingency table by data source (yes and no categories for each of 6 sources), gender (2 categories) and age group (5 categories), yielding an 8-dimensional, $(2^6\text{-}1) \times 2 \times 5$, contingency table. The age groups were selected so as to yield sufficiently large numbers in each group to avoid instability of the likelihood. The model selection process aimed at identifying a log-linear Poisson model that fitted this table well, taking into account interactions between sources and heterogeneity of captures (IWGDMF, 1995). All models contained at minimum the intercept (identified with the missing cell value) and one parameter for each source. Because the number of possible models was very large, a heuristic approach was used for model selection. The sparseness of the contingency table dictated a staged model selection, to stave off the likelihood issues associated with random 0 cells (Christensen, 1997, Chapter 8). The stages consisted in considering first the sources and their interactions, then considering age and gender by themselves and in interaction with the selected sources. The overall approach is detailed below.

2.5.2 Intermediate model: An intermediate model involving only source parameters and their interactions was first sought. Selection of this model took place by identifying all two-source interactions of importance. Interactions were identified as either “required”, “possible” or “unneeded” according to prespecified criteria. “Required” interactions were identified successively as those uniformly improving Akaike’s Information Criterion (AIC; Akaike, 1974) over all models containing three two-way interactions and any previously identified required interactions; that is, any model containing the required interaction had better AIC than any model without. When no further required interaction could be identified, models containing all required interactions and three two-way interactions were fitted. For each non-required interaction, an AIC average over all models containing the interaction was produced. An overall average AIC was also computed over all fitted models. “Possible” interactions were identified as those with associated average AIC lower than the overall average AIC. All remaining interactions were classified as “Unneeded” and removed from consideration. All log-linear models containing the required interactions, any subset of the possible interactions, and any subset of higher-order interactions allowed by the principle of hierarchy were then fitted (Goodman, 1970; Cormack, 1989). The intermediate model was selected in consideration of its AIC and significance of all terms.

2.5.3 Final model: Age group and gender were considered for inclusion in the final model as simple covariates, as interactions with the sources, and as modulators of the interactions between sources retained in the intermediate model. The number of possible models was still too high to test all of them. A bidirectional stepwise greedy algorithm, starting from several randomly chosen models, was used to identify a model with good AIC, using the intermediate model as smallest model. The algorithm sought at every step to optimise the AIC by adding or removing a single covariate or interaction.

2.5.4 Production of estimates: Overall, age-specific, gender-specific and age-gender-specific population estimates were obtained using the exponentials of appropriate linear combinations of parameter estimates from the final model. Confidence intervals (CI) at the 95% level were obtained on the log-scale from the estimated parameter covariance matrix and exponentiated. At this stage, potential overdispersion was accounted for by using quasi-likelihood maximization (Wedderburn, 1974).

All regression analyses were carried out using R version 3.0.0 (R Core Team, 2013). Descriptive analyses for the six databases were carried out using SPSS version 12.0.2 (SPSS Inc., 2003)

The census population for the island of Montréal was used to calculate the prevalence rate of injection drug use. The denominator was the projected population for 2009-2010 aged between 14-65 years (N=1 392 092; Institut de la statistique du Québec, 2006).

Completeness of data collected by all sources was estimated with its 95% CI by comparing the number of PWID observed to the total number of PWID estimated by the best fitting log-linear model, as well as the upper and lower limits of its 95% CI.

2.6 Ethical approval

Ethical approval for the present study was obtained from the *Comité d'éthique de la recherche de l'Agence de la santé et des services sociaux de Montréal*. Ethical approvals were also obtained from the *Comité d'éthique de la recherche sur les sujets humains du CHUM* for the Saint-Luc cohort and the CHUM's Service de médecine et de psychiatrie des toxicomanies, the *Comité d'éthique de la recherche en toxicomanie* for the CDC-IUD, CRAN and Foster-ARC, the Institutional Review Board of McGill University for SurvUDI and by the Ethics Board of Health Canada research and the Public Health Agency of Canada.

