# PREDICTORS OF CESSATION OF INJECTING DRUG USE IN A COHORT OF YOUNG, STREET-BASED INJECTING DRUG USERS

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## PREFACE

This thesis proposes to investigate the cessation of injecting drug use among young injecting drug users (IDUs) who are living on the street in Montreal, Canada. After a detailed review of the literature concerning transitions in route of administration of drug use and cessation of injecting drug use, a manuscript will be presented which is based on the first study of cessation of injecting drug use among young IDUs. Finally, a brief summary of our findings and conclusions will be outlined. The manuscript *Predictors of cessation of injecting drug use in a cohort of young street-based injecting drug users* will be submitted to the journal *Addiction*.

### Contributions of Authors

Dr. Élise Roy designed the Montreal Street Youth Cohort (MSYC) and has been conducting data collection and research related to the cohort since its inception in 1994. Dr. Roy also suggested the research topic of cessation of injecting drug use. The concept and design of the young IDU study were implemented by the author. Many people provided invaluable assistance in the creation of this thesis. I would like to thank Élise for providing access to the Montreal Street Youth Cohort data, as well as for providing clinical and methodological support. Dr. Jean-François Boivin also provided excellent assistance with methodological issues and also helped in establishing a link between the theory learned in class and how it is practiced in epidemiological research. Statistical and methodological support were provided by Lucie Blais.

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## ABSTRACT

**Objectives:** To identify the factors associated with cessation of injecting drug use in young street-based injecting drug users.

**Methods:** Subjects were originally recruited from various street-based outreach programs and had to have reported injecting drugs within the prior 6 months at baseline or during follow-up, as well as having completed at least 2 follow-up questionnaires. Follow-up occurred from January 1995 to September 2000. Cessation of injecting drug use was defined as having reported no injection at 2 consecutive follow-up questionnaires, averaging at least one year in total. Incidence rates of cessation were calculated and stratified by duration of injection. Adjusted hazard ratios were calculated in order to identify independent predictors of cessation.

**Results:** A total of 305 subjects met the inclusion criteria. Of those, 119 (39%) ceased injecting for approximately one year or more. The incidence of cessation was 32.6/100 person-years, but consistently declined as duration of time spent injecting increased. Independent predictors of IDU cessation were: having at least one parent born outside of Canada (HR=1.4; 95% Confidence Interval (CI): 1.1-1.7); injecting on a less than monthly or less than weekly basis on average within the last month (HR=6.6; 95% CI: 3.1-14.1 and HR=2.4; 95% CI: 1.1-5.5, respectively); injecting an average of two or fewer different types of drug within the last six months (HR=1.8; 95% CI: 0.9-3.5); and having been employed within the last six months (HR=1.7; 95% CI: 1.1-2.7). Independent predictors of not stopping injecting drugs were: homelessness within the last six months (HR=0.6; 95% CI: 0.4-1.0); and having attended a needle exchange program within the last six months (HR=0.5; 95% CI: 0.3-0.8).

**Conclusion:** Cessation of injecting drug use among youth is considerably higher in the first years of injecting. Young IDUs with non-Canadian family backgrounds, as well as those who inject less frequently, inject fewer different types of drugs, and have a more stable lifestyle tend to be more likely to stop injecting drugs for a period of one year.

## RÉSUMÉ

**Objectifs:** Identifier les facteurs associés à la cessation d'injection de drogue chez les jeunes sans abris toxicomanes.

**Méthodes:** Les sujets de cette étude ont d'abord été recrutés dans plusieurs types de programmes d'aide pour les sans-abri et devaient avoir rapporté au moins une injection à l'intérieur d'une période de six mois avant le début de l'étude, ou pendant le suivi et devaient également remplir au moins deux autres questionnaires au cours de l'étude. Les sujets ont été suivis de janvier 1995 jusqu'à septembre 2000. La cessation de l'injection de drogues a été définie par le fait de n'avoir rapporté aucune injection lors de deux questionnaires consécutifs couvrant une période d'environ un an. Les taux d'incidence de la cessation d'injection ont été calculés et stratifiés à partir de la durée de la période d'injection. Des modèles statistiques ont été construits dans le but d'identifier les facteurs indépendants de cessation.

**Résultats:** Un total de 305 sujets remplissaient les critères d'inclusion. De ce nombre, 119 (39%) ont cessé l'injection de drogues pour environ un an ou plus. La fréquence de la cessation était de 32.6/100 personnes-années, mais celle-ci déclinait lorsque la période d'injection augmentait. Les facteurs indépendants associés à la cessation de l'injection étaient : avoir au moins un parent né hors du Canada (HR=1.4; 95% intervalle de confiance (IC): 1.1-1.7); avoir une fréquence d'injection de moins d'une fois par mois ou moins d'une fois par semaine en moyenne (HR=6.6; 95% IC: 3.1-14.1 et HR=2.4; 95% IC: 1.1-5.5, respectivement); s'injecter en moyenne deux sortes de drogues ou moins (HR=1.8; 95% IC: 0.9-3.5); faire partie d'un programme d'échange d'aiguilles (HR=0.5; 95% IC: 0.3-0.8); avoir un emploi (HR=1.7; 95% IC: 1.1-2.7); et être sans-abris (HR=0.6; 95% IC: 0.4-1.0).

**Conclusion:** La cessation de l'injection de drogues parmis les jeunes utilisateurs est considérablement plus élevée lors des premières années d'injection. Les jeunes utilisateurs de drogues injectables venant de familles de l'extérieur du Canada, tout comme ceux qui ont une fréquence d'injection moins élevée, qui s'injectent moins de différentes sortes de drogue, ainsi que ceux ayant un mode de vie plus stable seront davantage portés à cesser l'injection de drogues pour une période d'un an.

## INTRODUCTION

Young people who identify themselves as being street-based, either due to their inability to find a place where they can take shelter or due to their use of services of agencies assisting people living on the street, are vulnerable to many negative health outcomes of both a physical and mental nature. This is due to the difficult social and economic environment in which they often find themselves once out on the street. When coupled with the lack of a supportive home environment, this can result in mental health problems from the resultant stress. It can also lead to a decision to engage in risky behaviours such as prostitution and injecting drug use, which leave these youth highly vulnerable to many serious health problems, including fatal and potentially fatal blood-borne infections such as those caused by hepatitis B virus (HBV), hepatitis C virus (HCV) and human immunodeficiency virus (HIV).

Although studies have been conducted which investigate the degree to which young injecting drug users (IDUs) are vulnerable to these diseases as well as which factors are more likely to make them vulnerable, no studies exist on the cessation of injecting drug use among young IDUs. An understanding of the degree to which young IDUs stop injecting drugs for an extended period of time, as well as what factors in their lives encourage them to stop, is a vital precursor to any intervention which seeks to reduce injecting drug-related harm among young IDUs.

This study was designed to identify the rate and trend over time of injection cessation as well as to identify the factors which predict a long-term cessation of injecting drug use among young, street-based IDUs.

## LITERATURE REVIEW

### 1. Scope of the injecting drug use problem and associated risks

The extent to which illicit injecting drug use has become prevalent globally during the last half century presents public health promoters with a significant challenge. Estimates have put the number of injecting drug users (IDUs) between approximately 5.5 million and 10 million worldwide [1]. Furthermore, the number of countries reporting IDUs in their population rose from 80 to 121 from 1992 to 1995 alone [2], and stood at 128 as of 1999 [1]. In Canada, one multi-center study estimated the number of injectors in this country to be around 125 000 with approximately 11 700 of those living on the island of Montreal, accounting for 0.66% of the island's population [3].

Administration of illicit drugs via the route of intravenous or subcutaneous injection has been a well-documented risk factor for several serious adverse health outcomes including blood-borne infections caused by human immunodeficiency virus (HIV), hepatitis B virus (HBV), and hepatitis C virus (HCV).

Several countries with relatively new IDU populations have subsequently experienced an epidemic of HIV/AIDS which began with the IDU population and proceeded to spread to the larger population via unprotected sexual acts. This has been the case in several south and southeast Asian countries. In Bangkok, Thailand, a sudden upsurge in IDUs in the 1980s resulted in an explosion in HIV rates within that population: whereas rates were virtually zero in surveillance studies from 1985-87, the prevalence of HIV infection among IDU groups in 1988 ranged from 32-43% [2]. A similar trend subsequently occurred in the early 1990s in neighbouring southeast Asian countries such as Myanmar (Burma) [2], Viet Nam [4], China's southwestern Yunnan province [5], and

Manipur in northeastern India [2], where previously low rates of HIV infection quickly multiplied to 50-70% of the IDU population. More recently, in the last several years, this situation has been duplicated in Eastern Europe and Russia, primarily due to the socioeconomic crises brought on by the collapse of communism in those countries which led to increased mobility of people and increased illicit drug production and demand [6, 7].

In countries where more established IDU populations reside, injecting drug use has still proven to be a major contributor to HIV/AIDS rates. In Spain, the injection of heroin with used needles and syringes has been considered the primary cause of new HIV cases [8]. In the U.S., 28% of all reported AIDS cases in 2000 were attributed directly to injecting drug use [9]. Canadian researchers have also cited intravenous heroin and cocaine use as key factors in increased national HIV/AIDS prevalence figures. In 2001, the proportion of reported positive HIV tests attributed to injecting drug use among adults in Canada was 24.6% [10]. The incidence rate of HIV infection among IDUs in Montreal was observed to be 6 per 100 person-years for IDUs followed from 1995 to 2000 [11].

Hepatitis B and C are two other blood-borne virus infections which are easily contracted from needles and other injecting paraphernalia when they are shared between injectors. The general worldwide prevalence of hepatitis B infection in the IDU population is estimated at 40-60%, while 60-70% of IDUs are thought to carry the antibodies to hepatitis C virus (HCV) [12]. In Vancouver, the hepatitis C prevalence rate was found to be 82% among IDUs in one study which also observed a seroconversion rate of 29 per 100 person-years among IDUs who returned for the first follow-up visit [13].

Aside from these infections, there is also a higher risk of fatal and non-fatal drug overdose for injectors, although exact rates are difficult to determine due to the lack of established criteria which clearly define what constitutes an overdose [12]. In addition, the use of depressants such as alcohol in conjunction with injected drugs as well as the injection of adulterated drugs leads to an even greater risk of fatal overdose [12]. Finally, IDUs are also at greater risk for adverse health effects such as skin and soft tissue infections, bone and joint infections, and endocarditis [14], as well as increased vulnerability to sexually transmitted infections (STIs). Injecting drug use has also been associated with mental health problems, although causal associations are difficult to assess [12]. There are also several recent reports from the United Kingdom of clusters of wound botulism cases in patients who are known injecting drug users [15].

## 2. Vulnerabilities particular to young injecting drug users, including street-based young IDUs

Vulnerability to infection from the blood-borne viruses described above has also been demonstrated to be high among injecting drug users who are of a younger age. Many studies have demonstrated the existence of high rates of risk behaviours such as sharing of needles and other injecting paraphernalia. In addition, with respect to HCV infection, there is a particular concern for young and recent onset IDUs, since most studies have demonstrated that HCV is acquired early on in a drug injecting career.

In an American study of IDUs aged 18 to 29 years old, 14% of subjects were found to be HIV positive at enrolment (33 of 229). Those subjects which had started to inject at 18 years of age or less were more than twice as likely to be HIV-positive

(OR=2.66, 95% CI=1.28-5.53) [16]. Among younger injectors in three related studies of street-recruited drug users in Amsterdam, the prevalence rate of HIV was found to range from 12-24% [17].

