



Hepatitis C in Canada: ► 2005-2010 Surveillance Report

*Centre for Communicable
Diseases and Infection Control
Infectious Disease Prevention
and Control Branch
Public Health Agency of Canada*



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For an electronic copy of this report, please contact:

Centre for Communicable Diseases and Infection Control
Public Health Agency of Canada
Tunney's Pasture
Postal Locator 0603B
Ottawa, Ontario K1A 0K9
E-mail: ccdic-clmti@phac-aspc.gc.ca

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Note to the reader

This report provides a comprehensive overview of the epidemiology of hepatitis C virus (HCV) in Canada. The specific objectives of this report are as follows:

1. Provide an overview of the estimated prevalence, reported rates and trends in HCV seropositivity in the general Canadian population and other key Canadian populations;
2. Describe factors that increase the risk of HCV transmission and that are associated with HCV acquisition;
3. Describe the epidemiological research related to the determinants of HCV infection and provide context to the surveillance statistics presented; and
4. Highlight gaps and opportunities for the use of HCV-related surveillance data to inform public health practice.

Five key aspects of HCV epidemiology are summarized in this report. Section 2.0 provides an overview of the clinical manifestations for HCV. Section 3.0 describes estimates of HCV incidence and prevalence in key populations, as well as HCV-related sequelae, comparing Canadian and international data. Sections 4.0 through 6.0 provide information pertaining to our current understanding of risk factors associated with HCV infection. Section 7.0 describes the underlying determinants of health associated with HCV infection and Section 8.0 discusses the public health implications of these findings.

This report is the first to provide a summary of national data on HCV in Canada. Until now, the vast majority of HCV-related information was available only at provincial or territorial levels, or as a result of population-specific research studies. None of these results can be aggregated into a national estimate and, as a consequence, our understanding of key themes and trends in HCV epidemiology at the national level has been limited. This report responds to the absence of national data on HCV from routine case reporting by incorporating data from other sources, including published research and enhanced surveillance systems, which were developed in partnership with study teams across Canada and funded by the Public Health Agency of Canada (PHAC) (e.g., the Tracks, Enhanced Hepatitis Strain Surveillance System, etc.). In addition, this report furthers PHAC's mandate to provide leadership and expertise that can influence the "underlying factors that impact the health of Canadians (known as determinants of health), including economic and environmental determinants." Thus, it provides a perspective on the epidemiology of HCV in Canada by analyzing its underlying determinants of health, along with voices from those who share their "lived experiences."

Further data collected through HCV surveillance are available on the PHAC website: <http://www.phac-aspc.gc.ca/sti-its-surv-epi/index-eng.php>

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implement national enhanced surveillance programs. Their ongoing contribution to national hepatitis surveillance is gratefully acknowledged. We would also like to thank Dr. Robert Remis for his work on modelling the incidence and prevalence of HCV infection in Canada. Finally, we acknowledge Ms. Jane Wilson for writing the chapter on determinants of health and Mr. Waylon Dean for editing this report.

AUTHORSHIP AND LEAD CONTRIBUTORS:

Centre for Communicable Diseases and Infection Control, Infectious Disease Prevention and Control Branch, Public Health Agency of Canada

Anna-Maria Frescura, Lily Fang, Maxim Trubnikov, Salman Klar, Gayatri Jayaraman

OTHER CONTRIBUTORS:

Centre for Communicable Diseases and Infection Control, Infectious Disease Prevention and Control Branch, Public Health Agency of Canada

Professional Guidelines and Public Health Practice Division:

Tom Wong

Surveillance and Epidemiology Division:

Chris Archibald, Anil Dudani, Stephanie Totten, Tory Atwood, Alain Demers, Anna Zycki, Hong-Xing Wu, Jun Wu, Qiong Li, Jill Tarasuk, Marissa McGuire, Susanna Ogunnaike-Cooke, Dorcas Taylor, Maria Koulouris, Pushpa Narayanan

Programs and Partnerships Division:

Josie Sirna, Jeff Potts, Kazimiera Adamowski, Amberine Sheikh, Manon Fiset

The Hepatitis C Network:

Mary Beth Fry, Stephen James, Adrienne Taplin-White, Tanis Liebrich, Pamela Amulaku, Tanya McKay, Patricia Adamek, Prema Ladchumanopaskeran, Maxine Zasitko, Neena Saxena, Sande Petkau, Shaleena Theophilus, Pierre Desmarais, Louise Lacroix, Dawn Shepherd, Hélène Chalifoux, Geoff Richardson, Jeannine McNeil

Communications Directorate, Marketing, Creative Services and E-Comms Division, Public Health Agency of Canada

Correctional Service of Canada

Jonathan Smith

British Columbia Centre for Disease Control

Alice Wong, Mel Kraiden

Yukon Health and Social Services

Rosalyn Robertson, Cathy Stannard

Northwest Territories Department of Health and Social Services

Helen MacPherson, Wanda White

Alberta Health Services

Shirin Ali, Karen Sutherland

Saskatchewan Health

Helen Bangura, Bonnie Penner

Manitoba Health

Souradet Shaw, Val Steeves

Ontario Ministry of Health and Long-Term Care

Michael Whelan

Ministère de la Santé et des Services sociaux du Québec

Philippe Bélanger

Nunavut Department of Health and Social Services

Elaine Randell

Nova Scotia Department of Health Promotion and Protection

Alyshah Lalani

Prince Edward Island Department of Health

Carolyn Sanford

New Brunswick Department of Health

Francois-William Tremblay, Claire Jardine

Newfoundland & Labrador Health and Community Services

Andrew J. Willis, Gillian Butler

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Acronyms and Abbreviations

ARYS – At Risk Youth Study

BAP – body art piercing

CADUMS – The Canadian Alcohol and Drug Use Monitoring Survey is an ongoing general population telephone survey of alcohol and illicit drug use among Canadians 15 years of age and older. The survey was launched in April 2008 and was designed to provide detailed national and provincial estimates of alcohol- and drug-related behaviours and outcomes.

CAS – The Canadian Addictions Survey was the predecessor to CADUMS (see description above), one of the most comprehensive surveys of substance use among Canadians 15 years of age and older in Canada.

CNDSS – Canadian Notifiable Disease Surveillance System – A surveillance system for notifiable disease in Canada.

DBS – Dried Blood Spot Testing

EHSSS – Enhanced Hepatitis Strain Surveillance System – A sentinel surveillance system for newly diagnosed cases of hepatitis B and C in Canada, which collects information on viral genotype and patient risk factors.

E-SYS – Enhanced Street Youth Surveillance in Canada – a sentinel surveillance system that monitors rates of sexually transmitted infections (STIs) and bloodborne infections (BBIs), risk behaviours and health determinants in the Canadian street youth population (<http://www.phac-aspc.gc.ca/sti-its-surv-epi/qf-fr/qa-qr-eng.php>).

HAART – highly active antiretroviral therapy is a treatment for suppressing HIV that consists of a potent drug “cocktail” (<http://www.medterms.com/script/main/art.asp?articlekey=17620>).

HBV – hepatitis B virus

HCV – hepatitis C virus

HIV – human immunodeficiency virus

IDU – injection drug use (defined as the risk factor or exposure). Those who engage in IDU are referred to as people who inject drugs.

I-Track – an enhanced (behavioural and biological) surveillance system which consists of repeated cross-sectional surveys conducted at selected sentinel sites across Canada; it monitors trends in HIV- and hepatitis C-associated injecting and sexual risk behaviours and prevalence among people who inject drugs in Canada (<http://www.phac-aspc.gc.ca/aids-sida/about/itrack-eng.php>).

MSM – men who have sex with men refers to a diverse population that includes gay, bisexual and other men who have had sex with one or more men. It is an inclusive term that is based solely on behaviour and does not take sexual identity or attraction into account.

M-Track – an enhanced (behavioural and biological) surveillance system which consists of repeated cross-sectional surveys conducted at selected sentinel sites across Canada; it monitors trends in HIV, hepatitis C, syphilis and other sexually transmitted and blood-borne infections and related risk behaviours among gay, bisexual, two-spirit men, and other men who have sex with men (<http://www.phac-aspc.gc.ca/aids-sida/about/mtrack-eng.php>).

NIDU – non-injection drug use

OPICAN – A multisite cohort study (i.e., the “OPICAN” study) of untreated illicit opioid users in the cities of Vancouver, Edmonton, Toronto, Montréal and Québec City. The principal objectives of this study are (1) to assess the key characteristics and behaviours of untreated illicit opioid use in different local settings across Canada; and (2) to monitor these indicators over time.

PHAC – Public Health Agency of Canada

RNA – ribonucleic acid

STBBI – sexually transmitted and blood-borne infections

TB – tuberculosis

VIDUS – Vancouver Injection Drug Users Study

WHO – World Health Organization

1.0 EXECUTIVE SUMMARY

The World Health Organization (WHO) estimates that 2%-3% of the world's population is infected with the hepatitis C virus (HCV).(1) North America and Western Europe have the lowest HCV prevalence, while Africa and Eastern Europe have the highest, which is mainly caused by hospital-associated transmission. In 2007, the prevalence of HCV in Canada was estimated at 0.8%, with approximately 21% of cases unaware of their infection.(2)

Reported cases of HCV have declined in Canada in recent years. However, the health care burden presented by existing cases that progress to more serious sequelae continues to escalate. In 2009, 11,357 cases of HCV were reported through the Canadian Notifiable Disease Surveillance System (CNDSS), corresponding to a rate of 33.7 per 100,000 population. This rate has decreased since 2005 (40.5 per 100,000). The majority of cases are over the age of 30 years and among males, but the gender gap is narrowing, which is mainly driven by increasing rates in younger females.(3)

The majority of HCV cases in Canada are among people who inject drugs. Among newly acquired HCV cases with known risk factor information, injection drug use was associated with 61% of infections.(3) The prevalence among participants of the I-Track study, a cross-sectional study of people who inject drugs in Canada, was 69% from 2005 to 2008. Sharing

contaminated syringes and other drug use paraphernalia are the main modes of HCV transmission among people who use drugs. Other factors, such as the duration and frequency of injection, assisted injection and co-infection with HIV can also increase the risk of HCV transmission. Changing patterns in drug use from injection to increased use of drugs by means other than injection (e.g., smoking, snorting) can impact upon drug-related risk behaviours which are associated with HCV transmission.

Sexual transmission of HCV is uncommon in the general population when compared to other modes of transmission. However, it is becoming widely recognized as a growing public health problem among HIV-infected individuals. Co-infection with HIV and other STI, unprotected sexual intercourse and "HIV serosorting" (i.e., the practice of selecting a sexual partner based on concordant HIV infection status) increase the risk of HCV transmission.

Determinants of health are important to consider in parallel with surveillance data, as they offer a greater understanding of the vulnerabilities and challenges that contribute to an individual's susceptibility to infection. For example, poverty and a lack of social support—factors that influence a person's health—contribute to homelessness, render individuals vulnerable to engaging in behaviours that increase their risk of infection, and can affect their ability to access health care services.(4)

2.0 BACKGROUND

The hepatitis C virus (HCV) gained prominence in Canada during the 1980s when it was discovered that blood transfusions were a source of infection. Although blood screening techniques have since improved, HCV continues to be a major public health concern because it requires an expensive and resource-intensive course of treatment, which is only effective against certain genotypes. In addition, new infections often arise in subpopulations that are difficult to target with traditional prevention programs, including people who inject drugs and those with multiple co-morbid conditions (e.g., mental health disorders and other addictions).

While the number of new cases of HCV in Canada has decreased in recent years, the number of prevalent cases remains high. The demand placed on the health care system is increasing as the population with chronic HCV ages and develops HCV-related sequelae. In fact, a recent study ranked HCV first among 51 pathogens weighed by their relative contribution to the overall burden of infectious diseases in Ontario.(5)

The global impact of HCV is also considerable, with an estimated prevalence five times greater than HIV.(6) The World Health Organization (WHO) recognized the importance of HCV at the 63rd World Health Assembly in May 2010. Resolutions were passed supporting globally coordinated action to address viral hepatitis and to provide a global endorsement of World Hepatitis Day as a way of raising national and international awareness.(1)

WHAT IS HEPATITIS C?

