Australian National Council on AIDS, Hepatitis C and Related Diseases

Hepatitis C Sub-Committee

Hepatitis C Virus Projections Working Group:

Estimates and Projections of the Hepatitis C Virus Epidemic in Australia 2002

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CONTENTS

Page

SUMMARY 1

1.0 INTRODUCTION 2
1.1 Objectives 2
1.2 Working procedures 2

2.0 REVIEW OF DATA SOURCES ON HCV IN AUSTRALIA 3
2.1 National surveillance 3
2.2 Risk factors for HCV infection 3
2.3 Prevalence and incidence of HCV in injecting drug users 4
2.4 Prevalence and incidence of HCV in other populations 4
2.4.1 HCV in prisons 5
2.5 HCV genotype prevalence rates 5

3.0 NATURAL HISTORY OF HCV INFECTION 6
3.1 Long-term sequelae following HCV infections 6

4.0 ESTIMATES AND PROJECTIONS OF HCV IN AUSTRALIA 6
4.1 Modelling the HCV epidemic in Australia 6
4.1.1 Estimating the number of injecting drug users in Australia 6
4.1.2 Modelling assumptions 7
4.1.3 Modelled estimates of HCV prevalence and incidence in 2001 9
4.2 Estimates and projections of long-term sequelae of HCV infection 10
4.2.1 Rates of progression 10
4.2.2 Modelled estimates of number of people living with HCV-infection by stage of disease 11
4.2.3 Estimates of HCV incidence and number of people living with HCV infection by State/Territory 11
4.2.4 Short-term projections of HCV prevalence and incidence 11
4.2.5 Long-term projections of number of people living with HCV 12
4.2.6 Modelled estimates of long-term sequelae of HCV infection 12
4.3 Loss of quality of life associated with HCV infection 13
4.3.1. Estimates of reduced QALYs associated with HCV infection 14

5.0 COMPARISON WITH 1998 REPORT FINDINGS 15

6.0 RECOMMENDATIONS 16

Page

TABLES
Table 1. Risk factors for HCV in Australia 17
Table 2. Prevalence of HCV antibody among populations of IDUs in Australia 18
Table 3. Incidence of HCV among injecting drug users in Australia 19
Table 4. Prevalence of HCV antibody among populations other than IDUs in Australia 20
Table 5. HCV genotype prevalence rates in Australia 21
Table 6. Estimated number of injecting drug users and dependent heroin users in Australia 22
Table 7. Rates of liver disease progression 23
Table 8. Estimates of HCV incidence and prevalence in 2001 by State/Territory 24
Table 9. Estimated quality of life years lost to HCV-infection in Australia in 2001 by stage of liver disease 25

FIGURES
Figure 1. Modelled estimates of heroin dependent IDUs 1961 to 2001 26
Figure 2. Modelled numbers of regular and occasional IDUs 1961 to 2001 27
Figure 3. Modelled HCV incidence 1961 to 2001 28
Figure 4. Estimated number of people living with HCV by stage of disease 1961 to 2001 29
Figure 5a. Estimated number of people living with HCV-related cirrhosis 1990 to 2020 30
Figure 5b. Estimated annual number of HCV-related liver failures 1990 to 2020 31
Figure 5c. Estimated annual HCV-related cases of HCC 1990 to 2020 32
Figure 5d. Cumulative HCV-related mortality 1990 to 2020 33

REFERENCES 34

APPENDIX 1. Hepatitis C Virus Projections Working Group 39

SUMMARY

In Australia to the end of 2000, over 160,000 diagnoses of hepatitis C virus (HCV) were reported to State and Territory surveillance systems. Of annual total notifications to the National Notifiable Diseases Surveillance System between 1991 and 2000, around 65% of HCV diagnoses were in the age range 20-39, with approximately 35% of all diagnoses in women.

Studies of HCV risk factors in Australia indicate that the vast majority, around 80%, of prevalent HCV infections were through injecting drug use. In injecting drugs users (IDUs), HCV prevalence ranged from 50% to 70% since the early 1970s. HCV incidence among IDUs in the 1980s and early 1990s has been estimated to be around 15% per year, with some evidence of a decline in HCV incidence in the late 1980s, but stable during the mid-to late-1990s.

Among people who develop HCV antibodies following exposure to HCV, around 75% develop chronic infection, remaining infectious and at risk of long-term sequelae of their infection. A previous systematic review of published studies estimated that of all people chronically infected with HCV, around 7% would develop cirrhosis after 20 years following exposure. Rates of liver failure and hepatocellular carcinoma (HCC) following cirrhosis were taken to be 4% and 1% per annum respectively.

A mathematical model of the HCV epidemic in Australia estimated that there were around 210,000 people living with HCV antibodies in Australia in 2001 (plausible range 157,000 to 252,000). HCV incidence in 2001 was estimated to be 16,000 new infections (11,000 to 19,000), 91% of whom were exposed through injecting drugs.

Of all people living with HCV antibodies in Australia at the end of 2001, it was estimated that:

- 53,000 (39,000 to 64,000) had cleared their HCV infection
- 124,000 (92,000 to 149,000) had chronic HCV infection and stage 0/1 liver disease
- 27,000 (20,000 to 32,000) had chronic HCV infection and stage 2/3 liver disease
- 6,500 (5,000 to 8,000) were living with HCV-related cirrhosis

During 2001 it was estimated that:

- 175 (130 to 210) people developed HCV-related liver failures
- 50 (40 to 60) people developed HCV-related HCC

Since the beginning of the HCV epidemic in Australia it was estimated that there had been 1,000 (750 to 1,200) cumulative HCV-related deaths

Projections of the number of people living with HCV are highly uncertain, but are likely to be between 321,000 and 836,000 people in 2020 depending on future patterns of injecting drug use. Projections of the number of people living with HCV-related cirrhosis, incident cases of liver failure and HCC, and cumulative numbers of HCV-related deaths were all projected to at least treble by 2020.

HCV-related morbidity was estimated to be substantial, corresponding to a total of 22,500 quality adjusted life years (QALYs) lost during 2001, with the majority of QALYs lost in people with stage 0/1 (77% lost) or stage 2/3 (18% lost) chronic HCV-infection.

1.0 INTRODUCTION

To plan an appropriate public health response to the hepatitis C virus (HCV) epidemic in Australia, both in terms of preventive measures and treatment needs, good estimates and projections of the rates of HCV infection and its long term sequelae are required. To achieve this, the Hepatitis C Virus Projections Working Group was formed in 1998 under the auspices of, and reporting to, the Australian National Council on AIDS and Related Diseases (ANCARD) Hepatitis C Sub-Committee. This working group produced its final report in August 1998 (HCVPWG 1998; Law et al, 1999).

Following the report of the initial working group, further developments in understanding of injecting drug use and the HCV epidemic in Australia have been made. At the same time, knowledge of the natural history of HCV infection has been refined and improved. These developments meant that a second round of HCV estimates and projections, refining previous estimates in light of new data surrounding the HCV epidemic in Australia, were timely. A second Hepatitis C Virus Projections Working Group was therefore formed under the auspices of, and reporting to, the Australian National Council on AIDS, Hepatitis C and Related Diseases (ANCAHRD) Hepatitis C Sub-Committee. Membership of the working group (see Appendix 1) included clinicians, epidemiologists, drug researchers, statisticians, mathematical modellers, and representatives of the Commonwealth, State and Territory Health Departments, the Australian Hepatitis Council and the Australian Injecting and Illicit Drug Users League.

1.1 Objectives

The agreed objectives of the HCV Projections Working Group were:

- to provide updated consensus estimates of HCV incidence and prevalence in Australia
- to estimate the numbers of people living with HCV by stage of liver disease
- to estimate morbidity associated with HCV infection
- to obtain projections of the long-term sequelae of HCV infection, including cirrhosis, liver failure and hepatocellular carcinoma, and HCV-related mortality
- to recommend a mechanism for updating and improving estimates over time

1.2 Working procedures

The HCV Projections Working Group was coordinated through the National Centre in HIV Epidemiology and Clinical Research. Meetings were monthly, through teleconferences held over the second half of 2001. Initial responsibility for specific activities was assigned to individual members of the Working Group, but the final report reflects the consensus view of all Working Group members. All participants gave their time without charge to participate in teleconferences and other discussions, and bore their own associated administrative costs.

2.0 REVIEW OF DATA SOURCES ON HCV IN AUSTRALIA

2.1 National surveillance

HCV infection has been a notifiable disease (doctor and/or laboratory) in most Australian State and Territory Health jurisdictions since 1990, and all States and Territories since 1995. Notifications increased rapidly to between 17,000 and 20,000 new HCV diagnoses annually during the period 1995 to 2000 (DoHA, 2002). Cumulative HCV notifications over the period 1990-2000 are over 160,000 (DoHA, 2002). In 2001 there were some 16,000 HCV notifications, and to mid-April 2002 over 4,000 notifications, corresponding pre rate to around 14,000 HCV notifications in 2002. The extent to which there have been duplicate HCV notifications is uncertain. In each State/Territory, new HCV diagnoses have been notified with case-identifying data, so that within each State/Territory duplicate notifications are likely to be limited. However, new HCV diagnoses are forwarded by State/Territory Health Departments to National Notifiable Diseases Surveillance System, maintained by the Commonwealth Department of Health and Ageing, in anonymous aggregate format. This means that it is not possible to assess duplicate notifications between State/Territories.

Around 65% of HCV notifications have been in people aged 20-39 years, with approximately 35% of notifications in females (DoHA, 2002). However, the proportion of female HCV notifications is larger than 35% in younger age-groups, particular age 15-19 years where there are similar numbers of men and women notified (DoHA, 2002).

The vast majority of HCV notifications have been prevalent HCV diagnoses, with newly acquired HCV cases constituting 100 to 450 cases per year over the period 1997-2001 (NCHECR, 2001). Enhanced surveillance mechanisms to improve ascertainment of newly acquired HCV cases have recently been introduced in most State and Territory health jurisdictions (Spencer et al, 2002a). However, generally fewer than 25% and probably nearer 10% of HCV infections are associated with acute symptoms (van der Poel et al, 1994). Furthermore, identifying recent HCV infections solely on the basis of a recent previous negative test is limited because negative HCV test results cannot be cross-checked between different testing laboratories. Combining these difficulties with the irregular testing of some people at increased risk of HCV infection, and large resources required for enhanced HCV surveillance, mean that only a minority of HCV infections will be diagnosed and notified close to the time of HCV exposure.

2.2 Risk factors for HCV infection

Studies examining the risk factors for HCV infection in Australia are summarised in Table 1. Routine HCV notification data, and the survey of antenatal patients, suggest that around 80% of prevalent HCV infections have occurred through injecting drug use. Recent studies of incident HCV notifications since 1995 indicate that the proportion of incident HCV infections due to injecting drug use was even higher at around 90% (Andrews and Curran, 1996; Copland, 2002). This may indicate that the proportion of HCV infections due to injecting drug use has increased in more recent years, but may also be biased upwards if HCV negative injecting drug users (IDUs) are retested more frequently than other population groups.