The prevalence and incidence rates of HCV infection found in studies of younger IDUs have proven to be exceedingly high, particularly with respect to those injectors which had two years or less of injecting experience [18-22]. One study of IDUs aged 18 to 25 in Baltimore found a highly elevated prevalence and incidence of HCV infection. Of 229 subjects, 86 (38%) were found to be HCV positive at baseline, while those who had only been injecting for less than two years were at a significantly higher risk for becoming infected with HCV during follow-up (RR=7.3; 95% CI, 1.6-32.8) [18]. Also, incidence rates were found to be comparable to those found in studies where subjects had a longer average duration of injecting drug use [18]. Similar findings were observed in a previous study in Baltimore [19], where hepatitis C (as well as hepatitis B) seroprevalence rates for those having injected less than six years were similar to those of the greater cohort which had an average duration of injecting of 12 years. Another study of IDUs aged 18 to 30 in Chicago demonstrated that HCV infection prevalence had already reached 27% in this population and 15% among those who had injected for two years or less [20], suggesting a rapid early onset of infection among IDUs. Additionally, the HCV seroconversion rate over two follow-up periods was 19 per 100 person-years [21]. In Canada, high hepatitis C virus infection rates were also observed among young IDU populations. Youth aged 24 or younger in the Vancouver Injection Drug Users Study (VIDUS) exhibited an HCV infection incidence rate of 37 per 100 person-years

with half of those who seroconverted in the study doing so within the first two years of injection use [22].

*Street-based young IDU vulnerability*

High rates of injecting drug use can also be found among youth who are living on the street and/or are using the services of street-based care services and organizations. Two studies of street youth in northern California found that 32% and 45% of the subjects had ever injected illicit drugs with approximately half of these injectors having injected within the previous 30 days in each study [23, 24]. In Vancouver, one sentinel surveillance study of street youth observed 48% of males and 32% of females reporting injecting drug use [25]. Among Montreal street youth, 36% of youth reported having injected drugs at baseline and 23% of all subjects within the last six months [26]. The incidence rate of initiation of injecting during five years of follow-up among subjects in that population who had never injected was found to be 8.2 per 100 person-years [27].

In the Montreal Street Youth Cohort (MSYC), rates for hepatitis B and C virus infection have also been found to be high. Of 436 subjects, 40 (9.2%) of these youth tested positive for at least one biomarker for hepatitis B virus [28]. This rate was 12 to 23 times higher than the HBV infection rate of the general youth population in the neighbouring province of Ontario, aged 14-30. Additionally, those street youth having injected drugs were over five times more likely to have an HBV infection than street youth who had never injected (OR=5.6). This strong association persisted after controlling for other potential confounding variables (OR=3.5; 95% CI=1.5-8.3). With respect to HCV infection, the prevalence among MSYC subjects injecting drugs was found to be 35% [29].

## Transitions in the Route of Drug Administration and the Role of Cessation of Injecting Drug Use

In the following sections, a review will be conducted of the existing literature regarding cessation of injecting drug use, as well as transitions in the route of administration of drug use in general. Before starting with the literature, it is important to point out the differences and similarities between these two categories of illicit drug use research.

Cessation of injecting drug use can be defined as one of two changes in the drug user's habits. The first is a transition away from injecting the drug (or drugs) of choice towards a different non-injecting delivery system. An example from heroin use would be to change from injecting heroin to smoking it. The second definition of cessation of injecting drug use is a complete withdrawal from illicit drug use altogether, or what might be defined as 'abstinence' from drug use. The cessation literature does not necessarily make a distinction between these two definitions when measuring cessation of injecting drug use since the main concern is one of harm reduction, i.e., reducing the risk of negative health outcomes caused specifically by the act of injecting itself.

Studies on transition in route of drug administration are primarily interested in examining changes in how drug users deliver the drug into their body. There tend to be two types of transition study: those concerning transitions from non-injecting drug use to injecting drug use; and those observing transitions of any type. The former includes studies that examined changes in route of administration in a group of users of a specific drug, as well as studies that looked at initiation into injecting drug use in selected groups such as military conscripts, street youth, gay men, etc., but did not define type of drug being used. The second group of studies usually examined more than two types of route

of delivery. For example, one study looked at transitions in any direction between heroin smoking, heroin sniffing, and heroin injecting [8].

Although this is a study on cessation of injecting drug use, a review of the transition literature will also be useful for formulating ideas on what kind of factors may be associated with or predict changes in route of administration, as well as on what constitutes a transition. The process of defining and measuring the transition event contains many of the same issues and obstacles as the process of defining and measuring the cessation event. By the same token, many of the factors predicting a transition may also be useful for predicting cessation.

## 3. Transitions in route of drug administration and associated factors

Before addressing studies that have looked at cessation of injecting drug use as the main outcome of interest, it is instructive to first review the literature regarding transitions in how the drug is administered. These studies provide an introduction to the key characteristics and behaviours in the drug user that may influence his or her decision to change their predominant form of drug use from the route of injecting to that of non-injecting, or *vice versa*.

The literature regarding transition patterns in how drugs are used essentially began in the early 1990s with the studies of Gossop *et al* in a population of heroin users in London, England and Des Jarlais *et al* among drug users in New York City [30, 31]. This shift in focus from the drug being used to the manner in which it was being administered by the user occurred primarily because of the growing HIV epidemic in IDU populations. The concept of harm reduction, i.e., of minimizing the negative health effects of injecting

drug use, as a means of combating HIV and other blood-borne viral infections was gaining ground and necessitated new research which would identify the key differences between injecting and non-injecting drug users [32].

The review of the literature on transitions in route of drug administration will be conducted by creating two groups of studies, based on the description of the existing literature from the previous introductory section. The first sub-section will address studies which examined transitions into injecting drug use. This sub-section will be subdivided further into: descriptive, cross-sectional studies of reasons for initiating injecting drug use; studies which compared those who had ever been an IDU to those who had never been an IDU by using univariate and multivariate analyses as well as more complex study designs such as case-control studies; and finally, prospective studies of IDU initiation. For the two latter groups, studies will be reviewed first with respect to those addressing select populations such as street youth, gay men, military conscripts, etc., followed by those in which populations were recruited on the basis of use of a specific drug such as heroin or cocaine. The second sub-section will contain a review of *multi-directional* transition studies, meaning those which have examined more than one type of transition in route (as explained in the introductory section above).

A discussion will follow concerning the strengths and limitations of these studies, as well as possibilities for use of variables in the present study. The review of variables for the second and third categories in the first sub-section on initiation will be addressed after each of the relevant studies and their study populations have been introduced. The types of factors used to determine associations in transitions in each of these studies will be assessed according to general categories: demographic characteristics; drug use

characteristics; engagement in other risk behaviors/categories; and factors which may potentially encourage a more stable lifestyle. The definition of outcome/event for each study will also be compared.

*1) Transition studies on initiation into IDU*

*Descriptive cross-sectional studies:*

Several of the studies reviewed on transitions into injecting drug use provide a general overview of what factors influence this change in route of illicit drug administration. These studies are cross-sectional surveys which give basic descriptive information on initial injecting experiences of injectors. The first of these originated from a Swedish study which investigated transitions into injecting drug use in a population of IDUs drawn from police arrests [33]. The researchers asked the subjects to recall the circumstances surrounding and reasons for injecting drugs for the first time. These results were mainly compared by gender and found that the majority of both men and women were introduced to injecting by a man as well as by a close friend. Curiosity and peer pressure were cited most often as reasons for injecting the first time. A study of young injectors in Melbourne, Australia demonstrated initiation episodes occurring on average at a very young age (16 years old), and coinciding with leaving/dropping out of school [34]. Initiation was also found in greater proportions of those experiencing episodes of homelessness and incarceration, as well as those who were curious about the 'rush' from injecting drugs. On average, these young injectors were initiated into injecting by friends and acquaintances (as opposed to partners and dealers) and had amphetamines as their first injected drug. One other study from Baltimore on gender differences in behaviours associated with IDU initiation found that, contrary to the Swedish study, women were

primarily initiated by other women [35]. However, both men and women were initiated by friends more than partners or dealers, which is consistent with what the Swedish researchers found.

These studies provide a base from which one may start to gain insight into characteristics common to injecting drug users. However, the information provided focuses more on *how* the drug user became an IDU rather than *why*. Furthermore, the comparisons of IDUs are only carried out on an internal basis and do not provide much direct information on how and why IDUs differ from non-IDUs, nor do they provide any information on factors which may be associated with a change in route of drug administration.

*Descriptive studies comparing ever IDU to never IDU:*

Studies which compared those who had ever injected drugs to those who had never injected drugs included 10 which looked at predictors among specific sub-populations. Two of these studies drew their population from a cohort of Swedish men conscripted for military service [36, 37]. The first study aimed to examine the differences between cannabis users and IDUs with respect to social and behavioural risk factors [36]. The second study went a step further and sought to determine if there were significant differences on the 'pathway' of being offered drugs, to using cannabis, and ending with intravenous drug use [37]. A third study from the same researchers sought to match subjects from the conscription data (which covers virtually all Swedish males at the age of 18-20) with records from an injection study in which persons arrested by the police were asked questions about their ID use if they were found to have evidence of intravenous needle markings [38]. Of 143 subjects who were also linked to the

conscription records, 43 of these had reported injecting for the first time after the conscription. Their exposure to risk factors was compared to that of the non-injectors.

A study from Baltimore comparing IDUs in an HIV study to subjects in an epidemiologic catchment area (ECA) which also contained the IDUs themselves sought to determine if early delinquent behaviour was associated with subsequent injecting drug use [39]. A St. Louis survey of injecting and non-injecting drug users drawn from relatives of subjects in a cohort of alcoholics sought to determine which juvenile behavioural characteristics might subsequently predict injecting drug use [40]. Characteristics similar to those used in the Baltimore study [39] such as various types of juvenile delinquency, early exposure to psychoactive substances, and negative home environment factors were scored and pooled into three categories: low, moderate and high risk. A study drawn from the same population attempted to determine the role of solvent use in IDU initiation [41].

A cross-sectional study of gay men in Minneapolis drawn from a chemical dependency treatment program looked at factors predicting injection drug use, as well as high risk sexual behaviours and HIV infection self-report status [42]. In addition to drug taking and sexual risk behaviours, the study also elicited information regarding sexual abuse and parental drug use histories of subjects.

Young injecting drug users were another specific study population represented in these comparison studies. Homeless youth in three cities in northern California were compared on the basis of current, past, and no injecting drug use status [24]. Risk factors assessed included drug use and sexual practices as well as the subject's social environment and psychosocial history, including traumatic life events. Two studies taken

from a cohort of young IDUs in Baltimore also investigated the factors associated with a transition to injecting drug use [43, 44]. In one of these studies, a case-control design was constructed from an underlying cohort study of HIV infection among young adult drug users in order to determine characteristics of drug users likely to transition into injection drug use [43]. Entry into the cohort was limited to those who had been injecting drugs for no more than five years and had injected in the previous six months or to those who had used non-injectable heroin or crack for at least one year and for no more than 10 years prior to the study. A cross-sectional study was also conducted with this group in order to determine the differences between adolescent (21 years of age or less) and young adult (older than 21 years of age) IDU initiation factors [44].

