



BC Centre for Disease Control  
Provincial Health Services Authority

# HCV

Annual Report  
2000-2019

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# List of Abbreviations

AIDS	Acquired Immune Deficiency Syndrome
BC	British Columbia
BCCDC	British Columbia Centre for Disease Control
BC-HTC	British Columbia Hepatitis Testers Cohort
DAA	Direct-acting antivirals
DC	Decompensated cirrhosis
HAISYS	HIV/AIDS information system
HBV	Hepatitis B virus
HCC	Hepatocellular carcinoma
HCV	Hepatitis C virus
HIV	Human immunodeficiency virus
iPHIS	Integrated Public Health Information System
OAT	Opioid Agonist Therapy
OPS	Overdose Prevention Site
NACRS	National Ambulatory Care Reporting System
PCR	Polymerase chain reaction
PHL	Public Health Laboratory
PHRDW	Public Health Reporting Data Warehouse
PLHIV	People living with HIV
PWID	People who inject drugs
RNA	Ribonucleic acid
STBBI/STIBBI	Sexually Transmitted Blood Borne Infections
SVR	Sustained virologic response
WHO	World Health Organization

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# Executive Summary

In 2016, Canada, alongside 193 other World Health Organization (WHO) member states, adopted the ambitious goal of eliminating Hepatitis C (HCV) as a major public health threat by 2030. Multiple national and international organizations have developed HCV surveillance indicators to monitor progress towards achieving this goal. The British Columbia (BC) Hepatitis C surveillance framework was adapted from those developed by the WHO and other organizations to provide a structure for monitoring HCV within the province. Leveraging comprehensive data sources available within the province, such as the Public Health Reporting Data Warehouse (PHRDW) Sexually Transmitted Blood Borne Infections (STIBBI) Data Mart (which includes >95% of all HCV screening tests, all confirmatory HCV tests performed and all cases of HCV reported in BC), and the BC Hepatitis Testers Cohort (BC-HTC) (a dynamic longitudinal cohort integrating the HCV-related data from multiple sources), this report provides estimates of key provincial indicators to support the monitoring and evaluation of BC's efforts to reduce the disease burden from HCV and to assess BC's progress towards HCV elimination.

## **HCV testing and diagnosis**

HCV antibody testing in BC has risen more than three-fold since 2000. In general, HCV antibody testing rates were highest among females and among persons aged 25-39 years. HCV antibody testing increased more rapidly among persons aged 40+ years after 2011.

New HCV diagnosis rates and HCV percent positivity among testers fell significantly between 2000 and 2019. This pattern was consistent for both males and females, although rates were generally higher among males. The decline in first-time HCV-positive diagnosis rates is encouraging, as it may represent falling transmission rates. However, this could also signal the need for increased testing among persons who are not currently engaged with the health care system in BC, as the majority of people living with HCV remain undiagnosed.

Similarly, HCV seroconversion rates among repeat testers fell rapidly from 2000 to 2019. Although historically higher among males, the gap in HCV seroconversion rates between male and female repeat testers has narrowed considerably in recent years. Significant overlaps in 12-month and 24-month seroconversion rates were observed after 2011, indicating that the majority of seroconversions may have occurred within a year of the previous negative test. This finding may reveal remaining gaps in disease prevention efforts targeted at high-risk individuals who are currently engaged in the health care system; a deficit that should be addressed if HCV is to be eliminated as a public health threat in BC.

## **HCV care cascade**

Major improvements in the progression along the HCV care cascade in BC have been observed since 2000. However, gaps remain in treatment initiation, especially among younger birth cohorts. By the end of 2019, approximately 61% of individuals who were HCV ribonucleic acid (RNA)-positive had initiated HCV treatment within the province. Given the current availability of highly effective and well-tolerated DAAs, the lifting of restrictions for publicly-funded DAA treatment within the province, and the availability of reflexive RNA testing for persons testing HCV antibody-positive, these findings reflect an opportunity to engage more people living with HCV into care.

## **Risk factors and co-infections**

In keeping with provincial trends, significant declines in new HBV and HIV cases among persons diagnosed with HCV have been observed since 2000. This appreciable drop in incident HBV and/or HIV co-infections within this population occurred alongside modest increases in the proportion of persons with any history of substance use (injection drug use and/or problematic alcohol use) during this time frame. By the end of 2015, people diagnosed with HCV belonging to younger birth cohorts were most likely to have used substances, and, accordingly, were most likely to be newly diagnosed with HIV.

### **Advanced liver disease and mortality**

Since 2000, all-cause mortality rates have steadily increased among persons diagnosed with HCV in BC; being consistently highest among the older birth cohorts. In contrast, liver-related death rates have steadily fallen for all individuals diagnosed with HCV beginning in 2014. Older birth cohorts were most heavily burdened with decompensated cirrhosis and hepatocellular carcinoma from 2000 to 2019, and were thus most likely to die from liver-related causes. Notably, drug-related deaths rose sharply within this time frame, particularly among HCV-positive males and those belonging to younger birth cohorts. This marked increase in drug-related deaths coincides with the fentanyl-related overdose crisis within the province.

# Background & Context

Hepatitis C is a liver infection caused by the hepatitis C virus (HCV). An HCV infection is typically classified as “acute” or “chronic” based on how long an individual has been living with HCV. Acute HCV infection refers to a new or recent infection, while chronic HCV infection refers to a long-term infection.

HCV is a significant global health problem, accounting for approximately 400,000 deaths in 2015 (1). An estimated 71 million people were living with HCV worldwide in 2015, about 250,000 of whom are in Canada (1, 2). Approximately 25% of newly infected individuals will spontaneously clear HCV after infection, while the remaining 75% will develop chronic illness (3). The majority of individuals infected with HCV will experience no symptoms, often delaying diagnosis until the advanced stages of the disease (4). HCV is a serious disease that may lead to cirrhosis (scarring of the liver) and hepatocellular carcinoma (HCC, a type of liver cancer), thereby increasing the risk of death.

HCV in British Columbia (BC) is characterized by the presence of “Twin Epidemics” (2, 5, 6). One epidemic is among individuals who were born between 1945 and 1965 (the baby boomer cohort), who represent two-thirds of **chronic** HCV infections. The baby boomer cohort, who mostly acquired their infections decades ago, is now experiencing increasing mortality and serious liver-related illnesses. This includes decompensated cirrhosis (DC) and HCC, as well as non-liver-related illnesses such as diabetes, cardiovascular disease, chronic kidney disease, and non-liver cancers (6-13). The second epidemic is among people who inject drugs (PWID), who represent 80% of **acute** (new) HCV infections in BC; most of whom live with concurrent problematic alcohol use, mental illnesses, or human immunodeficiency virus (HIV) co-infection (6, 14, 15). Additionally, unlike baby boomers, PWID with HCV infections are more likely to die from drug-related causes than liver-related causes (16).

In 2013, short-course (8-12 weeks), highly effective (~95% cure rate) and well-tolerated direct acting antiviral agents (DAAs) were introduced, which was a major breakthrough for HCV therapy (17). Prior to DAAs, treatment for HCV was based on interferon, which had significant side effects and much lower cure rates (~50%) (18). DAAs have revolutionized HCV management and could potentially halt, or even reverse, the rising tide of premature mortality, end-stage liver disease, and non-liver-related sequelae associated with HCV infection (19-22). This optimism has led the World Health Organization (WHO) to set ambitious goals for the global elimination of hepatitis as a major public health concern (17, 23, 24). By 2030, the WHO strategy aims to reduce HCV incidence by 80% and HCV-related mortality by 65%. These impact goals could be achieved by scaling up prevention, testing, care and treatment. Key intervention targets include the annual distribution of 300 needles/syringes per PWID, diagnosing 90% of HCV infections and treating 80% of people living with HCV all by 2030 (17). In Canada, the recommended target for needle/syringe distribution is higher, at 750 per PWID per year (25). The development of surveillance indicators across the prevention and care cascade in various jurisdictions is essential for monitoring progress towards achieving these goals, which has been the focus of multiple national and international organizations.

## Purpose

This report provides estimates of key provincial indicators that were developed to support the monitoring and evaluation of BC’s HCV program. This document is intended as a snapshot of HCV in BC along a continuum from prevention to testing and diagnosis to treatment as well as clinical outcomes, which can be used to monitor and evaluate BC’s HCV programs and services.

# Indicator Development

The development of indicators for the HCV program builds on historical indicators that formed the cornerstone of BC's viral hepatitis strategy (Healthy Pathways Forward) and BC's Guiding Framework for Public Health (26-28). With the advent of new DAAs and renewed interest in viral hepatitis, the Hepatitis Program at the British Columbia Centre for Disease Control (BCCDC) conducted a series of priority setting discussions to identify additional data needs for informing and monitoring policy and program in 2013. This exercise mapped out various data needs for the assessment of the HCV care cascade.

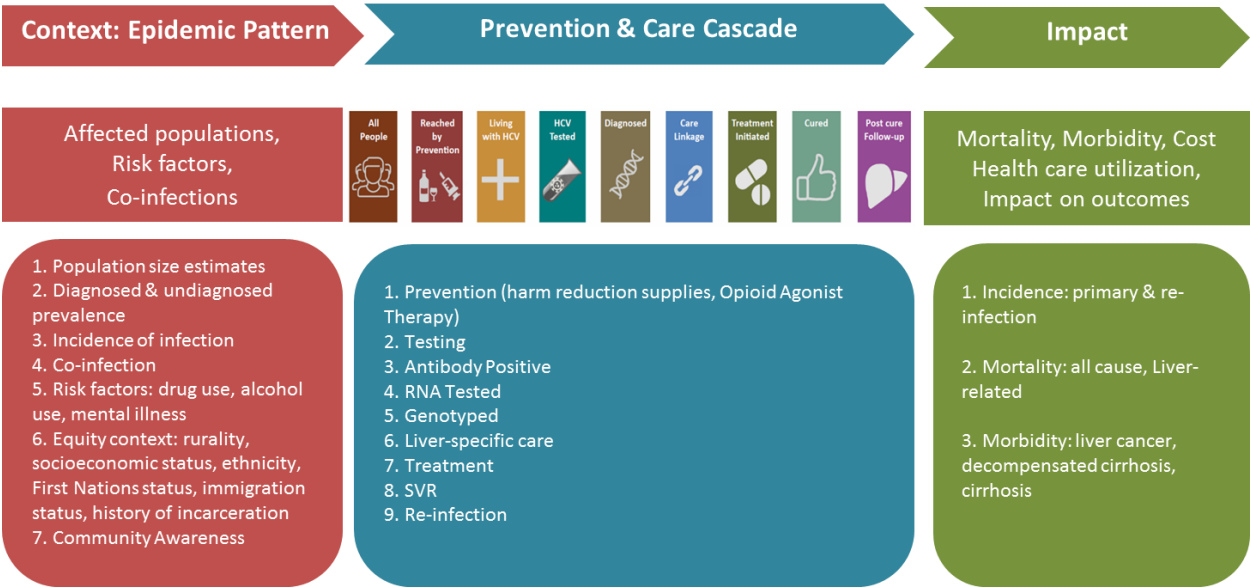
Grey literature (provincial/national strategies and reports from Scotland, Australia, United States, United Kingdom) (29-32) and peer-reviewed academic literature searches were conducted to examine experiences and best practices for hepatitis program monitoring. Findings informed the identification of indicators for monitoring the HCV disease burden in BC and the development of a surveillance framework for the province. The framework and indicators proposed by WHO and UNAIDS for program monitoring were also reviewed as they became available (33). The indicators were developed and initial findings presented in various peer-reviewed publications (6, 11, 12, 14, 34-47), allowing for external peer review of most of the indicators proposed for monitoring HCV in BC. Major publications from the BCCDC relevant to HCV monitoring indicators include the characterization of HCV and HBV epidemiology (6, 36), HCV incidence (15), and the creation of a population-level HCV care cascade for the province (45). The HCV care cascade was showcased as an example of population-level monitoring of hepatitis in the first WHO Global Hepatitis report (1).

Other indicators developed in the process included the estimation of population size of people who inject drugs (42) and the assessment of HCV reinfection (40, 47), opioid substitution/agonist therapy (40, 48), liver cancer (34), decompensated cirrhosis (11, 35), and mortality (10, 46) rates. These indicators were presented at the 2018 Global Hepatitis Summit in Toronto and reviewed by experts from Canada, the United States, Scotland, Australia, and Egypt. These indicators also informed the development of Canada's Blueprint to Inform HCV Elimination Efforts, which was recently released by the Canadian Network on Hepatitis C to accompany the Pan-Canadian STBBI Framework for Action (24, 49).

## The Hepatitis C Surveillance Framework

The BC provincial Hepatitis C surveillance framework (Figure 1) builds upon the WHO surveillance framework (33) and visualizes the HCV illness and care journey within the context of underlying vulnerabilities and risk to provide a framework for HCV monitoring.

Figure 1. The Hepatitis C Surveillance Framework



This report presents HCV indicators encompassing the following major aspects of the surveillance framework:

- HCV testing and diagnosis
- HCV care cascade
- Risk factors
- Co-infections
- Impact

Based on this surveillance framework, the following indicators were developed to monitor the HCV program in BC, and their alignment to nationally and internationally published indicators (Table 1). Table 1 represents a preliminary set of indicators. Additional indicators will be developed to better capture the concepts described within the Hepatitis C surveillance framework (Figure 1).

**Table 1. Hepatitis C Indicators for British Columbia**

No.	Indicator	Alignment
<b>Cascade of care</b>		
1	Estimated HCV prevalence	WHO Core
2	Number of people living with HCV who are diagnosed	WHO Core
3	Number of HCV cases with a HCV RNA test	
4	Number of HCV cases who cleared spontaneously	
5	Number of HCV cases with a RNA positive test	
6	Number of RNA positive cases who are genotyped	
7	Number of HCV cases initiating antiviral treatment	WHO Core
8	Number of HCV cases who achieved SVR	WHO Core
9	Annual HCV re-infection	
10	Engagement in primary care	
11	Engagement in liver care	
<b>Testing indicators</b>		
12	HCV testing volumes and by unique individuals	
13	HCV testing rate	WHO Add
14	Rate of new HCV diagnoses	
15	Percent positivity by test episodes and by unique individuals	
16	HCV incidence among repeat testers ( 12-month and 24-month seroconversion)	WHO Core, GFPH
<b>Affected populations</b>		
17	Estimated number of person who injects drugs (PWID)	
18	Number of needles–syringes distributed per PWID	HRRS/WHO Core
19	Percentage of PWID on Opioid Agonist Therapy (OAT)	
20	Retention in OAT: Proportion of PWID receiving OAT for 6 months	HRRS
21	Percentage of diagnosed HCV cases with HIV co-infection	
22	Percentage of diagnosed HIV cases with HCV co-infection	
<b>Impact</b>		
23	Decompensated cirrhosis rate among HCV cases	WHO Add
24	Hepatocellular carcinoma rate among HCV cases	WHO Add



No.	Indicator	Alignment
25	Liver-related mortality rate in among HCV cases	WHO Core
26	All-cause mortality rate among HCV cases	

*WHO Core: WHO Core indicator (33); WHO Add: WHO additional indicators for monitoring where possible (33); HRSS: BC Harm Reduction Services and Strategies indicator (50); GFPH: Promote, Protect, Prevent: Our Health Begins Here: BC's Guiding Framework for Public Health (28).*

# Data Sources

The Public Health Reporting Data Warehouse (PHRDW) Sexually Transmitted Blood Borne Infections (STIBBI) Data Mart is the data source for HCV testing data in Section 1 (HCV Testing and Cases) of this report. The STIBBI Data Mart integrates laboratory testing and surveillance data for all reportable STIBBIs. Specifically for HCV, the STIBBI Data Mart contains all HCV testing performed by BCCDC Public Health Laboratory (BCCDC PHL), which is >95% of HCV antibody screening tests and all confirmatory HCV antibody tests, as well as all HCV RNA and genotype tests performed in BC. It also includes all information received by public health about new cases of HCV. The STIBBI Data Mart provides near real-time data for population-level surveillance purposes. This report contains data from the STIBBI Data Mart from 2000-2019, excluding testers from clinical trials and the Evaluation of the Supervised Injection Site (ESIS) study due to lack of information regarding BC residency. See **Appendix A.1** for more details on the STIBBI Data Mart.

The **BC Hepatitis Testers Cohort (BC-HTC)**, a dynamic longitudinal cohort housed at BCCDC, is the data source for Sections 2-5 of report (51). The cohort is generated using data from everyone who tested for HCV or human immunodeficiency virus (HIV) at the BCCDC Public Health Laboratory, or who was reported as a case of hepatitis B (HBV), HCV, HIV or active tuberculosis since 1990/1992. In BC, >95% of all HCV and HIV screening tests (but virtually all confirmatory tests) and about 30% of all HBV tests are performed by the BCCDC Public Health Laboratory. Data from people who have had these laboratory tests or were cases were then linked with administrative data, including doctor and emergency room visits, hospitalization, prescription and death data for cohort formation. The BC-HTC is refreshed every two years, with the last cohort generated in 2015. Data presented from **2016-2019 represent follow-up data** for persons within the cohort at the time of the last refresh. Thus, beginning in 2016, new HCV cases who were absent from the BC-HTC from inception until the end of 2015 are **not included** in sections 2-5 of this report. Based on new cases of HCV in the STIBBI Data Mart, we estimate there are about 6,000 new HCV cases from 2016 to 2019 that are absent from the BC-HTC. See **Appendix A.2** for more details on the BC-HTC.

# HCV in BC, 2000-2019

## 1. HCV Testing and Cases

### 1.1. New HCV cases in BC, 2000-2019

HCV infection is reportable to public health in BC. This indicator estimates the annual rate of new HCV infections in BC. Here, a new HCV case is a person residing in BC with a new positive HCV antibody (also known as anti-HCV) test result or reported to public health as a new HCV infection. A positive anti-HCV test means an individual has been exposed to HCV. It does not mean that an individual is infected with HCV as a person will continue to have antibodies to HCV even after clearing or being cured of HCV. A confirmatory HCV RNA testing is required to confirm active HCV infections.

HCV case data excludes cases from clinical trials and the Evaluation of the Supervised Injection Site (ESIS) study due to lack of information regarding BC residency. The STIBBI Data Mart is the data source for this indicator. See Appendix A.1 for more information.

#### 1.1.1. Characteristics of new HCV cases in BC, 2019

In 2019, 1,958 new HCV cases were diagnosed in BC; 163 of whom were at the acute stage of infection. The majority of new HCV cases in the province were of male sex (65.5%) and aged 40+ years (57.0%). The highest proportion of cases resided in Fraser Health Authority (33.1%) (Table 2).

Table 2. Characteristics of new HCV cases in BC, 2019

Variable	Category	Frequency	Percent
Province	BC	1,958	100.0
Sex	Female	669	34.2
	Male	1,282	65.5
Age Group	0-14 years	7	0.4
	15-19 years	19	1.0
	20-24 years	116	5.9
	25-29 years	266	13.6
	30-39 years	432	22.1
	40-59 years	595	30.4
	60+ years	521	26.6
Health Authority	Vancouver Coastal	428	21.9
	Vancouver Island	315	16.1
	Fraser	648	33.1

Variable	Category	Frequency	Percent
	Interior	366	18.7
	Northern	143	7.3
Disease stage at diagnosis	Acute	163	8.3

### 1.1.2. Trends in new HCV cases in BC, 2000-2019

The rate of new HCV cases in BC has declined since 2000 (Figure 2). In contrast, the rate of acute HCV infection has remained relatively steady over time. New HCV cases within the province decreased from 99.7 (4,028 cases) per 100,000 in 2000 to 38.6 (1,958 cases) per 100,000 in 2019 (Figure 2). In 2019, the highest HCV case rates of 50.3 and 44.2 cases per 100,000 population were noted in Northern and Interior Health Authorities, respectively (Figure 3).

New HCV case rates fell for both males and females in BC between 2000 and 2019 (Figure 4). However, HCV case rates among males were consistently two-fold greater than those for females. The HCV case rates for males fell from 131.0 (2,627 cases) per 100,000 in 2000 to 51.1 (1,282 cases) per 100,000 in 2019. Similarly, the HCV case rate for females decreased from 65.6 (1,334 cases) per 100,000 in 2000 to 26.1 (669 cases) per 100,000 in 2019.

HCV case rates were consistently lowest for people aged less than 20 years old (Figure 5). HCV case rates declined steadily for people in the 40-59 age group over the twenty-year period. In contrast, HCV case steadily increased among people aged 60+ years during this time frame and has risen among people aged 25-39 years in recent years. Since 2016, the highest rates of new HCV cases were among people aged 25-39 years.

Figure 2. New HCV cases in BC, 2000-2019

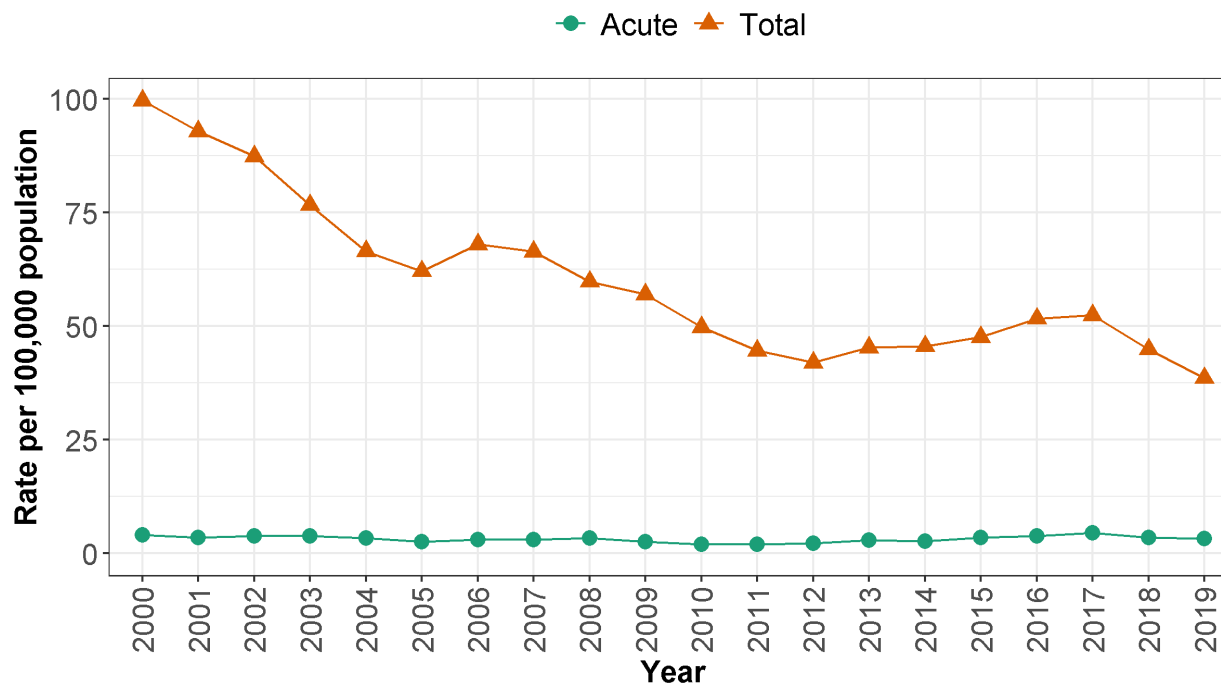


Figure 3. New HCV cases in BC by Health Authority, 2000-2019

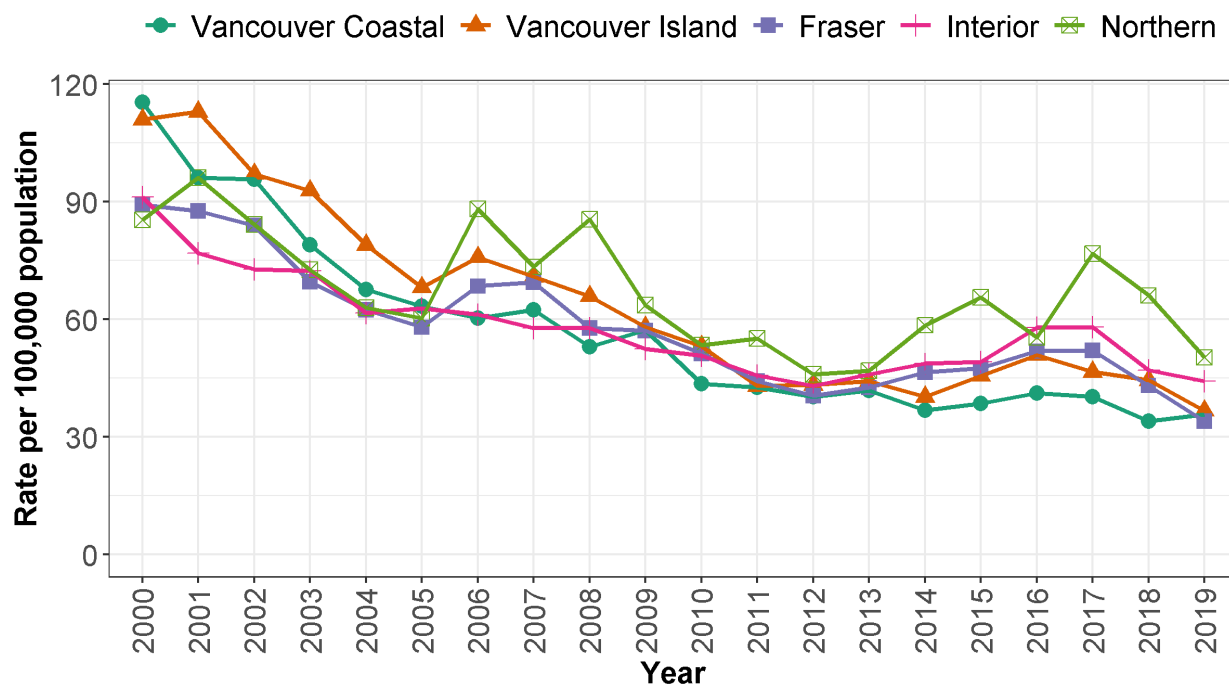


Figure 4. New HCV cases in BC by sex, 2000-2019

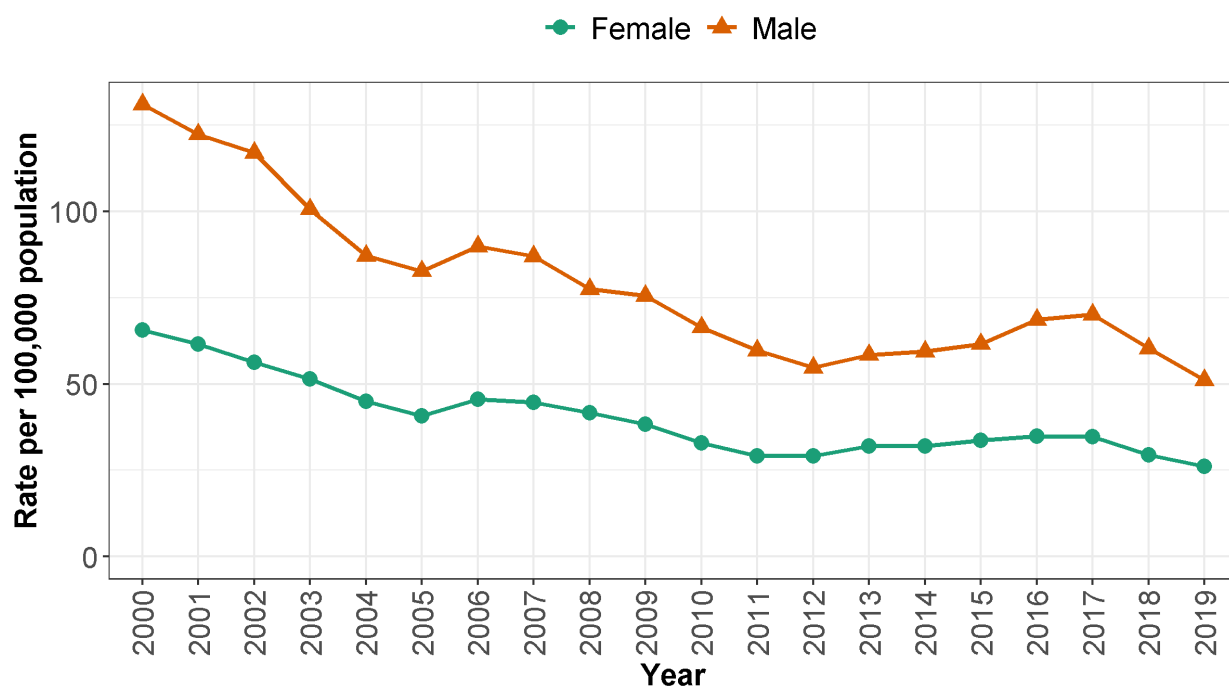
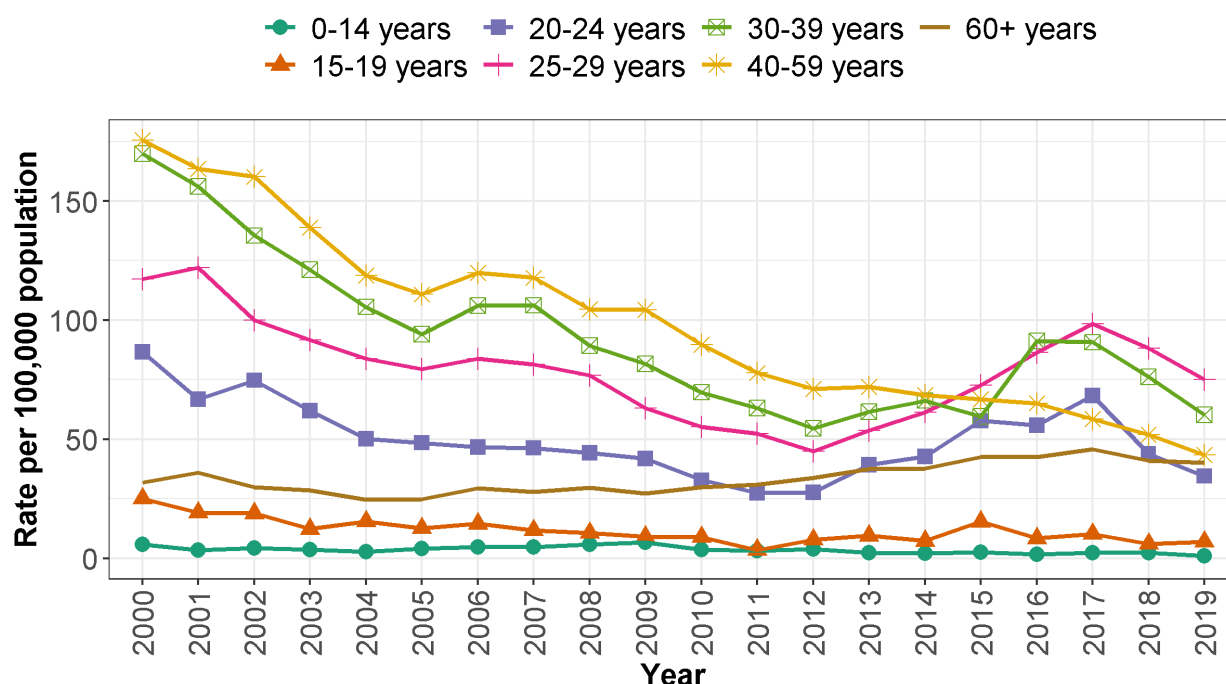


Figure 5. New HCV cases in BC by age group, 2000-2019



## 1.2. HCV testing in BC, 2000-2019

HCV infection is largely asymptomatic, therefore, screening is necessary for the early diagnosis of an active HCV infection. The HCV screening process involves testing for the presence of antibodies against HCV (anti-HCV) within the serum of the affected person. In BC, HCV testing is recommended for people presenting with risk factors, including injection drug use and receiving medical care in settings with suboptimal infection control practices (52). Monitoring the trends in HCV antibody testing over time provides some indication of the reach of testing for BC as whole, and for specific population groups.

The annual rates of HCV antibody testers (i.e. unique individuals who had an anti-HCV test) are presented. Individuals are excluded in subsequent years after they receive a positive anti-HCV test. As well, individuals who were tested as part of clinical trials and the Evaluation of the Supervised Injection Site (ESIS) study are excluded due to lack of information regarding BC residency. HCV antibody testing data from the BCCDC PHL represent >95% of HCV antibody screening tests and all confirmatory HCV antibody tests performed in BC.

### 1.2.1. Characteristics of HCV antibody testers in BC, 2019

In 2019, there were 275,977 individuals were tested for anti-HCV antibodies in BC. In the same year, females (54.9%) and persons aged 40-59 (27.4%) and 30-39 (25.3%) years formed the majority of HCV antibody testers in the province (Table 3). Most individuals tested for HCV antibody resided in Fraser (35.7%) and Vancouver Coastal Health Authorities (34.1%) in 2019.

**Table 3. Characteristics of HCV antibody testers in BC, 2019**

Variable	Category	Frequency	Percent
Province	BC	275,977	100.0
Sex	Female	151,416	54.9
	Male	123,399	44.7
Age Group	0-14 years	1,879	0.7
	15-19 years	9,164	3.3
	20-24 years	26,407	9.6
	25-29 years	35,367	12.8
	30-39 years	69,705	25.3
	40-59 years	75,729	27.4
	60+ years	57,107	20.7
	Vancouver Coastal	94,124	34.1
Health Authority	Vancouver Island	32,089	11.6
	Fraser	98,445	35.7
	Interior	35,607	12.9
	Northern	15,638	5.7

### 1.2.2. HCV antibody testers in BC, 2000-2019

In 2019, there were 5441.9 HCV antibody testers per 100,000 population; an increase from 1766.4 per 100,000 in 2000 (Figure 6). This rate increased steadily between 2000 and 2011, and rose more rapidly between 2012 and 2019.

From 2000-2019, HCV antibody testing rates were consistently higher among females than males (Figure 7). HCV antibody testing rates among females rose from 1795.4 per 100,000 population in 2000 to 5913.4 per 100,000 population in 2019 while HCV antibody testing rates for males increased from 1673.8 per 100,000 population in 2000 to 4914.7 per 100,000 population in 2019.

HCV antibody testing rates also differed by age group (Figure 8), being generally higher among people aged 20-39 years old. Testing rates rose for all age groups between 2011 and 2019, with the largest rise in HCV antibody testing being noted among persons aged 60+ years and 40-59 years. HCV antibody testing was generally lower among youth aged 14 years or younger.

Figure 6. HCV antibody testers in BC, 2000-2019

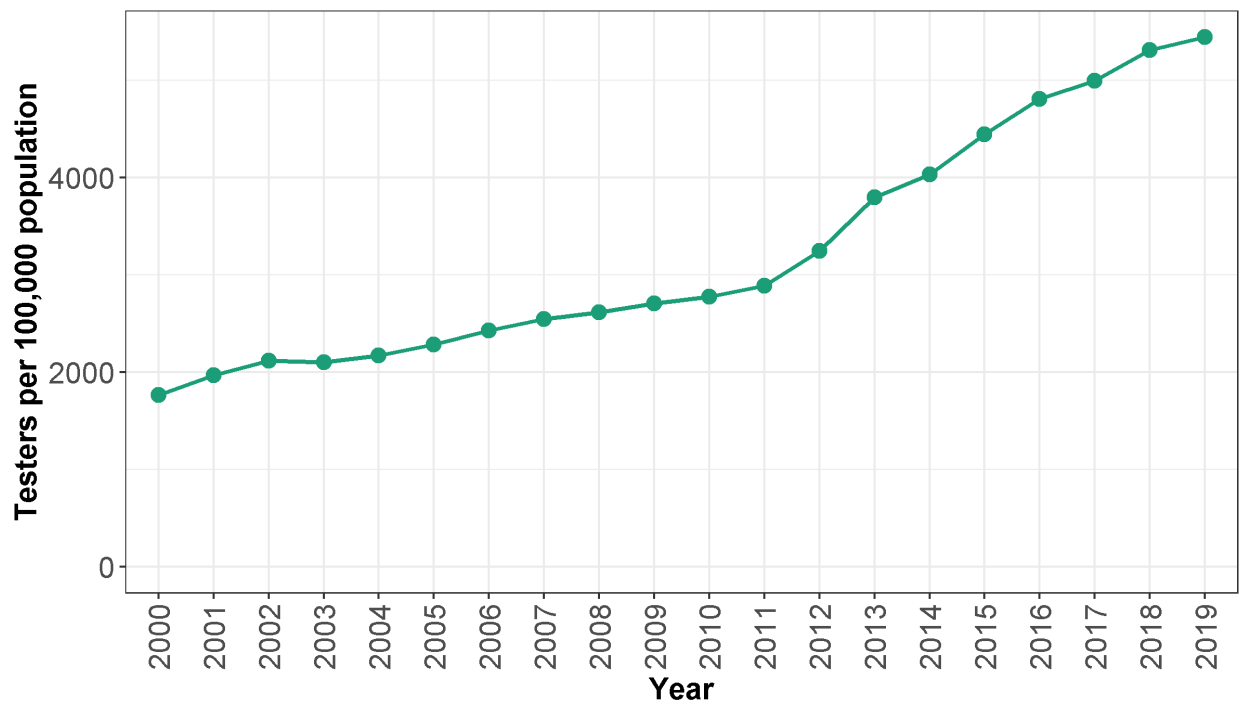


Figure 7. HCV antibody testers in BC by sex, 2000-2019

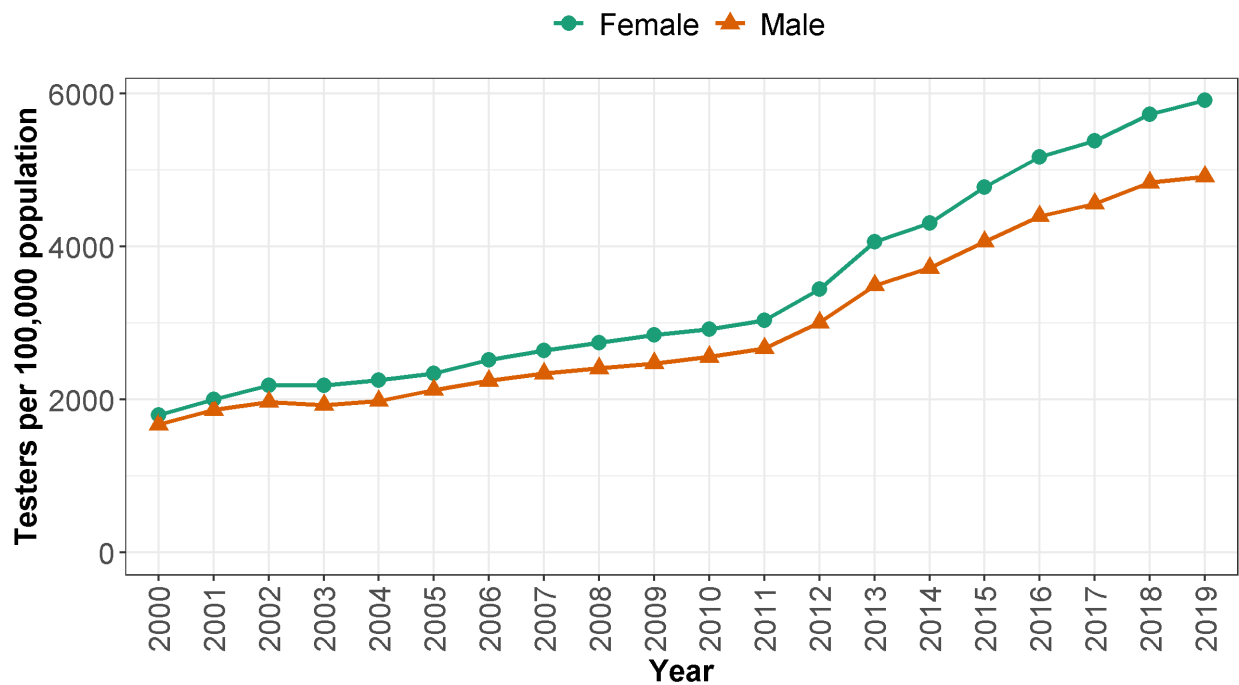
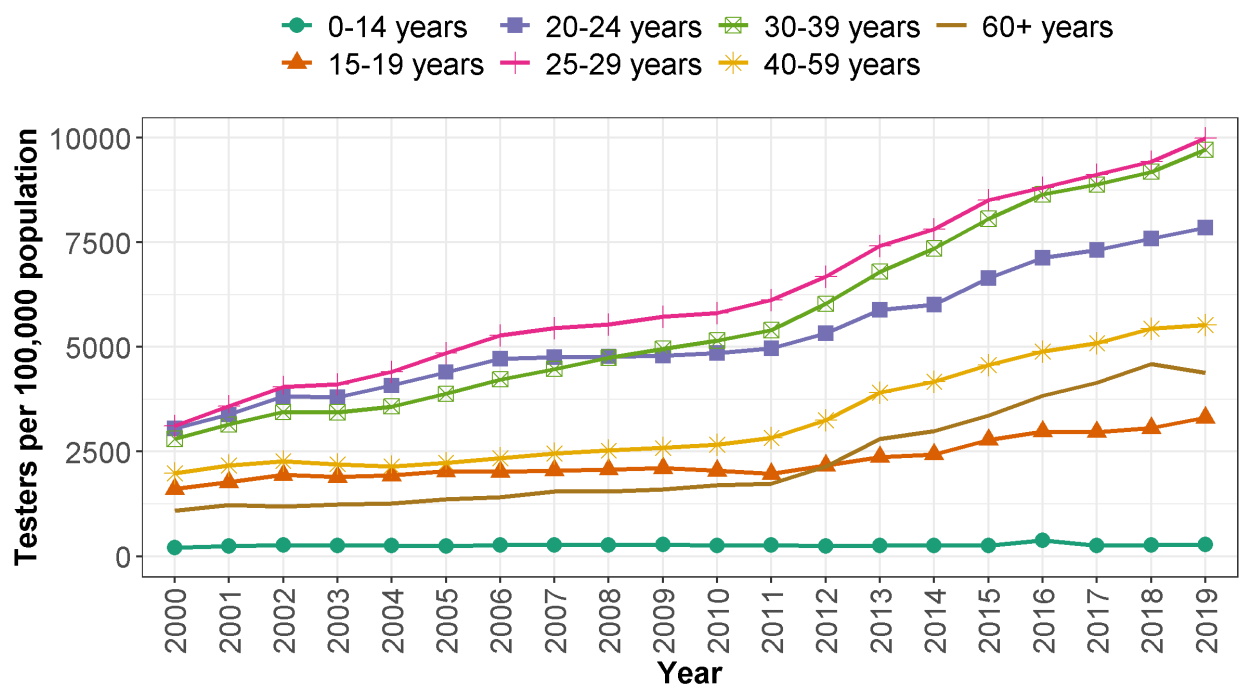




Figure 8. HCV antibody testers in BC by age group, 2000-2019



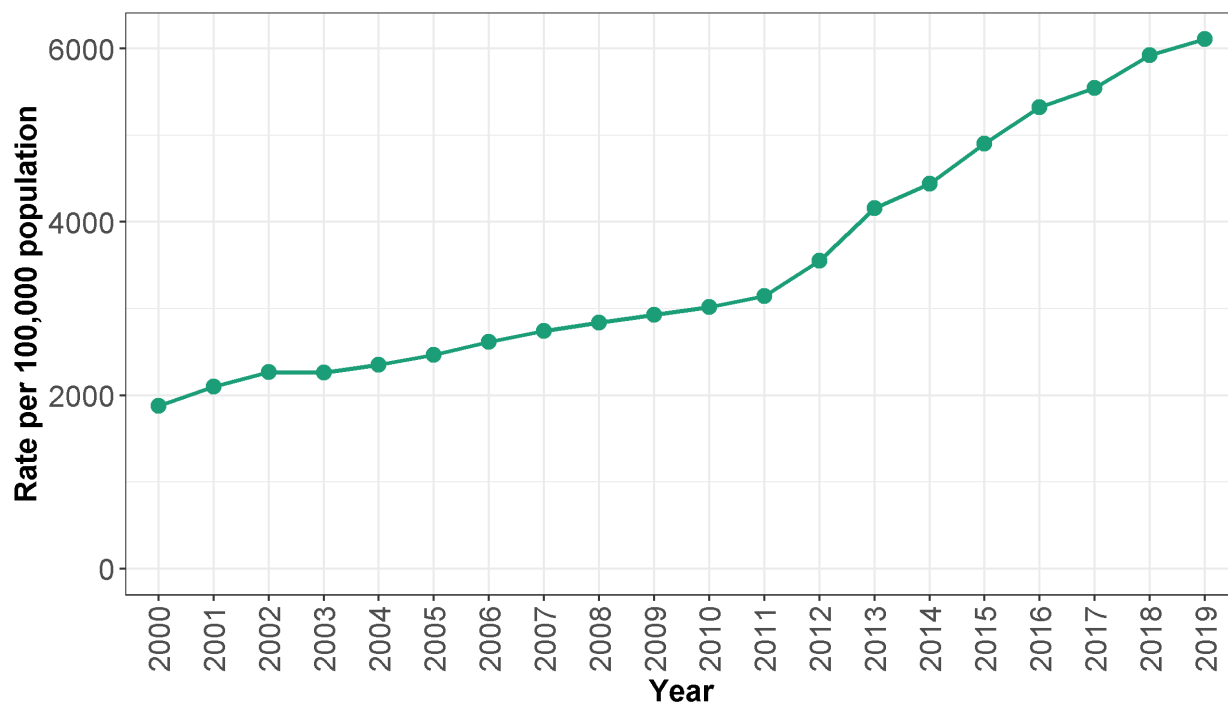
### 1.2.3. Trends in HCV antibody testing in BC, 2000-2019

Individuals may be tested for the presence of HCV antibodies multiple times within each year. In Section 1.2.2, individuals who tested multiple times within each year are only counted once that year. This is helpful to understand the reach of HCV antibody testing in the population. However, understanding the demand for anti-HCV testing is this important to inform resource allocation.

In this section, the number of unique testing episodes per 100,000 population is presented. Testing episodes include those for individuals who have never tested positive for HCV antibody and individuals who test positive for HCV antibody for the first time. That is, testing episodes are excluded after an individual tests positive for HCV antibody. Testing episodes conducted as part of clinical trials and the Evaluation of the Supervised Injection Site (ESIS) study are excluded due to lack of information regarding BC residency. HCV antibody testing data from the BCCDC PHL represent >95% of HCV antibody screening tests and all confirmatory HCV antibody tests performed in BCC.

In 2019, there were 309,796 anti-HCV testing episodes in BC; corresponding with a rate of 6108.8 testing episodes per 100,000 population. The testing episode rate rose steadily between 2000 and 2010, and increased more rapidly between 2011 and 2019 (Figure 9).

Figure 9. HCV antibody testing in BC, 2000-2019



## 1.3. HCV percent positivity in BC, 2000-2019

### 1.3.1. HCV percent positivity among HCV antibody testers in BC, 2000-2019

HCV percent positivity among HCV antibody testers represents the proportion of HCV antibody testers who had a positive test result for the first time. This indicator provides information on how widespread HCV is in the population that is tested, which helps inform where and among whom more testing may be needed.

