RISK FACTORS AND DETERMINANTS OF HIV AND HEPATITIS C PREVALENCE AND INCIDENCE AMONG A COHORT OF YOUNG INJECTION DRUG USERS

by

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ABSTRACT

Objectives: The primary objectives of this study were to determine the prevalence, incidence and risk factors for HIV and Hepatitis C (HCV) infection among young (aged 13 - 24 years) injection drug users (IDUs) participating in the Vancouver Injection Drug Users Study (VIDUS).

Methods: This study was a nested sub-study within the VIDUS project. The VIDUS is an open cohort consisting of over 1,400 Vancouver area IDUs. Participants must be aged 13 years and older, have injected illicit drugs at least once in the previous month and reside in the greater Vancouver area. Enrolment into the study began in 1996, and the majority of participants were enrolled between 1996 and 1997. Since 1997, on average, 100 new study participants have been enrolled each year. At baseline and semi-annually thereafter, subjects undergo an interviewer-administered questionnaire and provide a venous blood sample for HIV and HCV antibody testing. Questionnaires are administered in English, Spanish, Mandarin, French and Cantonese and elicit information on participants' risk factors and living conditions in the previous six months. Nonparametric and multivariate regression methods were used when analyses were conducted on cross-sectional data. Longitudinal data were analyzed using person-time techniques.

Results: Baseline HCV prevalence was 46% (107) and was associated with being Aboriginal, incarceration in the previous 6 months, survival sex, <100 lifetime partners, residence in the Downtown Eastside, and at least daily heroin, cocaine, or speedball injection. HCV seroconversion occurred among 37 of the youth, an incidence rate of 37.2 per person-years; the median age was 20 years and the median number of years injecting was 1.1. HCV seroconversion was independently associated with having an IDU partner and daily cocaine injection. Baseline HIV prevalence among the youth was

10% (23) and was independently associated with being female, daily cocaine injection, older age, and a greater number of years injecting. HIV seroconversion occurred among 16 youth, an incidence rate of 4.4 per person years; the median age was 22 and median number of years injecting was 3.0. HIV incidence was associated with being Aboriginal, at least daily crack or cocaine use, and <100 lifetime sexual partners.

Conclusion: This sub-study was the first attempt to examine demographic characteristics and risk factors among young IDUs in a city coping with epidemic proportions of HCV and HIV among the IDU population. Young IDUs are of particular importance in terms of prevention of blood-borne infections. Relative to older IDUs, younger IDUs have lower prevalence of HIV and HCV but alarmingly high incidence rates, particularly among female and Aboriginal youth. The window of opportunity to act is short, and preventive actions are urgently required. This study has provided important clues where resources need to be targeted.

TABLE OF CONTENTS

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CHAPTER 1

INTRODUCTION AND OVERVIEW

1.1 The HIV epidemic among youth

Young people are at the centre of the HIV/AIDS epidemic. Around the globe an estimated 11.8 million people aged 15 – 24 years are living with the virus, and one half of all new infections, an estimated 7,000 per day, occur in this age group[1] . Around the world youth are at increased risk for HIV infection for reasons beyond their control. Youth may not receive effective education regarding their sexual health and they may not have access to or knowledge about condom use. Furthermore, young people, especially girls, may be at increased risk for sexual abuse by familial members, extended family, acquaintances, strangers or sexual partners, increasing their risk for HIV directly or by limiting their ability to negotiate safer sexual practices[2, 3] . Young people marginalized by poverty, abuse, and neglect may find themselves living in precarious living arrangements, either on the street or in risky relationships. These young people are at increased risk of engaging in injection drug use and sex trade work, thereby significantly increasing their risk of blood-borne infections.

It is estimated that globally, there are over 100 million children under the age of 18 living in perilous conditions or on the street[4] and in Canada, there are an estimated 45,000 to 150,000 street youth, most of whom live in large urban centres [5] . These children and youth are particularly vulnerable to HIV through their social networks, older contacts, injection drug use – either their own or that of their sexual partners – and sex trade work. The relationship and potential transition from street youth to injection drug use remains largely unexplored. However studies of street

youth in North America have shown that those at highest risk for HIV are those who use injection drugs[6-9] .

In Canada, youth aged 24 and under represent a small proportion of the total number of AIDS cases, however they are the group that is most at risk in this shifting epidemic[10] . Furthermore, they are tremendously important in terms of prevention and fighting the spread of HIV/AIDS. In Canada, the median age of those with new infections has dropped from age 32 (for those infected before 1983) to 23 for those infected between 1985 and 1990[11] . Before the mid-1990's, those most at risk for HIV were men who have sex with men (MSM). Post-1995, the epidemic experienced a shift and increasing rates of HIV incidence among IDU populations occurred in urban centres across Canada[12] . In 1996, 47% of new infections were attributable to IDUs and in 1999 that figure dropped to 34%. Currently the modes of HIV transmission are split approximately equally between MSM, IDUs, and heterosexual contact[12] .

In Canada, the proportion of females among those with positive HIV test results varies considerably by age and is highest among adolescents and young adults[13] . Young females are particularly vulnerable to HIV infection due to an increased exposure to sexual violence and participation in sex trade work[14] . For girls and women who have been exposed to sexual violence or who work in the sex trade, this often means that sexual behaviour occurs in the context of unequal power. Condom use is a sexual behaviour that is often under the control of men, especially when sex is traded or forced, thus condom use becomes problematic for girls and women in sexual relationships where power imbalances exist. Furthermore, girls and women are at higher risk for HIV through sexual contact due to increased viral efficacy in sexual transmission from man to women[15] .

Of the 7,000 new infections occurring among youth each day, over one half of these occur among young women[4] . Young women are particularly important in

terms of risk for IDUs because they tend to account for a higher proportion of street youth and to be of younger age when injection drug use is initiated[16, 17] . Furthermore, young women who use injection drugs are more likely than their male counterparts to have been sexually abused in childhood and to face further sexual victimization through sex trade work and sexual violence[18] . Among Canadian women, about one half of new HIV infections are attributable to injection drug use[12] .

The HIV epidemic among Canadian Aboriginal peoples is a growing concern. The term Aboriginal comprises the many First Nations, Inuit, Innu, and Métis people living across the country. Within these groups there are many nations that are culturally and linguistically distinct. According to Statistics Canada, about 3% of the Canadian population identify as Aboriginal peoples[19] . The proportion of Aboriginal people living in each province varies, the western provinces have higher proportions; in Manitoba about 14% of the population are Aboriginal and in British Columbia this figure is approximately 4%[19] . The Canadian Aboriginal population is on average ten years younger than the non-Aboriginal population. The majority of aboriginal peoples are under the age of 25, thus the health of Aboriginal youth is of particular importance.

In Canada and particularly in the western provinces, Aboriginal people have been disproportionately affected by HIV/AIDS. The proportion of Aboriginal AIDS cases increased from 1% before 1990 to 9% in 2000[20] . Provinces with ethnicity reporting indicate that Aboriginal people account for approximately 20% of newly diagnosed HIV infections[20] . Governmental policies such as displacement from land to reserve and the residential school system have precipitated cultural, linguistic and familial erosion and have undoubtedly contributed to much higher rates of morbidity and mortality among some Aboriginal people and communities. These policies have placed Aboriginal people at higher risk for living in unstable housing, poverty and IDUs

and these factors have contributed to disproportionately higher rates of HIV and AIDS [21, 22] .

The epidemiology of the epidemic in Aboriginal populations is concerning; Aboriginal people infected with HIV are more likely to be in the IDU transmission group and much higher proportions of females and youth are infected than in the non-Aboriginal population. When Aboriginal Canadians were compared with non-Aboriginal Canadians among new HIV infections between 1998 and 2000: females accounted for 47% vs. 20%; in the age category 20 to 29 years, Aboriginals numbered 33% vs. 20%; and in the transmission category injection drug use, Aboriginals accounted for 60% vs. 34% [20] . The epidemiology of HIV and AIDS among Aboriginal people have important implications for the prevention and treatment of this population. Moreover, given the historical betrayal characterizing many government policies directed at Aboriginal peoples, intervention and prevention programs will need to come from, and be in collaboration with, Aboriginal people.

1.2 Hepatitis C among injection drug users

The highest risk for hepatitis C (HCV) in North America is the sharing of contaminated drug equipment between IDUs[23-26] . Among populations of long-term IDUs in North American urban centres HCV prevalence estimates generally range between 80% and 90%[27-29] . The sexual transmission of HCV is a controversial topic that has neither been proven nor ruled out. However among cohorts of IDUs HCV is highly prevalent and time to infection from initiation into injection drug use is short. Unlike HIV, HCV is highly transmissible through shared injection equipment other than needles, such as cottons[2], cookers[3] and straws[4][30, 31] .

[2] Typically a cotton ball used to swab the injection area with alcohol.
[3] a dish used to heat the powdered from of a drug to reduce it to liquid.
[4] a drinking straw that is inserted nasally to snort the powdered form of a drug.

Similar to HIV, HCV is a blood-borne virus that is transmitted through contact with infected blood. Unlike HIV, some individuals who are infected with HCV clear the virus, however most, approximately 80%, do not and live with chronic HCV infection[32] . Widespread HCV infection in North America occurred recently thus the long-term effects of HCV, and particularly co-infection with HIV and HCV, may not be entirely known. What is known is approximately 80% develop cirrhosis of the liver and 10% - 20% of those go on to die from liver disease and cancer[33] . The health consequences of chronic HCV infection are significant.

It is estimated that there are between 210,000 and 275,000 people in Canada living with HCV infection. Most of these infections are due to IDUs. Estimates of time to infection from the onset of injection drug use range between 1 and 4 years[27, 34, 35] , thus young IDUs are central to understanding the epidemiology of HCV infection, and preventing the spread of the HCV virus. HCV prevalence estimates among young IDUs are lower when compared with older injectors, however alarmingly high HCV incidence rates have been documented among young IDUs.

1.3 Research needs and study justification

Prior to 1990, the strongest risk factor associated with the spread of HIV in "developed" nations was unprotected intercourse between men who have sex with men (MSM) [10] . Since the mid-1990's the risk categories have shifted and young women have become the highest risk group for HIV infection worldwide. In the United States teenagers, aged 13 to 21, now account for one quarter of all new infections in the United States [36] . In Canada, youth aged 15 - 24, account for one quarter of all new infections[10] . The HIV epidemic among adolescents is well

established and growing [16, 37-40] . Research efforts focusing on risk factors among high-risk youth is urgently needed to stem the tide of new infections.

Transmission risk categories among Canadian youth are split fairly evenly between IDUs, heterosexual contact, and MSM. When newly diagnosed HIV data are gender and age stratified, females aged 24 and under account for a greater proportion of new infections than males and IDUs account for one half of those new infections. There have been few studies undertaken in Canada that have examined longitudinally socio-demographic characteristics and risk factors among young IDUs.

In Vancouver, British Columbia, much of the IDU population is concentrated in one area of approximately 10 city blocks known as the Downtown Eastside (DTES). There are approximately 5,000 IDU residing in the DTES. Since 1995, Vancouver has experienced an explosive HIV epidemic among IDUs. In 1996 the HIV incidence rate peaked at 19 per 100 person years, and has since declined but still remains unacceptably high. HCV is saturated among the IDU population in Vancouver, where an estimated 85% of IDUs are infected with HCV[26] . Youth living in the DTES are exposed to high rates of poverty, injection drug use and blood-borne infection. Despite being at high risk for blood-borne infections, there have been few studies characterizing the youth in the DTES and there have been no studies to date characterizing the young IDU population who live in or frequent the DTES.

In May of 1996 the Vancouver Injection Drug Users Study (VIDUS) began collecting data. The VIDUS project is an open cohort of Vancouver area IDUs designed to longitudinally examine risk factors for HIV and HCV incidence. Since the project began there have been many published articles and reports detailing the explosive HIV epidemic that occurred in 1996 among Vancouver area IDUs, risk factors for HIV and HCV, and drug use patterns of participants. However, prior to this current study, there had been no investigation of the young VIDUS participants.

Despite the growing epidemic that has been documented among youth and particularly among youth who use injection drugs, there has been little research undertaken on young IDUs, HIV and HCV prevalence and incidence rates and associated risk factors, particularly in a longitudinal fashion. Young IDUs are central to preventing the spread of blood-borne infections because of their vulnerability to infection and because it is during this period of life when many behaviour patterns are established that will affect risk for infection throughout their adult years. Characterizing risk factors and socio-demographics of young IDUs who are most at risk will enable communities struggling with these viruses to target resources where they are most needed. Furthermore, documenting HIV and HCV prevalence and incidence may help to draw the attention of policy makers who can target additional resources for this vulnerable population to prevent the further spread of the viruses.

1.4 Study objectives and thesis organization

This thesis is divided into seven chapters. The first chapter provides an overview of the HIV and HCV epidemic among young people aged 24 and under. This overview sets the stage for the thesis work by providing a brief summary of the current state of knowledge and the impetus for this thesis work. Chapter one gives details of the study site and methodological issues. The second chapter is a review of the current literature on young injection drug users, youth at risk for blood-borne infections in Canada, and young Aboriginal people in relation to the HIV and HCV epidemics. Chapters 3 through 6 address the main study objectives as outlined below, and the final chapter 7 summarizes the findings of this thesis work and outlines future study needs and directions for research among young IDUs.