Ever versus never IDU comparison studies have also been carried out on populations which are using specific drugs and three of these are reviewed here. In one of these studies, a cross-sectional comparison was made of non-injecting heroin users with former injecting heroin users (both frequent and infrequent injectors) in New York City [45]. Factors studied included drug use characteristics, severity of heroin dependence, depression, as well as gender and race phenomena. From the Drug Transitions studies in London, England, a comparison was made of heroin chasers (i.e., inhalation of vapours) and heroin injectors in a community sample [46]. Within this study, sub-group comparisons were made between those who had ever injected and those who reported having never injected heroin. Associated factors examined were similar to those of the New York study referred to above [45]. Finally, from the Multicenter Crack Cocaine and HIV Infection Study (centers in New York City, Miami and San Francisco), a cross-sectional study was conducted investigating initiation into drug injection from

crack cocaine smoking [47]. Regular crack users who reported a history of injecting drugs, after first having used crack, were compared to those regular crack users who had never injected drugs.

Studies conducted on initiation into injecting among specific population groups were primarily interested in social, behavioural and psychological characteristics as predictors of injection drug use. In particular, these studies emphasize the role of early misbehaviour and adverse social environments. Factors which played a role in initiation included psychological factors such as low emotional control [36, 37], a history of contact with police or juvenile authorities [36-38], juvenile arrest [40], forced institutionalization [24], truancy [37, 40], having dropped out of school [43], having engaged in fighting [40], as well as misbehaviour in general [39]. Factors of adverse living conditions and childhood environment which were seen more often in IDUs versus their non-IDU counterparts included having run away from home [37], living in a squat and having been kicked out of the house (for youth already homeless at the time of the study) [24], current exposure to physical violence [43], lower social class [36, 38], and trading of sex for money [43]. In addition, issues surrounding familial background were assessed: parental divorce was found to be a predictor of injection drug use among gay men [42] and military conscripts [36], as was a history of parental substance abuse in the latter population [36]. In addition, poor supervision and disrupted family histories were associated with injection in a population with deviant behaviours [40] and homeless youth [24], respectively.

These studies of selected groups also looked at early substance use in IDU versus non-IDU populations. However, the primary substances studied were mainly limited to

cannabis, solvent and alcohol use. The use of cannabis was hypothesized by Stenbacka to be a 'stepping stone' in between being first offered drugs and ending up as an injecting drug user. As such, an earlier start date of cannabis use and use of cannabis 5 or more times a week were found to be associated with injecting drug use among Swedish conscripts [37]. Similarly, cannabis use before the age of 15 was found to be predictive of ID use among relatives of alcoholics [40] and smoking marijuana was predictive of adolescent drug injecting [44]. A history of solvent use was also shown to significantly increase the likelihood of reporting injecting drug use even after controlling for psychiatric disorders associated with solvent use [41]. High alcohol use was found to be a strong correlate of injecting drug use [38, 24]. Finally, a comparison study of current, past and non-IDU street kids found a significant difference in the non-injection use of crack, cocaine, heroin, or speed (amphetamine), with the percentage of current and past IDUs using these drugs more than non-IDUs [24].

Similar results concerning background social and psychological characteristics were found among users of specific drugs as those found in specific groups. A history of physical abuse was more likely to be present in frequent former heroin injectors than in heroin users who had never injected (for both men and women) [45]. In addition, both infrequent and frequent former injectors had a higher proportion of subjects who ever participated in a treatment program compared to never injectors [45].

Patterns of drug use can be studied in even greater detail. Daily or more use of heroin was found to be significantly greater among IDU versus non-IDU heroin users [46], as was a longer history of heroin use [46]. Among crack and cocaine users, significant variables for later injection in a multivariate model included use of other

substances while smoking crack, and having ever snorted heroin [47]. Finally, frequent former injectors were more likely to be younger at first heroin use than never injectors as well as infrequent former injectors [45].

Also of importance are factors involving peer influence, particularly with respect to drug use. In one study frequent former injecting heroin users were found to have a greater proportion of sex partners who had ever been an IDU (both male and female) as compared to non-IDU heroin users [45], while another comparison study of heroin users found IDUs to be more likely to have friends who inject drugs than non-IDUs [46].

With these studies, a pattern begins to emerge as to what sort of factors may influence a change in route of administration. These include: psychological and social factors; drug use behaviours, including the influence of peers on those behaviours; and other risk behaviours (e.g., sex trading). There are, however, some limitations to what can be inferred from these studies. Transitions are by nature a temporal phenomenon and this makes it essential that the proper timeline of events be followed. With the above studies, it is not always certain whether the hypothesized causal factor precedes the IDU initiation event. Some of these studies do not make it clear whether the variables are based on life-time or current behaviour [37]. More importantly, the cross-sectional design of most of these studies prohibits a precise determination of the temporal relationships. For this reason, several prospective studies on the transition to IDU will now be examined.

*Prospective studies:*

Two of the prospective studies done on initiation into injecting drug use focus on specific population groups (street-based youth and a cohort addressing HIV risk factors in IDUs)

while the third addresses users of a specific drug (heroin). The latter two studies also contain some analysis of relapse into injecting drug use among past IDUs. In the Montreal Street Youth Cohort study, street-based youth (aged 14-25) who reported having never injected drugs at study entry and completed at least one interview-administered follow-up questionnaire (n=415) were followed until first report of injection [27]. Survival curves were calculated for cumulative incidence of initiation into injecting and a multivariate proportional hazards regression model was determined. The other study on a specific group comes from Amsterdam, the Netherlands and was part of a cohort study on harm reduction and HIV seroconversion in that city's drug users (heroin being the predominant drug of choice) [48]. Risk factors for the transition from non-injection to injection drug use were determined using both survival analysis for baseline characteristics and nested case-control analysis for current behavioural variables. In the study of intranasal heroin users from New York City, a randomized controlled trial was initiated to investigate the effects of a combined AIDS and drug injection prevention program on the proportion of subjects initiating injection of drugs [31]. The study population was restricted to heroin users reporting intranasal use as main route of administration in the six months prior to enrollment. In addition, subjects could have injected drugs beforehand, but only up to 60 times within the past two years (n=104).

Virtually all of the significant variables from these three studies involved drug use behaviours and influence of peers on these behaviours. In the Montreal study, independent predictors of initiation included current use of heroin, hallucinogens, cocaine/crack/freebase (last month), and currently having a friend who injects drugs (among girls only) [27]. In the Amsterdam HIV study group, significant baseline

variables in the proportional hazards model for initiation or re-initiation of IDU were a more recent history of injecting (within the last 1-5 years), and longer duration of regular cocaine use. For the conditional logistic multivariate model, heroin as drug most often used, regular use of heroin, and having a steady sex partner who is an IDU were all significant predictors of injecting drug use [48]. From the New York City heroin sniffing group, injecting drugs at follow-up was associated with the degree of non-injected drug use, prior injection, and having close relationships with current IDUs. However, the only variables remaining in the multivariate model were current sniffing of a heroin/cocaine combination and having been in drug abuse treatment [31].

Other risk factors of significance included current homelessness (last six months) [27], having ever experienced sexual abuse outside of the family [27], being less than 18 years old [27], being tattooed [27], and Surinamese/Antillean ethnicity (protective effect) [48].

*2. Multi-directional transition studies*

While the above studies provide a fairly extensive list of factors which may effect a change in route of administration, it is still not certain whether these variables apply only to initiation into injecting drug use or whether they have broader applications for changes in route of drug administration in general. These "multi-directional" studies are all cross-sectional in design and focus exclusively on populations using specific drugs. Therefore, these studies will be reviewed according to origin of study.

Studies which examine any sort of transition in route of drug administration had their start with the London, UK-based Drug Transitions Studies, which mainly documented the prevalence of certain types of transition without much investigation into

factors influencing the transitions. There are two main study populations used in these studies: one is a sample of heroin addicts in treatment and the other is a community sample of heroin users. The treatment study drew from 275 heroin users who were attending seven different clinics in the UK [30]. The community sample was taken from 408 heroin users who were recruited on the street by interviewers [49]. Finally, a later study sought to combine these two samples in order to investigate transition trends [50]. In each of these cross-sectional studies, a self-administered questionnaire was incorporated and the populations were heterogeneous with respect to route of heroin administration. Two of these studies included an investigation of factors associated with a transition event [30, 49]. Univariate test statistics found daily or greater heroin use to be associated with a transition in the treatment sample [30], while women in the community sample were found to be less likely to make a transition from heroin chasing to injecting after controlling for other factors [49].

The Sydney, Australia surveys of transition in route of administration focus on amphetamine [51], benzodiazepine [52], and heroin using populations [53]. In a study of route transition in 301 amphetamine users, eligibility was restricted to those who had used amphetamines at least monthly for the preceding six months in order to ensure 'regular' users were being represented [51]. However, in a study of benzodiazepine route transition, a population of heroin users was employed (n=312), of which half were purposively recruited from heroin treatment programs and the other half had to have been using heroin in the 3 months prior [52]. The third study investigated transitions in route of heroin use itself in a purposively selected ethnically divided population (half Caucasian and half Indochinese) [53]. Transitions between smoking, chasing and injecting heroin

were observed. Each study employed a cross-sectional design and used multivariate logistic regression in order to determine factors associated with a transition while controlling for potentially modifying factors. However, the multivariate models for the heroin study are limited due to a small sample size.

Variables of significance from the Sydney studies included drug use behaviours. In the study on amphetamine users, duration of use of that drug was found to predict a transition into injecting drug use [51]. Poly-drug use was also found to be associated with transitions in general in two of the studies [51, 52]. From the other non-drug related risk factors, general criminal involvement was found to be associated with transitions among benzodiazepine users [52]. Various indicators of the subject's mental health were also investigated in the Sydney transition studies, where it was observed that drug dependency levels (using the Severity of Dependence Scale (SDS)) [51, 52] and general health and risk-taking habits (using the Opiate Treatment Index (OTI) where a higher score indicates poorer health outcomes) [51] were significantly higher among drug users who made a transition in route of drug administration. Finally, one factor from those discouraging an IDU lifestyle found to be significant in these studies was having a history of treatment program attendance, which showed a protective effect against a transition into injecting drug use among heroin users [53].

From Brazil, a cross-sectional survey has been conducted on transitions involving snorting, smoking and injection of cocaine [54]. Subjects were recruited from various urban drug treatment and HIV counseling centers. Inclusion was on the basis of crack or cocaine use: subjects had to have reported using one or the other at least once in their lifetime (n=294). This study was cross-sectional in design and employed multivariate

models using logistic regression. Two variables which remained significant in the multivariate model were frequency of use and use of more than one drug: on average, cocaine users were more likely to make a transition if they were using cocaine at least 5 times per week during their period of peak usage, and if they were using other illicit drugs in addition to cocaine.

In Spain, a study in which heroin use characteristics for three cities were compared, included 909 heroin users which were defined as those having used heroin at least 15 times in their life and at least once in the month prior to interview [8]. Transitions in main route of administration were observed, meaning the route that had been used most frequently for at least one month (therefore, 'current route' was equated with that most frequently used in the 30 days prior to interview). The only significant differences observed in each type of transition were those between the three cities themselves, suggesting a cohort effect in which new users take heroin using the route which is most common among users in their city.

Many of the variables discussed above are suitable for an investigation of cessation of injecting drug use: especially those which consistently demonstrate an effect across the boundaries of studies of transition into injecting drug use and studies of any transition in route of administration. From the review just conducted, this would include: pattern of drug use, including type of drug used, frequency of use, duration of use, and poly-drug use; having friends or sex partners who are IDU; a history of physical or sexual abuse; some form of criminal involvement; various aspects of delinquent behaviour; some features of homelessness; and gender. There were also effects from treatment program attendance in several studies but the results are inconsistent: two studies show an effect

on transition while two others demonstrate a protective effect against transition. In addition, regarding ethnicity, the New York study indicated Hispanic ethnicity as a risk factor for transition into ID use while the Amsterdam study showed Surinamese ethnicity to be protective against IDU initiation.