Hepatitis C is a chronic liver disease caused by the hepatitis C virus, an enveloped, single-stranded linear RNA virus belonging to the *Flaviviridae* family. Six genotypes of the virus have been identified, though genotype 1 is the predominant strain in Canada.(7)

HCV is highly transmissible, spreading through contact with infected blood. While many people were infected through blood and blood products in the past, the majority of recent HCV infections in Canada occur through the sharing of drug preparation and injection materials (e.g., syringe/needle, spoon/cooker, water, filter, straw, pipe, etc.). Less common routes of HCV transmission include sexual transmission and spread

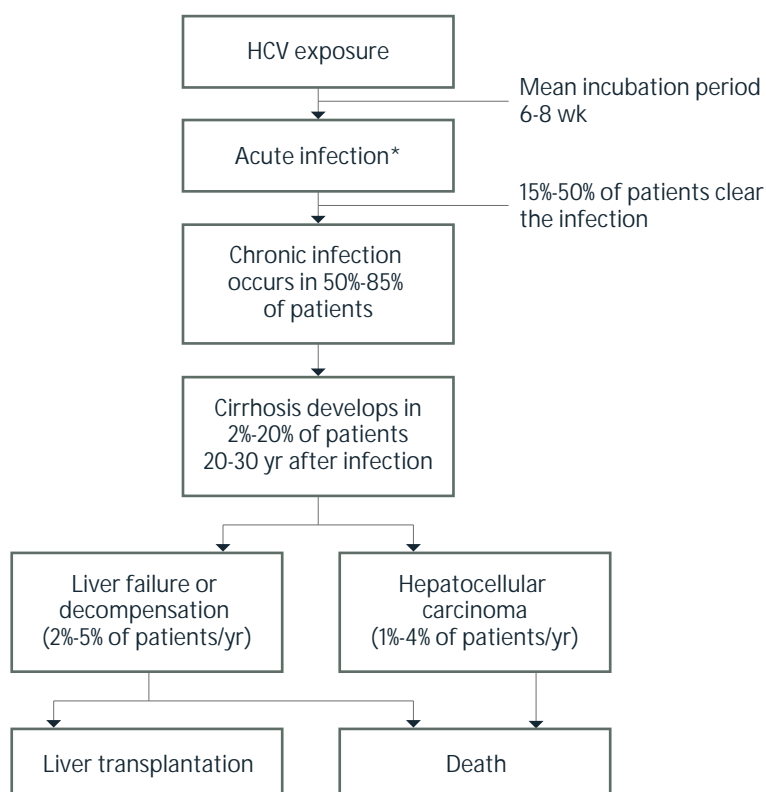
through the sharing of sharp instruments and personal hygiene equipment with an infected person (e.g., razors, toothbrushes, scissors and nail clippers).(7) Vertical transmission from mother to child is also possible and has been documented.(8,9)

Those with acute HCV infection are commonly asymptomatic, which poses a challenge for identifying new cases. Less than 25% of infected persons show symptoms, including jaundice (i.e., yellowing of the skin and/or eyes), nausea, fatigue, abdominal pain and appetite loss.(10)

Approximately 21% of those infected with HCV are unaware of their status (2), while 15%-50% of individuals will spontaneously clear and recover from their infection. Spontaneous clearance has been found to occur more often among those who experience symptomatic HCV infection, which is thought to signal a more robust immune response.(11) A Canadian cohort study found that Aboriginal ethnicity and the female sex were associated with increased rates of HCV clearance, while HIV co-infection and illicit drug use were associated with decreased clearance rates.(12) Approximately 50% to 85% of those who remain infected will progress to chronic infection and will be asymptomatic for decades. Chronic HCV infection can eventually lead to liver damage (cirrhosis), liver cancer and decompensated liver disease requiring liver transplantation (Figure 1).(7)

While no vaccine exists, antiviral medications are available to treat people infected with HCV. The current gold standard of therapy is pegylated interferon- α in combination with ribavirin. The determination of infecting genotype is important for the prediction of response to antiviral treatment. Infections with genotype 1 strains of HCV are less responsive to interferon than infections with other genotypes of HCV.(13) Treatment is combined with other interventions to reduce disease progression and secondary transmission, including restriction of alcohol use and other risky practices, hepatitis A and B immunization, and treatment of co-infections.(13-18) Early diagnosis and treatment reduce the likelihood of liver damage, help prevent further transmission and could, for some, help clear the virus.

FIGURE 1. Natural history of HCV(7)



THIS IS HEPATITIS...

"If I wake up and I feel really off in the morning, I feel nauseated in the morning, and ... it becomes an effort then to get myself motivated ... I know that ... my ability to get through the day is going to be impaired ... I've got to readjust my whole day for it, in some instances the whole week, or the whole month, depending on how it goes".(19)

"Getting through the treatment itself, was a confidence booster. The confidence comes from being a successful advocate for people living with Hepatitis C and co-infection, and the concrete belief that change can and will happen" –(Ontario HIV Treatment Network Video library, "From Courage to Care") "Treatment can be an opportunity, I used my hepatitis C treatment to change my life, my view my values, it brought me back to my core values." (Ontario HIV Treatment Network Video library, Positive Voices Leading Together)

3.0 GENERAL ESTIMATES OF HEPATITIS C IN THE CANADIAN POPULATION

OVERVIEW

Chapter 3.0 of this report presents the epidemiological data related to the prevalence and incidence of hepatitis C infection in Canada within a global context. In 2007, the estimated overall incidence of HCV in Canada was 0.03% and the number of existing cases or prevalence was 0.8% (or 242,521 Canadians). However, almost one quarter of Canadians infected with HCV are unaware they are infected. The reported rate of HCV infection decreased between 2005 and 2009. The majority of HCV cases are among Canadians 30 years of age and older and the highest reported rates are in the Yukon, Saskatchewan and British Columbia. HCV disproportionately affects males, but the gender gap is narrowing.

People who inject drugs accounted for the majority of HCV infections at 54% to 70%, based on modelled estimates. Other at-risk populations include: federal inmates, men who have sex with men (MSM), street-involved youth and Aboriginal peoples.

In 2007, an estimated 802 Canadians developed cirrhosis, 473 progressed to liver failure, 292 suffered hepatocellular carcinoma and 134 received a liver transplant due to HCV. The prevalence of various sequelae is expected to increase over time with total HCV-related deaths increasing from 483 in 2007 to 613 by 2027.

3.1 Modelled Estimates of HCV prevalence and incidence

It was estimated that by 2007 a total of 242,521 Canadians were infected with HCV, corresponding to an estimated prevalence of 0.8%.(2) There was a marked difference between the sexes—the prevalence of HCV among males was 1.6 times higher than among females

(Table 1). Similarly, in 2007 the incidence among males was estimated to be higher compared to females (0.03% vs. 0.02%). More than three quarters (83%) of incident HCV infections were among those using injection drugs.(2)

TABLE 1. Modelled prevalence and incidence of hepatitis C infection by exposure category and sex among all persons, Canada, 2007(2)

Exposure category/Sex		Prevalence		Incidence	
	Population	N	rate	N	rate
IDU ^a	84,361	52,512	62.2%	6,607	20.7%
Ex-IDU ^a	183,839	87,452	47.6%	0	0.0%
Haemophilia ^a	2,162	861	39.8%	0	0.0%
Transfused ^a	3,325,746	25,905	0.78%	1	0.000%
Other ^a	27,624,347	75,790	0.27%	1,337	0.005%
Male	15,413,109	146,781	0.95%	5,185	0.034%
Female	15,807,346	95,740	0.61%	2,760	0.018%
Total ^a	31,220,455	242,521	0.78%	7,945	0.026%

^a Number of cases and percentages may not add up exactly to the total due to a combination of modelling uncertainties and the use of rounded whole numbers in the calculations.

The number of HCV cases reported in Canada underestimates the true extent of HCV infection, because a large proportion of those who are asymptomatic have not been tested or diagnosed. It was estimated that only 192,000 (or 79%) of

HCV-infected persons living in Canada in 2007 knew they were HCV positive, suggesting that the remaining 21% have not been diagnosed and that they are unaware of their infection status.(2)

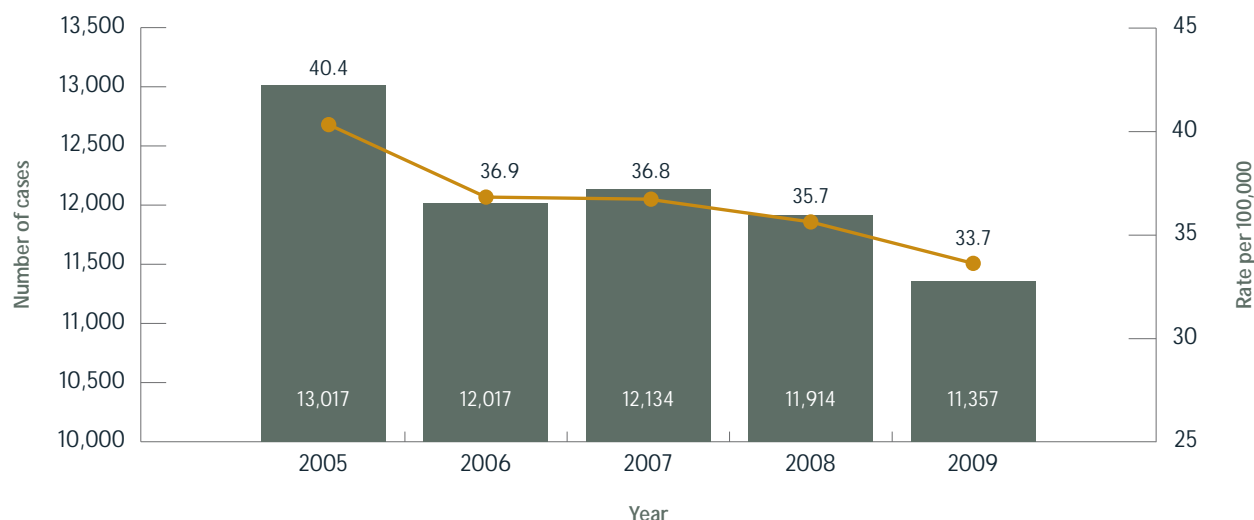
3.2 Routine reporting of laboratory confirmed cases of HCV (2005-2009)

Provincial and territorial public health offices report laboratory confirmed cases of HCV infection under a voluntary surveillance scheme to PHAC via the Canadian Notifiable Diseases Surveillance System (CNDSS). Further details about the CNDSS and the current national definition for HCV infection are provided in Appendix 1. However, routine reporting does not distinguish current from past or recent from resolved HCV infections, since the majority of cases reported to PHAC are based on laboratory confirmation that uses HCV antibody testing. A revised national definition for

HCV infection (forthcoming in 2011-2012) that distinguishes recent (newly acquired) from chronic and resolved infections should improve the accuracy of data collected through routine surveillance.

The reported rate of HCV infections decreased between 2005 and 2009. In 2009, 11,357 cases of HCV were reported through the CNDSS, corresponding to a rate of 33.7 per 100,000 population. This rate decreased significantly since 2005 when it was 40.4 per 100,000 population ($p < 0.001$), corresponding to 13,017 cases (Figure 2).

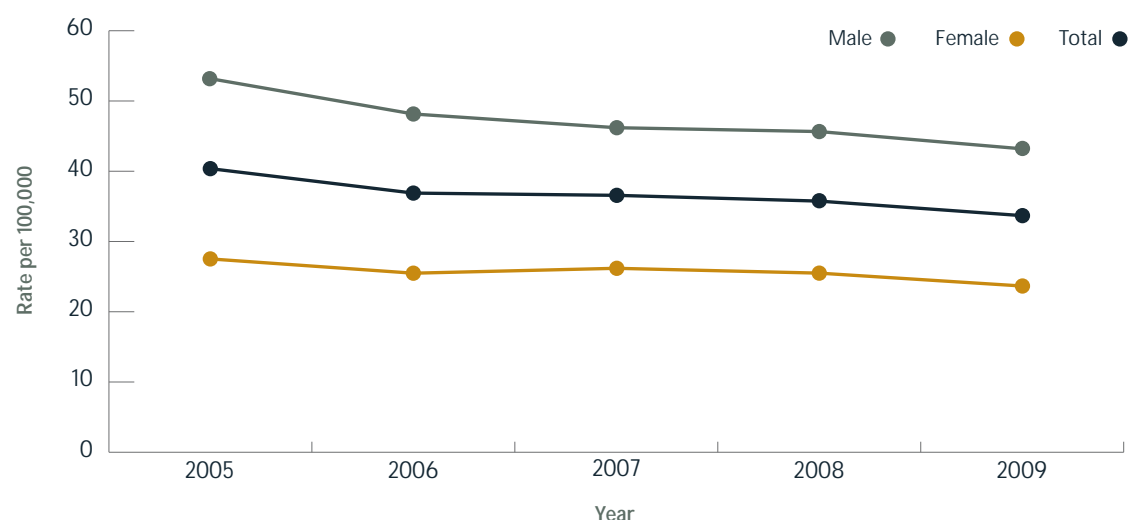
FIGURE 2. Reported number of cases and rate of hepatitis C, CNDSS 2005 to 2009



Between 2005 and 2009, the number of reported HCV cases was almost twice as high among males than females. In 2009, males accounted for 64% of reported HCV cases; however, the gender gap has narrowed since 2005 (Figure 3).

As in Canada, the majority of reported HCV cases in England (68%), Scotland (64%) and Australia (65%) are among males.(20,21) The prevalence of HCV in the U.S. was twice as high among males (2.1%) as females (1.1%).(22)

FIGURE 3. Reported rates^a of hepatitis C^b in Canada by sex, CNDSS, 2005-2009



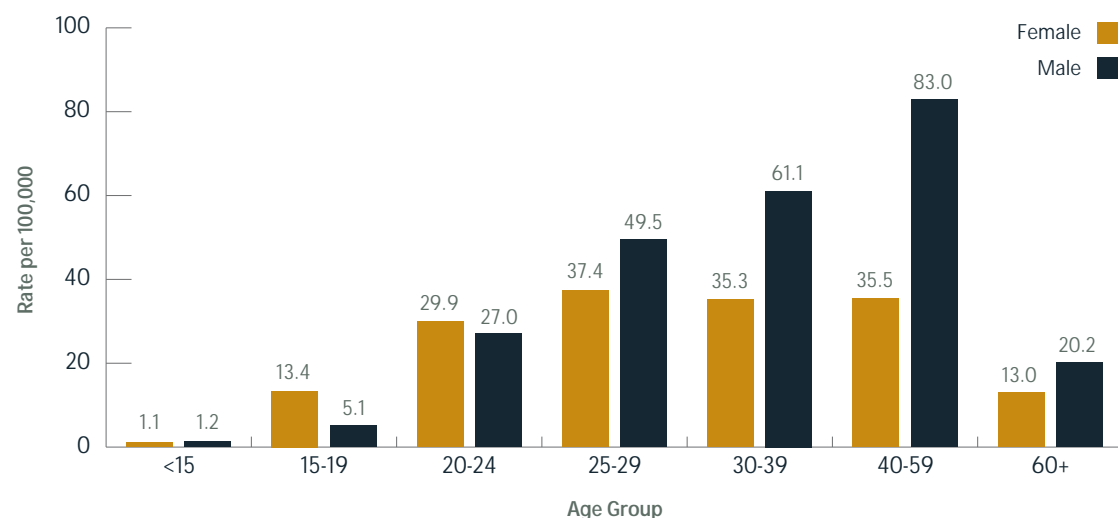
^a Rate is per 100,000 population. Population estimates provided by Statistics Canada, 2006 final postcensal estimates, 2007-2008 updated postcensal estimates, 2009 preliminary postcensal estimates

^b Does not distinguish between acute and chronic infection

The majority of HCV cases are among Canadians 30 years of age and older. The highest HCV infection rate reported in 2009 was among Canadians 40 to 59 years of age (at 59.5 per 100,000), although they may have been initially infected years earlier. Males between 40 and 59 years of age had the highest reported rate of infection (83.1 per 100,000 population), while in females, the highest reported rate was among those 25 to 29 years old (37.6 per 100,000) (Figure 4).