The primary objectives of this study were to determine prevalence, incidence and risk factors for HIV and Hepatitis C (HCV) infection among young (aged 13 - 24 years) injection drug users participating in the VIDUS project and to address some of the questions regarding the impact that these youth have on the HIV and HCV epidemics in Canada.

The **first** objective was to estimate the prevalence of HIV at the enrollment questionnaire among the youth participating in the VIDUS project. This initial investigation set the stage for characterizing who may be most at risk for the HIV virus among young injection drug users in the Vancouver area.

The **second** objective was to estimate the HIV incidence rate among the VIDUS youth and to use the longitudinal data available to ascertain time relevant risk factors for seroincident youth.

The **third** objective was to investigate risk factors for HCV prevalence and incidence among the youth. The incident analysis allowed for the identification of time relevant risk associations for HCV among the youth.

The **fourth** objective was to characterize the young Aboriginal VIDUS participants. This fourth objective was added following the previous three analyses where Aboriginal youth were consistently identified at high risk for both HIV and HCV.

Each of the four objectives is addressed in a chapter, consisting of a stand alone manuscript that has either been published, accepted for publication or under review with an international peer-reviewed scholarly journal. The final chapter, chapter seven, provides a review of the study findings and discusses the implications of the results. The unique contributions and their relevance to the current literature are discussed. Finally recommendations are put forth for future directions in research and resources that may be useful in caring for high-risk youth and preventing further transmission of

blood-borne infections. In summary, the goals of this study were to contribute to the body of knowledge of youth at risk for blood-borne infections by characterizing the VIDUS youth and establishing which risk factors were most important.

1.5 Study setting, overview of methods, and limitations`

1.5.1 Study setting

The Vancouver Injection Drug Users Study (VIDUS) office is located in a storefront office in the Downtown Eastside of Vancouver. VIDUS began enrolling participants in May of 1996 following the identification of an outbreak of HIV infection among Vancouver area IDUs. The VIDUS project was designed as an open cohort, where current injection drug users (used injection drugs within the previous month) can enroll at any time. Subjects were recruited through self-referral and street outreach. Subjects were eligible if they had injected illicit drugs at least once during the month prior to enrollment, resided in the Greater Vancouver region, and were able to provide written informed consent. Follow-up was every six months, at which time participants were eligible to return for follow-up interviews and blood tests. Every six months, participants were asked to complete a detailed socio-demographic and health status survey administered by trained nurses and interviewers and to provide a venous blood sample that was tested for HIV and HCV. Since the study began, over 1,400 Vancouver area injection drug users have been enrolled, the majority – approximately 1,100 – were enrolled during 1996 and 1997, however VIDUS continues to enroll new participants.

There are a variety of methods employed to ensure optimal follow–up of this hard to reach population. Some of the strategies include: contacting agencies (social services or personal contacts) that the subject frequents to remind the participant to

attend the VIDUS clinic, contacting the family physician, providing monetary compensation ($20.00) to return, contacting police and conducting interviews in jail when the participant is incarcerated, and conducting interviews in hospital when appropriate. These methods have proven highly successful – VIDUS currently has a 75% follow-up rate.

The VIDUS study has received ethical approval from the St. Paul's Hospital committee on human experimentation.

1.5.2 Methods: The VIDUS questionnaires

When participants first enroll in the VIDUS project they are administered the baseline questionnaire by one of the trained interviewers of the project. Semi-annually thereafter participants are eligible to complete a follow-up questionnaire. The VIDUS project, as of June 2002, is currently administering follow-up questionnaire number 11. All follow-up questionnaires ask standard socio-demographic, sexual and drug risk characteristics, however some questions have been changed, deleted, or added in some of the follow-up questionnaires. Following enrollment, participants complete the current follow-up questionnaire for that time period. For example, a participant who was enrolled in January 2002 and returned for follow-up in June 2002 would have completed the baseline questionnaire and follow-up number 11.

1.5.3 Methods: Definition of youth

Youth in this study were defined as aged 24 years and younger at the time of recruitment. Definitions of youth vary greatly and there seems to be no consistent means to define youth or adolescence. Some studies of risk factors for HIV among homeless or street youth have used the age cutoff as 19 years and younger[41] while

others have used age 24 years and younger[9] . United States based cohort studies of young IDUs have defined youth as age 29 years and younger[42, 43] . The rationale for using aged 24 and younger as the cutoff for this study is based on the age criterion for youth and/or adolescence as defined in reports generated by the United Nations, the centres for disease control in the United States and Canada, as well as Statistics Canada[4, 10, 44] . This age group represents those most at risk for blood-borne infections among IDUs, given their young age and risky drug and sexual patterns. Finally, established or older injectors are likely to be already HCV positive and it may be more difficult to ascertain risk factors for this virus if older injectors were included in these analyses.

During the study period there were 232 to 235 VIDUS participants who were enrolled and aged 24 years and younger. These youth are the focus of this thesis.

1.5.4 Variables of interest

The VIDUS Questionnaire asks participants questions about their current socioeconomic and demographic profile, and injection and sexual behaviour. All continuous variables are asked in reference to the previous six months at the time of interview. For this study, the following variables were operationalized either in some or all of the analyses:

Sociodemographics: Sex at birth (female/male), Aboriginal (are you Aboriginal, First Nations, Inuit, or Métis? [yes/no]), age (used mostly as a continuous variable or using cut-points [please see methods used in chapter 5]), education (ever attended high school [yes/no]), incarceration (yes/no), and unstable housing (lived in a shelter, hotel, jail, treatment centre, or on the street [yes/no]).

Health Status: Have you been diagnosed by a physician with an STD in the past 6 months? (yes/no).

Sexual Abuse: Has someone in your past ever sexually abused you? (yes/no).

Drug use behaviour: Years injecting, (current age minus how old were you when you first start injecting?), Current age, (mostly used as a continuous variable, however it was used with cut-points [please see 5]), ≥1 daily heroin, cocaine, speedball (participants were asked about their drug use frequency in the past six months for each drug, all responses answered yes for once or greater than once per day were included), ≥1 daily crack use (same as above, however it is used as opposed to injected crack), borrowing or lending (yes/no), help injecting (have you ever needed help injecting in the past six months? [yes/no]), alcohol use (in the past six months have you regularly had alcohol to drink? [yes/no]), methadone ever (have you ever been on methadone maintenance therapy [yes/no]).

Sexual behaviours: Sex trade (in the past six months have you traded sex for money, drugs or shelter? [yes/no]), use of condoms (always use condoms with client, casual, or regular sexual partners? [yes/no]), number of lifetime sexual partners (in earlier analyses <20 lifetime sexual partners was used and in subsequent analyses <100 lifetime sexual partners was used), IDU partner (participants were asked if their current sexual partner is an injection drug user [yes/no]).

1.5.5 Study analyses

There are four sub-studies each comprising a chapter of this document. Specific methods for each of the studies are described in the methods section in each of the relevant manuscript chapters. Below I have provided a brief description of the methods employed for each of the sub-studies in this document. In each of the sub-

studies, the same sample was used, participants in VIDUS who were 24 years of age and younger at the time of recruitment. In the first two studies, there were 232 youth who met the age criteria and in the second two studies there were 234 and 235 youth respectively due to additional enrollment.

The first sub-study is investigating HIV prevalence among the youth. In order to examine the relationship between HIV infection, and the independent baseline variables noted above (sociodemographics, drug use and sexual behaviours) bivariate analysis was undertaken comparing risk factors between young and older injectors and between HIV-positive and negative youth. To assess independent predictors of the primary outcome measure, HIV prevalence, variables significant in the bivariate analysis ($P<0.05$) were considered for inclusion in multivariate logistic regression modeling. These models assumed a linear relationship between independent baseline explanatory variables and log odds of HIV infection. Corresponding odds ratios and test-based 95% confidence intervals were calculated.

To calculate the incidence of HIV infection among the VIDUS youth, a time-dependent case-control analysis was undertaken to characterize differences between youth who became sero-positive and those who remained negative. Risk factors were examined from the questionnaire eliciting information in the six months prior to the seroconversion occurring. Controls were randomly selected from the available HIV-negative youth in that same questionnaire time period.

To ascertain risk factors for HCV prevalence among the youth, bivariate comparisons between youth who were HCV positive and negative at baseline were undertaken. Multivariate regression models were used to identify independent predictors of HCV positivity among the youth. Predictors of HCV incidence among the youth were calculated using person-time of observation techniques, specifically Cox regression modeling. Youth who dropped out of the study contributed person-time to

the date of their last visit, or last known negative test date. Temporal trends in incidence were stratified by demographic variables (e.g. gender, age, ethnicity) and variables of interest (e.g. types of drug use, sex trade).

In the final sub-analysis a bivariate comparison between Aboriginal and non-Aboriginal youth was undertaken. Comparisons were made between HIV and HCV sero-status, socio-demographic characteristics, and drug and sexual risk factors. Due to statistical power limitations that precluded formal statistical analysis to investigate temporal trends for HIV-positivity among Aboriginal youth, a profile of the youth who became HIV seropositve was undertaken to ascertain similarities and differences between Aboriginal and non-Aboriginal youth.

1.6 Limitations of the study

There are a number of limitations associated with this study that should be mentioned.

1.6.1 Poor validity and reliability of self-reported behavioural data among IDU populations, have been raised as issues in previous studies. There have been several studies undertaken that have raised the issue of social desirability biases in the responses of IDU populations. While Latkin and Ameijdan concluded that social desirability had minimal effect in earlier studies, a more recent study by Latkin suggested that social desirability did lead to under-reporting of syringe sharing behaviour [45, 46] . The VIDUS project has worked diligently at minimizing the effects of social desirability by using interviewer-administered questionnaires. The staff who have been hired to do the interviews are long-time workers within the Downtown Eastside community and are familiar to many of the residents and youth participating in the project.

1.6.2 Generalizability of the results may be a limitation. The VIDUS sample of young injection drug users may be particularly at risk cohort of youth given the high percentage of the cohort residing in the Downtown Eastside and in unstable housing. While the VIDUS sample of youth may not be representative of other young IDU populations, the investigators of the VIDUS project know of no recruitment methods that would have selected for particular youth characteristics over others. VIDUS youth are likely representative of other populations of young IDUs living in urban centres where there are high concentrations of IDUs living in one small urban area.

1.6.3 Loss to follow-up among the youth may present an additional concern for generalizability. Given the transient nature of IDU populations and in particular young IDUs, loss to follow-up may affect the generalizability of the study. There were 37 (16%) youth who were lost to follow-up among the VIDUS participants. When we compared the youth lost to follow-up with those who were followed, we found no differences with respect to socio-demographic characteristics and risk factors except that Aboriginal youth were more likely to be followed.

1.7 Ethical considerations and confidentiality

All participants in this study provided informed consent and signed copies are kept on file. All participants are given detailed explanations of their rights as human subjects complying with guidelines stated by the UBC Office of Research, Clinical Research Ethics Board. The VIDUS study consent form carefully outlines the purpose of the research, the objectives and duration of the subjects' participation in the study, and procedures employed to ensure confidentiality in lay language. No personal identifiers

are used in the study questionnaires and data are reported in aggregate form only. In addition to ethics approval being granted for the VIDUS study, approval was sought for this sub-study from the St. Paul's Hospital Committee on Human Experimentation. In addition, a great deal of care was taken to protect VIDUS participants from further harm that could occur from participating. Issues of confidentiality are taken very seriously and every attempt is undertaken to protect participants' anonymity. Furthermore, issues of a sensitive nature that are asked in the questionnaire and may cause emotional stress or pain for the participant, such as sexual abuse, are handled with care and counsellors and outreach workers are available if necessary.

1.8 Summary

This study has provided data for policy makers in the Greater Vancouver Region to use when allocating resources toward the prevention of blood-borne viruses among a highly vulnerable group – young IDUs. The data are also made available to other Canadian cities coping with blood-borne infections within their IDU populations and may be useful for providing reference points for young IDUs at highest risk. There is an urgent need to start addressing the vulnerability of youth to blood-borne infections. The VIDUS cohort provided an opportunity to establish contact with this high-risk and hard-to-reach population and to analyze the wealth of data available through this project.

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CHAPTER 2

REVIEW OF THE LITERATURE

2.1 Author's note

The following is a brief overview of the HIV and HCV literature as it pertains to this thesis topic. A more specific review of relevant literature has been done in the introduction to the four stand-alone manuscripts (chapters 3 through 6).

2.1 Introduction

An estimated 11 million people aged 15 – 24 are living with HIV/AIDS, and one half of all new infections, over 7,000 daily, are occurring among young people. Sub-Saharan Africa is the hardest hit, where over 70% of the young people living with HIV/AIDS reside[1] . Youth are at the centre of the epidemic, they are the generation coming of age in a world where AIDS is robbing individuals, families, communities and nations of human security. Many youth are at increased risk for HIV infection for a number of reasons beyond their control. Youth may not have access to HIV education or condoms. Young people, especially girls, may be the victims of sexual abuse. Furthermore, there are an estimated 100 million youth under age 18 living or working on the streets increasing their risk for sex trade work, injection drug use, and vulnerable relationships[1] .