It should also be re-emphasized that for the cross-sectional and case-control studies in which the time at which the associated factors were measured is not given, there is some uncertainty as to whether the factors studied preceded or followed a transition in route of drug administration.

*Transition studies: Definition of outcome/event*

The transition studies also provide some useful information on how one might also define a period of cessation of injecting drug use. This is a particularly problematic area of measurement in any transition study and this is reflected in the variability of definitions in the studies cited above. Three methods for measuring transitions are generally employed in these studies: use of a specified time period of sustained use of a new route of drug administration (which may or may not be the predominant route of administration during that time); a certain frequency of use of the new route; or, for studies on transition into IDU, a one-time change in route of administration.

For the transition studies modeled on the British Drug Transition Studies [30, 49, 50, 54], a time period of one month or more was employed during which a change in route of drug administration was sustained. The Sydney study on route of amphetamine administration, on the other hand, used an outcome definition that incorporated a notion of repetition of use of the novel route of administration: four consecutive occasions of use

of the route to which the subject transitioned were required in the six months prior to study entry [51]. In the studies solely on transition into injecting drug use, the only requirement for the outcome was either first report of injecting drug use during follow-up or self-report of injecting drugs at any time after an initial history of non-injecting use of the drug in question.

### 4. Cessation of injecting drug use

As can be seen from the literature reviewed above, the emphasis was on transitions into injecting drug use. Even those studies which examined any type of transition tended to report greater proportions of transition into injecting drug use in their populations. This initial focus on initiation into injecting arose from an emphasis in harm reduction schemes on primary prevention, the reasoning being that preventing drug users from 'graduating' to injecting drug use in the first place would be the most effective means of preventing HIV, HBV and HCV infection. In recent years, harm reduction strategists and the researchers working on transitions in route of drug administration have expanded their investigations to include studies of transitions away from and cessation of injecting drug use. Reasons for making 'healthy' transitions away from injecting drug use towards modes of use which decrease vulnerability to blood-borne viral infections, or towards cessation of illicit drug use altogether, needed to be more properly understood since treatment and education programs were already starting to encourage IDUs to move to non-injection of drugs as a harm reduction strategy [53, 55].

Before reviewing this literature, it should be noted that there are many studies which have been conducted regarding the cessation of *all* drug use, or what is often

referred to as 'abstinence' from drug use altogether. Most of this literature will not be addressed in the present review since it is felt that the objectives and methods of these studies differ so much from those of the present review as to make them incompatible, particularly due to the lack of an injecting drug using population in these studies. Only two studies addressing abstinence will be reviewed since they start with a population of injecting drug users.

*Cessation of injecting drug use*

The first such study on cessation of injecting drug use to appear in the literature was the study from Australia which examined reasons injectors gave for stopping (and restarting) injecting drug practices [55]. Of the 855 IDUs (those injecting drugs in the previous six months without having attended a treatment program in the last 30 days), 179 (21%) reported having stopped injecting for at least one year at some point in their injecting career. Reasons given for this cessation included: fatigued by IDU lifestyle; influence of significant personal relationships and social pressures; legal pressures; and employment. It should be noted that these factors were elicited using open-ended questions which may create problems in establishing reliable categories for analysis: this could compromise precision since it is up to the researcher to then translate the subject's response into some sort of variable. Furthermore, only simple test statistics for differences in proportions were conducted, meaning that no control for potential confounders exists in this study.

Several of the studies already introduced in the previous section on the transitions research will also figure in this section and it is to those that we now turn. The other studies from Australia on cessation included two of the Sydney transition studies: the one

regarding transitions in mode of amphetamine use [51] as well as the one examining route of benzodiazepine administration among heroin users [52].

The amphetamine study required monthly use of this drug for the six months preceding study entry while transition was a change in usual route of amphetamine administration lasting for four or more occasions of use [51]. Only 9% of the 301 subjects recorded a transition away from injecting. Reasons for cessation of amphetamine injecting were: concern about veins; fear of HIV; and concern about amphetamine addiction. In addition, those who stopped injecting also reported a reduction in frequency of amphetamine use. However, the proportion of subjects transitioning away from injecting was too small to use any sort of regression modeling.

For the benzodiazepine study, inclusion was quite different with criteria of either being in treatment for heroin dependence or any use of heroin during the previous 3 months, which yielded 312 participants, 88 of which had ever injected benzodiazepines [52]. Of these 88 subjects, 48 (55%) had not injected in the previous six months (which appears to be the criterion for transition away from injecting in this case). In this study, the investigators succeeded in building two logistic regression models to predict the factors associated with transition away from injecting: the first one examining demographic characteristics and the second addressing psychosocial variables. Between these two models, four variables retained significance: current employment; level of heroin dependence (higher level associated with lower rates of cessation); level of criminal involvement, using Opiate Treatment Index (OTI) score (higher score associated with lower rates of cessation); and better general health status, using OTI score (higher score, which equates with poorer health, associated with lower rates of cessation). When

the two models were combined, all variables remained significant, except for employment.

The Brazilian cross-sectional study of transitions among cocaine users admitted those who reported having used cocaine or crack more than once in their life [54]. Following *Griffiths et al* [49], transition was defined as a change in the 'exclusive or predominant' (not explained) route of administration lasting one or more months, leading to 279 individual transitions, of which 19% were from injecting to non-injectable habits of cocaine use (13% from injecting to smoking and 6% from injecting to snorting cocaine). Preoccupation with health and a preference for crack cocaine were given as the main reasons for making a transition from injecting to smoking. No further analyses were conducted with this data, presumably for the same reason of small numbers as in the Australian amphetamine study.

In Spain, a study in which three cities' heroin use characteristics were compared, included 909 heroin users which were defined as those having used heroin at least 15 times in their life and at least once in the month prior to interview [8]. Transitions in main route of administration were observed, meaning the route that had been used most frequently for at least one month (therefore, 'current route' was equated with that most frequently used in the 30 days prior to interview). In Madrid and Seville, 46.1% and 38.7% of subjects respectively made their first transition from injecting to smoking heroin. The only significant differences observed in the transition from injecting to smoking heroin (measured only as a comparison of proportions) were those between the three cities themselves, suggesting a cohort effect in which new users take heroin using the route which is most common among users in their city.

A study from Seattle investigating associations between retention in methadone treatment and drug use behaviours and incidence of HIV and hepatitis B and C infections, included cessation of drug injection as one of its outcomes [56]. Drawing from a longitudinal study on in- and out-of-treatment drug injectors, 716 subjects who had reported injecting drugs in the month preceding study entry were asked at the one-year follow-up visit if they had injected drugs in the previous month. In a multiple logistic regression model which controlled for frequency of injecting, cessation of injection remained strongly associated with both disrupted and continued methadone treatment status, as compared to those who left treatment entirely.

As can be seen, most of these studies have only presented means and proportions as a way of presenting results and/or do not have transition away from injecting as their main outcome. Moreover, an in-depth investigation of relevant variables is not present with the possible exception of the Sydney transition studies, mainly due to the inability to conduct sub-analyses because of the lack of subjects making a transition away from injecting.

We now move on to those studies which have cessation of injecting drug use (including complete abstinence of drug use) as the main endpoint and use design and analysis techniques more conducive to determining the causality of the relationship between putative risk factors and cessation. There are five of these studies in total, each with a different focus: time in treatment; drug user social networks; a two-city comparison (presently in abstract form only); characteristics of methadone maintenance programs; and effect of harm reduction programs on cessation rates.

A study done among injecting drug users and crack cocaine users in New York attempted to ascertain the impact of amount of time spent in a drug treatment program on the probability of cessation of drug use [57]. Street recruitment was used and eligibility was restricted to those who were at least 18 years old, had used crack or heroin in the last 48 hours (verified by urinalysis test), had not been in a drug treatment program in the 30 days prior to recruitment, and, for injecting drug users, self-report of having injected in the prior 30 days. A baseline questionnaire was administered, as well as a follow-up questionnaire six months after baseline (range 5 to 9 months). The outcome was defined as answering no to the question: 'have you used heroin or cocaine *in any form* [emphasis added] during the 30 days prior to the interview?'. Of the 993 subjects who completed the follow-up questionnaire, 141 (14%) ceased drug use by this definition. Variables which were associated with cessation of drug use in univariate models (using logistic regression) included: sex (males more likely to cease drug use); crack use at recruitment (those not using more likely to stop injecting); and time in treatment. This last variable was categorized into 0 days / 1-89 days / 90+ days, included any sort of treatment such as methadone maintenance, methadone detoxification, outpatient, residential, prison-based, or other. The more time spent in treatment during the period between recruitment and follow-up, the greater the odds of stopping drug use for at least one month. This variable remained significant when controlled for sex and crack use.

Although this study presents important findings on the role of drug treatment programs in the cessation of drug use there are some missing factors which are vital to a study of cessation in young injecting drug users. First, because this is a study of drug cessation in general, there is some confusion as to the implications for cessation of

injecting drug use in particular. This is especially apparent when one observes that no stratification of cessation with respect to injecting drug use versus non-injecting drug use has been carried out in this study. The definition of cessation itself is also restrictive since a period of only one month of no drug use is more likely to be due to chance factors such as low availability of drug of choice, disruptions in daily routines, etc.

Additionally, many potentially modifying variables such as drug use and injecting characteristics, and other risk behaviours are missing from the analysis. It is quite possible that these factors could have an effect on the dependent variable since there is a sizeable portion of the study population which stopped using drugs without attending any sort of treatment program (11% of the subjects who reported no treatment attendance). Finally, with respect to young injectors, there is no information on them here as the cut-off age was 18, the average age was 38 years old, and no stratification by age was presented.

Another study which investigated the cessation of drug use in general was one in which the drug user's social and drug networks were studied as the main predictors of cessation [58]. However, this study is of more relevance to an injecting drug user population since it consists entirely of adult IDUs. Subjects were recruited from a prospective study of HIV infection in injecting drug users in Baltimore. Eligibility criteria were: being at least 18 years old at study entry; and having injected and shared drugs within the six months prior to entry. Of the 335 IDUs who completed the follow-up questionnaire, only 24 (7%) reported cessation of drug use which was defined as no injection or inhalation of heroin or cocaine and no smoking of crack cocaine in the prior six months. The main predictor in this study was the drug user's network, which included

a measure of 'social support', 'drug network', and 'sex network'. Social support was defined as number of individuals who provided the subject with material assistance, socialization, etc. in the last month. The drug network consisted of those individuals with whom the subject shared drugs in the last six months and the sex network consisted of those individuals with whom the subject had sex in the last six months. The influence of each network on the subject was then measured by calculating the proportion of members in each network against the total number of individuals listed. In multivariate logistic regression models which controlled for sex, race, education level, marital status, employment status, criminal record, drug use characteristics, and history of treatment program attendance, a smaller proportion of individuals in a subject's drug network was predictive of cessation of drug use among IDUs.

