University of Alberta

Health Costs of Persons with Newly Diagnosed Hepatitis C Virus

by

Thu-Ha Nguyen

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Dedication

To my Alzheimer mother, even though she cannot remember her dream in this life!

Cho Mẹ, dù bây giờ Mẹ đã không còn nhớ đến ước mơ của Mẹ trong cuộc đời này!

Abstract

The objective of this study is to determine the health costs of persons with newly diagnosed hepatitis C virus (HCV) by time since diagnosis versus time since infection.

The study design is built on a cross-sectional survey of 413 newly reported HCV cases from the Capital Health region, and on related retrospective cohort data from the Alberta Government. Descriptive statistic is applied to analyze the data.

The total costs of health service utilization were $861,638, $635,093, and $1,396,206 for physician visits, ambulatory care, and hospitalizations, respectively. Generally, the average costs increased with time since diagnosis from pre- to post- 0-12 months and then fell slightly in post- 13-24 months. The average costs also increased with time since infection but varying. The lack of relationship between costs and time since infection may reflect the wide variability in the course of the disease. Moreover, the major costs were not related to liver disease.

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INTRODUCTION

Objective

The objective of this thesis is to determine health costs of persons with newly diagnosed hepatitis C virus (HCV) infection in the Capital Health (CH) region of Alberta, Canada by time since diagnosis of pre- and post-1998 versus time since infection.

The health costs of persons with newly diagnosed HCV or incidence cost of HCV infection answers essential questions about the health service utilization used regarding the care for persons infected with HCV. The pre- and post-time since diagnosis will address the trend of medical service used to treat HCV patients from the time the disease is identified, whereas the time since infection analysis provides information on the pattern of disease succession and the level of severity of liver disease.

The findings of this thesis can be used in health policy formulation and health economic prediction.

Background

In 1974, Prince et al found a new form of hepatitis virus which was unlike hepatitis A or hepatitis B in post-transfusion persons. They documented this new form as hepatitis non-A, non-B virus (Prince et al, 1974). After 15 years, after results from many research groups on cloning and sequencing of this virus's genes, the hepatitis C virus was discovered by investigators at Chiron, Inc. The virus was described as an enveloped virus of the genus *Hepacivirus* in the family *Flaviviridae* (Choo et al, 1989) with a small spherical and single-stranded RNA (Ribonucleic Acid). The HCV has 6 known genotypes with more than 100 subtypes (Davis, 1999). Genotype 1 is more common

(>70%) in North American patients (Nainan et al, 2006). The rate of HCV replication is about 1 trillion virions per day (Neumann et al, 1998). The only two known species threatened to HCV infection are humans and chimpanzees (Farci et al, 1991).

Hepatitis C is a viral infection of the liver and the most common progressive chronic blood-borne infection in the world. HCV is a major cause of acute hepatitis and chronic liver disease including fibrosis, cirrhosis, liver cancer, liver failure and death. The HCV infection has been called the "Silent Epidemic" and has been compared to a "viral time bomb" because two thirds of people who are HCV infected are unaware of the infection until development of the disease symptoms 10 to 30 years later (Hepatitis Research Foundation (HRF), 2003; World Health Organization (WHO), 2006).

Epidemiology

Mode of Transmission and Risk Groups

The hepatitis C virus is transmitted from person-to-person through human tainted blood or blood product transfusion, organ transplant, maternal-infant transmission, sexual contact with an HCV infected person, re-use of dirty needles or syringes (Centers for Disease Control and Prevention (CDC), 1998; WHO, 2006). The HCV infection has a large impact on society because it can be passed on quietly, spread easily, with rapid growth in the human body.

There are several groups of person at risk of HCV infection. First, injecting drug users (IDUs) are the highest risk group. According to a review of international studies, 65% to 90% IDU population are anti-HCV positive (Hagan, 1998). Also, the unsafe injection (reusable needle/syringe for immunization and curative treatments) is the most common potential risk factor. According to a review of published literature and unpublished WHO reports, at least 50% of injections were unsafe in five developing world regions (14 of 19 countries) (Simonsen et al, 1999). Second, persons who received blood transfusion or blood products from HCV tainted blood prior to 1990 or organ

transplant from HCV infectious donors prior to 1992 were at high risk. The risk for transfusion-associated HCV infection is about 1.5% per recipient (Donahue et al, 1992). Third, haemodialysis patients are the intermediate risk group that represents a high percentage of HCV infection. For example, in a study in Brazil, a prevalence of 14.6% of HCV infections exists among 281 haemodialysis patients (Morelra, 2003). Fourth, persons with multiple sexual partners and unsafe sexual contact are also in the intermediate risk group. In a study of 6,668 Sexually Transmitted Disease (STD) clinics' attendees in Calgary and Edmonton (May 1994-May 1995), primarily IDUs and persons who exchange sex for money or drugs accounted for 3.4% of the HCV infection (Romanowski et al, 1997). Also, the result of a study involving face-to-face-interviews of 437 street youth in Montreal between December 1995 to September 1996 shows that youths engaged in prostitution or had sexual partners with IDUs were anti-HCV positive (Roy et al, 2001). Fifth, children to HCV-infected mothers have been identified as being at intermediate risk. From a Canadian study, 122 babies (12.6%) of 969 children born to HCV-infected mothers became infected, most of these chronically. In addition, it was found that if the mother was also human immunodeficiency virus (HIV) co-infected, the transmission rate was 20% versus 9% in children with HIV-negative mothers (The Canadian Pediatric Society, 1997). Finally, health care professionals, persons with skin piercing tattoos, Vietnam veterans, prisoners and people with mental illness were found generally to be in the low risk group of HCV infection (CDC, 2005; Roy et al, 2001).

Natural History and Disease Progression

The natural history of hepatitis C virus infection is not fully understood. Although there are several studies on this topic, their findings are varied due to different research methods used for different HCV infection groups. Most people infected with HCV are unaware of the infection; hence the onset of the HCV infection is seldom identified. Moreover, the HCV disease progresses in different ways depending on the virus, host and other external factors (Seeff, 2002).

Generally, in 10% to 15% of HCV infected persons, immune systems respond strongly to the HCV invasion and are able to wipe out the virus completely from their bodies. They do not get sick from the HCV infection, continue to live and eventually die

of other causes. On the other hand, in 85% to 90% of HCV infected persons, the hepatitis C virus remains in the host bodies, continues to replicate, and slowly develops symptoms some 10, 20 or even 30 years later (Jensen & Ganger, 2000; Seeff, 2002).

Although the natural history of the hepatitis C virus infection is still incomplete, two main stages of the liver disease caused by HCV can be observed from the available information on acute and chronic HCV infections.

Acute HCV

The hepatitis C incubation period is from 2 to 21 weeks. After the initial exposure to the hepatitis C virus, HCV RNA can be found in the blood within 1 to 3 weeks. Within 2 to 8 weeks, the serum of alanine aminotransferase (ALT) increases as a result of liver cell injury. Within 4 to 9 weeks, at the onset of symptoms, the antibody to HCV (anti-HCV) appears in the blood of 50% to 70% patients. Among HCV infected people, only 10%-15% people's immune systems are able to remove the HCV RNA and the liver enzyme level returns to normal. On the other hand, 25% to 35% infected HCV persons develop malaise, fatigue, or anorexia. For the remaining people infected with HCV, i.e., the majority of patients, the infections are asymptomatic. Therefore, at the acute stage, the onset of the HCV infection is rarely diagnosed (National Institute of Health (NIH), 1997). For example, in one of documented studies on the onset of acute HCV involving 50 consecutive volunteer blood donors, it was found that 70% to 80% of the cases were asymptomatic, i.e., only 20% to 30% adults with acute HCV infection develop clinical symptoms (McCaughan et al, 1992).

Chronic HCV

In cases where the HCV infected individual's immune system failed to remove the hepatitis C virus after 6 months, chronic hepatitis C developed in 75% to 85% of the cases. Briefly, at this stage, the liver is damaged in a variety of ways. The disease progression rate depends on the duration of HCV infection and other factors such as age, gender, and alcohol consumption. The resulting inflammation and liver cell death can lead to liver fibrosis, a form of scarring tissues, mild or advanced. Moreover, cirrhosis, a form of widespread nodules in the liver combined with fibrosis occurs in 10% to 15% of the cases in 10 to 30 years (NIH, 1997). In Canada, it is estimated that 14%

of the HCV patients infected by blood transfusion between 1986 and 1990 will develop cirrhosis in 20 years with 95% confidence interval from 0% to 44% (Krahn et al. 2004). Only 1-4% per year will develop liver cancer or hepatocellular carcinoma (NIH, 1997).

Incidence and Prevalence

Hepatitis C virus infection is a "silent disease". When symptoms develop and are confirmed by lab tests, the onset of the symptom is regarded as a new case. Thus, the number of incidence cases of HCV does not reflect this new case. According to information given by CDC at the United States National Viral Hepatitis Prevention Conference in 2005, new HCV infections per year for the period of 1998 – 2003 were 25,000 – 40,000 cases and dropped to 26,000 in 2004 (CDC, 2005). In Australia, a report estimated 16,000 new HCV cases in 2001 (Law et al, 2003). In Canada, as of January 01, 1999, HCV infection became a reportable disease in all Canadian provinces and territories (Laboratory Centre for Disease Control (LCDC), 1999). The preliminary estimate of HCV incidence was 3,000-8,000 new cases per year (Remis, 2001).

In contrast to the incidence of HCV infection, it is harder to get the actual number of prevalence cases for hepatitis C because many of the HCV infected people have not yet developed the symptoms while the virus is replicating in their bodies and slowly damaging their livers (Morse, 2003). Therefore, the prevalence of HCV infection is still underestimated.

In the United States, the prevalence of HCV infection was estimated at 2.7 million persons (Alter et al, 1999) based on the National Health and Nutrition Examination Survey from 1988 to 1994 and involved 21,241 persons tested for antibody to HCV.

In Canada, the estimated HCV prevalence was 240,000 (0.8% of population) in 1998 (Remis et al, 1998). Based on this latest estimation, large increases in cases are predicted in the next 10 years: 92% for hepatitis C cirrhosis, 126% for liver failures, and 102% for hepatocellular carcinoma (liver cancer) (Zou et al., 2000).

Internationally, an estimate of 170 million people (3.1% of the world population) carry the hepatitis C virus in 1999 (WHO, 2000) which translates into 3-4 million new cases per year (Brown & Gaglio, 2003).

Morbidity and Mortality

Hepatitis C virus infection and liver-related disease are major leading causes of morbidity and mortality. According to a synthetic (incidence) study in New Zealand using known and estimated epidemiology variables to construct a cohort's life history, a person infected with HCV at the age of 20 will experience an average of about 25 years of illness before dying of another cause (Easton, 2002). For this reason, HCV infection has a significant impact on health care systems.

In the United States, a study using a multi-state health care database found that 19,300 HCV infected persons and 7,400 HCV alcohol abuse persons accounted for an estimated 64,800 hospitalizations related to HCV in 1995 (Kim et al, 2001). In 1998, according to the third National Health and Nutrition Examination survey (NHANES), the number of hospital discharges were 140,000 cases related to HCV (Kim, 2002). In another similar report, patients with chronic liver disease or cirrhosis accounted for 474,000 hospital discharges in 2003 (CDC, 2006).

Mortality from acute liver failure is a rare event in the U.S.A. From a multi-state health care database, HCV caused 2,600 in-hospital deaths in 1995 (Kim et al, 2001) and increased to 3,759 deaths from HCV in 1999 (Kim, 2002). According to a CDC National Vital Statistics Reports using preliminary 2004 data, chronic liver disease and cirrhosis caused 26,549 deaths or 9 deaths per 100,000 population (CDC, 2006).

In Canada, based on the 1997 mortality data from Statistics Canada and applying a proportion of 40% of deaths from liver disease caused by HCV in an Alabama population-based study (CDC unpublished study), the annual HCV mortality in Canada is estimated at 1,022 deaths (Pohani et al, 2001). Furthermore, based on the prevalence of HCV in Canada (240,000 cases) in 1998, the death rate is expected to increase by 126% in the next ten years (Zoo et al, 2000).

In southern Italy, 2,472 persons aged 30 or older from a random sample of the population were enrolled and interviewed. Clinical evaluations and serum samples from the study population were completed. Among these, 511 were HCV-positive. Then, these 511 subjects were followed up for a period of 12 years (1985-1996). After 12 years, 75 (14.8%) HCV-positive persons died and, of this number, 30 (40.0% of 75) died of liver related disease (Osella et al, 2000).

HCV Co-Infection

The hepatitis C co-infection with the HIV and/or hepatitis B increases significantly the risk of liver-related disease. The HCV co-infection is often found among injection drug users and persons treated for hemophilia. For instance, the result of a Chinese community-based survey of 397 injection drug abusers in 2002, showed that 270 (71.0%) of the injection drug abusers were HCV infected, 45 (11.3%) HIV positive, and 45 (11.3%) HCV-HIV co-infected (Ruan et al, 2004). HCV people co-infected with HIV appeared to have 12 to 300 times higher risk of developing liver cancer compared to non-carriers (NIH, 1997).

Diagnosis and Treatments

Under normal conditions, the liver cells contain several enzymes that perform various liver functions. When liver cells are damaged, liver enzymes leak into the bloodstream. Thus, several blood tests are used to determine the presence of hepatitis C virus in the liver or through the higher than normal level of liver enzymes or too much iron or copper. The HCV antibody tests such as enzyme immunoassay (EIA) or recombinant immunoblot assay (RIBA) are used to detect or confirm the presence of anti-HCV in the blood. The two most useful liver enzymes that exist in liver cells are alanine aminotransferase (ALT) or serum glutamic pyruvic transaminase and aspirate aminotransferase (AST) or serum glucamic oxaloacetic transaminase. The ALT and AST tests for the abnormal presence of ALT and AST in the bloodstream are used to diagnose HCV infection. The bilirubin test (total bilirubin and direct bilirubin), an important marker of liver function, is used to determine if the bilirubin level is higher than normal in the blood. The polymerase chain reaction (PCR) tests such as the qualitative or quantitative hepatitis C virus load or HCV genotype test are used to

confirm the presence of virus and the viral load in the bloodstream or HCV types. The protein-based test for alpha-fetoprotein, a tumor marker for liver cancer, is used to determine the presence of protein if high levels are detected in the bloodstream. In addition, an ultrasound is used to see whether the liver is swollen and a liver biopsy (laparoscopy or transvenous) is used to examine the liver tissues for signs of healthy, damage, or disease condition (Gretch, 1997; NIH, 2002; Franciscus, 2006).

Treatments for acute and chronic HCV infections are different. For acute HCV, the treatment used is mainly for relieving symptoms (nausea, vomiting, jaundice, and abdominal pain, etc.) and maintaining sufficient fluid intake. On the other hand, for chronic HCV, the treatment used involves medication or combinations of medication to wipe out the virus or further slow liver damage. Since the beginning of the 1990s, several new drugs have been introduced to treat hepatitis C. The Interferon drug was first approved by the Food and Drugs Administration in 1991. This injectable Interferon was successful in treating HCV patients with 15% response rate, in spite of some severe side effects. In 1998, the oral Ribavirin was introduced to reduce the level of ALT by approximately one third but it also has some serious side effects. However, the combination of Inteferon and Ribavirin were used to treat patients with genotypes 2 or 3. The result of combined therapy was found to be effective in 40-55% of patients with previously untreated infection. However, the result of combined drugs leaded to dramatic improvements but required careful monitoring (Patel and McHutchison, 2003).

For severe chronic HCV cases, liver transplantation is the treatment of last resort. The first liver transplant was done in 1963 (Starzl et al, 1963). The orthotropic liver transplant (OLT) is the definitive therapy for acute and chronic liver failure (Seaberg et al, 1998). In Canada, in 1998, there were 338 liver transplants and of these, 217 were related to hepatitis C infection. In the United States, in 2000, according to the United Network for Organ Sharing, 18,000 patients were waiting for OLT, but only 4,954 liver transplants were performed (Seaberg et al, 1998). Currently, hepatitis C is the leading cause for liver transplantation in the Western world.

To summarize, the multiple epidemiology factors of hepatitis C such as the mode of transmission, high risk groups involved, natural history and disease progression,

incidence and prevalence, morbidity and mortality, and co-infection contribute to the complexity of various diagnostic tests and treatments which include drugs and liver transplants. Moreover, due to lack of awareness of the infection and easy spread, plus rapid growth of the virus, HCV infection has a large impact on society. Quickly, the HCV infection has become an economic burden for health care systems with different severity levels of liver-related diseases. Unfortunately, the health care services and costs to treat these HCV infected patients are still largely unknown.

LITERATURE REVIEW

Search Cost Strategy

The search for English language papers between 1991 to early 2006 of hepatitis C virus infection costs was performed using the PubMed and Medline sites. The key word "cost" and any of the words "hepatitis C", "natural history", "liver disease" and "liver transplantation" in the title resulted in 110 articles. Finally, a manual search of bibliographies was performed to obtain cost estimates. Abstracts of these papers were examined and those with cost of care for persons with hepatitis C were printed in full. Most of these papers referred to health service utilization for care of HCV patients in the United States, Australia, and some European countries whereas only a few referred to Canadian HCV economic cost models. Unfortunately, none of these articles contains reference of the cost of HCV with respect to time since diagnosis versus time since infection.

Treatment Costs

There are several papers on the treatment cost of HCV infection from different studies on HCV infected groups using various research methods. For example, a study can use any one of the many HCV infected groups (injection drugs use, alcoholic liver disease, persons received tainted blood transfusion or HCV infected organ transplant, medical health care persons, etc.) with differences by age, gender, and level of liver disease severity. As another example, HCV infected persons can carry different virus subtypes (1a, 1b, or others). Additionally, HCV infected persons can have different environmental factors (living conditions, alcohol consumption, natural sexual

relationship, etc). However, costs reported from different studies varied widely depending on the host, virus, and environmental factors used in these studies (Seeff, 2002). Here, briefly, we review the basic cost available for HCV infection through literature found in different studies for drugs, incidence cases, liver transplantation, a combined cost of medical services, hospital and drugs, and for prediction of future cost for HCV infection.

Drugs Costs

According to the HCV-HIV Co-Infection News release in Nov 20, 2003, the cost for treating one HCV patient with a combination of Interferon and Ribavirin is nearly $30,000 per year (Public Health Agency of Canada, 2003). From a retrospective cohort study of 302 inmates in the United States using actual data between 1998 and 2002, the cost model for treatment of 100 consecutive inmates with Peginterferon and Ribavirin was $1,775,900 or $35,500 per sustained virologic response (Sterling et al. 2005).

Incidence Costs

In Canada, based on the forecasted total prevalence HCV cases and annual costs (2001-2040) with data from different sources (resources used from literature, clinical management guidelines, expert opinions and costs in Alberta), a hepatitis C model, using both the prevalence- and incidence-based approaches of HCV, estimated the total health care costs at $14.6 million (discounted) for 3,196 newly diagnosed HCV cases in 2001 or an average $3,846 per patient year (El Saadany, 2005).

In Australia, based on projections produced by the Hepatitis C Projection Working Group and 10,500 incidence HCV cases in 1996, an incidence cost from a hypothetical cohort study of 1,000 newly HCV infected persons estimated that the total lifetime undiscounted costs to be about $13 million Australian dollars over 50 years or $13,000 per HCV person, whereas, the discounted costs (at 5%) were $6 million (Shiell, 1998).

Medical Services, Hospital and Pharmaceutical Costs

In Scotland, in a retrospective observational study of 4,922 patients identified with viral hepatitis from 1989-99, 469 patients with a mean age of 34.8 were confirmed with positive anti-hepatitis C. Among the HCV infection group, 371 (79%) patients were hospitalized with 2,224 admissions for an average length of stay (LOS) of 5.45 days. The total cost of admitted cases was £2,775,645 or an average of £7,482 per admitted case (Steinke et al, 2002).

In New England, the first detailed cross-sectional study involving an insured population together with chronic HCV-related claims data from 1995-1997 on treatment patterns and costs of services for 191 chronic HCV (under 65 years of age without HIV infection) patients has contributed significantly to the understanding of health service utilization for chronic HCV (Rosenberg et al, 2000). The reported overall medical services (in-patient care, emergency room, hospital out-patient care, and ambulatory office care) and pharmaceutical costs were US $7.5 million or an average of $39,384 per chronic HCV patient for the entire 3-year period. Among this group, 11 patients received liver transplants at a cost of $1,957,717. Half of claims in the amount of $3,788,893 were used to pay for the hospitalization of 60 patients (31%) with an average length of stay of 11 days.