Young people at the heart of the HIV epidemic in Sub-Saharan Africa are largely vulnerable to infection through sexual transmission[2] . In North America, risk factors for transmission among young people are split about equally between heterosexual contact, men who have sex with men (MSM) and IDUs[3-6] . The links

between IDUs and heterosexual transmission of the HIV virus through sexual contact between IDU and non-IDU have been documented[7, 8] . Youth, especially street youth, may be particularly at risk for heterosexual transmission through sex with an IDU[9] . HIV is systemically patterned so as to render some young people more likely to become infected than others. Gender, ethnicity, socio-economic status, sexuality, and age are important factors in structuring vulnerability to infection.

In North America, since 1996, women account for 20% - 35% of HIV infections[8, 10] . The number of women infected per year has been steadily increasing since 1995. Infection rates among females vary greatly by age, the highest proportion of females infected are among female youth[10] . Since 1999 females have accounted for between 40% and 50% of new HIV positive tests among youth. IDUs accounts for approximately 35% to 45% of HIV infections among women overall and in some studies of IDUs, females are at greater risk for infection than males[11, 12] . Increasing proportions of young females becoming HIV infected are concerning and may have implications on their life expectancy and also on their children's quality of life.

IDUs in North America continue to contribute significantly to the HIV epidemic. In Canada in 1999, 34% of the new infections were due to IDUs, a drop from 1996 wherein 47% of new infections were attributable to IDUs[3, 13] . The drop in infections is likely due to expanded needle exchange programs (NEPs), however high HIV incidence rates among some groups of IDUs such as women and youth indicate that other interventions are clearly required. In the United States, IDUs accounts for approximately one quarter of new infections per year[14] . Many IDUs are also involved in sex trade work and may engage in unprotected sex with clients[7, 15, 16] . Furthermore among IDUs condom use with casual and regular sexual partners is low[17] .

The major route of Hepatitis C (HCV) infection in North America is sharing drug equipment between IDUs[18-21] . Cohort investigations of HCV infection among IDUs suggest that HCV is widespread, up to 90% of IDUs are infected and incidence rates are high, ranging between 11 to 29 per 100 person years[22-28] . Time to infection from first initiating injection drug use is estimated to range between 1 and 4 years[11, 24, 29, 30] . HCV prevalence estimates among young IDUs range between 25% and 65%, greater age and number of years injecting are important predictors of HCV positivity[26, 31, 32] . While sexual transmission of HCV remains a controversial topic, it has been postulated that there is risk of lateral transmission of HCV between sexual partners[33, 34] . Furthermore, risk factors for HCV may provide an indication of the potential for the spread of HIV among IDUs.

2.2 HIV prevalence and incidence and associated risk factors

HIV seroprevalence among IDUs in North America varies markedly by geographic region, and by proximity to major urban centres. Prevalence estimates range from 12% to 41% [35-41] . HIV seroprevalence among IDU in Vancouver increased from 4% in 1992-93 to 23% in 1996-97 [42] and again to 30% in 1998 [35] . As of April 2002, HIV seroprevalence among all VIDUS participants is approximately 32%. At the beginning of the VIDUS study (May to November, 1997) seroincidence of HIV infection was 19.4 per 100 person years, but has subsequently declined to 2–5 per 100 person years after the first year of the study[11, 17] .

There have been few studies specifically documenting HIV seroprevalence in younger IDUs. Results from IDU cohort studies have suggested that younger IDUs have an increased risk ratio for HIV (range: 2.2 – 3.3)[43-45] . In a study that looked at HIV seroprevalence among IDUs aged 16 – 24 in Puerto Rico, prevalence was 24%[46] . In the Puerto Rican sample risk factors associated with HIV were increased age, initiating injection at a younger age, lower level of education, having a history of

incarceration, and reporting a history of sexually transmitted infections. Another study from the United States found HIV prevalence among young IDU aged 13 to 29 to be 14.4% [47] . In this later study factors most strongly associated with HIV seroprevalence were trading anal sex, injecting cocaine or speedballs, smoking crack daily, and having two or more "trainers" before self-injection.

In Canada, among Winnipeg IDUs, HIV-prevalence rates for youth between the ages of 20 and 24 years was 10.5% [48] . A Vancouver study of female and male young offenders aged 12 to 19 years of age revealed an HIV prevalence rate of 0.25% [49] . Results from the Enhanced Surveillance of Canadian Street Youth Study showed that overall 20% of participants had ever injected drugs and in the same study, of street youth in Vancouver, 35% reported ever injecting drugs[3] . Among street youth in San Francisco aged 19 years and younger, 43% reported ever injecting drugs[50] . Several investigations of street youth have found IDUs to be significantly associated with HIV seroprevalence[9, 51-53] . The links between homeless youth and injection drug use are clear, and intervention programs for street youth that focus on reducing the incidence of IDUs or educating youth on safe injection practices may help prevent blood-borne viruses.

The centres for disease control in the United States and Canada have both indicated that women are at increased risk for HIV infection among IDUs[8, 54] . In Canada an estimated 54% of new HIV infections among women were attributable to IDUs in 1999. In the United States during 1999, 42% of AIDS diagnoses were attributable to IDUs among women. Among VIDUS participants, higher proportions of females were baseline HIV prevalent than males, 35% vs. 26% respectively[11, 17] . Several studies have found that younger female IDUs are at greater risk for HIV infection[44, 45, 55] .

Some of the excess risk for HIV among women could be attributed to sexual behaviours other than injection risk, in part because HIV infection is more effective from male to female than it is from female to male through sexual contact[16, 56] . Furthermore, females are more likely than males to engage in survival sex [57-59] , to report multiple sex partners and to have partners who are injection drug users and use condoms less frequently [48, 57, 60] . Females may be more likely than males to be influenced or coerced into engaging in behaviour such as high-risk sexual practices or risky injection behaviour than are males [61-65] .

Another important group with respect to the HIV epidemic identified by the centres for disease control in the United States and Canada are Amer-Indian Nations and Aboriginal people[66, 67] . Governmental policies directed at Canadian Aboriginal people such as removal from land to reserve and the residential school system have precipitated the loss of cultural and linguistic identity among some Aboriginal Nations. These policies have resulted in disparities between Aboriginal and non-Aboriginal Canadians in terms of health and economic status [68-72] . Consequentially, Aboriginal people are over-represented among the IDU population and among Canadians infected with HIV. Among VIDUS participants, Aboriginal people account for 25% and have been found to be at increased risk for HIV seroprevalence[17] .

2.3 HCV prevalence and incidence and associated risk factors

It has been suggested that the high transmission rate of HCV among IDUs is due to a combination of factors including high infectiousness per syringe-sharing contact, infectiousness throughout the course of the disease, and the frequency of needle and equipment sharing contacts in a given community [73] . Researchers have estimated that parenteral transmission of HCV is 10-fold more efficient than that of HIV[74] .

IDUs are the leading risk category for HCV infection;. Prevalence estimates of HCV infection among IDUs range from 38–95% [24] [31] [75] [76] . In the VIDUS cohort, overall HCV prevalence is 87%. Approximately 85% of persons infected with HCV develop persistent viremia and this generates a large reservoir of infected IDUs with potential for spreading the virus. There are approximately 40,000 cases of HCV in British Columbia, four times the national average[34] .

Injecting with someone else's potentially contaminated needle and syringe ("needle borrowing") is the principal route of transmission, however cohort studies of IDUs in Chicago and Seattle noted that sharing of other injection equipment including cottons, cookers, and straws also facilitated parenteral transmission of the HCV virus[74, 77] . Studies of young IDUs have determined that time to HCV infection following initiation into injection drug use is 1 – 4 years [23, 29, 30, 78]. Other studies have also suggested that young IDUs are more likely to borrow needles and share injection equipment than older IDUs[47, 79] . Many youth who inject drugs also engage in risky sexual activity[51, 80, 81] . Therefore in addition to parenteral risk, young IDUs may engage in sexual behaviour that has been postulated as risk factors for HCV[82] . Thus young IDUs are an important group with respect to the virus.

Consistent factors associated with HCV seroprevalence among IDUs include at least daily cocaine and speedball injection[26, 31, 83] , sharing needles[11, 22] , and sharing other injection equipment[74, 77] . Some studies have found female gender and sex trade work to be factors associated with HCV seroincident infection[78, 83] . In other studies of HCV transmission, associations have included high numbers of sexual partners and low condom use[26, 75] . In an earlier study of the VIDUS cohort, overall HCV seropositivity at baseline occurred among 82% of the cohort and was associated with older age, incarceration, higher number of sexual partners, greater number of years injecting, sex trade work, and borrowing syringes [83] . In this earlier study, the

overall incidence density rate was 29 per 100 person-years and was associated with female gender, Aboriginal ethnicity, participants engaged in sex trade work, borrowing needles, and at least daily cocaine or speedball injection.

2.4 Aboriginal People and the HIV epidemic

The annual proportion of AIDS cases among Canadian Aboriginal people has risen from less than 1% before 1990 to 10% in 1999[67] . Aboriginal people are over-represented among new HIV infections (i.e.19% in 1998, 24% in 1999, 22% in 2000 and 26% in 2001). Females represent one half of all positive HIV tests among Aboriginal people but only 20% among non-Aboriginal people. Aboriginal people are younger when diagnosed with HIV than non-Aboriginal people; 31% vs. 20% are among the age group 20 to 29. HIV infected Aboriginal people are more likely to be in the transmission group IDUs than non-Aboriginal people, 60% vs. 29%. These figures are worrisome especially because current surveillance data are incomplete, the majority of positive HIV tests reported to the Centres for Disease Control have no ethnic information[3] .

Aboriginal people are the fastest growing population in Canada, with 32% of the population under the age of 14 [84] . A Vancouver study conducted on incarcerated youth, researchers noted that Aboriginal youth were five times more likely to have engaged in injection drug use than non-Aboriginal youth [49]. There is little data specifically on Aboriginal youth, however available data suggest that Aboriginal persons are infected with HIV at a younger age than non-Aboriginal persons, that injection drug use is the most important mode of transmission, and that the epidemic shows no sign of abating[67] .

2.5 Conclusion

The future of the HIV epidemic is in the hands of young people. Many of the behaviours they adopt now will be those they will maintain throughout the course of their lives and will determine the course of the epidemic for years to come. There are many examples of successful interventions that show when young people are provided with effective education, access to condoms and sterile injecting equipment it positively affects the HIV epidemic. Learning to better protect children and youth from sexual victimization, poverty, and the streets will be the greatest challenge, however it will be necessary to decrease transmission of the HIV virus and to protect youth from the HIV epidemic sweeping the globe.

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CHAPTER 3

HIV PREVALENCE AND ASSOCIATED RISK FACTORS

3.1 FOREWORD

This manuscript has been accepted for publication as "Females experiencing sexual and drug related vulnerabilities are at elevated risk for HIV infection among youth who use injection drugs" with the *Journal of Acquired Immune Deficiency Syndromes, July 2002, Vol.30, No.3.*

3.2 Introduction

Youth are of particular importance with respect to HIV/AIDS, not only because they are at risk for infection, but it is during this period of life when many behaviour patterns are established that will affect their future risk of HIV infection [1]. The HIV epidemic among youth is well established and growing[2-4]. The United Nations estimates there are 6,400,000 females and 3,900,000 males aged 15 - 24 living with HIV around the globe[5]. In Canada, age at infection has decreased from age 32 before 1983 to 23 in 1990[6], and in the United States rates of HIV infection among adolescent women have tripled between 1985 and 1999[7].

Youth at higher risk for HIV infection are those who use injection drugs[1, 8]. Some cohort studies of injection drug users (IDUs) have reported that younger age and more recent initiation into injection are associated with increased risk for HIV[9-11]. This is troubling, particularly in light of recent school-based surveys suggesting that between 3% and 9% of high school students report use of injection drugs[12, 13]. Other studies have found that young female IDUs are particularly vulnerable to HIV infection, likely due to sexual and drug related risk factors[3, 14].

We undertook this study to characterize socio-demographic characteristics and sexual and drug risk factors among young IDUs in a city where an ongoing HIV-

epidemic among IDUs has occurred[15]. The objectives were to determine socio-demographic, drug and sexual differences between younger and older IDUs and to investigate risk factors for HIV infection among the young injectors.

3.3 Methods

Data were collected within a prospective open cohort study of injection drug users, the Vancouver Injection Drug Users Study (VIDUS). A description of this study has been previously published[15]. VIDUS has recruited over 1,400 Vancouver area IDUs since May 1996. The study office is located in the Downtown Eastside (DTES) of Vancouver. The DTES is Vancouver's poorest neighbourhood and many of the city's IDUs reside in an area of approximately ten city blocks where inexpensive housing in the form of hotels and single room occupancies (SROs), abound.

Eligibility criteria for the study included residing in the city of Vancouver and surrounding municipalities and having injected in the previous month. There were no age restrictions. Participants were administered a questionnaire by trained nurse-interviewers and were eligible to return for follow-up every six months. At each visit, eligible participants were tested for HIV and HCV through venous blood samples. This analysis is based on data from the enrolment questionnaire, administered between May 1996 and November 2000. This study was approved by the St. Paul's Hospital Committee on Human Experimentation.

