Hepatitis B virus: epidemiology and transmission risks

Hepatitis B virus (HBV) infection is a serious and common infectious disease of the liver, affecting millions of people throughout the world. The incubation period for HBV is 45-180 days, most commonly 60-90 days.¹

Clinical information
Acute infection is clinically recognised in only a small proportion of cases; less than 10% of children and 30-50% of adults show icteric disease. In those with clinical illness, the onset is usually insidious, with anorexia, vague abdominal discomfort, nausea and vomiting, sometimes arthralgia and rash, often progressing to jaundice. Following acute HBV infection, the risk of developing chronic infection varies inversely with age. Chronic HBV infection occurs among about 90% of infants infected at birth, 25-50% of children infected at 1-5 years of age and about 1-10% of persons infected as older children and adults. An estimated 15-25% of persons with chronic HBV infection will die prematurely of either cirrhosis or hepatocellular carcinoma.¹

Vaccination
HBV can be effectively prevented by vaccination. A safe and effective vaccine has been available since the 1980s. The complete vaccine series induces protective antibody levels in more than 95% of infants, children and young adults. After age 40, protection following the primary vaccination series drops below 90%. Protection lasts at least 20 years and should be lifelong.² Since 2008, hepatitis B vaccine has been included in the childhood immunisation programme in Ireland, alongside the targeted immunisation programme for those individuals who are at increased risk of HBV because of their occupation, lifestyle or other factors. These include healthcare workers (HCW), prison and security personnel, contacts of cases, people who inject drugs, people with certain medical conditions, clients in learning disability centres, people with multiple sexual partners, men who have sex with men, prisoners, and travellers to and immigrants from HBV endemic areas.³

Transmission
HBV has been found in virtually all body secretions and excretions. However, only blood, body fluids containing visible blood, semen and vaginal secretions represent a risk of transmission.⁴ HBV is transmitted by percutaneous and mucosal exposure to infective blood or body fluids. Major modes of HBV transmission include sexual or close household contact with an infected person, perinatal mother to infant transmission, injecting drug use and nosocomial exposure.¹

Percutaneous exposures that have resulted in HBV transmission include transfusion of unscreened blood or blood products, sharing unsterilised injection needles for IV drug use, haemodialysis, acupuncture, tattooing and injuries from contaminated sharp instruments sustained by hospital personnel.⁵

HBV is stable on environmental surfaces for at least 7 days and is 100 times more infectious than HIV.

Serological markers for HBV
HBsAg: Hepatitis B surface antigen is a marker of infectivity. Its presence indicates either acute or chronic infection.

HBeAg: Hepatitis B e antigen is a marker of a high degree of infectivity and correlates with a high level of HBV replication.

Anti-HBs: Antibody to hepatitis B surface antigen is a marker of immunity, either an immune response to HBV infection or to vaccination.

Anti-HBc: Antibody to hepatitis B core antigen is a marker of HBV infection.

Prevalence of HBV infection in Ireland, Europe and the world

Ireland
The prevalence of HBV in the general population in Ireland is low. However, HBV is more prevalent in certain sub-groups of the population.⁶ The prevalence of HBV is higher in injecting drug users, people born in countries of intermediate (2-7%) or high (>8%) hepatitis B endemicity, MSM, people with multiple sexual partners, household or sexual contacts of known cases.⁷

The prevalence of HBV infection is generally lowest in the blood donor population, followed by the general population, then pregnant women, then high-risk groups. To determine the risk of HBV in migrant populations, it is necessary to look at data on their country of origin.

The World Health Organization has classified Ireland as a country of low prevalence for HBV, i.e. prevalence of HBsAg <2%.⁸ The European Centre for Disease Prevention and Control (ECDC) carried out a literature review in 2010 of publications dated 2000-2009 on the prevalence of viral hepatitis in Europe.⁹ It reported that the HBsAg prevalence in the general population in Ireland is estimated to be 0.1%. Ireland and the Netherlands have the lowest prevalence of HBV infection in Europe. It also reported that the HBsAg prevalence rates in blood donors and pregnant women in Ireland are among the lowest rates in Europe.
Low risk populations in Ireland

General population
A European HBV seroprevalence study using residual sera showed a low prevalence in Irish samples collected in 2003 (anti-HBc 1.7%, HBsAg 0.1%). A national study of oral fluid samples collected by postal survey in 1998-1999 estimated anti-HBc prevalence in Ireland to be 0.51%.

Blood donors
Of 313,019 first time blood donors tested by the IBTS between 1997 and 2015, 34 (0.011%) were found to be HBsAg positive. (Personal communication, Dr Joan O’Riordan, IBTS, July 2016).