In the United States, using data from the Nationwide Inpatient Sample of the Healthcare Utilization Project (Kim et al, 2001), an estimated US $1,024 million total hospital charges for 140,000 hospitalizations due to HCV-related diagnosis in 1998 or average of US $7,330 per separation (Kim, 2002).

While the vaccine for hepatitis C infection is still in the testing stage and given the fact that drug therapy only works for a limited number of cases, the best treatment for a liver disease is a liver transplant.

Liver Transplant Costs

In the United States, from an economic analysis study of liver transplant, there were 1,680 transplantation procedures performed in 1988 with a median charge of $145,795 for each liver transplantation cost with a median length of stay of 33 days

(Evans et al, 1993). Another study from 1993 to 1999 examined the records of 1,683 patients (60% of the population sample) in the Health Care Financing Administration's Medicare Provider Analysis and Review file. Based on this study, the average total post-transplantation cost for the first-year, excluding immunosuppressive, decreased from $201,677 in 1993 to $143,363 in 1998 due to shorter hospital LOS (Best et al, 2001). Also in another US study of direct inpatient and outpatient costs for a one year of liver transplant care involving 37 patients using data extracted from the Cost Manager Module were found to differ based on the Child Turcotte Pugh (CTP) score. For example, the inpatient cost was $76,506 for CTP>10 and $52,969 for CTP <=10 whereas for outpatient, the direct cost was $8,304 and $5,028, respectively (Freeman et al., 2001).

In Canada, the immediate (post diagnosis) direct cost of a liver transplantation in Alberta in 1998 was $55,000, excluding post hospital care (Jacobs et al, 2001). In addition, the result of a retrospective analysis of hospital charts and clinical databases between 1991 and 1992 involving 119 adults in the Toronto General Hospital for liver transplantation reported an overall mean cost of $89,066 (range $30,505 to $690,431) (Taylor et al, 2002). Furthermore, other follow-up services increased the overall mean cost to $121,732 (1998 Canadian dollars).

Overall, liver transplantation is still the most expensive surgical procedures for treatment of liver disease.

End-Stage Liver Disease Costs

While there are numerous cost studies of liver transplantation, cost studies of dying of end-stage liver disease (ESLD) are rare. In one study for the 5-year period 1991-1995, involving 153 patients from 5 groups, the result shows that in the group with 7 patients who were admitted to the liver team and died of ESLD complication, the cost of dying of ESLD liver disease was $110,576 per admission (Wong L. et al, 1997).

Future Costs

In the USA, using a Markov computer cohort simulation, the future HCV cost from 2010 to 2019 is estimated at $10.7 billion in direct medical cost, $54.2 billion in

societal cost, and $21.3 billion in morbidity cost from disability of cirrhosis and hepatocellular carcinoma (Wong B. et al, 2000).

In Canada, the model forecasts an annual health care cost for the treatment of HCV-related disease ranging from $103 to $153 million over the time period 2001-2040 (El Saadany et al, 2005).

METHODOLOGY

Study Design

We designed the study of this thesis to determine the pattern of incidence cost of HCV infection in the Capital Health region, Alberta (Canada) by time since diagnosis (1998) versus time since infection (1958-1998) using both a cross-sectional survey and a retrospective cohort study. In 1997/98, the population of the CH region was 801,000 people.

Cross-Sectional Survey

The cross-sectional survey is a telephone survey done by the Capital Health region interviewers in 1998. A survey questionnaire (Appendix A) was used to collect information related to liver diseases from HCV infected persons in the CH region in 1998. The question on self-reported time when infected with HCV was used to identify the time length of HCV infection. This time frame will be referred to as the time since infection.

Retrospective Cohort Study

The retrospective cohort study was used to follow all newly reported cases of HCV infections during 1998 in the Capital Health region. The time frame used is a three-year study period consisting of one year before and two years after the diagnosis date of HCV infection. This time frame will be referred to as the time since diagnosis.

Study Population

Sample Study Population

The data sample used for this cohort study consists of 413 HCV patients who recalled the years of the hepatitis C infection in the Capital Health region cross-sectional phone survey in 1998.

Sample Population Characteristics

The characteristics of the study population from the CH cross-sectional phone survey are presented in Figures 1 through 5.

Figure 1 shows the break down of the 413 HCV study population by gender, age group, and time since infection with HCV. There were more males than females, i.e. 247 (59.8%) vs. 166 (40.2%). There were 80 persons (19.4%) less than 30 years old, 283 (68.5%) between 30 to 49, and 50 (12.1%) who were 50 years or older. Of these 413 persons, 199 persons (48.2%) had fewer than 10 years HCV infection, 109 (26.4%) between 10-19 years, and 105 (25.4%) with 20+ years of infection.

Figure 2 shows the number of HCV cases versus self-reported year of hepatitis C infection during the period 1958 to 1998. There were three high numbers of HCV infection cases for both male and female: 30, 42, and 48 for the year 1970, 1997, and 1998 respectively.

Figure 3 shows results of symptoms and risks responses. To the 5 questions on disease symptoms, 331 persons (80.1%) responded. Of these, 166 (50.2%) individuals answered 'fatigue'; 112 (33.8%), 'gastro-intestinal symptoms'; 109 (32.9%), 'pain'; 131 (39.6%), 'no symptoms', and the remaining for present/past 'jaundice', 'dark urine' or other symptoms in general. To the 3 questions dealing with risk factors, 375 persons (90.8%) responded. Of these, 204 (54.4%) persons answered 'IDU', 193 (51.5%), 'tattoo/body piercing'; 94 (25.1%), 'sharing razors/tooth brushes'; 85 (22.7%), 'received blood product'; and the remaining answered 'occupational exposed to blood', 'needlestick', 'sexual contact', 'household contact', 'hemodialysis', and other risk factors.

Figure 4 shows the lab test results and/or reason for HCV test, liver biopsy, and other tests for the hepatitis B virus (HBV) and human immunodeficiency virus (HIV). The results of reasons for HCV tests showed that 65 (15.7%) of patients were 'sick'; 112 (27.1%), 'doctor'; 125 (30.3%), 'patient requested'; and the remaining patients, 'other reasons or unknown'. To the question related to whether the liver test result was normal, 399 (96.6%) persons answered. There were 122 (30.6%) 'yes', 128 (32.1%) 'no', and 149 (37.3%), 'unknown'. For the question whether the patient had a liver biopsy, the result showed that 26 (6.6%) over 393 (95.2%) patients responded 'yes' to this question. For more information related to the HCV infection, the question whether the patient has been tested for HBV was asked. Out of 401 (97.1%) patients, 276 (69.4%) answered 'yes' whereas 19 (6.9%) had HBV positive. When the patient was asked whether he/she has been tested for HIV, out of 399 (96.6%) patients who answered, 287 (71.9%) said 'yes' whereas 6 (2.1%) had positive HIV test result.

Figure 5 shows responses to other questions related to blood transfusion, history of STD, natural sexual relationship, and IDU. In a total of 122 (29.5%) people who answered "yes" to the blood transfusion, 99 (81.1%) people had received blood prior to 1990 (Blood transfusion time), and 23 (18.9%) in/after 1990. For the question related to the patient history of STD, of the 368 (89.1%) persons who answered, 141 (38.3%) said 'yes'. Furthermore to the natural sexual relationship question, of the 364 (88.1%) people who responded to this question, 338 (92.9%) persons reported a heterosexual relationship whereas only a small number reported a gay or lesbian relationship. Finally, to the question related to whether the patient has 'ever done IDU', from 397 (96.1%) patients who answered, 293 (73.8%) said 'yes'. Of these, 201 (68.6%) responded 'stopped IDU' whereas 92 (31.4%) had no responses.

Based on the 413 newly diagnosed HCV infected person characteristics, a detailed analysis of medical administrative data sets in the next chapter will bring out the costs of health service utilization.

Data

Data Needed

Given the objective design for the incidence cost of HCV infection in a three-year cohort study as described above, we need the following data:

- Newly reported HCV positive cases with known dates of HCV infection (time since infection);
- Data from physician billing, ambulatory care and hospitalization inpatient for the above newly HCV infected cases for pre- and post-time HCV diagnosed (time since diagnosis);
- Cost information for ambulatory care and hospitalization.

Data Sources

Data and information needed for the study are derived from Capital Health region, Alberta Health and Wellness, and the Canadian Institute for Health Information (CIHI) organizations:

Capital Health Region

Newly Reported HCV Positive 1998 Cases

A data file of 1,230 newly HCV positive cases in the Capital Health region in 1998 is used as a master file for this study. Data elements include the HCV patient personal health number (PHN), demographic information, HCV onset/symptom diagnosis dates, and HCV reported dates to the CH region. These individuals were interviewed by telephone to determine their knowledge of the disease. This database is called the HCV 1998 Survey.

Hepatitis C Virus 1998 Survey

The purpose of this telephone survey of newly HCV reported positive cases in the CH region was to determine the study population and information about when and how they got infected with hepatitis C virus, blood borne pathogens disease such as HBV, HIV and STD, history of IDU, and personal behaviours/lifestyle

(Appendix A). One of the self-reported survey questions was related to the HCV 'Known dates when infected'. This question is the master key for the selection of records needed for this study population design. Out of 1,230 newly reported HCV positive cases were interviewed, 413 knew their infected dates. Therefore, this study population is focused on 413 HCV infected persons with the known date of HCV infection.

The above Capital Health data sets contain missing values for some elements such as PHN, gender, date of birth (DOB), etc. In order to fill out the missing fields and obtain the medical service information for the study population, we need other databases from Alberta Health and Wellness.

Alberta Health and Wellness

In order to fill out the above empty fields from some HCV infected records derived from the Capital Health region, we used the Alberta Health Care Insurance Plan (AHCIP) registry. In order to get health service utilization data needed for cost calculation in a three-year cohort study (Figure 6), we used three medical administrative databases and other cost files.

Alberta Health Care Insurance Plan Registry (AHICP)

The AHICP registry file was used to collect premium and assess eligibility of recipients for services claimed by medical practitioners. The registration of AHCIP is mandatory in Alberta. The registry has 18 variables such as unique identifier (personal health number), name, gender, date of birth, death, address, etc. The AHCIP registry file served as the source to search for missing information in the newly reported HCV positive cases.

Alberta Health Care Insurance Plan Fee-For-Service (FFS) Database

The first medical administrative database used in this study is the Fee-for-Service (FFS) database. The FFS data or physician billing or claims data is collected by AHW for medical and non-medical billable services and ministry payment to providers. This database contains more than 100 variables such as recipient/provider demographic

information, diagnoses, service dates, service type/category/location, site function, billable and payment information, etc. The variables used in this study are the recipient identifier, service date, three diagnosis fields (primary, secondary, tertiary) and payment to providers. Claims records were extracted for one year before and two years after HCV infection diagnosed (1998). The claims file is used to calculate the cost of physician visits for each newly HCV positive reported patient with 'known date when infected' status.

Ambulatory Care Classification System (ACCS) Database

The second medical administrative database used in this study is the ACCS database. The ACCS records are collected by Regional Health Authorities (RHAs) for their funding purposes. ACCS database includes day surgery/procedures, emergency room visits, and community rehabilitation program services occurring in publicly funded facilities. ACCS database contains more than 30 variables such as recipient/provider demographic information, service, diagnoses, procedures, case mix group (CMG), ACCS grouper, etc. The variables used in this study are recipient identifier, service dates, all six diagnosis fields (Dx_1 to Dx_6), and ACCS grouper. ACCS records were extracted for the pre-one year period and post-two years of the date of HCV diagnosed infection. In order to calculate the ACCS cost, we needed the ACCS Outpatients Costs file by ACCS grouper which is derived from the AHW Costing Branch and contains ACCS grouper code, grouper name and cost for ambulatory care visit.

Hospital Inpatient (HI) Files

Finally, the last medical administrative database used in this study is the hospital inpatient (morbidity) database. The hospital inpatient records are collected by Regional Health Authorities' hospitals. There is one record per patient's separation and contains many variables (170-730). The variables include the recipient/provider demographic information, 16 diagnosis fields and types, procedure/intervention and suffix, length of stay, grouper and weight (refine group number and case mix group), resource intensive weight (RIW), and date (discharge, transfer or death dates etc.). The morbidity file was used to calculate the hospital inpatient costs of one year before and

two years after diagnosis from each newly HCV positive reported patient with 'known date when infected' status.

Canadian Institute for Health Information (CIHI)

In addition, we used the cost per weighted case (CPWC) for Alberta in the fiscal year 2000/2001 for the entire hospital inpatient cost calculation. This information was derived from the CIHI report on "Canadian MIS Database – Hospital Financial Performance Indicator 1999-2000 to 2001-2002".

Data Processing and Analysis

Data Processing

Cleaning and Merging

At AHW, the process of cleaning 1,230 HCV infection records was completed using the registry file to search for missing information such as PHN, gender, DOB, etc. Then the anonymous identifier number (ID_ASN) was added to the HCV file for further use. The cleaned HCV infection file was sent back to the CH region.

At the CH region, the HCV file with 1,230 cleaned records was linked to the HCV survey data. The new merged file of HCV infection and HCV survey without PHN element was then sent to the Institute of Health Economic (IHE) for later use.

At AHW, the cleaned HCV file of 1,230 records was used to merge with FFS claims data (1997-2001), ACCS (1997/98-2001/02), and HI (1996/97-2000/01), using PHN as the key merging variable. The merge of medical administrative record files then was used to select records needed for one year before and two years after HCV diagnosed dates (Figure 6-9). PHN was then removed from the record. The three merged files of health service utilization carried anonymous identifier (ID_ASN) and were then sent to the IHE for further process.

As an AHW staff, the author was involved in the cleaning and merging process at AHW whereas as part of the thesis-based program, she was allowed to use the above data from IHE. In this work, the selection of 413 HCV newly reported cases from the HCV infection-HCV survey file was used as the master file for the cohort study. The master key, ID_ASN, was used for merging and selecting processes with FFS claims, ACCS, and HI files. The continuation of merging process is the merge of new ACCS file with the ACCS Outpatients Costs file. A complete graphic presentation of data processing for the health service utilization linkages is presented in Figures 10.

The calculations for time since infection and time since diagnosis from three new merged medical administrative files were performed using equations 1 to 4.

Calculating and Grouping

Time-Since-Infection

The time since infection is calculated by the subtraction of the HCV newly reported year (1998) and the known year when infected with HCV. The self-reported time when the person was infected with HCV is taken directly from the survey questionnaire. The time since infection is given by the following equation:

Equation 1: Time since infection = Year of reported HCV (1998) – Year HCV self-reported

The time since infection of HCV is further divided into 3 groups: Less than 10 years, 10 to 19 years, and 20 years or more.

Time-Since-Diagnosis

The time since diagnosis for physician billing, ambulatory care and hospitalization data can be found in fee-for-service claims, ambulatory care classification system, and hospital inpatient databases, respectively, and divided into pre and post time since HCV diagnosis. The corresponding calculations are given by the following formulas:

Equation 2: Time since diagnosis (phys) = HCV defined diagnosis date – Physician visit start date

Equation 3: Time since diagnosis (accs) = HCV defined diagnosis date – Ambulatory care start date

Equation 4: Time since diagnosis (hosp) = HCV defined diagnosis date – Hospitalization start date

If the time difference between the HCV diagnosed date and the service start is between –1 and –365 days, then the time since diagnosis is 0-12 months before diagnosed date (i.e., pre). After the diagnosed date (post), the time since diagnosis is either 0-12 or 13-24 months depending on whether the time difference is between 0 and 365 or 366 and 730 days (post), respectively.

In summary, the data needed for determining HCV incidence cost by time since infection versus time since diagnosis can be calculated from the survey and administrative health care utilization databases.

Disease Chapters

On the three medical administrative data sets, based on the primary diagnosis or the most responsible reasons for physician visits, ambulatory care, and hospitalization, the International Classification of Disease – 9th Revision – Clinical Modification (ICD-9-CM) codes were used to divide the diseases into 19 chapters from 1 to 17, E and V. We selected the top three leading causes of physician visits, ambulatory care, or hospitalization (Tables 1, 6, and 11) to draw a sketch pattern of health service utilization in the CH region due to HCV infection.

Liver-Related Disease

Also based on the primary diagnosis, we divided ICD-9-CM codes reported into two groups of liver-related diseases or hepatobiliary (ICD-9-CM = 070, 155, 571-577) and non-liver related diseases or non- hepatobiliary (remaining of ICD-9-CM). Tables 2, 7, and 12 are used to describe the proportion of health services used for liver-related diseases versus non-liver related diseases.

Cost Calculations

The cost charged for each physician visit exists in the FFS database. Thus, there is cost calculation for ambulatory care and hospitalization, but not for physician visit. The cost charged for each ambulatory care visit is derived from the result of merging ACCS database and ACCS costing file by ACCS grouper. According to each ACCS grouper number, there is an associated cost. This cost is based on the average

cost of ACCS blended data from 1999/2000 for the corresponding ACCS grouper (AHW, 2003). On the other hand, the cost charged for each hospitalization is calculated by the multiplication of Cost per Weighted Case (CPWC) and Resource Intensity Weight (RIW). The CPWC is a methodology developed by CIHI to measure the average cost of treating inpatient acute care cases and obtained from CIHI (CIHI, 2003) whereas the RIW is a measure of the relative amount of hospital resources used to treat a Case Mix group (CMG) or Day Procedure Group (DPG). RIW are calibrated annually so that the average inpatient acute care case in Canada has a value of one and these numbers are attached with each hospital separation from the hospital inpatient file.

For further cost details in totals and averages, we also calculated the costs of medical administrative data sets by time since diagnosis of HCV versus time since infection by age groups and gender (Tables 3, 4, 8, 9, 13, and 14) to give the varieties of health services used by different time fashion. For more accuracy on the number of visits, length of stay in the hospital, and costs of the calculations for standard error and 95% confidence interval were also used (Tables 5, 10, and 15).

Aggregating and Summarizing

Finally, for the summary of the incidence cost of HCV infection, we aggregated all records from each medical administrative data set to the level of one record per HCV patient. Furthermore, we combined all three new FFS, ACCS, and HI into 1 master file which included all the health service utilization used per person (Table 16) to give an estimate of average costs of HCV infection by time since diagnosis versus time since infection for pre- and post-time periods of diagnosis.

Analysis

The tools using for data analysis are SAS (Statistical Analysis Software) and SPSS (Statistical Package for the Social Sciences). All steps of data analysis were performed at AHW. For this thesis, the descriptive statistic is applied to analyze the HCV-survey file and three medical administrative data sets (FFS claims, ambulatory care, and hospital inpatient). Results from the analysis of HCV-survey were presented by the basic features of HCV patient characteristics as illustrated in the cohort sample above (Figures 1-5). Results of analysis of three medical administrative data sets are presented in Tables 1, 2,

5, 6, 11, and 12 for background information and in Tables 3-4, 8-9, and 13-14, and 16 for health service utilization costs. We also used standard error and 95% confidence interval (CI) in the analysis to provide a more accurate and detailed estimate of dispersion of the sample size (Tables 5, 10, and 15).

RESULTS

The results of this thesis introduce the incidence costs of hepatitis C infection by pre- and post-time since diagnosis versus time since infection. The incidence costs are based on the total health service utilization by 408 (98.8%) of the 413 HCV infected persons. Figure 11 shows among these 408, there were 139 (34.0%) that used all three health service utilization (physician visit, ambulatory care, and hospital service), 212 (52.0%) that used physician visit and ambulatory care, 2 (0.5%) that used physician visit and hospital service, 53 (13.0%) that used physician visits, and the remaining 2 (0.5%) that used ambulatory care. The cost is categorized into pre- and post-time since diagnosis of 0-12 months before, 0-12 and 13-24 months after HCV infection diagnosed in 1998. Moreover, the cost is further categorized by three time-since-infection intervals as recalled by HCV infected patients in the cross-sectional phone survey: <10 years, 10 to 19 and 20 or more years. The detailed incidence costs associated with physician visit, ambulatory care, and hospitalization are discussed in the next three sections. In the last section of this study we summarized average costs of health service utilization which combined physician visits, ambulatory care, and hospital inpatient costs together for newly diagnosed HCV infected persons.

Physician Visits Cost

The first section deals with the incidence cost of HCV infection associated with physician visits of 406 (98.3%) out of 413 HCV infected patients who visited physicians over a three-year period. Tables 1 and 2 present background information or reasons for physician visits grouped by disease chapters and liver-related diseases whereas Tables 3 to 5 details the incidence costs of physician visits.