The annual number of individuals with a positive HCV antibody test is presented as a percentage of the total number of HCV antibody testers for each group indicated, excluding individuals tested in clinical trials and the Evaluation of the Supervised Injection Site (ESIS) study due to lack of information regarding BC residency. HCV antibody testing data from the BCCDC PHL represent >95% of HCV antibody screening tests and all confirmatory HCV antibody tests performed in BC.

HCV positivity among individuals tested for HCV antibodies decreased steadily between 2000 and 2019, falling to 1% in 2017 (Figure 10). This decreasing trend in HCV-positivity was observed for both males and females (Figure 11) and across age groups (Figure 12). In 2019, the positivity rate for female testers was 0.4%, while that for males was 1.0% (Figure 11). In the same year, HCV testers aged 60+ years had the highest positivity rate of 0.9%, followed by testers in the 40-59 (0.8%), 25-29 (0.7%), 30-39 (0.6%), 0-14 (0.6%), 20-24 (0.4%) and 15-19 (0.2%) age groups (Figure 12).

Figure 10. HCV percent positivity among HCV antibody testers in BC, 2000-2019

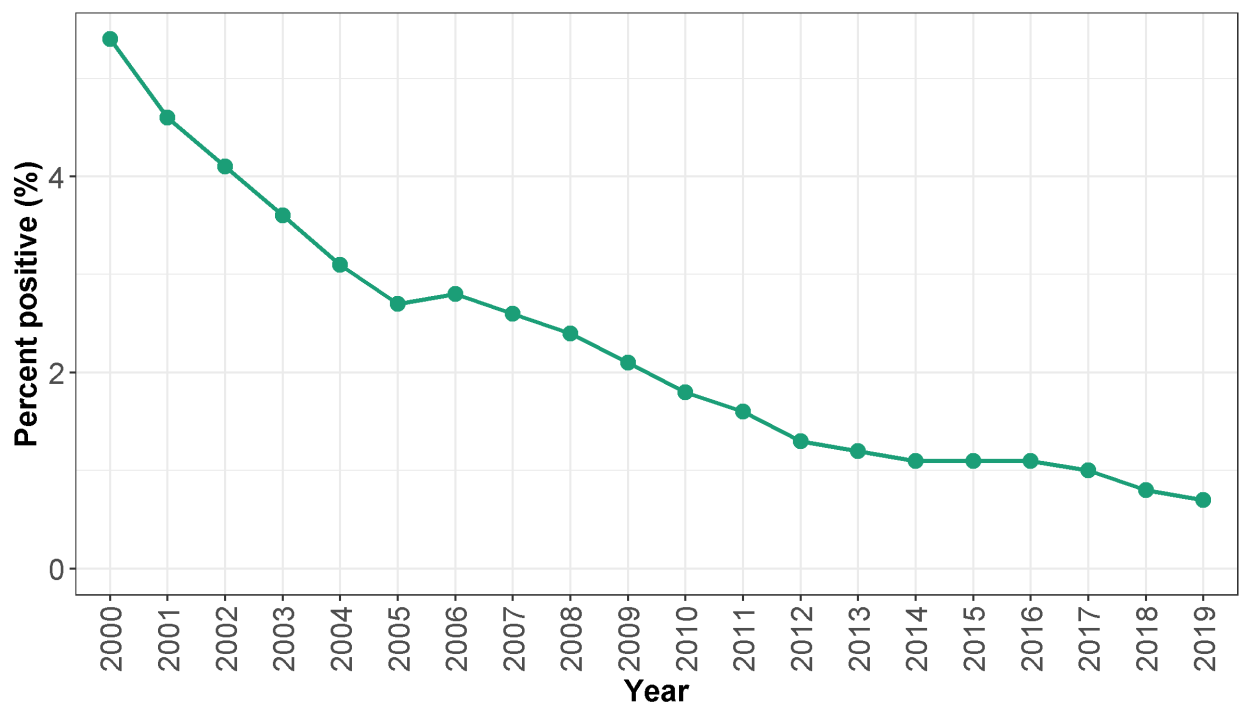


Figure 11. HCV percent positivity among HCV antibody testers in BC by sex, 2000-2019

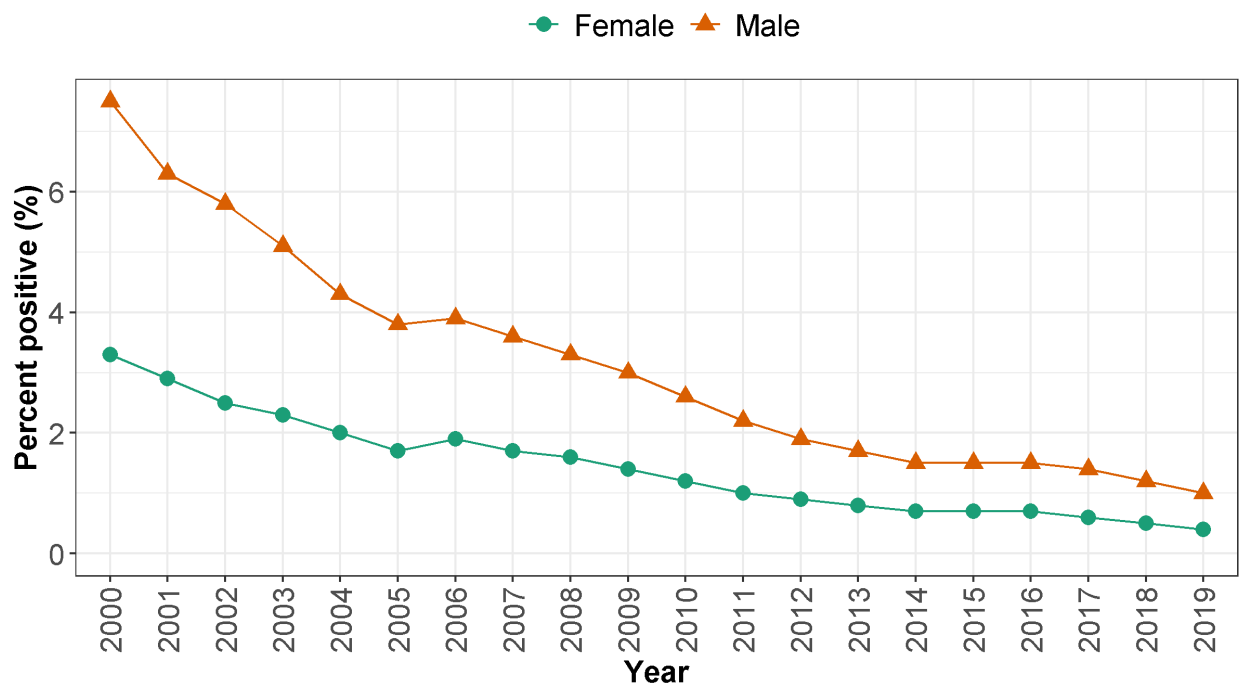
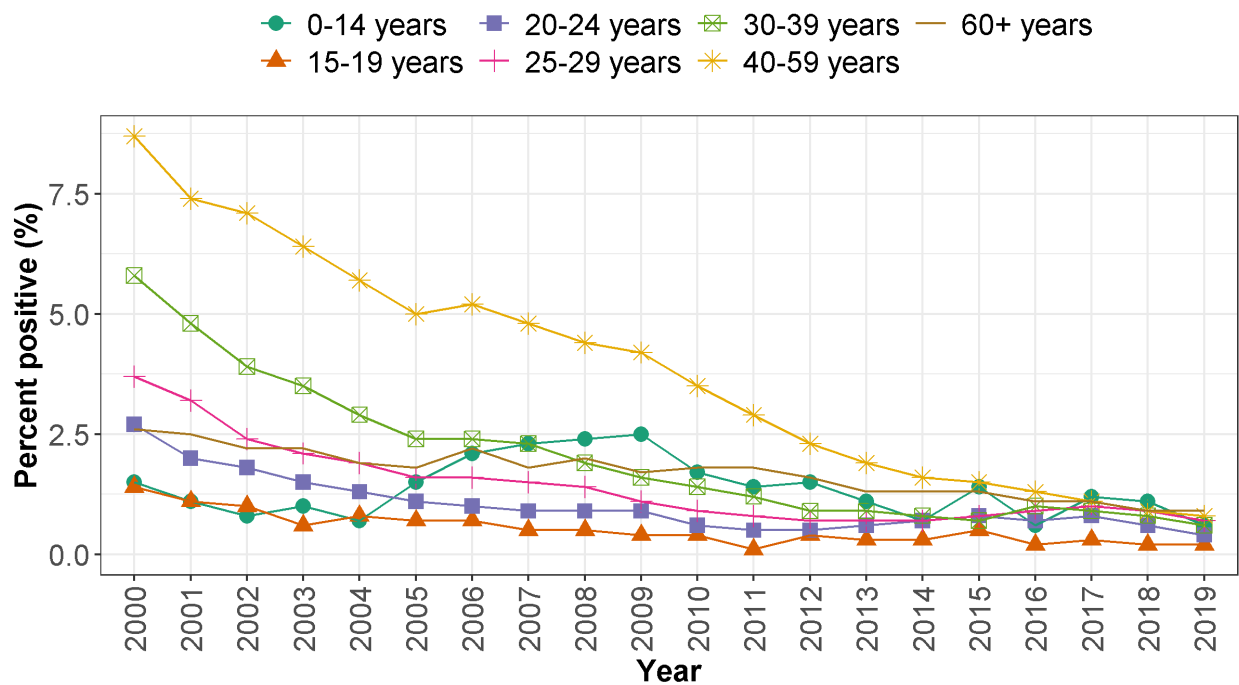


Figure 12. HCV percent positivity among HCV antibody testers in BC by age group, 2000-2019



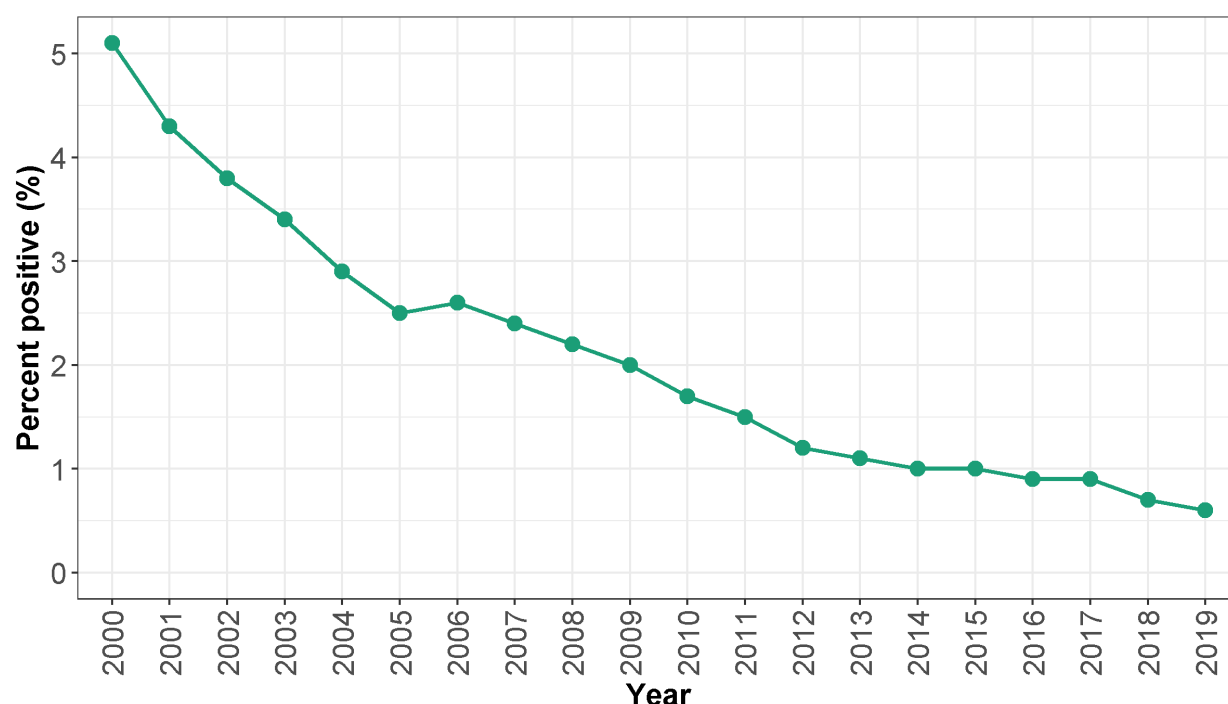
1.3.2. HCV percent positivity within HCV antibody testing episodes in BC, 2000-2019

Individuals may be tested for the presence of HCV antibodies multiple times within each year. HCV percent positivity by HCV antibody testing episodes represents the proportion of testing episodes that involved first-time HCV-positive test results. This indicator provides another way to understand how widespread HCV is in the population that is tested and can inform recommendations for how frequently people should be tested for HCV.

In this section, the annual number of anti-HCV positive testing episodes is presented as a percentage of the total number of testing episodes. Testing episodes include those for individuals who have never tested positive for HCV antibody and individuals who test positive for HCV antibody for the first time. That is, testing episodes are not included after an individual tests positive for HCV antibodies. Note each negative/indeterminate testing episode is counted per year, alongside the first-time HCV-positive testing episode, so individuals may be counted multiple times in each year. Testing episodes conducted as part of clinical trials and the Evaluation of the Supervised Injection Site (ESIS) study are excluded due to lack of information regarding BC residency. HCV antibody testing data from the BCCDC PHL represent >95% of HCV antibody screening tests and all confirmatory HCV antibody tests performed in BC.

HCV positivity within testing episodes decreased steadily between 2000 and 2019, falling below 1% in 2016 (Figure 13).

Figure 13. HCV percent positivity within HCV antibody testing episodes in BC, 2000-2019



## 1.4. HCV seroconversion among repeat testers in BC, 2000-2019

HCV seroconversion refers to the change in serological status from a negative to a positive anti-HCV test result. This indicator is a measure of new (incident) HCV infections, particularly among populations at-risk for HCV who tend to be routinely tested for HCV. In the subset of HCV testers with recent negative testing history, those who seroconverted can be identified and the time frame during which they were infected established. Documented seroconversions represent incident infections and may be indicative of a core transmission group. The number of individuals with an anti-HCV-positive test result within 12 or 24 months of a prior negative test result is presented as a proportion of all individuals with a prior negative test within 12 or 24 months, respectively, excluding testers/cases from clinical trials and the Evaluation of the Supervised Injection Site (ESIS) study due to lack of information regarding BC residency. HCV antibody testing data from the BCCDC PHL represent >95% of HCV antibody screening tests and all confirmatory HCV antibody tests performed in BC.

### 1.4.1. Characteristics of individuals who seroconverted within 24 months of their last negative anti-HCV test in BC, 2019

In 2019, there were 77,021 individuals who had another anti-HCV test within 24 months of their previous negative anti-HCV test result (Table 4). Of these individuals, 222 had a positive anti-HCV test result (i.e. seroconverted) within 24 months of their last negative anti-HCV test. In the same year, males (61.7%) and persons aged 25-39 years (62.2%) formed the majority of people who seroconverted within 24 months in the province. Most people who seroconverted within 24 months resided in Fraser (31.5%) and Vancouver Coastal Health Authorities (23.9%) in 2019.

**Table 4. Characteristics of individuals who received anti-HCV tests within 24 months of their last negative anti-HCV test (repeat testers) and those who seroconverted within 24 months in BC, 2019**

Variable	Category	Repeat Tester Frequency	Repeat Tester Percent	Seroconverter Frequency	Seroconverter Percent
Province	BC	77,021	100.0	222	100.0
Sex	Female	41,414	53.8	85	38.3
	Male	35,495	46.1	137	61.7
Age Group	0-14 years	261	0.3	1	0.5
	15-19 years	1,919	2.5	7	3.2
	20-24 years	8,143	10.6	23	10.4
	25-29 years	11,091	14.4	51	23.0
	30-39 years	21,605	28.1	87	39.2
	40-59 years	19,878	25.8	42	18.9
	60+ years	14,121	18.3	11	5.0
Health Authority	Vancouver Coastal	27,306	35.5	53	23.9
	Vancouver Island	7,832	10.2	32	14.4
	Fraser	28,519	37.0	70	31.5
	Interior	8,911	11.6	46	20.7
	Northern	4,441	5.8	21	9.5

#### **1.4.2. Characteristics of individuals who seroconverted within 12 months of their last negative anti-HCV test in BC, 2019**

In 2019, there were 49,281 individuals who had another anti-HCV test within 12 months of their previous negative anti-HCV test result (Table 5). Of these individuals, 131 seroconverted within 12 months of their last negative anti-HCV test. In the same year, males (57.3%) and persons aged 25-39 years (62.6%) formed the majority of people who seroconverted within 12 months in the province. Most people who seroconverted within 12 months resided in Fraser (32.1%) and Vancouver Coastal Health Authorities (25.2%) in 2019.

**Table 5. Characteristics of individuals who received anti-HCV tests within 12 months of their last negative anti-HCV test (repeat testers) and those who seroconverted within 12 months in BC, 2019**

Variable	Category	Repeat Tester Frequency	Repeat Tester Percent	Seroconverter Frequency	Seroconverter Percent
Province	BC	49,281	100.0	131	100.0
Sex	Female	25,668	52.1	56	42.7
	Male	23,544	47.8	75	57.3
Age Group	0-14 years	192	0.4	1	0.8
	15-19 years	1,372	2.8	6	4.6
	20-24 years	5,482	11.1	12	9.2
	25-29 years	7,185	14.6	28	21.4
	30-39 years	13,191	26.8	54	41.2
	40-59 years	12,469	25.3	22	16.8
	60+ years	9,388	19.0	8	6.1
Health Authority	Vancouver Coastal	17,480	35.5	33	25.2
	Vancouver Island	4,990	10.1	18	13.7
	Fraser	18,243	37.0	42	32.1
	Interior	5,646	11.5	23	17.6
	Northern	2,914	5.9	15	11.5

### 1.4.3. HCV seroconversion among repeat testers in BC, 2000-2019

HCV seroconversion rates within the province declined sharply between 2000 and 2011 and stabilized thereafter (Figure 14). In 2019, the HCV seroconversion rate within 12 months was 26.6 per 10,000 repeat testers, while the HCV seroconversion rate within 24 months was 28.8 HCV cases per 10,000 repeat testers (Figure 14). This trend in HCV seroconversion was similar to that observed for males and females (Figure 15) and across age groups (Figure 16 and Figure 17), with higher HCV seroconversion rates for males (38.6 per 10,000 repeat testers within 24 months) than females (20.5 per 10,000 repeat testers within 24 months) in 2019 (Figure 15). HCV seroconversion rates remained relatively lower for persons aged 60+ years between 2000 and 2019 (Figure 16 and Figure 17). In 2019, the seroconversion rate within 24 months was highest for persons aged 25-29 years (46.0 per 10,000 repeat testers), followed by testers in the 30-39 (40.3 per 10,000 repeat testers), 0-14 (38.3 per 10,000 repeat testers), 15-19 (36.5 per 10,000 repeat testers), 20-24 (28.2 per 10,000 repeat testers), 40-59 (21.1 per 10,000 repeat testers), 60+ (7.8 per 10,000 repeat testers) age groups (Figure 17). The seroconversion rates within 12 months and 24 months were nearly identical for all groups in recent years.



Figure 14. HCV seroconversion among repeat testers in BC, 2000-2019

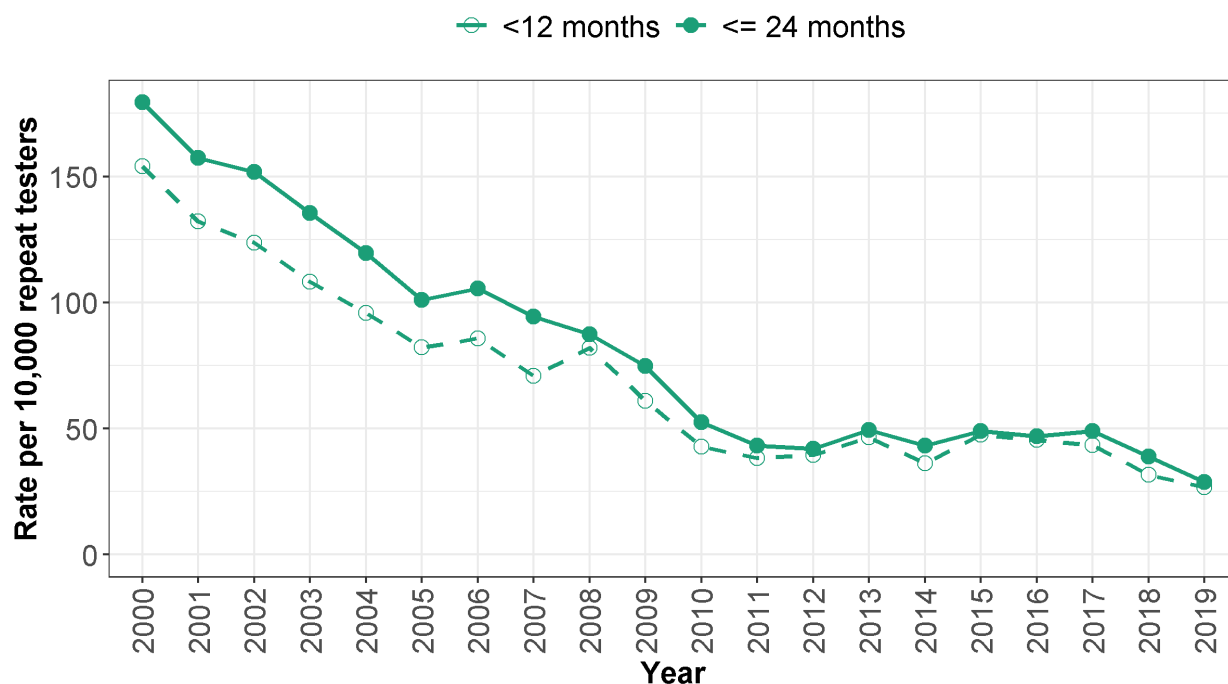


Figure 15. HCV seroconversion among repeat testers in BC by sex, 2000-2019

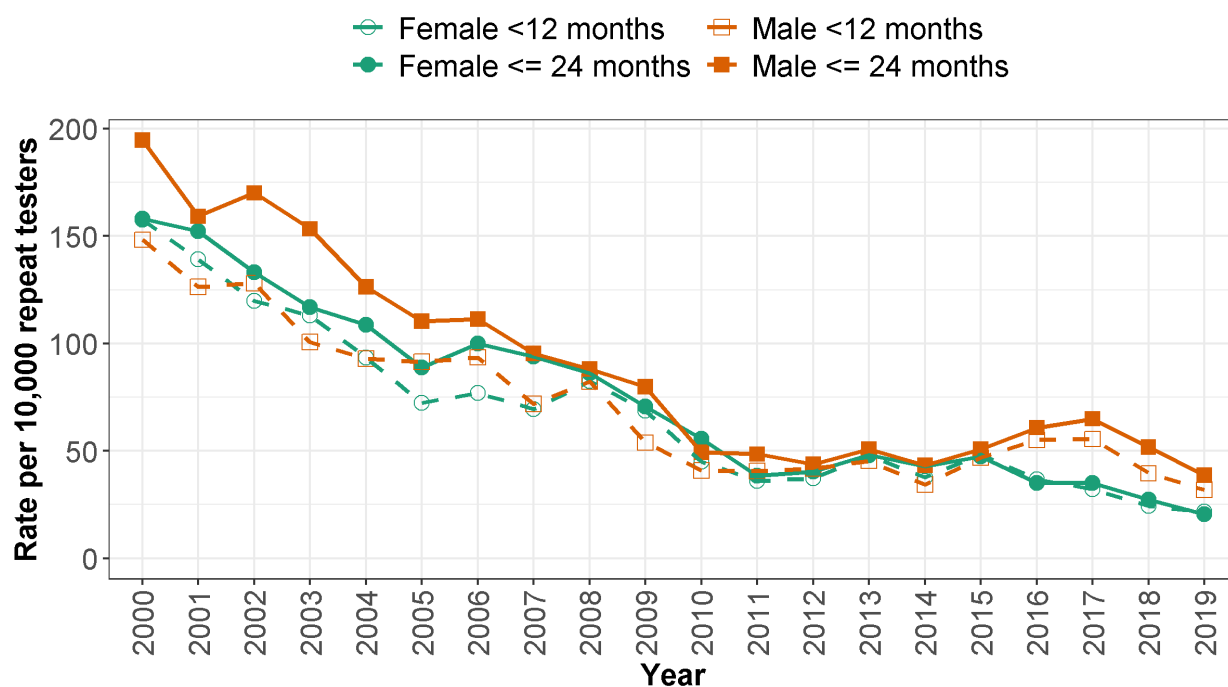


Figure 16. HCV seroconversion among repeat testers within 12 months of the most recent anti-HCV negative test in BC by age group, 2000-2019

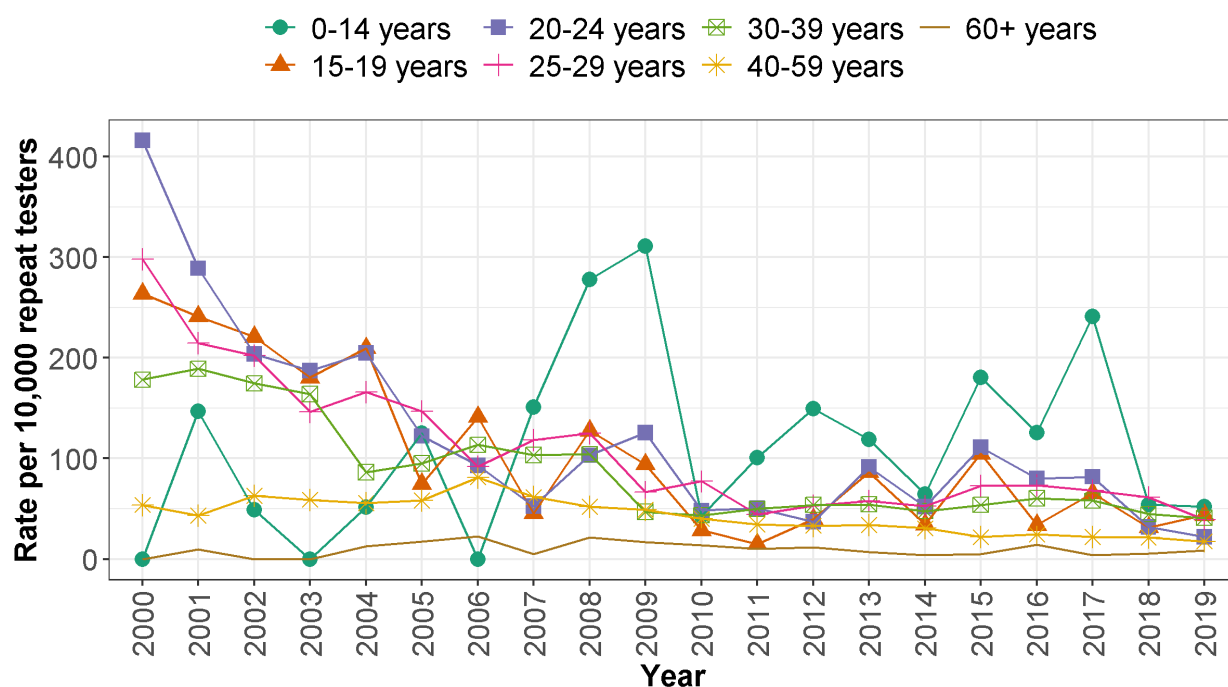
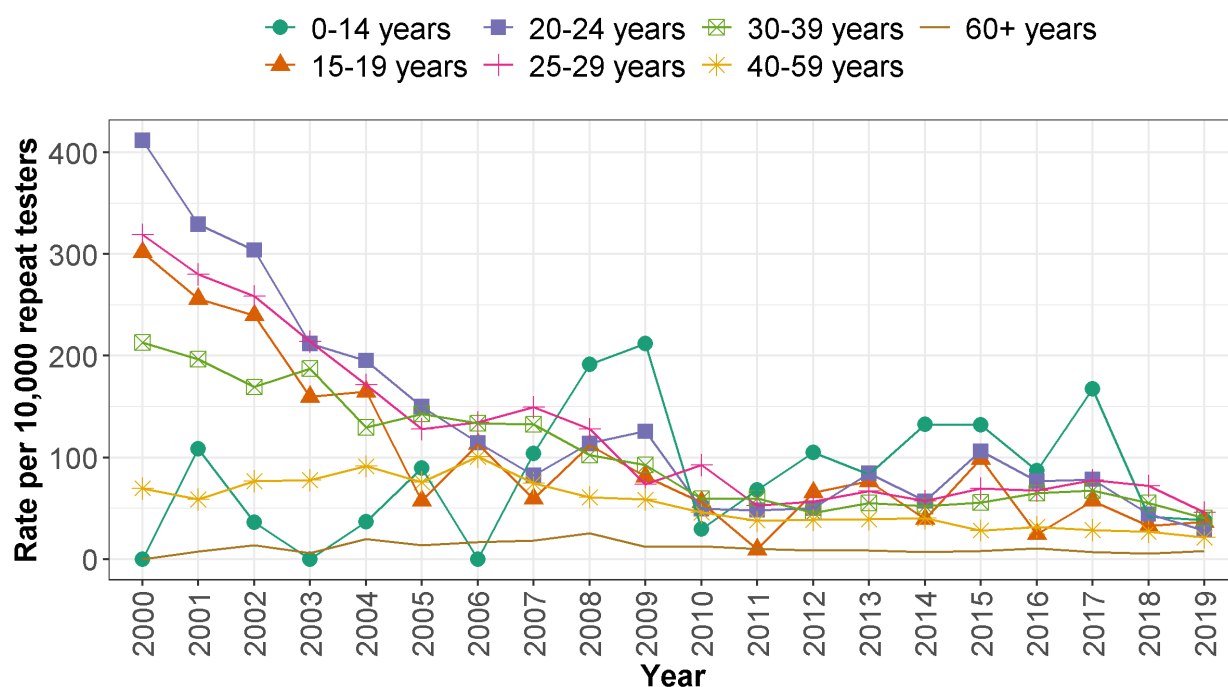


Figure 17. HCV seroconversion among repeat testers within 24 months of the most recent anti-HCV negative test in BC by age group, 2000-2019



## 2. HCV Care Cascade

The HCV cumulative care cascade is a tool designed to inform decision and policy makers about the effectiveness of programs to reduce the HCV disease burden within their jurisdictions. The cascade also serves to identify gaps in access to care and services utilized by affected populations.

Data for this section are generated from the **BC Hepatitis Testers Cohort (BC-HTC)**. Results presented are for persons for whom laboratory testing/case data were successfully linked with administrative data and who were **alive** at the end of each year. Data spanning 2016-2019 represent follow-up data for persons within the BC-HTC by the end of 2015, and thus excludes new cases from individuals absent from the cohort by the end of 2015. **See Appendix A.2** for more information about the BC-HTC.

### 2.1. HCV care cascade for BC, 2000-2019

The 2000-2019 cumulative HCV care cascade for BC is shown in Figure 18 (53). This graph shows the total number of people who have ever been diagnosed with HCV within the province and follows their journey from the first diagnosis (reinfections excluded) through each step of the care cascade. Also shown in Figure 19 is a cross-sectional view of the provincial cumulative HCV care cascade for the year 2019. Data for persons who were alive at the end of each year are presented.

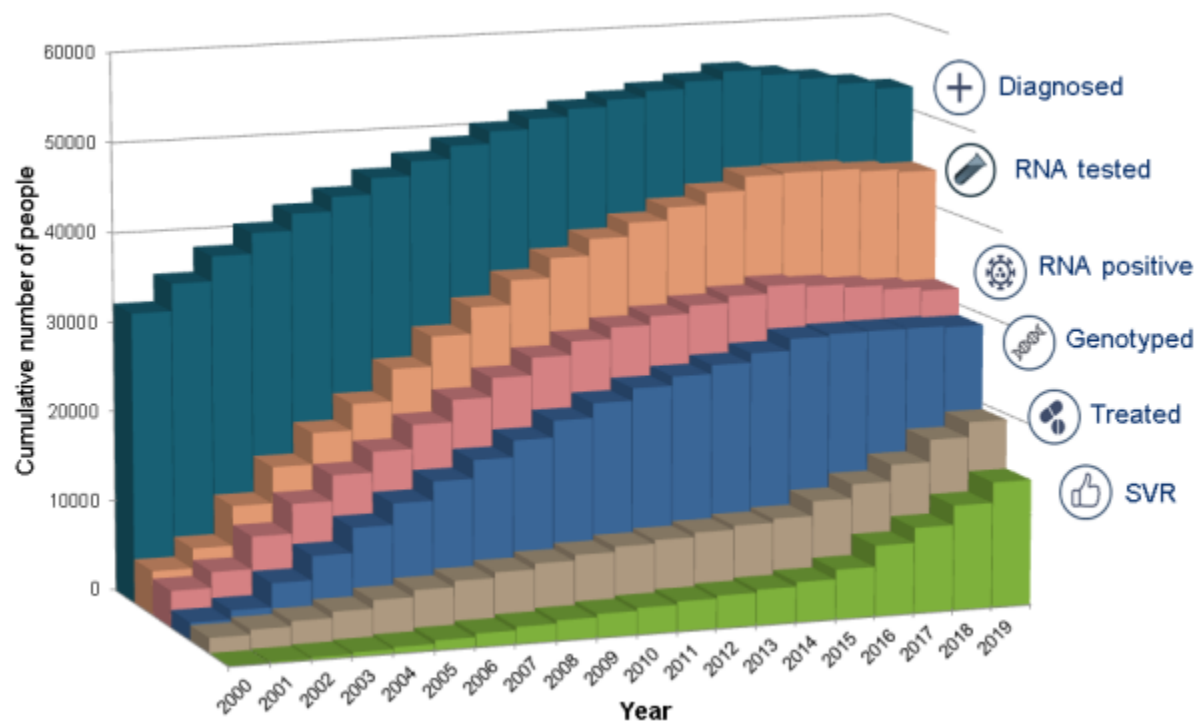
The cumulative HCV care cascade is comprised of the following stages:

1. **Diagnosed (anti-HCV+):** The cumulative sum of people diagnosed with HCV in BC
2. **HCV RNA tested:** The cumulative sum of those who received RNA tests
3. **HCV RNA detected (HCV RNA+):** The cumulative sum of those who tested positive for HCV RNA (active viral replication)
4. **HCV genotype performed:** The cumulative sum of those whose viral strains were successfully genotyped
5. **Treatment initiation:** The cumulative sum of those who initiated treatment
6. **Sustained virologic response (SVR):** The cumulative sum of those who achieved SVR post-treatment (cured).

The cumulative sum of persons diagnosed with HCV in BC steadily increased from 2000-2019 (Figure 18). The proportion of anti-HCV positive persons who were HCV RNA tested rapidly increased between 2000 and 2009; closing the gap between anti-HCV diagnosis and RNA-testing. Significant improvements in HCV treatment initiation were observed after DAA introduction in Canada in 2013, as did the proportion of individuals achieving SVR post-treatment. By the end of 2019, 52,641 individuals had been diagnosed with HCV in BC; 19,394 of whom had initiated treatment and 13,928 of whom had achieved SVR (Figure 19).

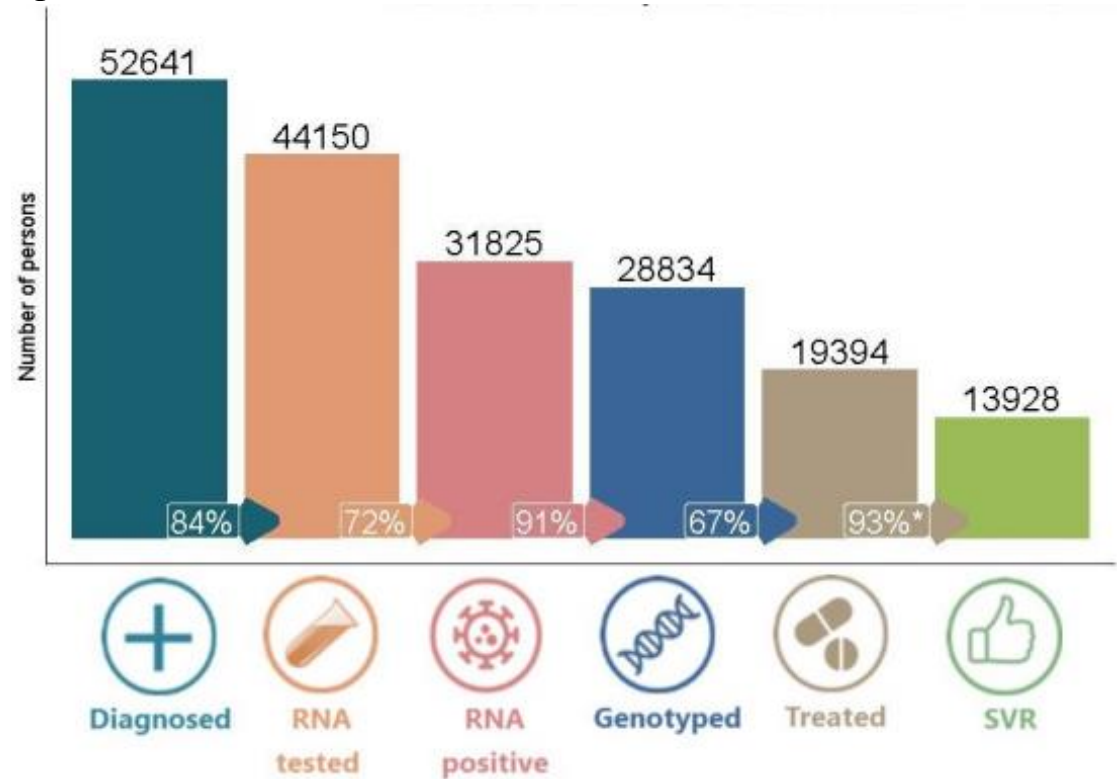
Detailed analyses of key steps of the care cascade for BC and for specific population groups are presented in sections 2.3-2.7 of this report.

Figure 18. The cumulative HCV care cascade for BC, 2000-2019



2016-2019 represent follow-up data for persons in the BC-HTC by the end of 2015

Figure 19. The cumulative HCV care cascade for BC, 2019



2019 represents follow-up data for persons in the BC-HTC by the end of 2015  
The denominator for %SVR includes only treated cases with known PCR information after treatment initiation

## 2.2. Characteristics of people ever diagnosed with HCV in BC, 2000-2019

A total of 52,641 individuals were diagnosed with HCV in BC between 2000 and 2019. Males formed 62.9% of persons diagnosed with HCV who were still alive by the end of 2019 (Table 6). Persons aged 40-59 (44.8%) and 60+ (44.5%) years in 2019, as well as the 1945-1964 (56.7%) and 1965-74 (21.9%) birth cohorts, formed the majority of this population. Persons diagnosed with HCV were mostly of non-East Asian and non-South Asian ethnic backgrounds (91.8%), and mostly resided in Fraser (30.7%) and Vancouver Coastal (23.7%) Health Authorities in 2019. By the end of 2015, less than 10% of people diagnosed with HCV had ever been diagnosed with HBV (6.3%) or HIV (5.3%) (Table 7). Persons with a history of injection drug use or problematic alcohol use formed 41.2% and 27.6% of this population, respectively, by the end of 2015. *[Note that important data sources for variable definition were only available until the end of 2015. See Appendix A.2 for more information about the BC Hepatitis Testers Cohort and variable definitions].*

**Table 6. Characteristics of people ever diagnosed with HCV in BC, 2019**

Variable	Category	Frequency	Percent
Province	BC	52,641	100.0
Sex	Female	19,522	37.1
	Male	33,116	62.9
Age Group	0-14 years	88	0.2
	15-19 years	72	0.1
	20-24 years	300	0.6
	25-29 years	890	1.7
	30-39 years	4,280	8.1
	40-59 years	23,602	44.8
	60+ years	23,409	44.5
Birth Cohort	<1945	2,127	4.0
	1945-1964	29,843	56.7
	1965-1974	11,537	21.9
	>=1975	9,134	17.4
Ethnicity	East Asian	2,173	4.1
	South Asian	2,155	4.1
	Other BC resident	48,313	91.8
Health Authority	Vancouver Coastal	12,451	23.7
	Vancouver Island	10,140	19.3
	Fraser	16,157	30.7

Variable	Category	Frequency	Percent
	Interior	8,834	16.8
	Northern	3,731	7.1

**Table 7. Co-infections and comorbidities among people diagnosed with HCV in BC, 2015\***

Variable	Frequency	Percent
BC	55,446	100.0
HBV (ever)	3,485	6.3
HIV (ever)	2,961	5.3
Injection drug use (ever)	22,864	41.2
Problematic alcohol use (ever)	15,287	27.6

\*\*Data available up to 2015 only. Important data sources for variable definition were only available until the end of 2015. See Appendix A.2 for more information about the BC Hepatitis Testers Cohort and variable definitions.

## 2.3. Trends in HCV diagnoses in BC, 2000-2019 (cumulative)

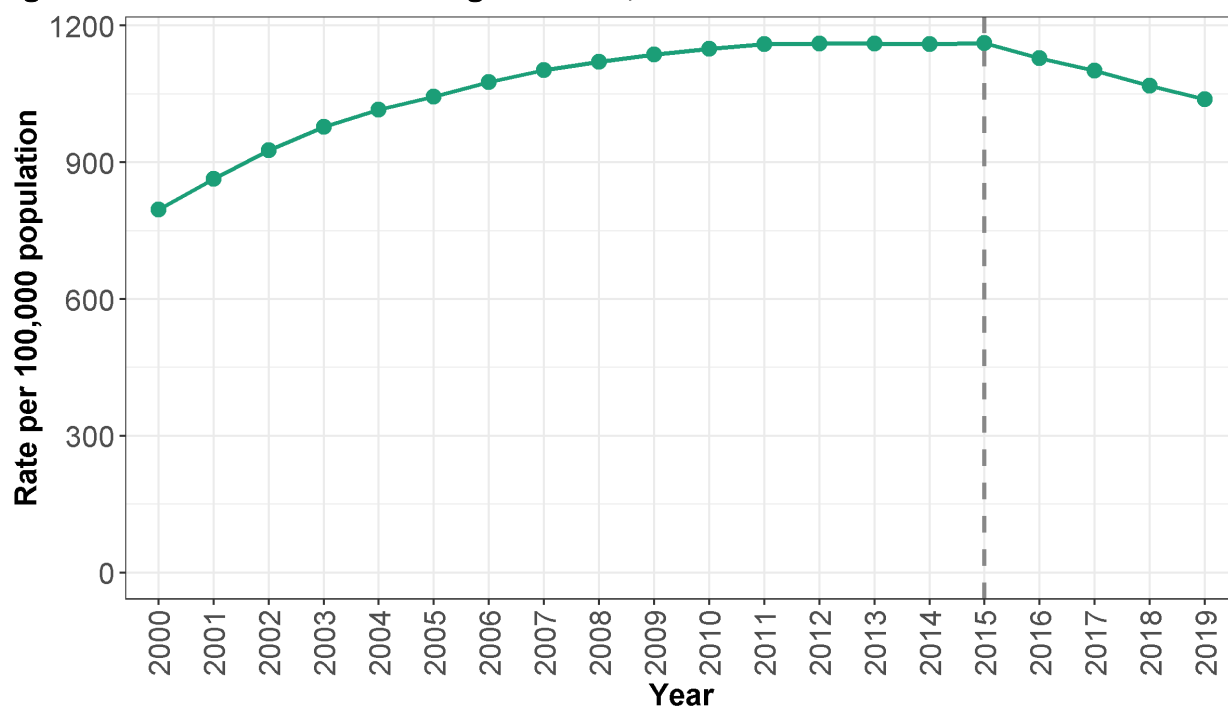
This indicator is a measure of burden of disease and is the first step of the HCV care cascade. It informs planning strategies and resource allocation to reduce the HCV disease burden among at-risk populations. The cumulative sum of people ever diagnosed with HCV (through testing and reported cases) that were alive by the end of each year is presented as a rate for the different population groups (Figure 20 to Figure 23). Persons who died by year-end were excluded from this analysis. This indicator reflects first-time HCV diagnoses and excludes reinfection. This indicator does not represent HCV prevalence, as HCV is curable and some diagnosed persons may have been treated and cured with no reinfection.

By the end of 2019, 52,641 people (1038.0 per 100,000 population) had been diagnosed in BC (Figure 20). In 2019, the highest regional cumulative HCV diagnosis rates of 1312.2 and 1180.7 per 100,000 population occurred in Northern (3,731 total HCV cases) and Vancouver Island (10,140 total HCV cases) Health Authorities, respectively (Figure 21). Cumulative HCV diagnosis rates differed by sex, always notably higher among males than females (Figure 22). In 2019, a cumulative sum of 33,116 HCV cases were male (1318.9 per 100,000 males), while 19,522 cases were female (762.4 per 100,000 females). Cumulative HCV diagnosis rates also varied by age group and were consistently highest among people aged 40-59 years, falling to 1722.6 per 100,000 population in 2019 (Figure 23). Of note, the cumulative HCV diagnosis rate has progressively increased in the 60+ age group, reaching 1797.8 per 100,000 population in 2019.

In addition to new diagnoses of HCV, changes in cumulative HCV diagnosis rates observed for different age groups were the result of death and movement between age groups. Similarly, death and migration in and out of Health Authorities also factored into observed changes in regional HCV diagnosis rates.