International comparisons suggest higher rates in slightly younger age groups. A 2009 U.K. report showed that between 50% and 60% of all reported cases were among individuals 25 to 39 years old (20) and 65% of reported HCV cases in Australia were among those 20 to 39 years old.(20,21)

FIGURE 4. Reported rates^a of hepatitis C infection^b by sex and age group, CNDSS, 2009



^a Rate is per 100,000 population. Population estimates provided by Statistics Canada, 2006 final postcensal estimates, 2007-2008 updated postcensal estimates, 2009 preliminary postcensal estimates

^b Does not distinguish between acute and chronic infection

In 2009, several provinces reported HCV rates higher than the national average, including British Columbia, Alberta, Saskatchewan, Yukon Territory and Northwest Territories (Table 2). Three provinces accounted for 76% of all reported cases: Ontario (38.7%), British Columbia (21.5%) and Quebec (15.3%). While there is geographic

variation regarding reported HCV infection rates, the Yukon Territory has consistently reported the highest rate of HCV infection. In 2009, the reported rate of HCV infection in the Yukon was 107.0 per 100,000, which was 3.2 times higher than the national HCV rate (33.7 per 100,000) (Table 2).

TABLE 2. Reported cases^a and rates of HCV by province/territory, 2005 and 2009, Canada

Jurisdiction	Number of Cases		Rates per 100,000 ^b		Rate Change (%)
	2005	2009	2005	2009	2005 - 2009
<i>Canada</i>	<i>13017</i>	<i>11357</i>	<i>40.4</i>	<i>33.7</i>	<i>-16.6</i>
BC	2878	2444	68.6	54.9	-20.0
AB	1384	1129	41.7	30.6	-26.6
SK	654	645	65.8	62.6	-4.9
MB	419	347	35.6	28.4	-20.2
ON	4576	4399	36.5	33.7	-7.7
QC	2393	1740	31.5	22.2	-29.5
NB	272	196	36.4	26.2	-28.0
NS	249	279	26.5	29.7	12.0
PE	43	35	31.1	24.8	-20.3
NL	84	90	16.3	17.7	8.6
YT	37	36	116.0	107.0	-7.8
NT	21	12	48.4	27.6	-42.9
NU	7	5	23.1	15.5	-32.7

^a Rate change calculated using unrounded values.

^b Bolded rates indicate rates above national average.

3.3 Reporting of acute HCV infection using enhanced surveillance (2005-2010)

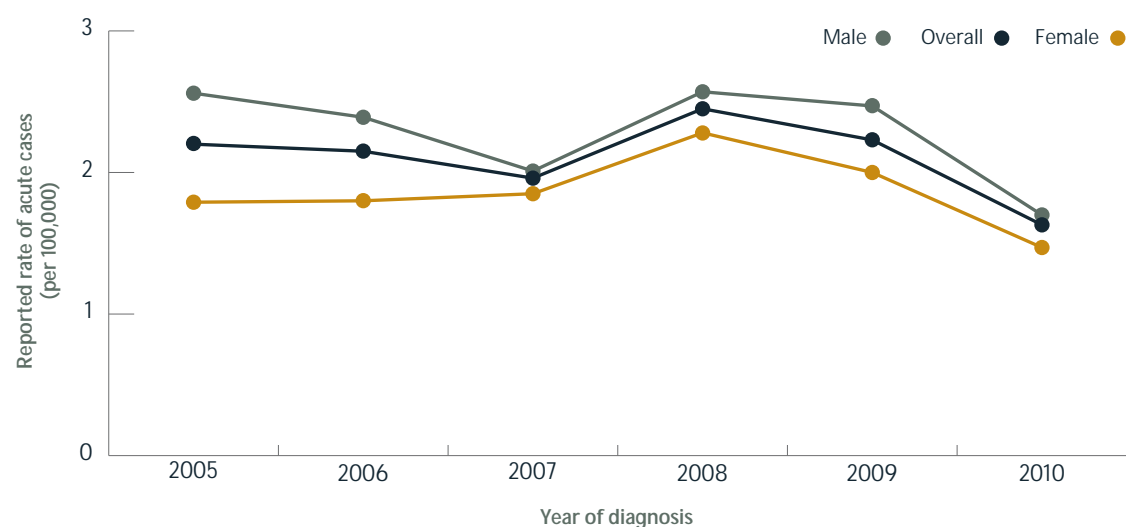
The Enhanced Hepatitis Strain Surveillance System (EHSSS) distinguishes between recent and chronic or resolved HCV infections. Newly acquired HCV infection is determined through seroconversion of antibodies to HCV or evidence of clinical hepatitis C, requiring that both clinical and laboratory criteria are satisfied. Appendix 1 provides more detail on EHSSS methodology.

Data from EHSSS suggest that the rate of newly acquired HCV infection between 2005 and 2009 remained unchanged at between 2.2 and 2.5 per

100,000 population, and that the rate as of September 2010, declined to 1.6 per 100,000 population. It is too early to predict, however, whether this decline will continue in 2011. While the rate of newly acquired HCV is still highest among males, the sex-related difference in reported rates may be narrowing (Figure 5).(3)

Data from the U.S. (where acute HCV cases are distinguished from chronic cases) suggest that the rate of acute HCV has declined over time, but has remained stable at 0.3 per 100,000 population since 2006.(23)

FIGURE 5. Reported cumulative rate^a of acute HCV infection by sex, EHSSS, 2005-2010^b



^a Rates of acute HCV infection were calculated using health-region-specific 2001 and 2006 census data and intercensal population estimates

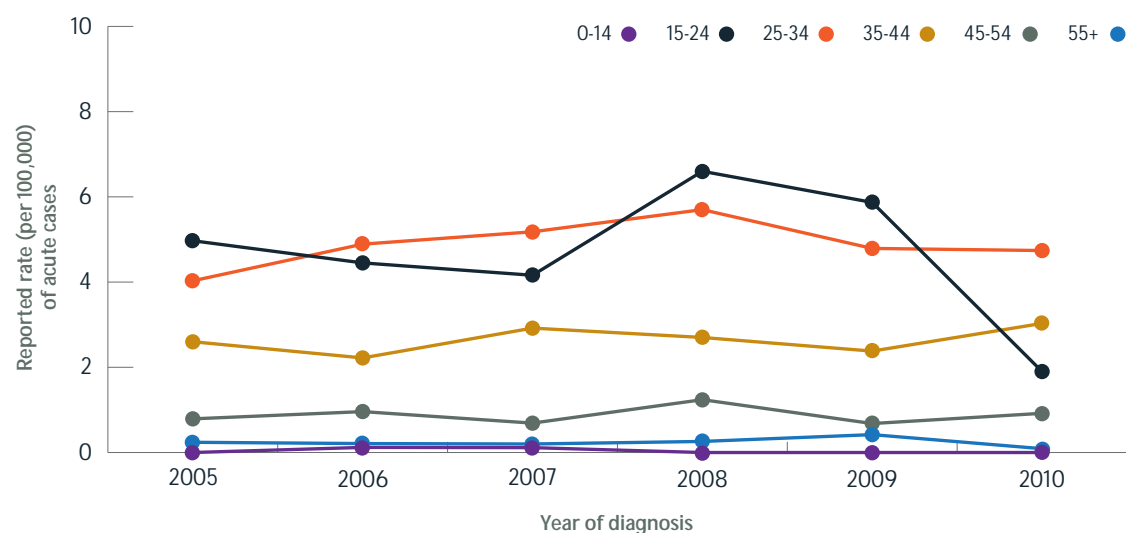
^b Data for 2010 are partial and rates have not been prorated for the entire year. Includes results from January 1, 2005 through September 30, 2010

Apparent decreases in the rate of newly acquired HCV infection in 2010 may be driven by reductions in infection rates among females 15-24 years old and males 25-34 years old. Among females 15-24 years old, rates of newly acquired HCV increased between 2007 and 2009. However, preliminary data from 2010 suggest a sharp decline in newly acquired HCV rates among this

group. Females 25-34 years old now account for the largest number of new HCV cases (Figure 6).

Among younger males, a pronounced reduction in newly acquired HCV infections has also been observed among those 25 to 34 years of age between 2008 and 2010 (Figure 7).

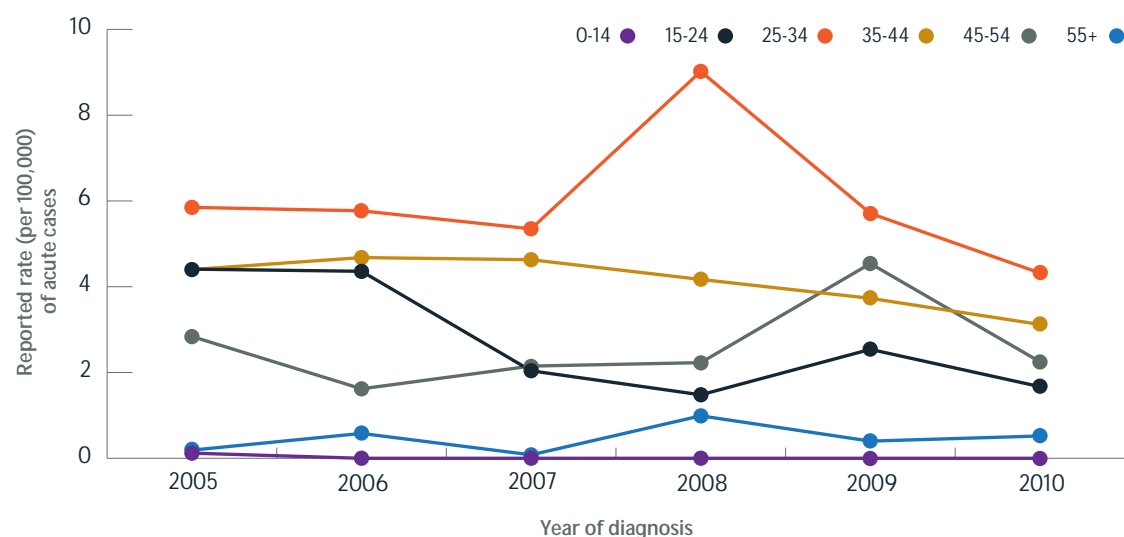
FIGURE 6. Reported rates^a of acute HCV infection among females by age group, EHSSS, 2005-2010^b



^a Rates of acute HCV infection were calculated using health-region-specific 2001 and 2006 census data and intercensal population estimates

^b Data for 2010 are partial and rates have not been prorated for the entire year. From January 1, 2005 through September 30, 2010

FIGURE 7. Reported rates^a of acute HCV infection among males by age group, EHSSS 2005-2010^b



^a Rates of acute HCV infection were calculated using health-region-specific 2001 and 2006 census data and intercensal population estimates

^b Data for 2010 are partial and rates have not been prorated for the entire year. From January 1, 2005 through September 30, 2010

Canadian data are similar to those in the U.S. where, between 1990 and 2007, reported rates of acute HCV declined from 5.3 per 100,000 to 0.5 per 100,000 among those 25 to 39 years old. In 2007, the rate among those 40 years and older was 0.3 per 100,000.

(24) As in Canada, the overall reported rate of acute HCV in the U.S. remains higher among males than females. The discrepancy between the sexes has also decreased since 2001, from a male-to-female ratio of 1.8:1 to almost 1.2:1.

3.4 Key populations at risk of HCV infection

Table 3 summarizes the estimated prevalence among key populations at risk for HCV, based on data collected from both routine and enhanced surveillance systems. These estimates are based on different years of data collection and do not distinguish current from past or resolved HCV infections. In addition, the prevalence estimates reported by M-Track, E-SYS and I-Track are

not nationally representative of the target populations sampled, since data collection only occurred across a small number of sites across Canada. Appendix 1 provides more detail on the surveillance systems used for the data presented below. Risk factors associated with HCV infection will be the focus of Chapters 5.0 to 7.0 in this report.

TABLE 3. Estimated prevalence of HCV infection in the Canadian general population and sub-groups

Population/ risk group	Canadian population ^a	People who inject drugs ^c	Inmates ^e	Men who have sex with men ^b	Street Youth ^d	Aboriginal population ^a
HCV prevalence	0.8%	69%	28%	5%	5%	3%

^a Cumulative as of 2007 based on PHAC-Remis modelling report, 2007

^b M-Track Phase 1 (2005-2007)

^c I-Track Phase 2 (2005-2008)

^d E-SYS Cycle 5 (2005-2006)

^e Infectious Disease Surveillance in Canadian Federal Penitentiaries 2005-2006 – Year-end point prevalence

3.4.1 PEOPLE WHO INJECT DRUGS

In Canada, the highest rates of HCV infection are reported among people who inject drugs, mainly from sharing of used drug-use paraphernalia. Actuarial modelling estimated that this group accounted for 54% to 70% of modelled HCV prevalent infections across provinces and territories in 2007.⁽²⁾ Data from phase 2 of I-Track, an enhanced surveillance system of HIV and HCV among people who inject drugs, suggest that the overall lifetime prevalence of HCV between 2005 and 2008 was approximately 69%, based on biological testing of participants.⁽²⁵⁾

3.4.2 FEDERAL INMATES

The reported prevalence of HCV among inmates of federal penitentiaries was 27.6% in 2006, up from 18.1% in 1999. During this time period, HCV rates have been consistently higher among women, which differs from trends in the general Canadian population. This is likely due to a larger proportion of women being tested for HCV compared to men, which leads to more cases being detected. In 2006, the estimated HCV prevalence among females was 36.0% compared to 27.3% among males. However, the disparity between males and females has declined since 2000, when there was a larger difference in HCV prevalence between genders (females: 42.4%, males: 19.7%).⁽²⁶⁾

3.4.3 MEN WHO HAVE SEX WITH MEN (MSM)

M-Track is an enhanced surveillance system that tracks HIV, HCV and syphilis prevalence and associated risk behaviours among men who have sex with men (MSM) in Canada by combining behavioural and biological surveillance. The prevalence of past or present HCV infection among men who participated in Phase 1 of M-Track was 5%, based on biological testing of participants.