3. RESULTS

A total of 1,480 PWID were identified in the six capture sources; their number varied from 31 to 432 per source (Table 1). The 1,480 identified PWID corresponded to 1,132 distinct individuals. Table 1 shows their distribution across the sources. A total of 278 cases of overlap between sources were observed. Of these, 4 were present in 4 data sources, 61 in 3 data sources and 213 in 2 data sources. Overall, 78.8% of the identified PWID were male (ranging from 83.3% in SurvUDI to 48.4% in Foster-ARC) and 59.3% were more than 36 years old (ranging from 43.3% in CRAN to 62.1% in the Saint-Luc cohort).

The best fitting model obtained using the approach detailed in 2.5, is schematically represented in Figure 1. It includes age group and sex as significant covariates as well as 6 interactions between 2 sources, 2 of which are modulated by age (i.e., there are 2 three-way interactions between age group and two of the sources). Five data source main effects interact with sex, and 3 with age group. Based on this model, the estimated PWID population size in the island of Montréal for the period July 1, 2009 to June 30, 2010 is 3910 PWID (95% CI: 3180 – 4900). Table 2 presents the total PWID population distributed by age group and gender. The estimated population represents a prevalence of 2.8 (95% CI: 2.3-3.5) PWID per 1000 residents among the population aged 14-65 years. Men accounted for 72.1% of the total population and 63.2% of PWID had more than 36 years.

The estimated completeness rate of all data sources was 29.0% (1132/3910) and its 95% CI ranged from 23.1 to 35.6%.

4. DISCUSSION

This study is one of the few on the size of the PWID population in Canada. This estimate is crucial to the planning of public health programs targeting injection drug use related harms at the population level. Using a six-source CRC analysis, the total number of PWID in 2009-2010 was estimated to be 3910 (95% CI: 3180 – 4900) for the island of Montréal, for a prevalence of 2.8 (95% CI: 2.3-3.5) PWID per 1000 residents aged 14-65 years. The PWID population of the island of Montréal is largely male and only one fifth of PWID are 30 years or younger.

4.1. Credibility of the estimate

As stated in section 2.1, four underlying assumptions are required to use the CRC method appropriately. They seem to have been sufficiently satisfied in the present study.

1) All sources included thorough data on drug consumption during the studied period which allowed identification of individuals who met the definition of PWID. In the treatment data sources, an individual might have omitted to report injection, but the opposite, which would have more impact on the produced estimate, seems rather unlikely. As for the SurvUDI and St-Luc Cohort projects, there is a possibility that individuals may have falsely reported injecting drugs in order to participate (and receive the financial compensation). However, this possibility is minimized by the training of the recruitment staff of both studies.

2) In all sources, data were available on the date or dates that each PWID was in contact with the data source and on his/her living area. We can thus be confident that the

second assumption was not violated since all data collected pertain to the study period and the targeted geographical area.

3) There is a potential bias associated with violation of the closed population assumption. Using a short reference period has been suggested as a way to minimize the impact of this bias (Domingo-Salvany et al., 1998). Population movements should have been limited during the chosen one year period.

4) In order to ensure that all PWID matches and only true PWID matches were identified, matching of individuals across sources was based on the perfect concordance of the encrypted codes (generated from gender, date of birth and initials). The quality of the identifying data is highly important for the matching process. These data can be considered reliable and complete in the treatment data sources and in the Saint-Luc cohort. However, for SurvUDI, they are not required to be confirmed by an identification card. This could have led to an underestimate of the number of matches involving the SurvUDI database. Conversely, basing matches only on gender, date of birth and initials of PWID may have produced false matches if two individuals of the same gender happened to have the same initials and the same date of birth. However, given the limited size of the population, one can suppose that this effect is marginal.

As for the additional assumptions of homogeneity of the capture probabilities and independence between sources they are addressed through the log-linear modelling. Indeed, the rather sizeable dependency phenomenon detected highlights that even exploratory analyses involving only two sources, or three or more sources under the independence assumption, would have been potentially misleading and have produced results biased toward zero in most cases. Without discussing all retained interactions, it is worthy to note that the positive one between the Saint-Luc cohort and SurvUDI sources, and their individual interactions with age group and sex, seem coherent with data from the field. Indeed, both studies are largely recruiting from the same community-based organisations distributing free sterile injection equipment (Hankins et al., 2002; Leclerc et al., 2012; Bruneau et al., 2011, 2012). The clientele of these organisations are mainly men, with male clients older than female clients (Leclerc et al. 2009).