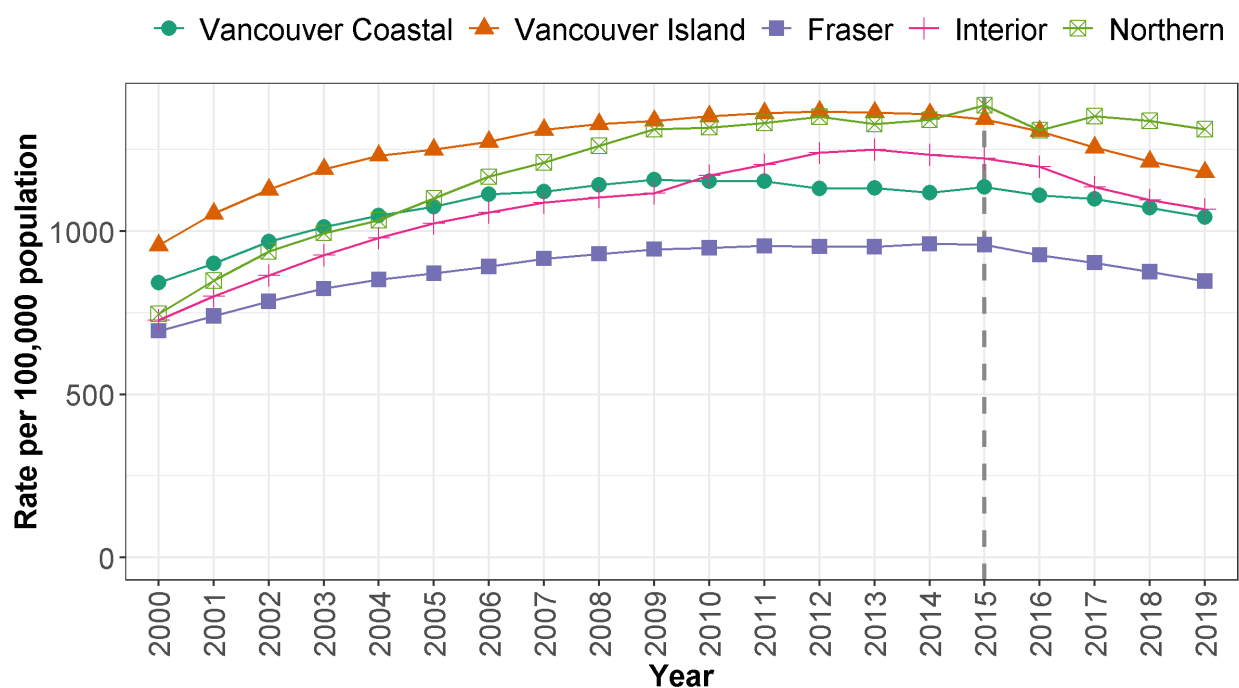


Figure 20. Cumulative rate of HCV diagnoses in BC, 2000-2019



2016-2019 represent follow-up data for persons in the BC-HTC by the end of 2015

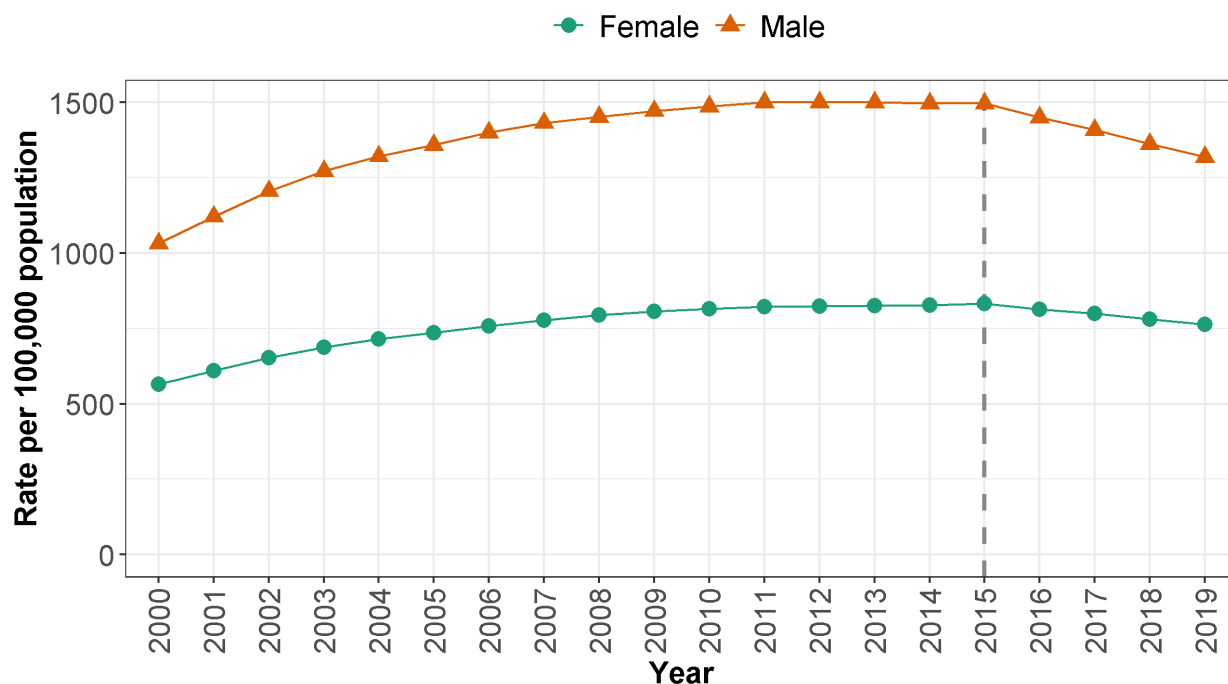
Figure 21. Cumulative rate of HCV diagnoses in BC by Health Authority, 2000-2019



2016-2019 represent follow-up data for persons in the BC-HTC by the end of 2015

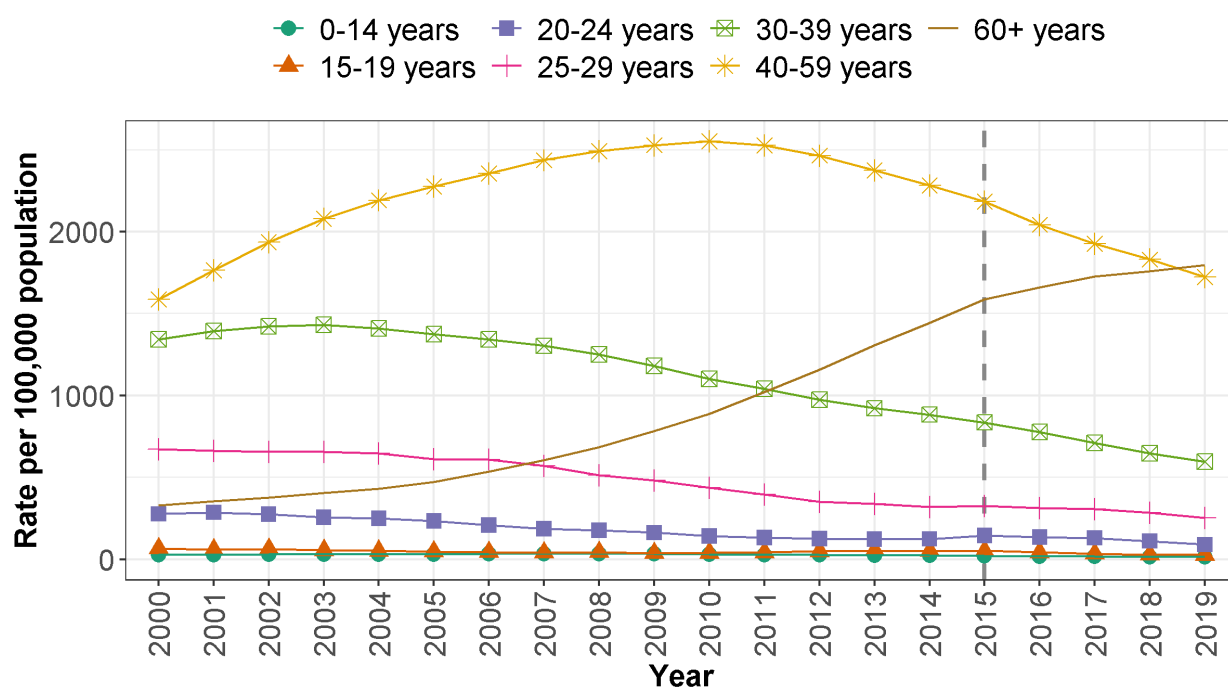
Individuals may move in and out of health regions over time

Figure 22. Cumulative rate of HCV diagnoses in BC by sex, 2000-2019



2016-2019 represent follow-up data for persons in the BC-HTC by the end of 2015

Figure 23. Cumulative rate of HCV diagnoses in BC by age group, 2000-2019



2016-2019 represent follow-up data for persons in the BC-HTC by the end of 2015

Individuals may move between age groups over time

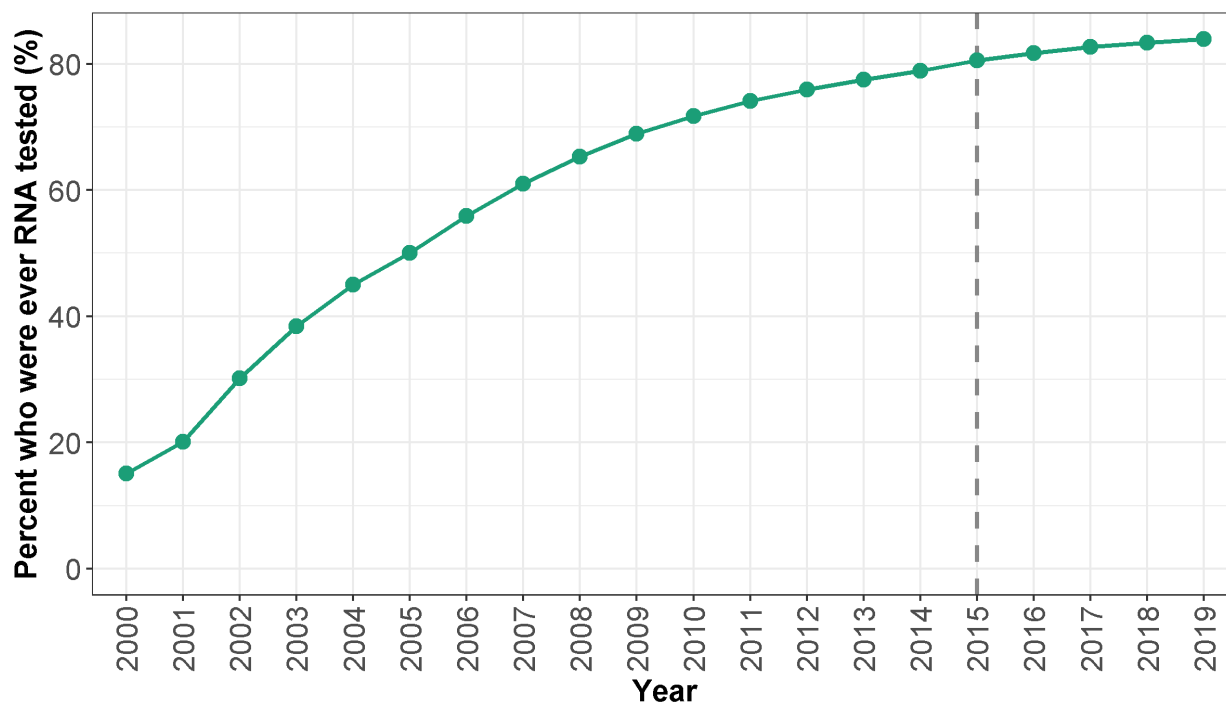
## 2.4. Trends in HCV RNA testing among people diagnosed with HCV in BC, 2000-2019 (cumulative)

Following an HCV diagnosis, testing by polymerase chain reaction (PCR) to detect HCV ribonucleic acid (RNA) is needed to confirm an active infection (versus a resolved infection). People with active HCV infection are at higher risk for complications, which can be reduced with treatment.

In BC, the proportion of individuals diagnosed each year that proceeded to RNA testing has increased and this progression along the care cascade is occurring more rapidly. HCV RNA testing was introduced in BC in the 1990s but was more commonly used after 2000. Progression to RNA testing after HCV diagnosis has changed significantly over time and these measures can provide both a snapshot of those who still require confirmatory testing as well as a means to monitor changes in laboratory procedures and changes in RNA testing by BC clinicians. The cumulative sum of people receiving HCV RNA tests post-HCV diagnosis and alive by year-end is presented as a proportion of diagnosed individuals living with HCV for each group indicated in Figure 24 to Figure 29.

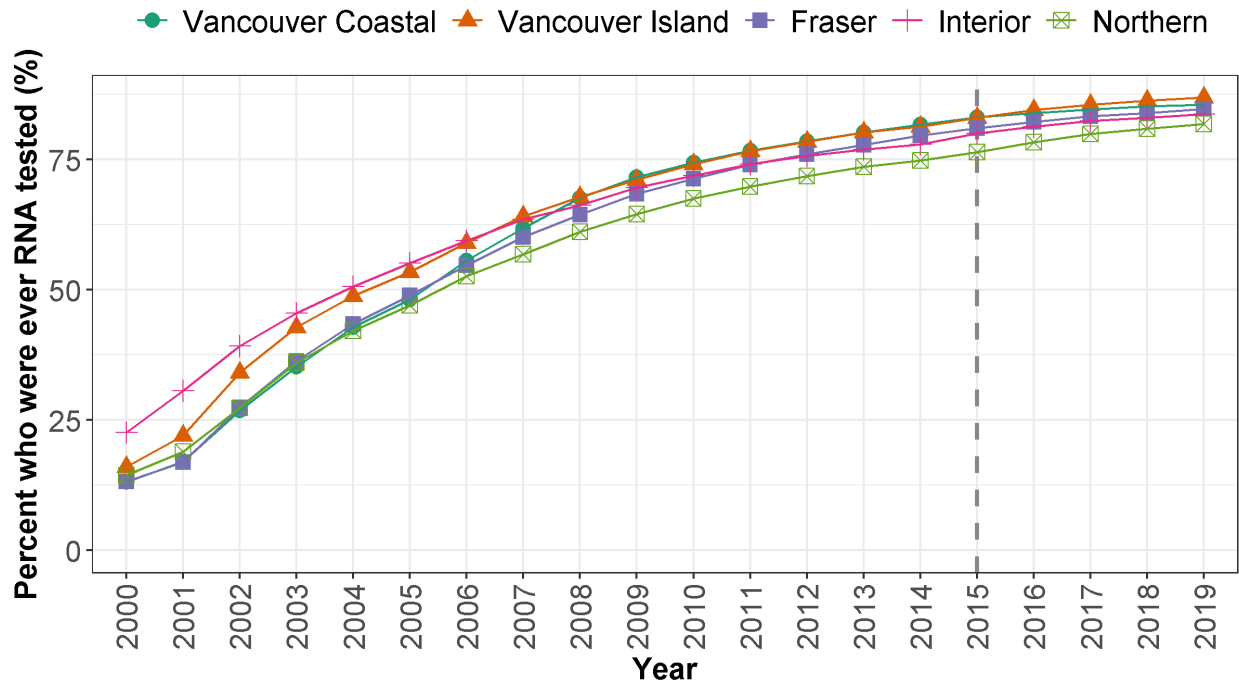
By the end of 2019, 83.9% of the people diagnosed with HCV had an HCV RNA test (Figure 24), with cumulative HCV RNA testing rates post-diagnosis being at or above 80% across all Health Authorities (Figure 25), sexes (Figure 26) and ethnicities (Figure 27). The cumulative HCV RNA testing rate was lowest in Northern Health Authority (81.8%) and highest in Vancouver Island Health Authority (86.9%) (Figure 25). HCV RNA testing was higher among females (86.0%) than males (82.6%) (Figure 26). South Asians (90.9%) (Figure 27), people aged 30-39 years (89.3%) (Figure 28), and people born after 1974 (86.8%) (Figure 29) were among the groups with the highest cumulative HCV RNA testing rates in 2019. HCV RNA testing post-diagnosis was least common among people aged 20-24 (77.7%) and people born before 1945 (79.0%) by the end of 2019.

Figure 24. HCV RNA testing among people diagnosed with HCV in BC, 2000-2019 (cumulative)



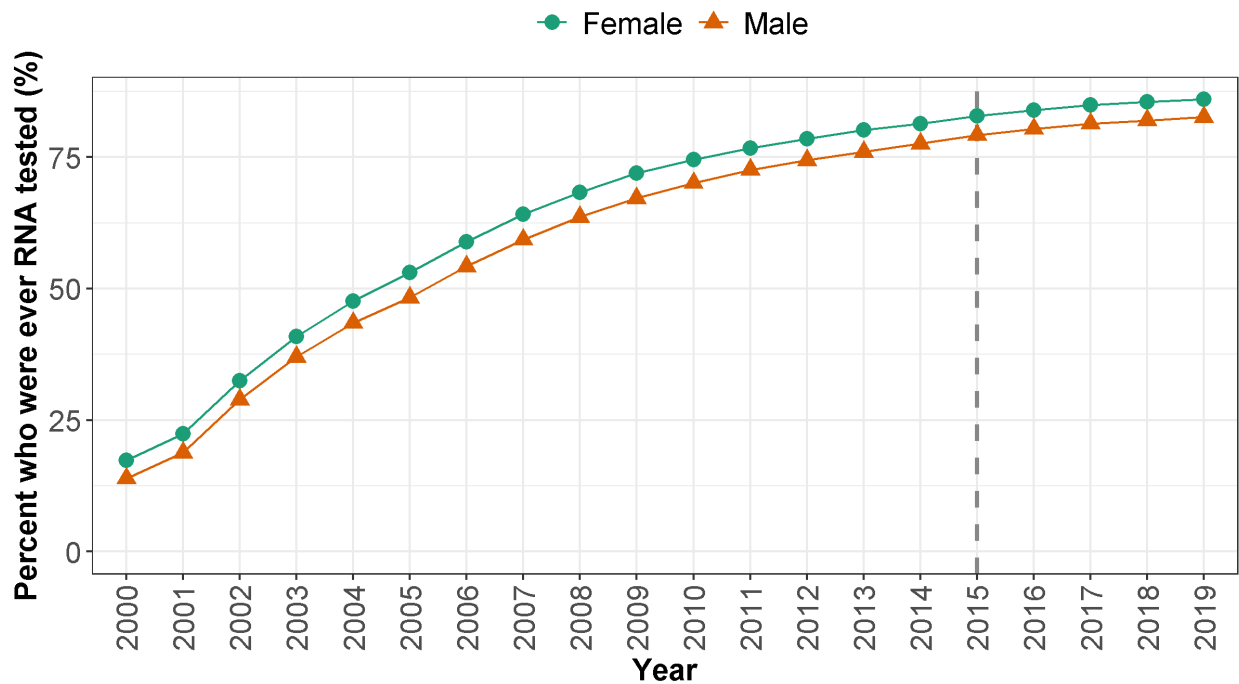
2016-2019 represent follow-up data for persons in the BC-HTC by the end of 2015

Figure 25. HCV RNA testing among people diagnosed with HCV in BC by Health Authority, 2000-2019 (cumulative)



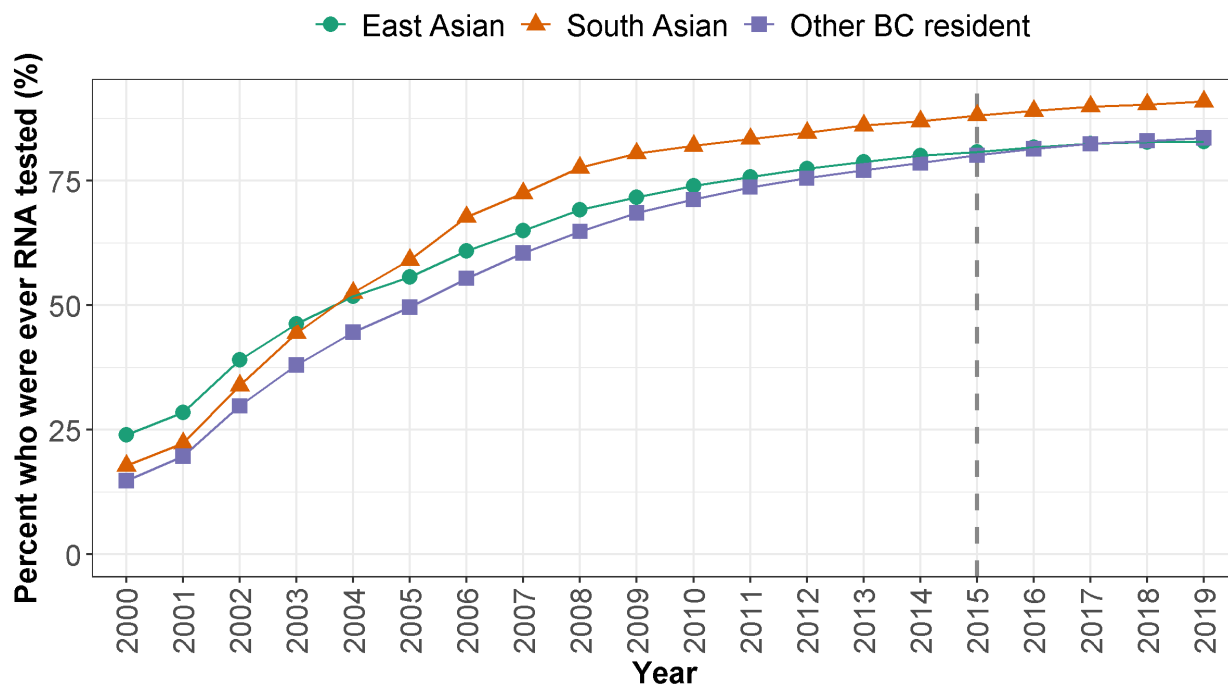
2016-2019 represent follow-up data for persons in the BC-HTC by the end  
Individuals may move in and out of health regions over time

Figure 26. HCV RNA testing among people diagnosed with HCV in BC by sex, 2000-2019 (cumulative)



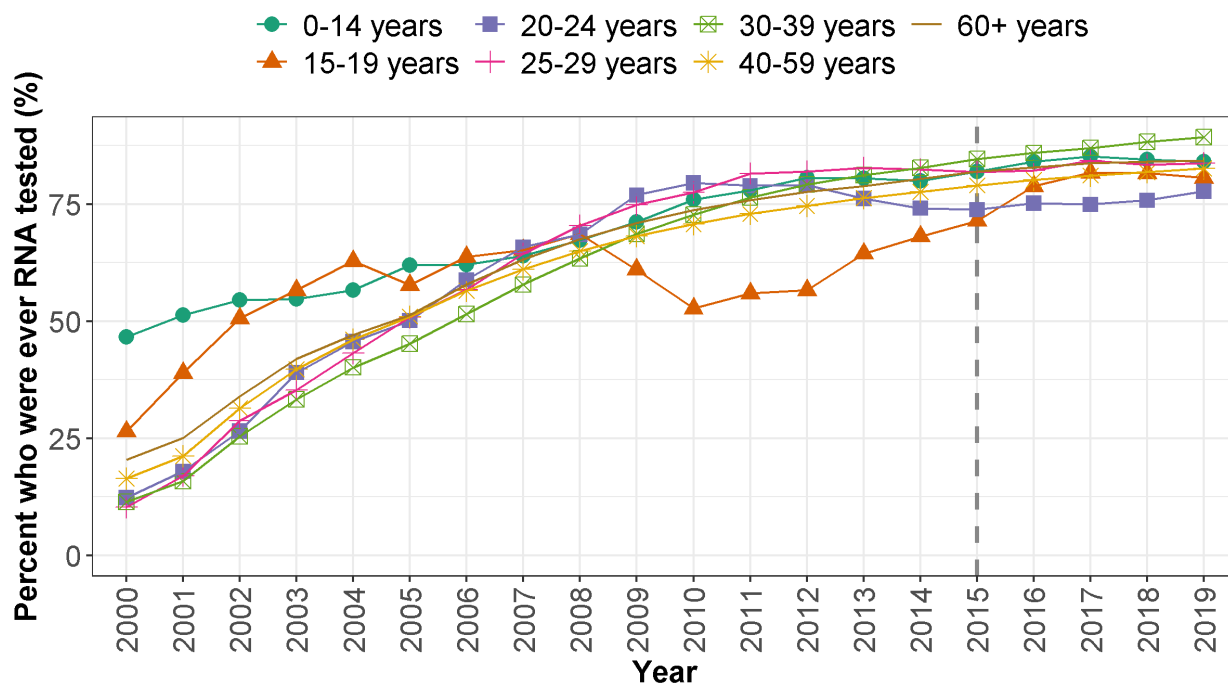
2016-2019 represent follow-up data for persons in the BC-HTC by the end of 2015

Figure 27. HCV RNA testing among people diagnosed with HCV in BC by ethnicity, 2000-2019 (cumulative)



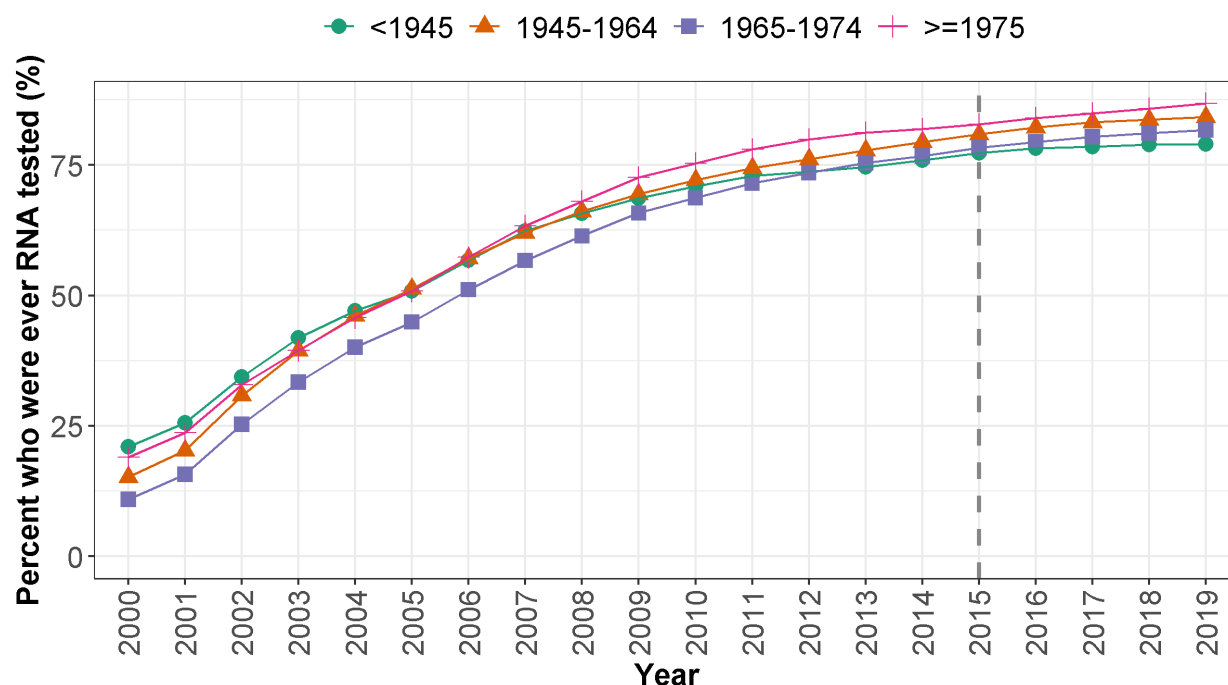
2016-2019 represent follow-up data for persons in the BC-HTC by the end of 2015

Figure 28. HCV RNA testing among people diagnosed with HCV in BC by age group, 2000-2019 (cumulative)



2016-2019 represent follow-up data for persons in the BC-HTC by the end of 2015

Figure 29. HCV RNA testing among people diagnosed with HCV in BC by birth cohort, 2000-2019 (cumulative)



2016-2019 represent follow-up data for persons in the BC-HTC by the end of 2015

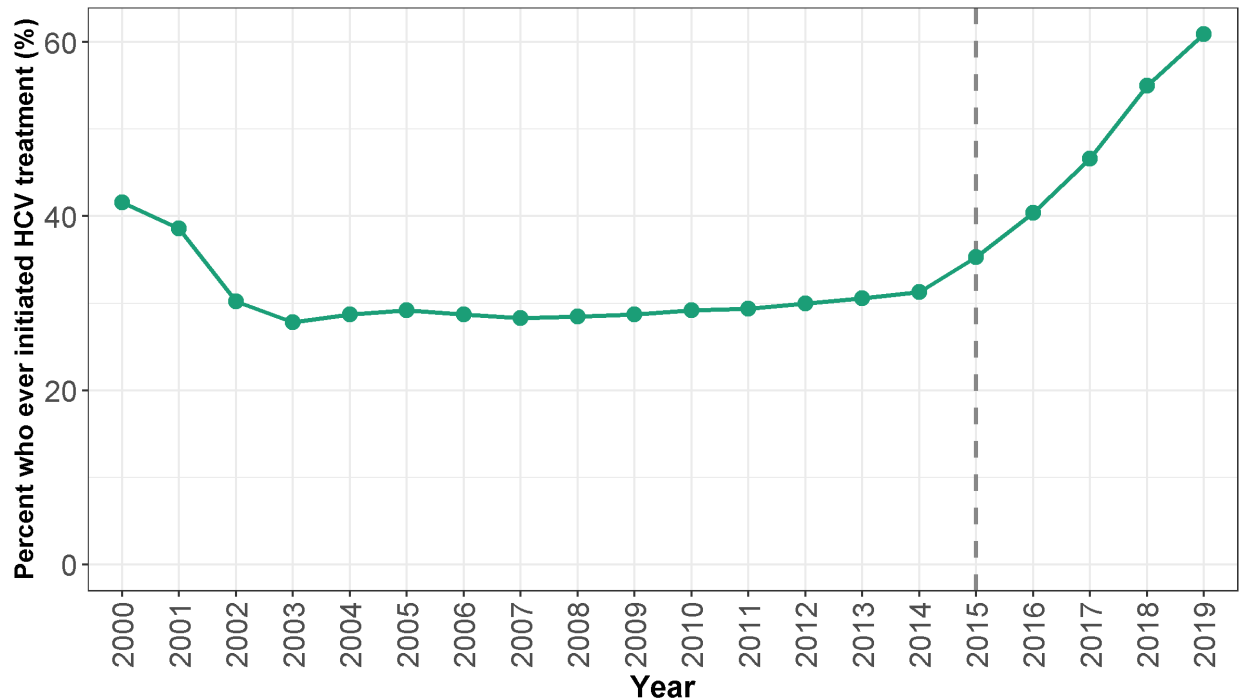
## 2.5. Trends in HCV treatment initiation among viraemic individuals diagnosed with HCV in BC, 2000-2019 (cumulative)

Approximately 25% of people diagnosed with HCV will spontaneously clear their infections without treatment (3). These individuals become HCV RNA-negative, are no longer actively infected (viraemic) and require no further treatment. Spontaneous clearance can happen at any time after diagnosis and may occur before or after RNA or genotype testing. People diagnosed with HCV who do not spontaneously clear their HCV infections are viraemic (HCV RNA-positive) and require treatment to cure HCV. This is a crucial step of the HCV care cascade and an indication of access to liver care and treatment for people living with HCV within BC. This indicator provides an estimate of viraemic HCV cases who have ever initiated HCV treatment and informs program development to reduce HCV-related morbidity and mortality. The cumulative sum of viraemic individuals diagnosed with HCV who had ever initiated treatment by the end of each year is presented as a percentage of the year-end cumulative sum of viraemic individuals diagnosed with HCV for each group indicated in Figure 30 to Figure 35. Persons who died by year-end were excluded from this analysis.

HCV treatment initiation rates among viraemic individuals fell between 2000 and 2003, increased slowly until 2014 and rose sharply thereafter (Figure 30). By the end of 2019, 60.9% of viraemic individuals diagnosed with HCV had initiated HCV treatment. This general trend in treatment initiation was observed among both males and females (Figure 31), and across all Health Authorities (Figure 32). By the end of 2019, 60.9% and 61.0% of RNA-positive males and females had initiated treatment, respectively (Figure 31). By year end, treatment initiation was lowest in the Northern (58.6%) and Vancouver Coastal (58.4%) Health Authorities (Figure 32). HCV treatment initiation rates increased with increasing age, with 19.4% of viraemic individuals aged 15-19 years and 71.2% of those aged 60+ years initiating treatment by the end of 2019 (Figure 33). Viraemic individuals diagnosed with HCV belonging to the 1945-1964 birth cohort (69.5%) were most likely to have

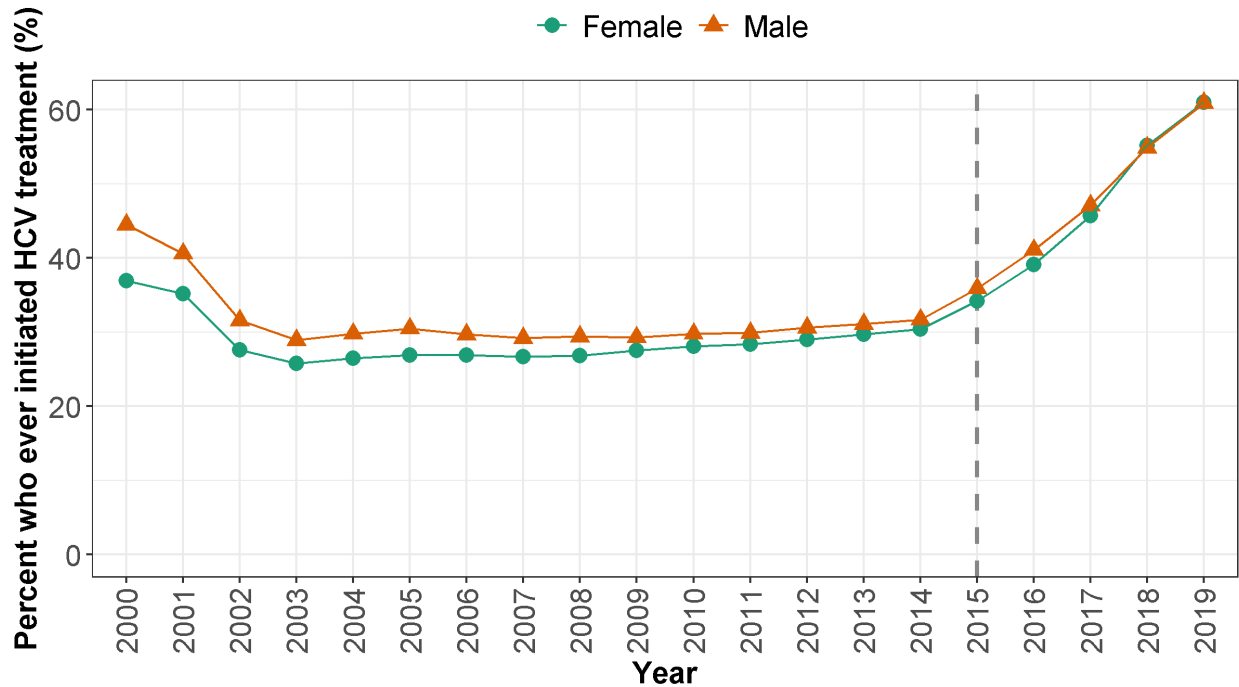
initiated treatment, while those born in 1975 and afterwards (41.8%) were least likely to have been treated at the close of 2019 (Figure 34). Similarly, a comparatively larger proportion of East Asians (71.2%) and South Asians (68.9%) had initiated treatment by the end of 2019 in comparison to people of other ethnic backgrounds (60.1%) (Figure 35).

Figure 30. HCV treatment initiation (ever) among viraemic individuals diagnosed with HCV in BC, 2000-2019 (cumulative)



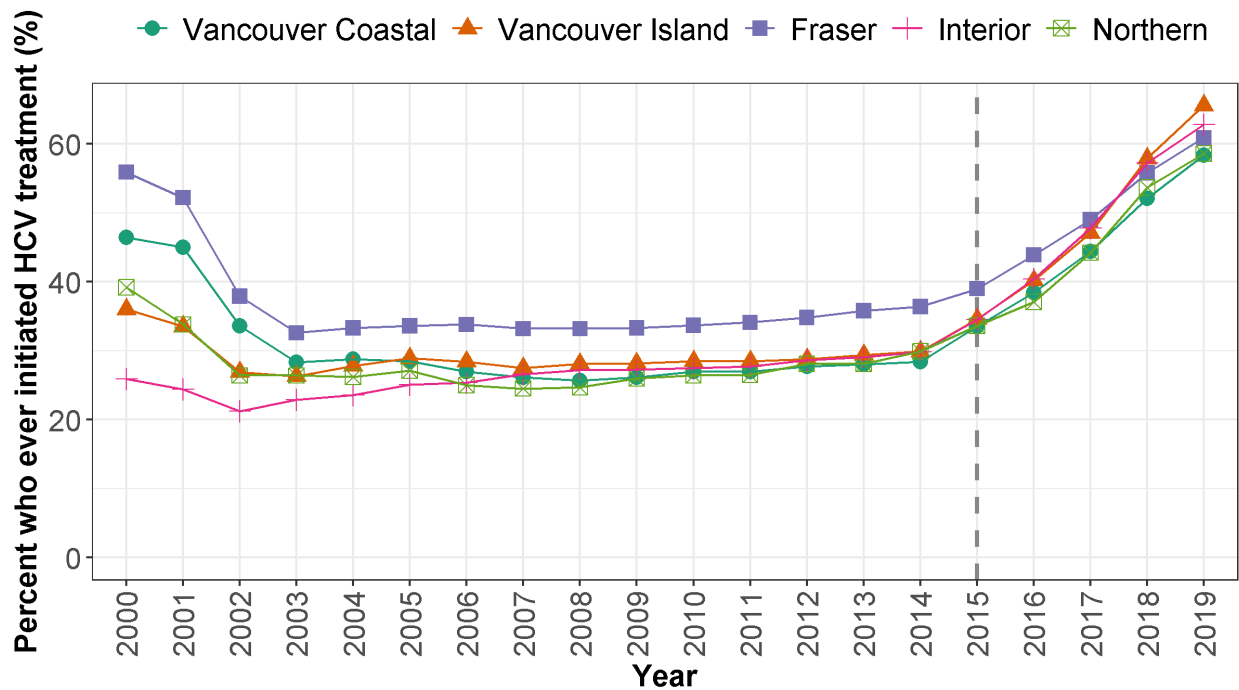
2016-2019 represent follow-up data for persons in the BC-HTC by the end of 2015

Figure 31. HCV treatment initiation (ever) among viraemic individuals diagnosed with HCV in BC by sex, 2000-2019 (cumulative)



2016-2019 represent follow-up data for persons in the BC-HTC by the end of 2015

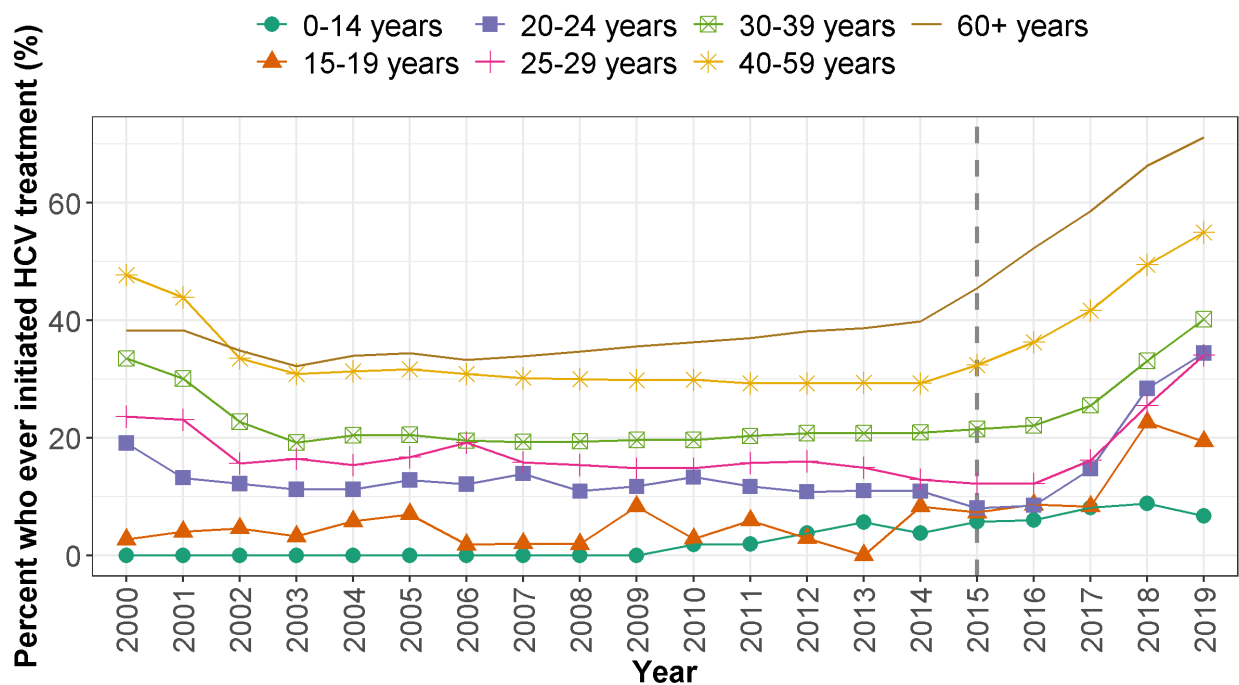
Figure 32. HCV treatment initiation (ever) among viraemic individuals diagnosed with HCV in BC by Health Authority, 2000-2019 (cumulative)



2016-2019 represent follow-up data for persons in the BC-HTC by the end of 2015

Individuals may move in and out of health regions over time

Figure 33. HCV treatment initiation (ever) among viraemic individuals diagnosed with HCV in BC by age group, 2000-2019 (cumulative)

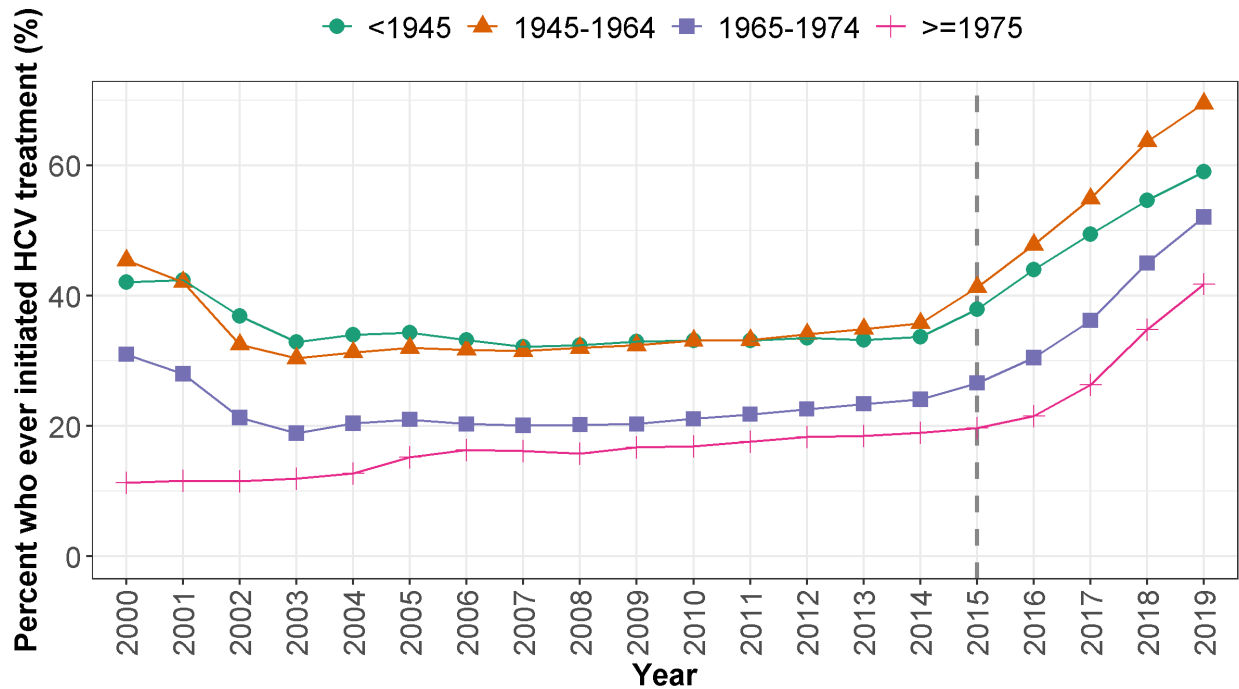


2016-2019 represent follow-up data for persons in the BC-HTC by the end

Individuals may move between age groups over time

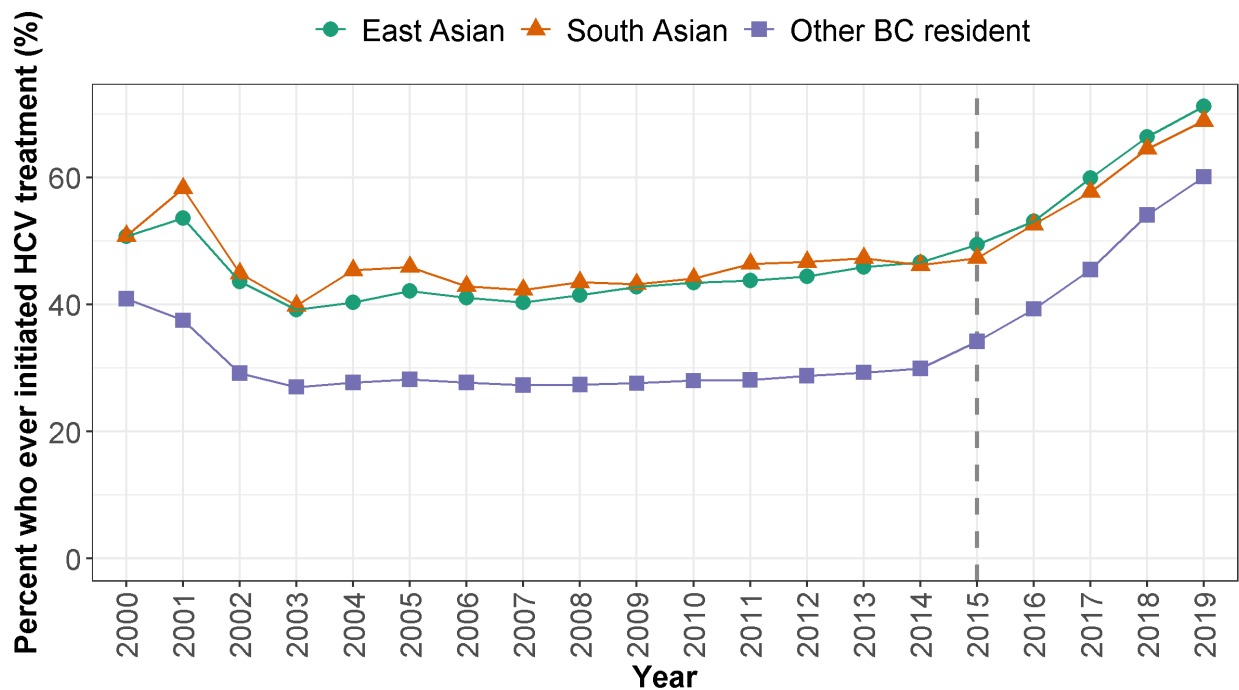


Figure 34. HCV treatment initiation (ever) among viraemic individuals diagnosed with HCV in BC by birth cohort, 2000-2019 (cumulative)



2016-2019 represent follow-up data for persons in the BC-HTC by the end of 2015

Figure 35. HCV treatment initiation (ever) among viraemic individuals diagnosed with HCV in BC by ethnicity, 2000-2019 (cumulative)



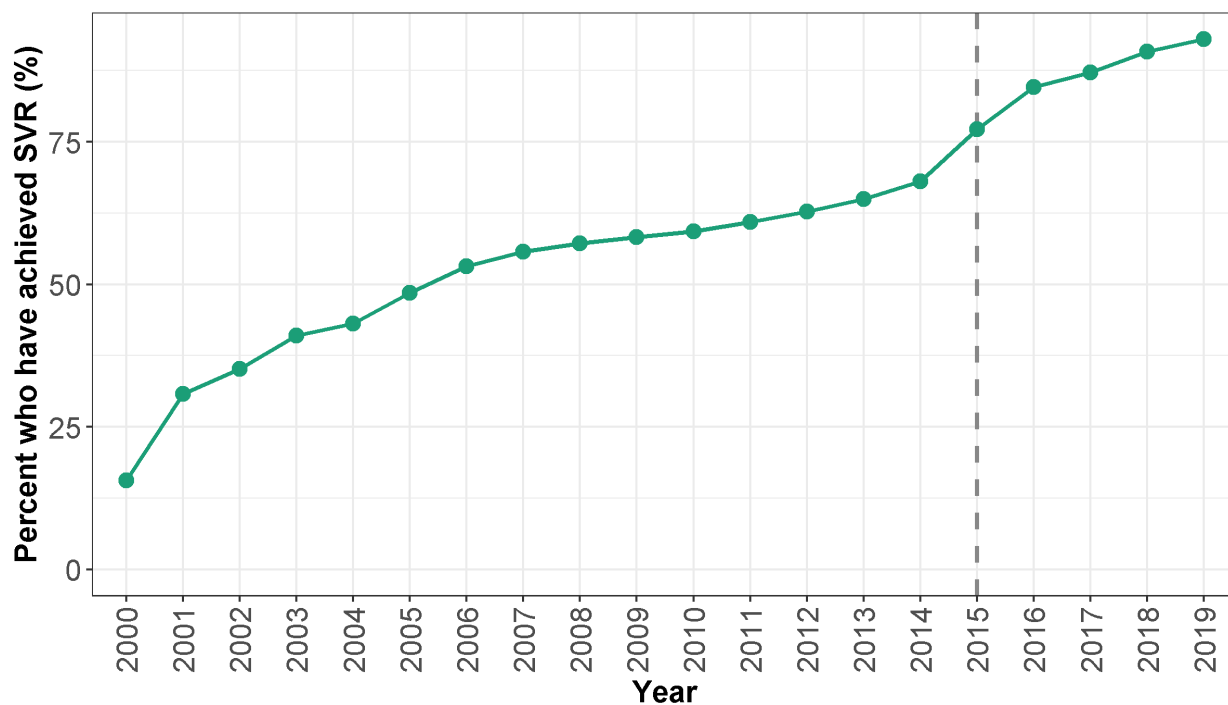
2016-2019 represent follow-up data for persons in the BC-HTC by the end of 2015

## 2.6. Trends in sustained virologic response (SVR) among viraemic individuals diagnosed with HCV post-treatment initiation in BC, 2000-2019 (cumulative)

The attainment of sustained virologic response (SVR) post-therapy is the main goal of HCV treatment. SVR attainment is indicative of a cleared infection and individuals achieving SVR should maintain an HCV RNA-negative status (no detectable viral replication) for at least 12 weeks after treatment completion. This indicator provides a measure of treatment effectiveness and an estimate of viraemic cases who may still require treatment. The cumulative sum of people diagnosed with HCV who achieved SVR after their most recent treatment course is presented as a percentage of the year-end cumulative sum of individuals who ever initiated treatment with documented RNA-testing post-treatment for each indicated group in Figure 36 to Figure 41. Persons who died by year-end were excluded from this analysis.