Table 1 shows main reasons for physician visits during a three-year period for patients diagnosed with HCV infection. The reasons, grouped in top-three leading

disease chapters, are also tabulated by time since infection. For both time since infections <10 and 20+ years, the top three leading disease chapters of physician visits in increasing frequency are 1) Mental Disorders 2) Symptoms/Signs/Ill-Defined Condition and 3) Injury and Poisoning whereas in the time since infection 10-19 years, the disease chapter Mental Disorders is ranked 2nd after Symptoms/Signs/Ill-Defined Condition. These top three leading disease chapters account for 10,997 (53.4%) of the total 20,599 physician visits whereas the remaining visits account for the other disease chapters.

The top three leading disease chapters for physician visits by HCV infected persons identified above do not contain liver-related diseases since there are no ICD-9-CM codes in the disease chapters. However, it is probably included in the disease chapter "All Others". The physician visits by liver-related diseases is discussed next.

Table 2 shows physician visits for HCV infection by liver-related disease and by time since infection. In the time since infection <10 years group, hepatobiliary accounted for 316 (3.3%) of the 9,525 physician visits whereas in the 10-19 and 20+ years, hepatobiliary comprise of 328 (5.5%) of 5,913 visits and 261 (5.1%) of 5,161 visits, respectively. Overall, among the total of 20,599 physician visits over a three-year period, there are 905 (4.4%) physician visits for liver-related disease or hepatobiliary and 18,509 (89.9%) for non-hepatobiliary.

The purpose of this thesis is not to calculate the incidence cost of HCV infection for the top three leading disease chapters or liver-related diseases but to determine the incidence cost of all treatments of HCV infected persons. Thus, the cost of physician visits by age group and gender is discussed in the next two tables.

Table 3 shows the total and average costs of physician visits by pre- and post-time since diagnosis versus time since infection and age group. The total physician visits cost in the pre-time since diagnosis of 0-12 months is $173,373 or an average cost of $471 per patient corresponding to 4,559 (22.1%) physician visits by 368 (89.1%) patients or an average of physician visits per patient of 12.4. For the post-time since diagnosis of 0-12 months, the total physician visits cost is $385,770 (average of $1,002 per patient) involving 8,484 (41.2%) visits by 385 (93.2%) patients (average of 22.0). Finally, for the

post-time since diagnosis of 13-24 months, the total physician visits cost is $302,495 (average of $862 per patient) for 7,556 (36.7%) visits by 351 (85.0%) patients (average of 21.5).

In summary, the two averages of physician visit costs by HCV infected patients in the post-time since diagnosis intervals are about twice the pre-time since diagnosis costs. The average physician visit costs per patient within a given time since diagnosis frame are fairly independent of both time since infection and age groups except for the <30 age group (zero) in the 20+ years. In contrast, the 50+ age group in the 10 to 19 years time since infection shows generally higher averages of physician visits (19.1, 30.0, and 33.2) and costs ($601, $1,105, and $1,157). In addition, physician visit cost is also broken down by gender as discussed next.

Table 4 shows the total and average costs of physician visit by pre- and post-time since diagnosis versus time since infection and gender. The total physician visits cost in the pre-time since diagnosis of 0-12 months is $79,709 for 154 females (average of $518) and $93,664 for 214 males (average of $438). The average physician visits for female and male are similar (12.7 vs. 12.2). For the post-time since diagnosis of 0-12 months, the total physician visits cost for 158 females is $154,161 (average of $976) with total of 3,309 (39.0%) physician visits (average of 20.9). At the same time frame, the total physician visits cost is $231,609 for 227 males (average of $1,002) involving 5,175 (61.0%) physician visits (average of 22.8). Finally, for the post-time since diagnosis of 13-24 months, the total physician visits cost for 153 females is $136,018 (average of $889) for 3,366 (44.5%) physician visits (average of 22.0). In addition in the same time period, the total physician visits cost for 198 males is $166,477 (average of $841) with 4,190 (55.5%) physician visits (average of 21.2). Overall, the physician visit costs by gender are similar.

To conclude, the overall physician visit cost is discussed next in terms of descriptive statistics with uncertainty an estimated range of values.

Table 5 shows the summary of total and average costs of physician visits of HCV infected patients by pre- and post-time since diagnosis versus time since infection

without age group and gender in the Capital Health region. However, the physician visit costs inside a given time since diagnosis interval show no significant pattern but the costs vary between the three-time since diagnosis intervals. For example, the physician visit costs of post-time since diagnosis of 0-12 and 13-24 months are about twice those of the pre-time since diagnosis of 0-12 months.

Ambulatory Care Cost

The second section deals with the incidence cost of HCV infection for ambulatory care. Using the same table templates as presented in the physician visits section, Table 6 lists the top three leading disease chapters for ambulatory care visits whereas Table 7 presents the proportion of liver-related diseases compared to non-liver related diseases, and the last three tables of this section, Tables 8 to 10 illustrate the incidence cost of HCV infection over a three-year period by age group and gender.

Table 6 shows the top three leading disease chapters of ambulatory care visits by time since infection over a three-year period for the 353 (85.5%) of the 413 HCV infected persons. The top three leading disease chapters account for 3,197 (60.1%) of the total 5,317 ambulatory care visits and are shared between the following disease chapters: the supplementary classification of factors influencing health status and contact with health services, mental disorders, symptoms/signs/and ill-defined condition, and injury and poisoning. The top three disease chapters do not include the liver-related diseases in terms of diagnosis. More detail related to disease diagnosis causing ambulatory care visits is discussed next.

Table 7 shows the number of ambulatory care visits for liver-related diseases by time since infection. As seen in this table, out of a total of 5,317 visits, 337 (6.3%) were for hepatobiliary and the remaining of 4,980 (93.7%) ambulatory care visits were for non-hepatobiliary. The incidence cost of HCV infection is discussed next.

Table 8 shows the total and average costs of ambulatory care visits by pre- and post-time since diagnosis versus time since infection and age group. There are no patients <30 years old in the group 20+ years since time infection who used ambulatory care. For the pre-time since infection of 0-12 months, the total cost is $169,106 resulting from 1,345 visits by 201 (48.7%) HCV infected patients or average of $841 per patient. For the post-time 0-12 months, the total ambulatory care cost is $253,576 for 280 (67.8%) patients with 2,023 visits or an average of $906 per patient. In addition, for the post-time 13-24 months, the total cost is $212,410 corresponding to 1,949 visits by 240 (58.1%) patients or average of $885 per patient. Overall, the average cost ambulatory care seems to be independent of the time since diagnosis.

The average ambulatory care cost per person is higher in the 10 to 19 years since infection group for the age group 50+ of the three time-since-diagnosis intervals. On the other hand, the average cost shows no significant trend as a function of the age group within these time-since-diagnosis intervals.

Table 9 shows the total and average costs of ambulatory care visits by gender. The average costs for male and female are similar in the pre-time since diagnosis. In the post-time since diagnosis 0-12 months, the male average cost is higher than those for females in the time since infection <19 years and the reverse after 20+ years. In contrast, the female average cost in the post-time since diagnosis 13-24 months is greater than the male cost after time since infection >10 years.

Table 10 shows the summary of total and average costs for ambulatory care visits by pre- and post-time since diagnosis versus time since infection without age group and gender. Over the three-year period, the total ambulatory care cost for 353 HCV infected patients with average ambulatory care visits of 7.4 times (SE=0.6, at 95% CI=6.2-8.6) is $635,093 with an average cost of $881 per patient (SE=$52, at 95% CI=$779-$983). The average ambulatory care cost per patient in the time since infection interval 10 to 19 years is the highest in all three pre- and post-time since diagnosis but similar between time since diagnosis intervals.

Hospital Inpatient Costs

The third type of cost for HCV infection is the hospital inpatient cost. There were 141 (34.1%) of 413 HCV infected persons hospitalized over a three-year period. The leading causes most responsible for hospitalization are illustrated in Table 11 whereas Table 12 describes the proportion of liver-related diseases for hospitalization. Finally, the costs for hospitalization are broken down by age group and gender in Tables 13 to 15.

In Table 11, the top three leading disease chapters of hospitalizations are tabulated by time since infection for HCV infected persons over a three-year period. The mental disorders disease chapter is the leading cause of hospitalization in the three-time since infection intervals (ranking 1st). The disease chapters ranking 2nd include the complication of pregnancy, childbirth and subcutaneous tissue, the injury and poisoning, and diseases of respiratory in the time since infection intervals <10 years, 10 to 19, and 20+, respectively. Finally, the disease chapters ranking 3rd are varied during the time since infection. In addition, the top three leading disease chapters account for 185 (60.3%) hospitalization whereas the remaining disease chapters account for 122 (39.7%) hospitalization. However, the top three leading disease chapters do not include the liver-related disease diagnosis which is discussed next.

Table 12 shows the number of hospitalizations by liver-related disease and by time since infection. The total number of hepatobiliary hospitalizations over the three-year period for 141 HCV infected patients is 20 (6.5%) of the total 307.

Tables 13 shows the total and average costs of hospitalization by pre- and post-time since diagnosis versus time since infection and age group. The total costs of hospitalization are $532,981, $673,719, and $389,406 for the pre- 0-12 months, post- 0-12, and post- 13-24 months time since diagnosis, respectively. The average hospitalization cost per HCV infected patient varies within the time since infection interval and age group. Overall, by pre- and post- time since diagnosis, the average costs are $6,922 (LOS=10.6 days) per patient in the pre-time since diagnosis, $8,983 (LOS=9.9

days) in the post-time since diagnosis 0-12 months, and dropping to $7,211 (LOS=9.2 days) afterward. High average costs in the age group 30-49 of $13,223 and $21,415 are observed in the time since infection interval 20+ for both pre- and post-time since diagnosis 0-12 and 13-24 months, respectively. The highest average cost of $25,570 with LOS=18.7 days is found in the 50+ age group in the time since infection interval 20+. This analysis is repeated as function of gender.

Table 14 shows the total and average costs of hospitalization by pre- and post-time since diagnosis versus time since infection by gender. Generally, the average costs of hospitalization for males are higher than those for females due to longer LOS in the hospital except for the following two time since infection intervals: 20+ and 10 to 19 for post-time since diagnosis 0-12 and 13-24 months, respectively. The corresponding higher female average costs are $19,247 and $5,100, respectively.

Table 15 shows the summary of total and average cost of hospitalization by pre- and post- time since diagnosis versus time since infection over a three-year period without age group and gender.

The total cost for hospitalization over the three-year period for 144 (34.9%) HCV infected patients is $1,596,106 or an average of $7,748 (SE=$800, at 95% CI=$6,170-$9,326).

The pattern of average hospitalization cost differs by time since infection. For those in the first two time since infection intervals <10 and 10 to 19 years, the pattern holds. However, for those in the time since infection interval 20+, the average costs per person steadily increases from $10,416 in the year before diagnosis to $12,005 in the year after and $16,143 two years after diagnosis.

Average Costs

A summary of all health service utilization average costs for physician visits, ambulatory care and hospitalization for 408 of 413 newly diagnosed HCV infected persons is shown in Table 16. For the time since diagnosis, the average costs per person increase from the pre- 0-12 months to the post- 0-12 months period, and then fall in the year after that (post- 13-24 months). For the pre- 0-12 months of time since diagnosis, the average costs per person for health service utilization increase with time since infection from $6,917 to $7,816 and $11,759 for the <10, 10 to 19 and 20+ years, respectively. For the post- 0-12 months of time since diagnosis, the average costs per person are higher than for the previous year and also increase with time since infection from $9,729 to $11,531 and $13,892. After the year of time since diagnosis (1998), for the post- 13-24 months, the average costs per person decrease from $8,191 for the <10 years time since infection to $6,464 for the 10 to 19 years, and then increase up to $17,494 for the 20+ years. Generally, there is a pattern in the relationship between overall average costs of health service utilization per person by time since diagnosis and time-since infection. This pattern is clearly seen in Figure 12.

However, for the time since infection <10 and 10 to 19 years, the average costs of health service utilization increase with pre- and post- time since diagnosis 0-12 months, and then slightly decrease for the post- 13-24 months time since diagnosis. On the other hand, for the time since infection 20+ years, the average costs per person steadily increase with time since diagnosis from pre- 0-12 months to post-.0-12 and 13-24 months. In other words, for a person with HCV infection, the longer the time since infection the higher the average costs for health service utilization along with time since diagnosis.

DISCUSSION AND CONCLUSIONS

In this paper we have developed a model of the health care costs incurred for persons with newly diagnosed hepatitis C virus infection. The model is based on actual data, and includes the following features: time since diagnosis (1998; pre-one year and post-two years), time since infection (1958-1998; <10, 10-19, and 20+ years), and demographic variables such as age (0-88 years; <30, 30-49, and 50+ years), sex, and details of diagnoses. We examined physician billings, ambulatory care costs and hospital inpatient costs in the Capital Health region over a three-year period for 413 HCV infected persons.

Before interpreting results of health costs found from this incidence cost study, a number of limitations need to be emphasized. First, the study screened only the primary diagnosis for main reasons of physician visits, ambulatory care visits, and hospitalizations from the HCV study population instead of all diagnosis variables included in medical databases. Thus, the percentages of medical services used for liver-related disease could be incomplete. Second, the study design lacks a retrospective cohort of a non-HCV infection control group for cost comparisons. Third, the study does not break down the health costs by disease stage levels but just looks at all newly diagnosed HCV cases. Fourth, the study health costs do not include pharmaceutical costs for treatment. And finally, the costs of medical examinations (laboratory tests, liver biopsies, liver imaging techniques, etc) used to confirm newly diagnosed HCV cases are also left out from the total costs of health service utilization.

However, the study's results indicate that time since diagnosis is a predictor of average cost per person. The average costs of health service utilization increased from pre- to post-time since diagnosis 0-12 months, and then fell slightly in the post- 13-24 months except for the 20+ years since infection. Our results also indicate that diagnosis is a big event in the economic life of a person who has hepatitis C infection. The average cost of health service utilization increased 32% in 0-12 months after HCV diagnosis compared to the time before diagnosis. Our findings of the increased cost immediately

after diagnosis is similar to the observation from another study on health care cost for chronic HCV person (Rosenberg et al, 2000)

Our results also show a quite clear picture about the relationship between average cost per person and time since infection. The average costs of health service utilization increased with time since infection. In 0-12 months after HCV diagnosis, the costs increased 41%, 48%, and 18% in time since infection <10, 10-19, and 20+ years, respectively. Moreover, the cost for 20+ years since infection interval continued to increase up to 49% in 13-24 months after diagnosis compared to time before diagnosis. Nevertheless, the majority of health costs, based on the primary diagnosis, of persons with newly diagnosed hepatitis C were not related to liver disease; in fact, costs of medical services for hepatobiliary diagnoses formed only a small proportion of total costs. It seems that costs for many diagnoses are ramped up, not just the cost of treating hepatitis C diagnosis. Our proportion cost findings for HCV infection may not reflect the true cost for hepatobiliary because we do not scan all diagnosis fields in databases for liver-related disease coding. Thus, our findings are not different from liver-related reasons for hospitalization of a cross-sectional analysis for HCV in a large insured New England population (Rosenberg et al, 2000).

Our results of average health costs of persons with newly diagnosed HCV somehow are hard to compare with findings from other studies because of differences in selections and characteristics of HCV study populations. Our study uses newly diagnosed HCV cases including all stages of disease, HCV co-infections, and all ages; while Rosenberg et al's study population was based on chronic HCV (excluding new cases), without HIV co-infection, and less than 65 years of age; or a retrospective observational study from Steinke et al which calculated cost of morbidity by combining both incidence and prevalence HCV cases.

When interpreting our results, we should note that the costs in relation to time since diagnosis refer to a cohort, which is all of those people who have been diagnosed in the Capital Health region in a given year (1998). However, we should also note that costs in relation to time since infection are not the costs of a cohort. That is, the costs do not

measure the economic trajectory of the disease of all persons who were infected in any given year (1958-1998).

The varying or lack of relationship between cost and time since infection may reflect the wide variability in the course of the disease. People with hepatitis C develop symptoms and complications at different times since infection, and this may make it very difficult to develop a predictive model, as some have done (Shiell, 1998; Wong B. et al, 2000; El Saadany et al, 2005).

In conclusion, our study on health costs of 413 persons with newly diagnosed HCV in the Capital Health region in 1998 has a number of limitations as listed above. Our results were obtained and/or calculated from health costs paid to providers for each HCV patient regardless disease severity (acute/ chronic/fibrosis/cirrhosis/hepatocellular carcinoma) or procedure of liver transplantation. Therefore, future research needs to measure costs at different levels with the addition of costs for pharmaceutical treatments and medical examinations. Furthermore, it would be more meaningful if we could add another part of health costs for the non-HCV population group to compare with the results of this study. Thus, the economic burden of HCV infection to the health care system will be more strongly emphasized. Unfortunately, this addition may require a lot of effort to determine true non-HCV infection in the control population group.

Table 1: Top Three Leading Disease Chapters of Physician Visits for HCV Infection by Time-Since-Infection in the Capital Health Region Over a Three-Year Period

Time-Since-Infection (Years)	Study Population (# Patients)	Disease Chapter			Physician Visit		
		Rank	Chapter #	Description	# Visits	% Subtotal	% Total
Less than 10	199 (196)	1st	5	Mental disorders	3,147	33.0	
		2nd	16	Symptoms, signs, and ill-defined condition	1,350	14.2	
		3rd	17	Injury and poisoning	893	9.4	
			Res	All others	4,135	43.4	
				Subtotal	**9,525**	**100.0**	**46.2**
10 to 19	109 (106)	1st	16	Symptoms, signs, and ill-defined condition	972	16.4	
		2nd	5	Mental disorders	956	16.2	
		3rd	17	Injury and poisoning	628	10.6	
			Res	All others	3,357	56.8	
				Subtotal	**5,913**	**100.0**	**28.7**
20 or more	105 (104)	1st	5	Mental disorders	2,015	39.0	
		2nd	16	Symptoms, signs, and ill-defined condition	692	13.4	
		3rd	17	Injury and poisoning	344	6.7	
			Res	All others	2,110	40.9	
				Subtotal	**5,161**	**100.0**	**25.1**
Total	**413 (406)**				**20,599**		**100.0**

Sources:
Capital Health 1998 HCV data file
Capital Health 1998 HCV Survey
Alberta Health Care Insurance Plan (AHCIP) Fee-For-Service (Claims file)

Notes:
Chapter 5 includes ICD-9-CM 290-319
Chapter 16 includes ICD-9-CM 780-799
Chapter 17 includes ICD-9-CM 800-999
Res: Residual

Table 2: Number of Physician Visits for HCV Infection by Liver-Related Disease and by Time Since Infection in the Capital Health Region Over a Three-Year Period

Time Since Infection (Years)	Study Population (# Patients)	Liver-Related Disease	Physician Visit		
			# Visit	% Subtotal	% Total
Less than 10	199 (196)	Hepatobiliary	316	3.3	
		Non-hepatobiliary	8,676	91.1	
		Missing	533	5.6	
		Subtotal	**9,525**	**100.0**	**46.2**
10 to 19	109 (106)	Hepatobiliary	328	5.5	
		Non-hepatobiliary	5,187	87.7	
		Missing	398	6.7	
		Subtotal	**5,913**	**100.0**	**28.7**
20 or more	105 (104)	Hepatobiliary	261	5.1	
		Non-hepatobiliary	4,646	90.0	
		Missing	254	4.9	
		Subtotal	**5,161**	**100.0**	**25.1**
Total	**413 (406)**	Total Hepatobiliary	905	4.4	
		Total Non-hepatobiliary	18,509	89.9	
		Total Missing	1,185	5.8	
			20,599	**100.0**	**100.0**

Sources:
Capital Health 1998 HCV data file
Capital Health 1998 HCV Survey
Alberta Health Care Insurance Plan (AHCIP) Fee-For-Service (Claims file)

Notes:
Liver-Related Disease is based on the primary diagnosis only
Hepatobilinary includes ICD-9-CM = 070, 155, 571-577
Non-hepatobilinary includes all ICD-9-CM codes except ICD-9-CM for hepatobilinary
Missing: ICD-9-CM for primary diagnosis is missing but service was provided and service charge was applied for other

Table 3: Total and Average Costs of Physician Visits by Pre- and Post-Time Since Diagnosis versus Time Since Infection and Age Group in the Capital Health Region Over a Three-Year Period