This study provides a useful insight into the importance of social contacts who are drug users in the IDUs' attempts to stop using drugs. However, although we are effectively dealing with cessation of injecting drug use in this study, there is still no way of discerning effects related to a transition away from the injecting process versus a complete withdrawal from drug use altogether. The latter outcome may be too strict to measure all the relevant effects and this seems to be borne out in the present study since there are only 7% of injectors who stopped using drugs entirely at follow-up. Furthermore, of all the independent variables assessed, only the drug network variable had a significant effect in multivariate regression models. Once again we also have no information on young injectors for the same reasons as in the previous study: age cut off at 18, an older mean age (approximately 37 years old), and no age-specific results in the

analyses. In addition, the stability of the cessation is questionable since it is only measured at one follow-up period.

The only Canadian transition study outside of those from Montreal Street Youth Cohort was published as an abstract which detailed the comparison of cessation experiences among injecting drug users in Montreal and Vancouver [59]. Follow-up in each of these cohorts was conducted during 3 visits lasting from 1995 to 1999. Interestingly, both cohorts reported that 21 % of their populations stopped injecting drugs for at least seven consecutive months (192 of 901 injectors in Montreal and 158 of 770 injectors in Vancouver). According to univariate analyses, those reporting cessation in both cities were found to be more likely to have stable housing and less likely to report incarceration, sex trade activities, and frequent crack use. Factors exclusively associated with cessation in the Montreal group were less alcohol use, and HIV-positive status (negatively associated with quitting). In Vancouver, quitting injecting was associated with attendance of non-methadone addiction treatment programs.

While this study provides follow-up data, there are no details regarding the temporality of the independent variables: it is unknown if these factors were measured prior to the outcome of cessation. Furthermore, there is no information provided regarding the effects of potential confounders on these variables. In addition, the outcome is once again defined as a cessation during one single follow-up period so that the stability of the cessation is questionable.

The final two studies on cessation of injecting drug use come from the Amsterdam Cohort Study which was a study which assessed the natural history of HIV infection as well as acting as an evaluation of AIDS prevention [60]. The study was conducted from

1985 to 1998 with continuous recruitment which included 1294 drug users altogether [61]. Recruitment occurred primarily at methadone maintenance clinics throughout Amsterdam, but also included some clinics treating drug-using prostitutes for sexually transmitted infections. An interview-administered questionnaire was given at every four month follow-up.

The study by Langendam *et al* [60] examined the effect of various characteristics of methadone maintenance programs and 'long-term' cessation of injecting drug use. Drawing from the Amsterdam Cohort, it further restricted the population to those IDUs who contributed at least two years of follow-up to the cohort. This was due to the nature of the outcome which defined cessation as having reported "no injecting drug use for at least one year after a period of at least one year of injecting during follow up", which left 488 subjects from 1279. Data from 339 of these subjects was also linked to the Dutch National Central Methadone Register in order to collect information on various indicators of methadone use. Of the 488 subjects, 110 (22.5%) ceased injecting for at least one year. Overall incidence of cessation of injecting was calculated as being 4.1 /100 person-years. A test for trend in overall cessation was also calculated and indicated a significant increase in cessation from 1985-89 to 1995-97.

Analysis of the factors associated with cessation was conducted using a nested case-control design in which 86 cases were matched to the cohort visits of the remaining 253 subjects (only the 339 linked subjects were used) on year of cohort entry and on year of cohort visit in order to adjust for selective recruitment over time and for secular trends, respectively. Factors that were examined dealt with methadone dosage, including changes in dosage over time, as well as frequency of program attendance, and changes in

main site of methadone prescription. Other variables used included demographics, homelessness, injecting frequency, main type of drug injected, main injecting partner, ID use of steady partner, current prostitution, injecting mainly at home, percentage of new needles acquired via a needle exchange program, use of various drugs and units of alcohol per day. Aside from the methadone maintenance variables, significant univariate variables for stopping injecting drug use were: less than daily injecting; non-injecting heroin use; no use or irregular use of needle exchange program; and current prostitution (less likely to stop). Each of these variables remained significant in the multivariate model except for use of non-injecting heroin. In a multivariate model assessing methadone variables adjusted for frequency of injecting, percentage of new needles obtained via needle-exchange programme and current prostitution, only a relatively larger increase in methadone dosage (>5mg/year) was a predictor of cessation of injecting. The significance of a steady increase in methadone dosage led the researchers to hypothesize that cessation of injecting is a long-term gradual process.

The other study from Amsterdam involved a more general investigation of the trends in injecting drug use transitions and determinants with an emphasis on explaining the reasons for the increased incidence of cessation described in the previous study [61]. The study included 996 subjects who had paid at least one follow up visit (subjects were asked to return every 4 months but actual mean time between follow ups was 5.3 months). During the study's time period, injecting cessation went from 10.0% to 17.1% per visit, which was reported to significantly exceed a linear increase due to drop out over time (this was because a significant quadratic effect was demonstrated). The definition of cessation in this study was less restrictive than in the previous one: among current

injectors at each follow-up, those who had reported no injecting for 4 consecutive months). The study used Generalized Estimating Equations (GEE) in order to analyze repeated outcomes within the same subject. This is a useful tool for utilizing the whole time at risk of each subject in the event that they quit injecting for the requisite period and then begin injecting again at a later date. Time-dependent variables were measured at the last cohort visit preceding the visit at which outcome was measured and at the corresponding index date for subjects not experiencing the outcome.

Independent predictors of cessation were: at least daily injecting (less likely to stop); greater percentage of needles from needle exchange program (less likely to stop); AIDS diagnosis; steady sexual partner who never injected drugs; non-injecting heroin use; and non-West European ethnicity.

In the Amsterdam cohort, one of the main problems is that the study population is highly unstable. Many of the injectors are just visitors to Amsterdam and, as such, represent the majority of the losses to follow-up. Since having a large proportion of visitors appears to be a feature unique to the Amsterdam IDU population, it is difficult to generalize to the situation in drug injecting populations in other large cities. Similarly, recruiting was done primarily from methadone maintenance clinics since over 60% of opioid users in Amsterdam are enrolled in such a program but this progressive scenario is most likely not the situation in any other city. In addition, the use of methadone clinics is supplemented by recruiting from sexually transmitted infection treatment clinics for drug-using prostitutes; however no attempt is made to stratify or control for the results from this population which might have different sociodemographic and drug taking characteristics. The other problem is that methadone maintenance is primarily given to

heroin users and this study purports to be a study on cessation of injecting drug use which implies use of any drug. Users of other drugs may be under-represented here. Another generalizability problem is that of age: almost no subjects under the age of 25 were recruited suggesting that this age group does not attend these types of treatment programs. Finally, there is a concern of bias due to the possibility of a healthy or concerned volunteer phenomenon: although 60% are enrolled that still leaves 40% of injectors who are not attending and who may also have different characteristics than those in attendance.

In summary, significant variables can be grouped into three categories: drug use characteristics; other risky behaviours; and factors which could potentially discourage an IDU lifestyle. Similar to the transition studies, indicators of heroin use tend to influence cessation in several studies. Non-injecting heroin use predicts cessation [60, 61] while a higher level of heroin dependence makes cessation less likely [52]. Current crack use [57], and greater frequency of crack use [59] were also negatively associated with cessation, while less alcohol use in one study was positively associated with cessation [59]. Having a steady sex partner who never injected drugs made one more likely to stop injecting [61], while sharing drugs with a smaller proportion of people (i.e., a smaller proportion of people in one's 'drug network') predicted cessation [58], as did less than daily injecting when compared to those who injected on a daily basis or more [60]. Infrequent use of needle exchange programs [60] and a lower percentage of needles obtained from a NEP [61] predicted cessation of injecting. Other influential risk factors which encouraged cessation included stable housing [59], and fewer self-reports of an incarceration experience [59], while current prostitution discouraged cessation [60].

Current employment [52], increased time spent in treatment [57] and a fear of contracting HIV [51] are all factors which discourage the IDU lifestyle and also predict cessation. Fear of HIV is contrasted with actual HIV status which is found to discourage cessation in one study [59], although this is not conclusive as an AIDS diagnosis was associated with cessation in another study [61].

Definitions of cessation event/outcome in the majority of the cessation studies include a period of approximately one year for duration of the non-injecting transition period [55, 60]. Two others use a period of six months and seven months respectively [58, 59] and three others use a period of one month, one month, and six months respectively [56, 57, 61]. The use of one month is probably due to the more restrictive nature of the outcome which is abstinence from all drug use.

In conclusion, many of the variables above are similar to those found in the section on transition studies. This would appear to indicate that they might be useful for the present study on cessation of injecting drug use in young IDUs. The review on cessation and transition literature indicates that many of the study populations include a consistently older average age. Of the studies in section 3, only Roy *et al* [27] and the two studies from Stenbacka and Stenbacka *et al* [33, 37] had a mean age below 25 years of age and, with the exception of Fuller *et al* and Irwin *et al* [43, 47], the majority of the populations were 30 years of age or older. The cessation studies had an even more pronounced skew in age, with age restrictions of 18 years of age and older [57, 58] or an inability to find sufficient numbers of subjects under the age of 25 [60, 61]. The result is an average age in the mid- to late-30s. This will not allow for observation of transition effects in young drug using populations which are in a crucial stage of drug use

trajectories as they balance the line between experimentation and sustained, life-long use. Many of the study populations are drawn heavily or even exclusively from drug treatment programs [30, 42, 52, 54, 56, 57, 60, 61]. This may make it difficult to assess the effects of being in treatment on cessation of injecting drug use. Similarly, several of the cessation studies focus primarily on methadone maintenance program indicators [56, 57, 60], which demonstrates the over-representation of heroin injectors in many of these studies. Only several studies do not have heroin as the principal injected drug of choice in their populations [27, 51, 52, 54, 59]. This limits the generalizability of the results to populations with more heterogeneous drug injection preferences.

## STUDY OBJECTIVES

1. To estimate the incidence rate of cessation of injecting drug use among young street-based injecting drug users.

2. To identify predictors of cessation of injecting drug use among young street-based IDUs.

The following is a manuscript, to be submitted for publication, which addresses the two study objectives outlined above.

**Title:** Predictors of cessation of injecting drug use in a cohort of young street-based injecting drug users

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## ABSTRACT

**Objectives:** To identify the factors associated with cessation of injecting drug use in young street-based injecting drug users.

**Methods:** Subjects were originally recruited from various street-based outreach programs in Montreal and completed an interview-administered questionnaire. Follow-up occurred from January 1995 to September 2000. Subjects entered into the sub-cohort for the present study had to have reported injecting drugs within the prior six months at baseline or during follow-up and had to have completed at least two follow-up questionnaires. Cessation of injecting drug use was defined as having reported no injection at two consecutive follow-up questionnaires, averaging at least one year in total. Incidence rates of cessation were calculated and stratified by duration of injection. Univariate and multivariate models were constructed in order to identify predictors of cessation.

**Results:** A total of 305 subjects met the inclusion criteria. Of those, 119 (39%) ceased injecting for approximately one year or more. The incidence of cessation was 32.6/100 person-years, but consistently declined as duration of time spent injecting increased. Independent predictors of IDU cessation were: injecting on a less than monthly or less than weekly basis on average within the last month (HR=6.6; 95% Confidence Interval (CI): 3.1-14.1 and HR=2.4; 95% CI: 1.1-5.5, respectively); injecting an average of two or fewer different types of drug within the last six months (HR=1.8; 95% CI: 0.9-3.5); being employed within the last six months (HR=1.7; 95% CI: 1.1-2.7); and having at least one parent born outside of Canada (HR=1.4; 95% CI: 1.1-1.7). Independent predictors of not stopping injecting drugs were: having attended a needle exchange program within the last six months (HR=0.5; 95% CI: 0.3-0.8); and homelessness within the last six months (HR=0.6; 95% CI: 0.4-1.0).