While sexual exposure appears to be a rare mode of HCV transmission among HIV-negative MSM, it is increasingly being reported among MSM who are HIV-infected.⁽²⁷⁻²⁹⁾ Further details regarding the sexual transmission of HCV are discussed in Chapter 5.0.

3.4.4 STREET-INVOLVED YOUTH

In 2005, the prevalence of HCV among street-involved¹ youth was estimated at 5%, based on results from E-SYS, an enhanced surveillance system that monitors the prevalence of HCV, HIV and other sexually transmitted infections among Canadian street-involved youth 15-24 years old using biological testing. E-SYS data also suggest a number of factors were correlated with increased risk of HCV infection, including a history of sexual abuse, a history of interaction with the justice system and a history of illicit activities as a primary source of income (e.g., stealing, sex trade, dealing drugs).⁽³⁰⁾

3.4.5 ABORIGINAL POPULATIONS

Actuarial modelling estimated that 4.1% of Aboriginal men and 1.9% of Aboriginal women were infected with HCV in 2007, resulting in an overall prevalence of 3.0%. It is important to note, that these estimates are more of a hypothesis than a conclusion, given the lack of representative data for Aboriginal populations.² (2)

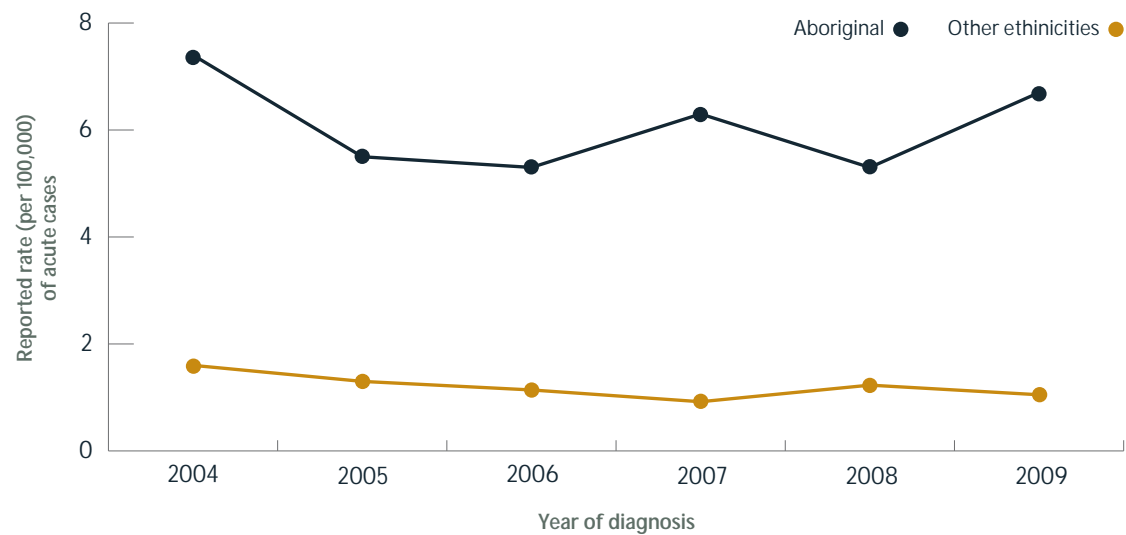
Among the data sources used to generate this population estimate, a study of Aboriginal street-involved youth in Winnipeg found that overall HCV prevalence was 47.7% among those who injected drugs but only 3.7% among those who did not. Within Aboriginal sub-groups, HCV prevalence was 22.3% among Métis and 19.4% among First Nations, indicating that there is a large amount of variation within Aboriginal populations. Among non-Aboriginal subjects, the HCV prevalence was 14.4%.⁽³¹⁾

Data from EHSSS suggest that between 2005 and 2009 reported rates of acute HCV were approximately five times higher among Aboriginal persons than persons of non-Aboriginal ethnicities (Figure 8)(3). These data are supported by other Canadian studies.⁽³²⁻³⁵⁾

¹ "Street-involved" is defined as individuals who have a history of unstable housing (e.g., have run away, been "thrown out" of home, or have had no fixed address for three or more consecutive days).

² "Aboriginal population" is a collective name for all of the original peoples of Canada and their descendants. The *Constitution Act* of 1982 specifies that the Aboriginal Peoples in Canada consist of three groups: First Nations, Inuit and Métis. (*Adapted from NAHO terminology guide*)

FIGURE 8. Reported rates of acute HCV infection by year and ethnic group, EHSSS, 2004-2009

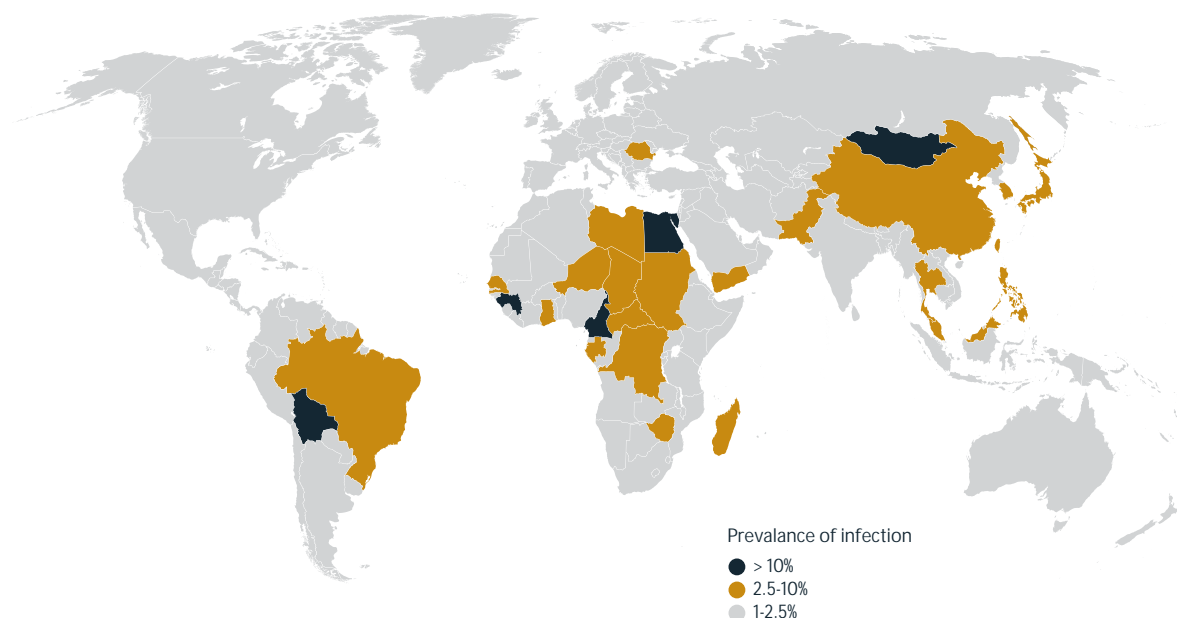


3.4.6 HCV PREVALENCE IN WESTERN EUROPE, AUSTRALIA AND THE UNITED STATES

As in Canada, less than 1% of the population is infected with hepatitis C in Western European countries, Australia and the U.S.(36) The prevalence of chronic HCV infection

in the U.K. was 0.4% in 2003.(20,37) The estimated prevalence of HCV infection in the U.S. between 1999 and 2002 was 1.6% (22), which is similar to the estimated prevalence in Australia in 2009 (1.3%).(21,38) Figure 9 presents an overview of HCV prevalence distributions worldwide as of 2004.

FIGURE 9. Epidemiology of hepatitis C globally, 2004 (Adapted from D. Lavanchy, WHO, 2009)

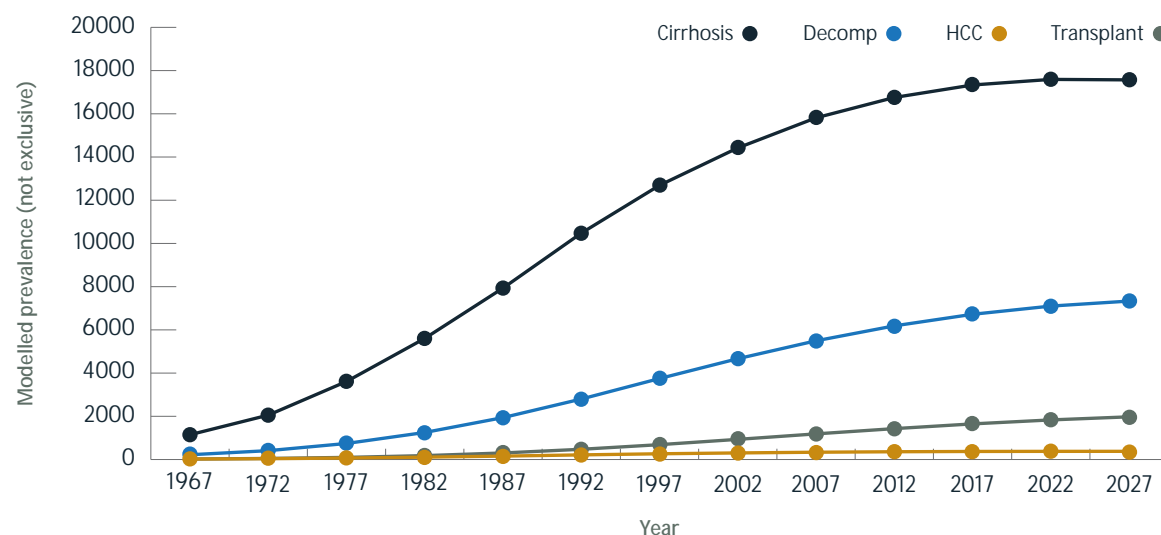


3.5 HCV-RELATED SEQUELAE

In 2007, an estimated 802 Canadians developed HCV-associated cirrhosis, 473 progressed to decompensated liver failure, 292 suffered hepatocellular carcinoma, and 134 received a liver transplant.(2) The

incidence of more advanced sequelae is projected to increase over time with total HCV-related deaths increasing from 483 in 2007 to 613 in 2027. The prevalence of various sequelae is also expected to rise, with the most notable increases for those needing liver transplants (Figure 10).(2)

FIGURE 10. Modelled prevalence of hepatitis C sequelae including cirrhosis, decompensated liver failure (decomp), hepatocellular carcinoma (HCC) and liver transplant (2)^{a,b}



^a Estimates assume stable risk populations and HCV infection risks and do not adjust for treatment

^b Estimates are mutually exclusive and are classified according to the category furthest to the bottom of the legend

Worldwide, there were an estimated 1.4 million cases of cirrhosis and 170,000 cases of hepatocellular carcinoma caused by HCV in 1990.(39) In 2005, an estimated 105 Australians developed hepatocellular carcinoma and 210 developed liver failure due to HCV.(21) The number of people who develop cirrhosis and hepatocellular

carcinoma due to HCV in England is expected to increase to 7,740 cases of cirrhosis in 2015 from 3,220 in 2003 and 2,540 cases of decompensated cirrhosis/hepatocellular carcinoma in 2015 compared to 950 in 2003.(40)

4.0 DRUG USE AND HEPATITIS C INFECTION

OVERVIEW

Chapter 4.0 presents data on the relationship between hepatitis C infection and the use of injection and non-injection drugs. Recent data suggest that HCV prevalence is declining among people who inject drugs. Nonetheless, Canadian studies report HCV prevalence in the range of 44% to 88% among people who inject drugs and estimates from 2007 suggest that a substantial number of new infections (83%) occur among this group. Important risk factors in the transmission of HCV among people who inject drugs include sharing injection equipment, early age of initiation into injection drug use, high frequency of injection, receiving assisted injections and co-infection with HIV (4.1.1).

Data suggest that the overall prevalence of HCV among people who use non-injection drugs ranges from 2.3% to 35.3% among international studies, but estimates as high as 54.6% have been reported among users of opioids in Canada. The major risk factor in acquiring HCV through non-injection drug use is the sharing of drug use paraphernalia such as oral implements (e.g., crack pipes) and intranasal implements (e.g., straws).