For the purposes of this study, young injectors were defined as those aged 24 or less at the time of recruitment. Young and older injectors were compared using contingency table analysis. Similarly, HIV-positive young and older participants and HIV positive and HIV negative young female injectors were compared to determine risk factors for HIV-positivity among the youth. All risk factor variables refer to behaviours and circumstance in the 6 months prior to the questionnaire. Selected

variables of interest are defined as follows: survival sex refers to trading sex for money drugs or shelter; condom use is always; help injecting is any; and sexual abuse is ever. Chi-square and Fisher's exact tests were used to compare categorical variables, whereas Wilcoxon rank sum tests were used to compare continuous variables. Logistic regression models were used to identify independent predictors of HIV-positivity among the young female IDUs. Forward stepwise regression was used involving all variables that were significant ($p<0.10$) in bivariate analyses. Those significant at $p<0.05$ were retained in the final model. All reported p-values are two-sided.

3.4 Results

There were a total of 1,437 participants eligible for this analysis. A total of 232 were aged 13 - 24 years (median 21) and 1,205 were older than 24 years (median 36) at baseline. As would be expected, the duration of injection career was much shorter in the young injectors compared with the older injectors (median 3 years vs 13 years; $p<0.001$). Age at first injection was also much lower among the youth (median 17 vs. 20; $p=<0.001$). The prevalence of HIV at baseline was also lower in the young injectors (10.0% vs. 23.5%).

The variables in Table 1 are comparing baseline socio-demographic, sexual and drug risk variables between the young and older VIDUS participants. Young injectors were more likely to be female, engage in sex trade work, have casual sexual partners, report using condoms with casual sexual partners, inject heroin daily, use crack cocaine daily, and require help when injecting. Young injectors were less likely to have: any high school education, greater than 20 lifetime sexual partners, and inject cocaine on a daily basis. There was no statistical difference between the young and older participants with respect to being Aboriginal, having a history of incarceration,

injecting speedballs daily, needle sharing behaviours, and having a history of sexual abuse.

Table 2 compares socio-demographic and risk variables between young and older VIDUS participants who were HIV positive at the baseline questionnaire. As would be expected, the median age between the younger and older HIV-positive participants differed (median 22 vs. 35; p=<0.001), as did the number of years injecting (median 7 vs. 13; p=<0.001), and age at first injection (median 16 vs. 20; p=<0.001). Young seropositive participants were more likely to: be female, work in the sex trade, have experienced sexual abuse, have greater than 20 lifetime partners, inject heroin and speedballs at least daily, and use crack cocaine at least daily. Young participants were marginally more likely to be Aboriginal and less likely to be married or living common law. There was no difference between the two groups with respect to: casual sexual partners; condom use with casual partners; daily cocaine injection; requiring help to inject; and needle sharing. In a multivariate model (data not shown) young injectors were significantly more likely to be female and inject speed on an at least daily basis.

Of the 232 young injectors, 23 were HIV positive at baseline and 209 were HIV negative. Of the 23 seropositive youth, 20 (87%) were female. Due to the very high proportion of females affected and to control for collinearity, Table 3 compares risk factors between young HIV-positive and negative females. HIV-positive young females were older (median 22 vs. 20; p=<0.001), had a greater number of years injecting (median 6.5 vs. 2; p=<0.001), however, age at first injection did not differ (median 16 vs. 16; p=<0.213). The HIV-positive female youth were more likely to work in the sex trade, have greater than 20 lifetime partners, and inject speedballs daily. HIV-positive female youth were less likely to have a regular sexual partner, to always use condoms with casual sexual partners, and marginally less likely to have casual sexual

partners. There was no statistical difference between the two groups with respect to using condoms with casual sexual partners, injecting heroin daily, and smoking crack at least daily.

Table 4 presents the results of our logistic regression modeling for independent predictors of seropositivity among the young female injectors. The final model shows that increased age, injecting for a greater period of time, and daily speedball injection were independently associated with HIV-positivity. Having a regular sexual partner was a protective factor among the young females.

Finally, Table 5 presents a profile of the 23 (10%) HIV-positive youth including socio-demographic, sexual and drug risk factors. This profile shows the highest burden of infection is in young females. The three young males who were seropositive at baseline were all Aboriginal, all of whom injected cocaine daily, and one of the young men engaged in sex trade work. Most of the youth engaged in polydrug use on a daily basis, including heroin and cocaine injection and in some cases, speedballs and crack. A low proportion of the youth reported always using condoms with regular and casual sexual partnerships but interestingly, many of the youth reported always using a condom with clients.

3.5 Discussion

Among young injectors in Vancouver, female youth are at highest risk for HIV infection. Typically in IDU cohorts the ratio of females to males is approximately one third to two thirds[15-17]. However, among VIDUS youth the split is about 50% between females and males. Another study of young IDUs, the REACH cohort in Baltimore Maryland, had a similar ratio of young female and male participants[10]. Whether these findings reflect a selection bias or are indicative of young females entering into injection drug use earlier than their male counterparts, requires further investigation.

In our study we found the HIV baseline prevalence was much higher among young females than young males (17 vs. 3). Doherty et al. also found higher baseline HIV prevalence, although not significant (17 vs. 11), among young female participants in the REACH cohort[10]. In both cases, the female IDU had unique risk profiles of combined sexual and drug related risk[18]. Other studies of young IDUs have similarly found that female injectors have higher risk profiles [19, 20]. These findings have important implications for prevention and addiction treatment for young IDUs and warrant further explorations into the unique characteristics and risk factors for young female injectors.

We found similar proportions of Aboriginal youth compared with older injectors in VIDUS, however Aboriginal people are far over-represented among the IDU population in the VIDUS cohort and across Canada[21]. Half of the HIV-positive female youth and all of the young males were First Nations participants. First Nation populations in North America have shouldered the burden of increased rates of morbidity and mortality, and HIV/AIDS has devastating potential in these communities. The respective national centres for disease control in Canada and the United States have identified the Aboriginal and Amer-Indian nations as increasingly vulnerable to the epidemic. Collaborative research in these populations is urgently needed to stem the tide of new infections[22, 23].

When we considered sexual risk variables, we found that the youth were significantly more likely to engage in survival sex when compared to older participants. Furthermore there was an overwhelming association between HIV-positivity and survival sex among the female youth when compared to older HIV-positive participants and HIV-negative female youth. Sex trade work has been shown to increase both risk for HIV infection as well as vulnerability to increased drug use and violence[24-26]. The high number of female youth and the strong relational association between survival sex and HIV positivity, suggests an urgent need for further research

and intervention programs among young females engaged in survival sex[27]. The overall rates of condom use fell below 30% and the youth engaged in more frequent sexual activity through survival sex and with casual sexual partners. The risks posed by the sexual transmission of HIV among young females in this cohort cannot be ruled out.

We found high rates of sexual abuse in both younger and older VIDUS participants. However, sexual abuse among the young female participants was reported by a staggering 70% of the HIV-positive and 60% of the HIV-negative youth. Childhood sexual abuse has been linked to subsequent work in the sex trade and a reduced ability to negotiate condom use[28, 29]. Furthermore, requiring help to inject was consistently reported more frequently among the young participants. The combined disempowerment associated with childhood sexual abuse, continued vulnerability to sexual predators through sex trade work and requiring help to inject is undeniably fueling the epidemic, specifically among young women[30, 31]. Treatment for drug addiction will need to consider lifetime sexual violence along with treatment for drug dependency, especially for young female IDUs. Issues around empowerment, self-care including safe injection practices, and condom negotiation need to be addressed in order for young women who have a history of sexual abuse and sex trade work, to protect themselves from HIV/AIDS.

Drug risk variables unique to the youth included greater use of daily heroin, whereas older participants were more likely to inject cocaine daily. The finding that daily heroin injection is greater among the young participants is counter-intuitive to the image of drug use among youth as a party enhancer. While the pharmacological effects of cocaine have been linked to elevated self-esteem, heroin has been described as having a numbing effect[32]. Increased heroin use may be explained by older contacts and drug use networks and/or by a lifetime characterized by violence through

childhood sexual abuse, sex trade work, and early entry into drug use and street life[30].

The youth were also more likely to smoke crack cocaine daily, a behaviour that has previously been shown to increase risk for HIV-infection among high-risk youth in Baltimore and San Francisco [10, 33]. Doherty et al. suggested that the association between increased risk for HIV and daily crack use may be linked to higher risk sexual behaviours among young crack users. Our findings of higher proportions of female, sex trade work, casual partners, low condom use and daily crack use among the young IDUs suggest confirmation of this assertion.

The drug risk variable that was associated with HIV-positivity, in univariate and multivariate analysis, among the female youth was daily speedball use. The use of injection speedballs by IDUs has been similarly associated with increased risk for HIV in other cities such as Baltimore[9, 10] and New York[34]. However, speedball use among young injectors, particularly females, warrants further investigation, particularly in light of the recent overdose deaths in Houston, Texas that were attributed to speedball use[35]. Whether female youth are using speedballs for their combined effects of alleviating pain associated with heroin withdrawal and cocaine's fast pace properties that may enable sex trade work, or due to drug use networks remains to be clarified. However, education around safe mixing and injection practices may help to prevent overdose deaths and HIV infection.

While daily heroin and speedball injection appear to be characteristic of young female IDUs, daily cocaine injection occurred in the three young HIV-positive males as shown in the profile in Table 5. The profile also illustrates the high rates of daily polydrug use that most of the HIV-positive youth were engaged in. Rather than focussing on one specific drug that may be increasing risk among the youth, it may be that the association between polydrug use and HIV-seroprevalence is mediated by

increased sex trade work and sexual activity, particularly for young females with histories of childhood sexual abuse[36].

When we compared the younger and older participants we found the youth were more likely to require help when injecting in the preceding six months. This behaviour, especially among youth, may increase vulnerability to both needle sharing and social networks and partnerships characterized by inequities in power[31]. Needle borrowing and lending were not statistically different from older injectors, however almost half of the youth reported needle sharing behaviors. This is cause for concern as the association between HIV-positivity and needle sharing behaviors has been well documented[9, 37, 38]. The potential link between needle sharing and those who require help when injecting is something that requires further investigation and may shed some light on high-risk networks.

There are several limitations with respect to this study. There may be sampling bias with respect to generalizabiltiy to other young injectors. As in most studies of IDUs, our study was based on self-reported behaviours and caution should be exercised in the interpretation of such data. However, other studies of IDUs have found that socially desirable responses had only a negligible effect on the responses concerning risk behaviours for HIV infection[39]. Another limitation is the risk behaviors identified in this study were cross-sectional in nature, and did not account for subsequent changes in behaviours. Nevertheless, these data provide information on a vulnerable population in which there has been little previous research conducted.

In summary, targeted interventions are required among young female and Aboriginal injectors. In our study, among the youth, females with multi-factoral drug and sexual vulnerabilities were at highest risk for HIV. Furthermore, we found that over 50% of the HIV-positive youth were Aboriginal. There is an urgent need to develop youth specific programs that are gender and culturally appropriate and

incorporate lifetime sexual violence survived through childhood sexual abuse and sex trade work.

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Table 1: A comparison of sociodemographic and sexual and drug risk variables between young IDUs (≤24 years) and older IDUs (>24 years) in the VIDUS cohort

	Young IDUs (232, 16%)	Older IDUs (1205, 84%)	Odds Ratios [95% CI]	p-value
Female	117 (50)	388 (32)	2.1 [1.6, 2.8]	0.001
Aboriginal	56 (24)	306 (25)	0.9 [0.7, 1.3]	0.686
Incarceration	72 (31)	407 (34)	0.9 [0.7, 1.2]	0.417
Any High School	162 (70)	1006 (83)	0.5 [0.3, 0.6]	0.001
Sex Trade	96 (41)	292 (24)	2.2 [1.7, 2.9]	0.001
Casual Partners	106 (46)	363 (30)	2.0 [1.5, 2.6]	0.001
Condom w/ Casual	61 (26)	186 (15)	2.0 [1.4, 2.7]	0.001
>20 Lifetime Partners	140 (60)	808 (67)	0.7 [0.6, 1.0]	0.048
Sexual Abuse	89 (38)	429 (36)	1.1 [0.8, 1.5]	0.423
≥1 per day Heroin	119 (51)	478 (40)	1.6 [1.2, 2.1]	0.001
≥1 per day Cocaine	77 (33)	559 (46)	0.6 [0.4, 0.8]	0.001
≥1 per day Speedball	33 (14)	205 (17)	0.8 [0.5, 1.2]	0.295
≥1 per day Crack	40 (17)	115 (10)	2.0 [1.3, 2.9]	0.001
Needle Borrowing	97 (42)	454 (38)	1.2 [0.9, 1.6]	0.236
Needle Lending	85 (37)	440 (37)	1.0 [0.8, 1.3]	0.971
Help Injecting	123 (53)	470 (39)	1.8 [1.3, 2.3]	0.001

Table 2: A comparison of sociodemographic and risk variables between HIV-positive young and older VIDUS participants