The proportion of HCV infections due to injecting drug use was lower in blood donors, probably because people with a history of injecting drug use are asked to exclude themselves from blood donation. Rates of HCV infection due to injecting drug use were also lower in liver clinic patients, between 51% and 75%, although this proportion had increased in one Melbourne liver clinic, from 51% during 1990-1993 (Strasser et al, 1995) to 64% during 1990-1998 (Ostapowicz et al, 2001). In the study by Li et al (1997), of liver clinic patients infected with HCV through routes other than injecting drug use, around half were in immigrants to Australia from countries with a high prevalence of HCV.

2.3 Prevalence and incidence of HCV in injecting drug users

Studies of the prevalence of HCV infection among IDUs in Australia appear in Table 2. Taken together, these studies indicate that the proportion of regular IDUs with HCV infection in Australia has been consistently in the range 50% to 70% since the early 1970s. Repeated surveys of people attending needle and syringe progams (NSPs) showed some decrease in HCV prevalence from 63% in 1995 to 51% in 1996, but prevalence has remained around 50% over the period 1996 to 2000. Among IDUs, prevalent HCV infections have been found to be very strongly associated with duration of injecting (Crofts et al, 1997b). Age has also been found to be associated with HCV seroprevalence, but primarily through its association with duration of injecting (Crofts et al, 1997b).

Studies assessing the incidence of HCV infection in IDUs are summarised in Table 3. In a combined analysis, based on two cohorts of IDUs in Melbourne and one in Sydney, the incidence of HCV infection among IDUs in the 1980s and early 1990s was estimated to be around 15 new infections per 100 person years of follow-up (Crofts et al, 1997b). These studies also provided an indication, though not statistically significant, of a reduction in HCV incidence among IDUs from around 18 infections per 100 person years in IDUs who started injecting prior to 1987, to 13 infections per 100 person years in IDUs who started injecting since then, coincident with the introduction of needle and syringe exchange programs, and other preventive campaigns, which were aimed at reducing the risk of HIV infection among IDUs. Data from people attending the Kirketon Road Centre in Sydney indicate that HCV incidence in clinic attenders has remained broadly consistent, at around 15 to 20 new HCV infections per 100 person years, over the period 1992 to 2000 (Gilmour et al, 2002). Furthermore, HCV prevalence among people aged less than 20 years attending needle and syringe programs has remained high, and if anything increased from 32% in 1998 to 44% in 2000 (MacDonald, 2002). Although generalisation from these highly selected populations is difficult, these data at least do not provide any evidence of a decrease in HCV incidence during the mid- to late-1990s.

2.4 Prevalence and incidence of HCV in other populations

Studies estimating HCV prevalence among other populations in Australia are summarised in Table 4. HCV prevalence rates were around 1% or lower in antenatal patients, first time blood donors and health care workers. Rates were higher in renal transplant recipients, dialysis patients, and much higher in people with haemophilia, as

a result of blood and blood products contaminated with HCV prior to the availability of screening tests for blood donations.

HCV incidence has been estimated among repeat blood donors in Victoria to be 1.9 per 100,000 (Whyte and Savoia, 1997).

2.4.1 HCV in prisons

HCV prevalence among entrants to or inmates in prisons has not been assessed nationally. There have, however, been some assessments in some States and Territories (Table 4), with several studies in New South Wales. Studies in New South Wales and Victoria indicate HCV prevalence rates of the order of 40% of all prisoners. Furthermore, a consistent finding in these studies was that HCV prevalence rates were 50% to 100% greater in women than men, perhaps reflecting that a greater proportion of women than men in prison are imprisoned for drug related offences. (Crofts et al, 1995; Butler et al, 1999; Awefoso et al, 2000). Rates appear somewhat lower in Western Australian prison inmates, at around 23% of male and 46% of female prisoners (Watson, 2002), and much lower in Darwin at 8% (Huffam et al, 1999).

The total prison population in Australia on 30 June 2001 was 22,458 persons, of whom 93% were men (ABS, 2002a). Prison populations by State/Territory were: ACT 82; NSW 8,975; NT 717; QLD 4,517; SA 1,389; TAS 346; VIC 3,391; WA 3,170. Of the total prison population on 30 June 2001, 18,123 (80.7%) were sentenced prisoners while 4,335 (19.3%) were being held on remand prior to trial or sentencing.

The total number of people held in prison at anytime during 2001 is uncertain, but would certainly be greater than the 22,458 people held on 30 June 2001. Of sentenced prisoners held on 30 June 2001, 3,098 (17.1%) had an aggregate sentence length of less than one year, while 1,074 (5.9%) were periodic detainees, who are held in prison for two consecutive days each week but are at liberty for the remainder (ABS, 2002a). Furthermore, total sentenced receptions in prisons during 2001 were 25,765 (ABS, 2002b). Taken together, these data suggest that at least 30,000 people were held in prisons in Australia at some time during 2001.

National rates of HCV prevalence in prisoners are likely to be slightly lower than the estimates 40% seen in New South Wales and Victoria, and are probably in the range 30% to 40% of all prisoners. Available data suggest that the prevalence of HCV in female prisoners is higher than this, probably in the range 50% to 70%. These prevalence estimates among prisoners suggest that between 7,000 and 9,000 people being held in prison on 30 June 2001 were HCV positive, of whom between 700 and 1,000 were women. It is probable that between 9,000 and 12,000 people with HCV were held in prisons at some time during 2001, of whom between 1,000 and 1,400 were women.

2.5 HCV genotype prevalence rates

Studies assessing HCV genotype prevalence rates are summarised in Table 5. A consistent feature of studies in Melbourne and Sydney is a trend to a decreasing prevalence of genotype 1 in the 1970s to the 1990s, with an increase in genotype 3

over the same period. During the 1990s, all the studies in Table 5 taken together indicate that the prevalence of HCV genotype 1 was around 55%, genotype 3 around 35%, genotype 2 between 5-10%, with other genotypes below 5% combined.

3.0 NATURAL HISTORY OF HCV INFECTION

Of people who develop HCV antibodies following exposure to HCV, at most 25%, and probably nearer 10%, experience an acute illness, while the majority experience no ill-effects at the time of infection (van der Poel et al, 1994). Of all people exposed to HCV, around 25% clear the HCV infection (van der Poel et al, 1994; Dore et al, 1997), and are not at risk of long-term HCV-related morbidity and mortality.

3.1 Long-term sequelae following HCV infections

A small proportion of people infected with HCV will develop long-term sequelae, in particular compensated cirrhosis, liver failure and hepatocellular carcinoma (HCC). The rate at which people exposed to HCV antibodies progress to compensated cirrhosis has been the subject of a recent systematic review (Freeman et al, 2001). This review suggests that progression rates to compensated cirrhosis in persons who acquire HCV infection in young adulthood and remain chronically infected with HCV is 7% at 20 years following infection. Rates of progression to cirrhosis following the first two decades after HCV infection are uncertain, although recent data suggest that progression rates accelerate with increasing duration of infection (Poynard et al, 2001).

Annual rates of developing liver failure or HCC following cirrhosis have been estimated to be around 4% and 1% respectively, with HCV-related mortality following cirrhosis 1.5% per annum (Fattovich et al, 1997).

4.0 ESTIMATES AND PROJECTIONS OF HCV IN AUSTRALIA

4.1 Modelling the HCV epidemic in Australia

Simple mathematical models were used to estimate the pattern of past HCV incidence in Australia, and thus forming the basis for predicting the long-term health consequences of HCV infection. Because the HCV epidemic in Australia has been largely through injecting drug use, and also because most HCV data are available for this subpopulation, the models adopted were based on an assumed pattern of injecting drug use in Australia. The estimates of HCV infections due to injecting drug use thus obtained were then inflated to allow for HCV infections through either receipt of blood or blood products, or other transmission routes.

4.1.1 Estimating the number of injecting drug users in Australia

Data regarding the number of IDUs in Australia are summarised in Table 6. The numbers of IDUs estimated from the National Drug Strategy Household Surveys (CDHHS, 1996; AIHW, 1999) were based on surveys of the general population. It is likely that both surveys gave underestimates of the total number of people who had

injected drugs in the previous 12 months because IDUs would probably be less likely to be contacted by such surveys, and even if contacted they may not have admitted to an illegal activity. However, a consistent feature of these survey results was an increasing number of people reporting injecting drug use, from 70,000 in 1993 to 110,000 in 1998.
Because of the lack of data on the numbers of IDUs in Australia at the time of the previous HCV Projections Working Group, the Delphi technique was used to reach consensus estimates (Law, 1999). The following definitions were adopted:

- a ***regular*** IDU injected for at least 12 months, an average of 10 times per month, with injecting in most months
- an ***occasional*** IDU injected at least once in the last 12 months, but not frequently enough to be considered a regular IDU.

The number of regular IDUs in 1997 was estimated using the Delphi method to be 100,000, with lower and upper plausible limits of 80,000 and 120,000. The number of occasional IDUs was estimated to be 175,000 (120,000 to 210,000).

Since 1998, further modelling, applied to national overdose deaths, NSW methadone maintenance therapy entrants, methadone maintenance therapy episodes and arrests for heroin-related offences, has been used to estimate numbers of dependent heroin users in Australia (see Table 6). The median number of dependent heroin users in Australia in 1997 was 74,000 (Hall et al, 2000), with consistent evidence of increasing numbers of dependent heroin users over the previous 30 years.

The estimates of the numbers of dependent heroin users are plotted over time in Figure 1. A good fit to these estimates was obtained by taking a consistent 8% annual increase in the number of dependent heroin users from 1970 to a total of 75,000 dependent heroin users in 1997. Prior to 1970 it was assumed there was a linear decline in the number of dependent heroin users to zero in 1960.

To include persons injecting drugs other than heroin, it is necessary to inflate these estimated numbers of dependent heroin users to give total estimated numbers of regular injectors. Data from National Needle and Syringe Program (NSP) surveys indicate that around three quarters of people attending NSPs report heroin as the most recently injected drug (NCHECR, 2001). This suggests that the total number of regular IDUs in 1997 was around 100,000, consistent with the estimates used by the previous HCV Projections Working Group.

4.1.2 Modelling assumptions

The incidence of HCV in Australia was modelled based on the following assumptions regarding the past pattern of injecting drug use in Australia:

- there were 100,000 regular IDUs in 1997 (lower and upper limits of 80,000 to 120,000), with a constant net increase of 8% per year between 1970 and 2001, and with 5% stopping injecting each year (Thorley, 1981; English et al, 1995).
- there were 175,000 occasional IDUs in 1997 (lower and upper limits of 120,000 to 210,000), with a constant net increase of 8% per year between 1970 and 2001, and with 10% stopping injecting each year.

- there were no IDUs in 1960, with a linear increase in the number of both regular and occasional IDUs between 1960 and 1970.

The first of the above assumptions was based on estimated numbers of dependent heroin users inflated to allow for injecting of other drugs. The second assumption is based on the results of the Delphi study estimates of the number of occasional drug users, which were adopted in the previous HCV Projections Working Group.

Based on these assumptions, estimated numbers of both regular and occasional injecting drug users between 1960 and 2001 were constructed (Figure 2).