**Conclusion:** Cessation of injecting drug use among youth is considerably higher in the first years of injecting. Young IDUs who inject less frequently, inject fewer different types of drugs, have a more stable lifestyle and have non-Canadian family backgrounds tend to be more likely to stop injecting drugs for a period of one year.

**Key words: street youth; injecting drug use; cessation; predictors.**

## INTRODUCTION

Those who inject illicit drugs such as heroin and cocaine have been demonstrated to be at higher risk than the general population for a number of negative health outcomes such as blood-borne infections caused by hepatitis C virus (HCV), hepatitis B virus (HBV) and human immunodeficiency virus (HIV)[1-13]. One particular sub-group of concern is that of young IDUs, including street-based young IDUs, who have been shown to be at highest risk for HCV infections[6-14]. Young, street-based IDUs are also thought to be a potential driving force in North American HIV and HCV epidemics because of their overall high rates of injecting drug use[15-19], as well as links to activities such as commercial sex, which may spread the disease to the general population[20].

However, very little is known about injecting drug use patterns among young IDUs. Some work done among young street-based injectors suggests that injecting drug use is a very dynamic process wherein frequent transitions are made between routes of administering drugs, including transitions away from injecting drugs towards either total abstinence of drug use or a non-injectable form of use such as smoking, intranasal use, etc[18]. The implications which arise from these transitions are potentially large: particularly those 'healthy' transitions away from injecting drug use, as well as cessation of drug use in general[21-22].

Within the past 10 years, there has been an emerging literature regarding transitions in route of drug administration among illicit drug users[1, 19, 23-47]. However, many of these studies either focused on transitions *into* injecting drug use[19, 24, 26-38, 40, 41] or addressed factors associated with making a general transition from one route of administration to another without specifying directionality (i.e., towards or away from

injection of drugs)[23, 25, 39, 42, 43]. However, research strictly based on initiation into injecting drug use does not provide all of the relevant information needed for risk reduction intervention strategies which often work at the level of encouraging and facilitating transitions away from injecting drug use.

There are several studies which have addressed cessation of injecting[1, 22, 44-48, 49-51] or transitions from drug injection to complete abstinence of drug use in general[52, 53]. Some of these studies did not investigate predictors of cessation[1, 22, 47-49] while others only seriously investigated a single risk factor such as time spent in a drug treatment program[52] or influence of peer networks[53]. Furthermore, many of the study populations in these cessation studies lack heterogeneity with respect to certain characteristics such as type of drug injected and treatment status. Most of the cessation studies, mainly conducted in Europe and Australia, only involve an investigation of cessation of heroin injection due to the dominance of this drug in these study populations[48, 50-53]. This does not allow for generalizability to other drug injecting populations with more diverse injecting drug preferences, such as those found in Montreal where cocaine is at least as common as heroin as the injected drug of choice. Similarly, most of the study populations were drawn from drug treatment programs[48, 50-52] which also does not accurately reflect the general IDU population. Finally, the average age in these IDU study populations is often 30 years and older, leading to very little available information regarding younger injectors. This is problematic, given that early intervention with drug injectors provides a strong potential for effective prevention of the serious social and health consequences related to injecting drug use.

This study proposes to estimate the rate and identify some of the predictors of cessation of injecting drug use in a cohort of young street-based IDUs.

## METHODS

### Study Population

Subjects for this study were drawn from the Montreal Street Youth Cohort (MSYC), which started in January 1995 and continued with semi-annual follow-up of subjects until September 2000. In summary this prospective cohort study was initiated in Montreal, Canada, to determine the prevalence and incidence of HIV infection and associated risk behaviours among street youth.

Selection criteria, recruitment and follow-up procedures of the MSYC are given in more detail elsewhere[19, 54]. Briefly, criteria for entry in the MSYC were chosen to capture as much as possible the whole spectrum of street youth in Montreal. These criteria were: being "street-active"; being between 14 and 25 years of age; English or French speaking; and being able to provide informed consent and to complete a questionnaire. Youth were considered "street-active" if they had, in the last year, either regularly used the services of street youth agencies or been without a place to sleep more than once. These agencies included shelters, drop-in centres, outreach vans, and other facilities offering free-of-charge outreach services such as short-term housing, food banks, and references for and accompaniment to diverse social and health services.

Subject recruitment was ongoing for the duration of the MSYC. Study interviewers recruited participants through regular visits to all major street youth agencies in Montreal. Frequency of visits was established according to the number of youth served by each agency, and ranged from twice a week to once a month. Youth agreeing to

participate were given an appointment for their interview at our study office located in the downtown area where most street youth hang out. Each interview included signature of the consent form, collection of contact information, completion of a 45-minute interviewer-administered questionnaire covering socio-demographic characteristics, alcohol and drug use, and sexual behaviours, and collection of two samples of gingival exudate for HIV antibody testing (results not shown in this paper). An identifying code permitted the linking of successive interviews for a given subject. Participants received a financial compensation (CAD $20) for each visit. Original approval was provided by the Human Subjects (Ethics) Committee, Department of Epidemiology and Biostatistics at McGill University and re-approvals, by the Institutional Review Board of the Faculty of Medicine at McGill University.

Inclusion in the present study sub-cohort of injecting drug users (hereafter referred to as the 'young IDU' cohort) was limited to subjects who reported at least one incident of injecting illicit drugs in their lives and also reported having either injected drugs within the six months prior to entry into the MSYC study (hereafter referred to as 'current' injectors) or reported no injecting experience at baseline for MSYC, but subsequently reported injecting drugs during at least one follow-up questionnaire (hereafter referred to as 'new' injectors). For the current injectors, at least two follow-up questionnaires had to have been completed in addition to the baseline interview. For new injectors, at least two follow-up questionnaires were required after the questionnaire in which they first reported injection. The reason for these restrictions on number of follow-ups is due to the nature of the dependent variable. We defined cessation of injecting drug use to be having answered no to the question 'In the last six months did you shoot up [inject] drugs?' at

two consecutive questionnaire interviews (i.e., cessation of injecting for at least one year on average). This means that subjects needed two or more follow-up periods after they reported injecting drugs in order to have the opportunity to experience the outcome.

**Measurement**

Potential predictors of cessation of injecting drug use which were assessed can be grouped into four general categories: socio-demographic; drug injecting/use habits; non-drug related risk factors; and factors which may enable a more stable, IDU-free lifestyle. Most of these predictors were measured on a time-dependent basis, meaning that values were reassessed at each follow-up questionnaire and were either based on the six months or one month preceding the interview. These time-dependent predictors were either irreversible meaning that their value could change only once, or reversible meaning that their value could change at each interview. Fixed predictors were measured once, at baseline, and their value did not vary thereafter.

Socio-demographic predictors were: sex; and having at least one parent who was born outside of Canada. Injecting habits (treated as reversible predictors except for drug of first injection) included: drug most often injected; drug injected at first episode (each of these two predictors had heroin as the reference category); frequency of injecting; number of times injecting; number of drugs being injected; and having friends who inject. Drug use characteristics (treated as reversible predictors) were: number of different drugs used; and excessive drinking (i.e., an average consumption of six or more drinks per sitting in the previous month). Other risk factors included: prostitution (measured as both a time-dependent reversible and irreversible predictor) and homelessness (age of first homeless episode and as a time-dependent reversible predictor); antecedents of

incarceration (for those 18 or older; treated as time-dependent irreversible); and self-perceived risk of contracting HIV (reversible). Finally, potential stabilizing factors consisted of: drug abuse treatment program attendance (irreversible); use of a needle exchange program; and measures of current employment and school attendance (all treated as reversible predictors). Time-dependent predictors were all measured within the previous six months, with the exception of frequency of injection, number of drugs used, and excessive drinking, which were measured within the previous month. Information for the drug abuse treatment predictor was missing at one questionnaire period and thus an imputation was made by using the information from the subsequent questionnaire. Imputation for this variable was only necessary for three subjects.

**Statistical analysis**

Means and proportions were calculated at entry into the young IDU study for most of the risk factors outlined above, as well as for characteristics such as age at entry into the young IDU study, and duration of injecting drug use (in years) prior to entry into the young IDU study. In addition to calculating the proportion of subjects who ceased injecting for at least two consecutive follow-up questionnaires, the stability of this cessation was tested by determining the proportion of those who ceased injecting after two consecutive questionnaires who also ceased after four questionnaires (i.e., for approximately two years). A comparison of stopping injecting versus abstaining from drug use altogether was also obtained by calculating the proportion of those ceasing injecting after two consecutive questionnaires or more who also stopped using heroin and cocaine (the drugs used most often by 97% of subjects) for at least two consecutive questionnaires.

The time axis in this study (i.e., survival time) was duration of injection and was measured as the total number of days from first episode of injection (year plus either mid-point of month or season of first injection, as reported by the subject) until either date of cessation (event) or date of censoring. Date of cessation was the date of the second questionnaire at which the subject reported not having had injected in the previous six months. Date of censoring was the date of the last questionnaire completed before end of follow-up in the MSYC (i.e., death, loss to follow-up, age of the subject exceeded 29 years old, the subject ceased to meet the definition of 'street-based', or end of the MSYC study).

Since the current injectors were already injecting before study entry, this presents a situation in which delayed entry (or left truncation) must be taken into account. Furthermore, entry can only occur once the subject has accrued enough follow-up time to have been able to experience the event, i.e., at least two follow-up questionnaires (approximately one year). Subjects who experienced the event at the same time as this entry date (i.e., those who reported injecting on the baseline questionnaire and reported not injecting on the two subsequent follow-up questionnaires), contributed one day in the analysis.

Incidence rates of cessation of injecting drug use were calculated by dividing the number of events by the total number of person-years at risk. This rate was also stratified by duration of injecting which was measured by year since entry into time at risk. Significance of the rates was assessed using 95% confidence intervals derived from the Poisson distribution.

A Cox proportional hazards regression model was used to identify the predictors of cessation of injection. This model took into account delayed entry times in the model for the current injectors. Crude and adjusted hazard ratios with 95% confidence intervals were estimated. Relevant exposure information was assessed by taking the value of the risk factor of interest at the questionnaire which immediately preceded the date which fell 365 days before the index date. The exposure was measured 365 days prior to the index date (i.e., approximately two questionnaire periods) since the cessation process is assumed to last one year. The index date was defined as time of event (see above) or the corresponding time for all other subjects still at risk in the young IDU cohort at that time.

The multivariate models were chosen using a backward selection procedure in which all predictors that were individually significant at the $p<0.20$ level were included in a model and subsequently removed one by one. Those predictors which led to a significant increase in deviance ($p<0.05$) when removed from the model were kept in the final model while the others were dropped. Other predictors which were not individually significant were added to the model and the change in deviance assessed. Potential confounders were identified as those variables which led to a substantial change in the point estimates of the other variables when removed from the model: these confounders were also kept in the final model. Interaction terms based on presumed effect modifiers were also entered into the model. The two models used were one in which subsets of drug-related and non-drug related predictors were assessed separately and one in which all predictors were assessed together. Finally, a check was made of residuals, goodness-of-fit, and the proportionality assumption for models of importance.

## RESULTS

Of the 549 subjects who had either injected drugs within the previous six months at baseline for the MSYC or started to inject during follow-up, 305 of those answered at least two follow-up questionnaires subsequent to their first report of injecting. These 305 subjects constitute the study population for the young IDU cohort. Of these 305 injectors, 57 were new injectors during follow-up in the MSYC while the other 248 had been injecting drugs in the six months preceding entry into the MSYC.