	HIV+ Young (23, 10%)	HIV+ Older (285, 24%)	Odds Ratios [95% CI]	p-value
Female Gender	20 (87)	111 (39)	10.5 [3.7, 29.2]	0.001
Aboriginal	12 (52)	94 (33)	2.2 [0.9, 5.1]	0.062
Married	1 (4)	76 (27)	0.1 [0.0, 0.7]	0.017
Sex Trade	20 (87)	98 (34)	12.7 [4.7, 34.6]	0.001
Sexual Abuse	16 (70)	116 (41)	3.3 [1.4, 8.0]	0.007
Casual Partners	7 (30)	79 (28)	1.1 [0.5, 2.9]	0.780
Condom w/ Casual	3 (13)	58 (28)	0.4 [0.1, 1.3]	0.128
>20Lifetime Partners	22 (96)	177 (62)	13.4 [2.8, 64.9]	0.001
Heroin Frequency	12 (52)	85 (30)	2.6 [1.1, 5.9]	0.026
Cocaine Frequency	13 (57)	161 (56)	1.0 [0.4, 2.4]	0.998
Speedball Frequency	11 (48)	65 (23)	3.1 [1.4, 7.1]	0.007
Crack Frequency	6 (26)	28 (10)	3.2 [1.2, 8.5]	0.017
Needle Borrowing	8 (35)	109 (38)	0.9 [0.4, 2.1]	0.742
Needle Lending	8 (35)	93 (33)	1.1 [0.5, 2.7]	0.833
Help Injecting	13 (57)	115 (40)	1.9 [0.8, 4.5]	0.130

Table 3: A comparison of sociodemographic and risk variables between HIV-positive and HIV-negative young female VIDUS participants

	HIV+ female (20, 17%)	HIV- female (97, 83%)	Odds Ratios [95% CI]	p-value
Aboriginal	9 (45)	29 (30)	1.9 [0.7, 5.1]	0.189
Sex Trade	19 (95)	57 (59)	13.3 [2.6, 69.3]	0.002
Sexual Abuse	15 (75)	58 (60)	2.0 [0.7, 5.9]	0.201
Any High School	11 (55)	67 (69)	0.5 [0.2, 1.5]	0.224
Regular Partner	6 (30)	58 (60)	0.3 [0.1, 0.8]	0.015
Casual Partners	4 (20)	42 (43)	0.3 [0.1, 1.0]	0.052
Condom w/ Casual	1 (5)	25 (26)	0.2 [0.0, 0.9]	0.042
>20 Lifetime Partners	20 (100)	64 (66)	21.3 [1.2, 363.1]	0.002
Heroin Frequency	11 (55)	57 (59)	0.9 [0.3, 2.3]	0.756
Cocaine Frequency	10 (50)	32 (33)	2.0 [0.8, 5.3]	0.149
Speedball Frequency	10 (50)	10 (10)	8.7 [3.2, 23.5]	0.001
Crack Frequency	6 (30)	17 (18)	2.0 [0.7, 5.9]	0.201
Needle Borrowing	7 (35)	42 (43)	0.7 [0.3, 1.9]	0.493
Needle Lending	8 (40)	38 (39)	1.0 [0.4, 2.8]	0.945
Help Injecting	13 (65)	64 (66)	1.0 [0.3, 2.6]	0.933

Table 4 **Logistic regression analysis in which the outcome was HIV-positivity among the female youth (≤24 years)**

	Unadjusted Odds Ratios [95% CI]	**Adjusted** Odds Ratios [95% CI]
Increased Age		
Per year	7.7 [2.6, 22.8]	1.7 [1.3, 2.3]
Speedball		
≥1 per day	1.3 [1.1, 1.6]	7.5 [1.9, 30.0]
Regular Partner		
Yes vs. no	7.8 [3.4, 17.9]	0.2 [0.0, 0.6]
Education		
Yes vs. no	1.3 [1.2, 1.5]	0.3 [0.1, 0.9]

Table 5 **Profile of socio-demographic, sexual and drug risk factors among the youth (≤24 years)**

	Gender	Ethnicity*	Age (years)	Sex Trade	>20 Partners	Daily Heroin	Daily Cocaine	Daily Speedball	Daily Crack	Regular Daily	Condom W/	Condom W/ Casual Clients	Condom W/
1	F	O	22	Y	Y	Y	Y	N	Y	N	Y	Y	
2	F	O	22	Y	Y	N	Y	N	Y	N	N	Y	
3	F	O	24	Y	Y	Y	Y	Y	N	Y	N	Y	
4	F	O	20	Y	Y	Y	Y	Y	N	N	N	N	
5	F	O	22	Y	Y	Y	Y	Y	Y	N	N	Y	
6	F	O	21	Y	Y	Y	Y	Y	Y	N	N	N	
7	F	O	17	Y	Y	Y	Y	Y	N	N	N	N	
8	M	A	24	N	N	N	Y	N	Y	N	Y	N	
9	F	O	21	Y	Y	Y	Y	N	Y	N	N	Y	
10	F	A	24	Y	Y	Y	Y	Y	Y	N	N	Y	
11	F	A	23	Y	Y	Y	Y	N	Y	N	N	Y	
12	F	A	21	N	Y	N	Y	N	Y	N	N	N	
13	M	A	23	N	Y	Y	Y	N	Y	N	N	N	
14	F.	O	22	Y	Y	Y	Y	Y	Y	N	N	Y	
15	F	O	23	Y	Y	Y	N	N	N	Y	N	Y	
16	F	A	22	Y	Y	Y	Y	Y	Y	N	N	Y	
17	F	O	24	Y	Y	N	N	Y	N	N	N	Y	
18	F	A	24	Y	Y	Y	Y	Y	Y	N	N	N	
19	F	A	21	Y	Y	N	Y	N	Y	N	N	Y	
20	F	A	24	Y	Y	Y	Y	Y	Y	N	N	Y	
21	F	A	20	Y	Y	N	N	Y	N	N	N	Y	
22	F	A	22	Y	Y	Y	Y	Y	Y	N	N	Y	
23	M	A	19	Y	Y	Y	Y	Y	N	N	Y	N	

*O=Other, A=Aboriginal

CHAPTER 4

HIV INCIDENCE AND ASSOCIATED RISK FACTORS

4.1 Foreword

This letter was a letter published as "HIV Incidence and Associated Risk Factors Among Young Injection Drug Users" in *AIDS 2002, volume 16, Number 3.* The brevity of this report was due to low statistical power or statistically small numbers for HIV incidence among the youth.

4.2 Introduction

Youth are of particular importance with regard to the HIV epidemic because of the window of opportunity available to prevent disease transmission. However, researchers have noted that HIV infection among injection drug users (IDUs) is associated with younger age and a fewer number of years injecting(1, 2). Studies have found that young female IDUs are at higher risk for HIV incidence than young male IDUs(3, 4). Other studies have noted that important predictors of HIV-positivity among young injectors include: cocaine and speedball injection, smoking crack cocaine, and younger age at first injection(5, 6). In a recent study of young injectors, Doherty et al. found that HIV incidence was associated with injection cocaine and smoking crack cocaine daily although there were very few cases of incident HIV during their study period(6).

4.3 Methods

We undertook this study to determine rates and risk factors for incident HIV infection among young injectors in a city where an explosive and ongoing HIV epidemic has occurred among IDUs. Data were collected through an open cohort study, the Vancouver Injection Drug Users Study (VIDUS), since May 1996. Participants are eligible to enroll if they have injected in the previous month and are residents of the

Lower Mainland of British Columbia. At baseline and every six months participants were eligible to complete an interviewer-administered questionnaire eliciting questions concerning socio-demographics, drug use, and sexual patterns as well as testing through venous blood sample for HIV and Hepatitis C.

For the current analysis, youth were defined as those participants in the cohort who were ≤24 years at enrolment. A nested case-control using prospective data was undertaken to compare socio-demographic and risk factors for HIV incident youth cases versus HIV-negative youth controls. Risk factors for the cases were measured using behaviour data from the questionnaire administered in the six months prior to the seroconversion occurring. Controls were matched with cases based on age and questionnaire time period. The data were compared using contingency table analysis. All reported p-values are two-sided.

4.4 Results

Among the 232 participants aged ≤24 years, the HIV incidence rate was 4.37 per 100 person years. In total there were 16 incident cases over a 5-year study period. Despite limited statistical power, a number of strong associations were detected. Cases were more likely to be Aboriginal (56% vs 16%; p=0.004), have > 20 lifetime sexual partners (81% vs 47%; p=0.023), inject cocaine daily (63% vs 19%; p=0.002), and to use crack cocaine daily (63% vs 19%; p=0.002). There was a marginal difference between cases and controls with respect to daily speedball injection (31% vs 9%; p = 0.055). Differences between the two groups with respect to engaging in sex trade work (50% vs. 28%; p = 0.134), residing in unstable housing (69% vs. 47%; p=0.152), female gender (63% vs. 41%; p = 0.153), and any condom use with casual sexual partners (31% vs 25%; p = 0.653) did not reach statistical significance. In a logistic regression analysis we found that Aboriginal status (AOR= 6.9, 95% CI= 1.8, 27.4, p=0.05) remained significantly associated with HIV infection [data not shown]. However we feel that while this variable is highly important, other variables may not have reached statistical

significance in multivariate models due to low statistical power and should not discount the importance of the variables detected in the case-control analysis.

4.5 Discussion

To our knowledge this is one of the few studies to examine time relevant risk factors associated with HIV infection in a young and vulnerable population in longitudinal fashion. The incidence rate of 4.37 per 100 person years in a young population with short injection careers is alarming. Furthermore, the numerous drug and sexual vulnerabilities identified bodes poorly for the future of the epidemic unless immediate preventive action takes place.

Our work raises a number of important issues. First, young Aboriginal people were at markedly elevated risk. Second, similar to other studies of young IDUs, we found that smoking crack daily increased the risk for HIV infection(7-10). Third, we also confirmed that daily use of injection cocaine and speedballs was associated with HIV infection, as was a high number of lifetime sexual partners(5, 6, 9, 11, 12).

Of the HIV seroconverters, 63% occurred in female participants and 50% were among those engaging in sex trade work. Use of condoms with casual sexual partners was very low for both positive and negative youth and over 50% reported living in unstable housing. The lack of statistical association should not negate the risks. Sex trade work has been previously shown to increase HIV vulnerability among young IDUs(7, 13, 14). Furthermore, a high number of sexual partners combined with low rates of condom use is cause for concern. Other research efforts have shown that females, particularly young females, are at increased risk through sexual contact due to the increased efficacy of viral transmission from male to female sex partners(12, 15). The frequency and type of drug use engaged in by this group of young IDUs demands response from policy makers and community workers.

In summary, our study found a high rate of new infections among young IDUs engaged in dual drug and sexual risks. The very high proportion of young Aboriginals

seroconverting is cause for alarm. Canadian and increasingly American First Nations people are witnessing the rapid spread of the virus and urgent action is required to stem the tide of new infections(16, 17). In conclusion, targeted interventions are required among young IDUs that focus on young Aboriginal and female populations and that take dual drug and sexual vulnerability into account.

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Table 1: Comparison of sociodemographic characteristics, drug and sexual risk variables between seroincident youth cases (N=16) and HIV-negative youth controls (N=32)

	HIV+ Youth (n = 16)	HIV- Youth (n =32)	Odds Ratios [95% CI]	p-value
Crack Frequency	10 (63)	6 (19)	7.2 [2.0, 26.3]	0.002
Cocaine Frequency	10 (63)	6 (19)	7.2 [2.0, 26.3]	0.002
Aboriginal	9 (56)	5 (16)	6.9 [1.9, 25.9]	0.004
>20 Lifetime Partners	13 (81)	15 (47)	4.9 [1.2, 19.6]	0.023
Speedball Frequency	5 (31)	3 (9)	4.4 [1.0, 20.3]	0.055
Sex Trade	8 (50)	9 (28)	2.6 [0.7, 8.9]	0.135
Unstable Housing	11 (69)	15 (47)	2.5 [0.7, 8.8]	0.152
Female	10 (63)	13 (41)	2.4 [0.7, 8.4]	0.153
Heroin Frequency	27 (59)	38 (41)	2.3 [0.6, 8.8]	0.206
Help Injecting	7 (44)	9 (28)	2.0 [0.6, 7.0]	0.279
Sexual Abuse	7 (44)	10 (31)	1.7 [0.5, 6.0]	0.393
Condom w/ Casual	10 (31)	4 (25)	0.7 [0.2, 2.3]	0.653

CHAPTER 5

HEPATITIS C PREVALENCE AND INCIDENCE AND ASSOCIATED RISK FACTORS

5.1 Foreword

This manuscript has been accepted for publication as "Opportunities for Prevention: Hepatitis C prevalence and incidence among young injection drug users" in *Hepatology, September 2002 Vol.36, No.3.*

5.2 Introduction

In North America the leading cause of Hepatitis C infection (HCV) is the sharing of contaminated equipment between injection drug users (IDUs)[1] . The incidence of HCV infection among populations of IDUs ranges from 4.2 to 22.0[2-6] per 100 person-years and prevalence estimates fall between 30% and 90% [2-4, 7, 8] . Due to the rapid acquisition of HCV infection following initiation into injection drug use, young IDUs or recent injection initiates represent an important group for HCV prevention. This may be particularly important in urban areas experiencing high prevalence of blood-borne infections among IDU populations. Studies have shown that younger IDUs engage in high-risk behaviours to a greater extent than established users, which increases their vulnerability to blood-borne infections[9, 10] .