Other assumptions made in modelling HCV incidence were:

- 65% of IDUs who start injecting regularly have previously injected occasionally (from the Delphi study).
- the HCV incidence rate in uninfected regular IDUs was taken to be 18% per annum from 1960 until 1985, after which it was taken to decrease linearly to 13% in 1989 and thereafter.
- the HCV incidence rate in occasional IDUs was taken to be 20% of that in regular IDUs.
- all people starting or stopping injecting, or becoming regular rather than occasional IDUs, did so independent of their HCV status.
- HCV incidence due to receipt of infected blood or blood products was taken to be 15% of HCV incidence in IDUs until the early 1980s, after which it was assumed to have gradually decreased following the introduction of donor self-deferral related to injecting drugs (which began in 1983), and to be stopped entirely from 1990 onwards with the introduction of blood donor screening for HCV.
- HCV incidence through other transmission routes (such as needlestick injuries in health care workers, or tattoos) was taken to be 10% of HCV incidence in IDUs between 1987 and 1997, reflecting the data on risk factors for recent incident HCV infections. Prior to 1987 it was assumed to increase linearly to 20% of HCV incidence in IDUs in 1977, and then fixed at this absolute number of infections per year prior to this, again broadly consistent with data on risk factors for prevalent HCV infections, and for people with HCV infection attending liver clinics.
- the number of HCV infections between 1950 and 1960 was held constant at a low level proportional to the modelled HCV incidence among IDUs. Any HCV infections prior to 1950 were assumed to have negligible effect on estimates and projections, and were not modelled.

Estimates of HCV prevalence in 2001 were based on the modelled pattern of HCV incidence, adjusted to allow for deaths following HCV-related cirrhosis (see section 5 below), deaths related to injecting drug use and for deaths unrelated to HCV infection. Deaths related to injecting drug use were assumed to be 1% per year (Thorley, 1981; English et al, 1995). Deaths unrelated to HCV infection and injecting drug use were calculated based on average death rates in the Australian general population (ABS, 1995), assuming that the average age at HCV infection was 25 years and that there were two male HCV-infected IDUs for each female HCV-infected IDU.

Sensitivity analyses performed by the previous HCV Projections Working Group indicated that the single most important source of uncertainty in estimates of HCV

incidence and prevalence arose due to uncertainty in the number of regular and occasional IDUs. Hence, lower and upper limits on the HCV epidemic were produced based on the upper and lower limits of the numbers of regular and occasional IDUs.

4.1.3 Modelled estimates of HCV prevalence and incidence in 2001

The modelled pattern of past HCV incidence is shown in Figure 3. Overall, the pattern of HCV incidence is consistent with a gradually increasing rate of HCV infections over the last three decades. The apparent plateau in HCV incidence in the late 1980s is a combination of the assumed decreasing HCV incidence in IDUs, and the gradual decrease in HCV transmissions through receipt of blood products initially due to screening of donors aimed at reducing HIV transmission.

The best estimate of the number of people living with HCV-antibodies to the end of 2001 was 210,000 (lower and upper limits of 157,000 and 252,000), with HCV incidence in 2001 estimated to be 16,000 (11,000 to 19,000). Of all HCV infections, 83% were estimated to be due to injecting drugs, 5% due to receipt of blood, and 12% due to other transmission routes. These include vertical transmission from HCV positive mother-to-baby, unsterile body piercing and unsterile tattooing, unsterile medical procedures in people born in countries of high HCV prevalence, and needlestick injuries in health care workers. Of incident HCV infections in 2001, 91% were estimated to be through injecting drug use, 0% to receipt of blood and 9% due to other reasons. Of those people exposed to HCV through injecting drug use, the model specifies that 55% were currently injecting in 2001. For both cumulative HCV incidence and HCV incidence in 2001, the results of the model are broadly consistent with the available data on risk factors (see section 2.2).

These estimates of HCV prevalence and incidence are based on the assumption that the trends in injecting drug use which appear to have occurred during the mid-1990s continue through 2001. This is clearly a highly uncertain assumption. There has been recent evidence of a heroin drought in Australia from the last quarter of 2000 through to early 2002 (Rouen et al, 2001). This may have resulted in fewer people injecting heroin, although there have been anecdotal reports of increased injecting of amphetamines and cocaine. Certainly, a decrease in opioid overdose deaths from a peak of 958 in 1999 to 725 in 2000 has been reported (Degenhardt, 2001), suggesting some decrease in injecting opioids. The number of needles and syringes distributed through Needle Syringe Programs has also been reported to have decreased. If there was a decrease in the number of people injecting drugs in 2001, then the best estimates of HCV incidence and prevalence may be too large. The modelled estimate of HCV incidence in 2001 is particularly sensitive to assumptions regarding the number of IDUs, and the best estimate of 16,000 needs to be interpreted as particularly uncertain.

The estimated 210,000 people living with HCV during 2001 is corroborated by other data, and so appears more robust. To the end of 2000 there have been over 160,000 HCV diagnoses notified through State/Territory health departments. Furthermore, HCV-prevalence among antenatal patients has been estimated to be 1.1% in 1995 (Garner et al, 1997) and 1.3% in 1999 (Spencer et al, 2002b). Direct estimates of HCV prevalence extrapolated from these estimates of HCV-prevalence in antenatal patients would be of the order of 200,000 people living with HCV in the late-1990s (HCVPWG, 1998).

4.2 Estimates and projections of long-term sequelae of HCV infection

Estimates and projections of the long-term sequelae of HCV infection were based on the modelled estimate of HCV incidence (Figure 3). Overall best estimates were based on the preferred estimate of HCV incidence, with upper and lower limits based on the corresponding limits on the estimated of the numbers of regular and occasional IDUs. When making projections, trends in HCV incidence between 2001 and 2020 were assumed to continue to increase for both the best estimates of HCV incidence, and the upper limit. However, as continuing trends in this way assumes an exponentially increasing number of IDUs, which is unlikely, the lower limit on HCV incidence was assumed to remain constant at the 2001 level thereafter. In any case, as progression from HCV infection to long-term sequelae take place over a time frame of several decades projections are not overly affected by the assumed pattern of HCV incidence between 2001 and 2020.

4.2.1 Rates of progression

Estimates and projections were made for the three main long-term sequelae of HCV infection: compensated cirrhosis, liver failure and hepatocellular carcinoma (HCC).

The progression rate to cirrhosis was modelled in the following way. It was first assumed that 75% of people exposed to HCV developed chronic infection. Of people with chronic HCV infection, it was assumed that one third had normal ALT values, one third abnormal ALT values, and one third abnormal ALT values with further covariates which would indicted that they would be at increased risk of progression (eg high alcohol intake). Annual rates of progression from stage 0/1 liver disease to stage 2/3 liver disease, and from stage 2/3 liver disease to cirrhosis are shown in Table 7.

Taken together, these assumptions combine so that of all people exposed to HCV, 5.3% and 15.3% are estimated to develop cirrhosis by 20 and 40 years respectively, with 7.1% and 20.4% of people with chronic HCV developing cirrhosis by 20 and 40 years respectively. This is consistent with current evidence regarding progression rates to cirrhosis (Freeman et al. 2001), and with an accelerating rate of disease progression with increasing duration of HCV infection (Poynard et al, 2001).

Rates of developing liver failure or hepatocellular carcinoma (HCC) from cirrhosis were assumed to be 4% and 1% respectively (Fattovich et al, 1997). It was further assumed that HCC could develop following liver failure, but not vice-versa. HCV-related mortality following cirrhosis was taken to be 1.5% per annum (Fattovich et al, 1997).

Estimates of the numbers of people with long-term sequelae of HCV infection were obtained by combining the estimated pattern of HCV incidence (Figure 3), with the assumed progression rate distributions. Mortality unrelated to HCV, both before and after cirrhosis, was assumed to be 1% per year (Thorley 1981; English et al. 1995) due to injecting drug use. Background mortality was based on ABS life tables, assuming that the mean age at HCV seroconversion among IDUs was 25 years (NCHECR, 2001), and that there were 2 male HCV-infected IDUs for each female HCV-infected IDU (ABS 1995). Lower and upper limits were obtained based on the lower and upper limits of HCV incidence (Figure 3). The best estimates and upper limits were obtained by

assuming that numbers of IDUs continued to increase at 8% per annum until 2020. Lower limits were obtained by assuming that the lower limit of HCV incidence in 2001 continued at this lower level until 2020. In any event, because of the protracted progression rate distributions to cirrhosis, liver failure and HCC, the projected numbers of long-term sequelae are relatively unaffected by HCV incidence during the period 2001 to 2020.

4.2.2 Modelled estimates of number of people living with HCV-infection by stage of disease

The modelled best estimates of number of people living with HCV by stage of disease between 1961-2001 are shown in Figure 4. At the end of 2001 these models estimate that there were a total of 210,000 (lower and upper limits of 157,000 to 252,000) people living with HCV in Australia. Of these,

- 53,000 (39,000 to 64,000) people had been exposed to HCV but had cleared the virus and were not chronically infected
- 124,000 (92,000 to 149,000) were chronically infected with HCV with stage 0/1 liver disease
- 27,000 (20,000 to 32,000) were chronically infected with HCV with stage 2/3 disease
- 6,500 (5,000 to 8,000) were living with cirrhosis

4.2.3 Estimates of HCV incidence and number of people living with HCV infection by State/Territory

Direct estimates of the relative size of the HCV epidemic by State and Territory are not available. Three indicators of the likely relative sizes were used (see Table 9):

- National HCV notifications between 1995 and 2000, the period for which data are available on all States and Territories (CDHA, 2002)
- Opioid overdose deaths between 1988 and 2000 (NDARC, 2002)
- Arrests for heroin, amphetamines or cocaine (ABCI, 2002)

The ranking order of States and Territories remained broadly consistent across the three indicators, although there was some variation in the magnitude of the individual indicators for some States. An overall indicator of the relative size of the HCV epidemic for each State/Territory was simply taken as the average of the three individual indicators. State/Territory specific estimates of HCV incidence and numbers of people living with HCV were then calculated by simply applying the overall indicator to the national estimates described in sections 4.1.3 and 4.2.2 (see Table 8). Clearly, these State/Territory specific estimates are rough approximations, and should be taken as likely orders of magnitude rather than accurate estimates.

4.2.4 Short-term projections of HCV prevalence and incidence

It is possible to use the mathematical model to give projections of both the number of people living with HCV, and the number of incident HCV infections, in 2002 and 2003. The number of people living with HCV is projected to increase to 226,000 (167,000 to 271,000) in 2002, and 242,000 (176,000 to 290,000) in 2003. HCV

incidence is projected to increase to 17,000 (11,000 to 20,500) in 2002 and 18,500 (11,000 to 22,000) in 2003.

These estimates are based on the assumption that recent trends in the number of IDUs continue through 2003. This assumption is highly uncertain, with some evidence suggesting decreases in the number of IDUs during 2001 (see section 4.1.3 above). Estimates of HCV incidence in particular are highly sensitive to the assumed patterns of injecting drug use and should be interpreted extremely cautiously. To try and allow for some of the uncertainty surrounding injecting drug use, lower limits were obtained based on the lower limit of the numbers of IDUs in 2002 and 2003 remaining at the 2001 lower limit level.

4.2.5 Long-term projections of number of people living with HCV

Attempts to project the number of people living with HCV infection into the future are clearly very uncertain. Such numbers depend on the future pattern of HCV incidence, which in turn depends on future patterns of injecting drug use. If we assume that what we believe about recent trends in injecting drug use continue, with an annual 8% increase in the total number of IDUs, for the foreseeable future, the total number of people living with HCV in 2020 is estimated by the current models to be 836,000. Of these 211,000 would be people exposed to HCV but who had cleared the virus; 501,000 would be chronically infected with HCV with stage 0/1 liver disease; 99,000 chronically infected with stage 2/3 disease; and a further 26,000 living with cirrhosis.