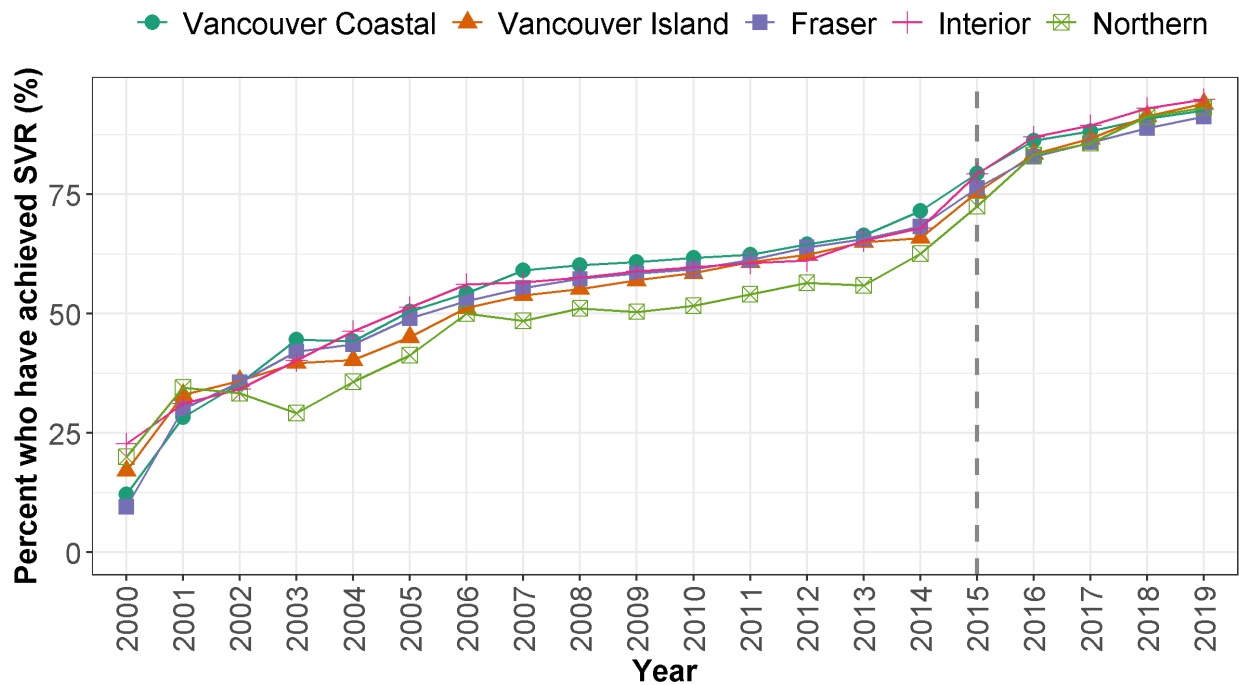
By the end of 2019, 93.0% of viraemic individuals diagnosed with HCV had achieved SVR after their most recent treatment cycle (Figure 36). Cumulative SVR rates showed a general increasing trend provincially (Figure 36) and across all Health Authorities (Figure 37) between 2000 and 2019, with rates greater than 90% for all Health Authorities in 2019. This increasing trend in cumulative SVR rate was observed for both males (92.6%) and females (93.7%), reaching SVR rates greater than 90% by the end of 2019 (Figure 38). Cumulative SVR rates rose across age groups (Figure 39), birth cohorts (Figure 40) and ethnicities (Figure 41) over the twenty-year period. Cumulative SVR rates among people born before 1965 rose markedly after DAA introduction in 2013, with SVR rates reaching 90% or above for all birth cohorts by the end of 2019 (Figure 40). Similarly, cumulative SVR rates were at or above 90% for all ethnic groups by the end of 2019 (Figure 41).

**Figure 36. Sustained virologic response among viraemic individuals diagnosed with HCV post-treatment initiation in BC, 2000-2019 (cumulative)**



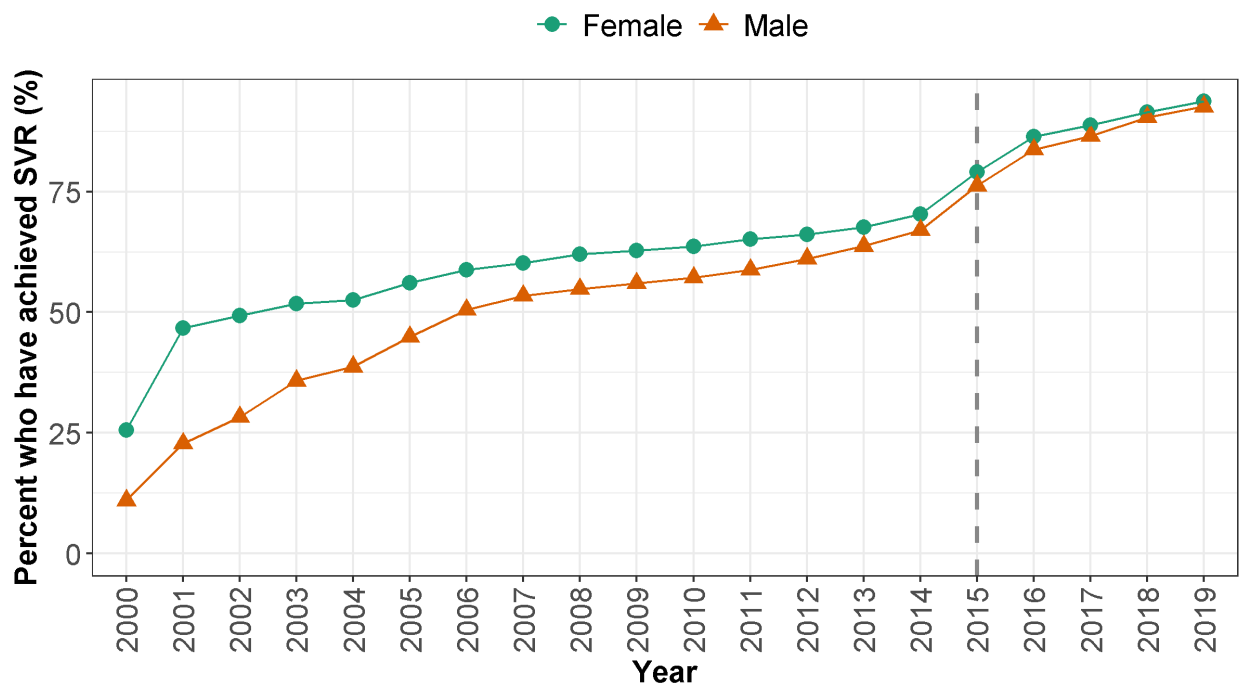
*2016-2019 represent follow-up data for persons in the BC-HTC by the end of 2015*

Figure 37. Sustained virologic response among viraemic individuals diagnosed with HCV post-treatment initiation in BC by Health Authority, 2000-2019 (cumulative)



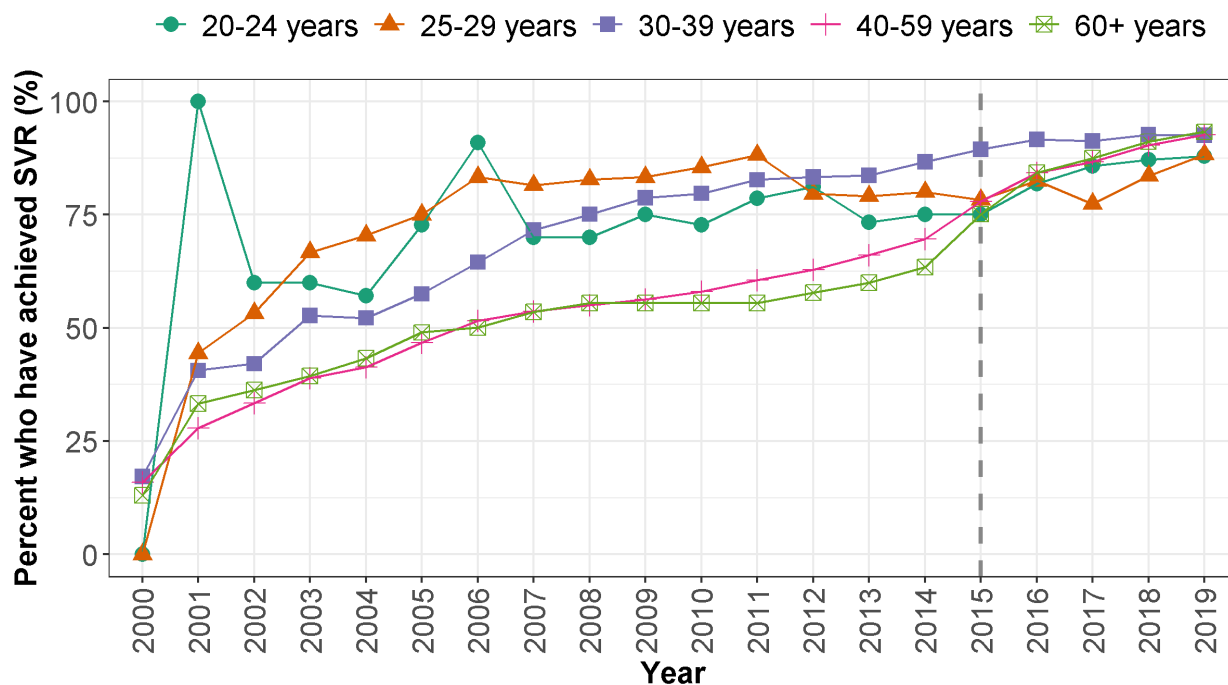
2016-2019 represent follow-up data for persons in the BC-HTC by the end of 2015  
Individuals may move in and out of health regions over time

Figure 38. Sustained virologic response among viraemic individuals diagnosed with HCV post-treatment initiation in BC by sex, 2000-2019 (cumulative)



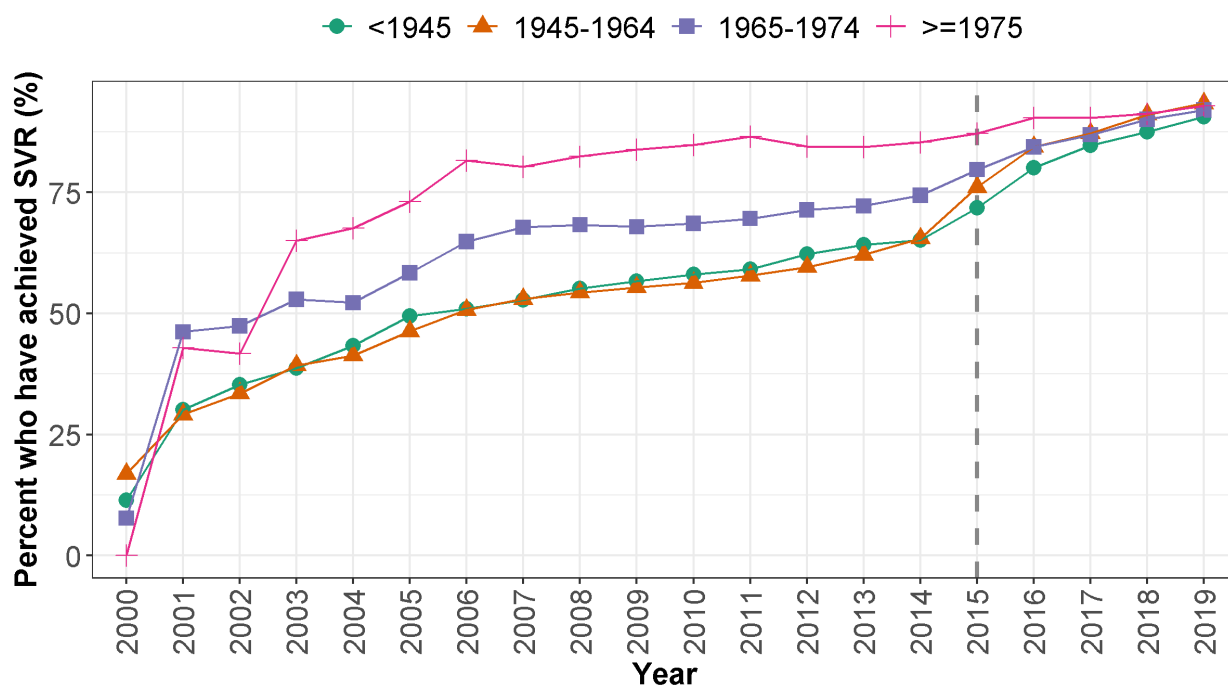
2016-2019 represent follow-up data for persons in the BC-HTC by the end of 2015

Figure 39. Sustained virologic response among viraemic individuals diagnosed with HCV post-treatment initiation in BC by age group, 2000-2019 (cumulative)



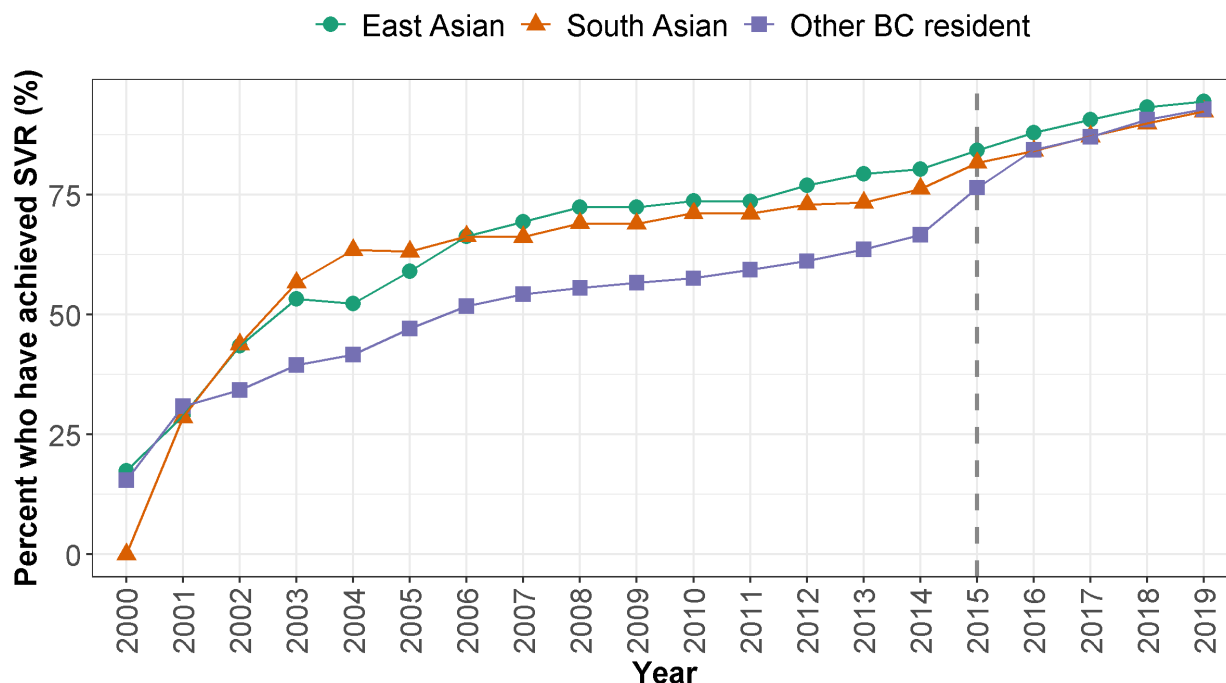
2016-2019 represent follow-up data for persons in the BC-HTC by the end of 2015  
Individuals may move between age groups over time

Figure 40. Sustained virologic response among viraemic individuals diagnosed with HCV post-treatment initiation in BC by birth cohort, 2000-2019 (cumulative)



2016-2019 represent follow-up data for persons in the BC-HTC by the end of 2015

Figure 41. Sustained virologic response among viraemic individuals diagnosed with HCV post-treatment initiation in BC by ethnicity, 2000-2019 (cumulative)



2016-2019 represent follow-up data for persons in the BC-HTC by the end of 2015

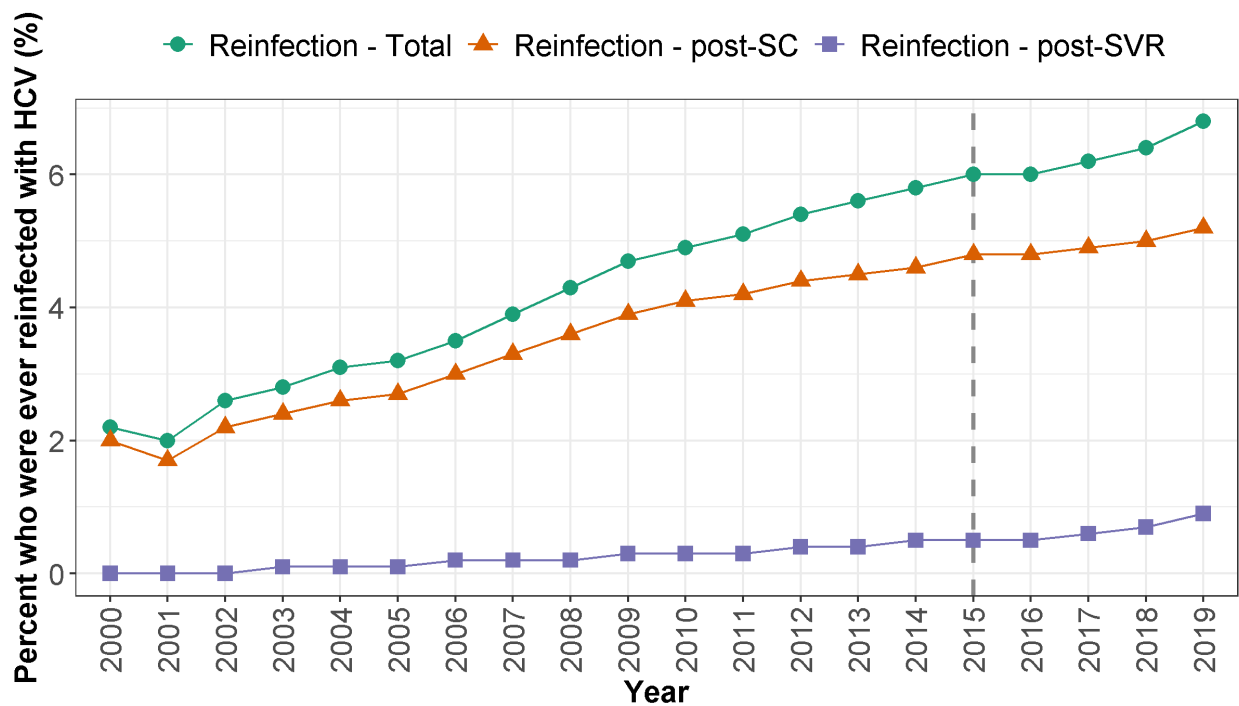
## 2.7. Trends in HCV reinfection in BC, 2000-2019 (cumulative)

Reinfection with HCV can occur after spontaneous clearance or sustained virologic response (SVR). The potential for reinfection with HCV reinforces the need for complementary prevention and harm reduction programs, such as needle/syringe distribution, and for the implementation of strategies to address recurrent risky behaviours related to the acquisition of HCV and other blood-borne infections. This indicator provides some context for the assessment of missed opportunities for education and the provision of additional support to at-risk populations with ongoing risky behaviours related to HCV acquisition. The cumulative sum of people diagnosed with HCV who ever got reinfected with HCV after spontaneous clearance or SVR at the end of each year is presented as a percentage of the year-end cumulative sum of people diagnosed with HCV who ever spontaneously cleared their infections or ever achieved SVR post-therapy for each group indicated in Figure 42 to Figure 47. Persons who died by year-end were excluded from this analysis.

By the end of 2019, 6.8% of persons who had ever cleared their infections, either spontaneously or through therapy, had been reinfected, at least once, with HCV (Figure 42). The majority of these HCV reinfections occurred among individuals who had spontaneously cleared their HCV infections. By the end of 2019, the cumulative HCV reinfection rate was 6.0% among females and 7.5% among males (Figure 43). In 2019, the highest regional cumulative HCV reinfection rate of 9.0% was recorded in Vancouver Coastal Health Authority (Figure 44). In the same year, the cumulative HCV reinfection rate was highest among people aged 30-39 (10.8%) and 25-29 (9.8%) years (Figure 45). From 2000-2019, the cumulative HCV reinfection rates rose rapidly among younger birth cohorts, showing a clear distinction between persons born before and after 1965 (Figure 46). By the end of 2019, 10.8% of individuals born after 1974 who cleared their infections had ever been reinfected with HCV. In contrast, 2.5% and 4.2% of those in the <1945 and 1945-1964 birth cohorts, respectively, had ever been reinfected with HCV. Cumulative HCV reinfection rates also differed by ethnicity,

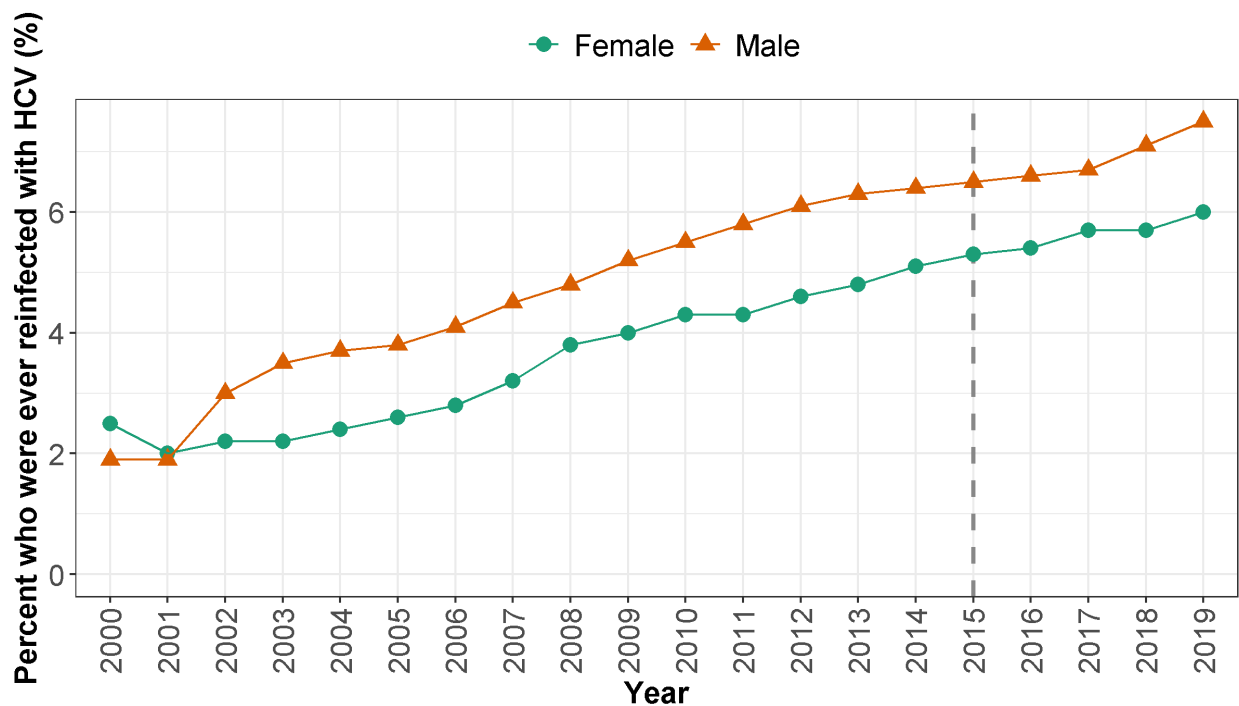
where cumulative HCV reinfection rates were consistently lowest among South Asians and East Asians since 2005 (2.3% and 3.6% in 2019, respectively) (Figure 47).

Figure 42. HCV reinfection (ever) among people who cleared their HCV infections in BC, 2000-2019 (cumulative)



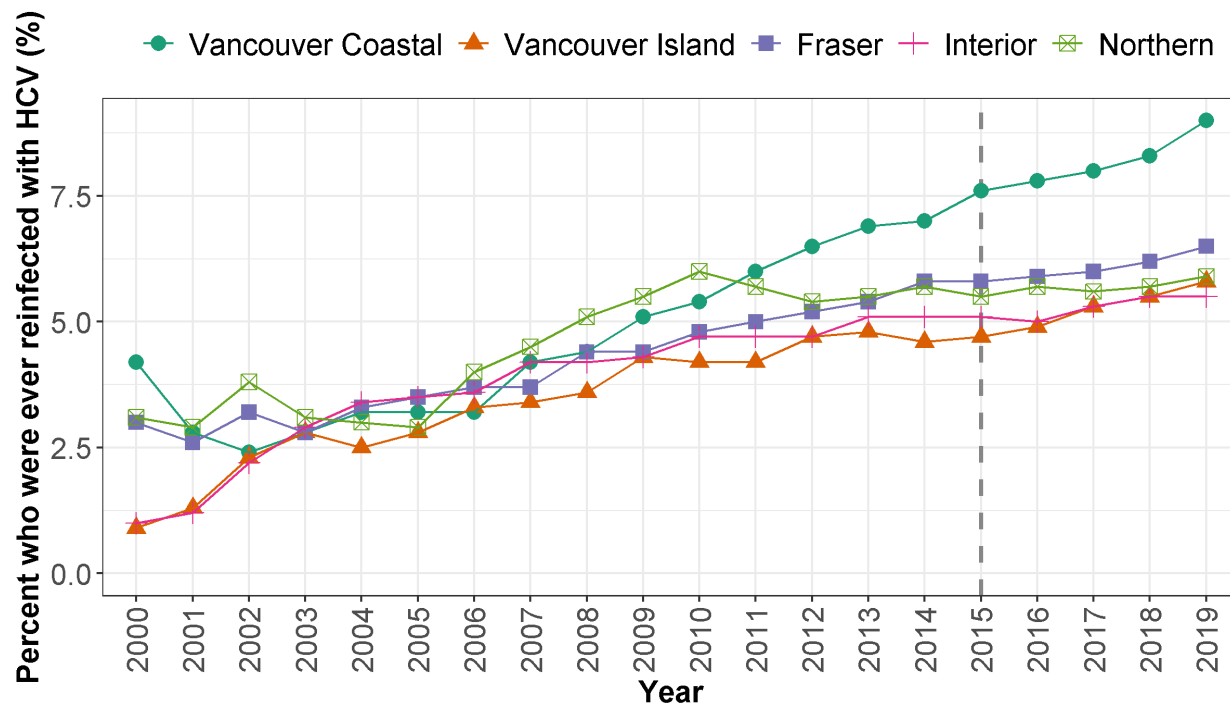
SC, spontaneous clearance; SVR, sustained virologic response. 2016-2019 represent follow-up data for persons in the BC-HTC by the end of 2015

Figure 43. HCV reinfection (ever) among people who cleared their HCV infections in BC by sex, 2000-2019 (cumulative)



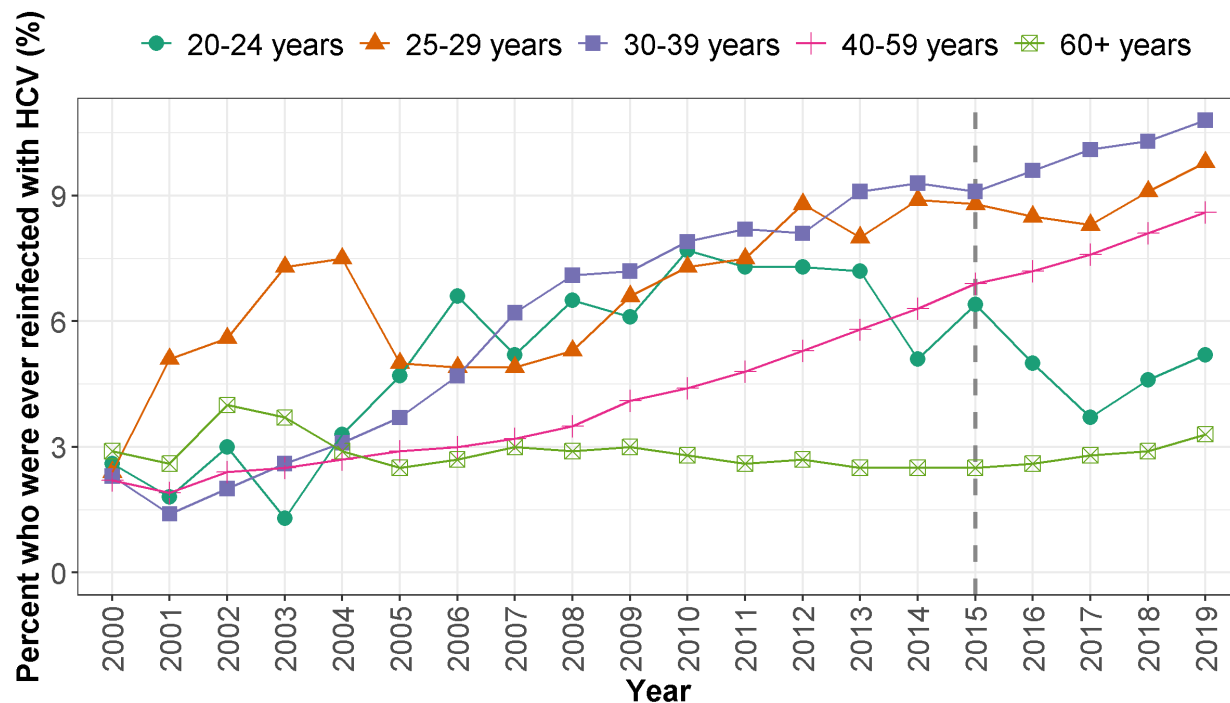
2016-2019 represent follow-up data for persons in the BC-HTC by the end of 2015

Figure 44. HCV reinfection (ever) among people who cleared their HCV infections in BC by Health Authority, 2000-2019 (cumulative)



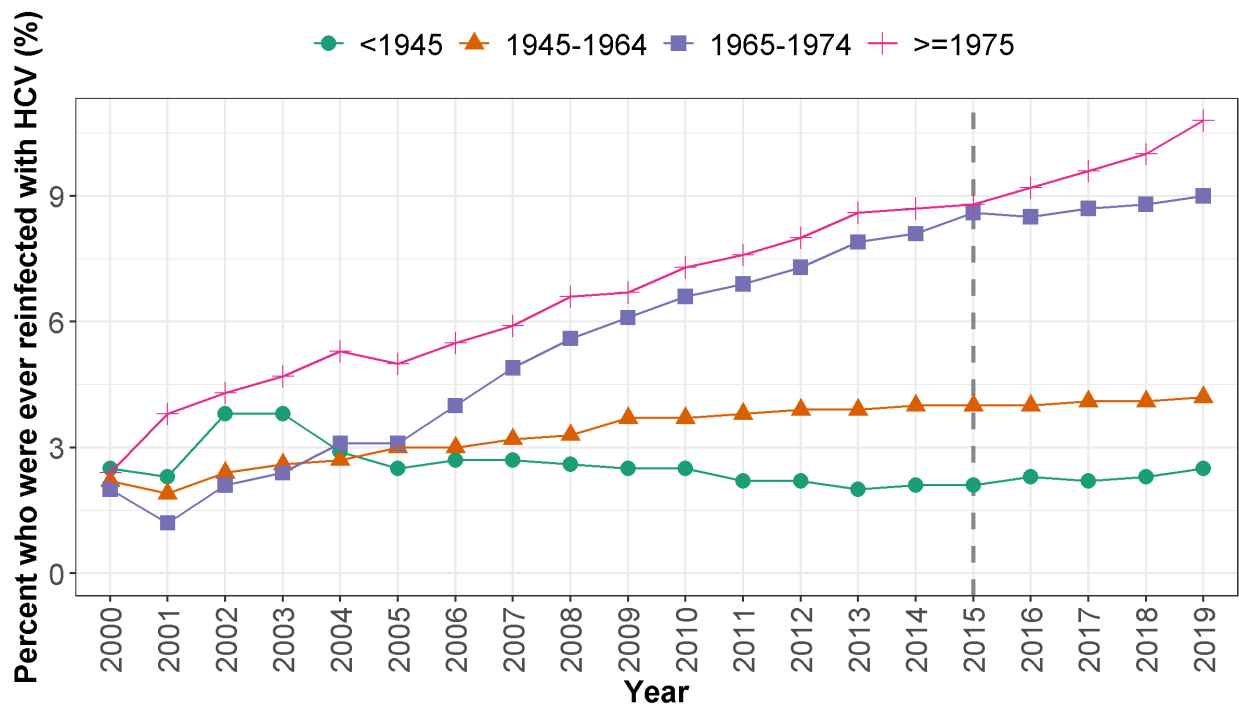
2016-2019 represent follow-up data for persons in the BC-HTC by the end of 2015  
Individuals may move in and out of health regions over time

Figure 45. HCV reinfection (ever) among people who cleared their HCV infections in BC by age group, 2000-2019 (cumulative)



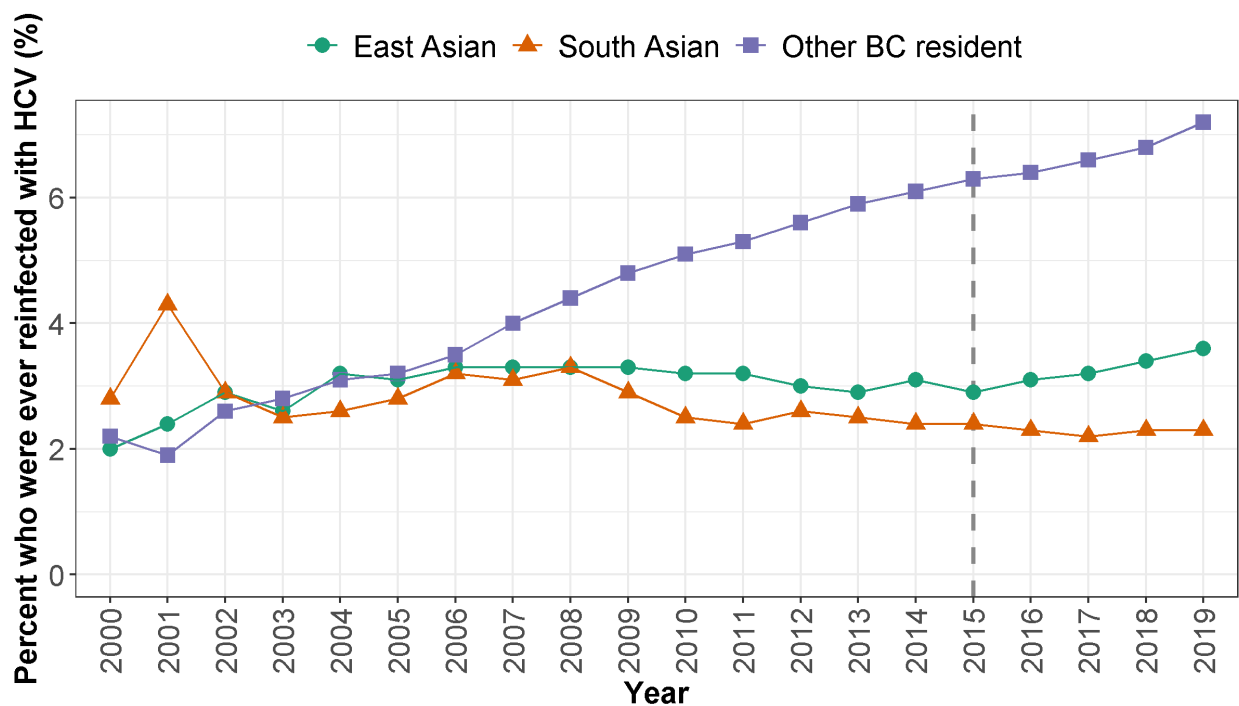
2016-2019 represent follow-up data for persons in the BC-HTC by the end of 2015  
Individuals may move between age groups over time

Figure 46. HCV reinfection (ever) among people who cleared their HCV infections in BC by birth cohort, 2000-2019 (cumulative)



2016-2019 represent follow-up data for persons in the BC-HTC by the end of 2015

Figure 47. HCV reinfection (ever) among people who cleared their HCV infections in BC by ethnicity, 2000-2019 (cumulative)



2016-2019 represent follow-up data for persons in the BC-HTC by the end of 2015



### 3. Risk Factors

These indicators identify subpopulations at higher risk for HCV infection or complications due to HCV infection in support of prevention initiatives developed using a syndemics lens (54). Estimates provided can also support treatment strategies targeted towards these groups. People who inject drugs (PWID) are a key population group known to have higher morbidity and mortality risks, as well as elevated risk of reinfection (16, 47, 55). Similarly, heavy alcohol use has been linked to severe health outcomes for people living with HCV (56, 57). The cumulative sums of people diagnosed with HCV with a history of injection drug use or problematic alcohol use at the end of each calendar year are presented as a percentage of the year-end cumulative sum of people ever diagnosed with HCV within each indicated population group in Figure 48 to Figure 53 (injection drug use) and Figure 54 to Figure 59 (problematic alcohol use). Persons who died by the end of the each year were excluded from this analysis.

Data for this section are generated from the **BC Hepatitis Testers Cohort (BC-HTC)**. Results presented are for persons for whom laboratory testing/case data were successfully linked with administrative data and who were **alive** at the end of each year. Note that important data sources for injection drug use and problematic alcohol use variable definition were only available until the end of 2015, limiting data presented in this section to 2000-2015. See **Appendix A.2** for more information about the BC-HTC. Population estimates of PWID were **inflated by +10%** to account for under-testing as reported in I-Track data on HCV testing history (58).

#### 3.1. Injection drug use (IDU) among people diagnosed with HCV in BC, 2000-2015

By the end of 2015, 45.4% of people diagnosed with HCV had a history of injection drug use (Figure 48), with similar prevalence among males and females (Figure 49). From 2000-2015, people diagnosed with HCV with a history of injection drug use most commonly resided in Vancouver Coastal Health Authority, reaching 53.5% in 2015 (Figure 50). Distinct patterns in injection drugs use history were observed among people diagnosed with HCV of differing age groups, being most common among people aged 30-39 years (72.9%) and least common among those aged under 20 and 60+ years old in 2015 (Figure 51). Similar distinctions were also observed according to birth cohort, where younger birth cohorts were most likely to have a history injection drug use between 2000 and 2015 (Figure 52). By the end of 2015, 69.4% and 63.8% of people diagnosed with HCV and born after 1974 or between 1965 and 1974, respectively, had a history of injection drug use. Similarly, injection drug use was generally least common among East and South Asians and most common among persons of other ethnic backgrounds (Figure 53). At the end of 2015, 11.3% and 18.9% of HCV-positive East Asians and South Asians in BC, respectively, had some injection drug use experience.