4.1 HCV infection among people who inject drugs

Hepatitis C infection has long been regarded as hyperendemic (i.e., high and sustained incidence) among people who inject drugs.⁽⁴¹⁾ Studies in the U.S., Australia and Western Europe uniformly report high HCV prevalence within this group in the range of 50% to 90%.⁽⁴¹⁻⁴⁷⁾ Canadian studies report HCV prevalence within a similar range of 55% to 88%.⁽⁴⁷⁻⁵²⁾ Results from I-Track indicate that the lifetime prevalence of HCV³ was 69% among participants in Phase 2 (2005-2008), and that the lifetime prevalence of HCV increased significantly with age (49% among those 15-24 years old and 86% among those 50-70 years old, $p < 0.001$) (Table 4).⁽²⁵⁾

Estimates from 2007 suggest that approximately 83% of new HCV infections in Canada occurred among people who inject drugs.⁽²⁾ Data from EHSSS associate 61% of newly-acquired HCV infections with the sharing of contaminated instruments for injection drug use.⁽³⁾

Among Canadian street-involved youth (15-24 years of age) who have injected drugs at least once, the average estimated prevalence of HCV was 18% between 1999 and 2005, and it has been increasing over time (from 15% in 1999 to 21% in 2005).⁽⁵³⁾ Among Aboriginal

street-involved youth, the rates of HCV were found to be higher among females. A cross-sectional British Columbia study of Aboriginal youth 18-30 years old in Vancouver and Prince George found that female participants had significantly higher rates of HCV than males (females: 43.6%; males: 25.4%). This difference remained when the analysis was limited to only those who used injection drugs.⁽⁵⁴⁾

Decreases in HCV prevalence have been observed in Canada among people who inject drugs. Between 1996 and 2007, the number of new HCV infections among people who inject drugs in Vancouver decreased from 26.8 to 13.2 per 100,000 people.⁽⁵⁵⁾ A recent report from British Columbia revealed a decrease in newly reported HIV cases with a concurrent decline in HCV cases among the general population between 1998 and 2009 (from 4,353 to 2,444 cases), despite an increase in HCV testing. Possible explanations for the decrease in cases include changes in drug use patterns from injection to non-injection use, which has a lesser risk of HCV transmission, and the positive impact of prevention work that includes measures such as the provision of condoms and clean syringes.^(20,21,56)

International research also suggests that HCV infections may be declining among people who inject drugs. A recent U.S. study that examined 10-year trends in HCV rates among users of injection drugs in four U.S. cities reported a relative decrease in HCV prevalence and incidence between 1994 and 2004 (i.e., 65% in 1994-

³ Note the following caveat for I-Track and M-Track hepatitis C virus results using dried blood spot testing: HCV testing was performed using the Ortho® HCV version 3.0 EIA. Confirmatory testing is not performed for samples that test positive. A positive result indicates past or present HCV infection, and does not differentiate acute from chronic or resolved infections.

1996, 35% in 1997-1999 and 35% in 2002-2004).(57) Similar downward trends were observed in European countries. Between 1995 and 2001 in the U.K., HCV prevalence among people who inject drugs decreased from 36.9% to 29.7% and incidence decreased by 1.2% per year. In the Netherlands, HCV incidence has declined from 27.5 to 2.0 per 100 person-years between 1985 and 2005.(58)

4.1.1 RISK FACTORS ASSOCIATED WITH USING INJECTION DRUGS

SHARING INJECTION DRUG-USE PARAPHERNALIA

Sharing injection paraphernalia is strongly associated with HCV and HIV seroconversion.(59,60) The OPICAN study, a multi-site cohort study of illicit opioid users in five Canadian cities reported that 13.2% of 679 study participants in five study sites had shared needles, and that the percentage varied by city (from 6.3% in Toronto to 22.0% in Montréal).(61,62) Among I-Track participants, 22% reported borrowing needles within the past six months and the lifetime prevalence of HCV was 76% among those who shared needles compared to 67% among those who did not report borrowing needles within the past six months (OR: 1.5, $p < 0.001$) (Table 4).(25)

Inmates and street-involved youth, two other populations with elevated HCV prevalence, also report high levels of needle sharing. In 2007, approximately 44% of male inmates who inject drugs reported sharing needles while incarcerated.(63-67) Results from E-SYS demonstrate that HCV prevalence was significantly higher among those who had reported borrowing needles at least once (40%) than among those who had reported never borrowing needles (15%). Moreover, consistent use of clean injecting equipment was lower among females (63%) than males (72%), leaving females more vulnerable to infection.(53)

Studies have reported decreases in the rates of needle sharing over time. Among youth who inject drugs in Montréal, sharing of needles and other drug-use paraphernalia has decreased significantly over a 10-year period (1995-2004), even after results were adjusted for age, injection frequency, and drug most often injected. (68) A similar downward trend has been observed in Vancouver, where rates of used syringe sharing decreased from 39.2% in 1996 to 6.7% in 2007.(55,68) Studies suggest that decreases in syringe use may be associated with increased availability of clean drug-use supplies or changing patterns in drug use.(55,56,69,70).

THIS IS HEPATITIS...

"Both due to a lack of power in decision making and because women are often on the bottom of the social hierarchy when it comes to injecting networks, coupled with the fact that many women 'turn a blind eye' to sharing risks, in order to demonstrate trust and love to their partners (...) women are exposed to a series of gender-specific risks related to the social practices of injecting."(71)

"I didn't know that a little drop of blood from the tip of a needle was going to infect me, so in urgency to get high, I grabbed the needle anyways." – (Ontario HIV Treatment Network Video library, *From Courage to Care*)

AGE OF INITIATION INTO INJECTION DRUGS

Young and recent initiates into injecting drugs have an increased risk of becoming infected with HCV.(72,73) The median age of injection drug initiation among I-Track participants was 20 years old, and starting injection drug use at a younger age (<20yrs) was more likely among those who were HCV seropositive (OR: 1.9, $p < 0.001$) (Table 4).(25) Among Canadian street-involved youth participating in E-SYS, the median age of injection initiation was between 15 and 16 years old (53), which follows another Vancouver-based study reporting that close to 40% of respondents 29 years of age and younger began injecting drugs at age 16 or younger.(74)

DURATION OF INJECTION

The length of time one has spent injecting appears to be a major risk factor for HCV infection, since transmission is more likely to occur with multiple exposure opportunities.(75) In the U.S., Latimer et al. reported a seven-fold increase in HCV infection among people who inject drugs with a five-year history of injecting drugs as compared to recent initiates (i.e., those with less than one year of injection drug experience).(76)

However, repeated exposures are not required to establish an infection. In fact, a number of studies show that the majority of drug users become infected with

HCV shortly after initiating injection drug use.(43,72,73) One U.S. study reported the annual odds of HCV infection at 1.93 (95% CI: 1.68-2.21) for the first two years of injection, with odds decreasing to 1.09 (95% CI: 1.07-1.11) for every subsequent year. (75) Estimates of the median time to HCV infection among new initiates is approximately three years, leaving a narrow window of opportunity for prevention.(77,78)

FREQUENCY OF INJECTION

Among participants of I-Track Phase 2 (2005-2008), increased frequency of injections (i.e., more than once or twice per week) was independently associated with being HCV seropositive (OR=1.4, $p<0.001$).⁽²⁵⁾

The probability of HCV infection appears to be higher among people who use drugs that have a shorter 'high,' requiring more frequent injection or larger doses to achieve the desired effect. Cocaine has a short half-life in the body; thus, those heavily dependent on this drug may inject the drug up to 20 times a day, which increases the odds of using shared equipment and needles.^(55,79-81) Among I-Track participants, the odds of being infected with HCV were 1.8 times greater if they had injected cocaine in the past six months (95% CI: 1.4-2.2, $p<0.001$).⁽²⁵⁾

ASSISTED INJECTION

People who use drugs and require help with injection are at a higher risk for sharing drug-use paraphernalia and subsequent HCV (and HIV) seroconversion. This is often the case with recent initiates, especially females.⁽⁸²⁻⁸⁴⁾ Among Canadian street-involved youth, the prevalence of HCV was 20.9% among those who had been injected by someone else at least once, compared to 13.2% for those who had never been assisted with injection. Approximately 89% of all street-involved youth who were tested for HCV had been assisted with injecting at some point in their lives.⁽⁵³⁾

Being injected by others is often also associated with exchange for sexual services, drugs or money.

According to Tompkins et al. (84) people who inject drugs are unable or unwilling to inject themselves for complex reasons, including lack of knowledge or confidence, a fear of needles and the injection process, a fear of overdose, and the desire to avoid self-identifying as a drug user. Many females who use drugs, report having been first injected by friends, associates, partners and family members; for some, being injected by others continues as an intrinsic feature of drug use for years, even if it causes pain, abscesses and other health complications.^(84,85)

CO-INFECTION WITH HIV

HIV infection is significantly higher among HCV-infected people who inject drugs than among those not infected with HCV, since both infections are blood-borne.^(59,61) Among HCV seropositive participants in I-Track Phase 2 (2005-2008), 17% were also infected with HIV.⁽²⁵⁾ High rates were observed among Canadian street-involved youth who participated in E-SYS, where 8% ($n=13$) of those who had injected drugs at least once were HCV/HIV co-infected, and among those who were HCV positive ($n=192$) 7% ($n=13$) were also HIV positive (the sample size was small, however). Among those who were HCV positive, 7% were also HIV infected.⁽⁵³⁾

Other Canadian studies conducted among people who inject drugs report HIV/HCV co-infection prevalence in the range of 16% to 22.8%.⁽⁸⁶⁻⁸⁹⁾ In U.S. and European studies, the risk of HIV/HCV co-infection among people with a history of drug use ranged from 25% to 28%.^(90,91)

Studies suggest that the median time from the first positive HCV test to a subsequent positive HIV test is 3.5 years (range = 1.2 to 6.2 years). In contrast, the median time from the first positive HIV test to a subsequent positive HCV test is only 1.3 years (range = 86 days to 3.4 years), indicating that HCV acquisition occurs within a shorter span of time. This evidence supports the need for greater HCV screening among people who are HIV positive, particularly those who have recently become infected with HIV.⁽⁹²⁾

THIS IS HEPATITIS...

"The automatic assumption with co-infection, is that you are a druggie, intravenous drug user, that it's your fault, that you are looking for trouble, and that you really did find it, almost a blame component, whether put on by ourselves or others." – (Ontario HIV Treatment Network Video library, *From Courage to Care*)

TABLE 4. Multivariate analysis of risk factors for HCV seropositivity among participants of Phase 2 of I-Track (2005-2008)

	Total (N=3076)	HCV+ (n=2970)	Adjusted Odds Ratio (HCV+)	95% confidence interval ^a
Gender				
Female	946	651 (69)	Ref	
Male	2024	1401 (69)	1.3	1.1-1.6
Age group				
15-24yrs	710	348 (49)	Ref	
25-49yrs	1916	1412 (74)	2.4	1.7-3.3
50-70yrs	330	282 (86)	8.9	6.2-13.0
Age at first injection				
<20yrs	1342	981 (73)	1.9	1.2-1.7
20 yrs or greater	1624	1067 (66)	Ref	
Regular injection				
Inject sometimes or never	1019	623 (61)	Ref	
Inject more than once or twice per week	1941	1423 (73)	1.4	1.2-1.7
Injected cocaine in the past 6 months				
Yes	2429	1732 (71)	1.8	1.4-2.2
No	539	318 (59)	Ref	
Injected non-prescription morphine in the past 6 months				
Yes	1186	862 (73)	1.3	1.0-1.5
No	1782	1188 (67)	Ref	
Injected Dilaudid in the past 6 months				
Yes	1165	858 (74)	1.4	1.2-1.7
No	1803	1192 (66)	Ref	
Used cocaine by non-injection in the past 6 months				
Yes	1394	889 (64)	0.6	0.5-0.7
No	1572	1161 (74)	Ref	
HIV infection status				
Positive	393	343 (87)	2.6	1.9-3.7
Negative	2575	1707 (66)	Ref	
Ever used the services of a needle exchange program				
Yes	2536	1841 (73)	2.4	1.9-3.0
No	434	211 (49)	Ref	
Borrowed needles in the past 6 months				
Yes	645	489 (76)	1.5	1.2-1.9
No	2283	1537 (67)	Ref	

^a All results are significant at the 95% confidence level

4.2 Non-injection drug use

The transmission of HCV by means other than syringe sharing has been suggested; however, the magnitude of HCV transmission via non-injection drug use (NIDU) (e.g., smoking and snorting) and the specific mechanism of transmission have been less clearly defined. Few studies have focused exclusively on HCV transmission among people who use drugs by non-injection. Among these it is difficult to differentiate those with no history of drug injection, thereby introducing an important risk of exposure misclassification among participants.(93)

Data collected through EHSSS suggest that approximately 9% of acute HCV infections may be attributable to risky practices associated with drug snorting.(3) Among participants in the OPICAN study, the overall HCV prevalence among participating opioid users was 54.6%. However, both studies included individuals who had also used drugs via injection, which emerged as the most strongly predictive risk factor for HCV infection.(94) Among participants of the Cedar project in Vancouver, 3.5% of those who reported smoking drugs exclusively were infected with HCV, compared to an overall prevalence of 59.4% among all drug users in the sample.(60)

An increased risk of HCV infection has been found among people who inject drugs in combination with solvents (e.g., glue, paint, petroleum, etc.). A study among Aboriginal people who inject drugs in Manitoba found that the prevalence of HCV infection was 81% among those reporting solvent and injection drug use, compared to 55% among those reporting only injection drug use.(52) A more recent study conducted among a broader population of sex workers, street-involved youth and people who use drugs in Manitoba found that those who used solvents and injected drugs, were at highest risk of HCV (adjusted odds ratio: 19.3, 95%CI:6.8-58.3; $p<.001$) compared to those who only injected drugs (adjusted odds ratio: 3.8, 95%CI: 2.3,7.5).(95)

International research indicates elevated HCV prevalence attributable to NIDU, but the reported estimates vary, mainly due to differences in study design, sample size and because non-injection drug users were often not the primary focus of research.(93) A systematic review of the evidence on HCV transmission via NIDU (i.e., through sniffing, smoking

or snorting drugs such as heroin, cocaine, crack or methamphetamine) of 28 eligible studies published between 1989 and 2006 reported that the prevalence of HCV ranged from 2.3% to 35.3%, with a median of 14%. After restricting eligible studies to those least likely to misclassify participant's previous exposure to injection drug use, this range narrowed to 2.3% to 17%.(93)