Baseline characteristics, taken at entry into the young IDU cohort (i.e., at first report of drug injecting in the MSYC), are reported in Table 1. Regarding general demographics, 39% (120) of the subjects were female, while the mean age at entry into the sub-cohort of injectors was 20 years. There were 43 youth (14%) who reported having at least one parent who was born outside of Canada.

The other baseline characteristics can be divided into three categories: drug injecting/use habits; non-drug related risk factors; and factors which may enable a more stable, drug-free lifestyle. The drug most often injected was heroin for 52% of subjects and cocaine for 42%. Poly-drug injecting was quite common, with 55% of subjects reporting current injecting use of more than one type of drug. However, daily injecting drug use was relatively rare when compared to many other IDU study populations: only 18% of IDUs having reported injecting on a daily basis within the prior six months. Drug injecting networks largely consisted of the IDU's peers: 41% currently injected exclusively with close friends or partners and 83% had at least one friend who currently injected drugs. The mean duration of injection before entry into the young IDU cohort for all subjects (including those who started injecting at entry) was 2.3 years. Regarding

homelessness, more than three quarters (77%) of the subjects were currently without a place to stay and/or dependent on centres and shelters providing services for the homeless. In addition, 89% had experienced their first episode of homelessness prior to their first episode of injecting drug use. A considerable proportion of subjects had some experience with sex work: 29% had currently exchanged sex for money or gifts, while 25% reported prostitution as a source of income within the last six months. Subjects were generally well acquainted with harm reduction programs: more than half had been in some type of drug detoxification program (62%) and 79% were currently using a needle exchange program (NEP). Finally, 62% of subjects were currently gainfully employed on either an occasional or regular basis.

Of the 305 subjects, 119 (39%) stopped injecting for two consecutive questionnaire periods (i.e., approximately one year). A total of 364.9 person-years (pyrs) of time at risk were observed, giving a crude rate of injection cessation of 32.6 per 100 pyrs. Of those who stopped injection for two questionnaires and were followed-up for at least four questionnaires, 52% (50 out of 96 subjects) continued to inject no drugs for another two consecutive questionnaires, for a total of approximately two years spent away from injecting. In addition, 77 of the 119 stoppers (65%) reported abstaining entirely from heroin and cocaine use during the time covered by the two consecutive questionnaires. Incidence rates for cessation of injecting drug use stratified by duration of time (by year) spent injecting, demonstrated a consistent downward trend in rates of cessation over time (see Table 2). During the first year of time at risk in the sub-cohort, the rate was 112.3/100 pyrs. However, each subsequent year shows a consistent significant decrease in the rate of cessation. The largest drop in this rate occurs after the

first year as the rate declines from 112.3/100 pyrs to 38.2/100 pyrs. These trends are also seen in the sub-groups of current and new injectors. This suggests that cessation becomes more difficult as time spent injecting progresses, particularly after the first couple of years. Cessation rates stratified by sex and duration of injecting (not shown) also demonstrated this decreasing trend.

Table 3 presents the crude hazard ratios of injection cessation with respect to relevant associated factors. The only significant univariate socio-demographic predictor for cessation was having at least one parent who was born outside of Canada. Predictors from drug injecting and drug use factors were: currently injecting cocaine the most frequently; cocaine as first drug ever injected; not having injected within the last month; having injected on a less than weekly basis on average within the last month; currently injecting two or fewer different types of drugs; not currently having any friends who inject; and using two or fewer different types of drug in the last month (excluding marijuana). Other significant predictors included: being 15 years of age or older at the time of first episode of homelessness; and being currently employed. In addition, current use of a needle exchange program was significantly negatively associated with cessation of injecting drug use, meaning that those who had used this service were less likely to stop injecting.

The multivariate model in Table 4, in which were included all individually significant predictors, included the following independent predictors of cessation of injecting drug use: not having injected within the last month (HR=6.4; 95% Confidence Interval (CI): 3.0-13.6); having injected on a less than weekly basis on average within the last month (HR=2.4; 95% CI: 1.1-5.3); having injected an average of two or fewer

different types of drug in the last six months (HR=2.1; 95% CI: 1.1-3.9); being employed in a regular or occasional job in the last six months (HR=1.7; 95% CI: 1.1-2.7); and having at least one parent born outside of Canada (HR=1.4; 95% CI: 1.1-1.7). Independent predictors of not being able to cease injecting drug use were also observed. These were: having experienced homelessness in the last six months (HR=0.6; 95% CI: 0.4-1.0); and having attended a NEP in the last six months (HR=0.5; 95% CI: 0.3-0.8). Similar results were observed for the models in which subsets of drug-related and non-drug related risk factors were assessed separately. No significant interaction terms were observed.

## DISCUSSION

Of the few studies which have specifically investigated incidence rates and predictors of cessation of injecting drug use, this was the first to do so using a study population of young IDUs. This study demonstrated that there is a consistent decline in the rate of cessation of injection as time spent injecting increases, including a substantial drop in the rate of cessation after the first two years of injecting. This is the first time that such a trend is reported. Given that our cohort was composed of very recent IDUs (mean duration of injecting : 2.3 years), one possible explanation is that severity of dependence on a drug has an important effect on one's ability to stop injecting. This would be in accordance with a Spanish study[55] which found that severity of dependence was significantly lower among heroin users (of any route of administration, including injection) who had been using that drug for less than five years. This finding was even stronger among those with less than three years duration of heroin use. A correlation between severity of dependence and duration of heroin use was also found in a study

from the UK[56]. There also appears to be such a trend among cocaine users as well, although results are not as clear as for heroin. A Brazilian study[47] found a significant association between longer duration of cocaine use and transition in route of cocaine administration (virtually all transitions in this study were from snorting cocaine into more addictive routes of administration, namely, smoking (mostly crack) and injecting). This factor was not kept in their multivariate model, although younger age at cocaine initiation (which could be seen as a proxy for duration of use) was retained.

Similarly, the crude rate of cessation of injecting drug use observed in our study was substantially higher than that of the Amsterdam study on methadone maintenance and cessation, which was the only other study to calculate such a rate[50]. However, the population used in that study had a mean age of 30 years old at entry, compared to our study population in which mean age at entry was less than 20 years old. More importantly, the mean duration of injecting drug use at entry into that study was 10.1 years versus 2.3 years in our study. One would expect to find that older, long-term injectors are much less likely to stop injecting drugs as compared to younger, short-term IDUs. Indeed, when cessation rates in our study were stratified by duration of injecting drug use (two year intervals), those injectors who had spent eight or more years injecting appear to have rates of cessation which are comparable to those of the Amsterdam methadone study.

Several independent predictors of cessation of injecting drug use were also discovered in this study. Among socio-demographic factors, having had at least one parent who was born outside of Canada predicted cessation. A similar result was found in the Amsterdam study on population trends in IDU transitions[51], in which being of non-

West European ethnicity was a predictor of cessation. Similarly, a British study comparing routes of administration of cocaine found that the proportion of subjects of Afro-Caribbean origin who were injecting was significantly less than that of white subjects[57]. It was hypothesized by the authors of the Amsterdam study that this phenomenon could be attributed to the cultural aversions towards use of hypodermic needles in general among certain ethnic groups. This theory of social acceptance of injecting practices as a contributing factor towards preferred route of drug administration has also been proposed elsewhere[58].

Among predictors relating to drug injecting habits and behaviours, we found that injecting drugs on a less frequent basis was predictive of stopping injecting. A similar, strong association was found in the Amsterdam studies[50, 51]: those in the study of injecting trends were less likely to stop if they were injecting on a daily or greater basis while those in the methadone study were over six times as likely to stop if they were less than daily injectors.

Another predictor of cessation was injecting fewer different types of drugs. Although this variable was not examined in other cessation studies, there is evidence of a similar phenomenon in severity of dependence studies where users of more than one drug were found to be more severely dependent on heroin[56]. Poly-drug use was also found to be a predictor of transition into injecting use of amphetamines[44] as well as any sort of transition in route of cocaine administration[47].

Other predictors not related to drug injecting behaviours included use of a NEP, which was negatively associated with cessation. This result was also observed in both of the Amsterdam cessation studies in which a lower proportion of needles obtained from a

NEP was predictive of cessation[50, 51]. This phenomenon could have been attributable to the fact that IDUs participating in a NEP may include a particularly high proportion of injectors whose pattern of drug use (e.g., daily injecting) puts them at elevated risk of blood-borne viral infections[59] and, by extension, makes them less likely to stop injecting. However, this may not be the case given the inclusion of frequency of injecting as a variable in our multivariate model. Another possible explanation is that NEP users continue to use drugs via injecting since they are reassured that such a program is preventing any harm from injecting drug use. Regardless of possible explanations for this result, it should be stressed that the variable used in our study was a rather crude indicator of NEP use (e.g., no measure of *degree* of NEP use) taken from a study that was not specifically designed to measure effectiveness of needle exchange programs and, as such, should not be used to make inferences in this regard.

Employment was also a factor in stopping injection, following the Australian study in which being employed was independently associated with a transition to non-injecting benzodiazepene use[45]. A stable home life was also found to be influential in cessation: those who were homeless were found to be less likely to stop. Stable housing was a factor in IDU cessation in another study from Montreal[49].

Although we could not find a significant association between drug detoxification program attendance and IDU cessation, the hazard ratio suggested a negative effect on cessation which differed from results found in other related studies[48, 52]. A similar phenomenon may be at work as that discussed above regarding NEPs, i.e., being in treatment is a marker for more intensive injecting drug use: a study of IDU initiation from New York found that previous drug treatment was a predictor of starting to inject[24].

However, it is difficult to draw conclusions from our study since it is not an evaluation study of detoxification programs. In addition, we lack specific information on treatment status indicators such as duration of attendance, and we were not able to stratify for certain treatment modalities which were represented exclusively in the studies mentioned above.

Our study had some limitations including a potential bias in the selection of subjects. Selecting out those IDUs who had not completed at least two follow-up questionnaires might have biased the results if, for example, loss to follow-up was related to severe injecting drug addiction which may have hindered daily functioning, including the youth's capacity to maintain study participation. However, our study used rigorous follow-up procedures which resulted in a very low rate of attrition (5.7 per 100 person-years)[60] and should have minimized these problems.

Issues concerning biases related to self-report and recall, as well as generalizability in the Montreal Street Youth Cohort have been addressed elsewhere[19]. One review of the IDU literature found self-report among injecting drug users to be reliable and valid[61]. Regarding generalizability, our study had the advantage of having a diverse array of recruitment sites, as well as having strong selection and follow-up strategies with respect to street youth which resulted in broadly based sampling of that population in Montreal. However, because the study population was drawn from street-based youth, it may not be possible to generalize our findings to all young IDUs. In addition, the injecting drug preferences in many other parts of the world tend to be more homogeneous than that of our population and so our results may differ from a population consisting primarily of either heroin or cocaine injectors.

Finally, there were also some phenomena which could influence cessation which were beyond the scope of this study. These include the availability of the drug(s) in injectable form[25, 62] and local drug using preferences[1, 25]. Further study of the incidence and predictors of re-starting injecting drug use among young IDUs will also be necessary in order to determine the stability of these cessation events.