Figure 48. Injection drug use (ever) among people diagnosed with HCV in BC, 2000-2015 (cumulative)

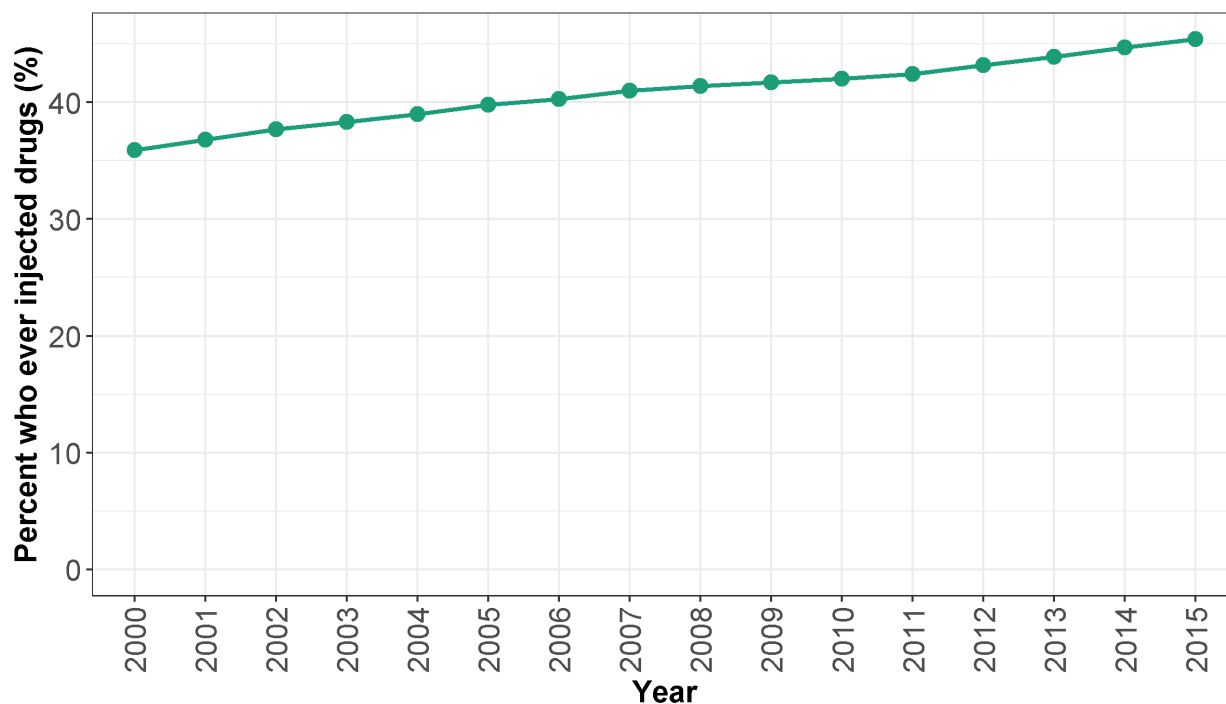


Figure 49. Injection drug use (ever) among people diagnosed with HCV in BC by sex, 2000-2015 (cumulative)

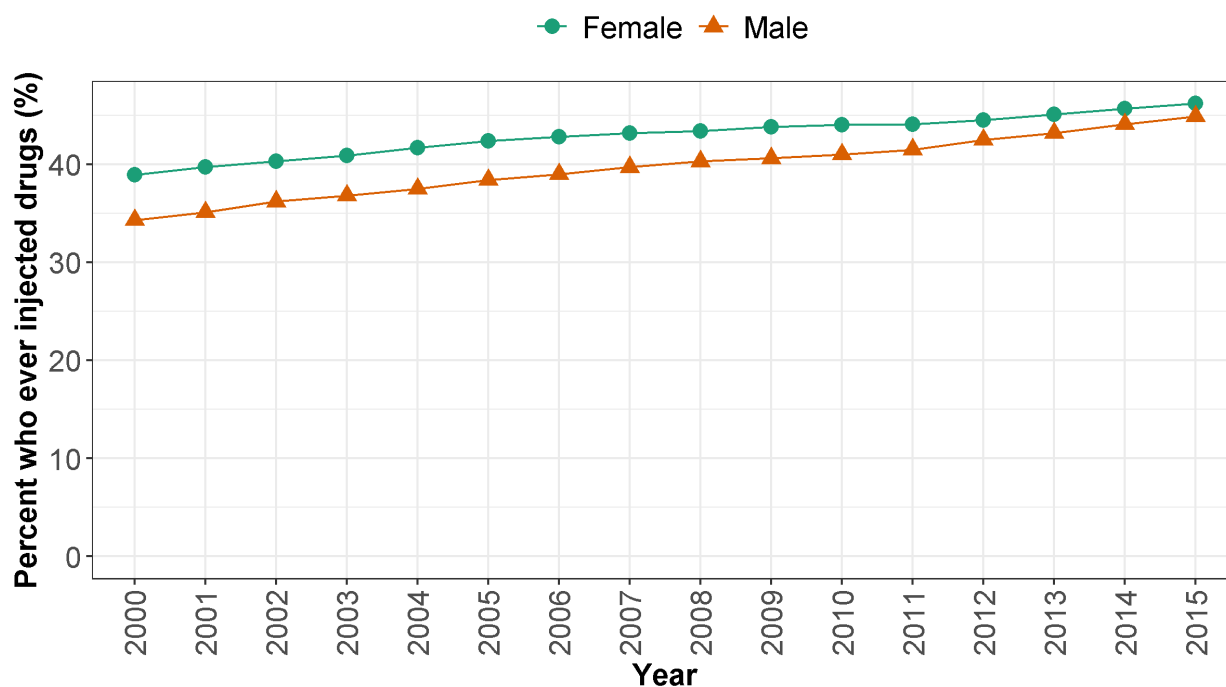
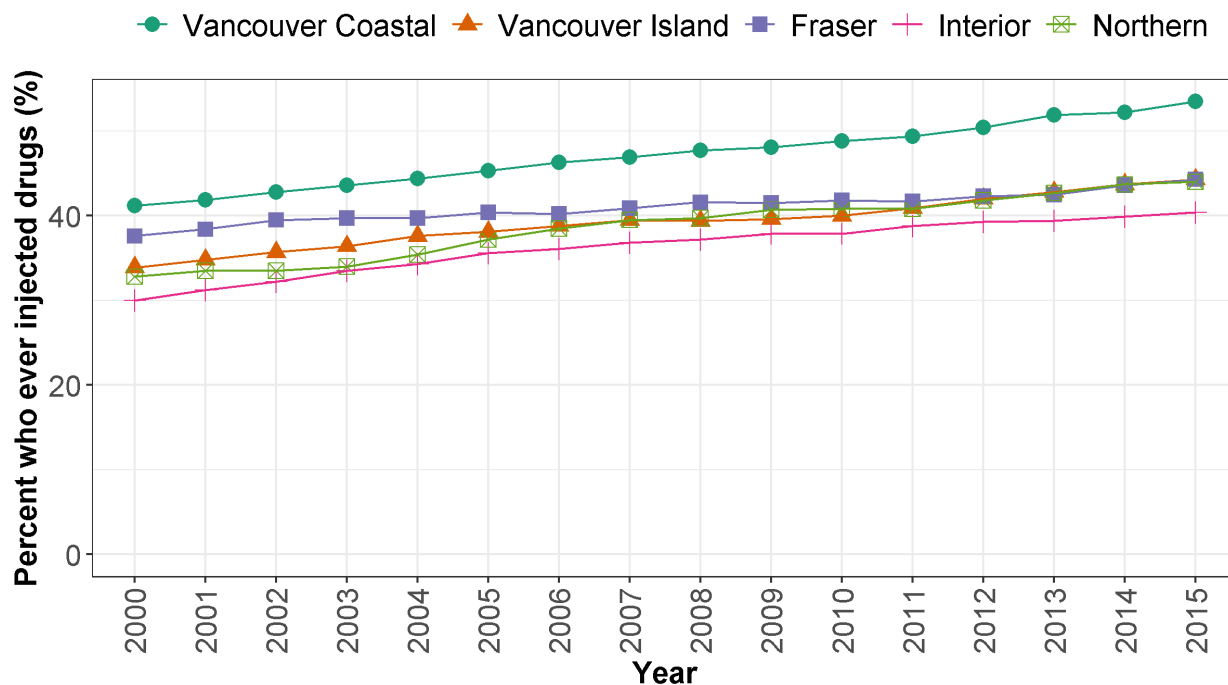
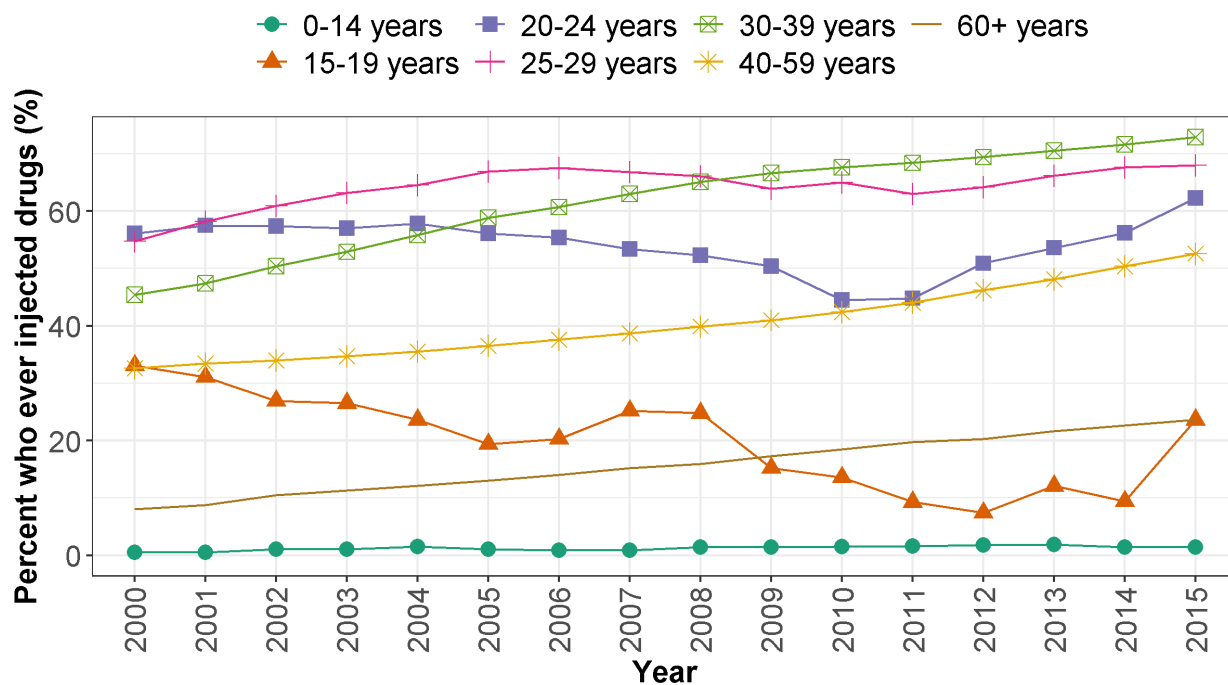


Figure 50. Injection drug use (ever) among people diagnosed with HCV in BC by Health Authority, 2000-2015



Individuals may move in and out of health regions over time

Figure 51. Injection drug use (ever) among people diagnosed with HCV in BC by age group, 2000-2015



Individuals may move between age groups over time

Figure 52. Injection drug use (ever) among people diagnosed with HCV in BC by birth cohort, 2000-2015

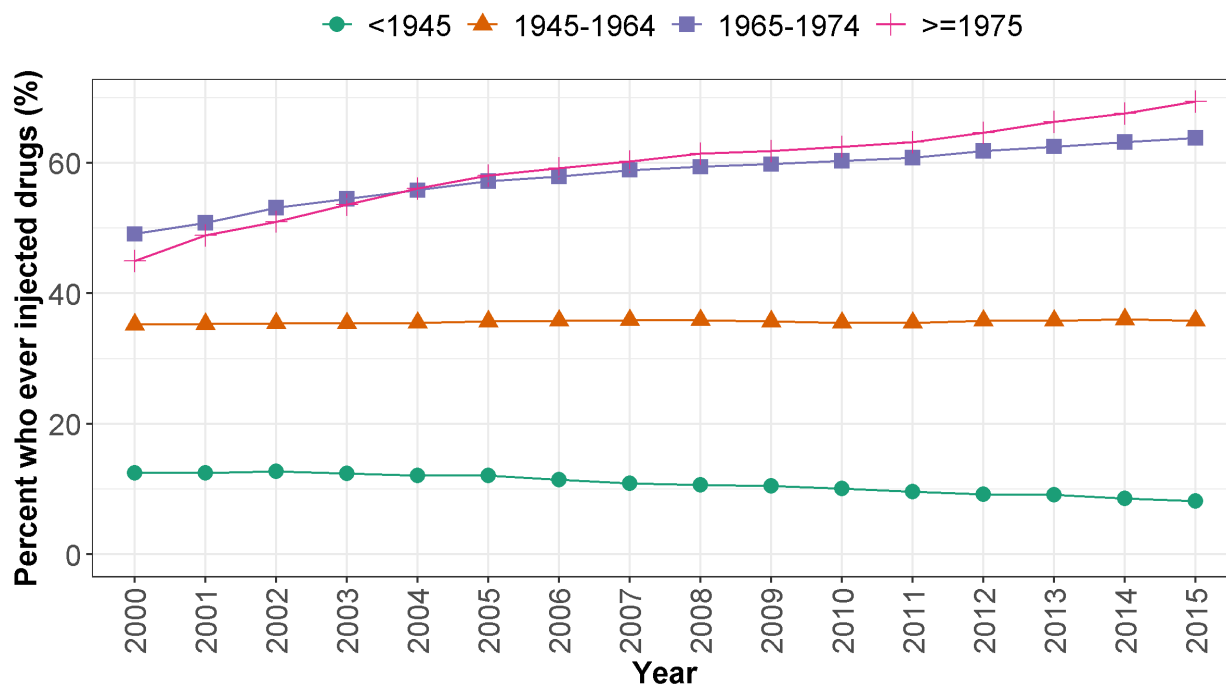
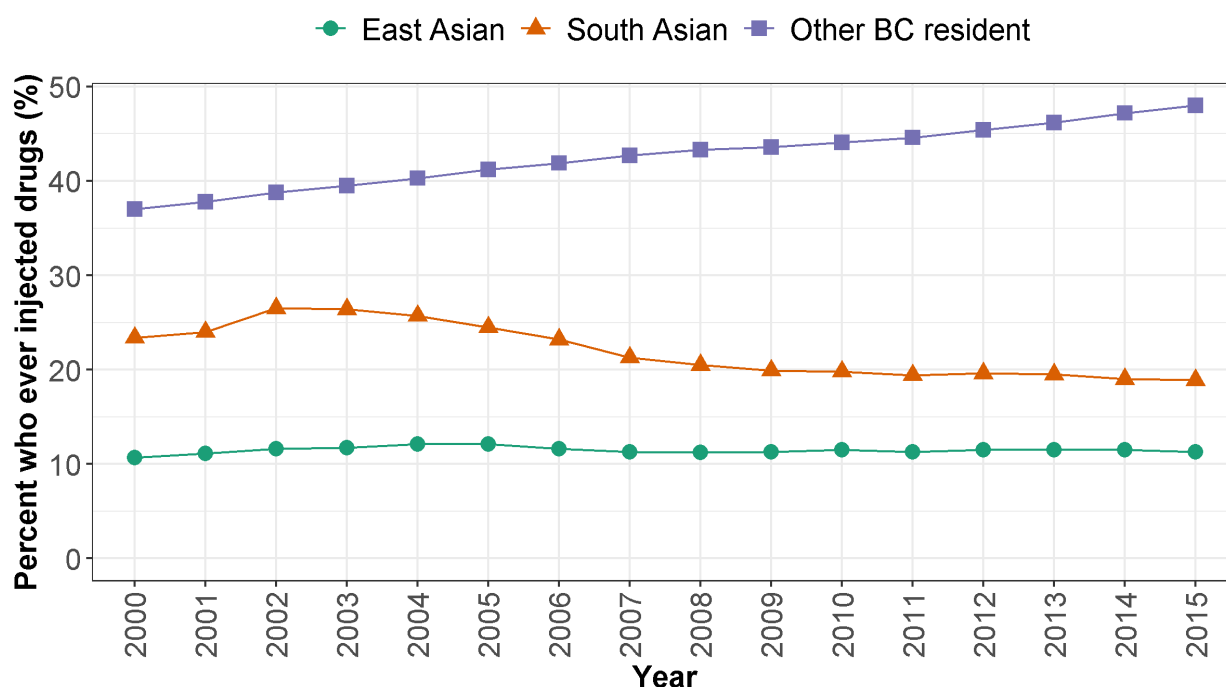


Figure 53. Injection drug use (ever) among people diagnosed with HCV in BC by ethnicity, 2000-2015



### 3.2. Problematic alcohol use among people diagnosed with HCV in BC, 2000-2015

By the end of 2015, 27.6% of people ever diagnosed with HCV had a history of problematic alcohol use (Figure 54), with similar prevalence among males and females (Figure 55). Between 2000 and

2015, the largest proportion of people diagnosed with HCV who had a history of problematic alcohol use resided in Northern Health Authority, reaching 35.9% in 2015 (Figure 56). Distinct patterns in problematic alcohol use were observed among people diagnosed with HCV of differing age groups, with alcohol abuse being most common among those aged 40-59 years (31.4%) in 2015 (Figure 57). Similar distinctions were also observed according to birth cohort (Figure 58) and ethnicity (Figure 59), where HCV-positive people born between 1965 and 1974 (33.1%) and persons of non-East Asian and non-South Asian ethnic backgrounds (29.3%) being most likely to have emergent health-problems related to alcohol abuse by the end of 2015.

Figure 54. Problematic alcohol use (ever) among people diagnosed with HCV in BC, 2000-2015

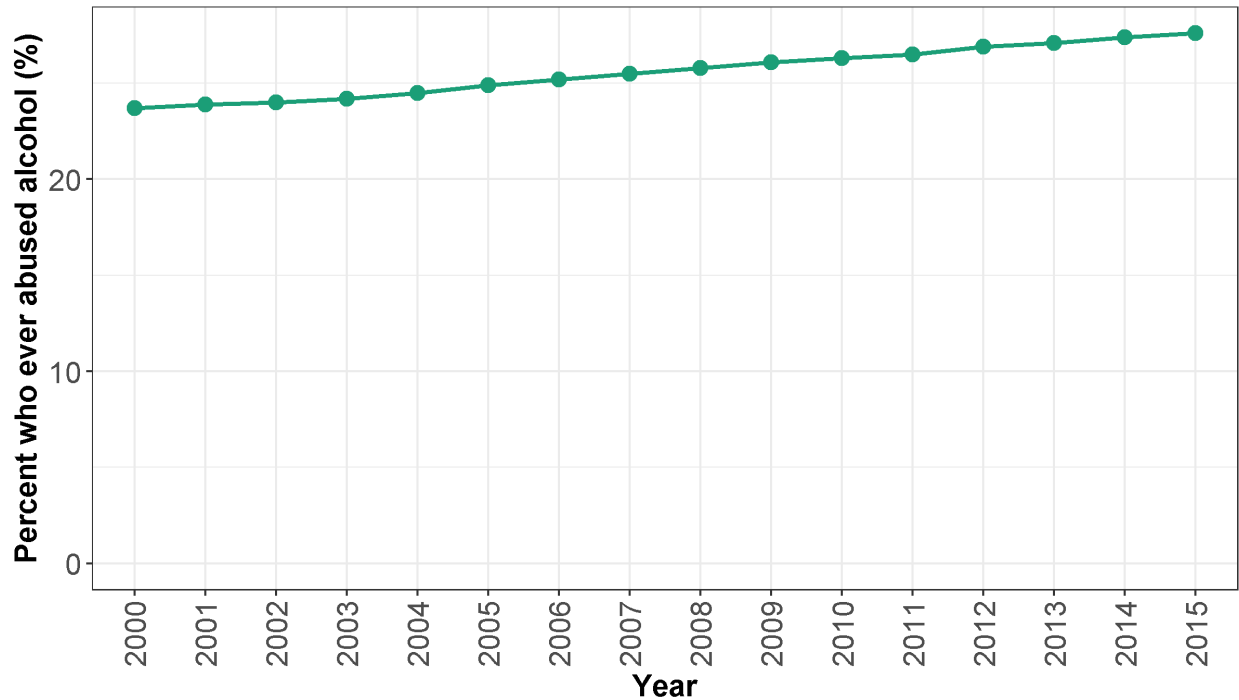


Figure 55. Problematic alcohol use (ever) among people diagnosed with HCV in BC by sex, 2000-2015

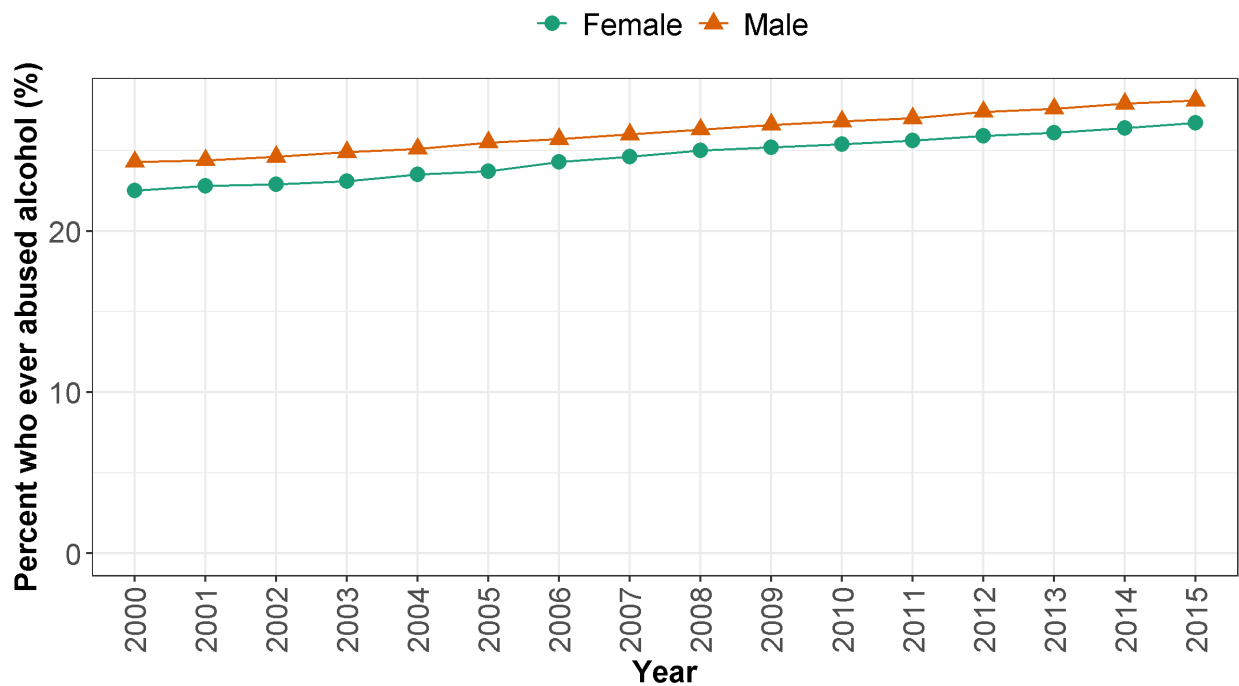
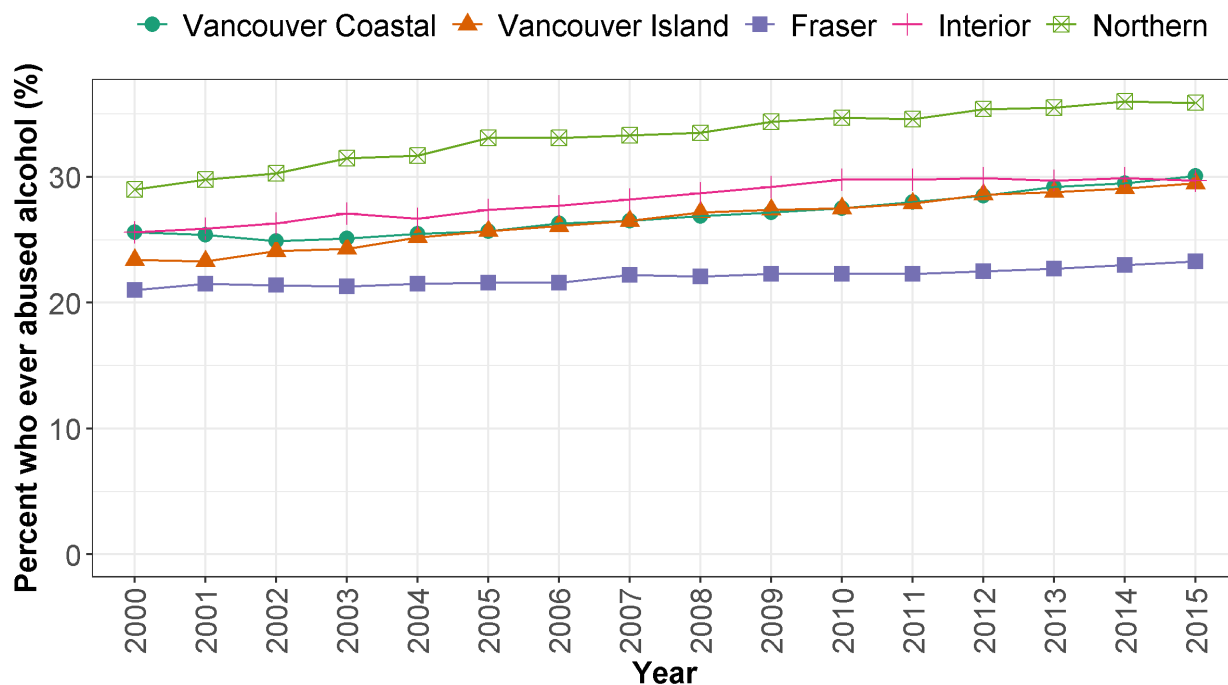
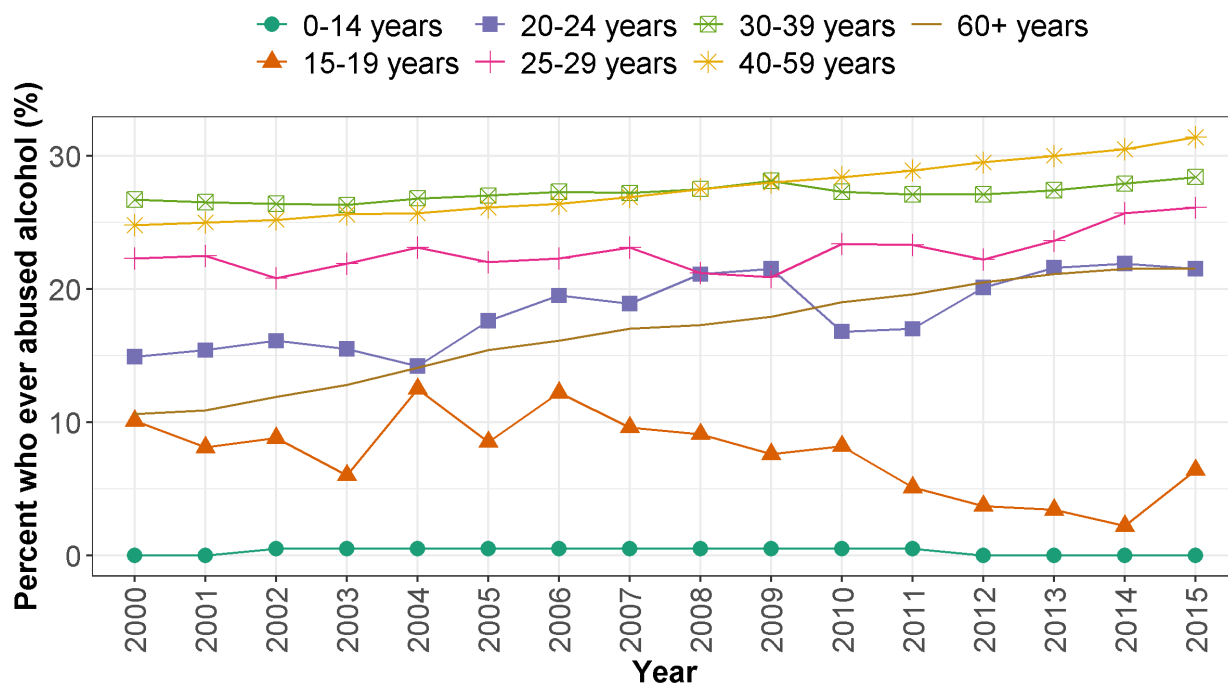


Figure 56. Problematic alcohol use (ever) among people diagnosed with HCV in BC by Health Authority, 2000-2015



Individuals may move in and out of health regions over time

Figure 57. Problematic alcohol use (ever) among people diagnosed with HCV in BC by age group, 2000-2015



Individuals may move between age groups over time

Figure 58. Problematic alcohol use (ever) among people diagnosed with HCV in BC by birth cohort, 2000-2015

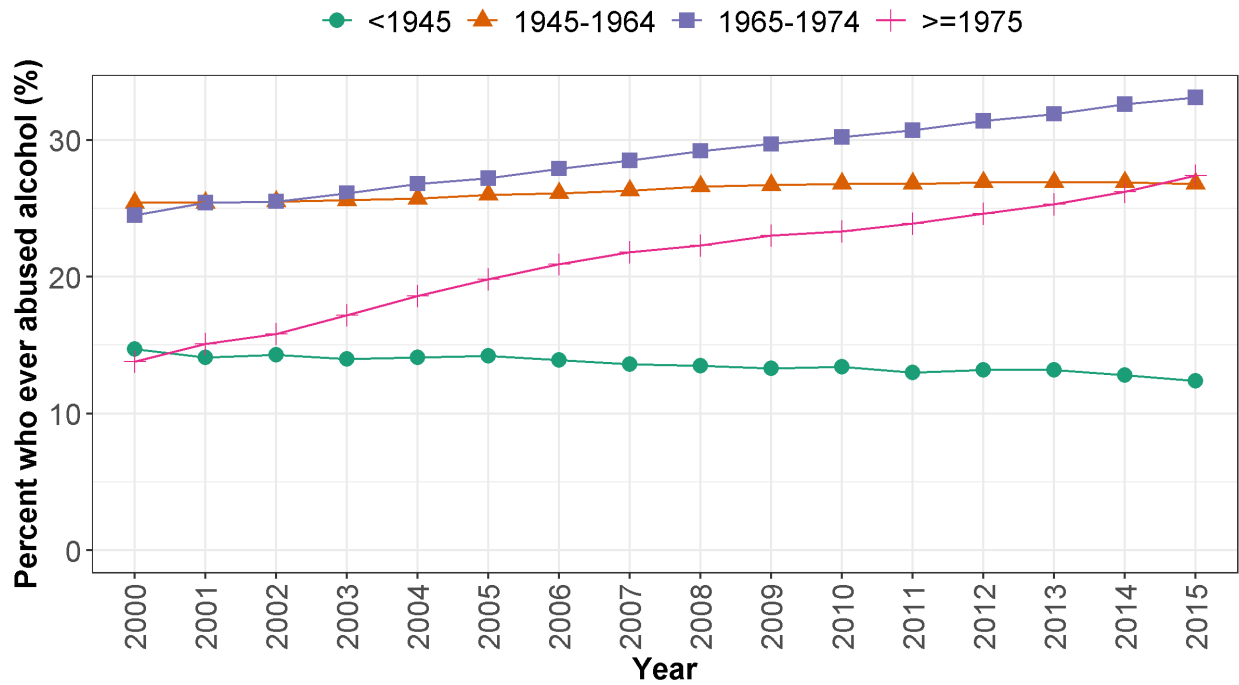
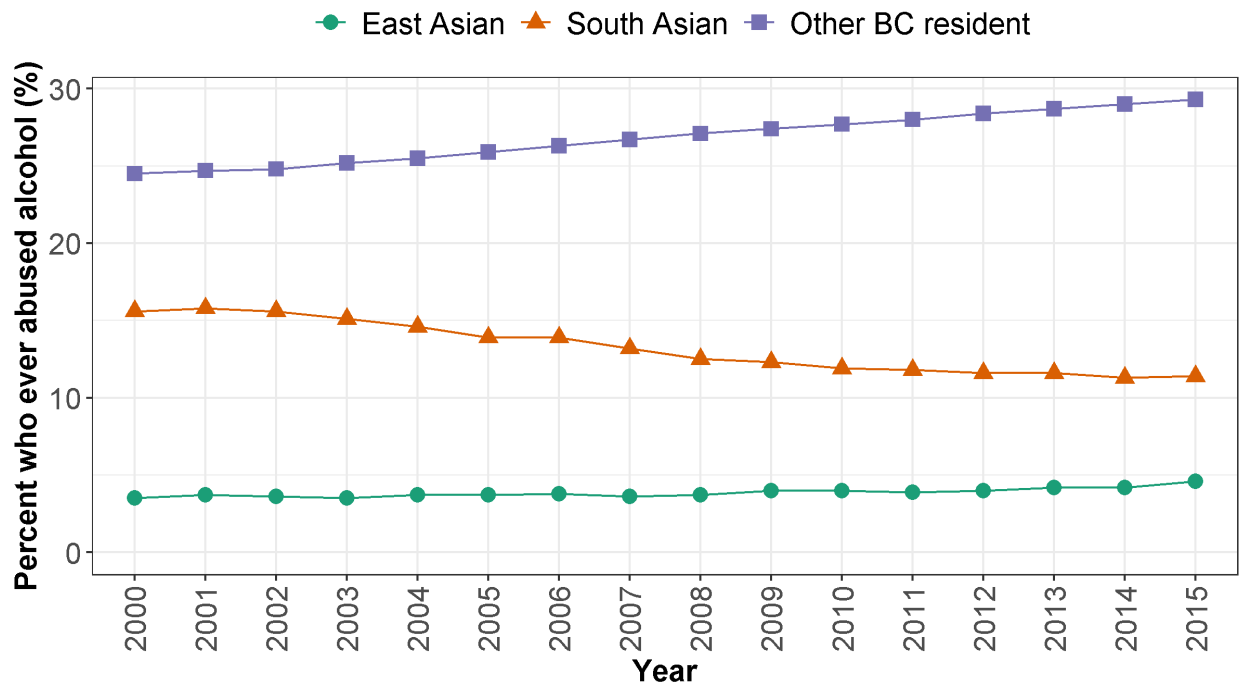


Figure 59. Problematic alcohol use (ever) among people diagnosed with HCV in BC by ethnicity, 2000-2015



## 4. Co-infections

As HCV, HBV and HIV share common routes of infection, monitoring new HIV and HBV diagnoses among people diagnosed with HCV can provide some measure of ongoing risk for infection within this population. These estimates can support the development of prevention and treatment strategies targeted at these populations, such as needle/syringe distribution programs. The rates of new HIV or HBV diagnoses among people diagnosed with HCV who were alive at the end of each calendar year are presented for the indicated population groups in Figure 60 to Figure 65 (HIV) and Figure 66 to Figure 71 (HBV). Persons who died by the end of each year were excluded from this analysis.

Data for this section are generated from the **BC Hepatitis Testers Cohort (BC-HTC)**. Results presented are for persons for whom laboratory testing/case data were successfully linked with administrative data and who were **alive** at the end of each year. Note that important data sources for HIV and HBV variable definition were only available until the end of 2015, limiting data presented in this section to 2000-2015. See **Appendix A.2** for more information about the BC-HTC.

### 4.1. New HIV diagnoses among people diagnosed with HCV in BC, 2000-2015

The rate of new HIV diagnoses among people living with HCV in BC followed an overall decreasing trend between 2000 and 2015 (Figure 60). Of note, new HIV diagnoses in the general BC population has been gradually decreasing over the same period (59). In 2015, there were 58 new HIV diagnoses among people diagnosed with HCV, representing a rate of 10.5 new HIV diagnoses per 10,000 people diagnosed with HCV. For comparison, the rate of new HIV diagnoses in the BC population in the same year was 5.1 new HIV diagnoses per 100,000 (59). Similar trends in HIV diagnoses were observed for males and females (Figure 61) and across all Health Authorities (Figure 62). By the end of 2015, new HIV diagnosis rates fell to 9.5 per 10,000 females diagnosed with HCV and 11.0 per 10,000 males diagnosed with HCV (Figure 61). Since 2013, Vancouver Coastal Health Authority has reported the highest recorded rate of new HIV diagnoses among people diagnosed with HCV, with a rate of 20.9 per 10,000 people diagnosed with HCV in 2015 (Figure 62). New HIV diagnoses occurred at relatively higher rates among younger birth cohorts and were most common among people born after 1974 (31.4 per 10,000 people diagnosed with HCV) at the end of 2015 (Figure 63).



Figure 60. New HIV diagnoses among people diagnosed with HCV in BC, 2000-2015

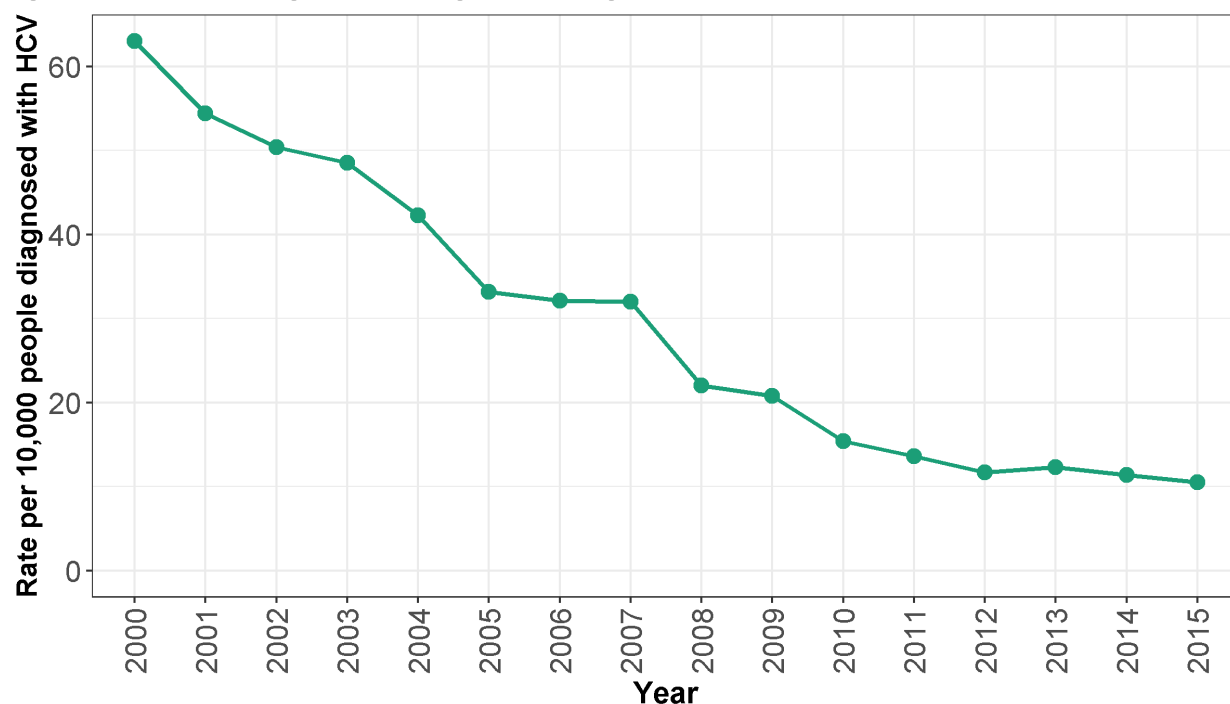


Figure 61. New HIV diagnoses among people diagnosed with HCV in BC by sex, 2000-2015

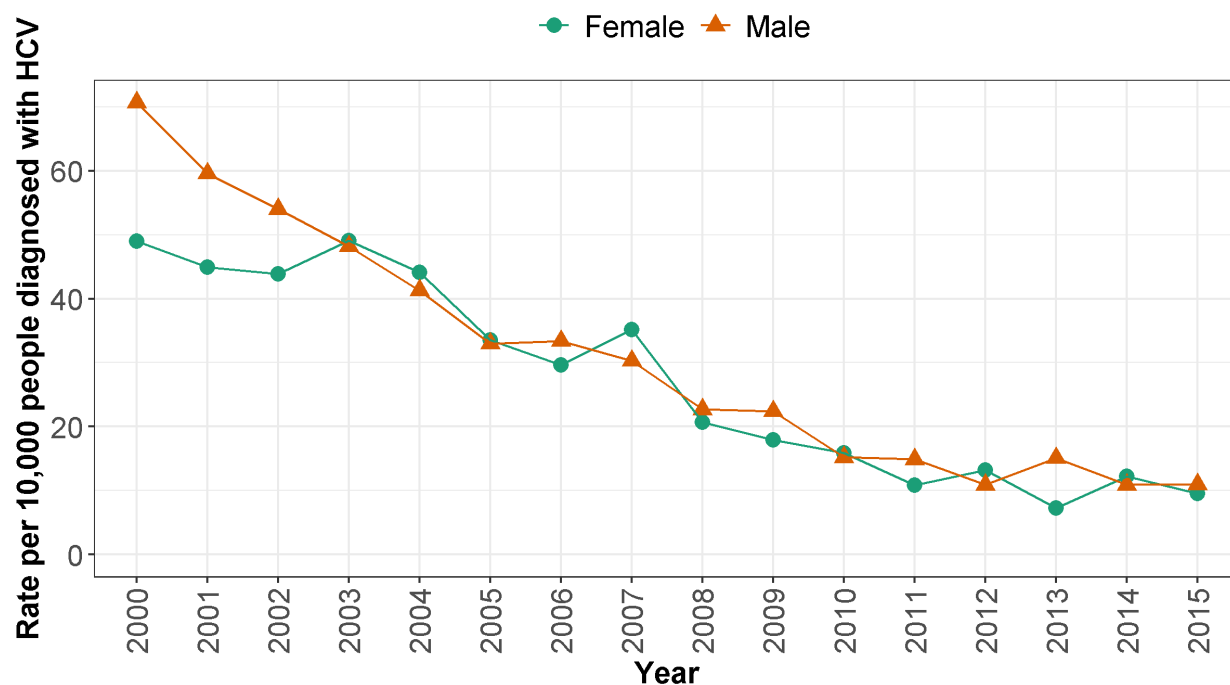
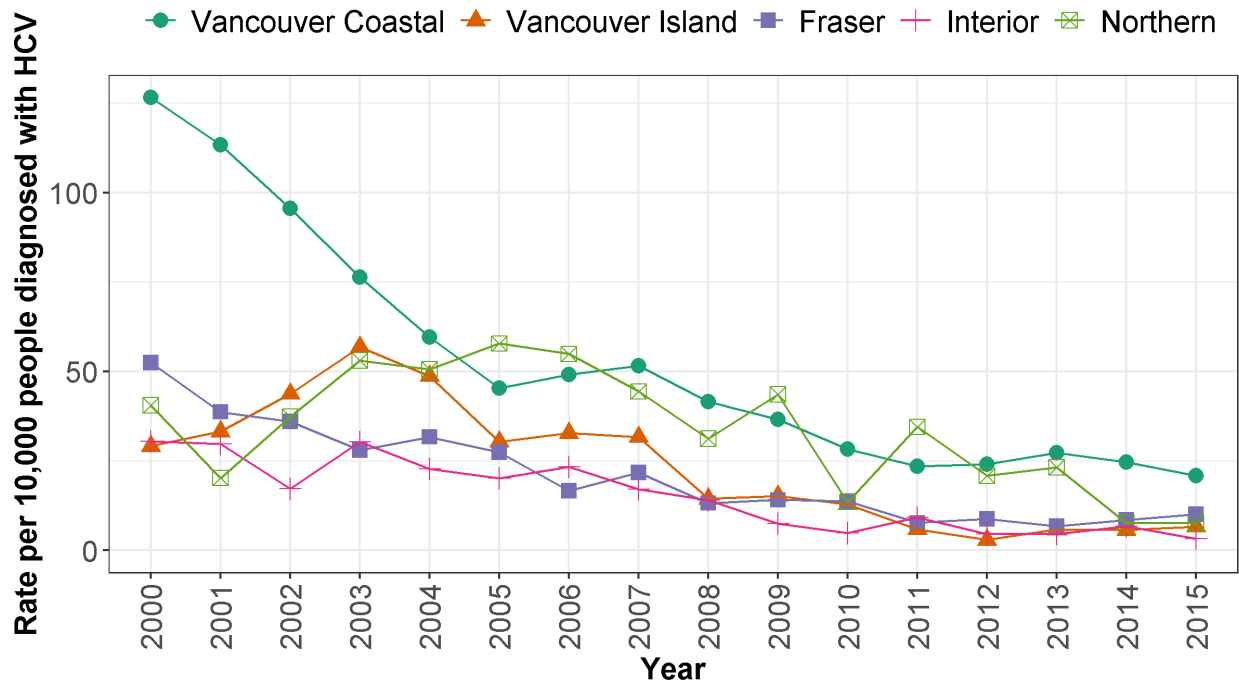


Figure 62. New HIV diagnoses among people diagnosed with HCV in BC by Health Authority, 2000-2015



Individuals may move in and out of health regions over time

Figure 63. New HIV diagnoses among people diagnosed with HCV in BC by birth cohort, 2000-2015

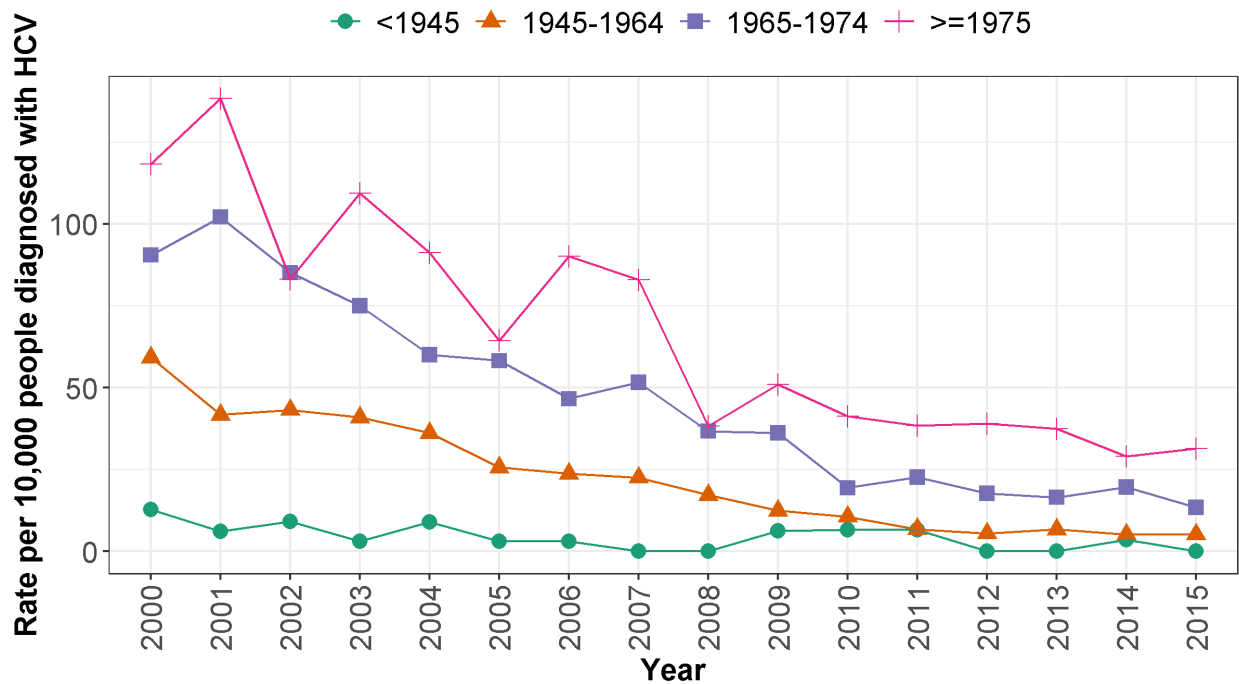
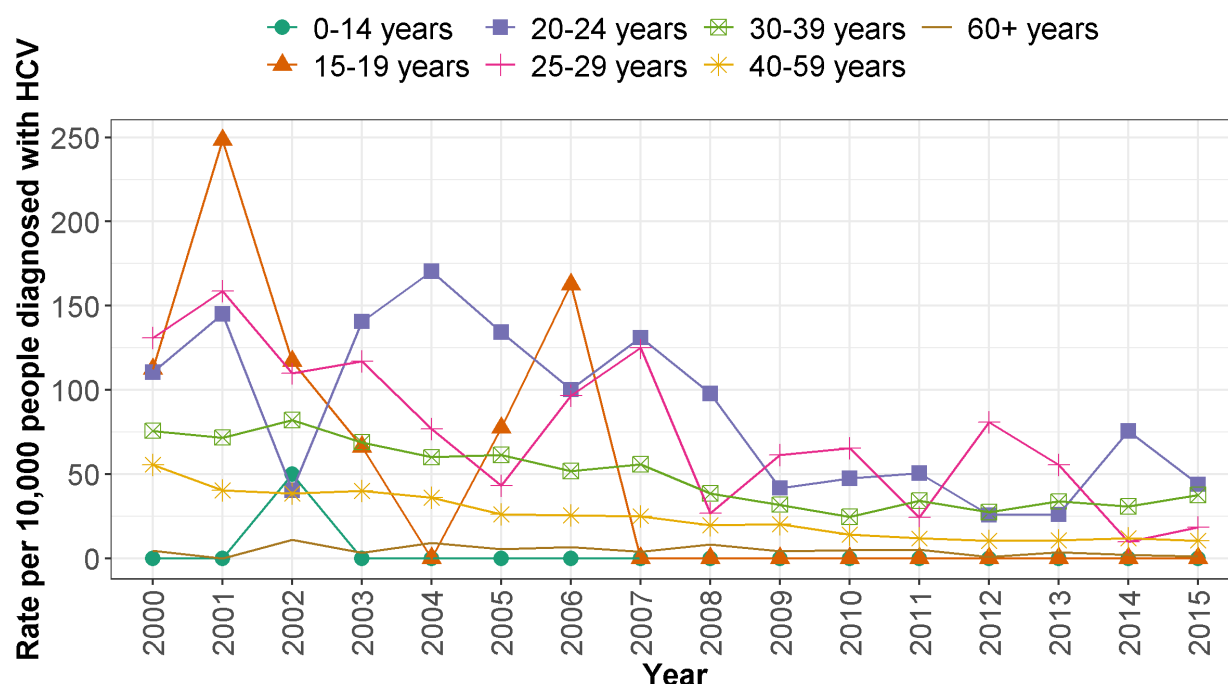
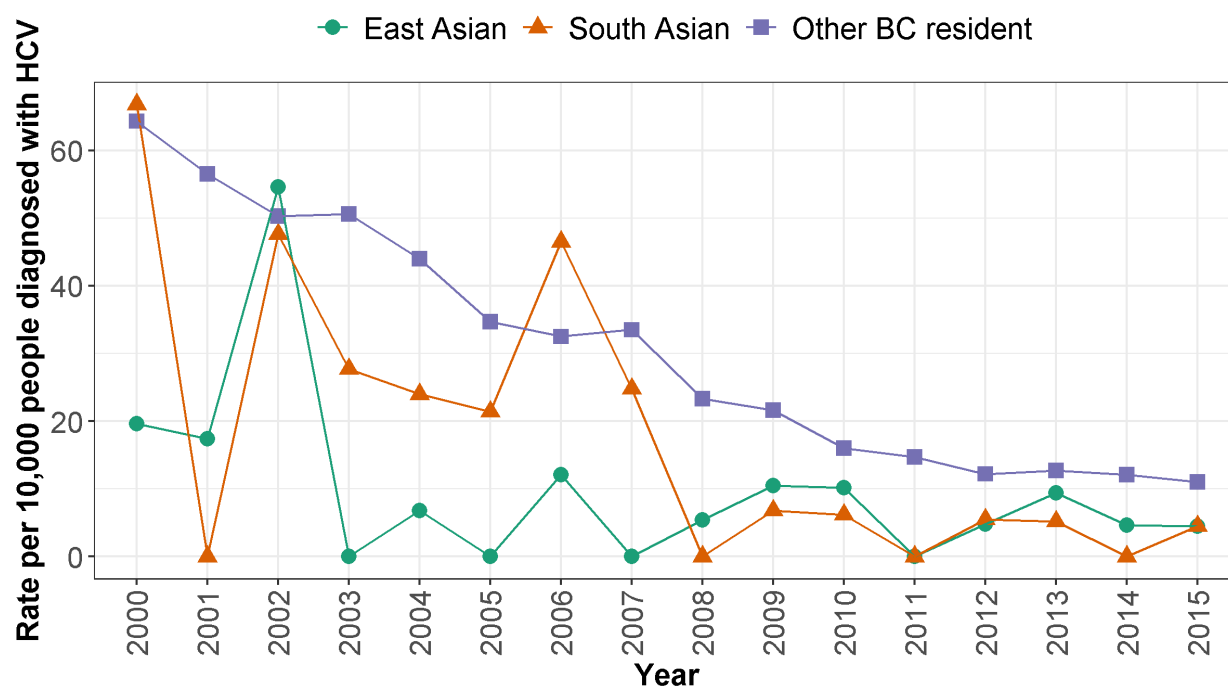


Figure 64. New HIV diagnoses among people diagnosed with HCV in BC by age group, 2000-2015



Individuals may move between age groups over time

Figure 65. New HIV diagnoses among people diagnosed with HCV in BC by ethnicity, 2000-2015



## 4.2. New HBV diagnoses among people diagnosed with HCV in BC, 2000-2015

The rate of new HBV diagnoses among people living with HCV in BC followed an overall decreasing trend between 2000 and 2015 (Figure 66). In 2015, there were 100 new HBV diagnoses among people diagnosed with HCV, representing a rate of 18.0 new HBV diagnoses per 10,000 people

diagnosed with HCV. For comparison, the rate of acute and chronic HBV infections reported in the general BC population in 2015 were 0.13 per 100,000 population and 24.3 per 100,000 population, respectively (60). Similar trends in HBV diagnoses were observed for males and females (Figure 67) and across all Health Authorities (Figure 68). By the end of 2015, new HBV diagnosis rates fell to 17.5 per 10,000 females diagnosed with HCV and 18.4 per 10,000 males diagnosed with HCV (Figure 67). Since 2001, Vancouver Coastal Health Authority has reported the highest recorded rate of new HBV diagnoses among people diagnosed with HCV, with a rate 29.1 new HBV cases per 10,000 persons diagnosed with HCV in 2015 (Figure 68). New HBV diagnoses occurred at similar rates across birth cohorts (Figure 69).