Time Since Infection (Years)	Age Group	Study Population	Pre- and Post-Time Since Infection					
			0-12 Months Before Hepatitis C Diagnosis					
			Patient		Physician Visit		Physician Visit Cost	
			#	%	#	Average/ Patient	Total	Average/ Patient
Less than 10	< 30	69	61	88.4	698	11.4	$26,859	$440
	30 - 49	114	101	88.6	1,197	11.9	$42,634	$422
	50+	16	15	93.8	136	9.1	$5,656	$377
	Subtotal	**199**	**177**	**88.9**	**2,031**	**11.5**	**$75,149**	**$425**
10 to 19	< 30	11	9	81.8	92	10.2	$3,029	$337
	30 - 49	82	72	87.8	1,000	13.9	$35,440	$492
	50+	16	15	93.8	287	19.1	$9,020	$601
	Subtotal	**109**	**96**	**88.1**	**1,379**	**14.4**	**$47,489**	**$495**
20 or more	< 30	0	0	0.0	0	0.0	$0	$0
	30 - 49	87	78	89.7	914	11.7	$40,443	$519
	50+	18	17	94.4	235	13.8	$10,292	$605
	Subtotal	**105**	**95**	**90.5**	**1,149**	**12.1**	**$50,735**	**$534**
	Total	**413**	**368**	**89.1**	**4,559**	**12.4**	**$173,373**	**$471**
			0-12 Months After Hepatitis C Diagnosis					
Less than 10	< 30	69	65	94.2	1,046	16.1	$44,841	$690
	30 - 49	114	102	89.5	2,696	26.4	$111,955	$1,098
	50+	16	16	100.0	292	18.3	$14,128	$883
	Subtotal	**199**	**183**	**92.0**	**4,034**	**22.0**	**$170,924**	**$934**
10 to 19	< 30	11	10	90.9	183	18.3	$11,549	$1,155
	30 - 49	82	76	92.7	1,530	20.1	$76,152	$1,002
	50+	16	16	100.0	480	30.0	$17,676	$1,105
	Subtotal	**109**	**102**	**93.6**	**2193**	**21.5**	**$105,377**	**$1,033**
20 or more	< 30	0	0	0.0	0	0.0	$0	$0
	30 - 49	87	83	95.4	1,762	21.2	$85,248	$1,027
	50+	18	17	94.4	495	29.1	$24,221	$1,425
	Subtotal	**105**	**100**	**95.2**	**2,257**	**22.6**	**$109,469**	**$1,095**
	Total	**413**	**385**	**93.2**	**8,484**	**22.0**	**$385,770**	**$1,002**
			13-24 Months After Hepatitis C Diagnosis					
Less than 10	< 30	69	57	82.6	1,045	18.3	$48,426	$850
	30 - 49	114	94	82.5	2,155	22.9	$88,290	$939
	50+	16	13	81.3	260	20.0	$10,843	$834
	Subtotal	**199**	**164**	**82.4**	**3,460**	**21.1**	**$147,559**	**$900**
10 to 19	< 30	11	11	100.0	166	15.1	$5,833	$530
	30 - 49	82	71	86.6	1,644	23.2	$62,011	$873
	50+	16	16	100.0	531	33.2	$18,515	$1,157
	Subtotal	**109**	**98**	**89.9**	**2341**	**23.9**	**$86,359**	**$881**
20 or more	< 30	0	0	0.0	0	0.0	$0	$0
	30 - 49	87	74	85.1	1,461	19.7	$58,092	$785
	50+	18	15	83.3	294	19.6	$10,486	$699
	Subtotal	**105**	**89**	**84.8**	**1,755**	**19.7**	**$68,578**	**$771**
	Total	**413**	**351**	**85.0**	**7,556**	**21.5**	**$302,495**	**$862**

Sources:

Capital Health 1998 HCV data file

Capital Health 1998 HCV Survey

Alberta Health Care Insurance Plan (AHCIP) Fee-For-Service (Claims file)

Table 4: Total and Average Costs of Physician Visits by Pre- and Post-Time Since Diagnosis versus Time Since Infection and Gender in the Capital Health Region Over a Three-Year Period

Time Since Infection (Years)	Gender	Study Population	Pre- and Post-Time Since Diagnosis					
			0-12 Months Before Hepatitis C Diagnosis					
			Patient		Physician Visit		Physician Visit Cost	
			#	%	#	Average/ Patient	Total	Average/ Patient
Less than 10	Female	87	82	94.3	983	12.0	$38,756	$473
	Male	112	95	84.8	1,048	11.0	$36,394	$383
	Subtotal	**199**	**177**	**88.9**	**2,031**	**11.5**	**$75,149**	**$425**
10 to 19	Female	49	46	93.9	671	14.6	$25,341	$551
	Male	60	50	83.3	708	14.2	$22,148	$443
	Subtotal	**109**	**96**	**88.1**	**1,379**	**14.4**	**$47,489**	**$495**
20 or more	Female	30	26	86.7	299	11.5	$15,612	$600
	Male	75	69	92.0	850	12.3	$35,122	$509
	Subtotal	**105**	**95**	**90.5**	**1,149**	**12.1**	**$50,735**	**$534**
	Female	166	154	92.8	1,953	12.7	$79,709	$518
	Male	247	214	86.6	2,606	12.2	$93,664	$438
	Total	**413**	**368**	**89.1**	**4,559**	**12.4**	**$173,373**	**$471**
			0-12 Months After Hepatitis C Diagnosis					
Less than 10	Female	87	83	95.4	1,672	20.1	$79,653	$960
	Male	112	100	89.3	2,362	23.6	$91,272	$913
	Subtotal	**199**	**183**	**92.0**	**4,034**	**22.0**	**$170,924**	**$934**
10 to 19	Female	49	46	93.9	945	20.5	$42,821	$931
	Male	60	56	93.3	1,248	22.3	$62,556	$1,117
	Subtotal	**109**	**102**	**93.6**	**2,193**	**21.5**	**$105,377**	**$1,033**
20 or more	Female	30	29	96.7	692	23.9	$31,687	$1,093
	Male	75	71	94.7	1,565	22.0	$77,782	$1,096
	Subtotal	**105**	**100**	**95.2**	**2,257**	**22.6**	**$109,469**	**$1,095**
	Female	166	158	95.2	3,309	20.9	$154,161	$976
	Male	247	227	91.9	5,175	22.8	$231,609	$1,020
	Total	**413**	**385**	**93.2**	**8,484**	**22.0**	**$385,770**	**$1,002**
			13-24 Months After Hepatitis C Diagnosis					
Less than 10	Female	87	80	92.0	1,638	20.5	$72,534	$907
	Male	112	84	75.0	1,822	21.7	$75,024	$893
	Subtotal	**199**	**164**	**82.4**	**3,460**	**21.1**	**$147,559**	**$900**
10 to 19	Female	49	46	93.9	1,237	26.9	$42,060	$914
	Male	60	52	86.7	1,104	21.2	$44,298	$852
	Subtotal	**109**	**98**	**89.9**	**2,341**	**23.9**	**$86,359**	**$881**
20 or more	Female	30	27	90.0	491	18.2	$21,423	$793
	Male	75	62	82.7	1,264	20.4	$47,155	$761
	Subtotal	**105**	**89**	**84.8**	**1,755**	**19.7**	**$68,578**	**$771**
	Female	166	153	92.2	3,366	22.0	$136,018	$889
	Male	247	198	80.2	4,190	21.2	$166,477	$841
	Total	**413**	**351**	**85.0**	**7,556**	**21.5**	**$302,495**	**$862**

Sources:

Capital Health 1998 HCV data file

Capital Health 1998 HCV Survey

Alberta Health Care Insurance Plan (AHCIP) Fee-For-Service (Claims file)

Table 5: Summary of Total and Average Costs of Physician Visits by Pre- and Post-Time Since Diagnosis versus Time Since Infection in the Capital Health Region Over a Three-Year Period

Time Since Infection (Years)	Study Population	Pre- and Post-Time Since Diagnosis										
		0-12 Months Before Hepatitis C Diagnosis										
		Patient		Physician Visit				Physician Visit Cost				
		#	%	Ave Vs/Pt	Std. Error	95% CI Lower	95% CI Upper	Ave $/Pt	Std. Error	95% CI Lower	95% CI Upper	Total
Less than 10	199	177	88.9	11.5	1.2	9.0	13.9	$425	$48	$330	$519	$75,149
10 to 19	109	96	88.1	14.4	1.8	10.7	18.0	$495	$65	$367	$623	$47,489
20 or more	105	95	90.5	12.1	1.9	8.4	15.8	$534	$122	$291	$777	$50,735
Total	**413**	**368**	**89.1**	**12.4**	**0.9**	**10.6**	**14.2**	**$471**	**$43**	**$388**	**$555**	**$173,373**
		0-12 Months After Hepatitis C Diagnosis										
Less than 10	199	183	92.0	22.0	2.8	16.4	27.7	$934	$113	$711	$1,157	$170,924
10 to 19	109	102	93.6	21.5	2.2	17.2	25.9	$1,033	$160	$715	$1,351	$105,377
20 or more	105	100	95.2	22.6	3.3	16.1	29.1	$1,095	$191	$717	$1,473	$109,469
Total	**413**	**385**	**93.2**	**22.0**	**1.7**	**18.7**	**25.4**	**$1,002**	**$84**	**$836**	**$1,168**	**$385,770**
		13-24 Months After Hepatitis C Diagnosis										
Less than 10	199	164	82.4	21.1	2.4	16.3	25.9	$900	$109	$684	$1,115	$147,559
10 to 19	109	98	89.9	23.9	2.8	18.3	29.5	$881	$116	$652	$1,111	$86,359
20 or more	105	89	84.8	19.7	3.2	13.3	26.2	$771	$142	$488	$1,053	$68,578
Total	**413**	**351**	**85.0**	**21.5**	**1.6**	**18.4**	**24.7**	**$862**	**$70**	**$724**	**$1,000**	**$302,495**
		0-12 Months Before Plus 0-24 Months After Hepatitis C Diagnosis										
Less than 10	199	196	98.5	18.2	1.3	15.6	20.8	$751	$56	$642	$860	$393,633
10 to 19	109	106	97.2	20.0	1.4	17.3	22.6	$808	$71	$668	$949	$239,224
20 or more	105	104	99.0	18.2	1.7	14.9	21.5	$806	$91	$626	$985	$228,781
TOTAL	**413**	**406**	**98.3**	**18.7**	**0.8**	**17.0**	**20.3**	**$780**	**$40**	**$702**	**$859**	**$861,638**

Sources:

Capital Health 1998 HCV data file

Capital Health 1998 HCV Survey

Alberta Health Care Insurance Plan (AHCIP) Fee-For-Service (Claims file)

Abbreviations:

Ave Vs/Pt: Average Visits/Patient

Ave $/Pt: Average Costs/Patient

Table 6: Top Three Leading Disease Chapters of Ambulatory Care for HCV Infection by Time Since Infection in the Capital Health Region Over a Three-Year Period

Time Since Infection (Years)	Study Pop (# Patients)	Disease Chapter			Ambulatory Care		
		Rank	#	Description	# Visit	% Subtotal	% Total
Less than 10	199 (173)	1st	V	Supplementary classification of factors influencing health status and contact with health services	693	25.8	
		2nd	5	Mental disorders	613	22.9	
		3rd	17	Injury and poisoning	349	13.0	
			Res	All others	1,026	38.3	
				Subtotal	**2,681**	**100.0**	**50.4**
10 to 19	109 (97)	1st	V	Supplementary classification of factors influencing health status and contact with health services	563	33.4	
		2nd	16	Symptoms, signs, and ill-defined condition	217	12.9	
		3rd	5	Mental disorders	181	10.7	
			Res	All others	727	43.1	
				Subtotal	**1,688**	**100.0**	**31.7**
20 or more	105 (83)	1st	5	Mental disorders	259	27.3	
		2nd	V	Supplementary classification of factors influencing health status and contact with health services	250	26.4	
		3rd	16	Symptoms, signs, and ill-defined condition	72	7.6	
			Res	All others	367	38.7	
				Subtotal	**948**	**100.0**	**17.8**
Total	**413 (353)**				**5,317**		**100.0**

Sources:
Capital Health 1998 HCV data file
Capital Health 1998 HCV Survey
Alberta Health Ambulatory Care Classification System (ACCS file)

Notes:
Chapter V includes ICD-9-CM V01-V82
Chapter 5 includes ICD-9-CM 209-319
Chapter 16 includes ICD-9-CM 780-799
Chapter 17 includes ICD-9-CM 800-999
Res: Residual

Table 7: Number of Ambulatory Care for HCV Infection by Liver-Related Disease and by Time Since Infection in the Capital Health Region Over a Three-Year Period

Time Since Infection (Years)	Study Pop (# Patients)	Liver-Related Disease	Ambulatory Care		
			# Visit	% Subtotal	% Total
Less than 10	199 (173)	Hepatobiliary	130	4.8	
		Non-hepatobiliary	2,551	95.2	
		Subtotal	**2,681**	**100.0**	**50.4**
10 to 19	109 (97)	Hepatobiliary	115	6.8	
		Non-hepatobiliary	1,573	93.2	
		Subtotal	**1,688**	**100.0**	**31.7**
20 or more	105 (83)	Hepatobiliary	92	9.7	
		Non-hepatobiliary	856	90.3	
		Subtotal	**948**	**100.0**	**17.8**
Total	**413 (353)**	Total Hepatobiliary	337	6.3	
		Total Non-hepatobiliary	4,980	93.7	
			5,317	**100.0**	**100.0**

Sources:
Capital Health 1998 HCV data file
Capital Health 1998 HCV Survey
Alberta Health Ambulatory Care Classification System (ACCS file)

Notes:
Liver-Related Disease is based on the primary diagnosis only
Hepatobiliary includes ICD-9-CM = 070, 155, 571-577
Non-hepatobiliary includes all ICD-9-CM codes except ICD-9-CM for hepatobiliary

Table 8: Total and Average Costs of Ambulatory Care by Pre- and Post-Time Since Diagnosis versus Time Since Infection and Age Group in the Capital Health Region Over a Three-Year Period

Time Since Infection (Years)	Age Group	Study Population	Pre- and Post-Time Since Diagnosis					
			0-12 Months Before Hepatitis C Diagnosis					
			Patient		Ambulatory Visit		Ambulatory Cost	
			#	%	#	Average/ Patient	Total	Average/ Patient
Less than 10	< 30	69	40	58.0	310	7.8	$33,552	$839
	30 - 49	114	60	52.6	484	8.1	$48,406	$807
	50+	16	8	50.0	34	4.3	$4,242	$530
	Subtotal	**199**	**108**	**54.3**	**828**	**7.7**	**$86,201**	**$798**
10 to 19	< 30	11	6	54.5	16	2.7	$2,941	$490
	30 - 49	82	40	48.8	211	5.3	$33,707	$843
	50+	16	9	56.3	38	4.2	$15,515	$1,724
	Subtotal	**109**	**55**	**50.5**	**265**	**4.8**	**$52,163**	**$948**
20 or more	< 30	0	0	0.0	0	0.0	$0	$0
	30 - 49	87	28	32.2	199	7.1	$22,992	$821
	50+	18	10	55.6	53	5.3	$7,751	$775
	Subtotal	**105**	**38**	**36.2**	**252**	**6.6**	**$30,742**	**$809**
	Total	**413**	**201**	**48.7**	**1,345**	**6.7**	**$169,106**	**$841**
			0-12 Months After Hepatitis C Diagnosis					
Less than 10	< 30	69	47	68.1	247	5.3	$32,149	$684
	30 - 49	114	80	70.2	690	8.6	$77,883	$974
	50+	16	9	56.3	38	4.2	$8,322	$925
	Subtotal	**199**	**136**	**68.3**	**975**	**7.2**	**$118,354**	**$870**
10 to 19	< 30	11	8	72.7	52	6.5	$6,088	$761
	30 - 49	82	59	72.0	461	7.8	$59,950	$1,016
	50+	16	8	50.0	99	12.4	$14,520	$1,815
	Subtotal	**109**	**75**	**68.8**	**612**	**8.2**	**$80,558**	**$1,074**
20 or more	< 30	0	0	0.0	0	0.0	$0	$0
	30 - 49	87	56	64.4	359	6.4	$43,531	$777
	50+	18	13	72.2	77	5.9	$11,134	$856
	Subtotal	**105**	**69**	**65.7**	**436**	**6.3**	**$54,664**	**$792**
	Total	**413**	**280**	**67.8**	**2,023**	**7.2**	**$253,576**	**$906**
			13-24 Months After Hepatitis C Diagnosis					
Less than 10	< 30	69	40	58.0	291	7.3	$33,254	$831
	30 - 49	114	72	63.2	557	7.7	$64,515	$896
	50+	16	8	50.0	30	3.8	$4,586	$573
	Subtotal	**199**	**120**	**60.3**	**878**	**7.3**	**$102,354**	**$853**
10 to 19	< 30	11	9	81.8	64	7.1	$8,435	$937
	30 - 49	82	49	59.8	664	13.6	$60,428	$1,233
	50+	16	12	75.0	83	6.9	$12,184	$1,015
	Subtotal	**109**	**70**	**64.2**	**811**	**11.6**	**$81,048**	**$1,158**
20 or more	< 30	0	0	0.0	0	0.0	$0	$0
	30 - 49	87	39	44.8	214	5.5	$23,841	$611
	50+	18	11	61.1	46	4.2	$5,167	$470
	Subtotal	**105**	**50**	**47.6**	**260**	**5.2**	**$29,008**	**$580**
	Total	**413**	**240**	**58.1**	**1,949**	**8.1**	**$212,410**	**$885**

Sources:

Capital Health 1998 HCV data file

Capital Health 1998 HCV Survey

Alberta Health Ambulatory Care Classification System (ACCS file)

Table 9: Total and Average Costs of Ambulatory Care by Pre- and Post-Time Since Diagnosis versus Time Since Infection and Gender in the Capital Health Region Over a Three-Year Period

Time Since Infection (Years)	Gender	Study Population	Pre- and Post-Time Since Diagnosis					
			0-12 Months Before Hepatitis C Diagnosis					
			Patient		Ambulatory Visit		Ambulatory Cost	
			#	%	#	Average/ Patient	Total	Average/ Patient
Less than 10	Female	87	52	59.8	329	6.3	$37,880	$728
	Male	112	56	50.0	499	8.9	$48,322	$863
	Subtotal	**199**	**108**	**54.3**	**828**	**7.7**	**$86,202**	**$798**
10 to 19	Female	49	28	57.1	156	5.6	$27,798	$993
	Male	60	27	45.0	109	4.0	$24,365	$902
	Subtotal	**109**	**55**	**50.5**	**265**	**4.8**	**$52,163**	**$948**
20 or more	Female	30	9	30.0	55	6.1	$6,540	$727
	Male	75	29	38.7	197	6.8	$24,203	$835
	Subtotal	**105**	**38**	**36.2**	**252**	**6.6**	**$30,742**	**$809**
	Female	166	89	53.6	540	6.1	$72,217	$811
	Male	247	112	45.3	805	7.2	$96,890	$865
	Total	**413**	**201**	**48.7**	**1,345**	**6.7**	**$169,106**	**$841**
			0-12 Months After Hepatitis C Diagnosis					
Less than 10	Female	87	65	74.7	349	5.4	$49,446	$761
	Male	112	71	63.4	626	8.8	$68,908	$971
	Subtotal	**199**	**136**	**68.3**	**975**	**7.2**	**$118,354**	**$870**
10 to 19	Female	49	36	73.5	211	5.9	$28,551	$793
	Male	60	39	65.0	401	10.3	$52,006	$1,333
	Subtotal	**109**	**75**	**68.8**	**612**	**8.2**	**$80,558**	**$1,074**
20 or more	Female	30	19	63.3	244	12.8	$23,848	$1,255
	Male	75	50	66.7	192	3.8	$30,816	$616
	Subtotal	**105**	**69**	**65.7**	**436**	**6.3**	**$54,664**	**$792**
	Female	166	120	72.3	804	6.7	$101,845	$849
	Male	247	160	64.8	1,219	7.6	$151,731	$948
	Total	**413**	**280**	**67.8**	**2,023**	**7.2**	**$253,576**	**$906**
			13-24 Months After Hepatitis C Diagnosis					
Less than 10	Female	87	56	64.4	337	6.0	$39,593	$707
	Male	112	64	57.1	541	8.5	$62,761	$981
	Subtotal	**199**	**120**	**60.3**	**878**	**7.3**	**$102,354**	**$853**
10 to 19	Female	49	31	63.3	429	13.8	$38,999	$1,258
	Male	60	39	65.0	382	9.8	$42,049	$1,078
	Subtotal	**109**	**70**	**64.2**	**811**	**11.6**	**$81,048**	**$1,158**
20 or more	Female	30	15	50.0	104	6.9	$11,192	$746
	Male	75	35	46.7	156	4.5	$17,816	$509
	Subtotal	**105**	**50**	**47.6**	**260**	**5.2**	**$29,008**	**$580**
	Female	166	102	61.4	870	8.5	$89,785	$880
	Male	247	138	55.9	1,079	7.8	$122,626	$889
	Total	**413**	**240**	**58.1**	**1,949**	**8.1**	**$212,410**	**$885**