A much more conservative scenario can be obtained by basing projections on the current lower limits on number of IDUs, and to assume that the total number of IDUs remains contained at the lower limit levels estimated in 2001. Under this scenario, the models estimate there would be 321,000 people living with HCV infection in Australia – 81,000 not chronically infected; 171,000 chronically infected stage 0/1; 52,000 chronically infected stage 2/3; and 17,000 living with cirrhosis.

The numbers of people living with HCV in 2020 are likely to lie somewhere in between these two scenarios. It is difficult to argue that numbers of IDUs will continue to increase by 8% per annum for a further two decades because the available population sizes of young adults in Australia are too small. Similarly, in the face of strong evidence of a continuing increase in the number of IDUs throughout the 1990s, it is difficult to argue that the number of IDUs will remain contained at the lower limit of best estimates in 2001. Thus the total of 836,000 people living with HCV in 2020 can be viewed as an upper limit on the likely numbers, and 321,000 a lower limit. The only realistic possibility that the number of people living with HCV in 2020 will be below this range is if a HCV-vaccine becomes available, if HCV transmission among IDUs is markedly reduced, or if anti-HCV treatments improve very rapidly to the point where a large proportion of people who are at risk of transmitting HCV (predominantly current IDUs) can access treatment and clear their HCV-infection and are thus no longer infectious.

4.2.6 Modelled estimates of long-term sequelae of HCV infection

The modelled number of people living with cirrhosis, annual incident number of HCV-related liver failures, annual incident cases of HCC, and cumulative HCV-related

mortality from 1990 to 2020 are shown in Figures 5a,b,c and d respectively. In 2001 the models estimate that there were:

- 6,500 (5,000 to 8,000) people living with cirrhosis
- 175 (130 to 210) new cases of HCV-related liver failure
- 50 (40 to 60) HCV-related cases of HCC
- 1,000 (750 to 1,200) cumulative HCV-related deaths

For all these measures of the long-term sequelae of HCV-infection, the models predict there will be at least a three-fold increase by 2020.

In Australia, both HCC incidence and mortality has increased over the last two decades, particularly in men (Law et al, 2000). The reported annual number of cases of HCC has gradually increased over the last decade or more, from 215 cases in 1983 to 603 cases in 1998 (AIHW, 2001). The proportion of HCC cases due to HCV infection is uncertain. In one study of cases of HCC in Sydney between 1990 and 1993, 5 of 9 (56%) cases tested were HCV infected (Brotodihardjo et al, 1994). A second study in Victoria in 1991 to 1992 found that 7 of 24 (29%) cases tested were HCV infected (Thompson et al, 1997). However, in both studies rates of testing for HCV infection were low, and the actual rate of HCV infection in cases of HCC would be somewhat lower than these rates if testing was selectively done in cases thought to be at an increased risk of HCV infection. Based on our projections of HCC, we estimate that 7% (5% to 8%) of HCC cases in 1998 were due to HCV infection, broadly consistent with the observed proportions noted above.

4.3 Loss of quality of life associated with HCV infection

The following assumptions were employed in determination of quality of life year (QALY) adjustments for HCV:

1. 75% of people who acquire HCV infection develop chronic HCV.
2. All people with chronic hepatitis C are at risk of progression to advanced liver disease complications.
3. People can either remain in disease states or progress forward but not regress.

Although there may be quality of life impairment and health care costs for people who are HCV antibody positive but do not have chronic HCV, we have taken the conservative approach of basing our analyses on cases of chronic HCV only.

Definitions for disease states and associated quality of life adjustments are as follows:

- ***Mild chronic hepatitis – undiagnosed (0.94)*** – chronic HCV, unaware of HCV status, with stage 0-1 (no-minimal) hepatic fibrosis.
- ***Mild chronic hepatitis – diagnosed (0.82)*** – chronic HCV, aware of HCV status, with stage 0-1 (no-minimal) hepatic fibrosis.
- ***Moderate chronic hepatitis – undiagnosed (0.94)*** – chronic HCV, unaware of HCV status, with stage 2-3 (moderate-severe) hepatic fibrosis.
- ***Moderate chronic hepatitis – diagnosed (0.82)*** – chronic HCV, aware of HCV status, with stage 2-3 (moderate-severe) hepatic fibrosis.

- ***Compensated cirrhosis – undiagnosed (0.84)*** –chronic HCV, unaware of HCV status, with associated cirrhosis but no evidence of liver failure or hepatocellular carcinoma (HCC).
- ***Compensated cirrhosis – diagnosed (0.74)*** – chronic HCV, aware of HCV status, with associated cirrhosis but no evidence of liver failure or hepatocellular carcinoma (HCC).
- ***Liver failure (0.32)*** – chronic HCV associated cirrhosis that has progressed to de-compensation.
- ***HCC (0.10)*** – chronic HCV associated cirrhosis that has progressed to HCC.

Quality of life adjustments were partly based on previous published estimates from a panel of hepatologists (Bennett et al, 1997). However, recent evidence from quality of life assessments among patient assessments were used to adjust the ratings provided by Bennett et al (1997). For example, studies indicate no significant difference in quality of life based on either degree of hepatic inflammation (as measured by ALT/AST) or extent of hepatic fibrosis (Bonkovsky et al. 1999). Therefore, we have used the same quality of life adjustment for diagnosed mild and moderate chronic hepatitis. Undiagnosed categories have higher quality of life estimates for two reasons. Firstly, development of symptomatic disease may often be a reason for HCV testing. Secondly, recent evidence suggests that quality of life impairment increases following diagnosis of HCV (Rodger et al, 1999). We have combined the quality of life adjustments from Bennett et al (1997) for ascites (0.35), variceal haemorrhage (0.28), and hepatic encephalopathy (0.30), to produce a category for liver failure (0.32). We have assumed that all people with liver failure and HCC are aware of their HCV status.

4.3.1. Estimates of reduced QALYs associated with HCV infection

Estimates of QALYs lost to HCV-infection in Australia in 2001 are summarised in Table 9. In Australia, after allowing for up to 10% duplicate reporting of HCV diagnoses, an estimated 70% of people living with hepatitis C are diagnosed. Table 8 outlines the estimates of diagnosed chronic HCV by stage of liver disease. It was assumed that proportions of diagnosed chronic HCV would increase with disease stage to reach 100% for advanced liver disease complications (HCC, liver failure).

In total, it is estimated that 22,500 (17,000 to 27,000) QALYs were lost to HCV infection in Australia during 2001. Even though the QALY adjustments are modest in early stage HCV disease, the majority of the estimated QALYs lost to HCV infection during 2001 were in either stage 0/1 disease (73% of QALYs lost) or stage 2/3 disease (18% of QALYs lost). Even though mortality associated with HCV infection is currently at modest, though not inconsequential, levels in Australia, these estimates suggest that lost quality of life through HCV infection is a larger problem, affecting all stages of chronic HCV-infection.

5.0 COMPARISON WITH 1998 REPORT FINDINGS

This report updates and refines the estimates and projections from the previous working group (HCVPWG, 1998). The estimates of HCV prevalence and incidence in the current report are broadly consistent with the previous findings. Current estimates are that there were 210,000 (157,000 to 252,000) people living with HCV at then end of 2001, compared with the previous report's estimated 190,000 (140,000 to 240,000) at the end of 1997. HCV incidence is estimated here to be 16,000 (11,000 to 19,000) in 2001 compared with 11,000 (8,500 to 13,500) in 1997 in the previous report. Current estimates are that HCV-incidence in 1997 was 12,000 (9,000 to 14,000).

The present report has expanded on the previous working groups report in several important areas:

- More data on HCV in prisons (section 2.4.1) and HCV genotypes (section 2.5) are presented and discussed.
- Better estimates of numbers of IDUs have been developed since the previous report, and are incorporated in current models (section 4.1.1)
- A systematic review of published studies has lead to revised, slower, rates of progression from HCV infection to cirrhosis being adopted in the current report (section 3.1). Furthermore, rates of progression to cirrhosis were modelled based on splitting all HCV-infected people into three subgroups: people who cleared their HCV-infection and so are not chronically infected; chronic HCV-infection with normal ALT values; chronic HCV-infection with abnormal ALT values; and abnormal ALT values with other covariates indicative if increased risk of progression (section 4.3.1). This modelling approach reproduced the overall population-level rates of progression to cirrhosis, and also provided a mechanism for estimating the numbers of people living with HCV by stage of liver disease (section 4.2.2).
- An assessment of HCV incidence and prevalence by State/Territory has been included (section 4.2.3).
- Despite the major uncertainties, some long-term projections of numbers of people living with HCV have been attempted (section 4.2.5).
- Projections of long-term sequelae of HCV-infection were expanded to include liver failure, as well as cirrhosis and HCC (section 4.2.6).
- Estimates of HCV-associated morbidity have been given, by estimating numbers of quality-adjusted life-years lost through HCV-infection in 2001 by stage of HCV-disease (section 4.3.1).

6.0 RECOMMENDATIONS

The HCV Projections Working Group made the following recommendations:

- That the working group be reformed in 2005 to update and refine estimates and projections
- An attempt be made to estimate the number of duplicate HCV notifications, particularly between State/Territories.
- To develop methods to monitor systematically HCV incidence in IDUs
- To further improve estimates of numbers of IDUs, and the effect of the heroin drought on these numbers
- To estimate the contribution to new HCV infections in IDUs of: prisons; juvenile justice systems; during drug treatment programs; in novice IDUs
- To evaluate the effectiveness of HCV prevention, especially Needle and Syringe Programs, and methadone treatment.
- Further study is needed on HCV-related morbidity, and financial cost of HCV-infection

Table 1. Risk factors for HCV in Australia

Populations	Site	Year	N	IDU	Tattoo	Blood	Other	Reference
New HCV diagnoses	N NSW	1993-94	467	85%	1%	6%	8%	Sladden et al, 1997
New HCV diagnoses	Qld	1994	532	77%	3%	6%	14%	Selvey et al, 1996b
	ACT	1994	154	81%	3%	8%	9%	
	NT	1994	57	64%	11%	7%	17%	
Incident HCV notifications	All States	1995	116	91%	-	1%	8%	Andrews and Curran, 1996
	SA	1995-2001	455	91%	-	-	-	Copland, 2002
Antenatal women	Adelaide	1995	17	71%	-	-	-	Garner et al, 1997
Blood donors	Sydney	1990-91	220	47%	10%	7%	35%	Kaldor et al, 1992
Liver clinic patients	Melbourne	1990-1993	342	51%	6%	15%	27%	Strasser et al, 1995
	Melbourne	1990-1998	1546	64%	6%	11%	19%	Ostaowicz et al, 2001
	Sydney	1990-1995	619	75%			25%	Li et al, 1998