Despite satisfying adherence to the underlying assumptions, some caution regarding the obtained estimate is necessary. The number of PWID in the island of Montréal for 2009-2010 could be underestimated to the extent that some PWID have a null probability of being included in any of the six data sources. Such individuals may exist, but the diversity of the data sources greatly limits their number. Among them, there were different types of institutional settings, including a low-threshold addiction treatment facility (one of the clinics of the CRAN) and tertiary health care facilities (CHUM). Data sources also included various community-based settings, via SurvUDI and the Saint-Luc cohort projects, and the judiciary system through the CDC-IUD. In addition, they covered different geographic areas of the island of Montréal and some served predominantly the French-speaking population and others served mostly the English-speaking population.

4.2. Comparison with the 1996 estimate

The estimated PWID population size for the island of Montréal in 2009-2010 represents a two-thirds reduction compared to the one obtained by Remis et al. (1998) for

1996 (also using the CRC method). Despite the absence of data regarding fluctuations between these two estimates, their comparison seemed of interest especially since data sources and methods were similar for both studies. Hypotheses regarding possible demographic, behavioural and environmental changes can be formulated in an attempt to explain the observed difference.

Several studies have demonstrated that PWID have higher rates of premature deaths compared to the general population (Miller et al., 2007; Quan et al., 2010; European Monitoring Centre for Drugs and Drug Addiction, 2011; Evans et al., 2012). While an increase in the mortality rate could be a plausible explanation for the reduction of the PWID population between the two periods, no available data seem to corroborate this hypothesis. Indeed, recent data on AIDS-related deaths for the province of Québec show a significant decrease in mortality since the mid-1990s for all exposure categories (Blouin et al. 2012). Furthermore, an analysis of the data from the Québec coroner's office showed no change in the annual number of deaths due to injection related overdoses between 2000 and 2009 for the island of Montréal (Leclerc et al., 2013a).

Another hypothesis could involve changes in PWID movements between the island of Montréal and other regions of the province of Québec. Between 1996 and 2009-2010, harm reduction programs, including distribution of sterile injection equipment (Noël and Cloutier, 2009; Noël et al., 2011) and OST (Centre de Recherche et d'Aide aux Narcomanes, 2011) developed significantly both in the island of Montréal and elsewhere in the province. This may have led to a decrease in the number of individuals leaving less urban regions of Québec to settle in the island of Montréal and an increase in the number of PWID leaving the island of Montréal to return to their hometown. In addition, since

OST programs have previously been associated with injection cessation (Goldstein et al., 2000; Galai et al., 2003; Shah et al., 2006; Evans et al., 2009), an increased offer in the island of Montréal may have resulted in a higher rate of injection cessation,which could have contributed to the observed reduction of the PWID population. However, the impact of OST programs is limited to opioid users while cocaine is the most often injected drug in the island of Montréal (Leclerc et al., 2013b).

Furthermore, the observed decrease in population size may be due to a decrease in the rate of initiation into injection between the two studies. In this regard, it is of interest to underline a media campaign aimed at preventing initiation into drug injection among street youth that was held in Montréal in 2005 (Roy et al., 2007). Among Montréal's street youth, the proportion reporting having ever injected drugs was 47% at entry in a cohort conducted from 1995 to 2000 (Roy et al., 2003) while it was 24% in a study conducted in 2011-2012 (Leclerc et al., 2013c). And in 2008-2010, a study exploring subgroups of cocaine users in downtown Montréal showed that young users (≤24 years) were proportionally more present in the subgroups where minimal injection was observed (Roy et al., 2013). A reduction of the PWID population could be explained by generational differences regarding drug use (Broz and Ouellet, 2008; Gamella, 1994; Golub and Johnson, 1999; Golub et al., 2005; van Ameijden and Coutinho, 2001) with new (young) drug users, who witnessed the adverse consequences of injection, choosing other modes of drug administration or other drugs.