Sources:

Capital Health 1998 HCV data file
Capital Health 1998 HCV Survey
Alberta Health Ambulatory Care Classification System (ACCS file)

Table 10: Summary of Total and Average Costs of Ambulatory Care by Pre- and Post-Time Since Diagnosis versus Time Since Infection in the Capital Health Region Over a Three-Year Period

Time Since Infection (Years)	Study Population	Pre- and Post-Time Since Diagnosis										
		0-12 Months Before Hepatitis C Diagnosis										
		Patient		Ambulatory Visit				Ambulatory Cost				
		#	%	Ave Vs/Pt	Std. Error	95% CI Lower	95% CI Upper	Ave $/Pt	Std. Error	95% CI Lower	95% CI Upper	Total
Less than 10	199	108	54.3	7.7	1.5	4.7	10.6	$798	$108	$584	$1,012	$86,201
10 to 19	109	55	50.5	4.8	1.0	2.9	6.8	$948	$247	$454	$1,443	$52,163
20 or more	105	38	36.2	6.6	2.3	2.0	11.3	$809	$148	$509	$1,109	$30,742
Total	**413**	**201**	**48.7**	**6.7**	**1.0**	**4.8**	**8.6**	**$841**	**$93**	**$658**	**$1,025**	**$169,106**
		0-12 Months After Hepatitis C Diagnosis										
Less than 10	199	136	68.3	7.2	1.6	4.1	10.2	$870	$140	$594	$1,147	$118,354
10 to 19	109	75	68.8	8.2	1.7	4.7	11.6	$1,074	$201	$673	$1,475	$80,558
20 or more	105	69	65.7	6.3	1.7	2.9	9.7	$792	$135	$523	$1,061	$54,664
Total	**413**	**280**	**67.8**	**7.2**	**1.0**	**5.3**	**9.2**	**$906**	**$93**	**$723**	**$1,088**	**$253,576**
		13-24 Months After Hepatitis C Diagnosis										
Less than 10	199	120	60.3	7.3	1.2	4.9	9.8	$853	$114	$627	$1,078	$102,354
10 to 19	109	70	64.2	11.6	3.2	5.3	17.9	$1,158	$183	$793	$1,523	$81,048
20 or more	105	50	47.6	5.2	1.4	2.4	8.0	$580	$105	$369	$791	$29,008
Total	**413**	**240**	**58.1**	**8.1**	**1.1**	**5.9**	**10.4**	**$885**	**$82**	**$724**	**$1,046**	**$212,410**
		0-12 Months Before Plus 0-24 Months After Hepatitis C Diagnosis										
Less than 10	199	173	86.9	7.4	0.8	5.7	9.0	$843	$72	$702	$984	$306,910
10 to 19	109	97	89.0	8.4	1.3	5.8	11.0	$1,069	$120	$833	$1,305	$213,769
20 or more	105	83	79.0	6.0	1.0	4.0	8.1	$729	$77	$577	$881	$114,414
Total	**413**	**353**	**85.5**	**7.4**	**0.6**	**6.2**	**8.6**	**$881**	**$52**	**$779**	**$983**	**$635,093**

Sources:

Capital Health 1998 HCV data file
Capital Health 1998 HCV Survey
Alberta Health Ambulatory Care Classification System (ACCS file)

Abbreviations:

Ave Vs/Pt: Average Visits/Patient
Ave $/Pt: Average Costs/Patient

Table 11: Top Three Leading Disease Chapters of Hospitalization for HCV Infection by Time Since Infection in the Capital Health Region Over a Three-Year Period

Time Since Infection (Years)	Study Population (# Patient)	Disease Chapter			Hospitalization		
		Rank	Chapter #	Description	# Admission	% Subtotal	% Total
Less than 10	199 (80)	1st	5	Mental disorders	44	24.6	
		2nd	11	Complication of pregnancy, childbirth and subcutaneous tissue	28	15.6	
		3rd	17	Injury and poisoning	27	15.1	
			Res	All others	80	44.7	
				Subtotal	**179**	**100.0**	**58.3**
10 to 19	109 (37)	1st	5	Mental disorders	15	18.1	
		2nd	17	Injury and poisoning	14	16.9	
		3rd	7	Disease of the circulatory system	9	10.8	
			9	Disease of the digestive system	9	10.8	
			11	Complication of pregnancy, childbirth and subcutaneous tissue	9	10.8	
			Res	All others	27	32.5	
				Subtotal	**83**	**100.0**	**27.0**
20 or more	105 (24)	1st	5	Mental disorders	14	31.1	
		2nd	8	Disease of the respiratory system	6	13.3	
		3rd	7	Disease of the circulatory system	5	11.1	
			17	Injury and poisoning	5	11.1	
			Res	All others	15	33.3	
				Subtotal	**45**	**100.0**	**14.7**
Total	**413 (141)**				**307**		**100.0**

Sources:
Capital Health 1998 HCV data file
Capital Health 1998 HCV Survey
Alberta Health Hospital Inpatient Files (Morbidity file)

Notes:
Chapter 5 includes ICD-9-CM 290-319
Chapter 7 includes ICD-9-CM 390-459
Chapter 8 includes ICD-9-CM 460-519
Chapter 9 includes ICD-9-CM 520-579
Chapter 11 includes ICD-9-CM 630-677
Chapter 17 includes ICD-9-CM 800-999

Abbreviation:
Res: Residual

Table 12: Number of Hospitalization for HCV Infection by Liver-Related Disease and by Time Since Infection in the Capital Health Region Over a Three-Year Period

Time Since Infection (Years)	Study Population (# Patients)	Liver-Related Disease	Hospitalization		
			# Admission	% Subtotal	% Total
Less than 10	199 (80)	Hepatobiliary	11	6.1	
		Non-hepatobiliary	168	93.9	
		Subtotal	**179**	**100.0**	**58.3**
10 to 19	109 (37)	Hepatobiliary	7	8.4	
		Non-hepatobiliary	76	91.6	
		Subtotal	**83**	**100.0**	**27.0**
20 or more	105 (24)	Hepatobiliary	2	4.4	
		Non-hepatobiliary	43	95.6	
		Subtotal	**45**	**100.0**	**14.7**
Total	**413 (141)**	Total Hepatobiliary	20	6.5	
		Total Non-hepatobiliary	287	93.5	
			307	**100.0**	**100.0**

Sources:
Capital Health 1998 HCV data file
Capital Health 1998 HCV Survey
Alberta Health Hospital Inpatient Files (Morbidity file)

Notes:
Liver-Related Disease is based on the primary diagnosis only
Hepatobiliary includes ICD-9-CM = 070, 155, 571-577
Non-hepatobiliary includes all ICD-9-CM codes except ICD-9-CM for hepatobiliary

Table 13: Total and Average Costs of Hospitalization by Pre- and Post-Time Since Diagnosis versus Time Since Infection and Age Group in the Capital Health Region Over a Three-Year Period

Time Since Infection (Years)	Age Group	Study Population	Pre- and Post-Time Since Diagnosis							
			0-12 Months Before Hepatitis C Diagnosis							
			Patient		Admission		LOS		Hospitalization Cost	
			#	%	#	Ave/Pt	#	Ave/Vs	Total	Ave/Pt
Less than 10	< 30	69	23	33.3	31	1.3	194	6.3	$109,187	$4,747
	30 - 49	114	14	12.3	17	1.2	163	9.6	$107,838	$7,703
	50+	16	2	12.5	2	1.0	13	6.5	$5,048	$2,524
	Subtotal	**199**	**39**	**19.6**	**50**	**1.3**	**370**	**7.4**	**$222,073**	**$5,694**
10 to 19	< 30	11	3	27.3	4	1.3	16	4.0	$6,096	$2,032
	30 - 49	82	15	18.3	21	1.4	208	9.9	$105,833	$7,056
	50+	16	3	18.8	4	1.3	49	12.3	$21,900	$7,300
	Subtotal	**109**	**21**	**19.3**	**29**	**1.4**	**273**	**9.4**	**$133,830**	**$6,373**
20 or more	< 30	0	0	0.0	0	0.0	0	0.0	$0	$0
	30 - 49	87	10	11.5	12	1.2	324	27.0	$132,232	$13,223
	50+	18	7	38.9	8	1.1	85	10.6	$44,846	$6,407
	Subtotal	**105**	**17**	**16.2**	**20**	**1.2**	**409**	**20.5**	**$177,079**	**$10,416**
	Total	**413**	**77**	**18.6**	**99**	**1.3**	**1052**	**10.6**	**$532,981**	**$6,922**
			0-12 Months After Hepatitis C Diagnosis							
Less than 10	< 30	69	16	23.2	27	1.7	137	5.1	$75,809	$4,738
	30 - 49	114	23	20.2	33	1.4	448	13.6	$215,287	$9,360
	50+	16	2	12.5	8	4.0	39	4.9	$33,813	$16,906
	Subtotal	**199**	**41**	**20.6**	**68**	**1.7**	**624**	**9.2**	**$324,908**	**$7,925**
10 to 19	< 30	11	2	18.2	4	2.0	37	9.3	$20,014	$10,007
	30 - 49	82	18	22.0	24	1.3	261	10.9	$178,340	$9,908
	50+	16	3	18.8	5	1.7	38	7.6	$18,396	$6,132
	Subtotal	**109**	**23**	**21.1**	**33**	**1.4**	**336**	**10.2**	**$216,750**	**$9,424**
20 or more	< 30	0	0	0.0	0	0.0	0	0.0	$0	$0
	30 - 49	87	8	9.2	10	1.3	74	7.4	$55,351	$6,919
	50+	18	3	16.7	7	2.3	131	18.7	$76,709	$25,570
	Subtotal	**105**	**11**	**10.5**	**17**	**1.5**	**205**	**12.1**	**$132,060**	**$12,005**
	Total	**413**	**75**	**18.2**	**118**	**1.6**	**1165**	**9.9**	**$673,719**	**$8,983**
			13-24 Months After Hepatitis C Diagnosis							
Less than 10	< 30	69	13	18.8	29	2.2	157	5.4	$82,464	$6,343
	30 - 49	114	18	15.8	28	1.6	185	6.6	$107,934	$5,996
	50+	16	3	18.8	4	1.3	77	19.3	$28,488	$9,496
	Subtotal	**199**	**34**	**17.1**	**61**	**1.8**	**419**	**6.9**	**$218,886**	**$6,438**
10 to 19	< 30	11	2	18.2	4	2.0	30	7.5	$9,536	$4,768
	30 - 49	82	8	9.8	12	1.5	48	4.0	$28,599	$3,575
	50+	16	3	18.8	5	1.7	26	5.2	$19,383	$6,461
	Subtotal	**109**	**13**	**11.9**	**21**	**1.6**	**104**	**5.0**	**$57,519**	**$4,425**
20 or more	< 30	0	0	0.0	0	0.0	0	0.0	$0	$0
	30 - 49	87	5	5.7	5	1.0	285	57.0	$107,076	$21,415
	50+	18	2	11.1	3	1.5	19	6.3	$5,925	$2,962
	Subtotal	**105**	**7**	**6.7**	**8**	**1.1**	**304**	**38.0**	**$113,001**	**$16,143**
	Total	**413**	**54**	**13.1**	**90**	**1.7**	**827**	**9.2**	**$389,406**	**$7,211**

Sources:
Capital Health 1998 HCV data file
Capital Health 1998 HCV Survey
Alberta Health Hospital Inpatient Files (Morbidity file)

Abbreviations:
Ave/Pt: Average/Patient
Ave/Vs: Average/Visit
LOS: Length Of Stay (Days)

Table 14: Total and Average Costs of Hospitalization by Pre- and Post-Time Since Diagnosis versus Time Since Infection and Gender in the Capital Health Region Over a Three-Year Period

Time Since Infection (Years)	Gender	Study Population	Pre- and Post-Time Since Diagnosis							
			0-12 Months Before Hepatitis C Diagnosis							
			Patient		Admission		LOS		Hospitalization Cost	
			#	%	#	Ave/Pt	#	Ave/Vs	Total	Ave/Pt
Less than 10	Female	87	18	20.7	24	1.3	125	5.2	$88,101	$4,894
	Male	112	21	18.8	26	1.2	245	9.4	$133,972	$6,380
	Subtotal	**199**	**39**	**19.6**	**50**	**1.3**	**370**	**7.4**	**$222,073**	**$5,694**
10 to 19	Female	49	10	20.4	16	1.6	103	6.4	$54,405	$5,441
	Male	60	11	18.3	13	1.2	170	13.1	$79,424	$7,220
	Subtotal	**109**	**21**	**19.3**	**29**	**1.4**	**273**	**9.4**	**$133,830**	**$6,373**
20 or more	Female	30	5	16.7	6	1.2	80	13.3	$39,509	$7,902
	Male	75	12	16.0	14	1.2	329	23.5	$137,569	$11,464
	Subtotal	**105**	**17**	**16.2**	**20**	**1.2**	**409**	**20.5**	**$177,079**	**$10,416**
	Female	166	33	19.9	46	1.4	308	6.7	$182,016	$5,516
	Male	247	44	17.8	53	1.2	744	14.0	$350,966	$7,976
	Total	**413**	**77**	**18.6**	**99**	**1.3**	**1,052**	**10.6**	**$532,981**	**$6,922**
			0-12 Months After Hepatitis C Diagnosis							
Less than 10	Female	87	24	27.6	41	1.7	229	5.6	$152,358	$6,348
	Male	112	17	15.2	27	1.6	395	14.6	$172,550	$10,150
	Subtotal	**199**	**41**	**20.6**	**68**	**1.7**	**624**	**9.2**	**$324,908**	**$7,925**
10 to 19	Female	49	13	26.5	17	1.3	174	10.2	$107,992	$8,307
	Male	60	10	16.7	16	1.6	162	10.1	$108,758	$10,876
	Subtotal	**109**	**23**	**21.1**	**33**	**1.4**	**336**	**10.2**	**$216,750**	**$9,424**
20 or more	Female	30	4	13.3	8	2.0	129	16.1	$76,989	$19,247
	Male	75	7	9.3	9	1.3	76	8.4	$55,071	$7,867
	Subtotal	**105**	**11**	**10.5**	**17**	**1.5**	**205**	**12.1**	**$132,060**	**$12,005**
	Female	166	41	24.7	66	1.6	532	8.1	$337,340	$8,228
	Male	247	34	13.8	52	1.5	633	12.2	$336,379	$9,894
	Total	**413**	**75**	**18.2**	**118**	**1.6**	**1,165**	**9.9**	**$673,719**	**$8,983**
			13-24 Months After Hepatitis C Diagnosis							
Less than 10	Female	87	18	20.7	31	1.7	178	5.7	$110,152	$6,120
	Male	112	16	14.3	30	1.9	241	8.0	$108,734	$6,796
	Subtotal	**199**	**34**	**17.1**	**61**	**1.8**	**419**	**6.9**	**$218,886**	**$6,438**
10 to 19	Female	49	7	14.3	11	1.6	65	5.9	$35,699	$5,100
	Male	60	6	10.0	10	1.7	39	3.9	$21,819	$3,637
	Subtotal	**109**	**13**	**11.9**	**21**	**1.6**	**104**	**5.0**	**$57,519**	**$4,425**
20 or more	Female	30	2	6.7	3	1.5	9	3.0	$3,962	$1,981
	Male	75	5	6.7	5	1.0	295	59.0	$109,039	$21,808
	Subtotal	**105**	**7**	**6.7**	**8**	**1.1**	**304**	**38.0**	**$113,001**	**$16,143**
	Female	166	27	16.3	45	1.7	252	5.6	$149,813	$5,549
	Male	247	27	10.9	45	1.7	575	12.8	$239,592	$8,874
	Total	**413**	**54**	**13.1**	**90**	**1.7**	**827**	**9.2**	**$389,406**	**$7,211**

Sources:
Capital Health 1998 HCV data file
Capital Health 1998 HCV Survey
Alberta Health Hospital Inpatient Files (Morbidity file)

Abbreviations:
Ave/Pt: Average/Patient
Ave/Vs: Average/Visit
LOS: Length Of Stay (Days)

Table 15: Summary of Total and Average Costs of Hospitalization by Pre- and Post-Time Since Diagnosis versus Time Since Infection in the Capital Health Region Over a Three-Year Period

Time Since Infection (Years))	Study Population	Pre- and Post-Time Since Diagnosis														
		0-12 Months Before Hepatitis C Diagnosis														
		Patient		Visit				LOS				Hospitalization Cost				
		#	%	Ave Vs/Pt	Std. Error	95% CI Lower	95% CI Upper	Ave LOS/Vs	Std. Error	95% CI Lower	95% CI Upper	Ave $/Pt	Std. Error	95% CI Lower	95% CI Upper	Total
Less than 10	199	39	19.6	1.3	0.10	1.1	1.5	9.5	1.9	5.7	13.3	$5,694	$1,303	$3,057	$8,332	$222,073
10 to 19	109	21	19.3	1.4	0.13	1.1	1.7	13.0	3.7	5.2	20.8	$6,373	$1,738	$2,748	$9,998	$133,830
20 or more	105	17	16.2	1.2	0.10	1.0	1.4	24.1	6.8	9.6	38.5	$10,416	$2,698	$4,697	$16,135	$177,079
Total	**413**	**77**	**18.6**	**1.3**	**0.07**	**1.2**	**1.4**	**13.7**	**2.1**	**9.4**	**17.9**	**$6,922**	**$1,016**	**$4,899**	**$8,945**	**$532,981**
		0-12 Months After Hepatitis C Diagnosis														
Less than 10	199	41	20.6	1.7	0.16	1.3	2.0	15.2	3.8	7.5	22.9	$7,925	$1,332	$5,233	$10,616	$324,908
10 to 19	109	23	21.1	1.4	0.19	1.1	1.8	14.6	4.6	5.1	24.2	$9,424	$3,199	$2,789	$16,059	$216,750
20 or more	105	11	10.5	1.6	0.31	0.9	2.2	18.6	10.5	0*	42.0	$12,005	$6,030	0**	$25,442	$132,060
Total	**413**	**75**	**18.2**	**1.6**	**0.11**	**1.4**	**1.8**	**15.5**	**2.9**	**9.7**	**21.3**	**$8,983**	**$1,485**	**$6,024**	**$11,942**	**$673,719**
		13-24 Months After Hepatitis C Diagnosis														
Less than 10	199	34	17.1	1.8	0.27	1.3	2.3	12.3	2.8	6.7	18.0	$6,438	$1,104	$4,192	$8,684	$218,886
10 to 19	109	13	11.9	1.6	0.27	1.0	2.2	8.0	1.8	4.1	11.9	$4,425	$832	$2,612	$6,237	$57,519
20 or more	105	7	6.7	1.1	0.14	0.8	1.5	43.4	32.5	0*	123.0	$16,143	$12,377	0**	$46,429	$113,001
Total	**413**	**54**	**13.1**	**1.7**	**0.18**	**1.3**	**2.0**	**15.3**	**4.6**	**6.1**	**24.5**	**$7,211**	**$1,732**	**$3,736**	**$10,686**	**$389,406**
		0-12 Months Before Plus 0-24 Months After Hepatitis C Diagnosis														
Less than 10	199	82	41.2	1.6	0.11	1.4	1.8	12.4	1.7	9.0	15.8	$6,718	$732	$5,269	$8,168	$765,867
10 to 19	109	37	33.9	1.5	0.11	1.2	1.7	12.5	2.3	7.8	17.2	$7,160	$1,458	$4,239	$10,080	$408,099
20 or more	105	25	23.8	1.3	0.11	1.1	1.5	26.2	7.8	10.4	42.0	$12,061	$3,251	$5,454	$18,668	$422,139
Total	**413**	**144**	**34.9**	**1.5**	**0.07**	**1.4**	**1.6**	**14.8**	**1.8**	**11.3**	**18.3**	**$7,748**	**$800**	**$6,170**	**$9,326**	**$1,596,106**

Sources:

Capital Health 1998 HCV data file
Capital Health 1998 HCV Survey
Alberta Health Hospital Inpatient Files (Morbidity file)

Abbreviations:

Ave Vs/Pt: Average Visits/Patient
Ave LOS/Vs: Average Length Of Stay/Visit
Ave $/Pt: Average Costs/Patient

Notes:

* LOS cannot be negative, thus LOS equals zero
** Cost cannot be negative, thus cost equal zero