Table 2. Prevalence of HCV antibody among populations of IDUs in Australia

Populations	Site	Source	Year	Prevalence (N)	Reference
Hospital inpatients	Victoria	Fairfield Hospital	1971	57% (44)	Moaven et al, 1993
Methadone clients	Sydney	Clinic attenders	1974-75	84% (110)	Freeman et al, 2000
Hospital in/outpatients	Victoria	Fairfield Hospital	1971-89	62% (431)	Fairley et al, 1990
Methadone clients	Sydney	Westmead Hospital	1986-89	86% (172)	Bell et al, 1990
Hospital inpatients	Geelong	Geelong Hospital	1989	47% (17)	Williamson et al, 1990
All prison entrants	Victoria	Victorian prisons	1991-92	65%[1] (1562)	Crofts et al, 1994
STD clinic	Adelaide	Clinic attenders	1991-93	30% (989)	Waddell, 1994
Methadone clients	S Australia	Clinic attenders	1992-93	94% (87)	Gaughwin et al, 1994
Broad spectrum	Victoria	Field recruited	1990-95	62% (519)	Crofts and Aitken, 1997
Primary care (KRC)	Sydney	Clinic attenders	1992-95	45% (1078)	van Beek et al, 1998
Methadone clients	Melbourne	Clinic attenders	1991-95	67% (1741)	Crofts et al, 1997a
Young IDUs	Perth	Field recruited	1993	8% (75)	Loxley, 1992
Methadone clients	Brisbane	Clinic attenders	1994	69% (260)	Selvey et al, 1997
Needle exchange sites	SE Qld	NSE attenders	1994	34%[2] (268)	Selvey et al, 1996a
Broad Spectrum	Sydney	Field recruited	1994	70% (139)	Loxley et al, 1995
	Perth			41% (76)	
	Adelaide			51% (102)	
	Melbourne			57% (115)	
Prison entrants	Sydney	Long Bay CC	1994	66% (206)	Butler et al, 1997
Vietnamese communities	Melbourne	Field recruited	1995	100% (27)	Louie et al, 1998
Juvenile Centre residents	Melbourne	MJJC	1995	36% (53)	Ogilvie et al, 1999
Needle exchange sites	All States /Territories	NSP attenders	1995	63% (979)	NCHECR, 2001
			1996	51% (1445)	
			1997	50% (1814)	
			1998	49% (1566)	
			1999	50% (1527)	
			2000	53% (1639)	
Prison inmates	NSW	NSW prisons	1996	73% (345)	Butler et al, 1999
Methadone clinics	NSW/Qld/SA/WA	Clinic attenders	1996	69% (326)	NCHECR, 1998
IDUs	Qld	Trawler Crew	1996	55% (20)	MacDonald et al, 1998
Needle exchange sites	NT	NSP attenders	1998	54%[2] (87)	Roberts and Crofts, 2000
Needle exchange sites	NT	NSP attenders	1998	36%[2]	Roberts and Crofts, 2000

1. Testing with in-house non-specific peptide assay
2. Self-reported HCV status

Table 3. Incidence of HCV among injecting drug users in Australia

Source , site	Year	Seroconverters N	(%)	Incidence per 100 pyrs	(95% CI)	Reference
Prison entrants, Victoria	1991-92	8	(17%)	38.2	(19.1, 76.4)	Crofts et al, 1995
STD clients 'ever injected' Adelaide	1991-93	2	(3%)	3.5	(0.4, 12.7)	Waddell, 1994
Methadone clients, SA	1991-93	1	(33%)			Gaughwin et al, 1994
Field recruited IDUs, Victoria	1990-91	5		16.6	(6.9, 40)	Crofts and Aitken, 1997
	1992-93	8		10.9	(5.5, 21.8)	
	1994-95	6		8.1	(3.6, 18.0)	
Clinic attenders (KRC), Sydney	1992-93	12	(13%)	18.9	(8.2, 29.5)	van Beek et al, 1998
	1994-95	19	(15%)	22.5	(12.4, 32.6)	
	1996	15		12.2	(6.8, 20.1)	NCHECR, 2001
	1997	20		17.6	(10.7, 27.0)	
	1998	20		20.5	(12.5, 31.6)	
	1999	12		16.8	(8.7, 29.5)	
	2000	6		16.9	(6.2, 36.8)	
Methadone clients, Melbourne	1991	2		33.3	(8.3, 133)	Crofts et al, 1997a
	1992	2		10.3	(4.6, 23)	
	1993	9		34.0	(18, 65)	
	1994	6		24.0	(11, 53)	
Methadone clients, Brisbane	1994-95	5		10.6	(2, 20)	Selvey et al, 1997
NSP sites, All States	1997-98	5	(10%)	10.8	(3.5, 28)	MacDonald, 2001

Table 4. Prevalence of HCV antibody among populations other than IDUs in Australia

Populations	Site	Source	Year	Prevalence (N)		Reference
Antenatal patients	Victoria	Provincial hospital	1989	0.4%	(252)	Fairley et al, 1990
	Geelong	Geelong Hospital	1990	3%	(99)	Williamson et al, 1990
	Adelaide	Lyell McEwin	1995	1.1%	(1537)	Garner et al, 1997
	Australia	Survey obstetricians	1999	1.3%[1]		Spencer et al, 2002b
Blood donors	WA	Donations	1987-89	0.7%	(1843)	Ismay et al, 1995
	NSW	Donations	1987-89	0.8%	(1592)	Ismay et al, 1995
	Geelong	Donors	1990	0.4%	(280)	Williamson et al, 1990
	Sydney	All donations	1990-91	0.4%	(217020)	Archer et al, 1992
	Sydney	First time donors	1990-91	1.0%	(94970)	Archer et al, 1992
	Victoria	All donors	1990-97	1.0%	(326556)	Wong et al, 1999
	Brisbane	First time donors	1994-95	0.5%	(34725)	Mison et al, 1997
Renal transplants	Melbourne	Two hospitals	1989	6.9%	(261)	Williamson et al, 1990
Dialysis patients	Melbourne	Two hospitals	1989	5.9%	(205)	Williamson et al, 1990
People with haemophilia	Melbourne	Patients	1987-1989	75.6%	(176)	Williamson et al, 1990
Prisoners	Victoria	All entrants	1991-92	39%[2]	(3269)	Crofts et al, 1995
	Victoria	Non-IDU entrants	1991-92	16%[2]	(1712)	Crofts et al, 1995
	Sydney	All entrants	1994	37%	(408)	Butler et al, 1997
	Sydney	Non-IDU entrants	1994	7.3%	(192)	Butler et al, 1997
	NSW	Inmates	1996	39%	(789)	Butler et al, 1999
	NSW	Non-IDU inmates	1996	13%	(444)	Butler et al, 1999
	Darwin	Inmates	1994-98	8.7%	(2647)	Huffam et al, 1999
	NSW	Inmates	1999	47%	(4032)	Awofeso et al, 2000
	WA	Male inmates	2001	23%	(322)	Watson, 2002
		Female inmates	2001	46%	(50)	Watson, 2002
Juvenile Centre	Melbourne	All residents	1995	23%	(83)	Ogilvie et al, 1999
	Melbourne	Non-IDU residents	1995	0%	(30)	Ogilvie et al, 1999
Health care workers	All States except NT	Tested following occupational exposure	1995-97	0.7%	(2571)	NCHCER, 1998

1. HCV prevalence in antenatal patients estimated from survey responses
2. Testing with in-house non-specific peptide assay

Table 5. HCV genotype prevalence rates in Australia

Year	Site	N	HCV-genotype 1	2	3	4	5	6	Reference
1971	Melbourne	18	60%	30%	10%	0%	0%	0%	Moaven et al, 1996
1974-75	Sydney	72	92%	6%	1%	0%	1%	0%	Freeman et al, 2000
1994	Melbourne	68	52%	5%	27%	-	-	-	Moaven et al, 1996
1994-96	Sydney	77	69%	6%	25%	0%	0%	0%	Freeman et al, 2000
1994-96	Victoria	500	55%	7%	38%	1%	0%	0%	McCaw et al, 1997
1990s	Sydney	420	52%	9%	32%	6%	0%	2%	Kaba et al, 1998

Table 6. Estimated number of injecting drug users and dependent heroin users in Australia

Method	Data source	Year	Number (lower, upper limits)	Reference
Estimates of number of injecting drug users				
Household surveys	National Drug Strategy Household Survey	1993	255,000 ever injected 70,000 injected in last 12 months	CDHHS, 1996
		1995	190,000 ever injected 85,000 injected in last 12 months	CDHHS, 1996
		1998	330,000 ever injected 110,000 injected in last 12 months	AIHW, 1999
Delphi	Expert opinion	1997	100,000 regular IDUs (80,000 to 120,000) 175,000 occasional IDUs (120,000 to 240,000)	Law, 1999
Estimates of number of dependent heroin users				
Multiplier method	Various	1984-87	34,000 (25,000 to 86,000)	Hall, 1995
		1988-92	59,000 (49,000 to 150,000)	Hall, 1995
	Overdose deaths	1997	74,000	Hall et al, 2000
	Methadone entrants	1997	68,000	Hall et al, 2000
Back projection	Overdose deaths	1967	670 (460 to 1,100)	Law et al, 2001
		1977	7,000 (5,000 to 11,000)	
		1987	30,000 (19,000 to 51,000)	
		1997	67,000 (39,000 to 120,000)	
Back projection	Methadone entrants	1977	4,000 (2,000 to 6,000)	Law et al, 2001
		1987	29,000 (18,000 to 44,000)	
		1997	71,000 (47,000 to 109,000)	
Capture-recapture	Methadone maintenance	1995-98	82,000 (68,000 to 109,000)	Lynskey et al, 2002
	Heroin arrests	1997-98	86,000 (78,000 to 102,000)	

Table 7. Rates of liver disease progression

	Stage 0/1 to stage 2/3	Stage 2/3 to cirrhosis
Not chronic HCV	0%	0%
Chronic HCV, normal ALT	1%	1%
Chronic HCV, abnormal ALT	2%	2%
Chronic HCV, abnormal ALT and further cofactors	3%	3%

Note: Stage 0=no hepatic fibrosis, stage 1=minimal hepatic fibrosis; stage 2=moderate hepatic fibrosis; stage 3=severe hepatic fibrosis; stage 4=cirrhosis.