Finally, the reduction of the size of the PWID population between the two studies may be attributable to environmental factors such as the drug market, which is recognised as an important modulator of drug use behaviours at the individual and social levels

(Gamella, 1994; Stimson and Choopanya, 1998; Sterk and Elifson, 2000; Ciccarone, 2009). In the island of Montréal, surveillance data have shown a significant increase of crack smoking from the early 2000s (Leclerc et al., 2013b, 2012). Also, ethnographic work conducted in downtown Montréal in 1997-1998 (Bourgois, 1997; Bourgois and Bruneau, 2000) and in 2007-2009 (Roy et al., 2012) suggest that on the street, since the beginning of the 2000s, ready-to-smoke crack has gradually surpassed the traditionally dominating powder cocaine (which is easily dissolvable for injection) . Since associations were observed between the forms of drugs available on the market and the modes of consumption used (Gamella, 1994; de la Fuente et al., 1996; Sotheran et al., 1999), it is plausible that the arrival of crack on the drug market contributed to the reduction of injection drug use as it was observed elsewhere in the world (van Ameijden and Coutinho, 2001; Bourgois, 2003a; 2003b; Inciardi et al, 2006).

While several hypotheses can be formulated regarding the decrease of the PWID population in the island of Montréal between 1996 and 2009-2010, it is most likely due to a combination of causes. The substantial gap in time between the two estimates also complicates the understanding of such a change. To better understand the changes that affect the PWID population of the island of Montréal, we believe that estimates of its size should be obtained at more regular intervals, such as every five years. Trends would thus be easier to follow and, consequently, planning of prevention and treatment programs would be optimized.

4.3. Conclusion

As other studies have demonstrated (Hser, 1993; Domingo-Salvany et al., 1998; Platt et al., 2004; Hickman et al., 2004; Böhning et al., 2004; Chiang et al., 2007; Khazaei et al., 2012; Pérez et al., 2013; Uuskula et al., 2013), the CRC approach, despite its limitations, is useful to estimate the size of PWID populations. This approach can be of particular interest when conducted at regular intervals thus allowing for close monitoring of the injection phenomenon and optimal provision of services to this high-risk population. Since unbiased CRC estimates are highly dependent on the quality of the data, reliable data sources should be seen as priorities by public health authorities.

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FIGURE LEGEND

Figure 1: Schematic representation of the final log-linear capture-recapture model

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Contributors

PL and CM designed the study and wrote the initial and final protocols. PL was responsible for the conduct of the study and for the writing of this manuscript. AF participated in the writing of the final protocol and supervised data collection. JB and SB participated in data collection. AV conducted the statistical analyses. CM, AV, AF, ÉR, JB, SB and CA participated in data interpretation. NA wrote the first draft of the manuscript. All contributed to and have approved the final manuscript.

Conflict of Interest

All other authors declare that they have no conflicts of interest.

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Table 1. Distribution of eligible PWID across the six data sources*

	SurvUDI	**Saint-Luc Cohort**	**CDC-IUD**	**CRAN**	**CHUM**	**Foster-ARC**	**Number of eligible PWID**
	yes	yes	yes	no	yes	no	2
	yes	yes	no	yes	yes	no	1
	no	yes	yes	yes	yes	no	1
	yes	yes	no	no	yes	no	13
	yes	yes	yes	no	no	no	24
	yes	yes	no	yes	no	no	12
	yes	no	yes	no	yes	no	4
	no	yes	yes	no	yes	no	3
	no	yes	no	yes	yes	no	1
	no	yes	yes	yes	no	no	2
	no	no	yes	yes	yes	no	1
	no	no	yes	no	yes	yes	1
	yes	yes	no	no	no	no	96
	yes	no	no	no	yes	no	3
	yes	no	yes	no	no	no	24
	yes	no	no	yes	no	no	6
	yes	no	no	no	no	yes	2
	no	yes	no	no	yes	no	8
	no	yes	yes	no	no	no	26
	no	yes	no	yes	no	no	27
	no	yes	no	no	no	yes	1
	no	no	yes	no	yes	no	12
	no	no	no	yes	yes	no	1
	no	no	yes	yes	no	no	5
	no	no	yes	no	no	yes	2
	yes	no	no	no	no	no	245
	no	yes	no	no	no	no	202
	no	no	no	no	yes	no	72
	no	no	yes	no	no	no	217
	no	no	no	yes	no	no	93
	no	no	no	no	no	yes	25
Number of eligible PWID per data source	432	420	150	123	324	31	