The principal route for HCV infection among IDUs is using someone else's contaminated needle and/or other drug use equipment [1, 11] . Young IDUs may have a lower anti-HCV seroprevalence than older IDUs due to more recent initiation into injection drug use[11] . However, younger IDUs may share needles and other injection equipment more so than older IDUs [12, 13] . Furthermore, younger IDUs may be more likely to have casual sexual partners, engage in sex trade work, and use condoms

inconsistently [13-15] . Thus, in addition to parenteral risk, young IDUs may engage in sexual behaviours that have been presumed to be risk factors for infection [16] .

Vancouver, Canada has experienced an explosive epidemic of HIV and extensive spread of HCV among IDUs. Little is known about recent initiates and young IDUs. Identifying risk factors for HCV infection among young IDUs may provide important prevention clues for cities coping with outbreaks of blood-borne infections among IDU populations. We undertook this study to estimate the prevalence and incidence of HCV infection among IDUs aged 24 and under and to characterize socio-demographic characteristics and risk factors for HCV among the young IDUs.

5.3 Methods

Data were collected within a prospective open cohort study of injection drug users, the Vancouver Injection Drug Users Study (VIDUS). A description of this study has been previously published[17] . VIDUS has recruited over 1,400 Vancouver area IDUs since May 1996. The study office is located in a storefront in the Downtown Eastside (DTES) of Vancouver. The DTES is Vancouver's poorest neighbourhood where an estimated 5,000 IDUs reside in an area of approximately ten city blocks, inexpensive housing in the form of hotels and single room occupancies (SROs) abound.

Eligibility criteria included residing in the city of Vancouver and surrounding municipalities, having injected in the previous month, and aged 13 years and older. Participants were administered a questionnaire by trained nurse-interviewers and were eligible to return for follow-up every six months. At each visit, eligible participants were tested for HIV and HCV antibodies through venous blood sample. This study was approved by the St. Paul's Hospital Committee on Human Experimentation.

5.3.1 Instrument

The VIDUS questionnaire is administered by trained nurses and interviewers and elicits information regarding socio-demographic, sexual and drug risk characteristics. Continuous variables were elicited in reference to the previous six-months prior to the interview. This includes the variables sex trade work, frequency of injection, incarceration, housing situation, sexual behaviours, needle and equipment sharing, and help injecting. Sex trade was defined as trading sex for money, drugs, or shelter. Needing help injecting was defined as ever requiring someone's help to inject drugs in the previous six months. The variable other equipment includes cookers, cottons, spoons and all other injection equipment aside from needles. Unstable housing was defined as living on the street, shelter, jail, hostel, or hotel.

5.3.2 Statistical analyses

For the purposes of this study, young injectors were defined as those aged 24 years or less at the time of recruitment. The rationale for the age cutoff is based on the age criterion for youth and/or adolescence used in reports on HIV/AIDS generated by the United Nations and the centres for disease control in the United States and Canada[18-20] . Young injectors identified at baseline as HCV antibody positive were compared with baseline anti-HCV negative youth using contingency table analysis. Chi-square and Fisher's exact tests were used to compare categorical variables and the Wilcoxon rank sum tests were used to compare continuous variables. Logistic regression models were used to identify independent predictors of baseline HCV positivity. Variables significant at $p<0.05$ in univariate analyses were included in an unconditional logistic regression model. All reported p-values were two-sided.

Youth who became HCV antibody positive during the study period were compared to youth who remained HCV negative and had at least one follow-up visit.

The date of seroconversion was estimated using the midpoint between the last negative and the first positive antibody test result. Cumulative incidence rates of HCV infection were calculated using Kaplan-Meier methods. In these analyses, time zero was defined as the date of enrolment. Participants who consistently remained seronegative were considered to be right censored at the time of their most recent test result. Annual rates of HCV seroconversion were calculated with actuarial methods. Relative risks and 95 percent confidence intervals were obtained for risk factors of interest. Adjusted and unadjusted time dependent Cox regression models were used to identify risk associations with HCV seroconversion among the young participants. All p-values reported were two-sided.

5.4 Results

Of the 1,437 participants enrolled in VIDUS, 232 were aged 13 - 24 years (median 21) at baseline. Almost half of the young participants, 107 (46%) were HCV positive at baseline, their median age was 22 (IQR: 20 – 23) years, and they had been injecting for a median duration of 4 years (IQR: 2 – 7). The median age of HCV-negative youth was 20 (IQR: 18 – 22), and they had been injecting for a median of 1.3 years (IQR: 0.3 – 3).

Table 1 compares baseline socio-demographic, drug and sexual risk variables between anti-HCV positive and anti-HCV negative youth. Baseline positive youth were older and their risk of being HCV positive more than doubled per 2-year increase in the number of years the youth had been injecting. As would be expected, HCV positive youth were more likely to be infected with HIV than HCV negative youth. HCV positive youth were more likely to be of Aboriginal ethnicity (37% vs. 13%; p=0.001), have been incarcerated in the previous six months (40% vs. 24%; p=0.006), engaged in sex trade work (53% vs. 32%; p=0.001), have greater than 100 lifetime sexual partners (40% vs. 26%; p=0.021), have had previous STD(s) (43% vs.

28%; p=0.013), reside in the IDU epicentre (53% vs. 33%; p=0.002), and inject heroin (52% vs. 35%; p=0.009), cocaine (40% vs. 17%; p=0.001), and speedballs daily (19% vs. 65; p=0.004). There was no difference between HCV anti-body positive and negative youth with respect to always using condoms with regular (14% vs. 20%; p=0.196), casual (23% vs. 28%; p=0.387) and client sexual partners (37% vs. 30%; p=0.228), using crack cocaine daily (11% vs. 11%; p=0.963), being female (51% vs. 50%; p=0.784), borrowing needles (42% vs. 41%; p=0.864), or sharing other drug equipment (79% vs. 79%; p=0.896).

Table 2 presents the results of our logistic regression modeling. Baseline anti-HCV positivity among the youth was independently associated with older age (OR: 1.29 [CI: 1.11, 1.49]), a greater number of years injecting (OR: 1.27 [CI: 1.12, 1.42]), daily cocaine injection (OR: 2.58 [CI: 1.30, 5.15]), and sex trade work (OR: 2.30 [CI: 1.21, 4.37]).

There were 76 youth who had follow-up data and 51 who were lost to follow-up. There was no difference between the youth who returned for follow-up and those who did not with respect to: female gender, those engaged in sex trade work, age, years injecting, incarceration in the previous six months, or types of drugs used. Aboriginal youth were significantly more likely than non-Aboriginal youth to return for follow-up visits.

Of the 76 HCV negative youth who had follow-up data, 37 (49%) became anti-HCV positive over the study period for an incidence rate of 37.3 (CI: 26.2, 51.4) per 100 person years. There was no difference between those who became HCV seropositive and those who remained negative with respect to: female gender (62% vs. 51%; p=0.339), Aboriginal ethnicity (19% vs. 18%; p=0.913), and median age (20 [IQR: 19 – 22] vs. 20 [IQR: 18 – 22]). However number of years injecting was higher among the seroconverters, (2 [IQR: 0.5 – 4] vs. 1 [IQR: 0.5 – 3]) for those who remained negative.

Table 3 presents the results of our Cox regression model identifying risk associations with HCV seroconversion among the youth. Only variables that reached marginal significance or significance are shown in table 3. Unadjusted risk associations for HCV seroconversion among the youth were; daily heroin (RR: 2.07 [CI: 1.03, 4.15]), cocaine (RR: 4.52 [CI: 2.23, 9.18]), speedball injection (RR: 2.76 [CI: 1.05, 7.31], having a partner who uses injection drugs (RR: 2.71 [CI: 1.35, 5.57]), requiring help when injecting (RR: 2.24 [CI: 1.09, 4.60]), and borrowing needles (RR: 2.57 [CI: 1.27, 5.21]). In the adjusted model, the variables that remained significant were; cocaine (RR: 3.04 [CI: 1.20, 7.70]), having a partner who uses injection drugs (RR: 2.48 [CI: 1.08, 5.66]), and requiring help when injecting (RR: 2.48 [CI: 1.08, 5.66]).

5.5 Discussion

The HCV incidence rate of 37.3 per person years among these young IDUs is alarming. Half of those who became HCV positive did so within the first 2 years of their injection career. This finding underscores the need for targeted interventions among new initiates in the early stage of injection drug use. Recent findings indicating the potential reversibility of HCV infection post exposure using interferon therapy are encouraging [21] . Treatment opportunities for HCV infection will be particularly important for young users given the rapid rates of HCV seroconversion that occur among IDU populations [3, 11] .

In recent studies of young IDUs, Hahn et al. identified an HCV incidence rate of 11 per 100 person years in San Francisco, while in Baltimore incidence rates of 16 and 23 per 100 person years were found [9, 11] . In all these studies, "young" was defined as age 30 and under. We found an anti-HCV prevalence of 46% at baseline in VIDUS, similar to the San Francisco cohort when restricted to 24 years and younger, however our incident rate was much higher. For every two years the youth continue to inject, their risk of being HCV positive doubles so that those who have been injecting for six

or more years are ten times more likely to be HCV positive. In the San Francisco, Baltimore and the Vancouver studies, greater number of years injecting was associated with HCV-positivity.

We found a significant association between HCV positivity and HIV infection. Among HIV positive youth, the prevalence of HCV at baseline was 88%, suggesting that co-infection will be an almost universal problem among these young HIV-infected IDUs. It may be the case that interventions such as safe injection rooms that have shown success in reducing risk behaviours may help reduce the incidence of HIV and HCV among young injection drug users in endemic cities[22] .

Females accounted for half of the baseline HCV prevalent cases, and 63% of the incident cases. In unadjusted and adjusted analyses, associations with seroconversion included requiring help to inject in the previous 6 months and having an IDU sex partner. Furthermore, while condom use did not reach statistical significance in our analyses, use of condoms in all sexual partnerships is well below 40% in this young cohort and sexual transmission should not be ruled out. While other studies have suggested that intimate partnerships may be protective against blood-borne infections [11] , our findings suggest that young female IDUs may be at increased risk for HCV infection both through sexual and parenteral risk from their intimate partners. This may be particularly important for young IDUs as sexual partnerships may be less stable. Education and intervention programs among high-risk youth that address both sexual and drug risks may contribute to reducing blood-borne infections among youth who use injection drugs.

Frequency of injection, or injecting at least daily, was associated with HCV infection in Vancouver, Baltimore, and San Francisco among young IDUs [9, 11] . Cocaine has been a persistent risk factor for blood-borne infection among the VIDUS cohort, likely due to the increased frequency of injection that is characteristic of injection cocaine use [17, 23, 24] . However, many of the youth were also using heroin and

speedballs along with cocaine on a daily basis. The amount of daily polydrug use occurring among these young injectors is concerning and warrants further investigation.

In previous studies of these young injectors we have found high rates of sexual abuse and participation in sex trade work [25] . Sex trade work was again associated with baseline HCV prevalence. The links between childhood victimization, violence in the sex trade and high-risk drug using behaviours such as frequent polydrug use should not be ignored in considering intervention and treatment programs for young IDUs.

High and increasing rates of HCV have been found in Canadian prison populations[26] . We found an association between HCV prevalence and incarceration in the previous six months. Incarceration did not come out as a predictor of HCV seroconversion, therefore we were unable to directly associate incarceration and HCV seropositivity. However these data raise serious concerns about the potential for blood-borne infection transmission among young IDUs within the prison system.

In our study almost 80% of the youth reported sharing ancillary drug equipment. This risk factor did not reach statistical significance, most likely because this behaviour was saturated among these young IDUs, however transmission through shared ancillary equipment should not be ruled out. The study by Hagan et al. showed a strong association between HCV seroconversion and sharing ancillary drug equipment [6] . For IDUs recently initiating injection use, the message that blood-borne infections, particularly HCV, can be transmitted through ancillary equipment may not have been heard, possibly because young IDUs are less likely to access services and therefore receive education and prevention information. Another reason for high proportions of sharing drug equipment among young IDUs could be the nature of their social network systems which may be characterized by trust and sharing. Given the high-risk nature of sharing drug preparation equipment and the high proportion of

youth reporting this behaviour, youth specific services such as peer group intervention programs, may help reduce sharing equipment among this vulnerable population.

HCV prevalence was associated with living in the downtown eastside of Vancouver, the IDU epicentre. It has been argued that public policies which have concentrated IDUs into one small area within an urban setting, have contributed to the rapid spread of blood-borne infections among IDU populations [23] . It is concerning that many of the youth reported residing within the IDU epicentre. It is likely that the lack of affordable housing options for high-risk youth, outside of the IDU epicentre, has contributed to this high incidence rate of HCV infection.

Needle borrowing in the six months prior to interview was reported among 40% of the youth, a finding similar to that of young IDUs in other cities with well supported needle exchange programs (NEPs)[9, 13] . While it may be encouraging that over half of the young IDUs reported not sharing needles, for those who continue to share, other interventions are clearly required. Borrowing needles was associated with HCV seroconversion univariately, however it did not remain in the final model. Borrowing needles is likely the most efficient means for contracting HCV among IDUs, however socially desirable responses may explain why it was not a direct measure of risk in this cohort. HCV seroconversion may also be explained by the high number of youth reporting sharing ancillary drug equipment. Interventions such as safe injection rooms may be particularly important for young IDUs in order to provide education on safe injection practices and clean equipment.