Table 8. Estimates of HCV incidence and prevalence in 2001 by State/Territory

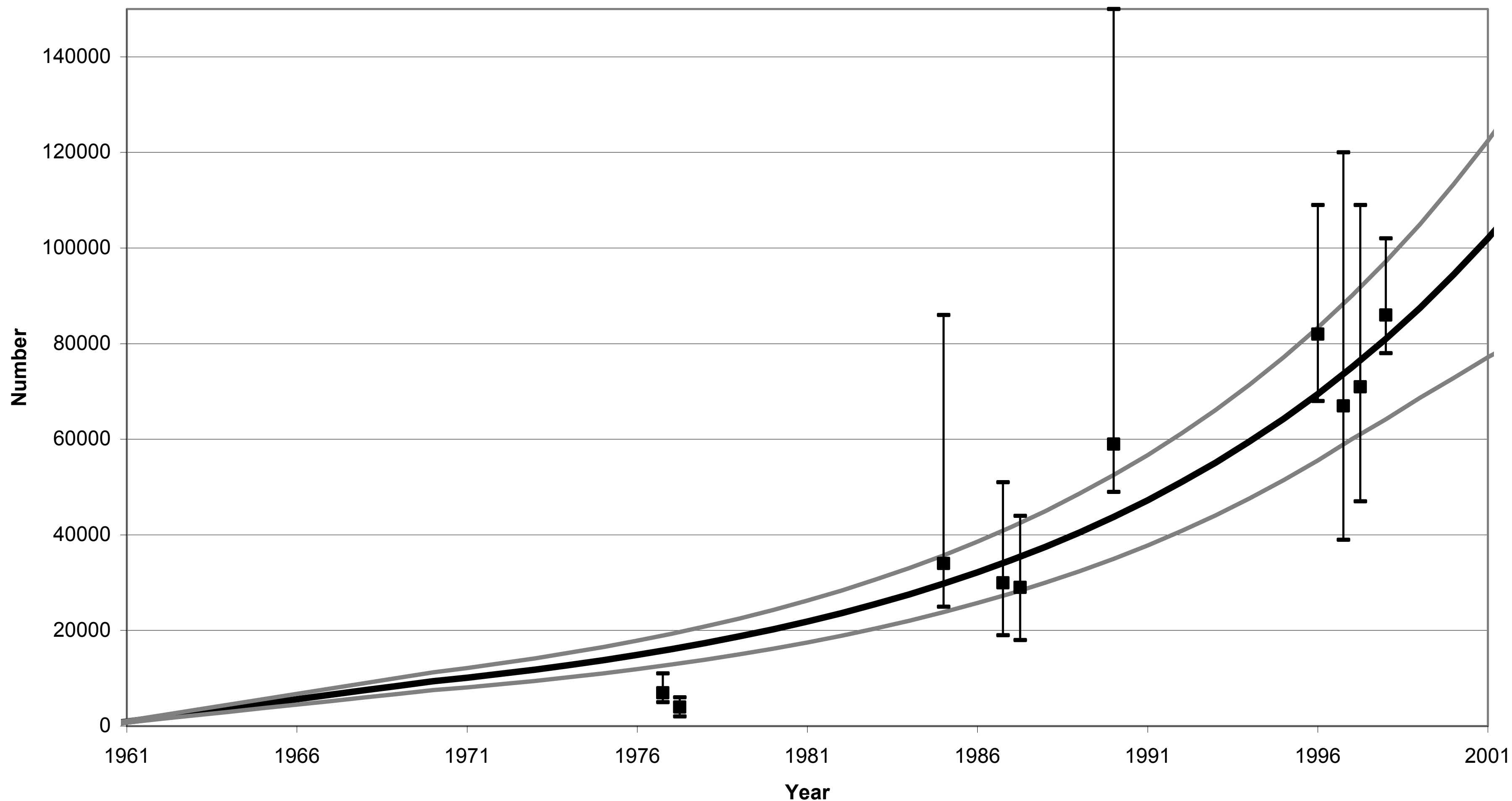
	State / Territory								
	ACT	NSW	NT	QLD	SA	TAS	VIC	WA	Total[1]
Indicators of HCV incidence and prevalence									
National HCV notifications 1995-2000 (DoHA, 2002)									
	1.6%	38.4%	1.3%	16.4%	5.0%	1.6%	29.1%	6.6%	108,495
Opioid overdose deaths 1988-2000 (NDARC, 2002)									
	1.2%	47.6%	0.5%	6.9%	6.1%	0.7%	29.0%	8.1%	6,394
Arrests for heroin, amphetamines or cocaine 2000-01 (ABCI 2002)									
	0.7%	33.2%	1.1%	14.6%	5.7%	0.4%	31.6%	12.7%	16,899
Composite indicator of HCV incidence and prevalence[2]									
	1.2%	39.7%	1.0%	12.6%	5.6%	0.9%	29.9%	9.1%	100%
HCV incidence in 2001 by State/Territory									
	200	6,400	160	2,000	900	140	4,800	1,500	16,000
Numbers of people living with HCV in 2001 by State/Territory									
	2,500	83,000	2,100	26,500	12,000	1,900	63,000	19,000	210,000
Numbers living with chronic HCV and early (stage 0/1) liver disease									
	1,500	49,000	1,200	15,500	7,000	1,100	37,000	11,000	124,000
Numbers living with chronic HCV and moderate (stage 2/3) liver disease									
	320	11,000	270	3,400	1,500	240	8,000	2,500	27,000
Numbers living with cirrhosis									
	80	2,600	65	800	350	60	1,900	600	6,500

1. Rows may not sum to totals due to rounding
2. Composite indicator calculated as average of three individual indicators

Table 9. Estimated quality of life years lost to HCV-infection in Australia in 2001 by stage of liver disease

		Percentage	Person years in 2001 (lower/upper limits)	QALY adjustments	QALYs lost (lower/upper limits)
Mild chronic HCV	Undiagnosed	40%	50,000 ***(37,000 to 60,000)***	0.94	3,000 ***(2,200 to 3,600)***
	Diagnosed	60%	74,000 ***(55,000 to 89,000)***	0.82	13,400 ***(9,900 to 16,000)***
Moderate chronic HCV	Undiagnosed	25%	7,000 ***(5,000 to 8,000)***	0.94	400 ***(300 to 500)***
	Diagnosed	75%	20,000 ***(15,000 to 24,000)***	0.82	3,600 ***(2,700 to 4,300)***
Compensated cirrhosis	Undiagnosed	20%	1,000 ***(800 to 1,300)***	0.84	160 ***(130 to 200)***
	Diagnosed	80%	4,100 ***(3,200 to 5,100)***	0.74	1,100 ***(800 to 1,300)***
Liver failure[1]	Diagnosed	100%	1,300 ***(1,000 to 1,600)***	0.32	880 ***(680 to 1,100)***
HCC	Diagnosed	100%	50 ***(40 to 60)***	0.10	45 ***(35 to 55)***
Total			210,000 ***(157,000 to 252,000)***		22,500 ***(17,000 to 27,000)***

1. Person years of liver failure in 2001 calculated as cumulative incidence of liver failure and HCC minus cumulative HCV-related mortality, which assumes average duration of survival with HCC is around 12 months.



Best modelled estimates in black, lower and upper limits in grey (see section 4.1.1 for details). See Table 6 for references.

Figure 2. Modelled numbers of regular and occasional IDUs 1961 to 2001

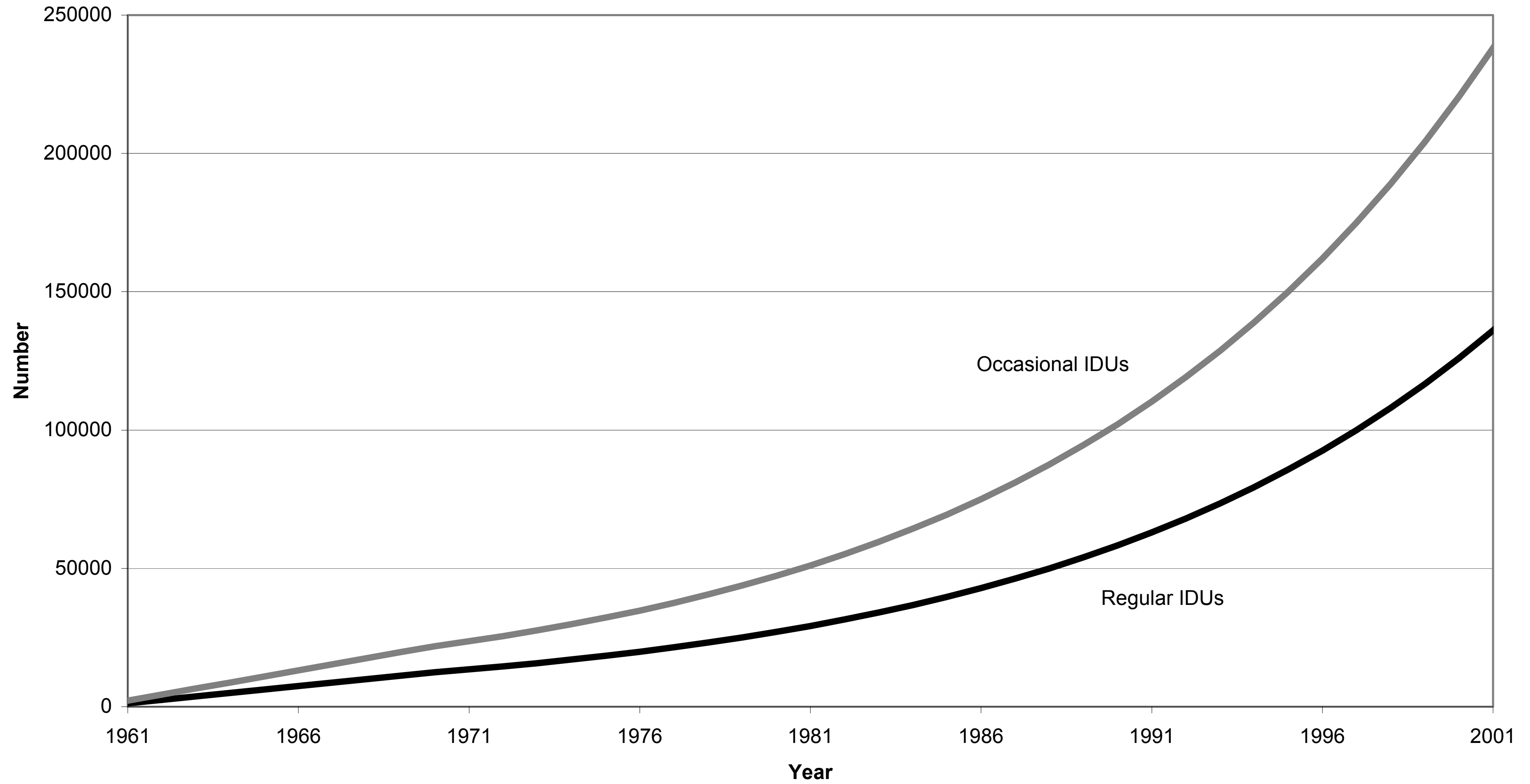
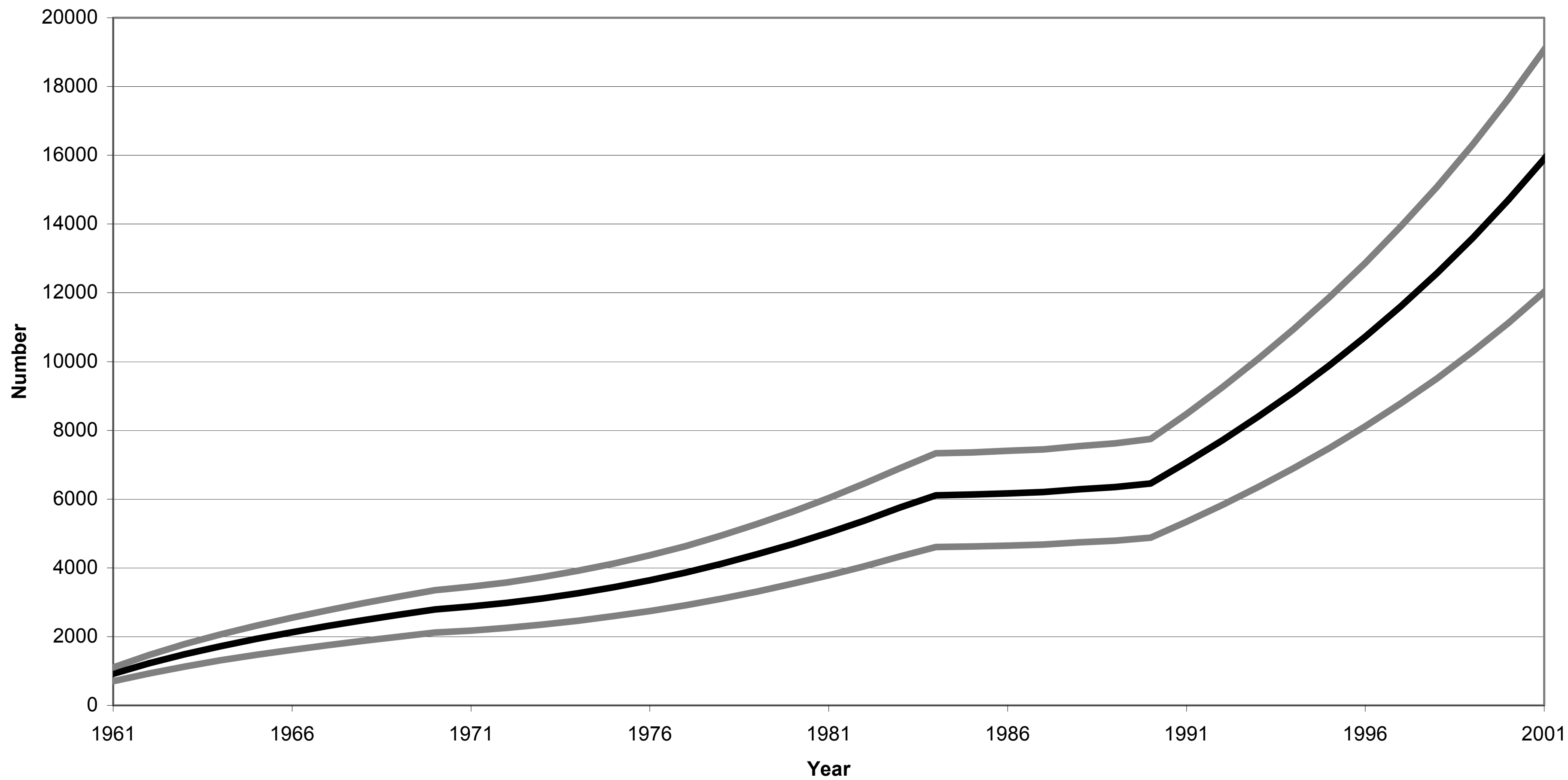