Table 16: Average Costs per Patient for Physician Visits, Ambulatory Care, and Hospitalization of Hepatitis C Infection by Pre- and Post-Time Since Diagnosis versus Time Since Infection in the Capital Health Region Over a Three-Year Period

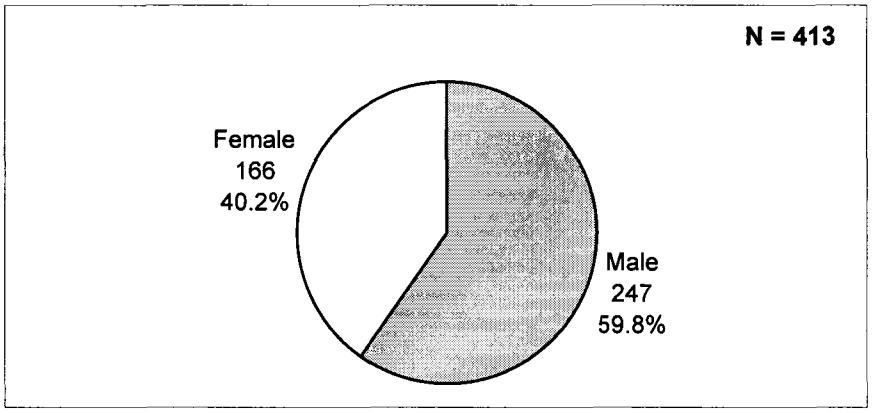
Time Since Infection (Years)	Age Group	Study Population	Pre- and Post-Time Since Diagnosis											
			0-12 Months Before Hepatitis C Diagnosis				0-12 Months After Hepatitis C Diagnosis				13-24 Months After Hepatitis C Diagnosis			
			CLAIMS	ACCS	MORB	Average	CLAIMS	ACCS	MORB	Average	CLAIMS	ACCS	MORB	Average
Less than 10	< 30	69	$440	$839	$4,747	$6,026	$690	$684	$4,738	$6,112	$850	$831	$6,343	$8,024
	30 - 49	114	$422	$807	$7,703	$8,932	$1,098	$974	$9,360	$11,431	$939	$896	$5,996	$7,832
	50+	16	$377	$530	$2,524	$3,431	$883	$925	$16,906	$18,714	$834	$573	$9,496	$10,903
	All ages	199	**$425**	**$798**	**$5,694**	**$6,917**	**$934**	**$870**	**$7,925**	**$9,729**	**$900**	**$853**	**$6,438**	**$8,191**
10 to 19	< 30	11	$337	$490	$2,032	$2,859	$1,155	$761	$10,007	$11,923	$530	$937	$4,768	$6,236
	30 - 49	82	$492	$843	$7,056	$8,390	$1,002	$1,016	$9,908	$11,926	$873	$1,233	$3,575	$5,682
	50+	16	$601	$1,724	$7,300	$9,625	$1,105	$1,815	$6,132	$9,052	$1,157	$1,015	$6,461	$8,634
	All ages	109	**$495**	**$948**	**$6,373**	**$7,816**	**$1,033**	**$1,074**	**$9,424**	**$11,531**	**$881**	**$1,158**	**$4,425**	**$6,464**
20 or more	< 30	0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	30 - 49	87	$519	$821	$13,223	$14,563	$1,027	$777	$6,919	$8,723	$785	$611	$21,415	$22,811
	50+	18	$605	$775	$6,407	$7,787	$1,425	$856	$25,570	$27,851	$699	$470	$2,962	$4,131
	All ages	105	**$534**	**$809**	**$10,416**	**$11,759**	**$1,095**	**$792**	**$12,005**	**$13,892**	**$771**	**$580**	**$16,143**	**$17,494**
Overall Average		413	**$471**	**$841**	**$6,922**	**$8,234**	**$1,002**	**$906**	**$8,983**	**$10,891**	**$862**	**$885**	**$7,211**	**$8,958**

Sources:
Capital Health 1998 HCV data file
Capital Health 1998 HCV Survey
Alberta Health Care Insurance Plan (AHCIP) Fee-For-Service (Claims file)
Alberta Health Ambulatory Care Classification System (ACCS file)
Alberta Health Hospital Inpatient (Morbidity file)

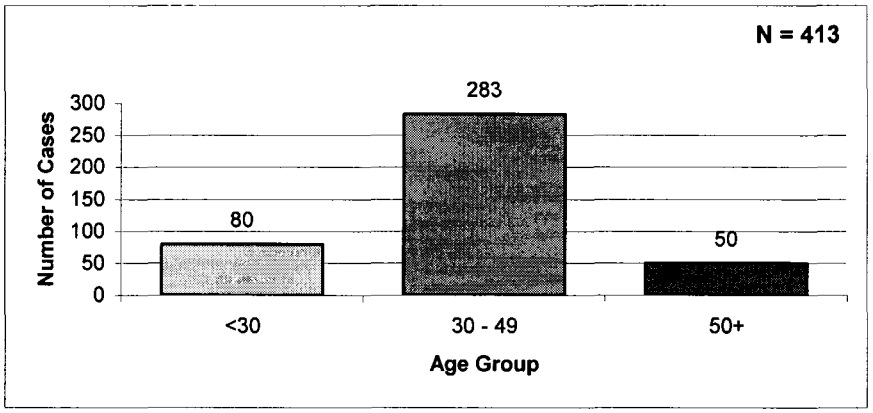
Abbreviations:
CLAIMS: Physician Visit Costs
ACCS: Ambulatory Care Costs
MORB: Hospital Inpatient Costs

Figure 1: Hepatitis C Study Population with "Known Year of Infection" in the Capital Health Region by Gender, Age Group and Time Since Infection, Alberta, 1998

Gender



Age group



Time since infection

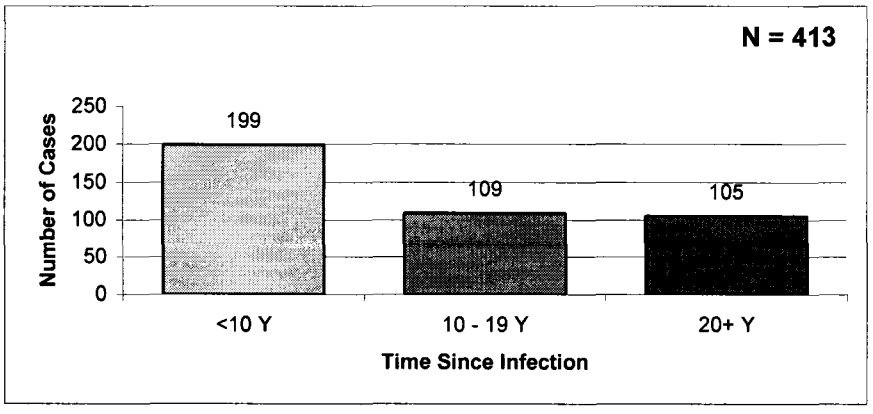


Figure 2: Self-Reported Time When Hepatitis C Infected by Gender in the Capital Health Region, Alberta, 1998

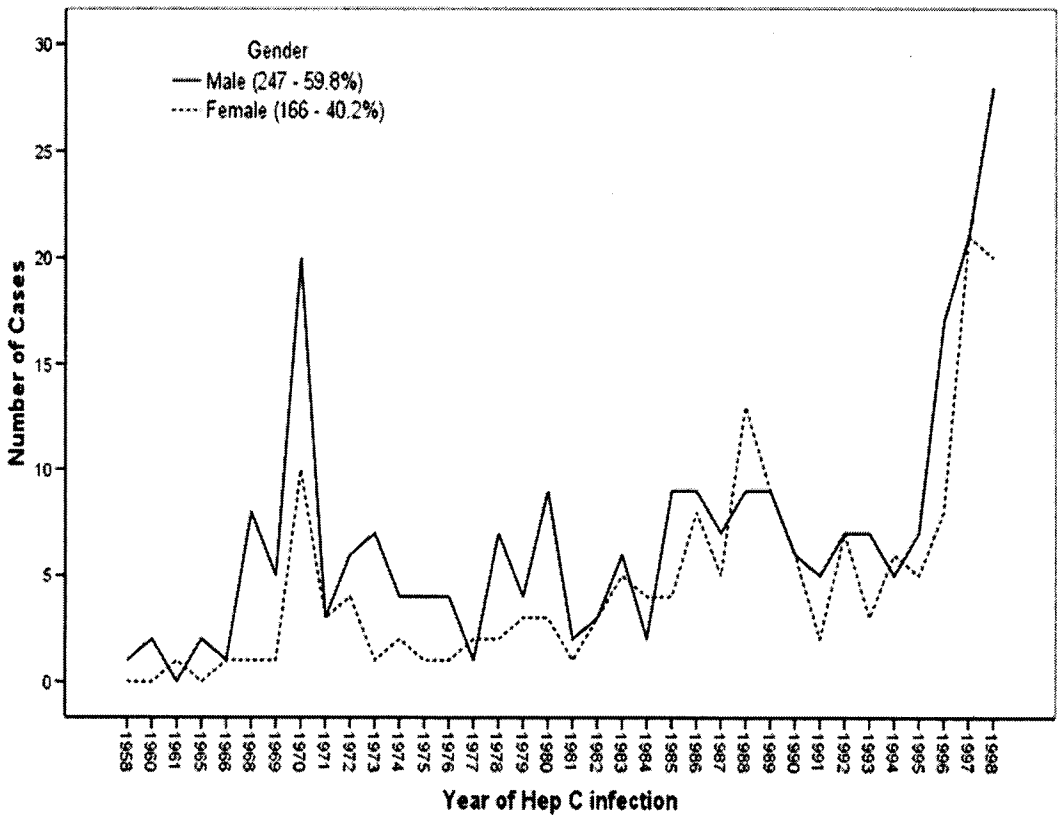
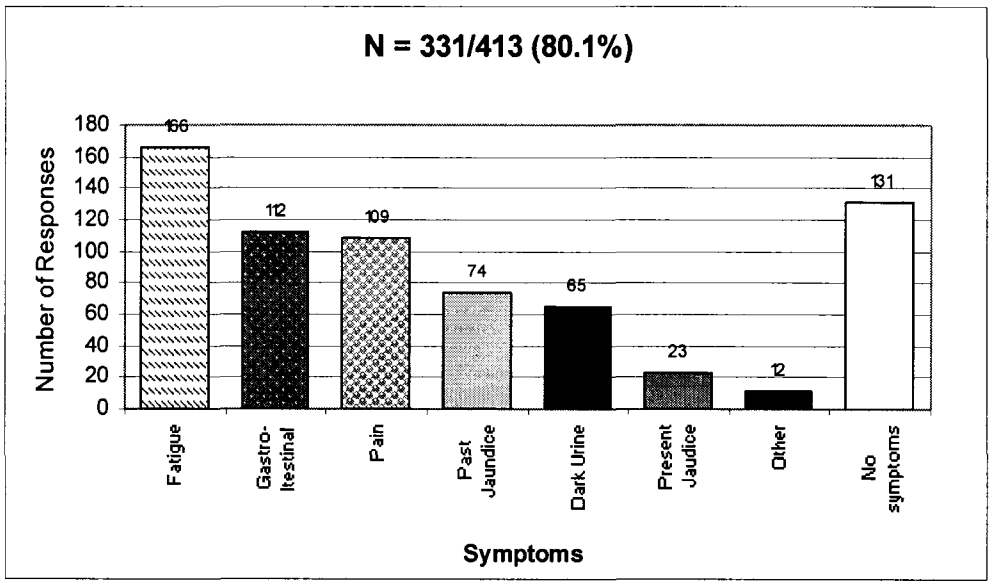


Figure 3: Hepatitis C Study Population With "Known Year of Infection" in the Capital Health Region by Symptom and Risk, Alberta, 1998

Symptoms



Risks

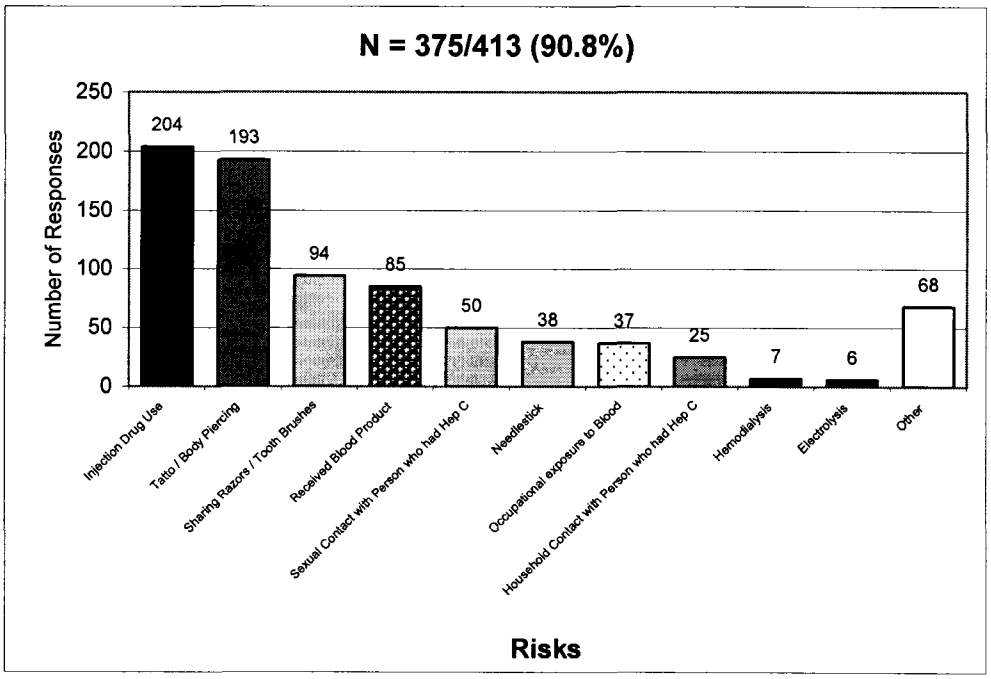
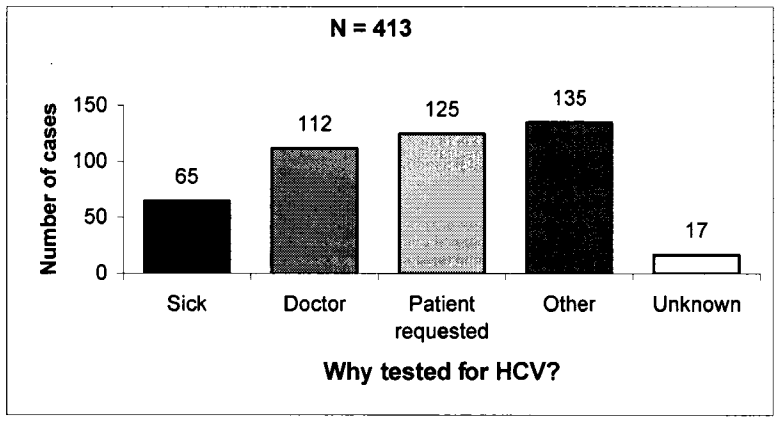
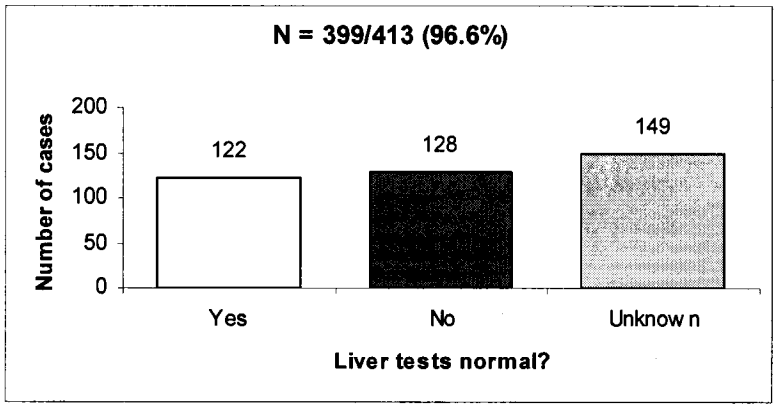


Figure 4: Hepatitis C Study Population With "Known Year of Infection" in the Capital Health Region by Tests for HCV, Liver, Biopsy, HBV and HIV, Alberta, 1998

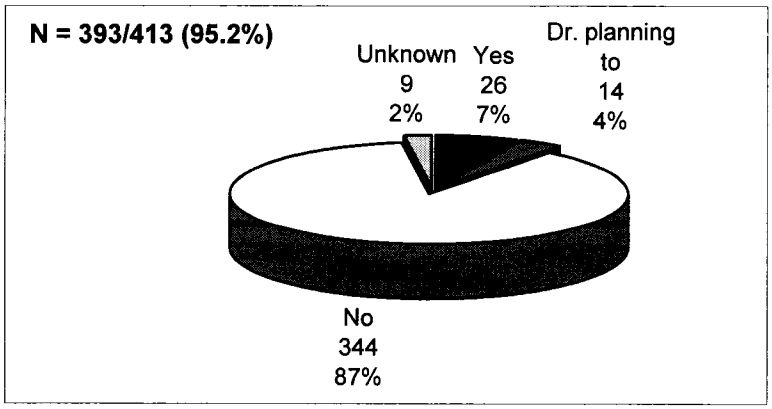
Why tested for HCV?



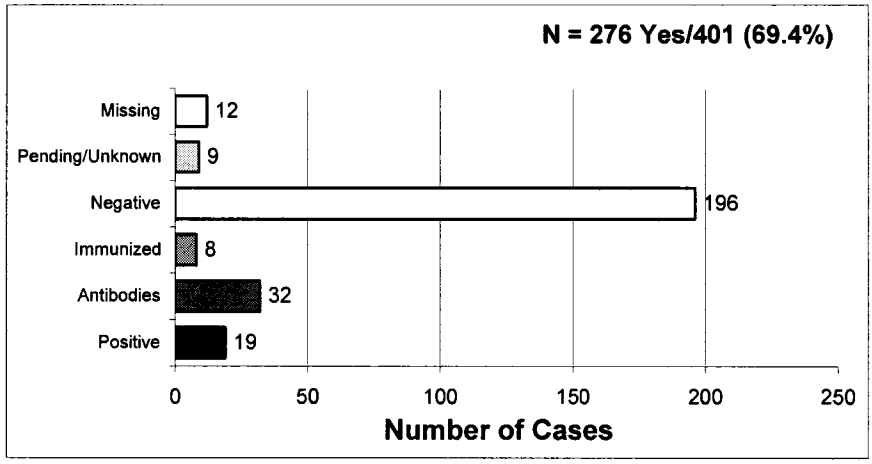
Liver test normal



Have had liver test biopsy?