This study has several limitations that should be noted. We have included cross-sectional data of the baseline HCV prevalent youth in order to characterize young IDUs who may be most at risk and the types of behaviours they may be engaged in, however causal inference based on cross-sectional data needs to be interpreted with care. Furthermore, the study instrument did not address the practices of tattooing and body piercing, which have been shown to be associated with HCV-infection[27] .

Another important limitation concerns generalizability. As with other observational studies with voluntary recruitment, our study may have limited potential for generalization. While our results are not applicable to general populations, they likely reflect urban centres experiencing high prevalence of IDUs and HCV infections among these populations. We know of no difference in sampling for the VIDUS project that may have selected for any specific youth characteristics that may differ from other young IDUs. Nevertheless, as this is not a probability sample, bias in recruitment is always possible. As in most studies of IDUs, our study was based on self-reported behaviours and caution should be exercised in the interpretation of such data. Other studies of IDUs have found that socially desirable responses had only a negligible effect on the responses concerning risk behaviours for infection [28] .

For young IDUs living in endemic cities, the window of opportunity for HCV prevention is narrow. The links between high-risk polydrug use, unstable housing, sex trade work and sexual partnership vulnerability should not be ignored. The complexities of these risk associations require a complex response. While access to sterile syringes has reduced the transmission of blood-borne infections, we need to complement this service with others that address housing, vulnerability among peer group networks, condom use in intimate and casual partnerships, and the dynamic drug using relationships of those who require help when injecting.

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Table 1: A comparison of sociodemographic and risk variables between baseline HCV positive and negative young IDUs (≤24 years, N=234)

	HCV-positive (107, 46%)	HCV-negative (127, 54%)	Odds Ratios [95% CI]	p-value
Age				
≤19	15 (14)	46 (36)	1	0.001
20 – 24	92 (86)	81 (64)	3.5 [1.8, 6.6]	
Years Injecting				
0-1	21 (20)	65 (51)	1	0.001
2-3	20 (19)	31 (24)	2.0 [0.9, 4.2]	
4-5	26 (24)	19 (15)	4.2 [2.0, 9.0]	
≥6	40 (37)	12 (9)	10.3 [4.8, 22.1]	
Female	55 (51)	63 (50)	1.1 [0.6, 1.8]	0.784
Aboriginal	40 (37)	17 (13)	3.9 [2.1, 7.2]	0.001
HIV-Positive	21 (9)	4 (2)	7.5 [2.8, 19.9]	0.001
Incarceration	43 (40)	30 (24)	2.2 [1.2, 3.8]	0.006
≥ 1 per day Heroin	56 (52)	45 (35)	2.0 [1.2, 3.4]	0.009
≥ 1 per day Cocaine	43 (40)	22 (17)	3.2 [1.8, 5.8]	0.001
≥ 1 per day Speedball	20 (19)	8 (6)	3.4 [1.5, 7.8]	0.004
≥ 1 per day Crack	12 (11)	14 (11)	1.0 [0.4, 2.3]	0.963
Needle Borrowing	45 (42)	52 (41)	1.0 [0.6, 1.8]	0.864
Sharing Equipment	85 (79)	100 (79)	1.0 [0.6, 2.0]	0.896
Help Injecting	50 (47)	75 (59)	0.6 [0.4, 1.0]	0.060
Sex Trade	57 (53)	40 (32)	2.5 [1.5, 4.2]	0.001
>100 LifetimePartners	43 (40)	33 (26)	1.9 [1.1, 3.3]	0.021
Condom w/ Regular	15 (14)	26 (20)	0.6 [0.3, 1.3]	0.196
Condom w/ Casual	25 (23)	36 (28)	0.8 [0.4, 1.4]	0.387
Condom w/ Client	40 (37)	38 (30)	1.4 [0.8, 2.4]	0.228
Previous STD	46 (43)	35 (28)	2.0 [1.6, 3.4]	0.013
Residing in DTES	57 (53)	42 (33)	2.3 [1.4, 3.9]	0.002

Table 2: Logistic regression determining associations of anti-HCV seroprevalence among the young (≤24) IDUs in the VIDUS cohort

Variable	Adjusted Odds Ratios [95% CI]
Age	
Per year	1.29 [1.11, 1.49]
Years Injecting	
Per year	1.27 [1.12, 1.42]
Frequent Cocaine Injection	
≥ 1 per day	2.58 [1.30, 5.15]
Sex Trade	
Yes vs. no	2.30 [1.21, 4.37]

Table 3: Risk associations for the young IDUs (≤24) who tested anti-HCV positive during the study period

Characteristic	Risk Ratio [95% CI]	Adjusted Risk Ratio [95% CI]
Unstable Housing	1.88 [0.93, 3.81]	1.86 [0.85, 4.03]
≥ 1 Daily Heroin	2.07 [1.03, 4.15]	1.39 [0.63, 3.04]
≥ 1 Daily Cocaine	4.52 [2.23, 9.18]	3.04 [1.20, 7.70]
≥ 1 Daily Speedball	2.76 [1.05, 7.31]	1.01 [0.29, 3.37]
IDU Partner	2.71 [1.35, 5.57]	2.48 [1.08, 5.66]
Previous STD	1.91 [0.95, 3.85]	1.42 [0.60, 3.38]
Need Help Injecting	2.24 [1.09, 4.60]	2.48 [1.08, 5.66]
Borrowing Needles	2.57 [1.27, 5.21]	1.13 [0.47, 2.73]

*All continuous variables are elicited in reference to the previous six months at the interview prior to seroconversion.

**Only the variables that reached marginal significance or significance are reported in the table.

CHAPTER 6

COMPARING SOCIO-DEMOGRAPHIC AND RISK FACTORS BETWEEN ABORIGINAL AND NON-ABORIGINAL YOUTH

6.1 Foreword

This short communication is currently under review as "Higher prevalence and incidence of HIV and hepatitis C and associated risk factors among young indigenous injection drug users".

6.2 Introduction

In Canada and the United States, the respective centers for disease control have identified Aboriginal and Amer-Indian Nations at high risk for HIV/AIDS[1-3] . Aboriginal people in Canada are over represented among marginalized groups such as IDUs and street youth, especially in provinces such as British Columbia where higher proportions of Aboriginal people reside[4] . Historical factors such as the residential school system, displacement from land to reserve, and governmental policies that have precipitated cultural, language, and familial erosion have facilitated vulnerability to high-risk behaviour and blood-borne infections among Aboriginal people. Despite higher risk profiles, there is little documentation of the HIV/AIDS epidemic among Aboriginal peoples.

In Canada, the term Aboriginal includes the many different nations of indigenous peoples including First Nations, Inuit, and Métis, all groups having diverse languages and cultural traditions. In Canada, approximately 3% of the total population identify themselves as Aboriginal and in some provinces the proportion increases to between 4% and 12%[5] . In 1998 of the newly diagnosed HIV infections in Canada, Aboriginal peoples numbered 26% and in 1999 this figure was 18%[2] . The proportion

of AIDS cases attributable to Aboriginal peoples increased from 1% before 1990 to 11% in 1999[2] .

The epidemiology of the HIV epidemic among Aboriginal peoples differs from non-Aboriginal peoples. Between 1998 and 2000 females accounted for 47% of new HIV infections among the Aboriginal populations and only 20% among non-Aboriginal people[6] . Newly infected Aboriginal people were significantly younger with one third of new infections occurring among individuals under 29 years of age[6] . Among Aboriginal peoples, over half of the new infections were attributable to IDUs[7] . We undertook this study to compare young (aged 24 and under) Aboriginal IDUs and non-Aboriginal IDUs in a city where explosive and ongoing HIV and HCV epidemics have occurred and where approximately 25% of the IDU population are Aboriginal.

6.3 Methods

Data were collected within a prospective open cohort study of injection drug users, the Vancouver Injection Drug Users Study (VIDUS). This study has been previously described [8] . VIDUS has recruited over 1,400 Vancouver area IDUs since May 1996, 25% are Aboriginal. The study office is located in a storefront in the Downtown Eastside (DTES) of Vancouver. The DTES is Vancouver's poorest neighbourhood where an estimated 5,000 IDUs and 1,000 street youth reside in an area of approximately ten city blocks; inexpensive housing in the form of hotels and single room occupancies (SROs) abound.

Eligibility criteria included residing in the city of Vancouver and surrounding municipalities and having injected in the previous month. There were no age restrictions. Participants were administered a questionnaire by trained nurses and interviewers and were eligible to return for follow-up every six months. At each visit, eligible participants were tested for HIV and HCV antibodies through venous blood sample. This study was approved by the St. Paul's Hospital Committee on Human Experimentation.

6.3.1 *Instrument*

The VIDUS questionnaire is administered by trained nurses and interviewers and elicits information regarding socio-demographic, sexual and drug risk characteristics. Continuous variables were elicited in reference to the previous six months prior to the interview. This includes the variables sex trade work, frequency of injection, housing situation, sexual behaviours, and needle sharing. Sex trade was defined as trading sex for money, drugs, or shelter. Unstable housing was defined as living on the street, shelter, jail, hostel, or hotel. Aboriginal youth were identified through the question: Are you of First Nations, Aboriginal, Inuit, or Métis origin?

6.3.1 *Statistical analyses*

For the purposes of this study, young injectors were defined as those aged 24 years or less at the time of recruitment. We used contingency table analysis to compare socio-demographic and risk factor variables from the baseline questionnaire for Aboriginal and non-Aboriginal youth. Chi-square and Fischer's exact tests were used to identify differences in risk factors.

There were 18 subjects who seroconverted under study. Since this low number precluded formal statistical analyses, we undertook a profile of the youth who became HIV seropositive during the study period to illustrate risk factors associated with seroconversion. The variables shown in the profile were from the questionnaire answered in reference to the six months prior to the seroconversion being identified. All reported p-values are two-sided.

6.4 Results

There were 235 participants aged ≤24 years, 57 (24%) were Aboriginal and 178 (76%) were Non-Aboriginal. Aboriginal youth were more likely to be HIV-positive (OR: 4.9 CI; [2.5 – 9.7]), HCV-positive (OR: 3.8 CI; [1.8 – 7.7]), female (OR: 2.7 CI; [1.4 – 4.9]), work in the sex trade (OR: 2.6 CI; [1.4 – 4.8]), use condoms with clients (OR: 2.9 CI;

[1.6 – 5.4]), and inject cocaine (OR: 2.7 CI; [1.5 – 5.0]), speedballs (OR: 2.3 CI; [1.1 – 5.0]) and use crack (OR: 2.5 CI; [1.2 – 5.1]) on a daily basis. There was a marginal association between a history of sexual abuse and Aboriginal ethnicity (OR: 1.8 CI; [0.9 – 3.2]). Aboriginal youth were less likely to borrow needles (OR: 0.4 CI; [0.2 – 0.7]), and use condoms with casual sexual partners. There were no differences between the two groups with respect to unstable housing (OR: 1.0 CI; [0.6 – 1.9]), alcohol use (OR: 1.1 CI; [0.6 – 2.0]), or ever accessing methadone maintenance therapy (OR: 0.0 CI; [0.0 – 0.0]).

Table 2 presents a profile of the young participants who seroconverted during the study period. Over half of the youth who became HIV seropositive were Aboriginal, and 70% of the Aboriginal youth who seroconverted were female. The majority of the seropositive Aboriginal youth were engaged in sex trade work, had a high number of lifetime sexual partners and used condoms inconsistently with casual and regular sexual partners. The majority of these Aboriginal youth were injecting cocaine on a daily basis.

6.5 Interpretation

Aboriginal youth were almost 5 times more likely to be HIV positive and almost 4 times more likely to be HCV positive than non-Aboriginal youth. While there has been much literature documenting the explosive HIV outbreak that occurred in Vancouver, it is only recently that discussion has begun to take place regarding the epidemic's concentration among Aboriginal people[9] . The significantly higher proportion of Aboriginal youth with HIV and HCV infection should be an urgent warning to policy makers that these communities require resources to stem the tide of new infections. Furthermore, there is a need for more research to understand the full scope of the epidemic within Aboriginal communities.

Almost 70% of the young Aboriginal participants were female. This differs from other populations of young IDUs in which females account for 30 – 50% of the cohort[10-13] . The link between young Aboriginal females, injection drug use and sex

trade work requires further investigation. The concentration of new HIV infections among young Aboriginal females is concerning and underscores the need for targeted interventions. Furthermore, the prevalence of HIV-positive young Aboriginal women in prime child bearing years, highlights the need for medical services designed to meet the needs of these young women and potentially their children.

Almost all the Aboriginal youth who became seropositive were engaged in sex trade work as were well over half of the HIV-negative Aboriginal youth. Sex trade work has been previously shown to increase HIV vulnerability among IDUs as well as vulnerability to predators and continued sexual violence[14, 15] . Furthermore, half of the Aboriginal youth reported a history of sexual abuse. The links between sexual victimization and sexual violence experienced through sex trade work should not be ignored.

While it is encouraging that Aboriginal youth were more likely to report condom use with clients, overall condom use, especially among intimate sexual partners, was low. Aboriginal youth were significantly less likely to use condoms with casual sexual partners, in fact only 15% reported condom use with casual partners. Sexual transmission may play an important role in the higher prevalence and incidence of HIV among this population of IDUs.