Figure 3. Modelled HCV incidence 1961 to 2001



Best estimates in black, lower and upper limits in grey (see section 4.1.3 for details)

Figure 4. Estimated number of people living with HCV by stage of disease 1961 to 2001

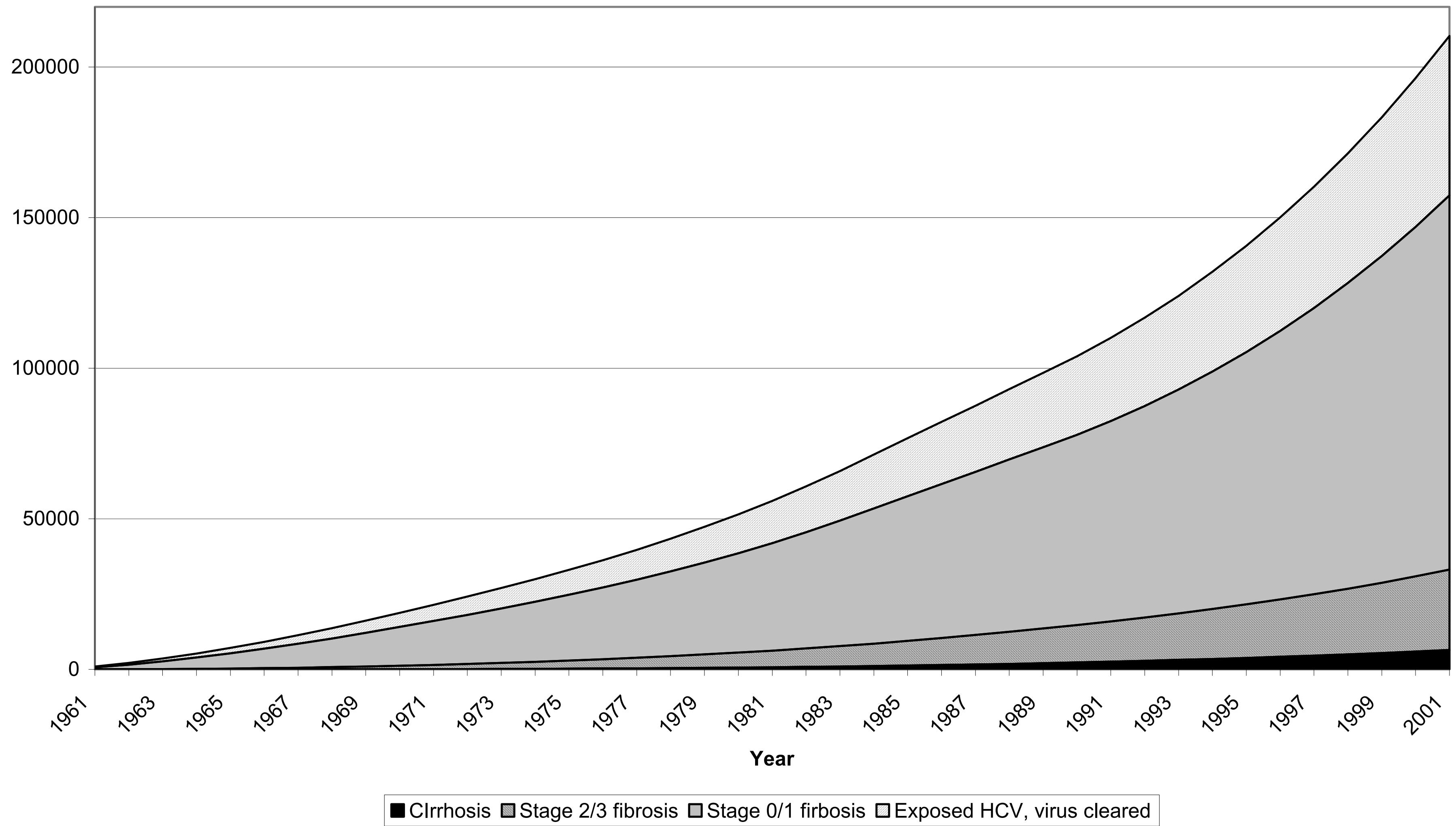
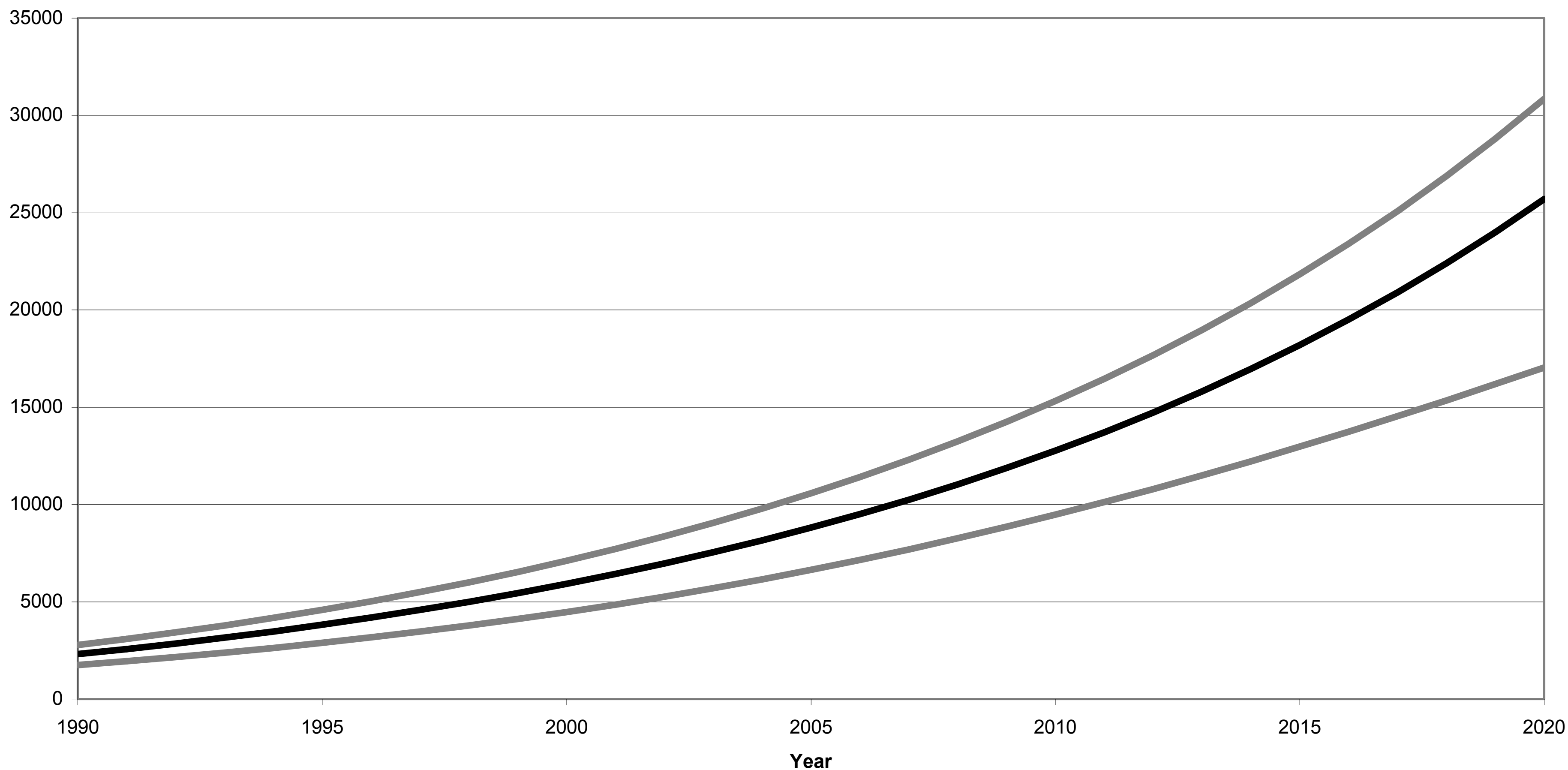
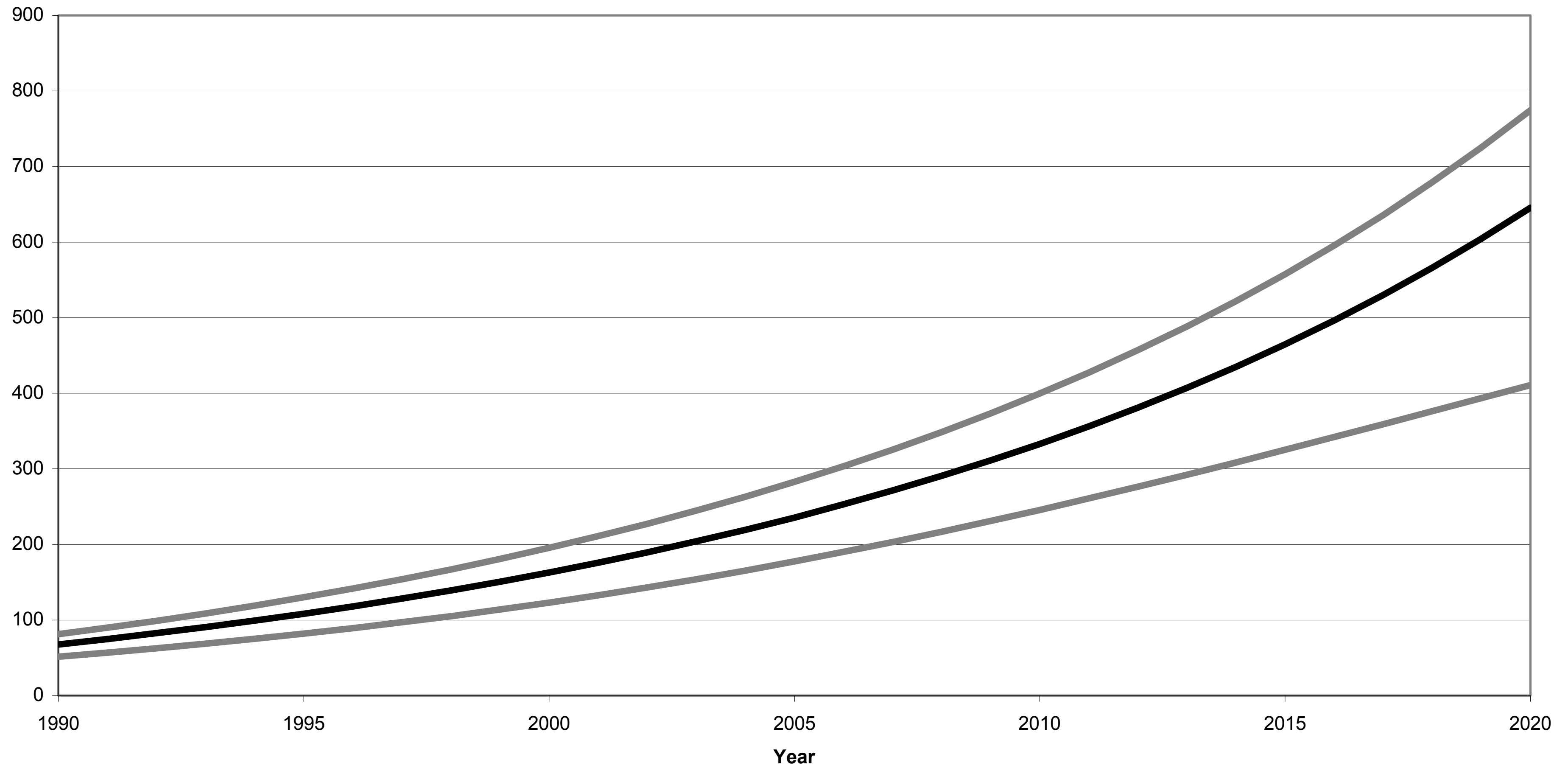