4.2.1 RISK FACTORS ASSOCIATED WITH NON-INJECTION DRUG USE (NIDU)

SHARING OF NIDU EQUIPMENT

Sharing used drug paraphernalia is the main risk factor for HCV transmission through NIDU. Equipment contaminated with blood or other bodily fluids provides a potential route of transmission for HCV.(96) Even in the absence of syringe sharing, the sharing of used drug preparation paraphernalia, such as cotton swabs, spoons or cookers, has been reported as an independent risk factor for HCV infection.(97) A study in Seattle found that 54% of HCV infections could be attributed to cotton swab or cooker sharing among people who inject drugs and who did not share syringes.(97) A recent meta-analysis demonstrated that the prevalence of HCV ranged from 20.0% to 33.3% among those who shared pipes or other oral implements, and prevalence ranged from 3.1% to 46.2% among those who had shared straws or other intranasal implements.(93,98,99) Sharing the inhalation tube for crack cocaine use has also been independently associated with HCV infection (adjusted odds ratio: 3.6, 95% CI 1.3-9.8, $p=0.01$).(100) Oral lesions (e.g., blisters, sores and cuts on lips) and dental cavities (common among crack smokers) may facilitate oral transmission of blood-borne infection.(101,102)

A study that sought to detect HCV RNA on crack-use paraphernalia found that approximately 2% of the equipment used by individuals who tested positive for HCV antibodies showed evidence of HCV RNA, demonstrating a possible mode of transmission.(103) The ability of HCV to survive for at least 16 hours in the environment, along with the high levels of virus circulating in the drug-using population, could create ideal conditions for transmission.(104)

4.3 Drug use trends

Changes in drug use trends and the modes of drug intake (injection versus non-injection) have the potential to influence levels of HCV infection.(105) An individual who changes from using drugs via injection to non-injection will be less likely to share needles or equipment, a behaviour strongly associated with HCV transmission.(106)

Canadian drug use trends reflect overall North American drug use trends.(107) The Canadian Alcohol and Drug Use Monitoring Survey (CADUMS) is an ongoing general population survey of alcohol and illicit drug use among Canadians 15 years of age and older that provides data on drug use trends in Canada.(108) CADUMS began in 2008 and was derived from an earlier comparable survey, the Canadian Addiction Survey (CAS). Both are affected by respondent bias and underestimate the true prevalence, as those who use drugs are less likely to have a telephone and be captured in this survey.

In 2009, among Canadians 15 years of age and older:

- The reported past-year use of five illicit drugs excluding cannabis (cocaine/crack, speed, ecstasy, hallucinogens, heroin) was 2.1% and higher among males (2.8%) than females (1.5%).
- The prevalence of past-year cocaine or crack (1.2%), ecstasy (0.9%), speed (0.4%) and hallucinogen use (0.7%) in 2009 is comparable to the rates of use reported in 2004 (Table 5).
- There are some geographical differences in overall drug use and choice of drugs, which may be due to differences in behaviour or drug availability, acceptability and population structure between different regions.
- Among youth 15-24 years old, the reported rate of using at least one of five illicit drugs (cocaine/crack, speed, ecstasy, hallucinogens, heroin) in the previous 12 months was significantly lower in 2009 than 2004 (5.5% vs. 11.3%), although their rates of drug use remain higher than those 25 years and older.

TABLE 5. Percentage of Canadians reporting drug use, CAS 2004, CADUMS 2008 and 2009

Selected Illicit drug use in past-year	CAS 2004 N=13,909 %	CADUMS 2008 N=16,672 %	CADUMS 2009 N=13,082 %
Cocaine/crack	1.9	1.6	1.2
Speed	0.8	1.1	0.4
Hallucinogens	0.7	—	0.7
Ecstasy	1.1	1.4	0.9
Methamphetamine/ Crystal meth	—	0.2	0.1
Any 5 drugs ^a (hallucinogens incl. salvia)	—	3.9	2.1 ^b
Pharmaceutical to get high		0.6	0.6

N – Sample size

^a Cocaine/crack, speed, ecstasy, hallucinogens, heroin

^b Indicates that the difference between 2008 and 2009 is statistically significant

Other studies have reported an increase in the use of prescription opioids (55,109,110) and a decline in heroin use (55,111) over the last decade among people who inject drugs.

Cocaine injection has also declined in Canada, but has been accompanied by an increase in crack cocaine smoking.(55,109,111,112)

Enhanced surveillance data of street-involved youth in Canada demonstrate that the use of MDMA (i.e., ecstasy), cocaine, crack cocaine, crystal methamphetamine, speed (amphetamine), hallucinogens and heroin via NIDU have significantly increased between 1999 and 2006, while other drugs taken by injection have decreased (e.g., cocaine, heroin, Ritalin, Dilaudid, and speedball) (Table 6).

TABLE 6. Trends of self-reported injection and non-injection drug use among Enhanced Street Youth Surveillance (E-SYS) participants from 1999-2006 across seven sites in Canada

Drugs	By E-SYS Cycle				
	N ^b	1999 (%)	2001 (%)	2003 (%)	2006 (%)
<i>Non-Injection drug use - Ever</i>	6029	95	94	95	94
Marijuana ^a	5180	83	80	77	74
MDMA ^a	5180	2	3	5	16
Cocaine ^a	5180	3	2	6	10
Crack ^a	5180	3	4	8	11
Crystal Methamphetamine ^a	5180	3	3	9	10
Speed ^a (Amphetamine)	5180	1	1	2	2
Hallucinogens ^a	5190	6	3	10	8
Non-IDU Heroin	3948 ^c	—	0.2	2	12
<i>Injection drug use - Ever</i>	5978	20	19	22	23
Cocaine ^{a,b}	734	52	61	38	29
Heroin ^{a,b}	734	51	40	26	17
Speedball ^{a,b}	733	18	18	12	10
Morphine ^b	735	21	46	35	28
Ritalin ^{a,b}	628 ^c	—	31	15	13
Dilaudid ^{a,b}	628 ^c	—	31	23	22

^a Significant trend detected using Cochran-Armitage ($p < .05$)

^b This is the number of participants who were asked the particular questions. Those who reported no history of non-IDU were not asked question on non-IDU drug use, and those with no history of regular IDU use were not asked a question on the use of IDU drugs.

^c Includes only those who used injection drugs more than once.

—Not collected in a given cycle.

5.0 SEXUAL TRANSMISSION OF HEPATITIS C

OVERVIEW

Current research suggests that sexual transmission of HCV is uncommon when compared to other modes, such as injection drug use. When sexual transmission of HCV does occur, the strongest predictors have been unprotected sex with multiple sex partners, traumatic sex and co-infection with HIV and other sexually transmitted infections.

Because HCV is effectively transmitted through blood-to-blood contact, sexual transmission has been studied to a lesser extent. An additional challenge is the difficulty in establishing sexual exposure as an independent risk factor for HCV transmission. Biological studies have indicated that HCV-RNA levels in the semen of HCV-infected persons may be sporadic and often in small concentrations suggesting low risk for sexual transmission.(113,114) Current epidemiological research also suggests that sexual transmission of HCV is uncommon when compared to other modes of transmission, such as injection drug use. Evidence from published studies on the sexual transmission of HCV is limited; however, more attention is being paid to this mode of transmission among HIV-infected persons. Other factors associated with sexual transmission of HCV include the presence of other sexually transmitted infections, having unprotected sex with multiple sex partners, having traumatic sex and being under the influence of alcohol and/or drugs during sex. In the absence of the above-mentioned risk factors, however, the risk of HCV transmission appears to be low.(115,116)

BIOLOGICAL RISK FACTORS FOR SEXUAL TRANSMISSION OF HCV

A review of published literature from 1995 to 2009 on the sexual transmission of HCV found that transmission through sexual activity is rare among heterosexual couples (27) and MSM partnerships in which both partners are HIV negative.(117-119)

HIV/HCV CO-INFECTION

Sexual transmission of HCV is becoming increasingly significantly among HIV-positive MSM (117-119) and sex trade workers who report having unprotected sex with multiple sexual partners and those already infected with HIV.(27)

In Canada, the seroprevalence of HCV among participants in M-Track was 5%, and lower among MSM who did not report a history of injection drug use (2%).

Also, among M-Track participants who did not inject drugs, HCV prevalence was 3.1 times higher among HIV-infected participants than among those who were uninfected with HIV (4% vs. 1% respectively, $p<0.001$). (120)

Increasing rates of HCV among HIV-positive MSM have also been reported in other countries. In the Netherlands, the rate of HCV among HIV-positive MSM has increased tenfold since 2000.(121) Ongoing transmission of HCV among this group has also been observed over the past decade in the U.S. (29), UK (122) and Australia.(123,124)

The risk of acquiring HCV through sexual transmission among persons living with HIV may be higher for several reasons, including a reduced ability to prevent HCV from multiplying once infected (125,126), increased HCV viral load in the plasma, and increased shedding of HCV in semen.(127,128)

CO-INFECTION WITH OTHER STIS

Co-infection with STIs other than HIV has been associated with an increased probability of sexual transmission of HCV among female sex workers and MSM.(27)

BEHAVIOURAL RISK FACTORS FOR SEXUAL TRANSMISSION OF HCV

TRAUMATIC SEXUAL PRACTICES

The factors most strongly associated with sexual transmission among MSM are sexual activities that are likely to result in abrasion, trauma and bleeding such as fisting, and the use of sex toys.(27,129-133)

HIV-STATUS SEROSORTING

HIV serosorting has been reported among gay men in international and Canadian studies.(134) Serosorting is the practice of “preferentially having [unprotected] sex with partners of concordant HIV status or of selectively using condoms only with HIV discordant partners.”(135) Although both men may be HIV-infected, their HCV

infection status may be unknown, and HCV may be transmitted from one to the other if a condom is not used. The risk of transmission is further increased given the higher HCV viral load among HIV-positive individuals. The practice of serosorting may be based on the assumption that HIV-infected persons are only at risk for “easily treatable” STIs, but the practice actually increases the risk for HCV transmission when one partner is infected.(136)

MULTIPLE SEX PARTNERS

Persons who have unprotected sex with many sexual partners may be more likely to have concurrent STIs, including ulcerative (136) and non-ulcerative types (137,138), and may be more likely to experience traumatic sexual intercourse, which increases their risk of HCV infection. Commercial sex workers, for example,

and especially those involved in the survival sex trade, have multiple sexual partners and are at an increased risk for STIs and HCV infection from increased exposure to sex without condoms, including anal sex.(139) Group sex and HIV-status serosorting were reportedly found associated with an increased sexual transmission of HCV.(132)

SUBSTANCE USE

While not an independent risk factor for HCV acquisition and transmission (140), use of substances such as drugs and alcohol can reduce a person’s ability to make informed decisions and result in higher risk sexual practices.(117) These may include the inconsistent use of condoms, and the possibility of traumatic intercourse and violent sex resulting in mucosal tearing, which can lead to transmission of HCV.(132,141)

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A series of in-depth interviews were carried out among commercial female sex workers in Brazil.(142) According to participants, unprotected sex was frequent with clients who paid more, were perceived as “regular,” or simply “looked clean.” No condom use was reported with steady partners.

“Every day I hang out with around five or six different clients, ‘cause I work day and night. All of us usually have lots of clients, and we get more money or drugs [for unprotected sex].” [Female commercial sex worker, 22]

Being high negatively affected their ability to negotiate condom use. Unprotected sex frequently ensued when participants were desperate for crack or to get money to buy crack, while fear of violence and/or lack of confidence also contributed to poor condom negotiation/use:

“(...) ‘cause the more you smoke it [crack], the more you wanna smoke. Then you don’t have it and someone tells you: ‘Let’s do it [have sex]?’ you don’t have condoms, but you say ‘Okay,’ then you make out without [a] condom. ‘Cause you’re dying for a stone... [crack].” [Female commercial sex worker, 22]

6.0 OTHER RISK FACTORS ASSOCIATED WITH HEPATITIS C INFECTION

OVERVIEW

Other risk factors associated with HCV infection include contaminated blood transfusions, healthcare-associated transmission, tattooing and body piercing. The risk of infection through contaminated blood transfusions has been virtually eliminated in Canada since the early 1990s and healthcare-associated transmission of HCV is largely restricted to developing countries.

6.1 Transfusion of blood and blood products and other hospital-associated HCV transmission

Before 1991, most HCV infections in Canada occurred through transfusions of contaminated blood. Nonetheless, the universal introduction of HCV antibody and nucleic acid amplification screening methods has

significantly improved the quality of HCV screening of Canada's blood supply and virtually eliminated this risk, which is now estimated at 1 per 2.3 million donations.(143)

6.2 Healthcare-associated transmission

In developing countries and transitional economies, healthcare-associated transmission of HCV continues to be associated with the majority of new HCV infections. Re-use of contaminated or inadequately sterilized syringes and needles used in medical, paramedical and

dental procedures accounted for 2.3 million to 4.7 million new HCV infections each year.(144) The high prevalence of HCV in Egypt (>14%) is largely attributed to the mass treatment of endemic schistosomiasis, which frequently involved the use of unsterilized needles and syringes.(144)

6.3 Tattooing and body piercing

A recent meta-analysis that included data from 83 international studies indicated a significant risk of HCV infection from tattooing (pooled OR 2.74, 95% CI 2.38-

3.15). The strongest association between tattooing and risk of hepatitis C was among people who used non-injection drugs (OR 5.74, 95% CI 1.98-16.66).(145)

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"That's the stigma that concerns me. Because if you ever tell somebody you've got hep C... I have to immediately follow it up with the fact that I got it from a transfusion so that they don't think that ... I'd, you know, had an.... unsavoury sort of life or something."(19)

7.0 DETERMINANTS OF HEALTH AND HEPATITIS C INFECTION

OVERVIEW

The determinants of health are factors and conditions that have an influence on the health of individuals. Critical to this definition is understanding that the determinants do not act in isolation from each other. Rather, it is the complex interaction of these determinants that has an impact on the health and well-being of individuals and communities. Examining determinants of health related to HCV helps to explain what puts people at risk for infection and how best to reduce transmission.⁽¹⁴⁶⁾ Some of the main determinants that influence the risk of HCV infection include income, access to health services and gender. An individual's physical environment can also negatively impact health, and unstable housing has been linked to higher rates of HCV infection among people who inject drugs in Vancouver.⁽¹⁴⁷⁾ Determinants of health are important to consider in parallel with surveillance data, as they offer a greater understanding of the vulnerabilities and challenges that contribute to an individual's susceptibility to infection and how best to approach disease management.