Been tested for HBV and Result



Been tested for HIV and Result

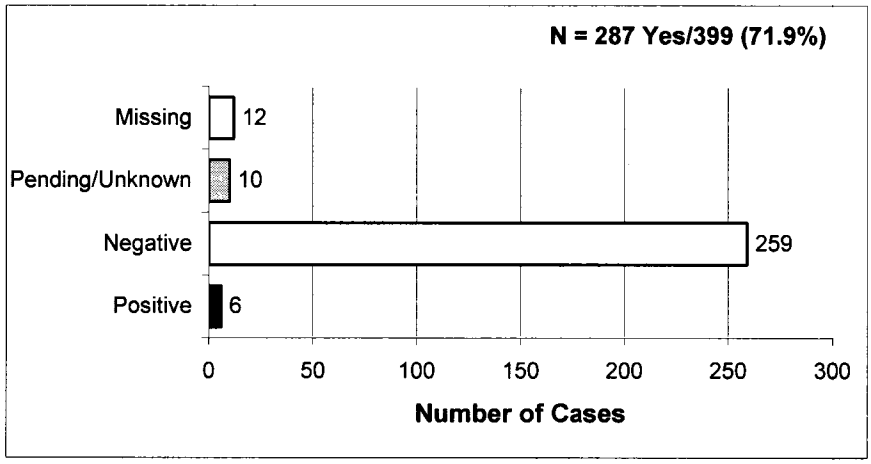
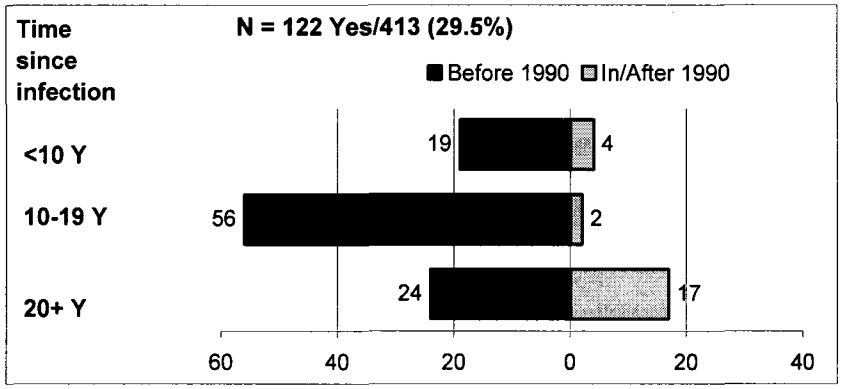
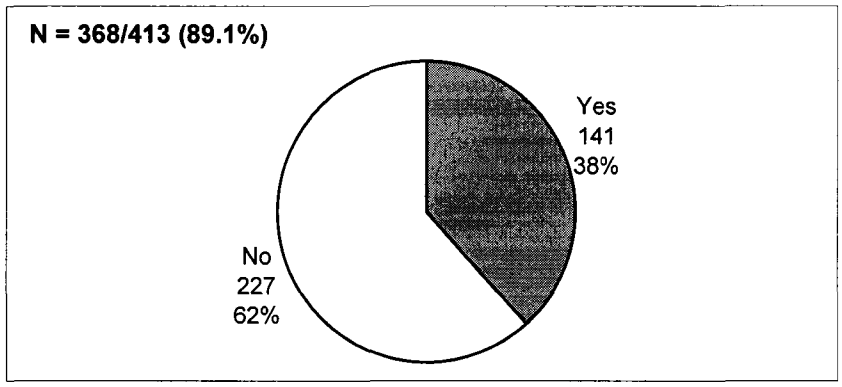


Figure 5: Hepatitis C Study Population With "Known Year of Infection" in the Capital Health Region by Blood Transfusion, History of STD, Natural Sexual Relationship, IDU, and Stopped IDU, Alberta,

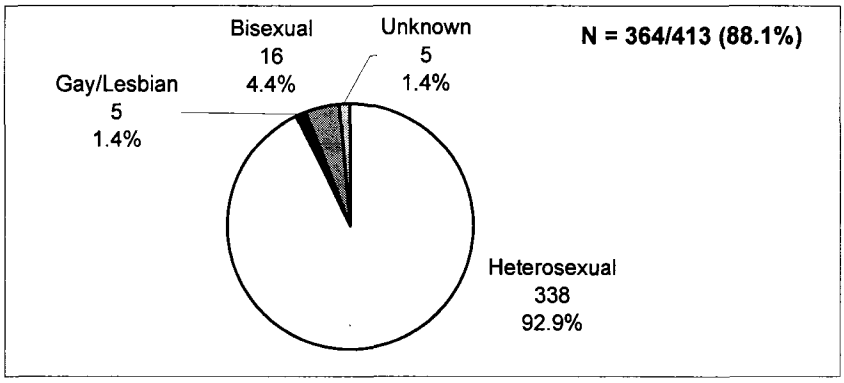
Blood transfusion time



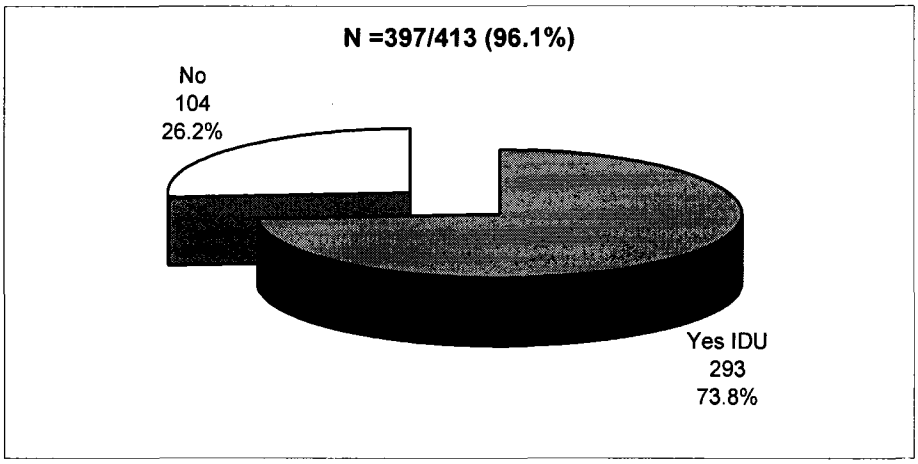
History of STD



Natural sexual relationship



Ever done IDU



Stopped IDU

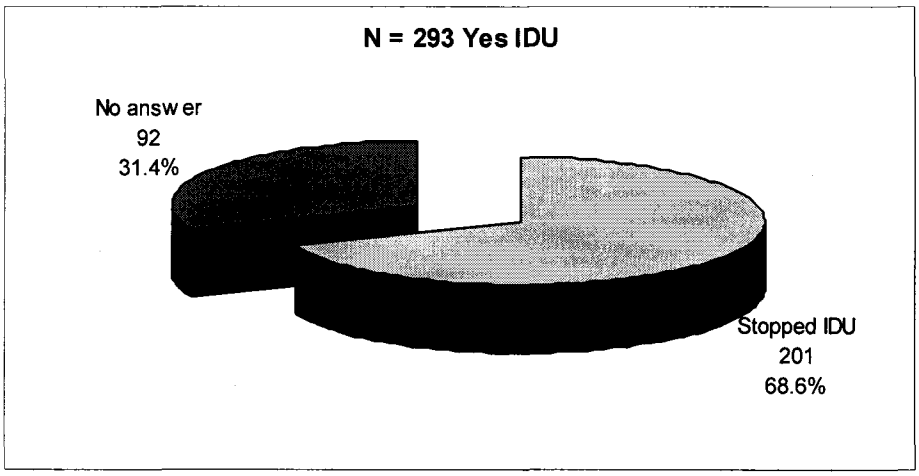


Figure 6: Data Required from Alberta Health and Wellness for a Three-Year Period for Patients Diagnosed with Hepatitis C in the Capital Health Region, Alberta,

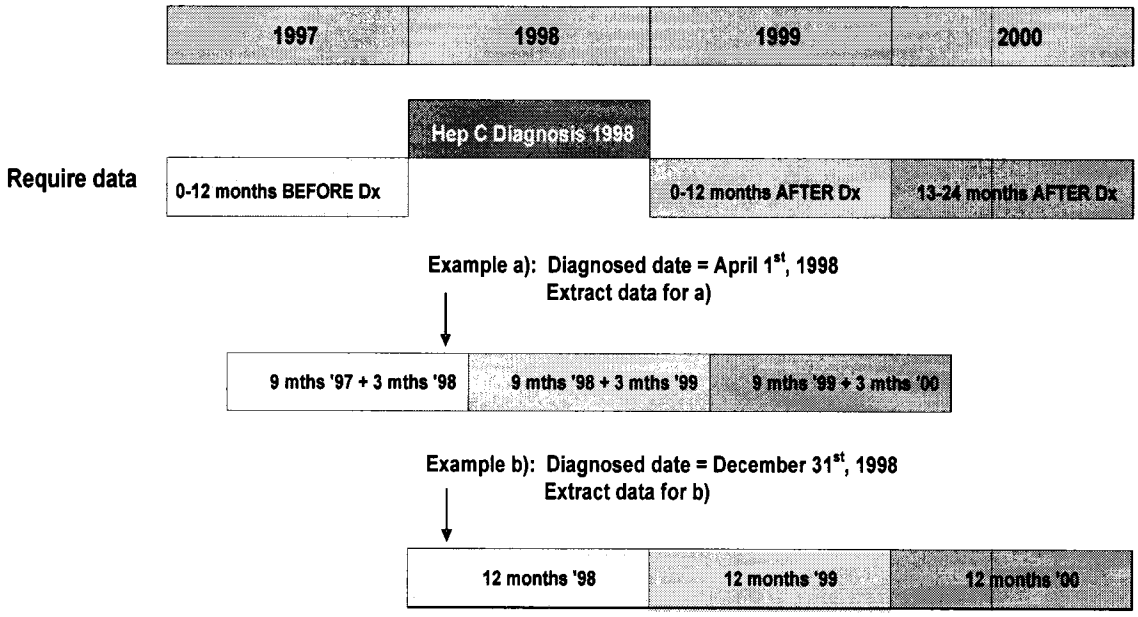
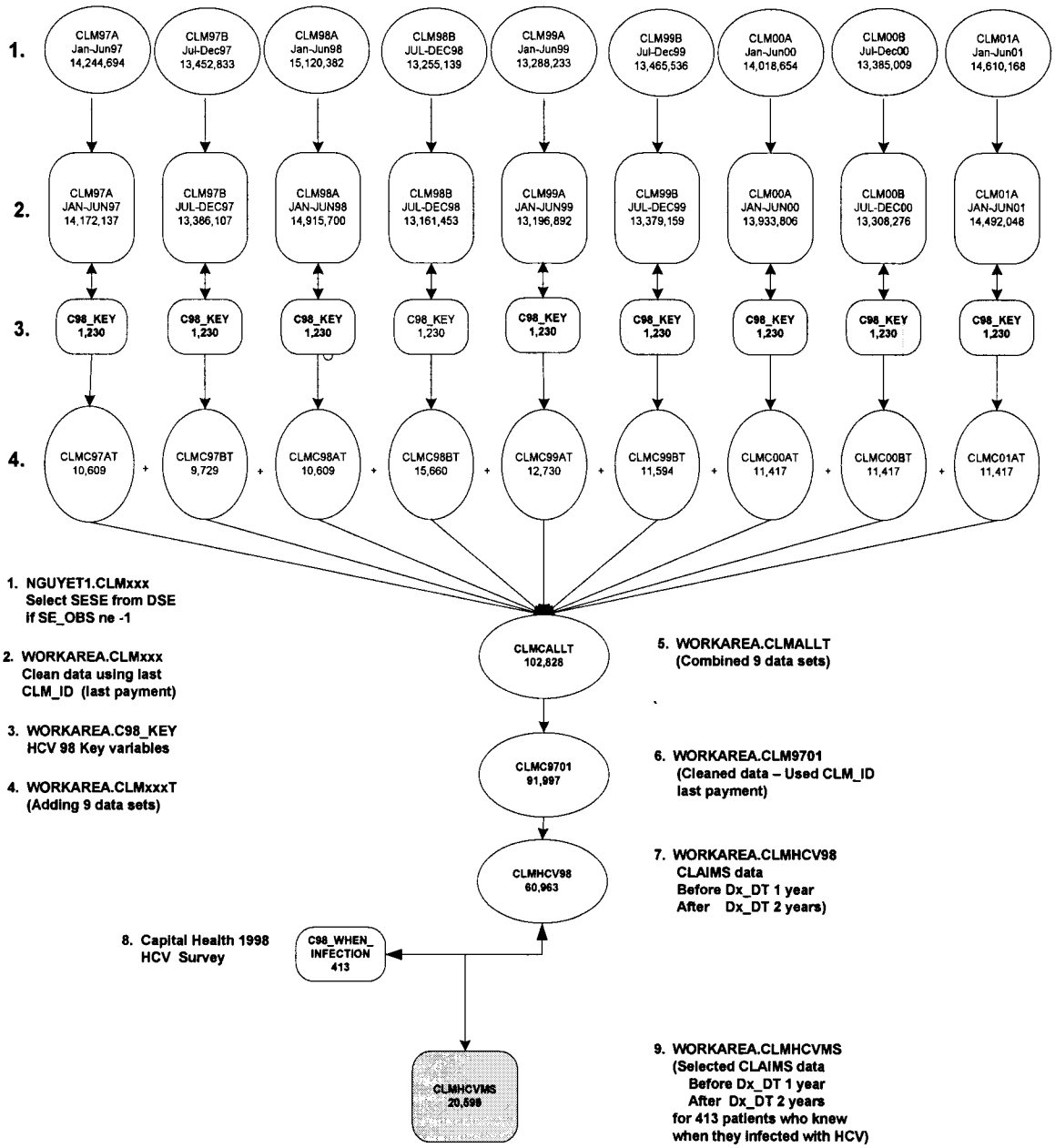


Figure 7: Physician Visit Data for a Three-Year Period for Patients Diagnosed with Hepatitis C in the Capital Health Region, Alberta



Source:
- Capital Health 1998 HCV data file
- Capital Health 1998 HCV survey
- Alberta Health Care Insurance Plan (AHCIP) Fee-For Service (Claims file)

Figure 8: Ambulatory Care Visit Data for a Three-Year Period for Patients Diagnosed with Hepatitis C in the Capital Health Region, Alberta

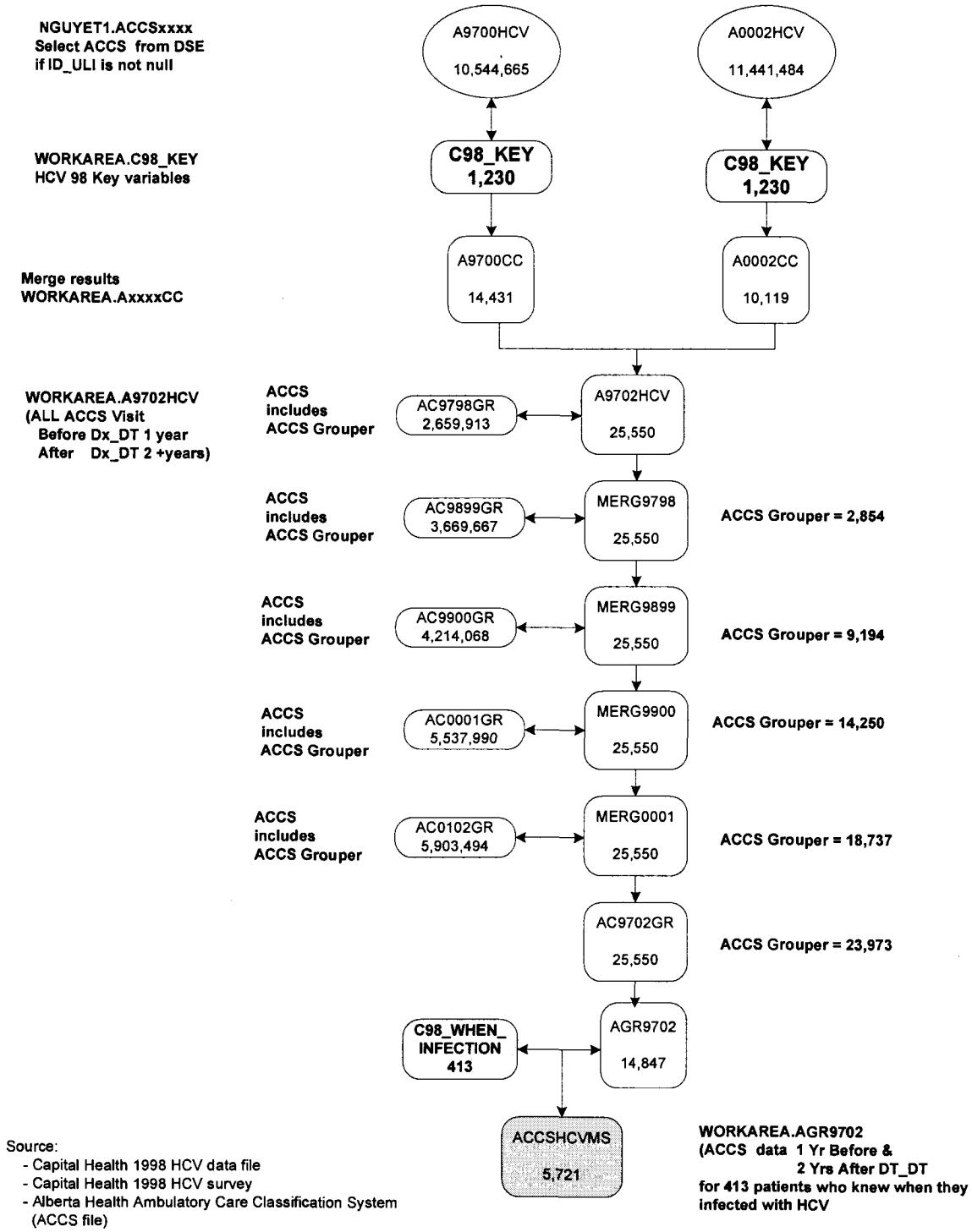
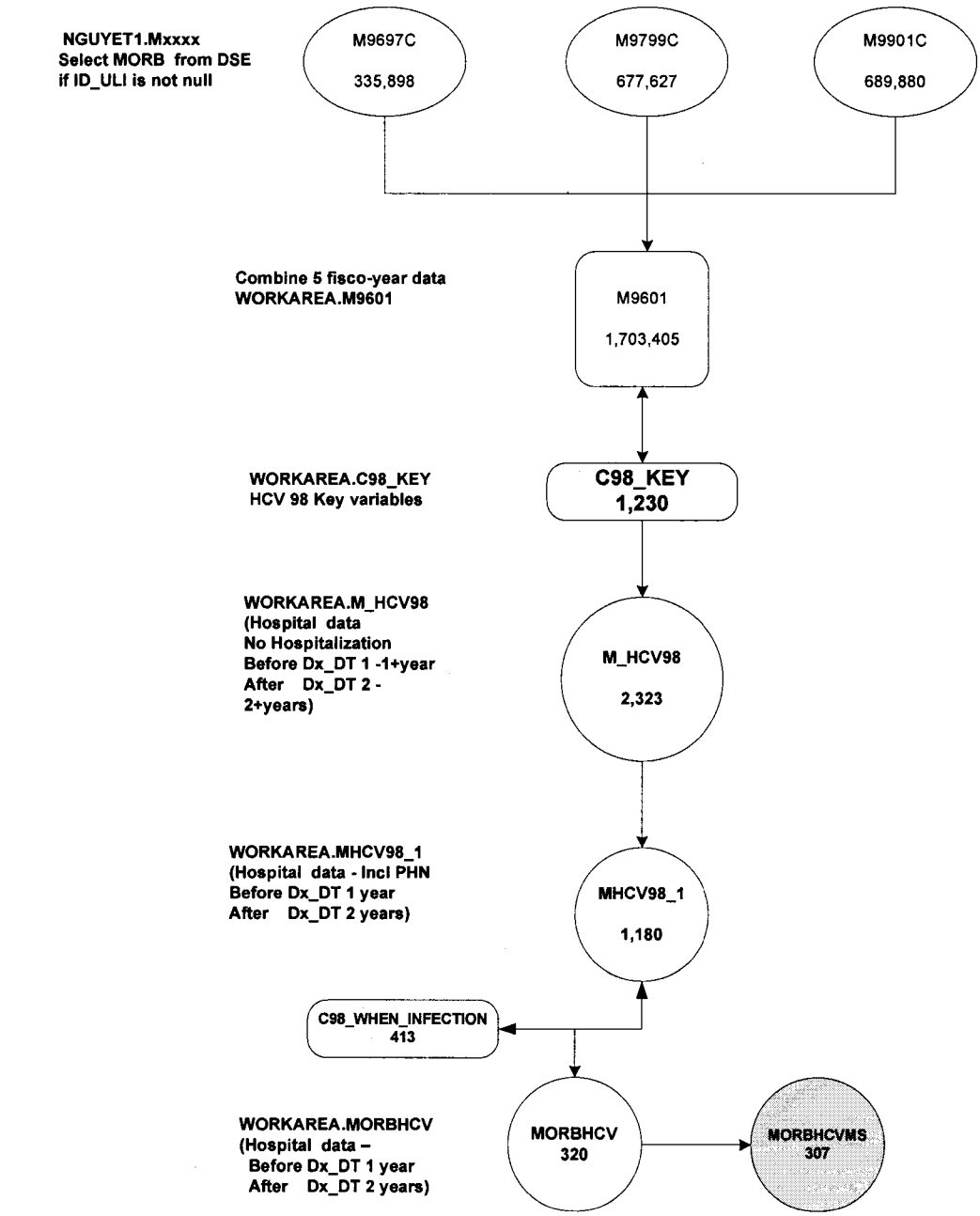


Figure 9: Hospital Inpatient Data for a Three-Year Period for Patients Diagnosed with Hepatitis C in the Capital Health Region, Alberta



Source:
- Capital Health 1998 HCV data file
- Capital Health 1998 HCV survey
- Alberta Health Hospital Inpatient Files (Morbidity file)

Figure 10: Overall Data Processing for a Three-Year Period for Patients Diagnosed with Hepatitis C in the Capital Health Region, Alberta