Figure 5a. Estimated number of people living with HCV-related cirrhosis 1990 to 2020



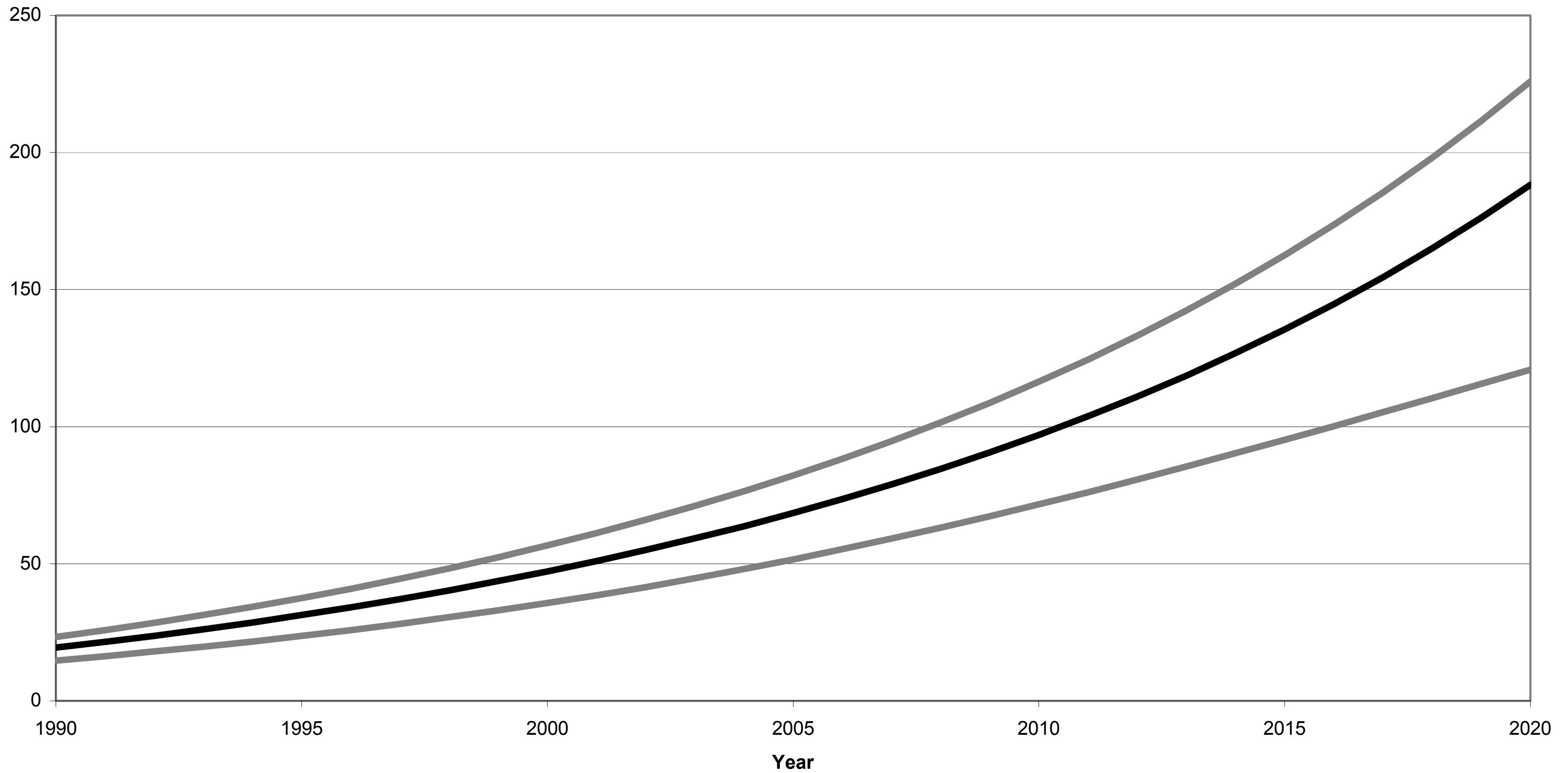
Best estimates in black, lower and upper limits in grey (see section 4.2.1 for details)

Figure 5b. Estimated annual number of HCV-related liver failures 1990 to 2020



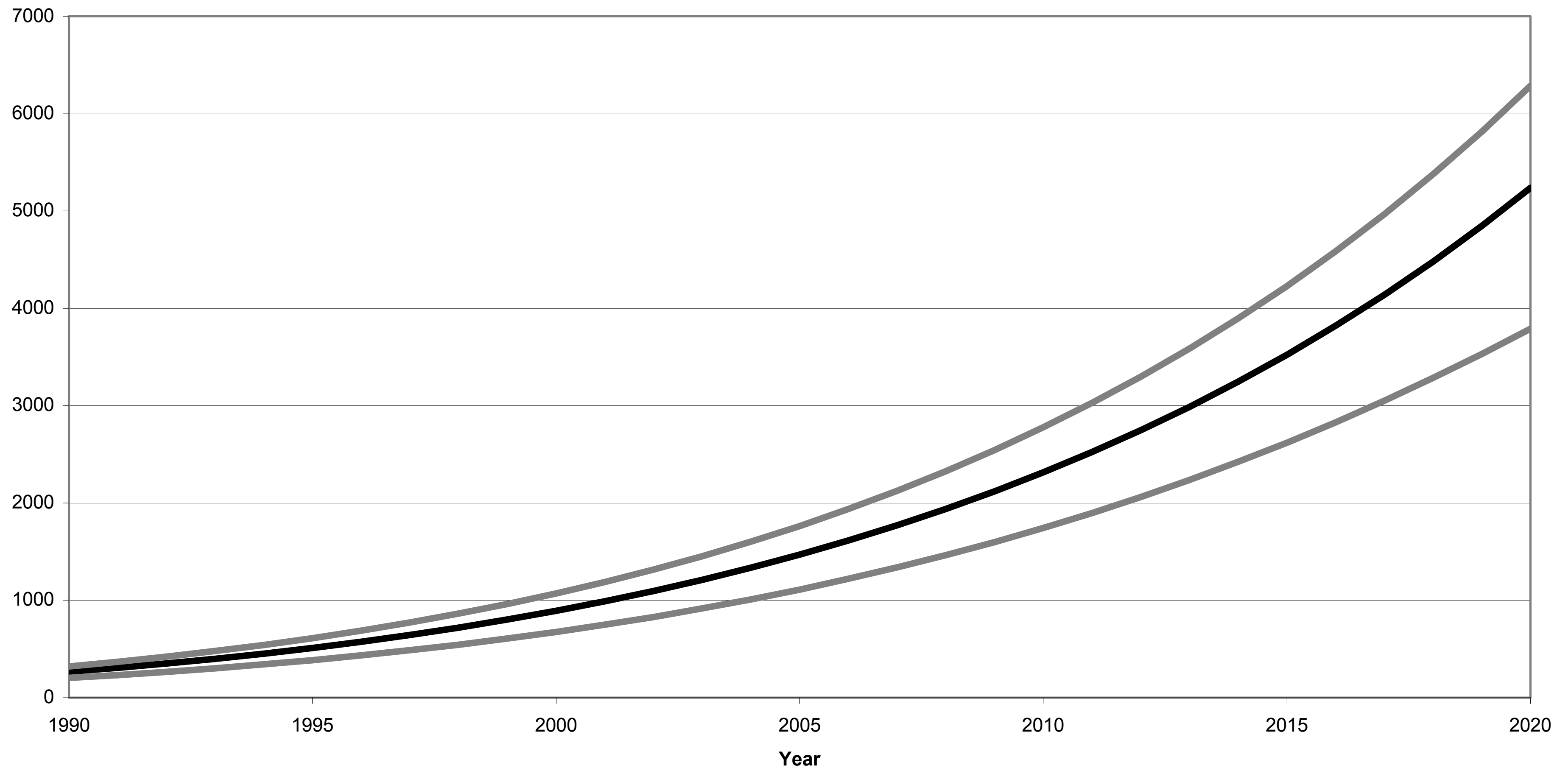
Best estimates in black, lower and upper limits in grey (see section 4.2.1 for details)

Figure 5c. Estimated annual number of HCV-related cases of HCC 1990 to 2020



Best estimates in black, lower and upper limits in grey (see section 4.2.1 for details)

Figure 5d. Cumulative HCV-related mortality 1990 to 2020



Best estimates in black, lower and upper limits in grey (see section 4.2.1 for details)

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