The determinants of health are “the economic and social conditions that influence the health of individuals, communities and jurisdictions.”⁽¹⁴⁸⁾ Within the context of population health, the determinants of health are essential to our understanding of what makes and keeps people healthy. On the whole, they represent an acknowledgement that factors outside the health care system significantly affect health.⁽¹⁴⁹⁾ In January 1997, the Federal, Provincial and Territorial Advisory Committee on Population Health (ACPH) defined population health as “the health of a population as measured by health status indicators and as influenced by social, economic and physical environments, personal health practices, individual capacity and coping skills, human biology, early childhood development, and health services.”⁽¹⁴⁹⁾

The following determinants of health contribute to health inequalities ⁽¹⁵⁰⁾:

- Income and Social Status
- Social Support Networks
- Education and Literacy
- Employment/Working Conditions
- Social Environments
- Physical Environments
- Personal Health Practices and Coping Skills
- Healthy Child Development
- Biology and Genetic Endowment
- Health Services
- Gender
- Culture

These determinants are important to consider in parallel with surveillance data, as they offer a greater understanding of the vulnerabilities and challenges that contribute to an individual's susceptibility to infection.

DETERMINANTS OF HEALTH RELATED TO HCV INFECTION

Understanding what puts people at risk for HCV infection is crucial to reducing transmission. Epidemiological data indicate that persons who engage in certain behaviours, such as sharing drug-use equipment, are most at risk for HCV infection. However, an individual's risk is further influenced by living conditions and the structures put in place around them to deal with illness.⁽¹⁵¹⁾ For example, income and a lack of social support—factors that influence a person's health—contribute to homelessness, render individuals vulnerable to engaging in behaviours that increase their risk of infection, and can affect their ability to access health care services.⁽⁴⁾

Factors such as social networks, social support and housing conditions are noted as “key drivers” for hepatitis transmission in the U.S.⁽¹⁵²⁾ Maher et al. also described a number of independent structural factors linked with HCV infection among people who inject drugs in Sydney, Australia. These factors include limited access to health care services, such as vaccination and effective drug treatment programs, a history of incarceration within the year preceding the study, and membership in an ethnic minority group. Surprisingly, none of the individual behavioural risk factors (e.g., sharing syringes and other injecting paraphernalia, and being injected by others) held significance after adjusting for structural factors.⁽¹⁵³⁾

The main determinants of health related to HCV infection are summarized below:

Gender – In general, men are considered more likely to engage in risky behaviours that can increase the risk of disease, injury and death.(154) While women can be at a lower health risk than men due to their health-seeking behaviours, factors such as gender inequality and power imbalance can also have a negative impact on women's health.(155) Women who inject drugs are especially vulnerable to the social context in which drug use and sexual activity take place. As Sterk et al. noted (156): "In addition to the power imbalance in...women's sexual relationships and the stressors of being a drug user, [behavioural] change often also is impacted by a woman's level of knowledge, risk perception, skills support, and ambivalence."(156)

Gender differences emerge as early as injection initiation.(157) The majority of females report first being injected by a male sex partner (158-161), and women were more likely than men to report receiving drugs in exchange for sex with a partner who was at least five years older.(158) Being injected by others is associated with other forms of exchange, such as drugs or money, and has been found to increase the risk of HIV and other blood-borne infections in various settings.(83,84) While reasons for choosing to be injected vary, studies report that some women preferred being injected as this prevented them from having visible physical damage, which may affect their value in the commercial sex market.(84)

Women are also more likely to report sharing needles than males.(159,161-166) The most commonly reported reasons for sharing needles included: the unavailability of clean needles/syringes (162,167-173), financial constraints (170,173), accidental sharing, and the immediacy of desire for drugs.(167) Women are more likely to report receptive sharing of needles with a sexual partner, as they may believe that this will confirm or create intimacy in their relationship.(164,167)

Physical environments (e.g., housing) – Housing is an important factor in health. Overcrowding, for example, can result in poor hygiene and promote the spread of infectious diseases. Homelessness is also associated with poor health, premature death and poor access to health services.(174) Factors associated with homelessness include poverty, lack of social support, social isolation, mental illness, and drug and alcohol addiction.(4)

A lack of stable housing among people who inject drugs is widespread. A recent cohort study in Vancouver reported a high prevalence and incidence of HCV infection among people who inject drugs and who reported unstable housing—an association that remained significant even after adjusting for other risk factors.(147) Similarly, an Australian study also reported an association between unstable housing and choosing personal networks over pharmacies as a primary source of injection paraphernalia.(175)

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"Large numbers of drug users with serious physical, mental and social problems are crowded into the small area of the Vancouver Downtown Eastside....The area includes others on the margins—sex workers, people with mental health problems, and the elderly. Many reside in single-room occupancy hotels without private sanitation. People [here] live much of the time on the streets and the back alleys, where they meet friends, hang out, inject drugs, smoke crack, eat, and do other things. This environment encourages unsafe drug use. A confluence of factors brings high-risk people into a high-risk setting."

Gerry Stimson, Harm Reduction: the advocacy of science and the science of advocacy. The 1st Alison Chesney and Eddie Killoran Memorial Lecture, London School of Hygiene and Tropical Medicine, November 17, 2010

Income – Income is considered one of the most important determinants of health because a person's wealth affects other determinants, such as housing, food, the amount of physical activity, access to health care, the potential for social exclusion, and risky

practices such as the use of tobacco, alcohol and drugs.(176) Lower income levels are connected to other determinants of health such as homelessness, lack of education and restricted access to health care, which increase vulnerability to risk behaviours for HCV infection.

Securing money for basic necessities or drugs may force individuals—women in particular—to engage in practices associated with an increased risk for HCV, such as sex work. Survival sex work has been related to increased rates of HCV in Canadian youth 14-24 years of age living in Vancouver.(139) HCV transmission may be less a result of direct sexual transmission between client and partner, but more related to the large overlap between sexual and drug-related networks in which sharing of drug-use paraphernalia is prevalent. Evidence suggests that drug-using youths involved in survival sex work are less likely to negotiate safer injecting practices and more likely to have older partners who may be HCV infected and who control access to drugs and their preparation.(160,177-180)

Employment and working conditions – Different types of income-earning situations, such as cross-border (international), cross-jurisdictional (interprovincial) or other work-related mobility may contribute to an increased vulnerability of acquiring infectious diseases. Mobility often involves disruption of socially significant and supportive environments, such as family and friends, and can also affect access to health care, the quality of follow-up services and can contribute to transmission of HCV.

Education and literacy – With higher rates of literacy, people are better able to learn about risks to their health and how to protect themselves.(176) Awareness of risk factors for hepatitis C and ways to prevent transmission of the virus is important in reducing the rate of

transmission. Lower literacy levels can affect a person's ability to access information about risks, the need for testing, and availability of resources and has been linked to higher levels of STI diagnosis.(181)

Health services (i.e., access to health care) –

Persons at the low end of the income scale are less likely to see medical specialists when needed (176), and are less likely to receive information about HCV prevention. Disparities in access to health care are seen in persons with many diseases, including HCV. These are further increased by the burden of substance abuse and mental illness experienced by those living with HCV infection.(182) Several factors that further limit access to treatment have been identified, such as reluctance or refusal to seek health care for testing and treatment.

Social environment (i.e., social exclusion) –

Social exclusion refers to the inability of certain groups or individuals to participate fully in Canadian life due to structural inequalities in access to social, economic, political and cultural resources. These inequalities arise out of oppression related to race, class, gender, disability, sexual orientation, immigrant status and religion.(183) The result is diminished access to social, cultural and economic resources including health care and health information.

In Canada, Aboriginal peoples, visible minorities, women, recent immigrants, MSM and people with disabilities are considered vulnerable to social exclusion.(176,184) Aboriginal peoples also tend to be disproportionately affected by HCV and are over-represented in every area of poor health, including chronic disease and infections. Among Aboriginal peoples in Canada, colonization and residential schooling (where families and communities were disassembled) have contributed to the dissolution of social support. "The full effect of this...is reflected in [Aboriginal] communities' high levels of youth suicide, HIV/AIDS (54,185,186), addiction, social dislocation, discrimination, human-rights violations, children in care of the state and poverty."(187)

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PROJECT SPOTLIGHT: *Increasing Awareness of Hepatitis C in At-risk Ethnocultural Communities*, a project of the Canadian Ethnocultural Council in collaboration with the Canadian Liver Foundation, 2005 to 2011.

Immigrants to Canada from certain countries are at a higher risk for hepatitis C. It is apparent from 40 focus groups and consultations conducted by the Canadian Ethnocultural Council in collaboration with the Canadian Liver Foundation across Canada with four selected immigrant communities that:

- language, literacy, stigma, and isolation are barriers that impact negatively on the health of the communities;
- access to culturally appropriate information on hepatitis C is inadequate;
- better links to local public health agencies need to be established to share information and resources.

Some of the needs were met through training of healthcare providers in the communities, developing and distributing culturally appropriate tools, promoting open dialogue and networking with local public health departments. The projects helped reach over 40,000 individuals through the ethnic media (TV, radio, newspaper, and cultural events) and about 6,000 through focus groups and consultations.

Stigmatization or societal judgment of those infected with HCV is also an important barrier in accessing treatment and can result in the withdrawal of care, support or services by healthcare practitioners.⁽¹⁸⁸⁾ Those infected with HCV are frequently assumed by medical practitioners to be drug users and viewed as responsible for acquiring their infection. This effect may

be compounded if vulnerable populations are already stigmatized because of other personal attributes such as race, age, poverty or sexual preference.⁽¹⁸⁹⁾ These circumstances may cause those infected with HCV to avoid testing, treatment and care, and to conceal their infection status or injection drug use from medical practitioners.⁽¹⁹⁰⁾

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Canada's women in prison

As an illustration of the relationship between determinants of health and hepatitis C infection, the situation of Canada's women in federal prisons is informative. According to Correctional Service of Canada:

- female inmates have low rates of education and employment;
- in a 1990 survey, 82 % reported sexual or physical abuse at some point in their lives;
- between 2007 and 2008, 72% of female offenders identified as having a drug or alcohol addiction at intake;
- while Aboriginal peoples represent 3% of Canada's population, 30% of female offenders in federal prisons are Aboriginal.

"If one happens to be ...poor, Aboriginal and a woman...the odds are stacked against them."

Correctional Service of Canada. 2008. "The Social Determinants of Health and Women Offenders' Vulnerability to Infection," by MB Pongrac, in Public Health in Federal Corrections, Vol. 6 No.1.

Social support networks – Lack of social support can make people more vulnerable to social situations where risk behaviours for HCV are present, and where they have little or no support for healthier behaviours. Some researchers have indicated that the shared injection experience in drug use is seen by some people who inject drugs as an opportunity for trust and intimacy and fostering of relationships.⁽¹⁹¹⁾ This same sense of

community among people who inject drugs may also result in greater risk to the individual user: “People who inject drugs commonly form social networks and partnerships to facilitate the acquisition of drugs (by pooling their resources) and for companionship and safety. Implicit to these networks is an obligation of reciprocity and trust among members, which may also increase the risks associated with injecting.”^(157,167)

8.0 PUBLIC HEALTH IMPLICATIONS

Although the estimated prevalence of HCV in Canada (<1%) is lower than in many other countries, it remains a public health concern. The number of reported cases in Canada appears to be decreasing, but the number of individuals developing sequelae is anticipated to increase over time as individuals infected decades ago advance to more severe stages of disease progression.(2,88,192) Moreover, it is difficult to predict future trends when one fifth of HCV-infected persons continue to go undiagnosed and may be unknowingly exposing others to HCV.

Transmission of HCV among people who inject drugs remains the most significant contributor to overall HCV rates. Rates of infection are influenced by factors such as sharing drug use equipment, younger age of initiation into injection drug use, duration of injection drug use, frequency of injection, low socio-economic status and unstable housing. Gender differentials introduced into drug injecting networks, where females are more likely to be assisted with injection or in sexual partnerships that are reliant on drug exchange, can also affect the risk of HCV transmission. Males represent about two thirds of reported cases, but the difference in reported rates between males and females has narrowed since 2005. Preliminary data from 2010 suggesting a dramatic decline in the rates of acute HCV infection among females 15-24 years old are encouraging, but it is difficult to predict whether this trend will continue. Changing rates among males and females may be a reflection of different serologic testing rates among males and females. Females are more likely to be tested, leading to higher reported rates of HCV detection.

Many infections among people who inject drugs could be prevented by promoting practices and circumstances that decrease the risk of HCV transmission. The short time span between being a new drug initiate and becoming infected with HCV (approximately 3 years)(78), as well as becoming co-infected for people already infected with HIV (median time 15 months)(92), suggests that there is only a brief period where prevention is possible.(193)

Some evidence suggests that there may be a risk for HCV transmission through the sharing of non-injection drug use equipment, such as crack pipes, and through sexual practices, such as having unprotected sex with multiple partners and unprotected rough sex, which may result in trauma to the ano-genital mucosa. While sexual transmission of HCV is uncommon, this mode of transmission is becoming significant among HIV-infected MSM. Continued surveillance is therefore needed.