Figure 66. New HBV diagnoses among people diagnosed with HCV in BC, 2000-2015

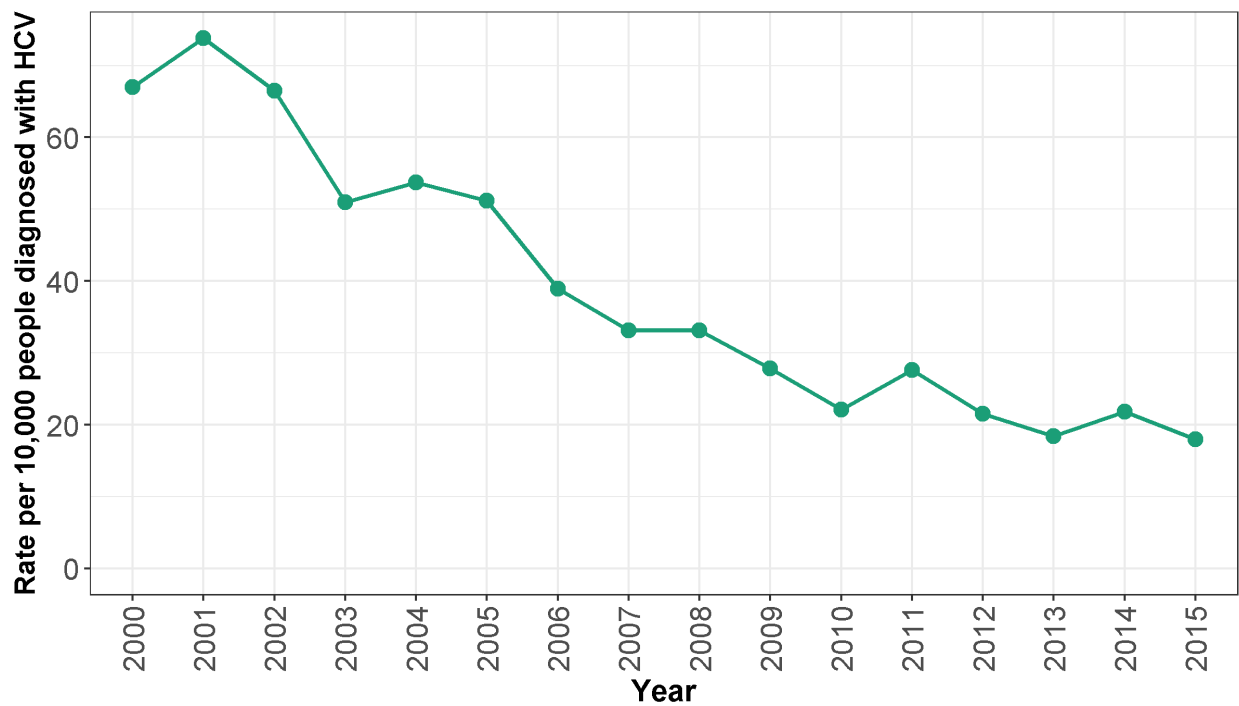


Figure 67. New HBV diagnoses among people diagnosed with HCV in BC by sex, 2000-2015

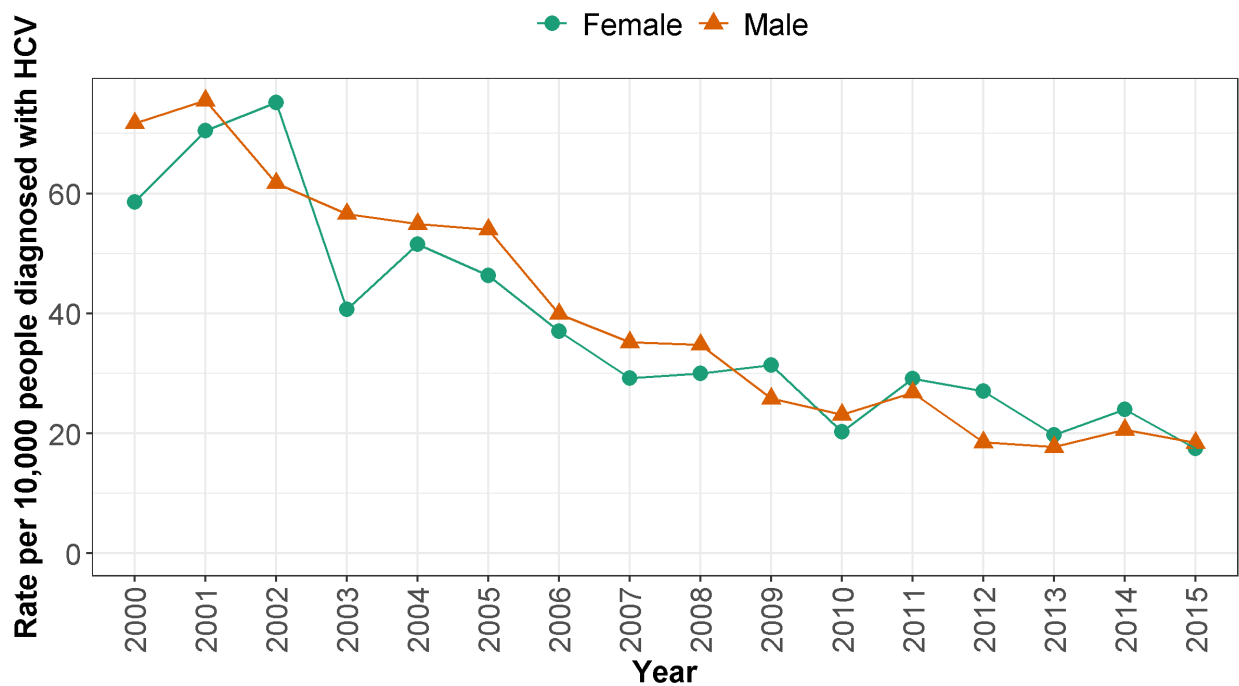
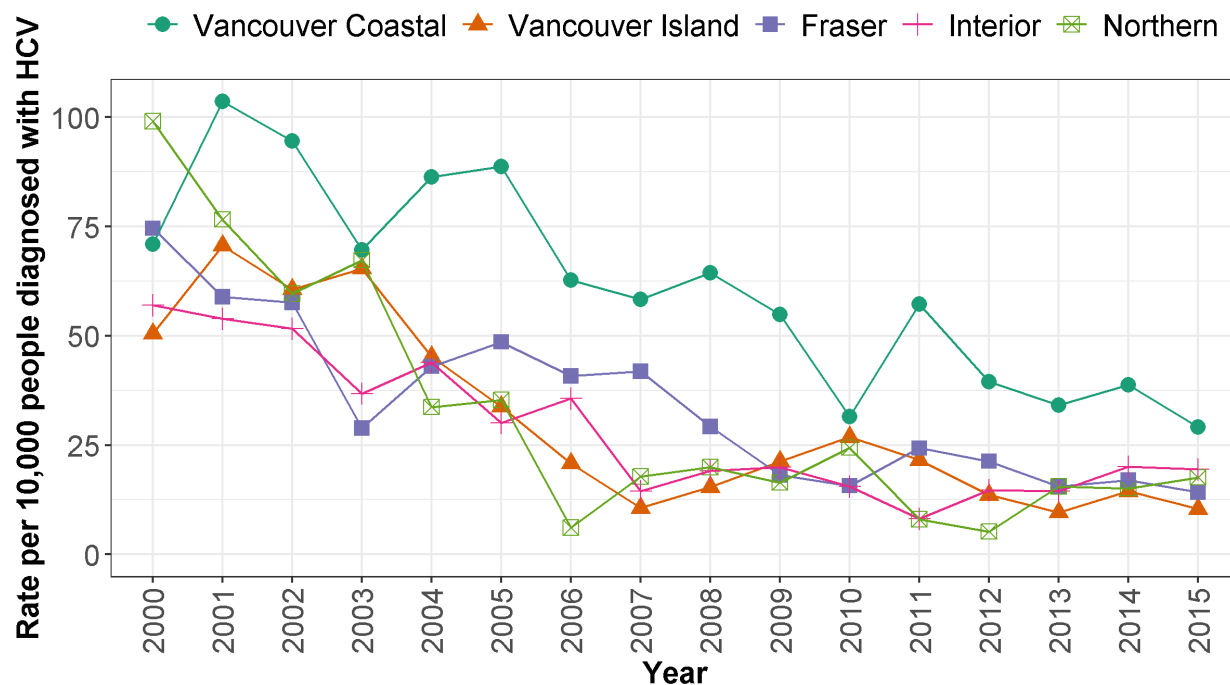


Figure 68. New HBV diagnoses among people diagnosed with HCV in BC by Health Authority, 2000-2015



Individuals may move in and out of health regions over time

Figure 69. New HBV diagnoses among people diagnosed with HCV in BC by birth cohort, 2000-2015

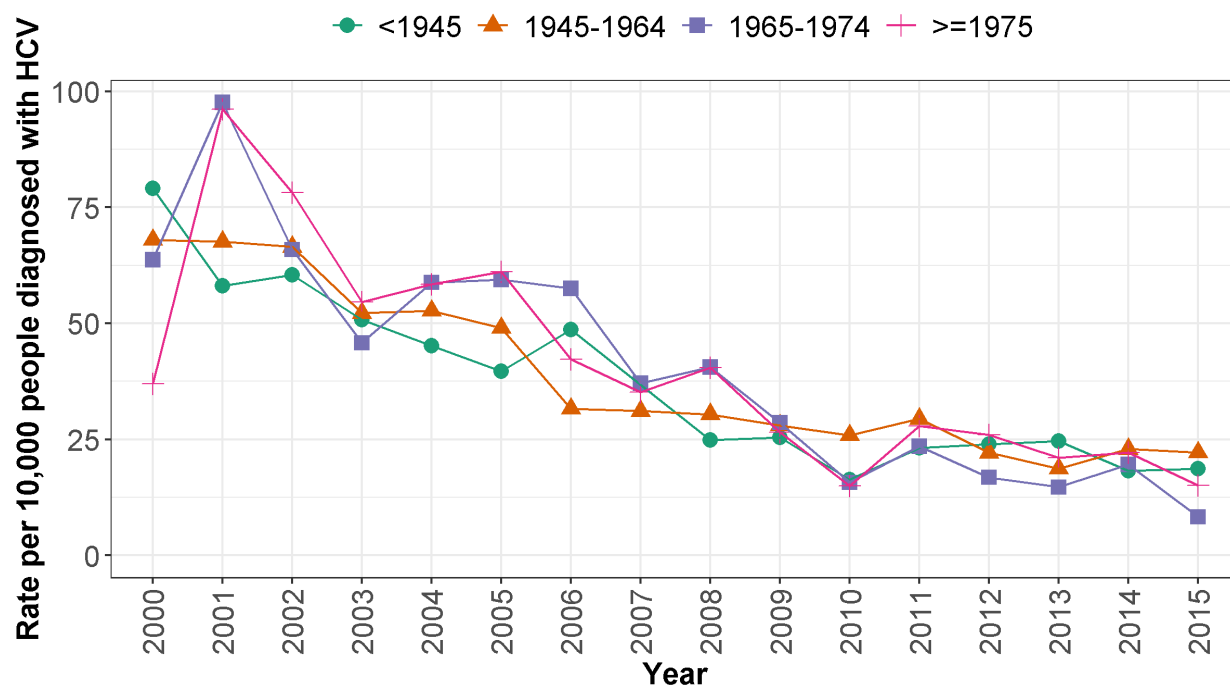
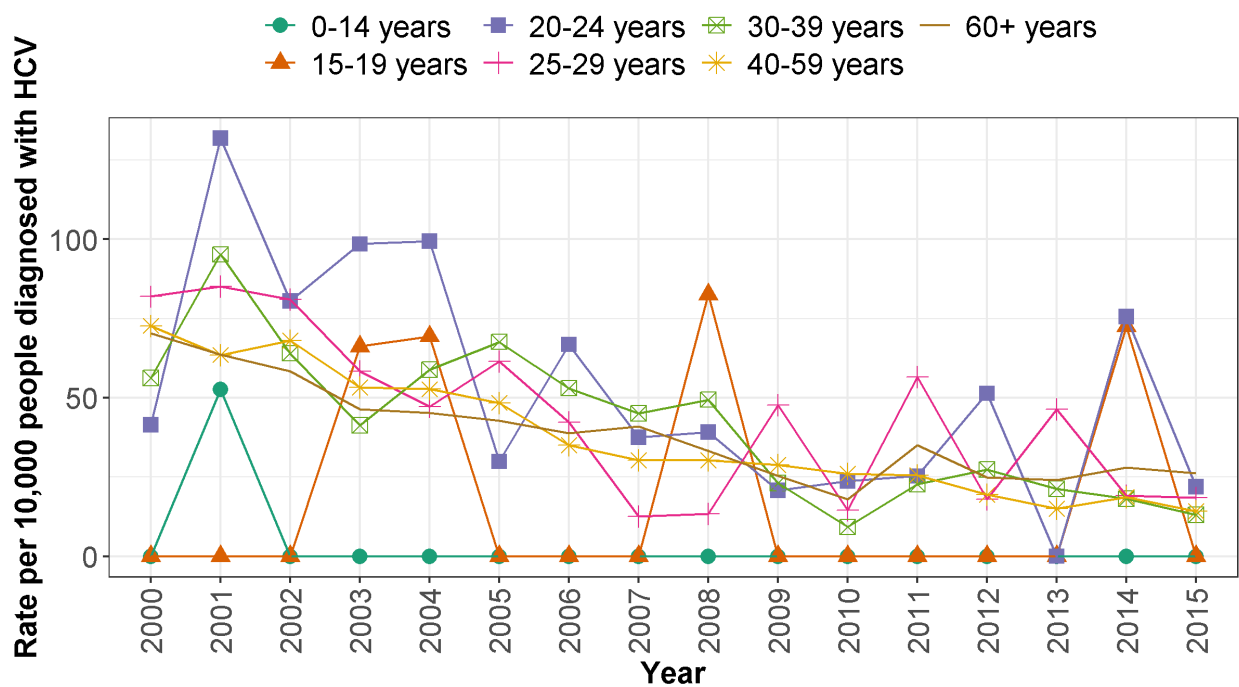
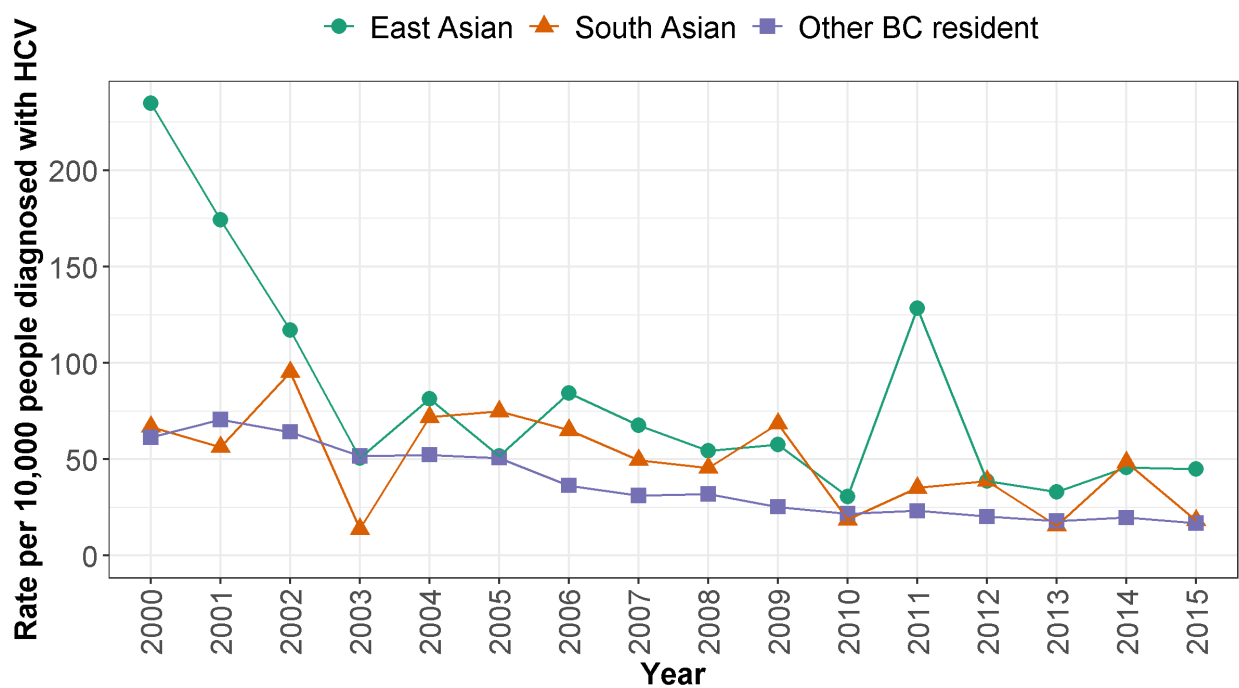


Figure 70. New HBV diagnoses among people diagnosed with HCV in BC by age group, 2000-2015



Individuals may move between age groups over time

Figure 71. New HBV diagnoses among people diagnosed with HCV in BC by ethnicity, 2000-2015



## 5. Impact

These indicators provide some understanding of the burden of advanced liver disease and death associated with HCV infection. Treatment of HCV has been shown to decrease complications of HCV (61, 62). As an increasing proportion of people living with HCV are treated earlier in the course of their infections, we anticipate a reduction in advanced liver disease and death related to HCV over time. Thus, these indicators can serve as measures of the effectiveness of HCV programming, including treatment and other measures in preventing complications and premature death.

Data for this section are generated from the **BC Hepatitis Testers Cohort (BC-HTC)**. Results presented are for persons for whom laboratory testing/case data were successfully linked with administrative data and who were **alive** at the end of each year. Data spanning 2016-2019 represent follow-up data for persons within the BC-HTC by the end 2015, and thus excludes new cases from individuals absent from the cohort by the end of 2015. Note that important data sources for decompensated cirrhosis variable definition were only available until the end of 2015, and that data for hepatocellular carcinoma variable definition were only available until the end of 2016, limiting data presented on decompensated cirrhosis and hepatocellular carcinoma to 2000-2015 and 2000-2016, respectively. See **Appendix A.2** for more information about the BC-HTC.

### 5.1. Advanced Liver Disease

The cumulative sums of people diagnosed with HCV who were ever diagnosed with decompensated cirrhosis (DC) or hepatocellular carcinoma (HCC) are presented as a proportion of the year-end cumulative sum of people ever diagnosed with HCV within the indicated population groups in Figure 72 to Figure 77 (DC) and Figure 78 to Figure 83 (HCC). Persons who died by the end of the each year were excluded from this analysis.

#### 5.1.1. Decompensated cirrhosis diagnoses (ever) among people diagnosed with HCV in BC, 2000-2015 (cumulative)

The total number of people diagnosed with HCV who had ever been diagnosed with decompensated cirrhosis in BC increased between 2000 and 2015 (Figure 72). There were 240.4 decompensated cirrhosis diagnoses per 10,000 people diagnosed with HCV in BC by the end of 2015, with higher year-end prevalence rates among males (252.1 DC diagnoses per 10,000 males diagnosed with HCV) than females (219.9 DC diagnoses per 10,000 females diagnosed with HCV) (Figure 73). Similar trends in decompensated cirrhosis diagnoses were observed in all Health Authorities (Figure 74). By the end of 2015, older people were most affected by DC, recording the highest cumulative DC rates over the 16-year period (60+ years [Figure 75]; <1945 [Figure 76]). By the end of that year, disparities in decompensated cirrhosis diagnosis rates were also observed among people of differing ethnic backgrounds (Figure 77).

Figure 72. Decompensated cirrhosis diagnoses (ever) among people diagnosed with HCV in BC, 2000-2015 (cumulative)

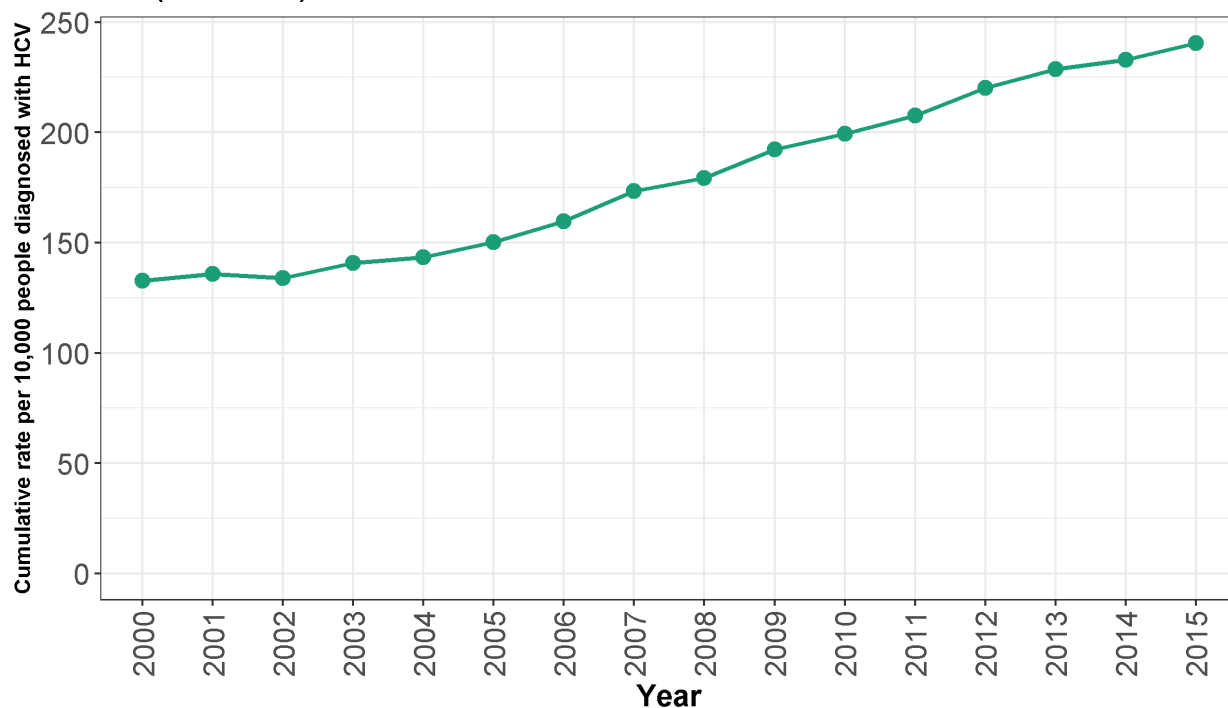


Figure 73. Decompensated cirrhosis diagnoses (ever) among people diagnosed with HCV in BC by sex, 2000-2015 (cumulative)

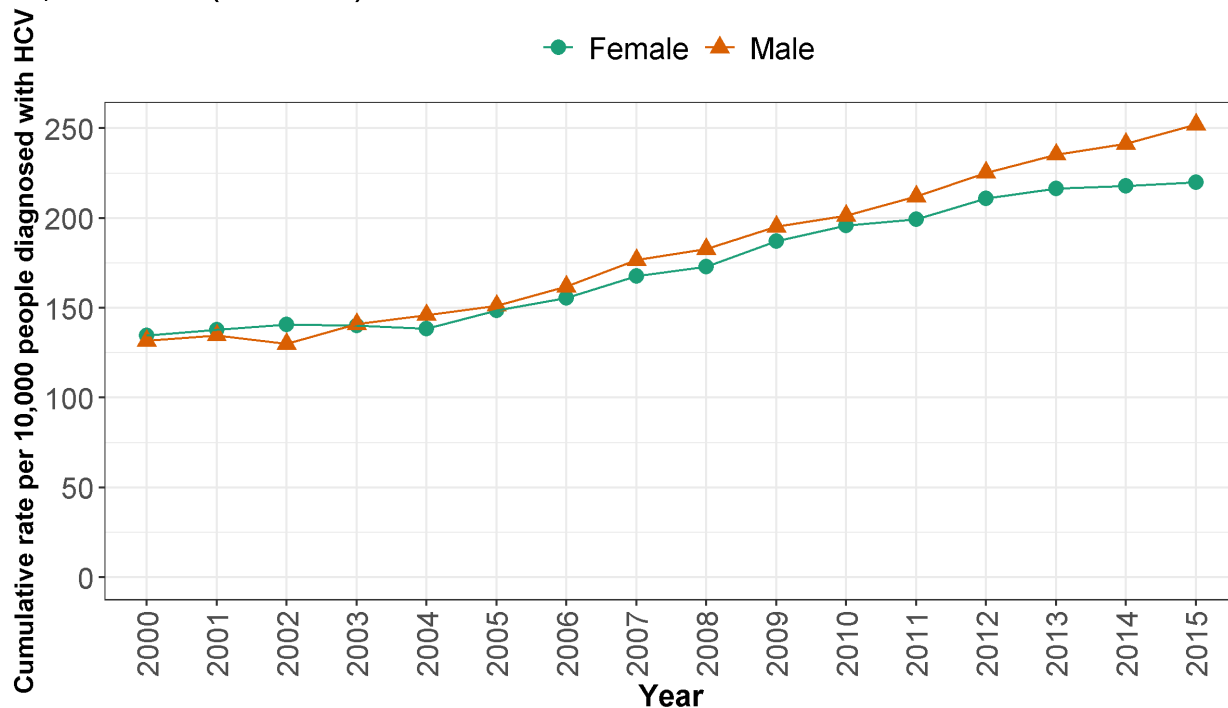
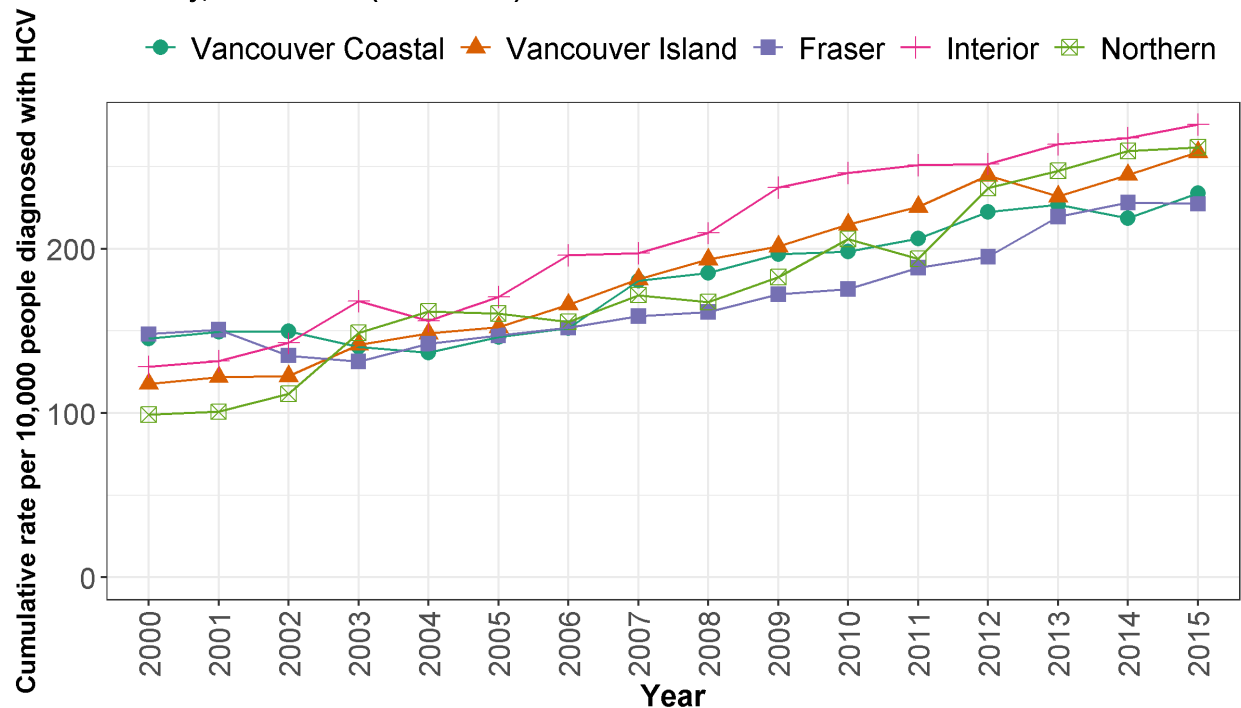


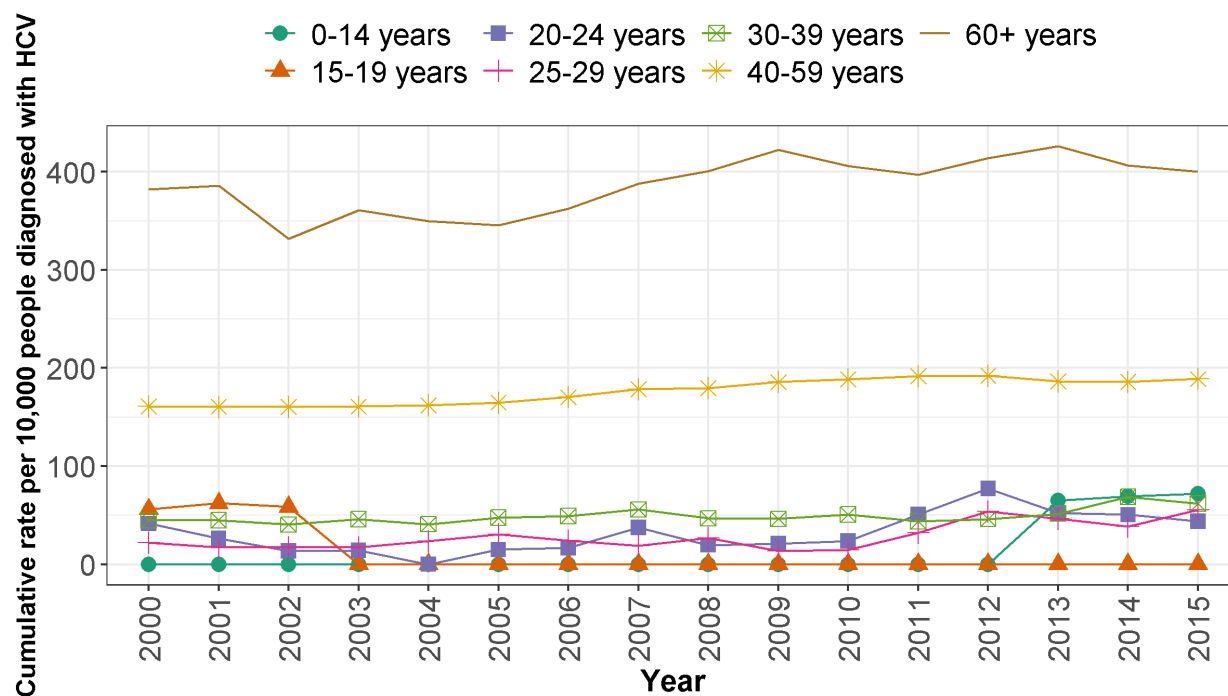


Figure 74. Decompensated cirrhosis diagnoses (ever) among people diagnosed with HCV in BC by Health Authority, 2000-2015 (cumulative)



Individuals may move in and out of health regions over time

Figure 75. Decompensated cirrhosis diagnoses (ever) among people diagnosed with HCV in BC by age group, 2000-2015 (cumulative)



Individuals may move between age groups over time

Figure 76. Decompensated cirrhosis diagnoses (ever) among people diagnosed with HCV in BC by birth cohort, 2000-2015 (cumulative)

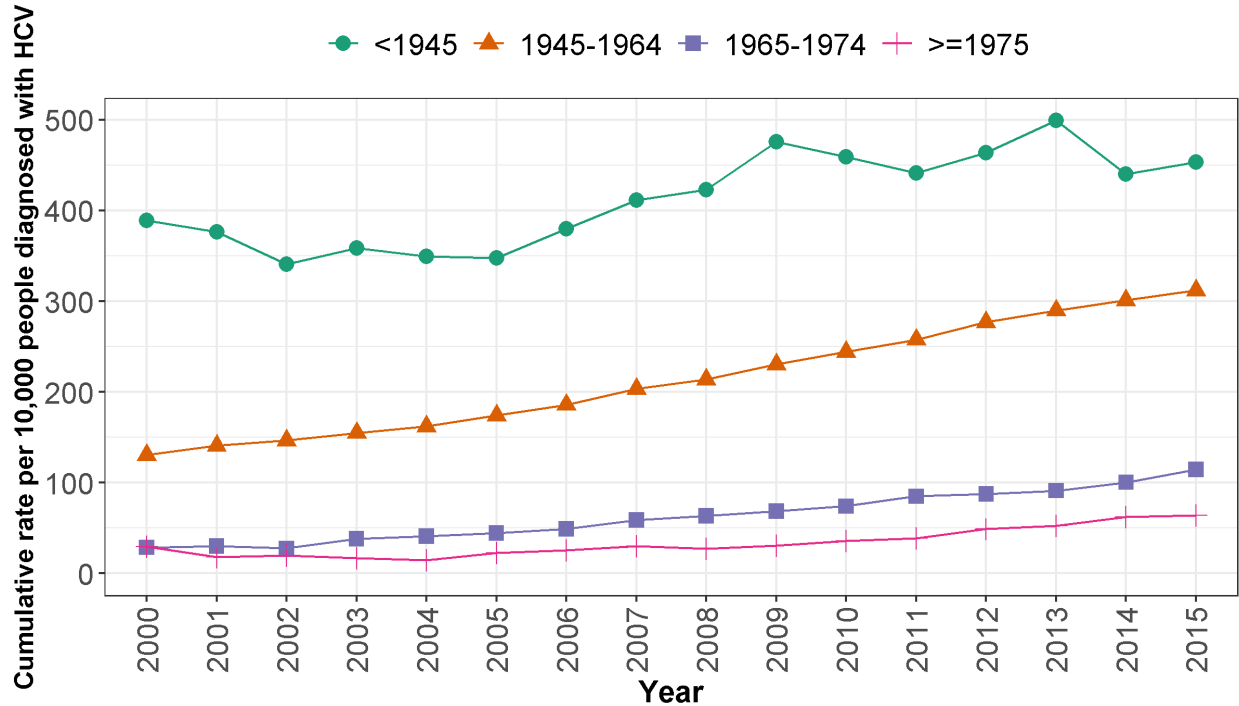
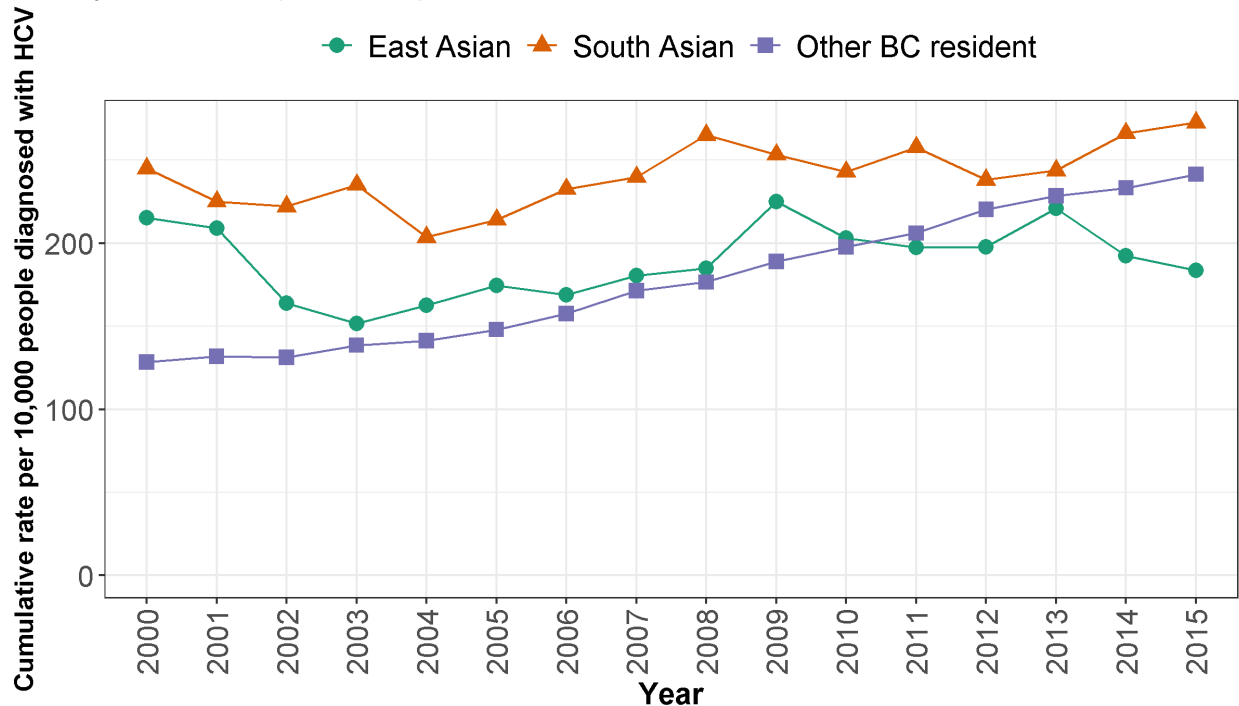


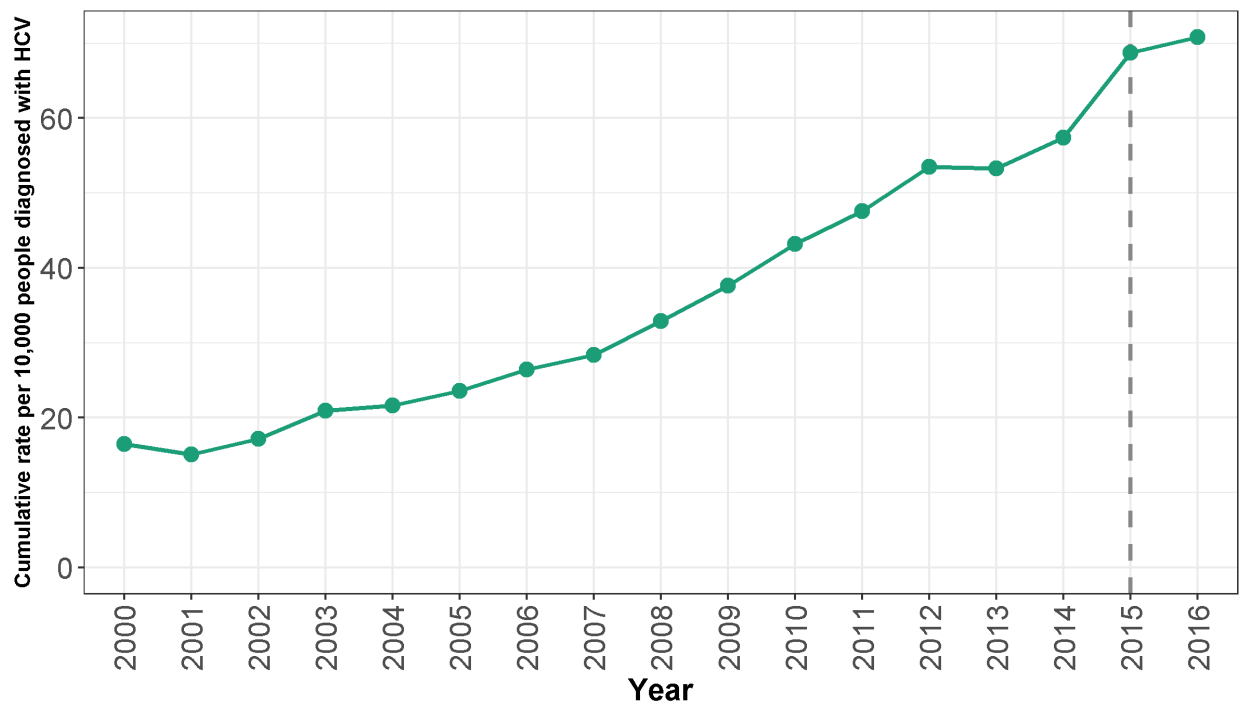
Figure 77. Decompensated cirrhosis diagnoses (ever) among people diagnosed with HCV in BC by ethnicity, 2000-2015 (cumulative)



5.1.2. Hepatocellular carcinoma diagnoses (ever) among people diagnosed with HCV in BC, 2000-2016 (cumulative)

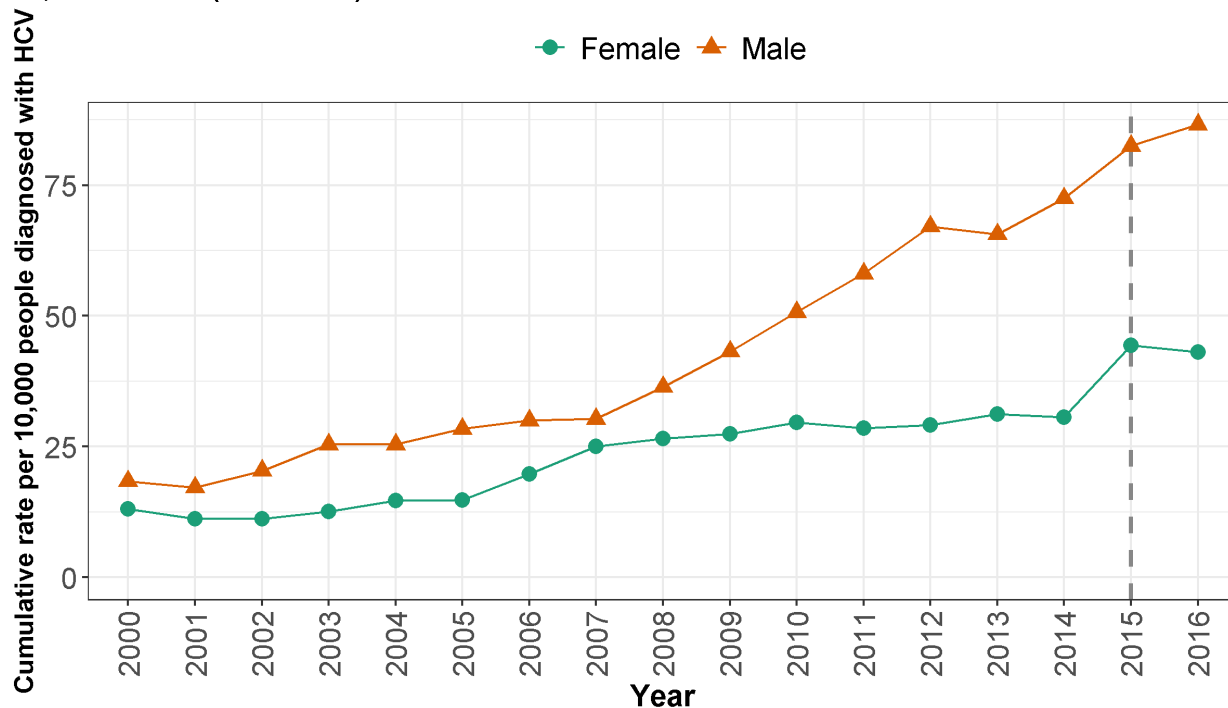
The total number of people diagnosed with HCV who had ever been diagnosed with HCC in BC increased between 2000 and 2016 (Figure 78). There were 70.8 HCC diagnoses per 10,000 people diagnosed with HCV in BC by the end of 2016, with higher year-end prevalence rates among males (86.6 HCC diagnoses per 10,000 HCV-positive males) than females (43.1 HCC diagnoses per 10,000 females diagnosed with HCV) (Figure 79). Similar trends in HCC diagnoses were observed in all Health Authorities, with the highest HCC rate occurring in the Vancouver Island Health Authority (92.2 HCC diagnoses per 10,000 people diagnosed with HCV) (Figure 80). By the end of 2016, older people were most affected by HCC, recording the highest cumulative HCC rates over the 16-year period (60+ years [Figure 81]; <1945 [Figure 82]). Among people of varying ethnic backgrounds, East Asians had the highest rate of HCC diagnoses between 2000 and 2016 (Figure 83).