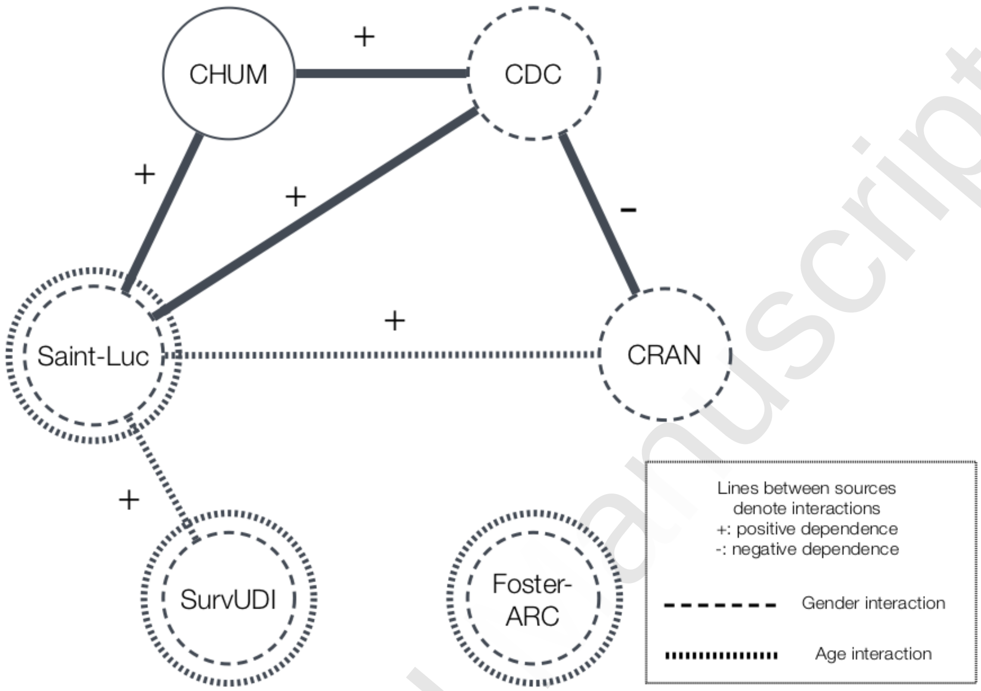
* SurvUDI (PWID epidemiological surveillance network); Saint-Luc Cohort (PWID Cohort); Drug treatment centres: CDC-IUD (Centre Dollard-Cormier Institut universitaire sur les dépendances), CRAN (Centre de recherche et d'aide pour les narcomanes), CHUM (Service de médecine et de psychiatrie du Centre hospitalier de l'université de Montréal), and Foster-ARC (Foster-Addiction Rehabilitation Centre).

Table 2. Capture-recapture estimates* for PWID aged 14 to 65 years in the island of Montréal distributed by age group and gender

	Estimated female population n (95% CI)	Estimated male population n (95% CI)	Estimated total population n (95% CI)
14-30 years	170 (120-260)	530 (430-690)	710 (560-920)
31 - 36 years	180 (130-270)	550 (440-700)	730 (580-950)
37 - 42 years	230 (170-340)	610 (480-800)	840 (660-1110)
43 - 48 years	250 (180-360)	620 (480-820)	870 (680-1150)
49 - 65 years	240 (190-330)	510 (400-680)	760 (600-1000)
Total	1090 (810-1500)	2820 (2300-3540)	3910 (3180-4900)

* Results rounded to nearest ten. Subgroup estimates may not sum to stated total due to rounding."

Figure 1.



SurvUDI (PWID epidemiological surveillance network); Saint-Luc (PWID Cohort); Drug treatment centres: CHUM (Service de médecine et de psychiatrie du Centre hospitalier de l'université de Montréal), CDC (Centre Dollard-Cormier Institut universitaire sur les dépendances), CRAN (Centre de recherche et d'aide pour les narcomanes) and Foster-ARC (Foster-Addiction Rehabilitation Centre).