Generally, interventions to prevent or reduce infectious disease in Canada are implemented at the provincial/territorial or municipal levels. These interventions address accessibility of relevant products or tools (e.g., condoms, sterile needles), physical structures (e.g., derelict or substandard housing, lighting, design of social facilities), social structures (e.g., policies that facilitate or constrain behaviours such as enforcement of alcoholic beverage laws), and media messages (i.e., messages and images in the broadcast and print media that portray high-risk behaviours without serious consequences).(194) At the individual level, interventions target personal risk factors and focus on psychological and biological aspects of prevention through counselling, screening and treatment. (195,196)

A recent meta-analysis of strategies effective at reducing HCV seroconversion found that employing a combination of interventions was most effective at reducing HCV transmission among IDU.(195,197)

Reducing the number of individuals initiating drug injecting, for example, may be effective. In countries that have reported reductions in drug use initiation, this was mostly as a result of shifts in drug use patterns (e.g., a heroin shortage in Australia, shift towards more non-injection use in the Netherlands).(198,199) Monitoring drug trends is therefore an effective tool to explain fluctuations in HCV incidence.

Moreover, awareness of factors that promote resilience and addressing determinants of health such as education and literacy, social exclusion and gender inequality, could improve access to health care services, which would provide more opportunities to promote awareness of the risk of infection, while offering testing and treatment for HCV infection.

9.0 LIMITATIONS/TECHNICAL NOTES

The following information describes various limitations that should be taken into consideration when interpreting the surveillance data presented here. Further details about each data source can be found in Appendix 1.

HCV infection status: All HCV reporting is based on antibody testing and, as such, does not distinguish current from past infections and, unless otherwise stated, does not distinguish acute from chronic or resolved infections. This is true for both routine and enhanced surveillance data, except for EHSSS, where a definition exists to distinguish acute cases (Appendix 1).

- A revised national definition for HCV infection that distinguishes recent (newly acquired) from chronic and resolved infections is forthcoming. This should improve the completeness of data collected through routine surveillance.

Reporting delay: There may be a delay between the time a person is tested positive for HCV infection and the time the report is received at PHAC. This time lag is referred to as reporting delay. In cases where there are discrepancies between data reported by PHAC and those reported by individual provinces and territories, provincial/territorial data should be considered more accurate, since they are the most current. The 2010 data presented in this report are also preliminary and subject to change.

Underreporting: The number of reported cases likely underestimates the true burden of infection in a given population for a variety of reasons. For example, many people who are newly infected with HCV do not exhibit symptoms and therefore may not present to a healthcare practitioner for testing. Also, HCV often occurs in hard-to-reach populations that may not have a trusted healthcare professional or access to healthcare facilities where testing for HCV can occur.

Annual trends: Observed trends must be interpreted with caution since there are a number of factors that contribute to changes, including changes in survey methodology for enhanced surveillance, HCV testing policies and provincial/territorial HCV case definitions.

Better estimates of HCV trends in Canada, including measures of prevalence and incidence of acute hepatitis C, and more detailed data about risk behaviours, would help inform HCV policy by targeting prevention programs toward those at greatest risk for infection. The majority of data presented in this report include national estimates, though a few cross-jurisdictional comparisons were not made nor were data available. More local data and data that differentiate between urban and rural areas could help inform relevant and targeted interventions.

Other suggested approaches to complement Canadian HCV surveillance data include:

- The majority of surveillance data in Canada are collected from individuals at the point of diagnosis and include those with access to care. Less data are available and reported on care and disease outcomes (e.g., the number of people being treated or the burden of sequelae). Greater use of administrative databases could be made to collect these data.
- Current HCV surveillance methods do not allow for timely reporting of results. More rapid dissemination of results would allow for more relevant policy and program formulation based on current trends.
- Current enhanced surveillance methods that employ cross-sectional survey designs are subject to recall bias and are not able to distinguish between current and past HCV infection. This may result in a discrepancy in the timing of reported risk behaviours (e.g., borrowing needles in the past six months) and the timing of infection, which limits the ability to make direct causal associations between risk and infection. Changes to HCV biologic testing procedures and reporting to distinguish current from past infection would provide valuable information about the impact of risk factors.

- There is no direct measure of national incidence and prevalence, in particular regarding the number of infections among immigrants and whether these were acquired prior to arrival or once in Canada. Representative, population-based surveys are needed to capture this information.

As enhanced surveillance systems in Canada mature, larger combined datasets that include multiple survey cycles will provide a better indication of trends in HCV prevalence and risk behaviours among high-risk populations. The ability to adapt the content of these surveys to new priorities will be beneficial for monitoring emerging developments in the future.

APPENDIX 1. DESCRIPTION OF HEPATITIS C DATA SOURCES

In Canada, HCV was made a nationally notifiable disease in 1991, with all provinces and territories reporting cases by 1999. PHAC collects epidemiological data on HCV through routine surveillance of HCV infections, consisting of case reports sent to the Agency from the provinces and territories, and through enhanced surveillance, which collects risk factor information and biological measurements for a sample of individuals. Enhanced HCV surveillance is currently conducted for the following groups: the general population, people who inject drugs, MSM and street-involved youth.

A description of the data sources used in the development of the report entitled, *Hepatitis C in Canada: 2011 Surveillance Report*, can be found below.

Canadian Notifiable Disease Surveillance System

(CNDSS): Through routine surveillance, provincial and territorial ministries of health voluntarily submit diagnosed and reported cases of HCV to PHAC on an ongoing basis via the CNDSS. The national HCV surveillance report includes data from January 2005 to December 2009. Additional information and annual rates by province/territory can be found at: <http://www.phac-aspc.gc.ca/sti-its-surv-epi/hepc/index-eng.php>

The national case definition for HCV used for routine reporting is presented below. Generally, jurisdictions establish their own case definitions, which may not conform to the national definition.

HCV NATIONAL CASE DEFINITION - SEPT 2008

Surveillance systems currently in place to capture Canadian data on HCV do not consistently differentiate between acute and chronic disease. The following national case definition for HCV was developed in 2007-2008, based on extensive consultations with provincial/territorial experts:

- Detection of anti-hepatitis C antibodies (anti-HCV) (positive anti-HCV tests should be confirmed by a second manufacturer's EIA, immunoblot or NAT for HCV RNA).

OR

- Detection of hepatitis C virus RNA

NOTE: If HCV-RNA is used solely to confirm active infection, a repeat test is recommended. The HCV serologic window period is approximately 5-10 weeks. It is estimated that 30% of acute infections may be missed if anti-HCV is the only marker of infection used during this period. HCV-RNA is detectable within two to three weeks of infection and, in the context of clinical illness, can identify acute HCV infection even in the absence of anti-HCV.

Enhanced Hepatitis Strain Surveillance System

(EHSSS): EHSSS is a sentinel surveillance initiative coordinated by PHAC in partnership with local, provincial and territorial public health departments. EHSSS aims to expand upon the information available through the CNDSS by gathering data on viral genotype and patient risk factors for newly diagnosed cases of hepatitis B and HCV.

Because the system uses a case definition for acute infection, variables associated with newly acquired HCV infection can be described. In EHSSS, an acute HCV infection meets either of the following criteria:

- a) seroconversion from negative HCV antibody (anti-HCV) to positive anti-HCV in 12 months; or
- b) evidence of clinical hepatitis C, requiring satisfaction of both clinical and laboratory criteria.

Clinical criteria include an acute illness with a discrete onset of symptoms. Laboratory criteria include laboratory confirmation of HCV infection and elevated serum aminotransferase levels, excluding other causes of acute hepatitis.

The national HCV surveillance report includes EHSSS data on acute cases collected between 2005 and 2009. Data were collected from nine sites across Canada and the method used in the EHSSS has been described in more detail previously in this report.(200)

Enhanced Street Youth Surveillance (E-SYS):

E-SYS is a multi-centre, enhanced surveillance program focused on Canadian street-involved youth that describes the prevalence of sexually transmitted and blood-borne infections (STBBIs), risk behaviours, testing behaviours and socio-economic factors associated with STBBI infection in this group. The information presented in this report is based on data collected from 1999 to 2005. During this period, there were 6,053 street youth recruited from 1999 to 2005 from seven sites (Vancouver, Edmonton, Saskatoon, Winnipeg, Toronto, Ottawa and Halifax).(201)

I-Track: I-Track is a multi-centre, enhanced surveillance system that describes changing patterns in drug injecting practices, sexual risk behaviours, HIV and HCV prevalence and testing behaviours among people who inject drugs (IDU) in Canada. Information presented about IDU in this report is based on data collected during Phase 2 of I-Track, which was completed between 2005 and 2008 in 10 Canadian sites. Dried blood or oral fluid samples were collected for HIV and HCV antibody testing. Results from I-Track do not distinguish between past or present infection with HCV.

M-Track: M-Track is a second-generation HIV surveillance system focused on gay, bisexual, and other men who have sex with men (MSM) in Canada. M-Track is an enhanced HIV surveillance system that tracks HIV, HCV and syphilis, along with associated risk behaviours among MSM in Canada, by combining behavioural and biological surveillance through the use of periodic, cross-sectional surveys administered at selected centres across Canada. Information on demographics, sexual behaviours, drug use, HIV and other sexually transmitted and blood-borne infections (STBBI) testing, and attitudes towards HIV and other STBBIs is collected via a self-administered questionnaire, and HIV, HCV and syphilis testing are conducted using dried blood spot specimens. Two cycles of the M-Track survey have been conducted to date. Data collected for Phase 1 (2005 to 2007) from five sites (Victoria, Winnipeg, Toronto, Ottawa and Montréal) have been included in the national HCV report. For more information on M-Track, please consult http://www.phac-aspc.gc.ca/aids-sida/about/mtrack_e.html

CAVEAT FOR I-TRACK AND M-TRACK HEPATITIS C VIRUS RESULTS USING DRIED BLOOD SPOT TESTING:

HCV testing was performed using the Ortho® HCV version 3.0 EIA. Confirmatory testing is not performed for samples that test positive. A positive result indicates past or present HCV infection, and does not discriminate acute from chronic or resolved infections.

APPENDIX 2. GLOSSARY

Acute – refers to a health effect, sudden onset, often brief.(202)

Chronic – refers to a health-related state, lasting a long time.(202)

Cirrhosis – scarring of the liver as a result of chronic damage to the liver.

Correlate – A general term used to describe the fact that two or more variables are related.(203)

Determinant – any factor, whether event, characteristic, or other definable entity that brings about a change in a health condition or other defined characteristic.(202)

Epidemiology – refers to the study of the occurrence, distribution and determining factors associated with health events and diseases in a population (i.e., the study of how often diseases or health events occur in different groups and the reasons for them). The aims of epidemiology are to discover the sources and causes of health events and disease occurrences and to find ways to control and prevent them.

Gender – refers to the socially constructed roles, behaviour, activities and attributes that a particular society considers appropriate for men and women. Gender is different from the term “sex,” which refers to the biological and physiological characteristics that define males and females. (<http://www.who.int/topics/gender/en/>).

Haemophilia – A group of inherited bleeding disorders in which the ability of blood to clot is impaired.

HCV sequelae – pathological conditions resulting from prior HCV disease.

Hepatocellular carcinoma – Primary liver cancer.

Hyperendemic – exhibiting a high and continued incidence.

Incidence – The number of instances of illness commencing, or of persons falling ill, during a given period in a specified population. More generally, it is the number of new events, i.e., new cases of a disease in a defined population, within a specified period of time.(202)

Incubation period – the time interval between invasion by an infectious agent and appearance of the first sign or symptom of the disease in question.(202)

Meta-analysis – A statistical synthesis of the data from separate but similar, i.e., comparable studies, leading to a quantitative summary of the pooled results. Meta-analysis has a qualitative component, i.e., it applies a predetermined criteria of quality (e.g., completeness of data, absence of biases), and a quantitative component, i.e., integration of the numerical information. The aim is to integrate the findings, pool the data, and identify the overall trend of results. An essential prerequisite is that the studies must stand up to critical appraisal and various biases.(202)

Morbidity – any departure, subjective or objective, from a state of physiological or psychological well-being.(202)

Nosocomial – arising while a patient is in a hospital or as a result of being in a hospital; relating to a hospital; denoting a new disorder, unrelated to the patient’s primary condition, associated with being in a hospital.(202)

People of Aboriginal origin – includes those of First Nations, Métis and Inuit descent.

Perinatal transmission – transmission of a disease causing agent from mother to child in the period immediately before and after birth.

Prevalence – the number of events, e.g., instances of a given disease or other condition in a given population at a designated time. When used without qualification, the term usually refers to the situation at a specified point in time (point prevalence).(202)

Seroconversion – The development of detectable antibodies in the blood directed against an infectious agent. It normally takes some time for antibodies to develop after the initial exposure to an agent.

Seroprevalence – the level of a pathogen in a population, as measured in blood serum.

Seropositive – giving a positive result in a test of blood serum, e.g., for the presence of a virus.

Serosorting – practice of using HIV status as a decision-making point in choosing sexual partnerships. The term is frequently used to describe the behaviour of a person who chooses a sexual partner assumed to be of the same HIV serostatus for the purpose of engaging in unprotected sex with the intention to reduce the risk of acquiring or transmitting HIV.(204)

Schistosomiasis – A disease that is caused by parasites (genus: *Schistosoma*) that enter the human body by attaching to the skin, penetrating it, and then migrating through the venous system to the portal veins where the parasites produce eggs. Eventually, the symptoms of acute or chronic disease (e.g., fever, abdominal discomfort, blood in stools) appear.

Surveillance – Defined as the ongoing collection, analysis, interpretation and dissemination of health-related data, which is a key component of epidemiology. The objective of surveillance is to assess the health status of populations, detect changes in disease trends or changes in how the disease is distributed, define priorities, assist in the prevention and control of the disease, and monitor and evaluate related treatment and prevention programs.

Vertical transmission – The transmission of infection from one generation to the next: from mother to infant prenatally, during delivery, or in the postnatal period via breast milk.(202)

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