Figure 78. Hepatocellular carcinoma diagnoses (ever) among people diagnosed with HCV in BC, 2000-2016 (cumulative)



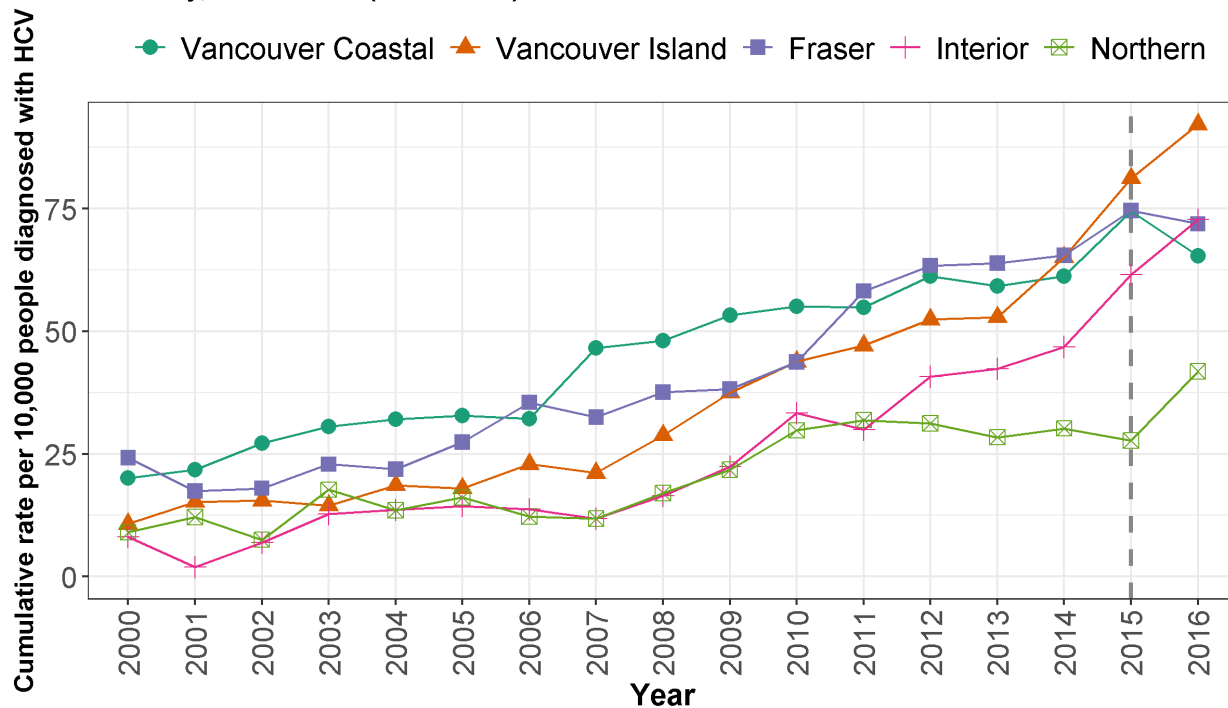
2016 represents follow-up data for persons in the BC-HTC by the end of 2015

Figure 79. Hepatocellular carcinoma diagnoses (ever) among people diagnosed with HCV in BC by sex, 2000-2016 (cumulative)



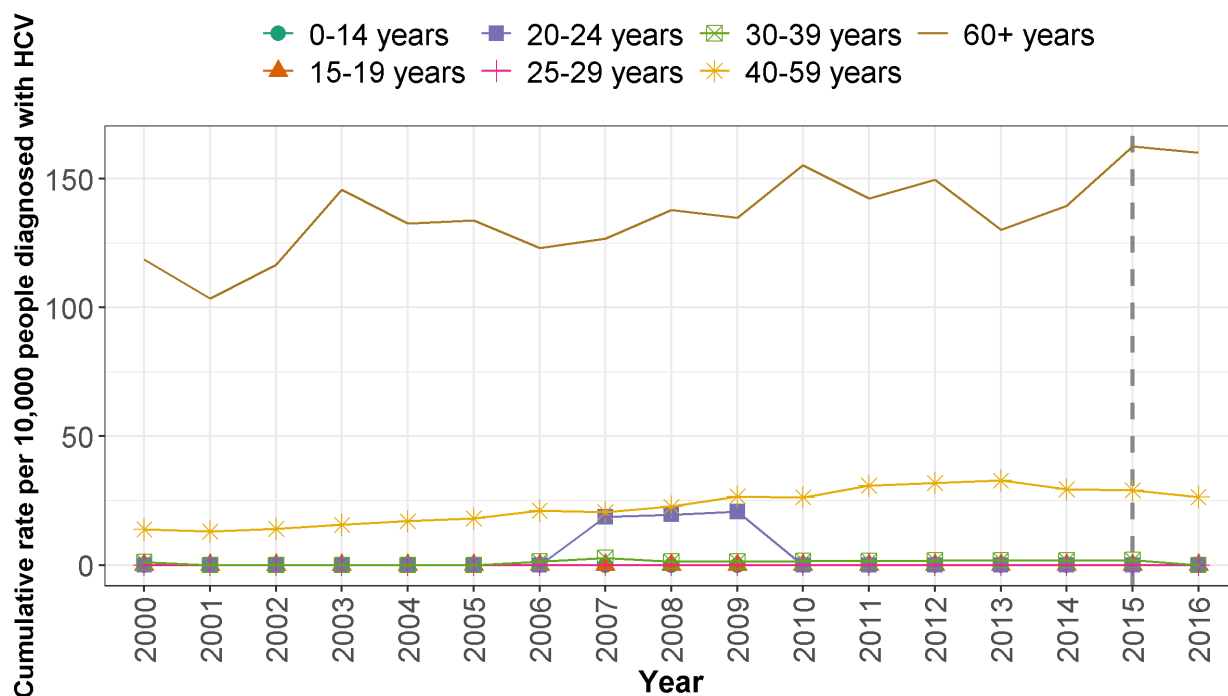
2016 represents follow-up data for persons in the BC-HTC by the end of 2015

Figure 80. Hepatocellular carcinoma diagnoses (ever) among people diagnosed with HCV in BC by Health Authority, 2000-2016 (cumulative)



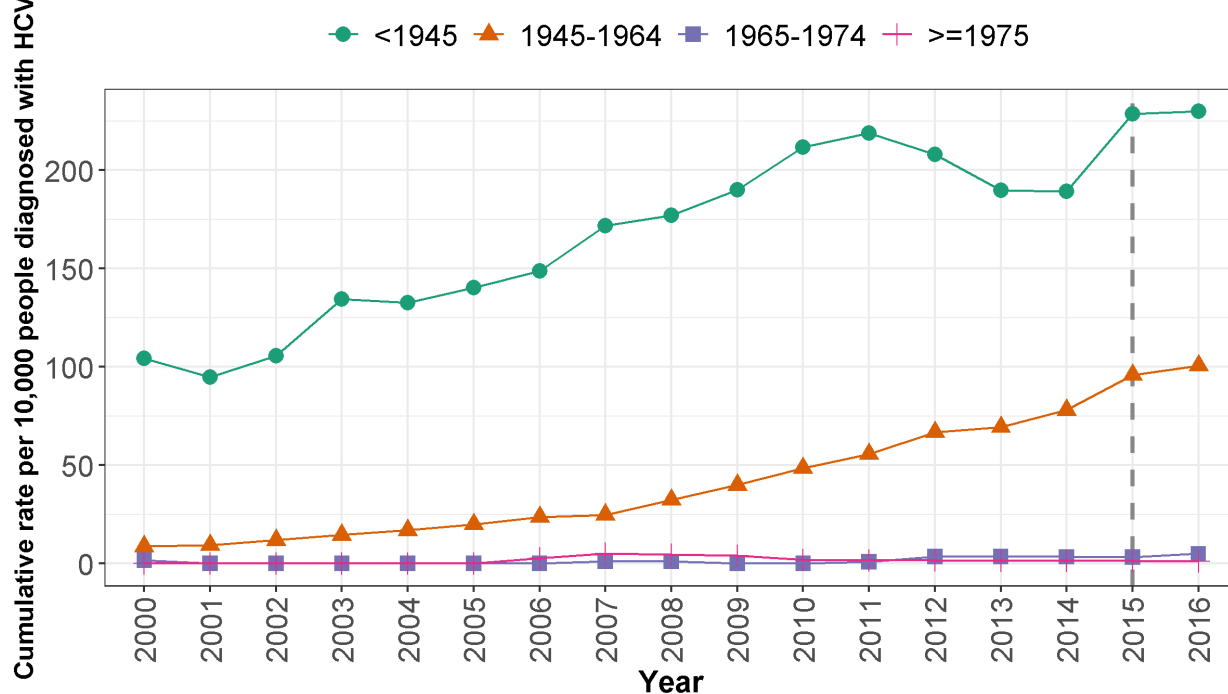
2016 represents follow-up data for persons in the BC-HTC by the end of 2015  
Individuals may move in and out of health regions over time

Figure 81. Hepatocellular carcinoma diagnoses (ever) among people diagnosed with HCV in BC by age group, 2000-2016 (cumulative)



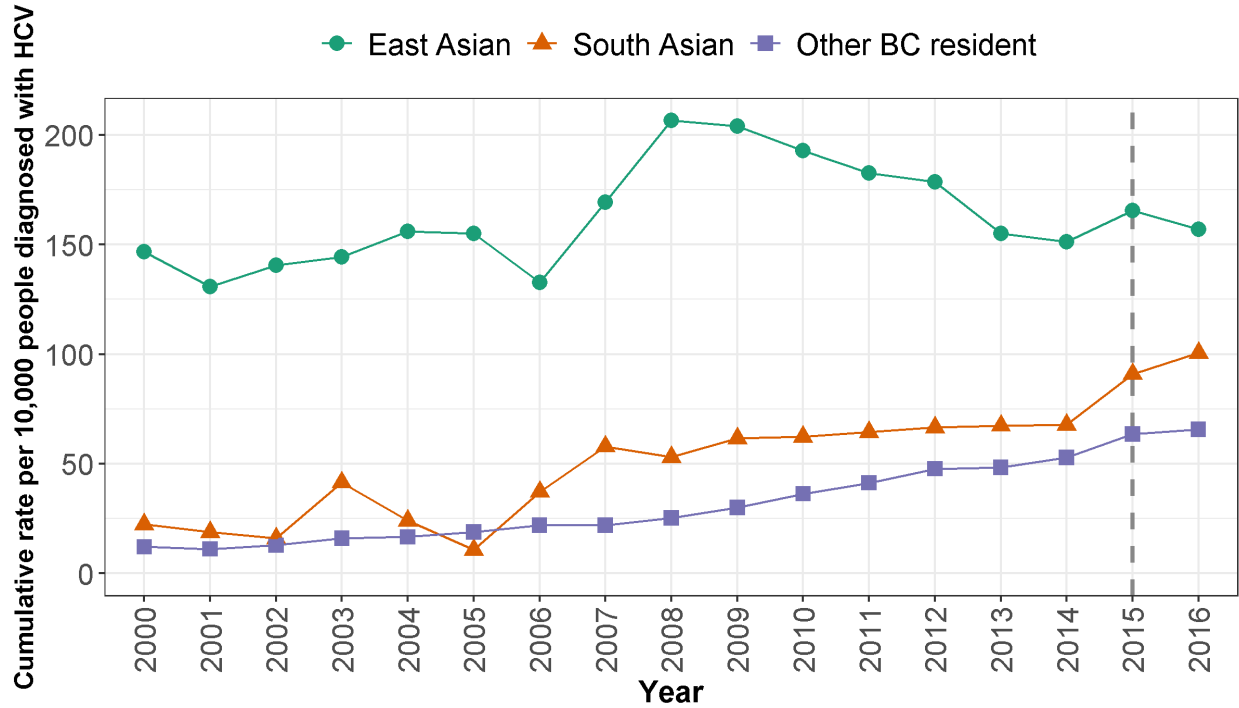
2016 represents follow-up data for persons in the BC-HTC by the end of 2015  
Individuals may move between age groups over time

Figure 82. Hepatocellular carcinoma diagnoses (ever) among people diagnosed with HCV in BC by birth cohort, 2000-2016 (cumulative)



2016 represents follow-up data for persons in the BC-HTC by the end of 2015

Figure 83. Hepatocellular carcinoma diagnoses (ever) among people diagnosed with HCV in BC by ethnicity, 2000-2016 (cumulative)



2016 represents follow-up data for persons in the BC-HTC by the end of 2015

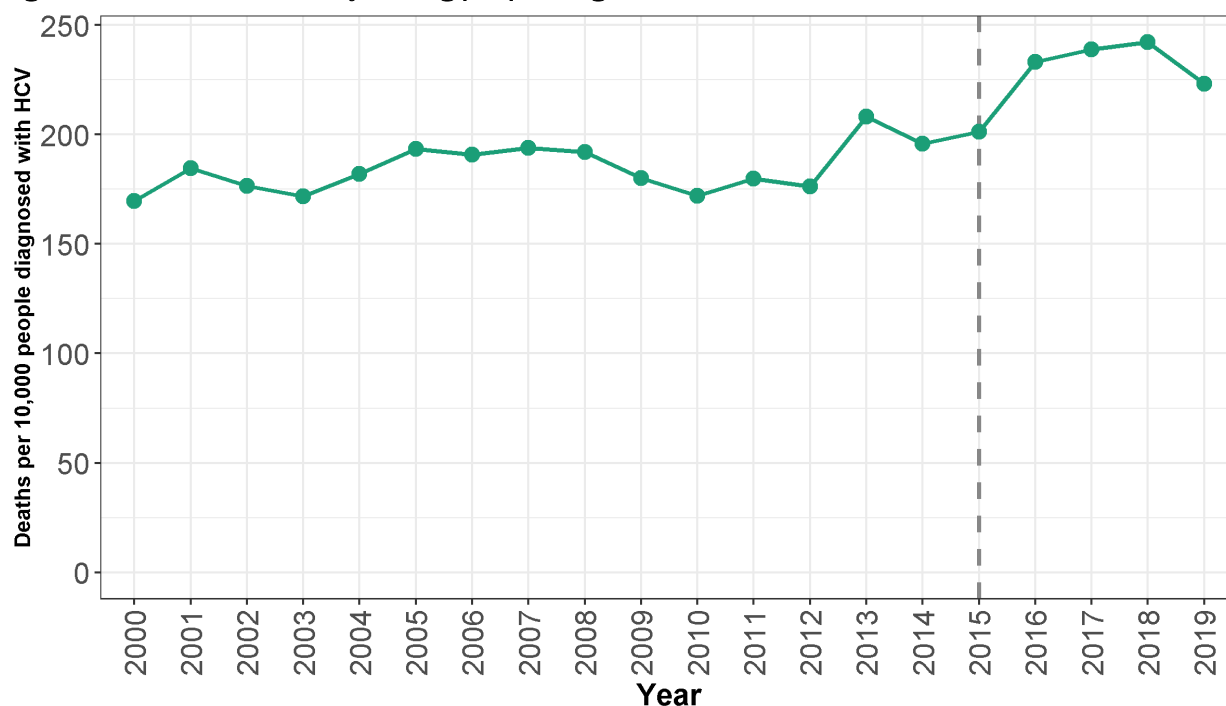
## 5.2. Mortality

The number of deaths (all causes, liver-related or drug-related) among people diagnosed with HCV who were alive at the start of each calendar year are presented as a proportion of the total number of people diagnosed with HCV who were alive at the start of the year within each indicated group in Figure 84 to Figure 89 (all-cause mortality), Figure 90 to Figure 95 (liver-related mortality) and Figure 96 to Figure 101 (drug-related mortality). All-cause mortality is a particularly important indicator to monitor in the context of BC's overdose crisis, given that people at risk for HCV are often also at risk of overdose-related death. The significant increase in drug-related overdoses and deaths led to the declaration of a public health emergency in BC in April 2016 (63).

### 5.2.1. All-cause mortality among people diagnosed with HCV in BC, 2000-2019

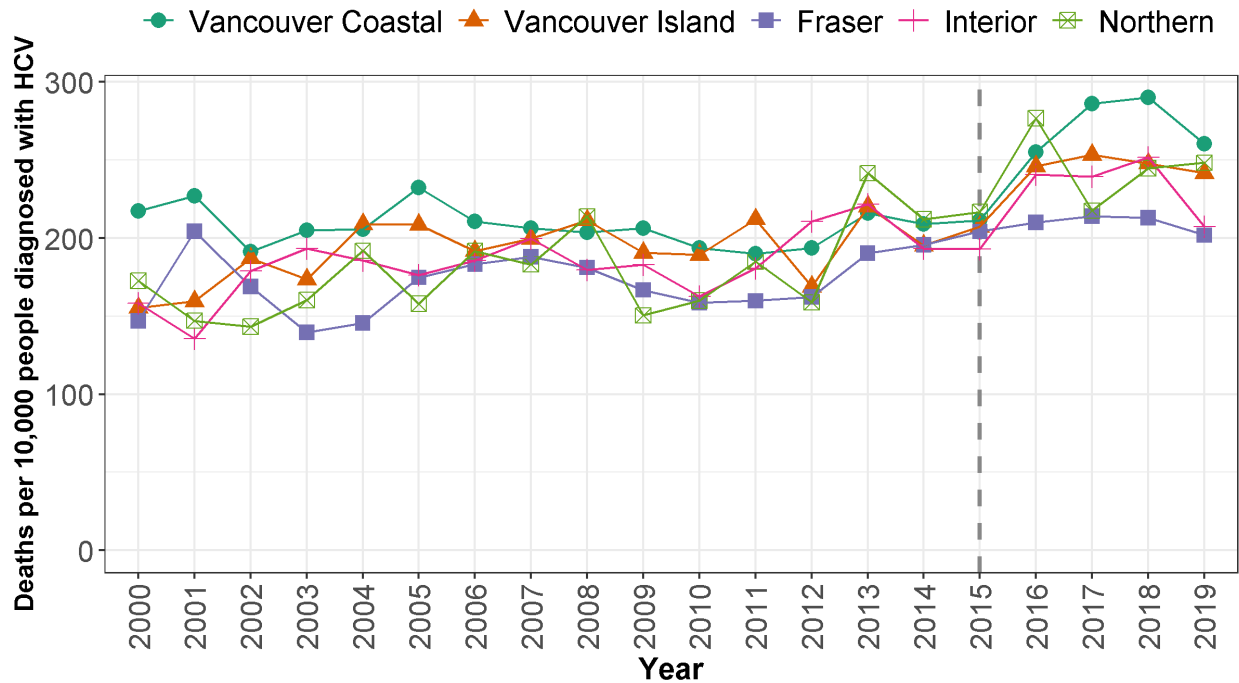
The rate of death from all causes among people diagnosed with HCV in BC remained stable between 2000 and 2012, rising steadily thereafter (Figure 84). This trend was consistent with that observed across all Health Authorities (Figure 85) and among both males and females (Figure 86). There were 223.1 deaths per 10,000 people diagnosed with HCV in BC by the end of 2019, with higher year-end death rates among males (241.6 deaths per 10,000 males diagnosed with HCV) than females (191.4 deaths per 10,000 females diagnosed with HCV). Between 2000 and 2019, all-cause mortality rates were consistently highest among males (Figure 86), and among older individuals (60+ years [Figure 87]; <1945 [Figure 88]) diagnosed with HCV. Since 2015, all-cause mortality among people 30-39 years old has been increasing, which may be in part due to overdose deaths. In 2019, over a quarter of all overdose deaths were among this age group (64).

Figure 84. All-cause mortality among people diagnosed with HCV in BC, 2000-2019



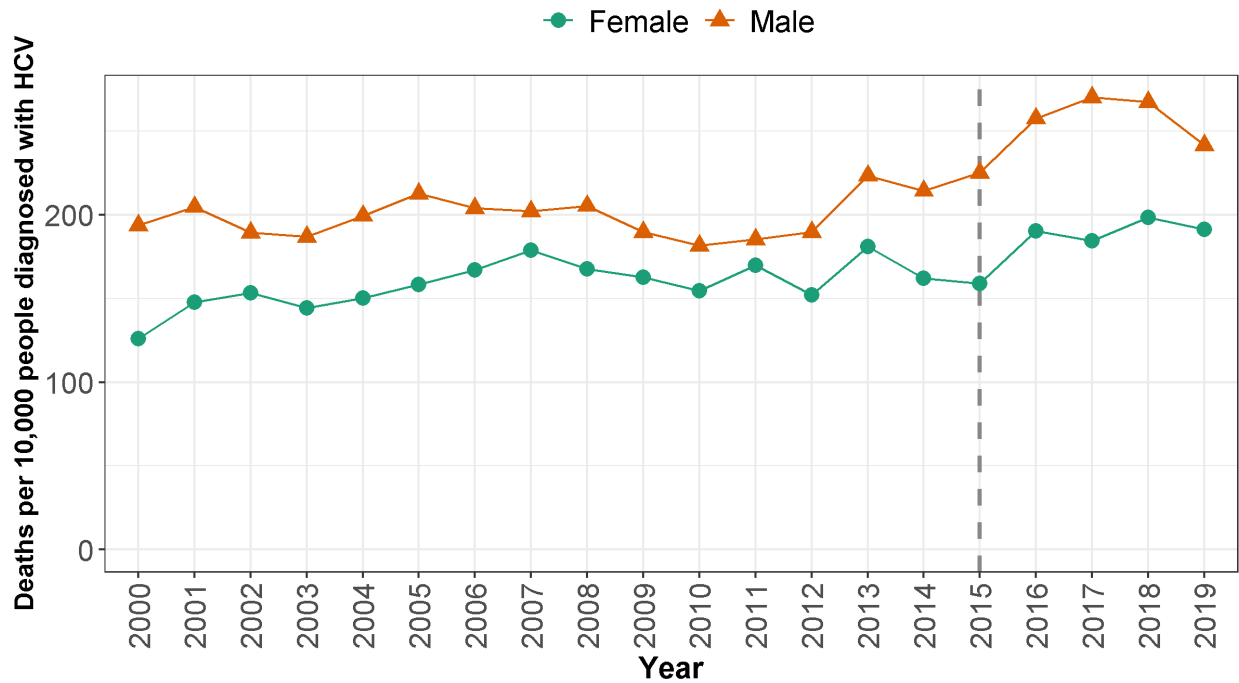
2016-2019 represent follow-up data for persons in the BC-HTC by the end of 2015

Figure 85. All-cause mortality among people diagnosed with HCV in BC by Health Authority, 2000-2019



2016-2019 represent follow-up data for persons in the BC-HTC by the end of 2015  
Individuals may move in and out of health regions over time

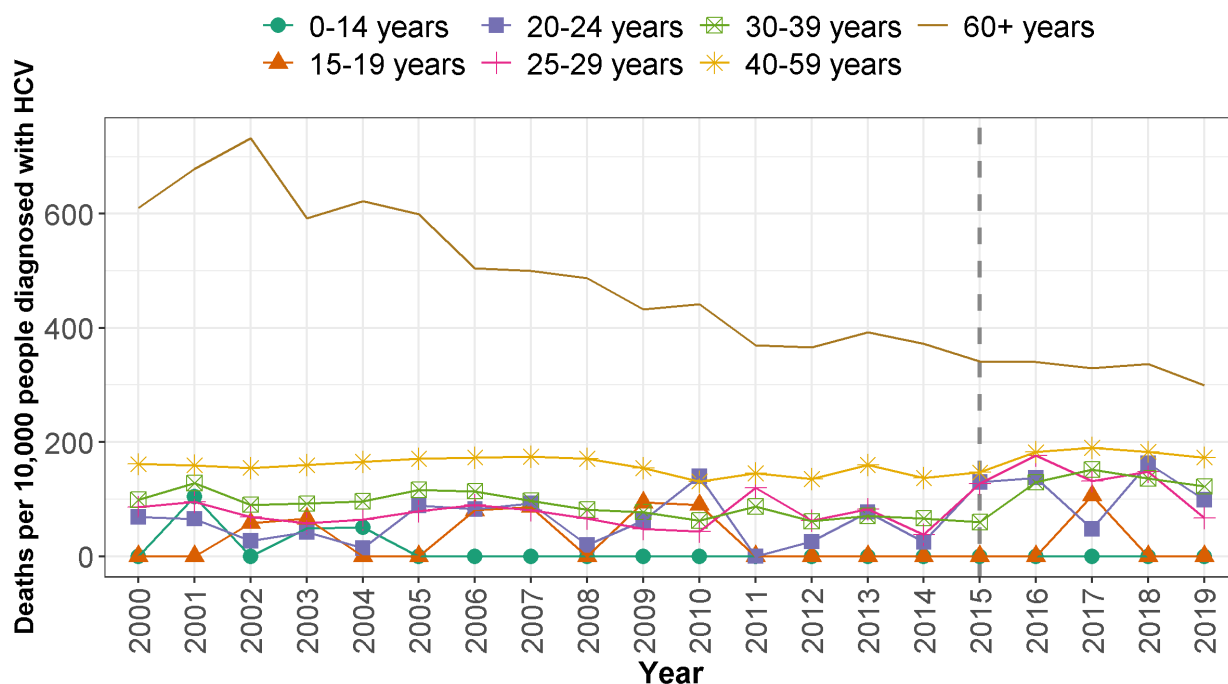
Figure 86. All-cause mortality among people diagnosed with HCV in BC by sex, 2000-2019



2016-2019 represent follow-up data for persons in the BC-HTC by the end of 2015

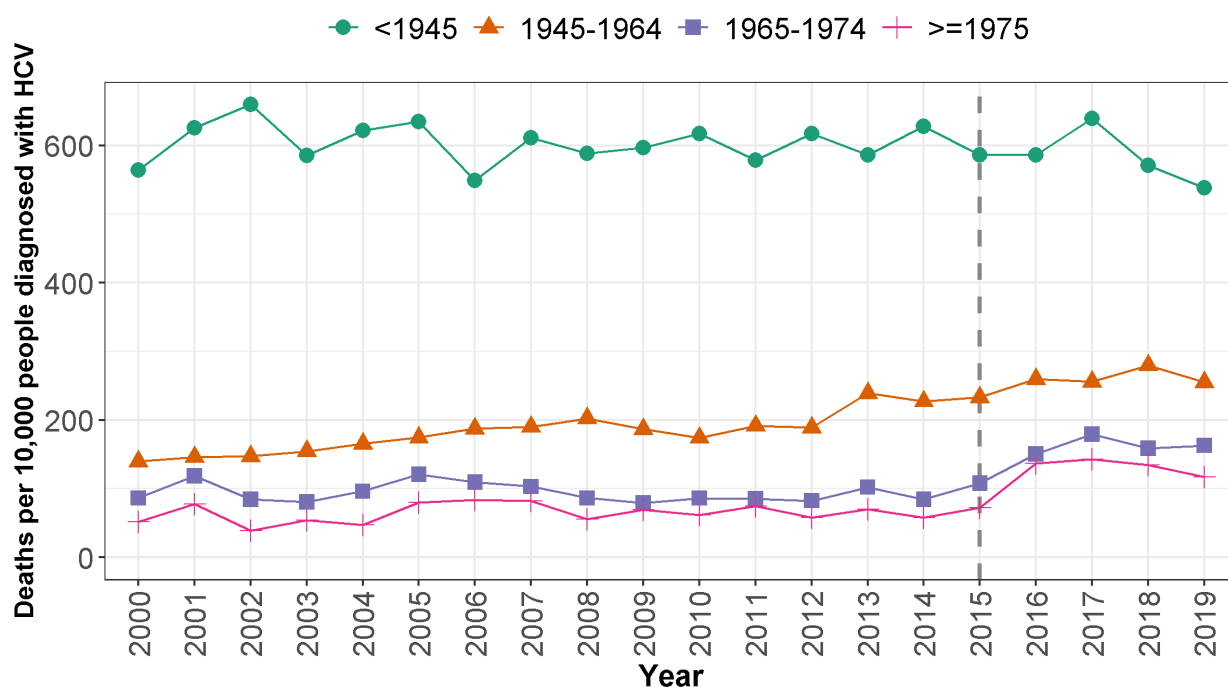


Figure 87. All-cause mortality among people diagnosed with HCV in BC by age group, 2000-2019



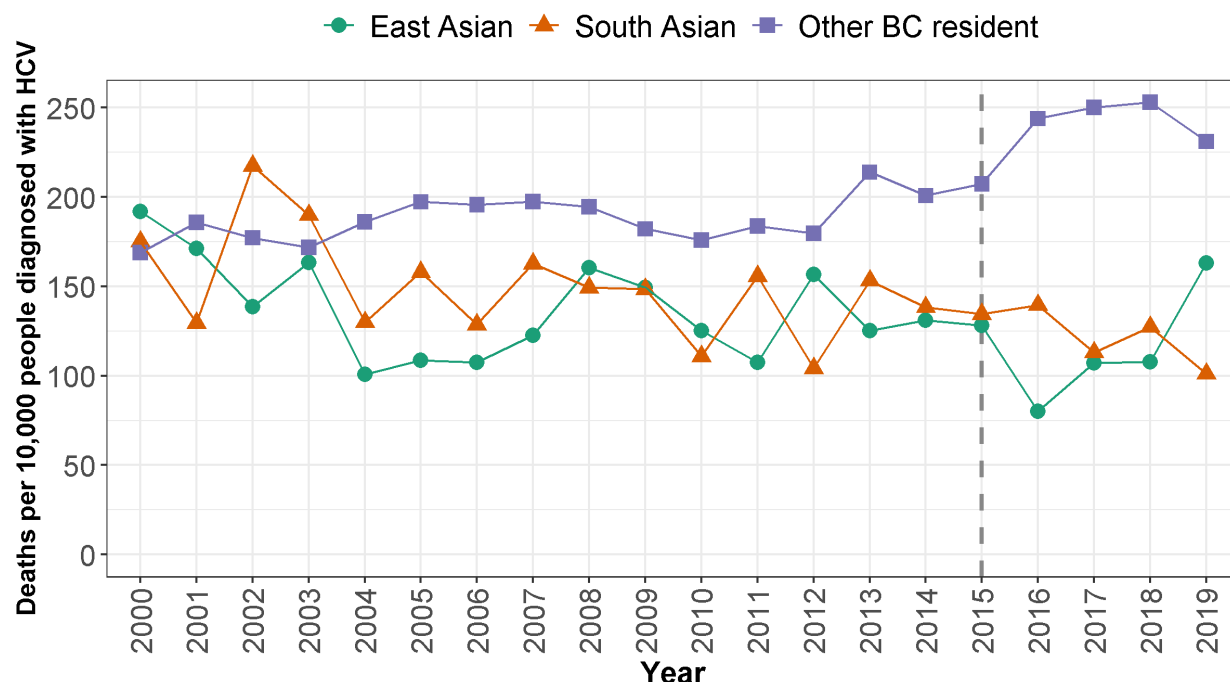
2016-2019 represent follow-up data for persons in the BC-HTC by the end of 2015  
Individuals may move between age groups over time

Figure 88. All-cause mortality among people diagnosed with HCV in BC by birth cohort, 2000-2019



2016-2019 represent follow-up data for persons in the BC-HTC by the end of 2015

Figure 89. All-cause mortality among people diagnosed with HCV in BC by ethnicity, 2000-2019

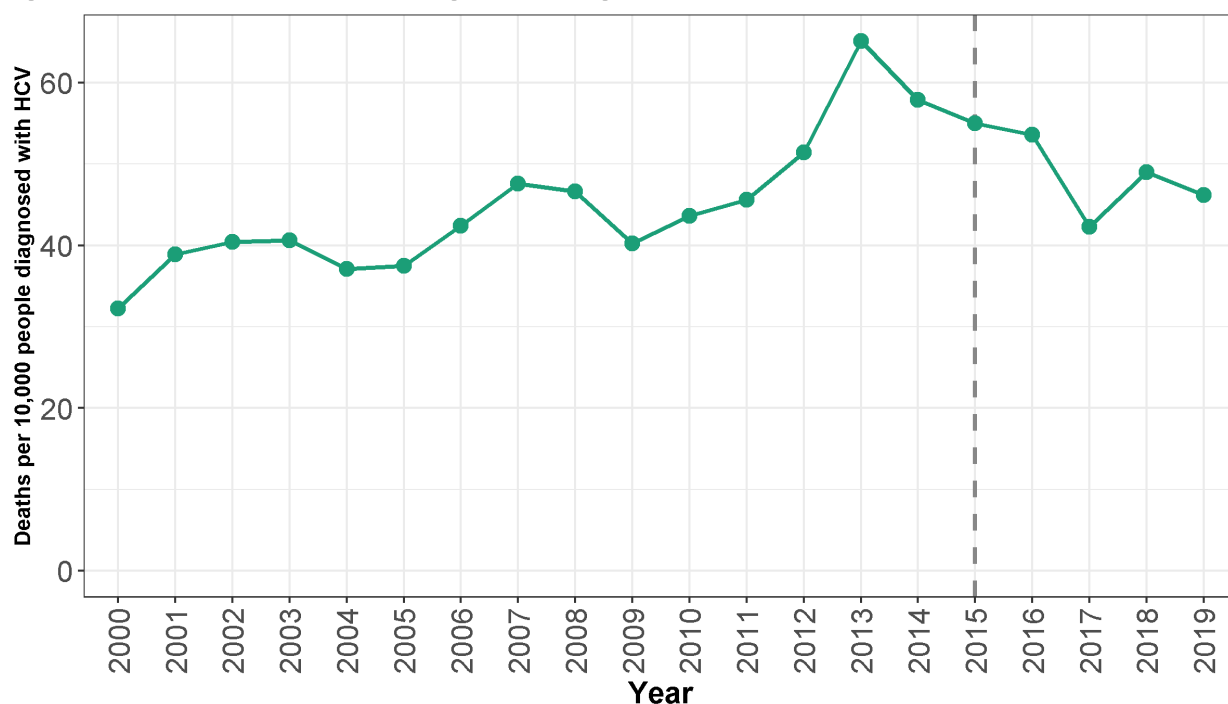


2016-2019 represent follow-up data for persons in the BC-HTC by the end of 2015

### 5.2.2. Liver-related death among people diagnosed with HCV in BC, 2000-2019

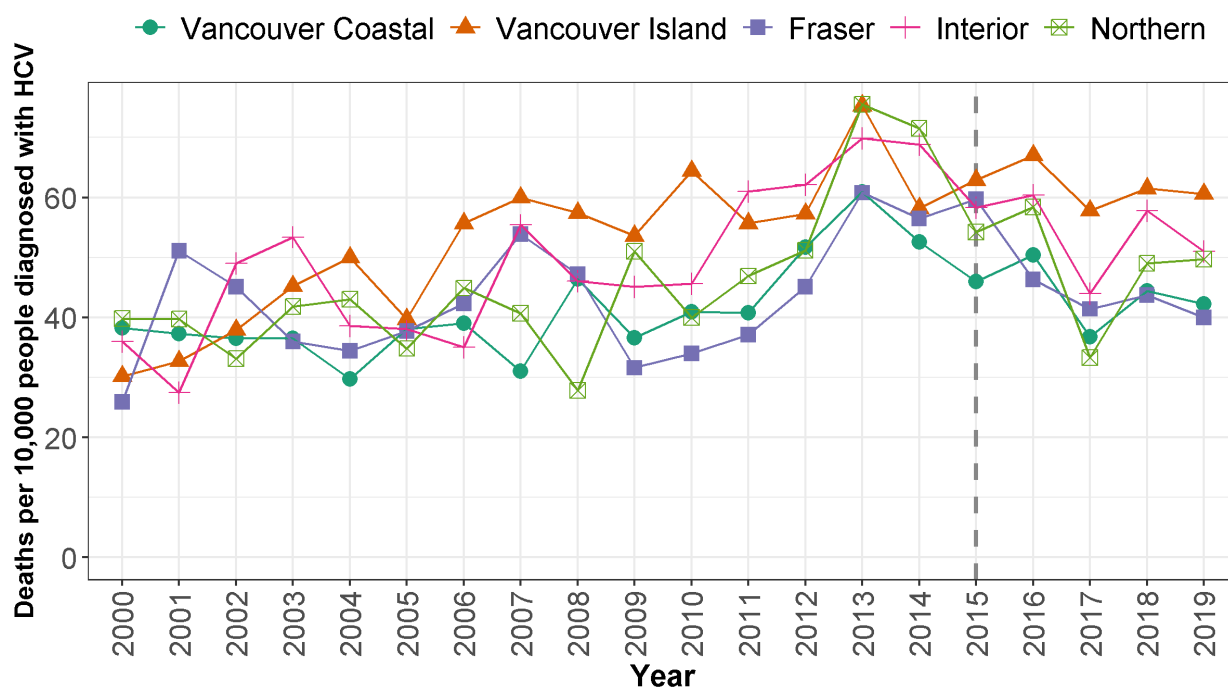
The rate of death from liver-related causes among people diagnosed with HCV in BC increased gradually between 2000 and 2013, followed by a significant fall from 2014 to 2017 (Figure 90). This trend was consistent with that observed across all Health Authorities (Figure 91) and among males and females (Figure 92). There were 46.2 liver-related deaths per 10,000 people diagnosed with HCV in BC by the end of 2019, with higher year-end rates of liver-related death among males (51.3 deaths per 10,000 males ever diagnosed with HCV) than females (37.7 deaths per 10,000 females ever diagnosed with HCV). Between 2000 and 2019, liver-related mortality rates were consistently highest among males (Figure 92), and among older individuals (60+ years [Figure 93]; <1945 [Figure 94]) diagnosed with HCV.

Figure 90. Liver-related death among people diagnosed with HCV in BC, 2000-2019



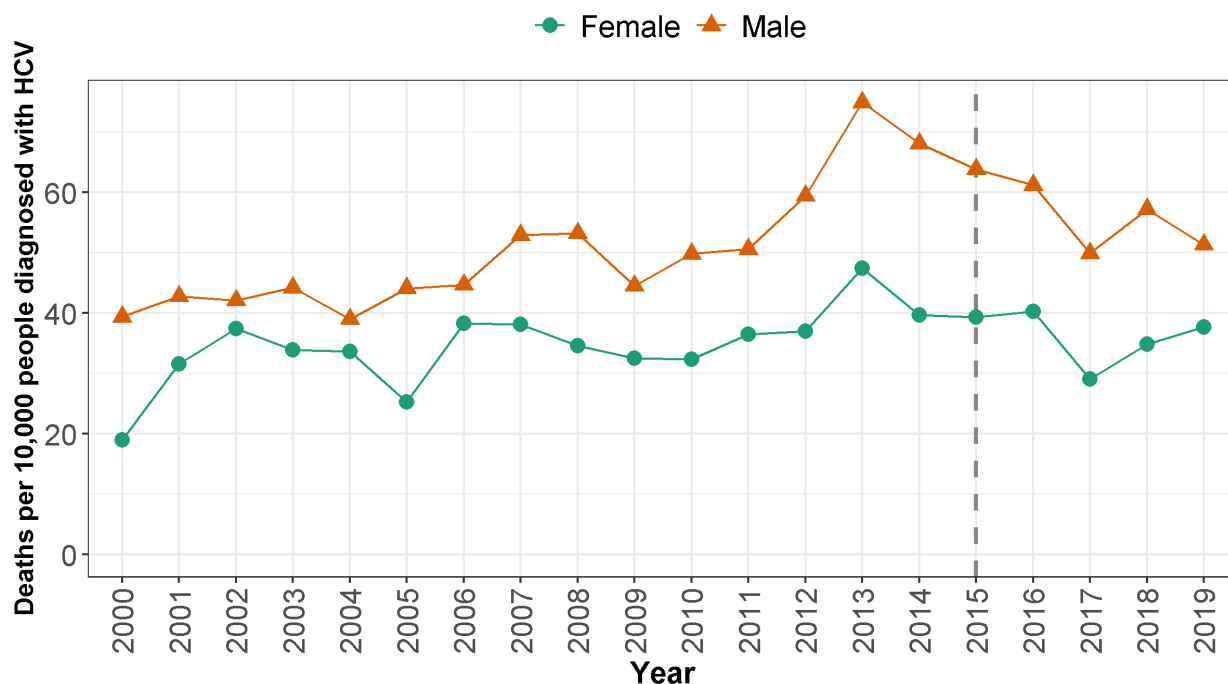
2016-2019 represent follow-up data for persons in the BC-HTC by the end of 2015

Figure 91. Liver-related death among people diagnosed with HCV in BC by Health Authority, 2000-2019



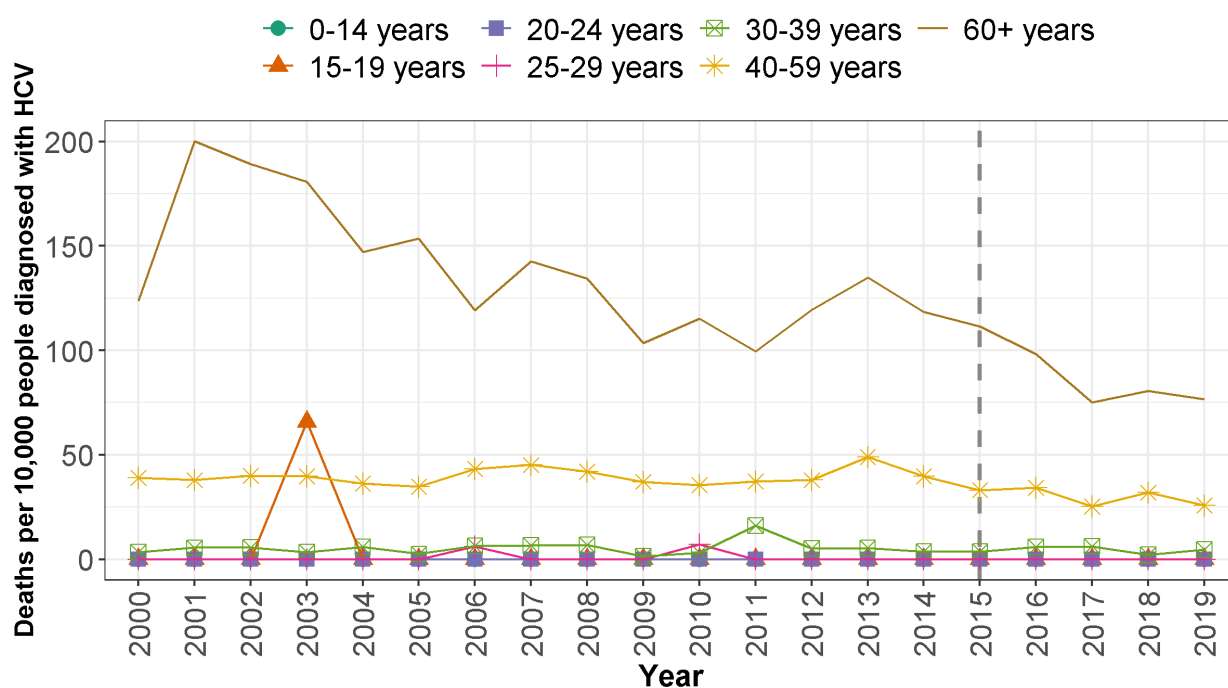
2016-2019 represent follow-up data for persons in the BC-HTC by the end of 2015  
Individuals may move in and out of health regions over time

Figure 92. Liver-related death among people diagnosed with HCV in BC by sex, 2000-2019



2016-2019 represent follow-up data for persons in the BC-HTC by the end of 2015

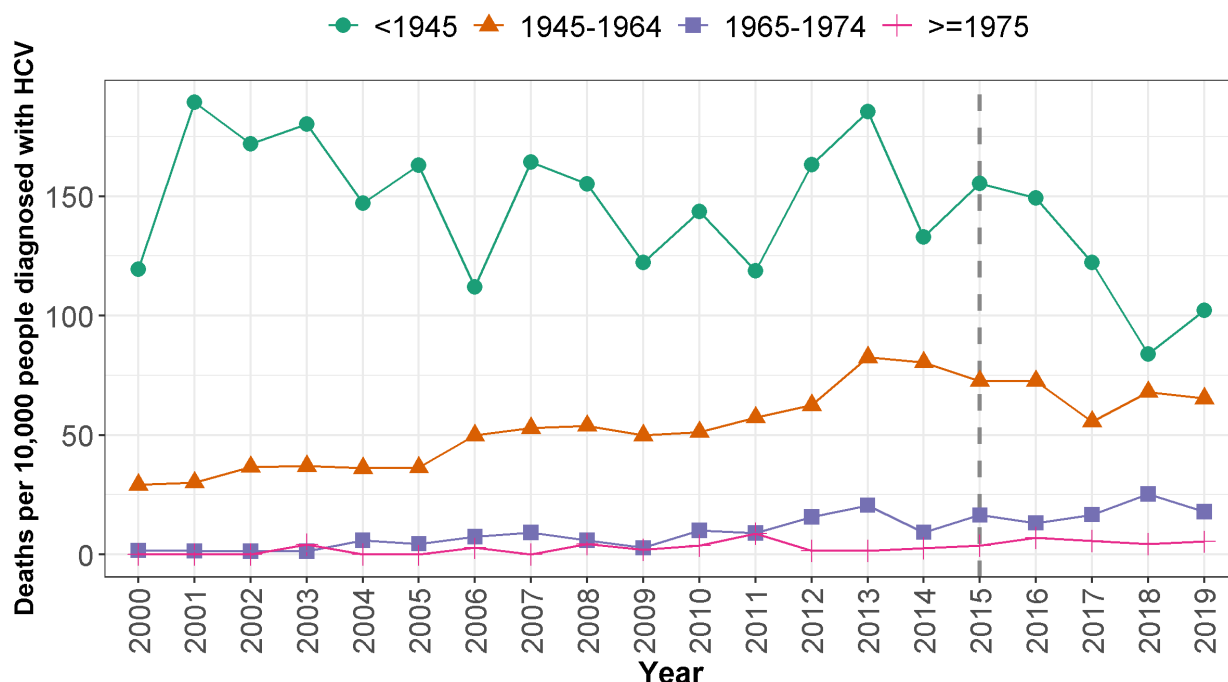
Figure 93. Liver-related death among people diagnosed with HCV in BC by age group, 2000-2019



2016-2019 represent follow-up data for persons in the BC-HTC by the end of 2015

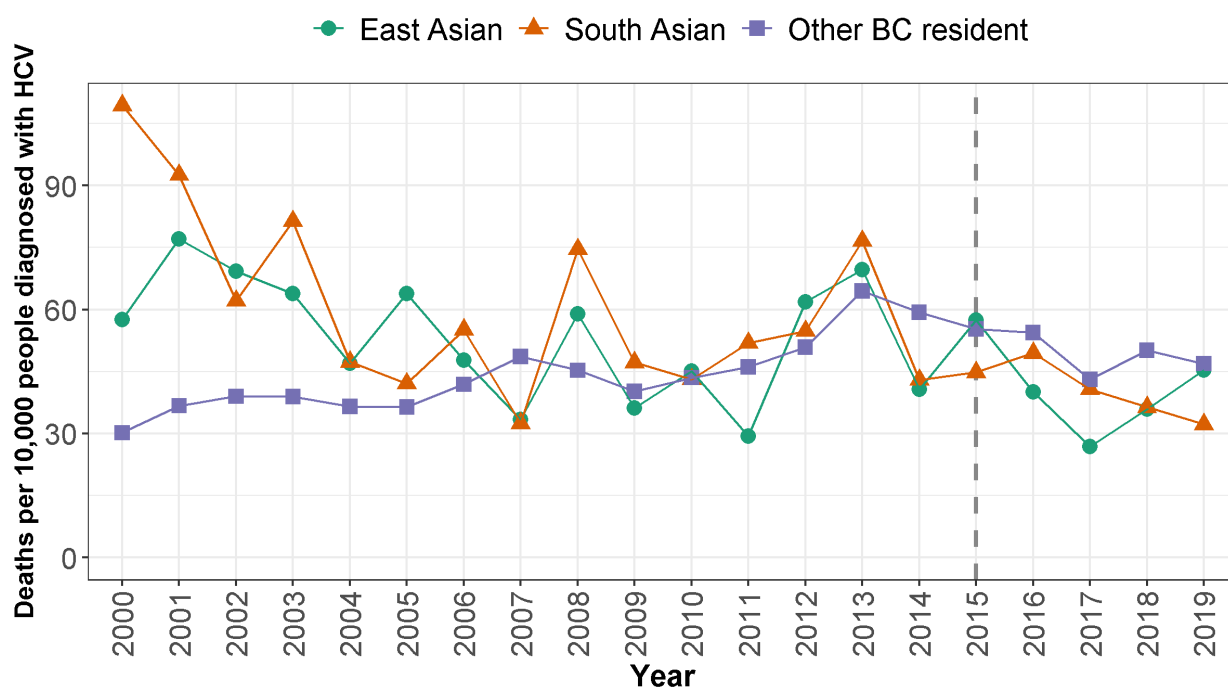
Individuals may move between age groups over time

Figure 94. Liver-related death among people diagnosed with HCV in BC by birth cohort, 2000-2019



2016-2019 represent follow-up data for persons in the BC-HTC by the end of 2015

Figure 95. Liver-related death among people diagnosed with HCV in BC by ethnicity, 2000-2019



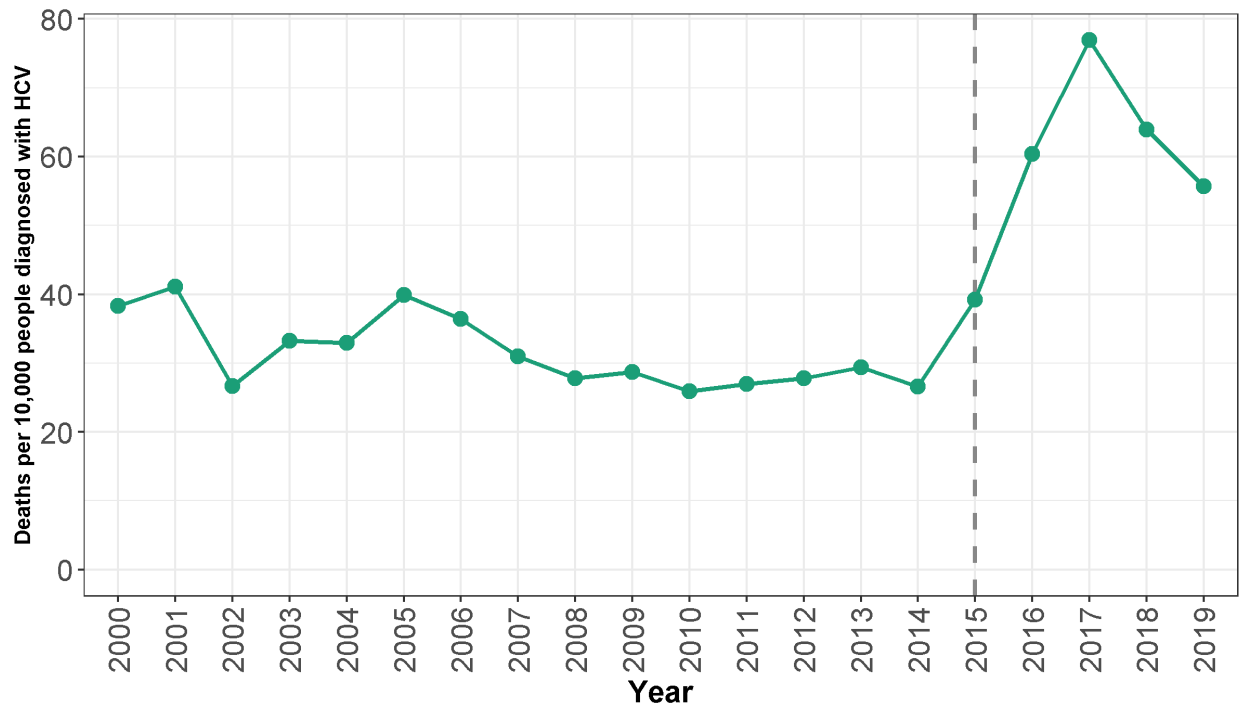
2016-2019 represent follow-up data for persons in the BC-HTC by the end of 2015

### 5.2.3. Drug-related deaths among people diagnosed with HCV in BC, 2000-2019

The rate of death from drug-related causes among people diagnosed with HCV in BC increased sharply between 2014 and 2017, declining in subsequent years (Figure 96). This trend was

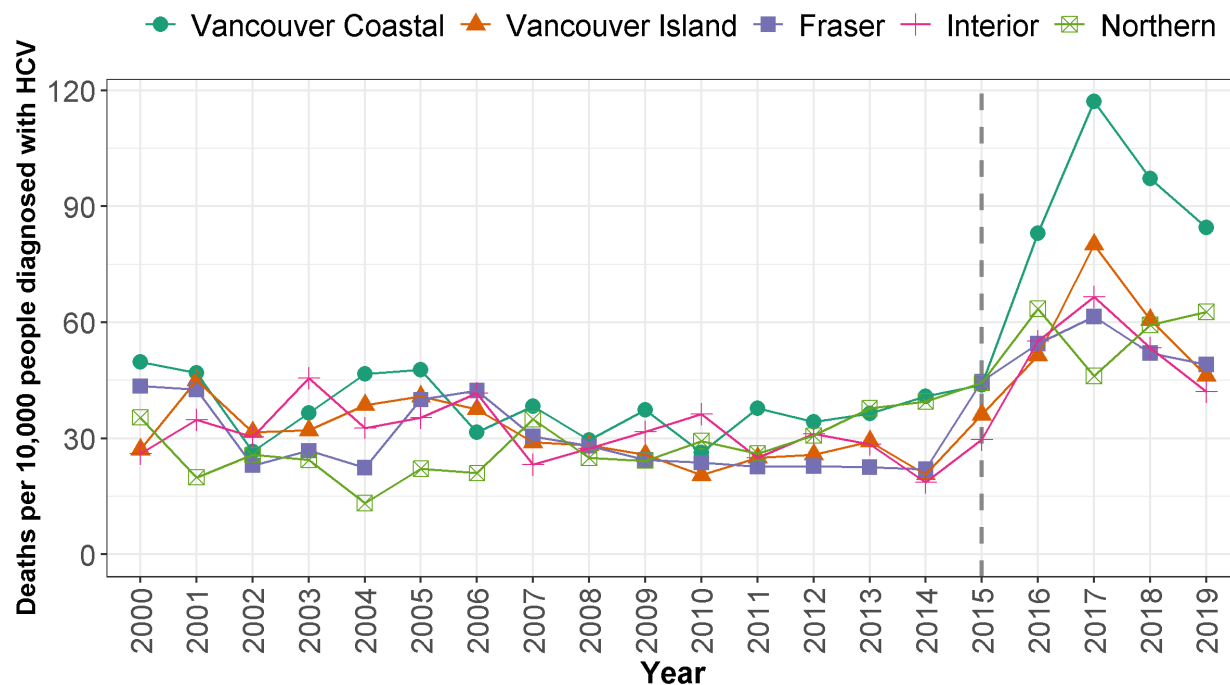
consistent with that observed across all Health Authorities (Figure 97) and among males and females (Figure 98), and coincides with the fentanyl-related overdose crisis in BC (67). There were 55.7 drug-related deaths per 10,000 people diagnosed with HCV in BC by the end of 2019, with higher year-end rates of drug-related death among males (59.5 deaths per 10,000 males ever diagnosed with HCV) than females (49.2 deaths per 10,000 females ever diagnosed with HCV). Between 2014 and 2019, drug-related mortality rates were consistently highest among males diagnosed with HCV (Figure 98) and among younger birth cohorts (birth year >1964) (Figure 100).