In summary, various predictors of cessation of injecting drug use among young IDUs have now been identified. The high initial rate of cessation followed by a sharp decline in stopping suggest that interventions should target youth early in their drug injecting career. Interventions have been suggested[63] which promote the use of less harmful drug regimens, either via a treatment regimen (e.g., methadone) or through awareness-raising initiatives (e.g., media campaign advocating heroin chasing), although the latter approach is controversial given the concern that drug use in general is being condoned as well as the potential adverse health effects associated with alternate routes of drug administration[64].

**Table 1** Subject characteristics at entry into the young IDU cohort (N=305)

| CHARACTERISTICS AND BEHAVIOURS | **Number of youth** | ***Proportion (%)*** |
|---|---|---|
| **1.1 Socio-demographic risk factors** | | |
| Female | 120 | 39 |
| < 20 years old | 163 | 53 |
| At least one parent born outside of Canada | 43* | 14 |
| **1.2 Drug injecting-related risk factors** | | |
| Drug most often injected (in last six months) | | |
| Cocaine | 129 | 42 |
| Heroin | 159 | 52 |
| Speedball | 3 | 1 |
| PCP | 8 | 3 |
| Alcohol | 1 | - |
| Other | 5 | 2 |
| Number of different drugs injected (in last six months) | | |
| 1 | 138 | 45 |
| 2 | 80 | 26 |
| 3 | 66 | 22 |
| 4-7 | 21 | 7 |
| Frequency of injecting (in last month) | | |
| Less than weekly | 186 | 61 |
| Weekly but less than daily | 66 | 22 |
| Daily or more | 54 | 18 |
| Drug first injected | | |
| Cocaine | 135* | 45 |
| Heroin | 132 | 44 |
| Speedball | 1 | - |
| PCP | 17 | 6 |
| Other | 15 | 5 |
| Have friends who currently inject (in last six months) | 250 | 83 |
| **1.3 Drug use-related risk factors** | | |
| Number of different drugs used (in last month)† | | |
| 0 | 17 | 6 |
| 1 | 48 | 16 |
| 2 | 72 | 24 |
| 3 | 82 | 27 |
| 4 | 46 | 15 |
| 5-10 | 40 | 13 |
| Average number of alcoholic drinks consumed at once (in last month) | | |
| 0 | 33 | 11 |
| 1 | 14 | 5 |
| 2-5 | 97 | 32 |
| 6-10 | 105 | 34 |
| >10 | 56 | 18 |
| **1.4 Non-drug related risk factors** | | |
| Homeless (in last six months) | 235 | 77 |
| ≥15 years old at first homeless episode | 166 | 54 |
| Had first homeless episode before first IDU episode | 270 | 89 |
| Sex in exchange for gifts or money (in last six months) | 87 | 29 |
| Prostitution as source of income (in last six months) | 75 | 25 |
| Incarceration experience | 79 | 26 |
| Self-perceived HIV risk higher than others (in last six months) | 72** | 25 |
| **1.5 Factors encouraging more stable, IDU-free lifestyle** | | |
| Ever been in drug abuse treatment program‡ | 188 | 62 |
| Used Needle Exchange Program (in last six months) | 240 | 79 |
| Employed (in last six months) | 188 | 62 |
| Employed or in school (in last six months) | 206 | 68 |

*N=300 due to missing values **N=292 due to missing values

†Crack and cocaine treated as one drug; marijuana excluded ‡Data from Q1 imputed for Q0

**Table 2** Rates of cessation of injecting drug use

| *Duration of injecting (years)*† | *Number censored* | *Number of events* | *Person-years* | *Cessation rate (/100 person-years)* | *95% confidence intervals* |
|---|---|---|---|---|---|
| **2.1 Cessation rates among ALL INJECTORS (one year intervals)** | | | | | |
| ≥0 < 2* | 15 | 41 | 36.5 | 112.3 | 80.6 – 152.4 |
| ≥2 < 3 | 23 | 22 | 57.6 | 38.2 | 23.9 – 57.8 |
| ≥3 < 4 | 26 | 17 | 63.6 | 26.7 | 15.6 – 42.8 |
| ≥4 < 5 | 28 | 12 | 54.9 | 21.8 | 11.3 – 38.2 |
| ≥5 < 6 | 20 | 16 | 54.8 | 29.2 | 16.7 – 47.4 |
| ≥6 < 7 | 26 | 4 | 36.3 | 11.0 | 3.0 – 28.2 |
| ≥7 < 8 | 17 | 4 | 17.7 | 22.6 | 6.2 – 57.9 |
| ≥8 < 9 | 11 | 0 | 13.4 | 0 | 0 – 27.5 |
| ≥9 < 10 | 8 | 1 | 6.6 | 15.2 | 0.5 – 55.9 |
| ≥10 | 12 | 2 | 23.6 | 8.5 | 1.0 – 30.6 |
| Total | 186 | 119 | 364.9 | 32.6 | 26.7 – 38.5 |
| **2.2 Cessation rates among CURRENT INJECTORS (one year intervals)** | | | | | |
| ≥0 < 2** | 1 | 14 | 13.8 | 101.4 | 55.4 – 170.2 |
| ≥2 < 3 | 18 | 18 | 46.5 | 38.7 | 22.9 – 61.2 |
| ≥3 < 4 | 22 | 15 | 59.7 | 25.1 | 14.1 – 41.4 |
| ≥4 < 5 | 28 | 11 | 54.2 | 20.3 | 10.1 – 36.3 |
| ≥5 < 6 | 20 | 16 | 54.8 | 29.2 | 16.7 – 47.4 |
| ≥6 < 7 | 26 | 4 | 36.3 | 11.0 | 3.0 – 28.2 |
| ≥7 < 8 | 17 | 4 | 17.7 | 22.6 | 6.2 – 57.9 |
| ≥8 < 9 | 11 | 0 | 13.4 | 0 | 0 – 27.5 |
| ≥9 < 10 | 8 | 1 | 6.6 | 15.2 | 0.5 – 55.9 |
| ≥10 | 12 | 2 | 23.6 | 8.5 | 1.0 – 30.6 |
| Total | 163 | 85 | 326.7 | 26.0 | 20.5 – 31.5 |
| **2.3 Cessation rates among NEW INJECTORS (one year intervals)** | | | | | |
| ≥0 < 2*** | 14 | 27 | 22.0 | 122.7 | 80.9 – 178.5 |
| ≥2 < 3 | 5 | 4 | 11.1 | 36.0 | 9.8 – 92.3 |
| ≥3 < 4 | 4 | 2 | 3.9 | 51.3 | 6.2 – 185.1 |
| ≥4 < 5 | 0 | 1 | 0.6 | 166.7 | 5.0 – 928.3 |
| Total | 23 | 34 | 38.3 | 88.8 | 59.0 – 118.6 |

†time spent injecting while also at risk in the young IDU cohort (see Methods)

*this interval includes subjects who were censored or experienced the event shortly before one year had passed since their entry into the young IDU cohort: 2 censored; 9 event for a total of 0.68 person-years.

**this interval includes subjects who were censored or experienced the event shortly before one year had passed since their entry into the young IDU cohort: 0 censored; 1 event for a total of 0.04 person-years.

***this interval includes subjects who were censored or experienced the event shortly before one year had passed since their entry into the young IDU cohort: 2 censored; 8 event for a total of 0.64 person-years

**Table 3** Crude hazard ratios of injection cessation

| *Predictor* | *Hazard Ratio (HR)* | *95% confidence interval* |
|---|---|---|
| **1.1 Socio-demographic predictors** | | |
| Female | 1.02 | 0.70 – 1.48 |
| At least one parent born outside of Canada | 1.35 | 1.13 – 1.60 |
| **1.2 Drug injecting-related predictors** | | |
| Drug most often injected (in last six months) | | |
| Heroin | Reference | - |
| Cocaine | 1.62 | 1.05 – 2.50 |
| Other | 1.03 | 0.25 – 4.29 |
| Number of different drugs injected (in last six months) | | |
| ≥3 | Reference | - |
| <3 | 3.19 | 1.74 – 5.85 |
| Frequency of injecting (in last month) | | |
| At least once a week | Reference | - |
| Less than weekly | 3.50 | 1.62 – 7.57 |
| Not in last month | 8.61 | 4.22 – 17.55 |
| Drug first injected | | |
| Heroin | Reference | - |
| Cocaine | 1.59 | 1.07 – 2.36 |
| Other | 1.13 | 0.59 – 2.16 |
| Do not have friends who currently inject (in last six months) | 1.57 | 1.01 – 2.43 |
| **1.3 Drug use-related predictors** | | |
| Number of different drugs used (in last month)† | | |
| ≥3 | Reference | - |
| <3 | 1.97 | 1.33 – 2.92 |
| Average number of alcoholic drinks consumed at once (in last month) | | |
| ≥6 | Reference | - |
| 2-5 | 0.81 | 0.51 – 1.27 |
| 0-1 | 0.90 | 0.53 – 1.51 |
| **1.4 Non-drug related predictors** | | |
| Homeless (in last six months) | 0.87 | 0.59 – 1.29 |
| ≥15 years old at first homeless episode | 1.53 | 1.05 – 2.24 |
| Sex in exchange for gifts or money (in last six months)* | 0.72 | 0.49 – 1.06 |
| Prostitution as source of income (in last six months) | 0.72 | 0.44 – 1.17 |
| Incarceration experience (in last six months)* | 0.93 | 0.61 – 1.40 |
| Self-perceived HIV risk higher than others (in last six months) | 0.84 | 0.51 – 1.39 |
| **1.5 Predictors encouraging more stable, IDU-free lifestyle** | | |
| Attended drug abuse treatment program (in last six months)‡* | 0.61 | 0.33 – 1.13 |
| Used Needle Exchange Program (in last six months) | 0.45 | 0.30 – 0.66 |
| Employed (in last six months) | 1.47 | 1.01 – 2.14 |
| Employed or in school (in last six months) | 0.98 | 0.66 – 1.46 |

†Crack and cocaine treated as one drug; marijuana excluded ‡Data from Q1 imputed for Q0

*Time-dependent irreversible

**Table 4** Adjusted hazard ratios of injection cessation

| *Predictor* | *Adjusted HR* | *95% confidence intervals* |
|---|---|---|
| At least one parent born outside of Canada | 1.38 | 1.14 – 1.67 |
| Frequency of injecting (in last month) | | |
| At least once a week | Reference | - |
| Less than weekly | 2.36 | 1.05 – 5.30 |
| Not in last month | 6.37 | 2.99 – 13.57 |
| Number of different drugs injected (in last six months) | | |
| ≥3 | Reference | - |
| <3 | 2.07 | 1.07 – 3.94 |
| Used Needle Exchange Program (in last six months) | 0.51 | 0.31 – 0.84 |
| Employed (in last six months) | 1.74 | 1.11 – 2.73 |
| Homeless (in last six months) | 0.61 | 0.38 – 0.97 |

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## SUMMARY AND CONCLUSION

This study demonstrated that the overall rate of cessation of injecting drug use among young IDUs is high. However, it was also shown that with each passing year spent injecting drugs there is a consistent decline in the rate of injecting cessation, including a large decrease in the rate of cessation after the first two years of injecting. It was also demonstrated that cessation is significantly more likely among young IDUs with at least one parent born outside of Canada. Those who inject less frequently and inject fewer different types of drugs were also more likely to stop injecting. Finally, young IDUs with a more stable housing and employment situation tended to be more likely to stop injecting drugs for a one year or more.

It is clear that there is a subset of the young IDU population which is more likely to stop injecting illicit drugs. This subset could be the focus of any drug harm reduction targeting young injecting drug users.

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