Aboriginal youth were much more likely to inject cocaine on a daily basis. Injection cocaine has been a persistent and strong risk factor for HIV and HCV infection among IDUs[8, 16, 17] . Aboriginal youth were more likely to use crack and speedballs on a daily basis, risk factors that have also been shown to increase vulnerability to blood-borne infection[10, 18] . A further 42% of Aboriginal youth were using heroin on a daily basis. The amount of daily poly-drug use occurring among these young injectors is concerning. Associations between crack use and increased vulnerability in the sex trade has been previously documented[19] . The multiple sexual and drug risk factors identified in this young population may make intervention and prevention programs challenging. However these factors will likely need to be considered when

developing programs to reduce the risk of blood-borne infections among young Aboriginal IDUs.

Despite the high prevalence of HIV, HCV and associated risk factors, none of these young injectors have ever accessed methadone maintenance therapy. This is concerning as methadone has been shown to decrease risky behaviours[20, 21] . Access issues to opiate treatment in this population may need to be carefully examined. Furthermore, other harm reduction methods such as safe injection sites may reduce blood-borne transmission within the Aboriginal community, especially if developed in collaboration with Aboriginal peoples.

Almost 40% of the young Aboriginal people were HIV-positive and 82% were HCV positive. These prevalence findings are exceedingly high for such a young population. Furthermore, the HIV incidence rate of 6.8 and the concentration of seroconversions among young Aboriginal females suggests that the HIV epidemic among Aboriginal injection drug users is far from abating. The dynamics between disempowerment associated with sexual victimization, sex trade work, daily polydrug use and sexual vulnerability in intimate partner relationships will need to be addressed in order to prevent further transmission. The historical and continued betrayal characterizing many governmental policies directed at Aboriginal peoples demands that the response to these epidemics comes in collaboration and from the Aboriginal communities; otherwise the effects may be minimal.

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Table 1: Comparison of sociodemographic characteristics, drug and sexual risk variables between Aboriginal youth (N=57) and Non-Aboriginal youth (N=178) in the VIDUS project

	Aboriginal Youth (n = 57)	Non-Aboriginal Youth (n = 178)	Odds Ratios [95% CI]	*p-value
HIV-positive	22 (39%)	20 (11%)	4.9 [2.5, 9.7]	0.001
HCV-positive	47 (82%)	99 (56%)	3.8 [1.8, 7.7]	0.001
Female	39 (68)	80 (45)	2.7 [1.4, 4.9]	0.002
Unstable Housing	33 (58)	102 (57)	1.0 [0.6, 1.9]	0.937
Sex Trade	34 (60)	64 (36)	2.6 [1.4, 4.8]	0.002
Sexual Abuse	28 (49)	63 (35)	1.8 [0.9, 3.2]	0.064
Condoms w/ Casual	9 (16)	52 (29)	2.2 [1.0, 4.8]	0.045
Condoms w/ Clients	30 (53)	49 (28)	2.9 [1.6, 3.2]	0.001
Alcohol Use	25 (44)	75 (42)	1.1 [0.6, 2.0]	0.819
≤ 1 Daily Heroin	24 (42)	96 (54)	0.6 [0.3, 1.1]	0.120
≤ 1 Daily Cocaine	29 (51)	49 (28)	2.7 [1.5, 5.0]	0.001
≤ 1 Daily Crack	16 (28)	24 (13)	2.5 [1.2, 5.1]	0.011
≤ 1 Daily Speedball	13 (23)	20 (11)	2.3 [1.1, 5.0]	0.029
Borrow Needles	14 (25)	84 (47)	0.4 [0.2, 0.7]	0.003
Methadone Ever	0 (0)	5 (3)	0.0 [0.0, 0.0]	0.201

Table 2 Profile of socio-demographic, sexual and drug risk factors among the young (≤24 years) VIDUS participants who have HIV seroconverted during the study period

	Gender	Ethnicity*	Years Fixing	Sex Trade	>100 Partner	Daily Heroin	Daily Cocaine	Daily Speedball	Daily Crack	Condom W/ Regular	Condom W/ Casual	Condom W/ Clients
1	F	O	2	Y	Y	N	Y	N	N	N	N	Y
2	M	O	.25	N	N	Y	Y	Y	Y	N	Y	Y
3	M	O	1	N	Y	N	N	N	N	N	Y	N
4	F	O	3	Y	Y	Y	Y	N	N	N	N	Y
5	M	O	2	N	N	Y	N	Y	N	N	N	N
6	F	O	1	Y	Y	Y	N	N	N	Y	N	N
7	F	O	8	Y	Y	Y	N	N	N	N	N	N
8	F	O	2	Y	Y	Y	N	N	Y	N	N	Y
9	M	A	3	Y	Y	Y	Y	Y	N	N	Y	N
10	M	A	4	N	Y	N	N	N	N	N	N	N
11	F	A	4	Y	Y	N	Y	N	N	N	N	Y
12	M	A	2	N	Y	N	Y	N	N	N	N	N
13	F	A	3	Y	Y	N	Y	Y	N	N	N	Y
14	F	A	3	Y	N	N	Y	N	N	Y	N	Y
15	F	A	7	Y	Y	Y	Y	N	N	Y	N	Y
16	F	A	2	Y	Y	N	N	N	Y	Y	N	Y
17	F	A	4	Y	Y	N	N	N	N	N	N	Y
18	F	A	.25	Y	Y	Y	Y	Y	Y	N	N	Y

*O=Other, A=Aboriginal

CHAPTER 7

GENERAL DISCUSSION

7.1 Summary of study findings

Data from the VIDUS project have provided insight into a hidden and little known population in Canada that is at high risk for transmission of blood-borne infections such as HIV and Hepatitis C. This preliminary investigation suggests that young IDUs who are most at risk for these infections are female and Aboriginal youth. Through this investigation, several risk factors of youth who are most vulnerable to infection were characterized.

In this population HIV infection is concentrated among females. In fact 87% of the baseline HIV positive youth were female. A further 63% of the seroincident youth cases were female. This differs from older populations of IDUs where typically there are more males who inject and who therefore comprise a higher proportion of the affected population [1-3] . In the studies that have identified females at higher risk for HIV, overall presence of females is lower. Among the youth, females account for over one half of the population and the majority of HIV infections is concentrated among the young females. To my knowledge the finding that HIV infection is concentrated among females in a young IDU population is a unique contribution to the literature that has not been documented in a developed nation.

Health Canada has documented the increasing impact that HIV and AIDS is having on Aboriginal communities. However there has been little epidemiologic investigation into the impact that HIV is having within these communities. Furthermore, given the younger overall age of the Aboriginal population and the younger age when HIV infection is occurring among this group, examining the epidemic from within a youth cohort may be a useful contribution to understanding the epidemic. There was a much higher prevalence of both HIV and HCV among the young Aboriginal IDUs and especially among young Aboriginal females.

Risk factors associated with HIV prevalence among the female youth were increased age, sex trade work, not using condoms with casual partners, a high number of lifetime sexual partners, and greater than once daily speedball injection. There were a number of sexual risk factors identified among these young IDUs. Risk factors that remained in the model when adjusted were increased age and greater than once daily speedball injection. Daily speedball injection being an important predictor differs from other analyses done on the older VIDUS participants. While it is difficult to determine why this may be the case, it may be worthwhile to explore the link between higher proportions of young females engaged in sex trade work injecting heroin and speedballs on a daily basis.

The only independent predictor of HIV incidence among the young IDUs was Aboriginal ethnicity. Other associations detected univariately were at least daily crack use and cocaine injection, and a high number of lifetime partners. While daily cocaine injection is a consistent risk factor for HIV among the VIDUS cohort as well as other cohorts of IDUs, it may be informative to explore cocaine use among Aboriginal youth[4-6] . Furthermore, among the youth in VIDUS, a greater number of lifetime sexual partners is an important predictor of HIV-positivity. Finally, similar to other cohorts of high-risk youth, frequent or daily crack use was linked to HIV among these young IDUs[7, 8] .

HCV seroprevalence among the youth was independently associated with increased age, a greater number of years injecting, at least daily cocaine injection, and sex trade work. A greater number of years injecting and increased age are consistent risk factors for HCV in other studies of IDUs. The consistency with which these variables are shown to be associated with HCV infection should send an urgent message to policy makers in Vancouver and in other urban settings that resources are needed to prevent the spread of this virus among young IDUs. Daily cocaine injection was again confirmed as an important predictor of HCV seroprevalence. The chaotic

nature and frequency of injection associated with cocaine use is likely fueling the HCV epidemics.

Independent associations with HCV seroconversion were daily cocaine injection, having a partner who uses injection drugs, and requiring help when injecting. The latter two variables are interesting and an addition to the current literature; furthermore they indicate the potential importance of sexual partnership vulnerability among young IDUs. These two variables did not reach statistical significance in other analyses when the cohort was considered as a whole. Thus these variables may be important in terms of prevention among young IDUs.

When young Aboriginal participants were compared with young non-Aboriginal participants, much higher HIV and HCV prevalence rates were found. In fact Aboriginal youth had almost a five-fold increase of being HIV positive and a four-fold increase of being HCV positive. The large disparity between Aboriginal youth and non-Aboriginal youth in terms of seroprevalence of both viruses is concerning.

In most cohorts of IDUs, females account for approximately 30% of the population[9, 10] . Among young IDUs, the number of females participating in IDU cohorts increases to roughly half the population[11, 12] . Among Aboriginal youth, females accounted for 68% of the group vs. 45% of non-Aboriginal youth. This finding warrants further investigation as to why young Aboriginal females may be particularly vulnerable to engaging in injection drug use. Furthermore, given the higher risk associations found among young females, urgent intervention programs are required to meet the needs of young Aboriginal females who use injection drugs.

7.2 Unique contributions, impact and implications

The studies comprising this thesis have contributed to our understanding of the impact that HIV and HCV are having on youth in Canada and who is most at risk for these viruses. These studies compliment the few that have characterized young IDUs in North America, particularly in a longitudinal fashion. Furthermore, because this thesis

was undertaken from an interdisciplinary perspective, it is hoped that the contributions made from the data analyses attempted to go beyond a mere reporting of the numbers, and to theorize about why some youth are at higher risk than others.

It is also hoped that this work will generate discussion within health boards and among policy makers to advocate for more research, resources and better policy development related to harm reduction and treatment initiatives for this vulnerable population. Through this work, we now know young females and particularly young Aboriginal females are becoming infected at an earlier age than young males. We know from these studies that those most at risk are engaging in dual drug and sexual related high-risk behaviours; many of the youth worked in the sex trade, and there was low condom use especially in intimate partner relationships. Furthermore, there appears to be considerable poly-drug use among the youth, which has implications for prevention, treatment, and intervention programs.

In a recent (April 2002) HIV/AIDS Epi Update report generated by Health Canada, the studies described here were mentioned several times, thereby contributing to how we think about risk in Canada and among youth. Perhaps, through publication of these manuscripts, there will be greater dissemination of the findings. This knowledge will allow public access within the community and among researchers alike to advocate for services and targeted interventions. Finally, these initial findings may lead to other studies of high-risk youth in Canada.

7.3 Recommendations

In general, the research described here gives rise to two primary recommendations. The first is for more research to be conducted on young high-risk youth in Canada, including both IDUs and non-IDUs who are at risk for HIV infection. The second is a call for intervention studies among this vulnerable population of young IDUs.

7.3.1 *Research*

It is clear that youth who use injection drugs are at high risk for blood-borne infections. In the case of HCV, time to infection is short. More research is needed to better understand the transition from non-injection to injection drug use so that appropriate interventions can occur that either help stop this transition or provide education on safer injection practices. Given the established risk for HIV and HCV among street youth who use injection drugs, researching the translation between street life and injection drug use may facilitate better prevention in this area. Young IDUs are sharing needles and other drug preparation equipment. Investigating what form of education may better reach this population is important.

Condom use was low among the youth studied. Exploring ways to encourage and support Canadian youth to use condoms will be important to reduce the incidence of blood-borne infections. The high prevalence of sex trade work among this young population is concerning. Research is needed on how best to intervene and prevent sex trade work among youth since clearly there is an association between sex trade work and increased vulnerability to blood-borne viruses. A history of sexual violence was highly prevalent among the high-risk young females. Researching ways to intervene among high-risk youth who have been the victims of sexual abuse may be important in understanding drug use and sexual vulnerability in this population.

7.3.2 *Intervention*

There are many examples of successful interventions that have occurred among high-risk populations particularly from parts of Africa and Thailand[13] . There are examples of peer based interventions that have reduced the practice of sharing needles and drug preparation equipment among young IDUs[14, 15] . Interventions such as these may be worth exploring in this context given the high prevalence of sharing among these young IDUs. There are several studies that have shown success in

increasing condom use among young populations[16, 17] . Increasing the use of condoms or better facilitating their use among girls would also be useful in this setting.

7.4 Conclusions

The aim of the research presented here was to describe the prevalence and incidence of HIV and HCV among a previously unknown population and to characterize their risk for blood-borne infection. This work has made contributions to our understanding of this vulnerable population. The studies summarized here and those of others strongly suggest a need for further research and intervention studies to prevent the spread of these viruses. The combined sexual and drug vulnerabilities identified in these studies, particularly among young females, will make intervening challenging. However, an investment in these youth who are "just starting out" will be an important investment in terms of the health of the Canadian population.

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