Figure 96. Drug-related death among people diagnosed with HCV in BC, 2000-2019



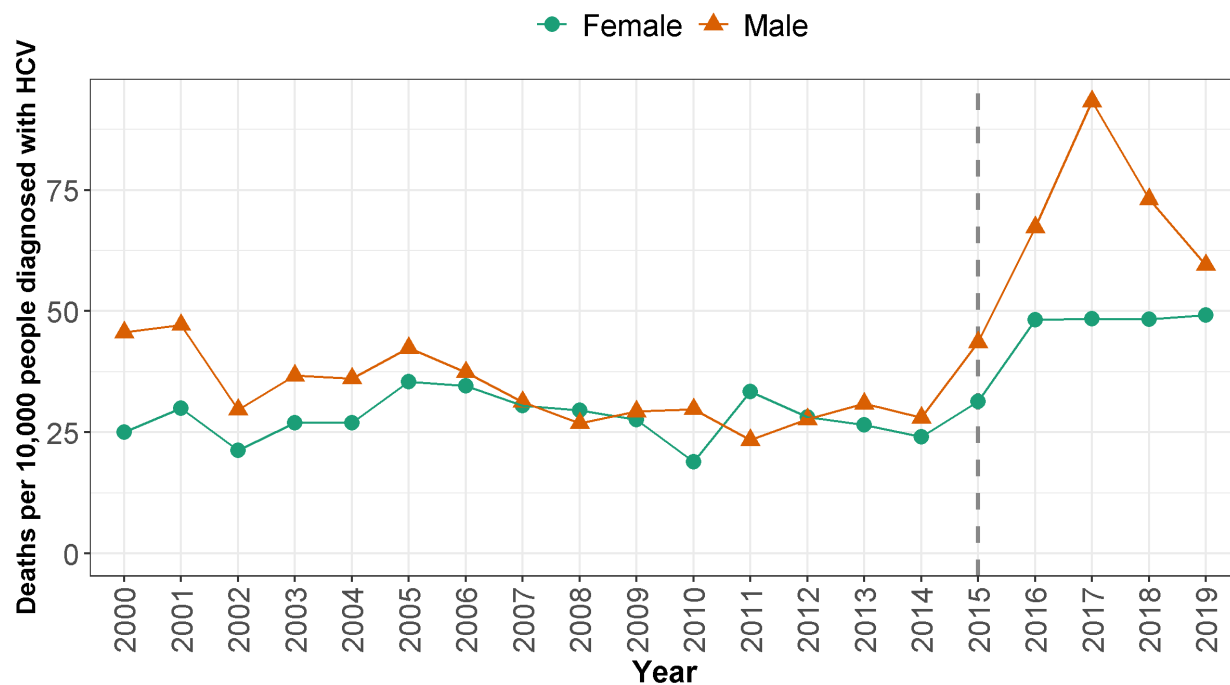
2016-2019 represent follow-up data for persons in the BC-HTC by the end of 2015

Figure 97. Drug-related death among people diagnosed with HCV in BC by Health Authority, 2000-2019



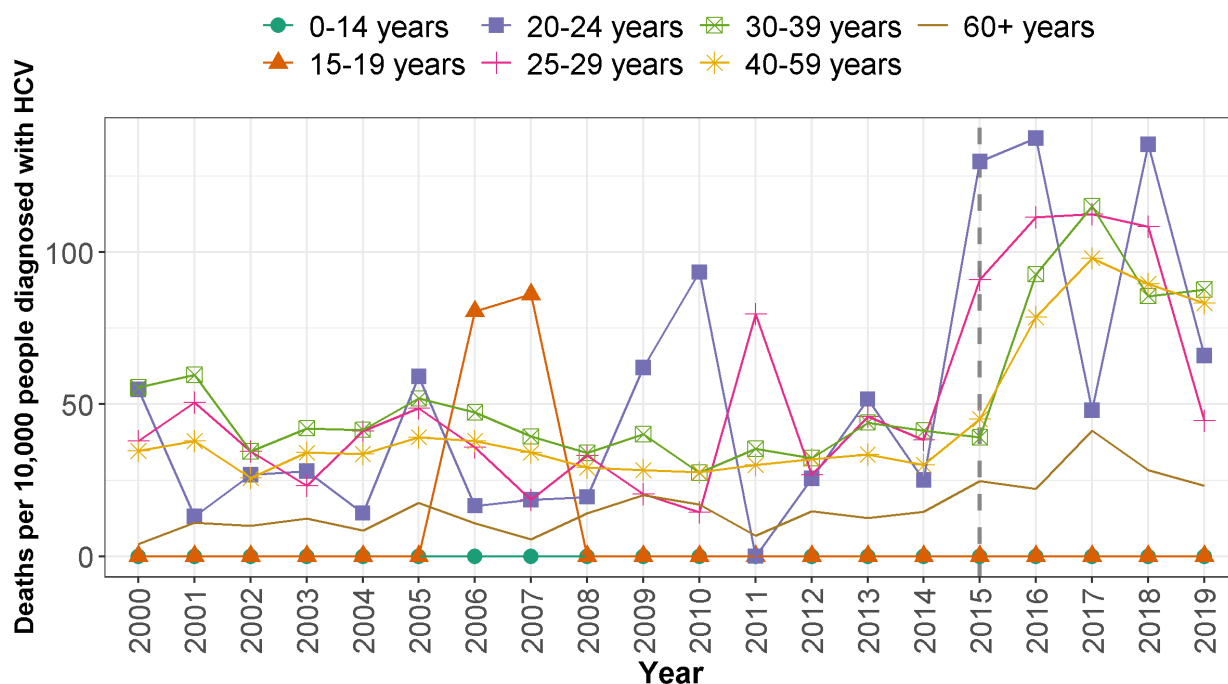
2016-2019 represent follow-up data for persons in the BC-HTC by the end of 2015  
Individuals may move in and out of health regions over time

Figure 98. Drug-related death among people diagnosed with HCV in BC by sex, 2000-2019



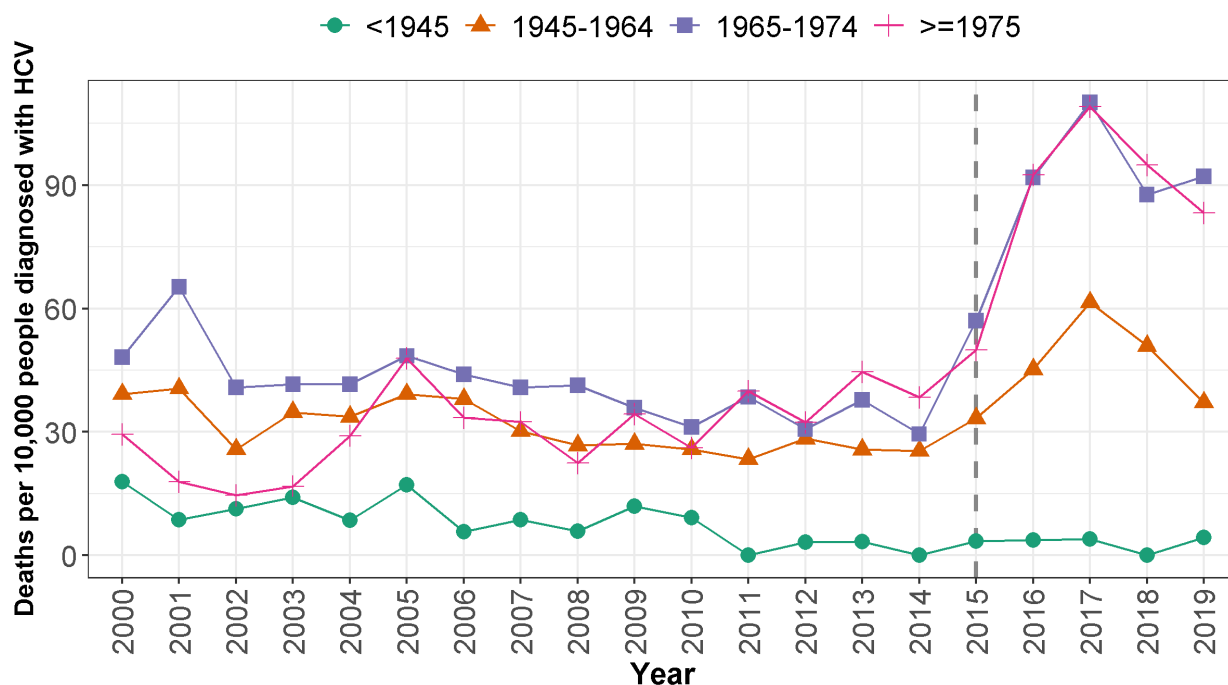
2016-2019 represent follow-up data for persons in the BC-HTC by the end of 2015

Figure 99. Drug-related death among people diagnosed with HCV in BC by age group, 2000-2019



2016-2019 represent follow-up data for persons in the BC-HTC by the end of 2015  
Individuals may move between age groups over time

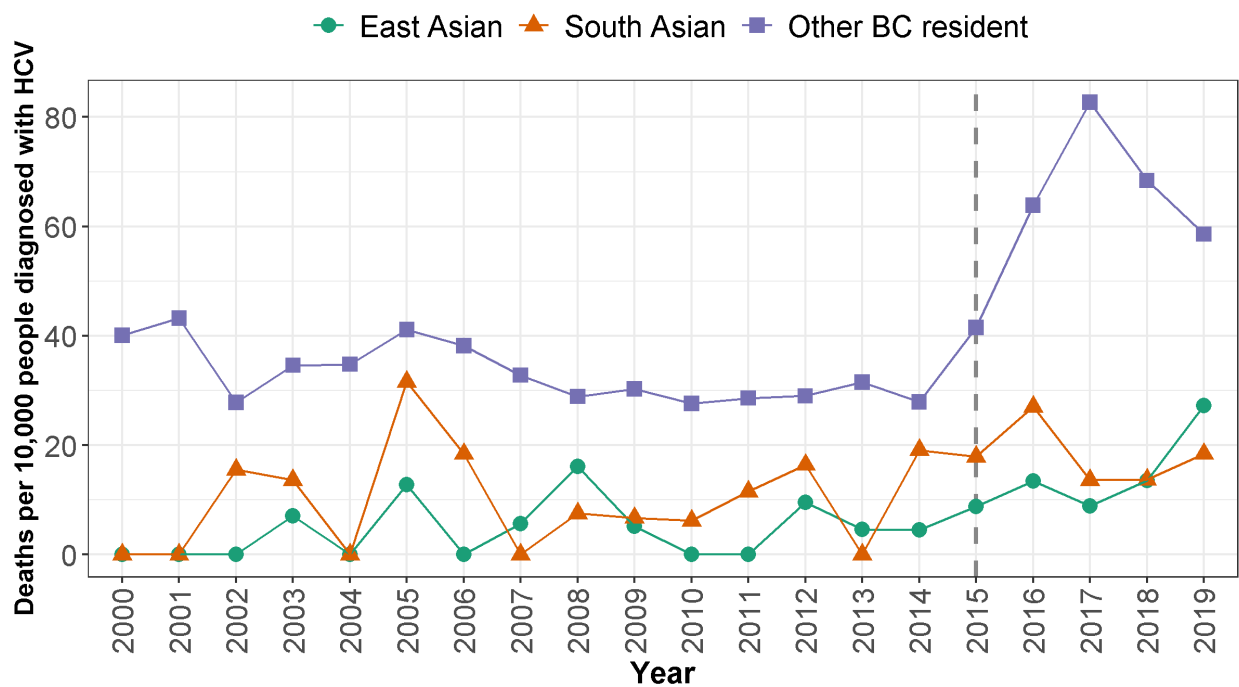
Figure 100. Drug-related death among people diagnosed with HCV in BC by birth cohort, 2000-2019



2016-2019 represent follow-up data for persons in the BC-HTC by the end of 2015



Figure 101. Drug-related death among people diagnosed with HCV in BC by ethnicity, 2000-2019



2016-2019 represent follow-up data for persons in the BC-HTC by the end of 2015

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## Partners

We would like to acknowledge the contributions of our many partners who without their support this report would not have been possible.

- Members of the STIBBI Task Group.
- The BCCDC Public Health Reporting Data Warehouse (PHRDW) team.
- Staff from the BCCDC Public Health Laboratory (PHL).
- Staff from Clinical Prevention Services division of the BCCDC.
- Physicians, health care providers, and public health staff in BC for taking the time and effort to complete and submit case report forms.

# Technical Appendix

## A. Data Sources and Variable Definitions

### A.1. STIBBI Data Mart

The Public Health Reporting Data Warehouse (PHRDW) Sexually Transmitted Blood Borne Infections (STIBBI) Data Mart is the data source for HCV testing data in Section 1 (HCV Testing and Diagnosis) of this report. The STIBBI Data Mart integrates laboratory testing and surveillance data for all reportable STIBBIs. Specifically for HCV, the STIBBI Data Mart contains all HCV testing performed by BCCDC Public Health Laboratory (PHL), which is >95% of HCV antibody screening tests and all confirmatory HCV antibody tests, as well as all HCV RNA and genotype tests performed in BC. It also includes all information received by public health about new cases of HCV. The STIBBI Data Mart provides near real-time data for population-level surveillance purposes. Section 1 of this report contains STIBBI Data Mart data from 2000-2019. Frequencies and rates presented will be close to, but not exactly match, those of the BCCDC Annual Summaries of Reportable Diseases (65) or the BCCDC Reportable Diseases Data Dashboard (66) due to differing data sources. Those reports use case numbers reported by public health in Panorama (the public health reportable disease information system), whereas indicators within this report are derived from the STIBBI Data Mart, which also includes BCCDC PHL data.

#### A.1.1. LIMITATIONS

- The STIBBI Data Mart currently excludes some the tests ordered and/or performed in the Vancouver Island Health Authority and the tests performed at Providence Healthcare (PHC) laboratories.
- Due to missing Personal Health Numbers (PHNs), and to avoid potential wrongful attribution of out-of-province cases to BC, testers from clinical trials and the Evaluation of the Supervised Injection Site (ESIS) study are excluded from these analyses.
- Patient health region for previous years in HCV testing data sets within STIBBI Data Mart may be incorrect as health region information is overwritten with every update of the BCCDC PHL information system.
- Trends in RNA testing and RNA-positive cases may be influenced by changes in PCR technology in the BCCDC PHL.

#### A.1.2. VARIABLE DEFINITIONS

##### A.1.2.1. TESTING

###### HCV antibody testers

Unique individuals receiving HCV antibody tests at the BCCDC PHL, excluding those from testers originating from clinical trials or the Evaluation of the Supervised Injection Site (ESIS) study, for whom testing was completed and the outcome of the testing episode was either positive (censored at the first positive test), negative or indeterminate. Individuals are excluded in subsequent years after they receive a positive anti-HCV test.

###### Repeat HCV antibody testers

Unique testers with multiple HCV testing episodes at the BCCDC PHL, excluding those from testers originating from clinical trials or the Evaluation of the Supervised Injection Site (ESIS) study, for whom testing was completed and the outcome of the testing episode was either positive (censored at the first positive test), negative or indeterminate.

### **HCV testing episode**

Unique testing episodes for HCV testers receiving HCV antibody tests at the BCCDC PHL, excluding those from testers originating from clinical trials or the Evaluation of the Supervised Injection Site (ESIS) study, in which testing was completed and the outcome of the testing episode was either positive (censored at the first positive test), negative or indeterminate. Testing episodes for HCV span one sample collection date. Testing episode is attributed to the year of the start of the testing episode.

### **HCV percent positivity**

HCV percent positivity among HCV antibody testers represents the proportion of HCV antibody testers who had a positive test result for the first time in the BCCDC PHL information system. Individuals tested in clinical trials and the Evaluation of the Supervised Injection Site (ESIS) study due to lack of information regarding BC residency. HCV antibody testing data from the BCCDC PHL represent >95% of HCV antibody screening tests and all confirmatory HCV antibody tests performed in BC.

## **A.1.2.2. CASE DEFINITIONS**

### **Hepatitis C Virus (HCV) case**

A new HCV case is a person residing in BC with a new positive HCV antibody (also known as anti-HCV) test result reported by the BCCDC PHL or a person reported to public health (i.e. entered into Panorama, the public health reportable disease information system) as a new HCV infection. Case definitions for HCV for the purposes of reporting to public health can be found at:

[http://www.bccdc.ca/health-professionals/clinical-resources/case-definitions/hepatitis-c-infection-\(hcv\)](http://www.bccdc.ca/health-professionals/clinical-resources/case-definitions/hepatitis-c-infection-(hcv)). The earliest stage of disease (acute versus chronic) from either data source was noted. The case was attributed to the earliest year of HCV case determination. HCV cases exclude clinical trial or the Evaluation of the Supervised Injection Site (ESIS) study participants due to lack of information regarding BC residency.

#### **Notes/limitations:**

- The numbers of diagnoses reported here are close to, but do not exactly match, the case numbers reported in the BCCDC Annual Summaries of Reportable Diseases (65) or the BCCDC Reportable Diseases Data Dashboard (66) due to differing data sources. These reports use case numbers reported by public health in Panorama (the public health reportable disease information system), whereas this indicator is derived from the STIBBI Data Mart, which also includes BCCDC PHL data.
- As most people living with HCV do not have symptoms, a person may be tested for HCV long after they were infected. Thus, HCV case rate is not the same as incidence rate. As well, an increase or decrease in new anti-HCV positive cases may be due to the targeting of testing to low or high risk groups.
- Individual risk factors associated with new diagnoses were not generally available (i.e. no public health enhanced follow-up on most new diagnoses).

### **HCV serconverter**

Repeat HCV antibody tester with a positive HCV antibody test result for the first time after prior negative testing episode(s).

#### **Notes/limitations:**

- Detection of seroconversion is dependent on prior testing history and does not capture new (incident) cases that are diagnosed at first test without a prior test on record or incident cases that are undiagnosed/untested in BC.
- 12 and 24 month intervals are used to define a recent/incident infection. However, individuals with a prior test >12 or 24 months previous may have actually acquired infection within 12 or 24 months of their diagnosis, respectively.

- Individuals having a previous negative anti-HCV test outside of BC within 12 or 24 months, or who test using different identifiers are not captured due to an inability to link with their prior testing history.
- As negative anti-HCV tests performed at Victoria General Hospital laboratory are not received by BCCDC, some clients' prior negative testing history may be missed, potentially underestimating number of repeat testers and identified seroconversions in Vancouver Island Health Authority.
- The introduction of initiatives successfully targeting previously untested high-risk groups may result in higher rates, as would any outbreaks in previously low-moderate risk settings (e.g. dialysis patients).

### **A.1.2.3. DEMOGRAPHICS**

#### **Age**

For cases, age indicated at earliest HCV case determination. For repeat testers, age indicated at sample collection.

#### **Sex**

For cases, sex indicated at earliest HCV case determination. For repeat testers, sex indicated at laboratory sample collection.

### **A.1.2.4. HEALTH REGION**

#### **Health Authority**

Cases are assigned to health regions (i.e., Health Authority) by residence. If residence is unknown, the case is then assigned to the health region of the healthcare provider's service location.

- HCV case counts for Fraser Health Authority may be underreported beginning in June 2019 due to the transition to PARIS EMR for public health reporting at the end of that month. HCV case counts for Fraser Health Authority are therefore subject to change.
- The majority of correctional facilities in British Columbia are located in Fraser Health Authority. Consequently, HCV cases identified within correctional facilities but with permanent residence outside of Fraser Health Authority may be wrongly attributed to Fraser Health Authority.

## **A.2. BC Hepatitis Testers Cohort (BC-HTC)**

The BC Hepatitis Testers Cohort (BC-HTC), a dynamic longitudinal cohort housed at the BC Centre for Disease Control (BCCDC), is the data source for sections 2-5 of the report (51). The cohort is generated using data from everyone who tested for HCV or human immunodeficiency virus (HIV) at the BCCDC Public Health Laboratory, or was reported as a case of hepatitis B (HBV), HCV, HIV or active tuberculosis since 1990. In BC, >95% of all HCV and HIV screening tests (but virtually all confirmatory tests) and about 30% of all HBV tests are performed by the BCCDC Public Health Laboratory. Data from people who have had these laboratory tests or were cases were then linked with administrative data, including doctor and emergency room visits, hospitalization, prescription and death data for cohort formation. The BC-HTC is refreshed every two years, with the last cohort generated in 2015.

## A.2.1. INCLUSION CRITERIA

Criteria for inclusion in BC-HTC	Date Ranges
All individuals:	
<ul style="list-style-type: none"> <li>· tested at the BCCDC Public Health Laboratory (BC-PHL ) for HCV or HIV OR</li> <li>· reported to BC public health as a confirmed case of HCV, HIV or AIDS, HBV, or active TB OR</li> <li>· included in BC Enhanced Strain Surveillance System (EHSSS) as an acute HBV or HCV case</li> </ul>	
All individuals meeting at least one the above criteria were linked internally across all their tests and case reports. Those with a valid personal health number (PHN) were then sent for deterministic linkage with the province-wide Cancer and Ministry of Health (MoH) datasets.	
<b>Provincial Communicable Disease Data Sources:</b>	
BCCDC-PHL HIV laboratory testing datasets (tests: ELISA, Western blot, NAAT, p24, culture)	1988–2015
BCCDC-PHL HCV laboratory tests datasets (tests: antibody, HCV RNA, genotyping)	1992–2020, Apr
HIV/AIDS Information System (HAISYS) (public health HIV/AIDS case reports)	1980–2015
Integrated Public Health information System (iPHIS) (public health case reports of HCV, HBV, and TB)	1990–2015
Enhanced Strain Surveillance System (EHSSS) (risk factor data on a subset of acute HCV and acute HBV cases)	2000–2013
<b>Cancer and MoH Administrative Data Sources:</b>	
Client Roster (CR) (Registry of enrollment in the universal public health insurance plan including residential history)	1990–2016
BC Cancer Registry (BCCR) (primary tumour registry, excludes metastatic cancers)	1923–2016
Discharge Abstracts Dataset (DAD) (hospitalization records) (S1)	1985–2015
Medical Services Plan (MSP) (physician diagnostic and billing data) (S2)	1990–2015
PharmaCare/PharmaNet (Pharma) (prescription drug dispensations) (S3, S4)	1985–2019, Dec
BC Vital Statistics (VS) (deaths registry) (S5)	1985–2019, Dec
National Ambulatory Care Reporting System (NACRS) (Emergency Departments)	2012–2015
Chronic Disease Registry (S6)	1992–2015

Criteria for inclusion in BC-HTC	Date Ranges
The final BC-HTC comprises all individuals successfully linked on PHN to the MoH Client Roster (S7) (a registry of all BC residents enrolled in the publicly-funded universal healthcare system)	

*HCV: Hepatitis C Virus; HBV: Hepatitis B Virus; HIV/AIDS: Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome; RNA: Ribonucleic Acid; ELISA: Enzyme-linked immunosorbent assay; NAAT: Nucleic acid amplification test*

- S1. British Columbia Ministry of Health [creator]. Discharge Abstract Database (Hospital Separations). British Columbia Ministry of Health [publisher]. Data Extract. MOH (2013). 2016. <https://www2.gov.bc.ca/gov/content/health/conducting-health-research-evaluation/data-access-health-data-central/health-authorities>
- S2. British Columbia Ministry of Health [creator]. Medical Services Plan (MSP) Payment Information File. British Columbia Ministry of Health [publisher]. Data Extract. MOH (2013). 2016. <https://www2.gov.bc.ca/gov/content/health/conducting-health-research-evaluation/data-access-health-data-central/health-authorities>
- S3. British Columbia Ministry of Health [creator]. PharmaCare. British Columbia Ministry of Health [publisher]. Data Extract. MOH (2013). 2019. <https://www2.gov.bc.ca/gov/content/health/conducting-health-research-evaluation/data-access-health-data-central/health-authorities>
- S4. British Columbia Ministry of Health [creator]. PharmaNet. British Columbia Ministry of Health [publisher]. Data Extract. MOH (2013). 2019. <https://www2.gov.bc.ca/gov/content/health/conducting-health-research-evaluation/data-access-health-data-central/health-authorities>
- S5. BC Vital Statistics Agency [creator]. Vital Statistics Deaths. BC Vital Statistics Agency [publisher]. Data Extract. BC Vital Statistics Agency (2014). 2019. <https://www2.gov.bc.ca/gov/content/health/conducting-health-research-evaluation/data-access-health-data-central/health-authorities>
- S6. British Columbia Ministry of Health [creator]. Chronic Disease Registry. British Columbia Ministry of Health [publisher]. Data Extract. MOH. (2016) 2016. <https://www2.gov.bc.ca/gov/content/health/conducting-health-research-evaluation/data-access-health-data-central/health-authorities>
- S7. British Columbia Ministry of Health [creator]. Client Roster (Client Registry System/Enterprise Master Patient Index). British Columbia Ministry of Health [publisher]. Data Extract. MOH (2013). 2016. <https://www2.gov.bc.ca/gov/content/health/conducting-health-research-evaluation/data-access-health-data-central/health-authorities>

### A.2.2. LIMITATIONS

- The cohort used for these analyses includes eligible persons for whom testing or case report data was available by the end of 2015. Indicator data beyond 2015 (from 2016-2019) represent follow-up data for these individuals.
- Thus, beginning in 2016, new HCV cases who were absent from the BC-HTC from inception until the end of 2015 are not included in sections 2-5 of this report. Based on new cases of HCV in the STIBBI Data Mart, we estimate there are about 6,000 new HCV cases from 2016 to 2019 that are absent from the BC-HTC.



## A.2.3. VARIABLE DEFINITIONS

### A.2.3.1. INFECTIONS

#### Hepatitis C Virus (HCV) infection

HCV infection and date of diagnosis was defined at the first occurrence of:

- a confirmed anti-HCV positive test (see “HCV RNA tested” in section A.2.3.5 below) OR
- a confirmed anti-HCV positive test (see “HCV RNA tested” in section A.2.3.5 below) OR
- a confirmed HCV RNA positive test (see “HCV RNA positive” in section A.2.3.5 below) OR
- an HCV genotype result OR
- dispensation of at least one HCV specific treatment (interferon-based or direct-acting antivirals (DIN/PINs below)) OR
- a confirmed public health HCV case report
- **Ever diagnosed with HCV**  
Persons recorded as ever having an HCV infection at any point on or before the end of the year in question.
- **New HCV diagnoses**  
Persons recorded for the first time as having an HCV infection within the year in question.

Dispensation of antivirals specific to HCV treatment (interferon-based or direct-acting antivirals)  
PharmaNet DIN/PIN: IFN/DAA - 2239729, 2239730, 2239731, 2241159, 2246026, 2246027, 2246028, 2246029, 2246030, 2253410, 2253429, 2254581, 2254603, 2254638, 2254646, 2370816, 2371448, 2371456, 2371464, 2371472, 2371553, 2416441, 2418355, 2432226, 2436027, 2444747, 2444755, 2447711, 2451131, 2452294, 2456370, 2467542, 2467550; IFN (only if use with RBV) - 705896, 705918, 705926, 812471, 812498, 812501, 889067, 891002, 1911988, 1911996, 1912003, 2019914, 2217015, 2217023, 2217031, 2217058, 2217066, 2223141, 2223384, 2223392, 2223406, 2223414, 2231511, 2231512, 2231651, 2238674, 2238675, 2239832, 2240693, 2240694, 2240695, 2242966, 2242967, 2242968, 2242969, 2248077, 2248078; \*RBV - 2425890, 2425904, 2436396, 2436418, 2436426, 2439212

#### Hepatitis B Virus (HBV) infection

HBV infection and date of diagnosis were defined at the first occurrence of:

- a case of HBV recorded in iPHIS or Panorama, OR
- at least 2 MSP (medical) visits based on diagnostic codes, OR
- at least 2 MSP fee item codes for HBV DNA or 2 MSP fee item codes for HBeAg, OR
- at least 1 MSP fee item code for HBV drug resistance mutation analysis, OR
- at least 1 hospitalization (DAD) code involving acute or chronic hepatitis B diagnoses with or without hepatic coma and with or without delta agents inactive carriers, OR
- 1 hepatitis B-specific drug dispensation (DIN/PINs below) with at least 1 HBV DNA or HBeAg MSP fee item code within 1 year of dispensation, OR
- 1 hepatitis B-specific drug dispensation with at least 1 Alanine Aminotransferase (ALT) fee item code or 1 Aspartate Aminotransferase (AST) fee item code within 1 year of dispensation AND at least one of Anti-HBc/Anti-HBs/HBsAg fee item codes 1 year before drug dispensation.
- **Ever diagnosed with HBV**  
Persons recorded as ever having an HBV infection at any point on or before the end of the year in question.
- **New HBV diagnoses**  
Persons recorded for the first time as having an HBV infection within the year in question.

Physician Billing Data: MSP ICD-9 diagnostic codes: starting with 0702, 0703 or exact code V0261; or fee item codes 90831 and 90675.

Hospitalization Data: DAD1/ICD-9-CM diagnostic codes: starting with 0702, 0703; or exact code V0261. DAD2/ICD-10-CA diagnostic codes: starting with B16, B180, B181; or exact code Z2250.



Dispensation of antivirals specific to HBV treatment PharmaNet DIN/PIN: 02192691, 02239193, 02239194, 02247128, 02247823, 02282216, 02282224, 02393239, 02396955, 02403889, 02418312, 02420333, 02430576, 02430584, 02448777, 02451980, 02452634, 02453797, 02453940, 02460173, 02464241, 02467232, 02472511, 02479087, 02479907, 02485907.

### **Human Immunodeficiency Virus (HIV) infection**

HIV infection and date of diagnosis were defined at the first occurrence of either 3 MSP or 1 NACRS or 1 hospitalization for HIV or 1 positive HIV serologic test, HAISYS or BC Vital Statistics indication (see below) (47).

- **Ever diagnosed with HIV**  
Persons recorded as ever having an HIV infection at any point on or before the end of the year in question.
- **New HIV diagnoses**  
Persons recorded for the first time as having an HIV infection within the year in question.

Physician Billing Data: MSP ICD-9 diagnostic codes: starting with 042, 043, 044, 7953, 7958, 79571, V08.

Hospitalization Data: DAD1/ICD-9-CM: starting with 042, 043, 044, 7953, 7958, 79571, V08.;

DAD2/ICD-10-CA: starting with B20-B24, B9735, F024, O987, R75, Z21.

NACRS Data: starts with B20, B24, R75, Z21, F024, O987, B9735

### **A.2.3.2. ADVANCED LIVER DISEASE**

#### **Decompensated cirrhosis (DC)**

Decompensated cirrhosis excluding alcoholic hepatic failure was defined as the occurrence of either 1 physician visit (MSP) or 1 hospitalization code (DAD) relevant to decompensated cirrhosis including esophageal varices with bleeding, spontaneous bacterial peritonitis, hepatic encephalopathy, hepatorenal syndrome, chronic hepatitis C with hepatic coma, ascites, or other sequelae of chronic liver disease that is not alcohol related of either 2 MSP or 1 NACRS or 1 hospitalization codes (see below).

- **Ever diagnosed with DC**  
Persons recorded as ever being diagnosed with DC at any point on or before the end of the year in question.

Physician Billing Data: MSP ICD-9 diagnostic codes: exact code 4560, 45620, 56723, 5722, 5724, 07044, 7895, 5728.

Hospitalization Data: DAD1/ICD-9-CM: exact code 4560, 45620, 56723, 5722, 5724, 07044, 7895, 5728; DAD2/ICD-10-CA: exact code R18, I850, I983, I9820, K721, K729, K767, K652.

NACRS Data: exact code R18, I850, I983, I9820, K721, K729, K767, K652.

#### **Hepatocellular carcinoma (HCC)**

Hepatocellular carcinoma data was obtained from the BC Cancer Registry. HCC diagnosis was defined and dated at the first occurrence of BC Cancer Registry codes pertaining to HCC (see below).

- **Ever diagnosed with HCC**  
Persons recorded as ever being diagnosed with HCC at any point on or before the end of the year in question.

Codes: Topography: C220. Histology (Hist1/Hist2/Hist3): starting with 81703, 81713, 81723, 81733, 81743, 81753.

### **A.2.3.3. DEATH**

#### **Death/Cause of death**

Death data and underlying causes of death (UCOD) were obtained from Vital Statistics. Drug-related death and liver-related death were defined based on underlying cause of death (UCOD) codes

pertaining illicit drug use and liver-related death, respectively. Based on findings from a study by the Centers for Disease Control in the US (68), additional cases of drug-related death were identified by re-classifying deaths from ill-defined and unspecified causes (code R99) as drug-related if deceased individuals were aged 20-64 years and had a history of injection drug use (see section A.2.3.4 for definition).

Liver-related death: UCOD code starting with B15-B19; B94.2; C22; K70-K76.

Drug-related death: UCOD code exact code F55, or starting with F11-F16, F19, X40-X44, X60-X64, X85, Y10-Y14, Y40-Y574, Y577-Y579, Y598, Y880, D521, D590, D592, D611, D642, E032, E064, E231, E242, E273, F551, G210, G211, G240, G251, G254, G256, G444, G620, G720, H263, I427, I952, J702, J703, J704, L105, L233, L244, L251, L270, L271, L432, L560, L561, L640, M022, M102, M320, M804, M814, M835, M871, N140, N141, N142, O355, P040, P041, P044, P584, P961, P962, R781, R782, R783, R784, R785, R786, R825.

#### **A.2.3.4. RISK FACTORS**

##### **Injection drug use**

Injection drug use was defined at the occurrence of at least 2 physician visits, 1 hospitalization, OR 1 emergency department visit related to major drug-related diagnoses involving addiction, dependence, and drug-induced mental disorders; illicit drug use most likely to be injecting (e.g. excluding cannabis), or illicit use of prescribed drugs including: hallucinogens, barbiturates/tranquillizers, sedatives, hypnotics, anxiolytics, opioids, cocaine, amphetamine; or discharge to drug rehabilitation, counselling, and surveillance (age 11-65 years) (Codes below). Estimates of injection drug use are inflated by +10% to account for under-testing as reported in I-Track data on HCV testing history (58).

- **History of injection drug use**  
Persons recorded as ever having used injection drugs (see Injection drug use) at any point on or before the end of the year in question.
- **Recent injection drug use**  
Persons with a history of injection drug use with the occurrence of at least 1 MSP or 1 NACRS or 1 hospitalization code within 3 calendar years of the year in question (specified year inclusive).

PharmaNet DIN/PIN: exact code 999776, 999792, 999793, 2241377, 2242963, 2242964, 2295695, 2295709, 2408090, 2408104, 2424851, 2424878, 2453908, 2453916, 2468085, 2468093, 2474921, 22123346, 22123347, 22123348, 22123349, 66999990, 66999991, 66999992, 66999993, 66999997, 66999998, 66999999, 67000000, 67000001, 67000002, 67000003, 67000004, 67000005, 67000006, 67000007, 67000008, 67000009, 67000010, 67000011, 67000012

Physician Billing Data: MSP ICD-9 diagnostic codes: starting with 292, 3040, 3041, 3042, 3044, 3045, 3046-3049, 3054-3057, 3059, 6483, 7960, 9621, 9650, 9658, 9663-9664, 9670, 9684-9685, 9694, 9696-9699, 970, E8500, or exact codes V6542; MSP ICD-9 fee item code: exact codes 39.

Hospitalization Data: DAD1/ICD-9-CM: starting with 292, 3040, 3041, 3042, 3044, 3045, 3046-9, 3054-3057, 3059, 6483, 7960, 9621, 9650, 9658, 9663-9664, 9670, 9684-9685, 9694, 9696-9699, 970, E8500, or exact codes V6542; DAD2/ICD-10-CA: starting with F11, F13-F15, F19, or exact codes R781-R782, T387, T400-T406, T408-T409, T412, T423-T428, T436, T438, T439, T507.

NACRS Data: starting with F11, F13-F15, F19, 751, 753 or exact codes R781-R782, T387, T400-T406, T408-T409, T412, T423-T428, T436, T438, T439, T507.

##### **Problematic alcohol use**

Problematic alcohol use was defined at the first occurrence of 2 MSP or 1 hospitalization codes for major alcohol-related diagnoses including alcoholic mental disorders and dependence/abuse syndromes; alcoholic polyneuropathy, myopathy, cardiomyopathy; pseudo Cushing's syndrome; or discharge to alcohol rehabilitation, counselling, or surveillance.

- **History of problematic alcohol use**

Persons recorded as ever having had problematic alcohol use (see Problematic alcohol use) at any point on or before the end of the year in question.

Physician Billing Data: MSP ICD-9 diagnostic codes: starting with 291, 303, 3050, 3575, 4255

Hospitalization Data: DAD1/ICD-9-CM: starting with 291, 303, 3050, 3575, 4255; DAD2/ICD-10-CA: starting with F10, E244, G312, G621, G721, I426, Z502, Z714

NACRS Data: starting with F10, E244, G312, G621, G721, I426, Z502, Z714

### **A.2.3.5. CARE CASCADE**

**HCV Diagnosis** (see “Hepatitis C infection” in section A.2.3.1)

#### **HCV RNA testing**

HCV RNA testing was recorded and dated at the first occurrence of an HCV RNA test.

#### **HCV genotyped**

HCV genotyping was recorded and dated at the first occurrence of a successfully completed HCV genotype test.

#### **HCV treatment initiation**

HCV treatment course initiation was recorded and dated at the first dispensation of HCV-specific antiviral drugs in PharmaNet (DIN/PINs below). HCV treatment courses were defined for each HCV-specific interferon-based or direct-acting antiviral drug or combination of drugs based on the number of days’, supply issued to each participant and the intervals between drug dispensation dates.

Dispensation of antivirals specific to HCV treatment (interferon-based or direct-acting antivirals)  
PharmaNet DIN/PIN: IFN/DAA - 2239729, 2239730, 2239731, 2241159, 2246026, 2246027, 2246028, 2246029, 2246030, 2253410, 2253429, 2254581, 2254603, 2254638, 2254646, 2370816, 2371448, 2371456, 2371464, 2371472, 2371553, 2416441, 2418355, 2432226, 2436027, 2444747, 2444755, 2447711, 2451131, 2452294, 2456370, 2467542, 2467550; IFN (only if use with RBV) - 705896, 705918, 705926, 812471, 812498, 812501, 889067, 891002, 1911988, 1911996, 1912003, 2019914, 2217015, 2217023, 2217031, 2217058, 2217066, 2223141, 2223384, 2223392, 2223406, 2223414, 2231511, 2231512, 2231651, 2238674, 2238675, 2239832, 2240693, 2240694, 2240695, 2242966, 2242967, 2242968, 2242969, 2248077, 2248078; \*RBV - 2425890, 2425904, 2436396, 2436418, 2436426, 2439212.

#### **Spontaneous clearance (HCV)**

Spontaneous clearance of HCV and the date of occurrence were defined at the first occurrence of an HCV RNA-negative test result after the HCV diagnosis date in the absence of a PharmaNet DIN/PIN record of HCV treatment initiation (see “HCV treatment initiation”). For the subset of participants who were diagnosed with HCV and spontaneously cleared their infections but went on to initiate their first course of treatment, spontaneous clearance of HCV and the date of occurrence were defined at the first occurrence of an HCV RNA-negative test on or before the first treatment course initiation (PharmaNet DIN/PINs below).

#### **Notes/limitations:**

- This definition may incorrectly classify individuals who received HCV treatment through clinical trials or compassionate access, record(s) of which may not be noted within PharmaNet, as spontaneously cleared.

#### **Sustained virologic response (SVR) post-HCV treatment**

Sustained virologic response after HCV treatment course completion and the date of occurrence were defined at the first occurrence of an HCV RNA negative test result at or after 10 weeks (70 days) following the completion or putative completion date of an HCV treatment course (47). For the

HCV Care Cascade, the most recent SVR status (following the most recent treatment course) was indicated.

#### **HCV reinfection**

Reinfection with HCV and the date of occurrence were defined at the first occurrence of an HCV RNA-positive test result >28 days after the SVR or spontaneous clearance date in the absence of or ahead of the next HCV treatment course, where applicable. When a treatment course is begun within 84 days after SVR or spontaneous clearance date, then HCV reinfection is noted, with the reinfection date being determined at the mid-point between the SVR/spontaneous clearance date and the treatment start date.

### **A.2.3.6. DEMOGRAPHICS**

#### **Sex**

Sex was as indicated in the BC Ministry of Health Client Roster.

#### **Age**

Age was calculated based on imputed date of birth. The maximum age of each participant in each indicated calendar year is presented.

#### **Ethnicity**

Ethnicity was determined based on the first and last names of BC-HTC participants using the validated name recognition software Onomap (69, 70). Onomap does not identify Indigenous peoples and has been shown to have high sensitivity and specificity for identifying persons of Asian descent in particular. Therefore, ethnicity was grouped as South Asian, East Asian (Chinese, Filipinos, Japanese, Koreans and South-East Asians), and Other (Caucasian, Black, Central Asian, Latin American, Pacific Islander, West Asian, and those with unknown ethnic background) to reduce the potential for misclassification. Onomap sensitivity and specificity for identifying persons of East Asian and South Asian ethnic backgrounds within the BC-HTC, as validated with the small subset of BC-HTC participants with self-reported ethnicity, are indicated below.

Onomap sensitivity: South Asians (96.5%), East Asians (66.7%).

Onomap specificity: South Asians (98.6%), East Asians 99.5%).

#### **Birth Cohort**

Birth cohorts were defined by dividing participants' imputed birth years into four groups:

- people born before 1945 (<1945)
- people born between 1945 and 1964 (1945-1964)
- people born between 1965 and 1974 (1965-1974)
- people born after 1974 ( $\geq 1975$ )

### **A.2.3.7. HEALTH REGION**

#### **Health Authority**

Health Authority for each participant for each year was obtained from the Client Roster.

## **A.3. Population Data**

Population data and associated rates are based on the P.E.O.P.L.E. 2019 Population Estimates and Projections released by BC Stats, BC Ministry of Technology, Innovation and Citizens' Services.

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1. World Health Organization. Global hepatitis report 2017: World Health Organization; 2017.
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