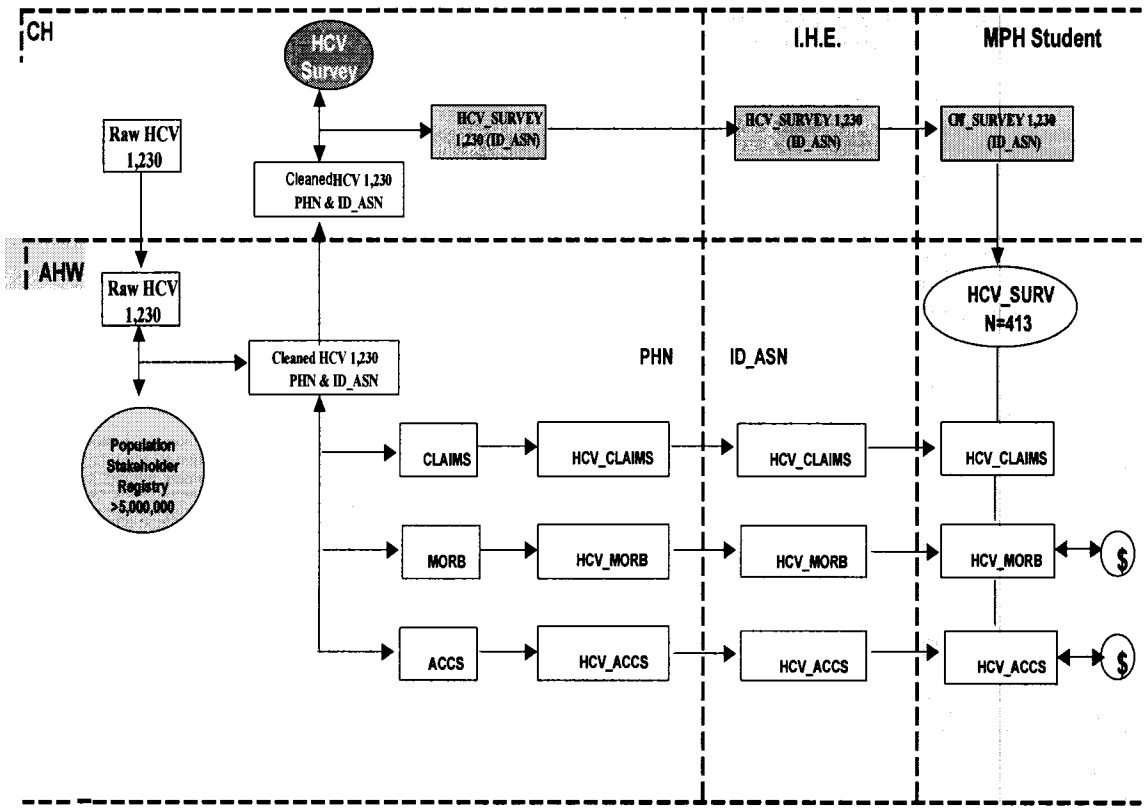


Figure 11: Number of Hepatitis C Infected Person by Health Service Utilization Used in the Capital Health Region Over a Three-Year Period

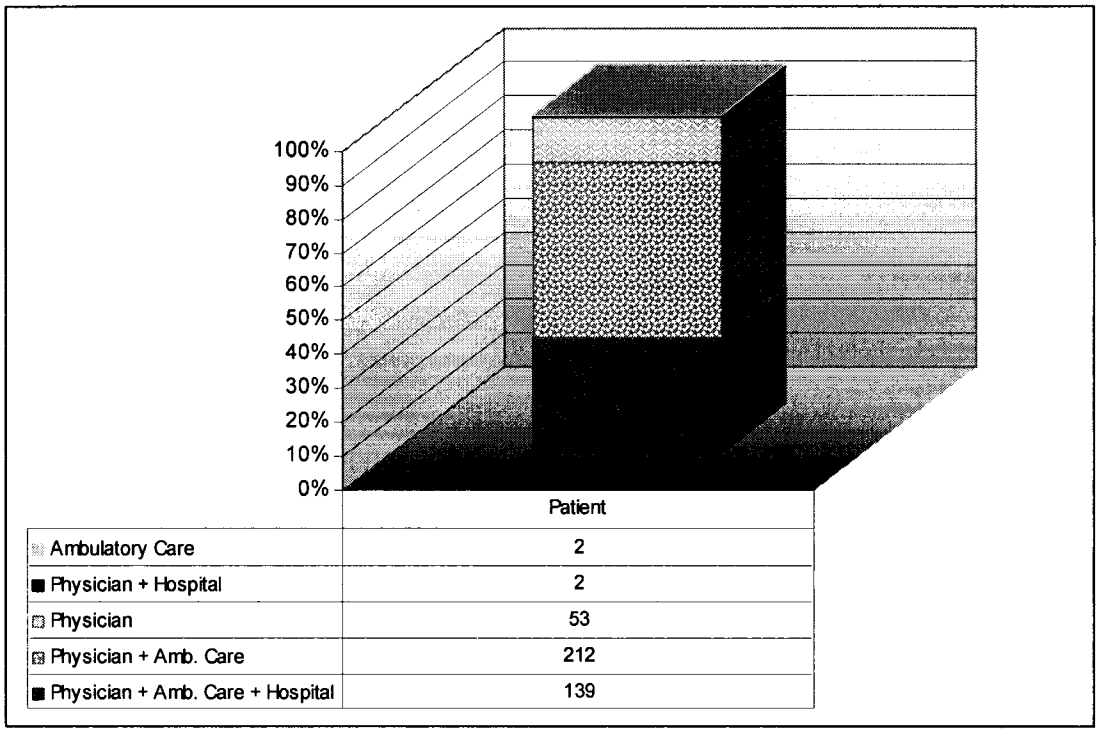
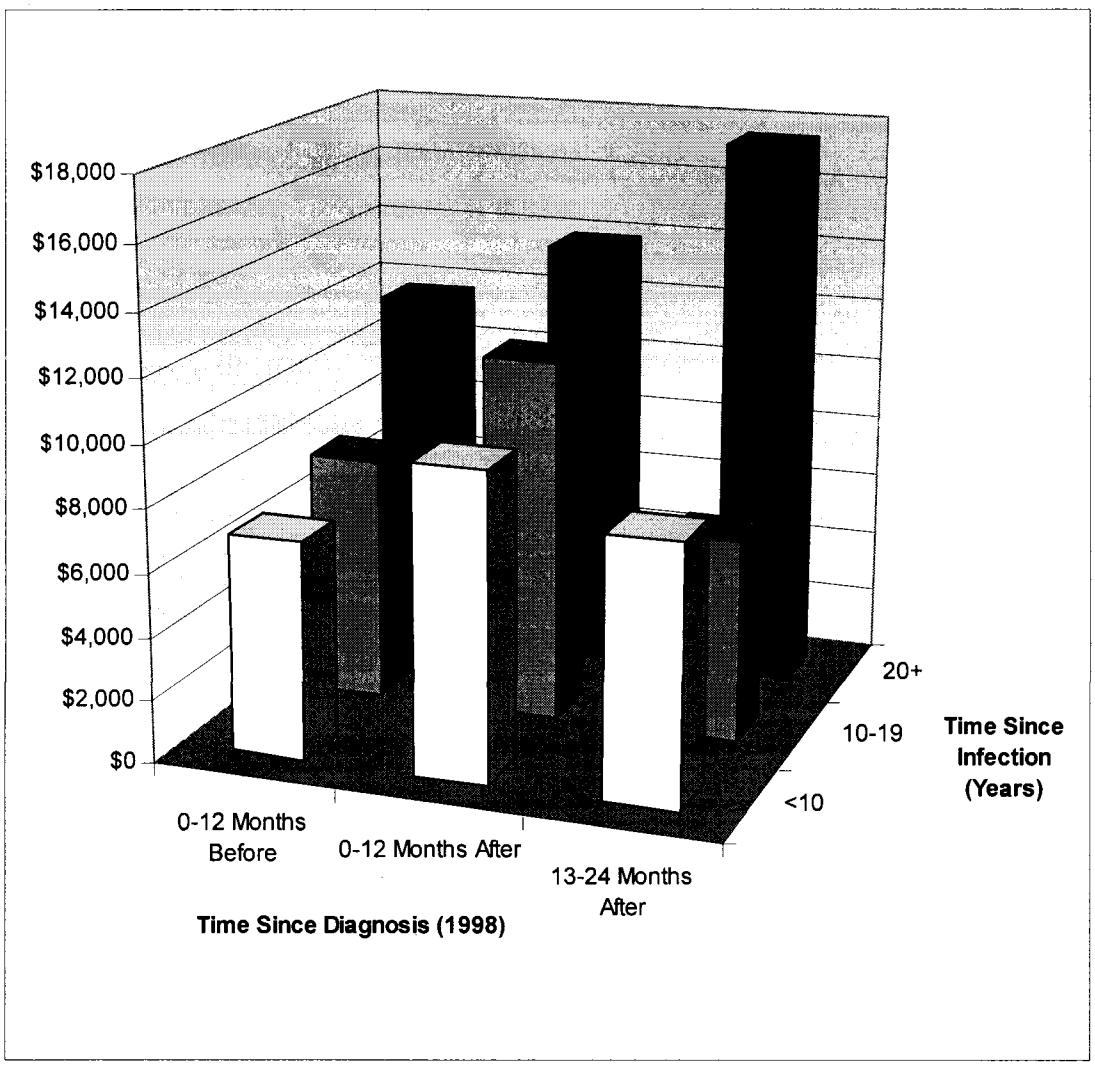


Figure 12: Average Cost per Hepatitis C Infected Person for Health Service Utilization Used by Pre- and Post-Time Since Diagnosis versus Time Since Infection in the Capital Health Region Over a Three-Year Period



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APPENDIX

Appendix A: HBV-HCV Survey Questionnaire

Health
Canada Logo

Enhanced Hepatitis Strain Surveillance System

Please fill out this questionnaire by recording the answer in the space provided or circling one of the choices listed for each question.

I. Site Specific Demographics:

Site: _____

Date Tested: _____

Patient Information

Last Name: _____

First Name: _____

Gender: □ Male □ Female

Date of Birth: _____

Parent or Guardian Name (if applicable):_____

Patient's Primary Ethnic Group: _____

Where was the Patient Born? _____

If born outside of Canada, the year the patient came to Canada: _____

Street Address: _____

City/Town: _____

Province: _____

Postal Code: _____

Primary Phone Number: (_____) _____

Other Phone Number: (_____) _____

PHN: _____

Consent to HC Study □

Laboratory and Physician Data:

Physician Surname: _____

Initials: _____

City: _____

Province: _____

Laboratory Name: _____

Specimen Number: _____

Current Laboratory & Clinical Results:

Anti-HAV IgM:	□ Negative	□ Positive	□ Indeterminate	□ Unknown
	Date: _____ (yyyy/mm/dd)			
Anti-HAV total	□ Negative	□ Positive	□ Indeterminate	□ Unknown
	Date: _____ (yyyy/mm/dd)			

HBsAg: □ Negative □ Positive □ Indeterminate □ Unknown
Date: _____ (yyyy/mm/dd)

Anti-HBc IgM: □ Negative □ Positive □ Indeterminate □ Unknown
Date: _____ (yyyy/mm/dd)

Anti-HBc: □ Negative □ Positive □ Indeterminate □ Unknown
Date: _____ (yyyy/mm/dd)

Anti-HBVs: □ Negative □ Positive □ Indeterminate □ Unknown
Date: _____ (yyyy/mm/dd)

HBeAg: □ Negative □ Positive □ Indeterminate □ Unknown
Date: _____ (yyyy/mm/dd)

Anti-HCV: □ Negative □ Positive □ Indeterminate □ Unknown
Date: _____ (yyyy/mm/dd)

HCV RNA: □ Negative □ Positive □ Indeterminate □ Unknown
Date: _____ (yyyy/mm/dd)

Symptoms: □ **Yes** □ **No** □ **Unknown**

Date of Symptom Onset: _____ (yyyy/mm/dd)

Nausea: □ Yes □ No □ Unknown
Malaise: □ Yes □ No □ Unknown
Fatigue: □ Yes □ No □ Unknown
Loss of Appetite: □ Yes □ No □ Unknown
Dark Urine: □ Yes □ No □ Unknown
Abdominal Discomfort: □ Yes □ No □ Unknown
Clinical Jaundice: □ Yes □ No □ Unknown

Were liver enzymes tested? □ Yes □ No □ Unknown
Liver Enzymes (AST or ALT) > 2.5 times upper limit of normal: □ Yes □ No □ Unknown

AST Value: _____ Date: _____
ALT Value: _____ Date: _____

Past Laboratory & Clinical Results

Had this person been tested for Hepatitis B Previously? □ Yes □ No □ Unknown

If yes, HBsAg: □ Negative □ Positive □ Indeterminate □ Unknown
Date: _____ (yyyy/mm/dd)

If yes, anti-HBc: □ Negative □ Positive □ Indeterminate □ Unknown
Date: _____ (yyyy/mm/dd)

If yes, anti-HBs: □ Negative □ Positive □ Indeterminate □ Unknown
Date: _____ (yyyy/mm/dd)

What was the source of this test information? ◻ **Patient** ◻ **Physician** ◻ **Lab**

What was the location the test took place (e.g. city, province)? _____

Had this person been tested for Hepatitis C previously? ◻ Yes ◻ No ◻ Unknown
If yes, anti-HCV test result: ◻ Positive ◻ Negative ◻ Unknown
Date: _____

What was the source of this test information? ◻ **Patient** ◻ **Physician** ◻ **Lab**

What was the location the test took place (e.g. city, province)? _____

Has the patient ever been tested for HIV? ◻ Yes ◻ No ◻ Unknown
Has the patient ever donated blood? ◻ Yes ◻ No ◻ Unknown

If yes:
When? _____ City _____ Province_____
(yyyy/mm/dd)
When? _____ City_____ Province_____
(yyyy/mm/dd)
When? _____ City_____ Province_____
(yyyy/mm/dd)

Epidemiological Data: Hepatitis B:

Was there anyone in the patient's household who had Hep. B, was a carrier of the Hep. B Virus, or was an IDU?
◻ Yes ◻ No ◻ Unknown

If yes, was patient Hep. B positive, Hep. B carrier, or IDU? (select appropriate box)
◻ Hep. B positive ◻ Hep. B positive & IDU
◻ Hep. B Virus carrie ◻ Hep. B Virus carrier & IDU ◻ IDU ~ Unknown
If yes, relation of that person to the patient:
◻ Spouse/partner ◻ Mother ◻ Father ◻ Sibling ◻ Children
◻ Grandparent ◻ Other ◻ Unknown

Was the patient born to a Hepatitis B-infected mother? ◻ Yes ◻ No ◻ Unknown
If yes, did the infant receive prophylactic HBIg? ◻ Yes ◻ No ◻ Unknown

Epidemiological Data: Hepatitis C:

Was there anyone in the patient's household who had the Hep. C Virus, or was an IDU?
◻ Yes ◻ No ◻ Unknown

If Yes, was patient Hep. C positive or IDU? ◻ Hep. C positive ◻ Hep. C positive & IDU
◻ IDU ◻ Unknown

If Yes, relation of that person to the patient:

□ Spouse/partner □ Mother □ Father □ Sibling □ Children
□ Grandparent □ Other □ Unknown

Was the patient born to a Hepatitis C-infected mother? □ Yes □ No □ Unknown
If yes, has confirmatory testing **been performed on the infant?** □ Yes □ No □ Unknown

If yes, test results: □ anti-HCV positive □ PCR positive □ PCR negative □ Indeterminate
Test Date: _____
(yyyy/mm/dd)

Risk Factors

□ Is the case a member of a high risk patient population (e.g. blood disorder)? □ Yes □ No □ Unknown

		Last 6 Months	**Ever**
□ Transplant:		□	□
Organ (e.g. heart)	Specify: Type_____ When_____ (mm/yyyy)		
Tissue (e.g. bone)	Specify: Type_____ When_____ (mm/yyyy)		
Cell (e.g. bone marrow)	Specify: Type_____ When_____ (mm/yyyy)		
Other (e.g. assisted reproduction)	Specify: Type_____ When_____ (mm/yyyy)		
□ Blood transfusion:		□	□ Before 1990 □ 1990 to present □ Both
□ Blood product (e.g. clotting factors, immune globulin, albumin):		□	□
□ Surgery		□	□
□ Dental Surgery (e.g. Tooth extractions, root canals)		□	□
□ Hemodialysis		□	□
□ Endoscopy		□	□
□ Acupuncture		□	□
□ Other medical procedures (e.g. EEG)		□	□
	Specify: Type_____ When_____ (mm/yyyy)		
□ Body Piercing (including ear)		□	□
	Number of times (1,2,3,...10, >10, or unknown)	_____ number	_____ number
□ Tattooing		□	□
	Number of times (1,2,3,...10, >10, or unknown)	_____ number	_____ number
□ Other percutaneous exposure (e.g. electrolysis)		□	□

	Last 6 Months	Ever
□ Injection Drug Use	□	□
Did you share needle, syringe or other material used for injecting (e.g. cooker, cotton) with others?	□ yes □ no	□ yes □ no
How many partners did you share with?	_____ number	_____ number
How long have you been injecting? (only once, <1 month, 1,2,...6)	_____ Months	_____ years
□ Non-injection drug use	□	□
Did you share a straw or other device(s) used for snorting with others?	□ yes □ no	□ yes □ no
How many partners did you share with?	_____ number	_____ number
Did you share a crack-pipe or other device(s) with others?	□ yes □ no	□ yes □ no
How many partners did you share with?	_____ number	_____ number
□ Heterosexual activity	□	□
How many partners? (1,2,..., unknown)	_____ number	_____ number
□ Homosexual activity	□	□
How many partners (1,2,..., unknown)	_____ Number	_____ number
□ Known sexual contact with HBV/HCV positive person or IDU	□ HBV(+)	□ HBV(+)
	□ HCV(+)	□ HCV(+)
	□ IDU	□ IDU
	□ HBV(+) & IDU	□ HBV(+) & IDU
	□ HCV(+) & IDU	□ HCV(+) & IDU
□ Occupational Exposure (e.g. Health Care Worker)		
Field: Health Care Worker	□	□
Dental	□	□
Other	□	□
□ Incarceration in prison or jail	□	□
□ Engaged in any of above risk factors while in prison or jail? (e.g. IDU, tattooing, piercing)	□	□
Which activities? (IDU, tattooing, piercing)	□ IDU	□ IDU
	□ tattooing	□ tattooing
	□ piercing	□ piercing
	□ tattooing&piercing	□ tattooing&piercing
	□ IDU & tattooing	□ IDU & tattooing
	□ IDU & piercing	□ IDU & piercing
	□ all	□ all

	Last 6 Months	Ever
□ Association with an institution other than a prison/jail?	□	□
(e.g. psychiatric hospital, group or retirement home)		
As patient/resident or employee? (Circle one)	patient Resident employee	patient resident employee
Did you share personal hygiene products while at the institution?	□ Yes	□ Yes
(e.g.disposable razor, electric razor, toothbrush, nail clippers)	□ No	□ No
If yes, what did you share?	□ disposable razor	□ disposable razor
	□ electric razor	□ electric razor
	□ toothbrush	□ toothbrush
	□ nail clippers	□ nail clippers
	□ more than one	□ more than one
□ Other possibly sources of infection	□	□

Describe other possible sources of infection:_____

_____

_____

_____

_____

History of Hepatitis A Vaccination

Has the patient ever received vaccination for Hepatitis A? □ Yes □ No □ Unknown

Number of Doses received: _____ (1,2,3)

Year of last dose: _____ (yyyy)

History of Hepatitis B Vaccination

Has the patient ever received vaccination for Hepatitis B? □ Yes □ No □ Unknown

If yes, number of vaccine doses received?: _____ (1,2,3)

Year most recent dose was given : _____ (yyyy)

Has the patient ever received HBIg? □ Yes □ No □ Unknown

If Yes, Date: _____ (yyyy/mm/dd)

Was this a combination Vaccine? (e.g. Twinrix) □ Yes □ No □ Unknown

History of Therapy

Has the patient ever received therapy for Hepatitis B? □ Yes □ No □ Unknown

Has the patient ever received therapy for Hepatitis C? □ Yes □ No □ Unknown

Diagnosis and Comments

	Acute	Chronic	Indeterminate
Hepatitis B:	□	□	□
Hepatitis C:	□	□	□

Diagnosis comments:_____

_____

_____

_____

_____.

Date Reported to Health Unit: _____
(yyyy/mm/dd)

Was the Patient interviewed? □ Yes □ No

If no, why not? □ Refused □ Unable to locate □ Other
□ Died □ Non-case
□ From endemic area □ Language barrier

Interviewer name: _____ Interview date: _____
(yyyy/mm/dd)

Case entered by: _____