Pregnant women
Routine antenatal testing for HBsAg was introduced in the Rotunda Hospital in 1998. Uptake was almost 100% and >16,000 pregnancies were screened between January 1998 and June 2000. This showed a HBsAg prevalence of 4.2% in non-EU women and 0.03% in Irish women tested. Screening of >24,000 pregnant women in the West of Ireland in 2004-2009 demonstrated a prevalence of HBsAg of 0.21%, and all positive women were thought to be of non-Irish origin.

High risk populations in Ireland

Prisoners
A national cross sectional survey of Irish prisoners in 1998 showed a prevalence of anti-HBc of 8.7% total, and of 18.5% in prisoners who were people who inject drugs.

People who inject drugs
A cross-sectional study of 316 opiate users attending 21 addiction treatment centres in the HSE East was carried out between Dec 2001 and Jan 2002. The prevalence of HBsAg was 2% and of anti-HBc was 17%.

Homeless people
Homeless people also have evidence of increased exposure to HBV, with a prevalence of anti-HBc of 9% in a study performed in Dublin in 1999-2000.

Asylum seekers
Screening of asylum seekers in the HSE eastern region 1999-2003 found a prevalence of HBsAg of 5%.

Trends in hepatitis B infection in Ireland

Hepatitis B is a notifiable disease in Ireland. There was a dramatic increase in annual HBV notifications between 1997 (31 cases) and 2008 (919 cases), mostly attributable to large numbers of people immigrating to Ireland from HBV endemic countries. Between 2000 and 2010, 95% of asylum applicants, and 73% of new work permit recipients, were from countries with intermediate or high HBV endemicity. The number of hepatitis B cases reported in Ireland increased by 5% in 2014 with 445 cases (9.7/100,000) compared with 425 cases in 2013. However, there has been a general downward trend in the number of reported cases since peak levels in 2008 (n=901). The trend (a decline since the peak in 2008 with an increase in 2014) correspond to immigration trends in Ireland during the same period. Between 2010 and 2014, 8% of reported cases of hepatitis B were acute and 92% were chronic. The majority of acute cases of hepatitis B were sexually acquired. Where reported, the risk factors for chronic infection included, born in an endemic country (69%), sexually acquired (13%) and vertical transmission (5%).

Hepatitis B infection in Europe

Although there is a decreasing trend in HBV, each year there are between 7,000 and 8,000 newly diagnosed cases of HBV in the EU/EEA region. There has been a steady downward trend in the reported rates of acute cases in Europe that is likely related to the impact of vaccination campaigns. 99% of countries have integrated HBV into routine immunisation (2014). The total percentage of people infected with HBV varies between different countries, with higher rates in the southern part of Europe. The country with the highest prevalence (>4%) is Romania followed by medium prevalence countries (>1-2%), Spain, (parts of) Italy, and Greece. Countries with a low prevalence (<1%) include Belgium, the Czech Republic, Finland, Germany, Ireland, Netherlands, Slovakia and Sweden.

The most severely affected population groups are people who inject drugs, sex workers, men who have sex with men, people living with HIV, inmates, and immigrants from high-endemic regions. In some countries, sexual transmission is more common than transmission through household contacts or injecting drug use.

In 2013, 19,101 cases of hepatitis B infections were reported in 28 EU/EEA member states, a crude rate of 4.4 / 100,000 population.

Maps of HBV prevalence in different population groups by country in Europe are available in the ECDC Technical Report.

Global distribution
The global prevalence of chronic HBV infection (based on % of population HBsAg positive) is as follows:
High prevalence (≥8%): sub-Saharan Africa, South-East Asia, the Eastern Mediterranean countries, south and western Pacific islands, the interior of the Amazon basin and certain parts of the Caribbean.

Moderate prevalence (2–7%): in south-central and south-west Asia, eastern and southern Europe, the Russian Federation and most of central and South America.

Low prevalence (<2%): Australia, New Zealand, northern and western Europe, and North America.

Transmission risks
The hepatitis B virus can survive outside the body for at least 7 days. Several factors influence the risk of transmission of HBV infection, including the viral load of the source.

In a healthcare occupational context, the level that is regarded as “high” for a viral load differs in various regions. In America and Ireland, HCWs who are infected with HBV but have a circulating viral burden <10⁴ genome equivalents/ml are allowed to continue working unrestricted. Transmission of HBV via a percutaneous route is considered unlikely at HBV DNA levels below 10⁷ genome equivalents/ml.

Needlestick injuries
Those who are e antigen positive generally have higher viral loads, and the transmission rate of HBV following a needlestick injury from a source who is e antigen positive is estimated to be between 30% and 62%. The same injury with exposure to blood from a source who is e antigen negative is associated with 6-37% risk of serological evidence of HBV infection in the recipient. Some patients are infected with pre-core mutant viruses. This is associated with a high viral load in the absence of the e antigen, and thus is also associated with a high risk of HBV transmission.

The risk from needlestick injuries in the community is more difficult to estimate and the exact incidence of needlestick injuries and the transmission rate is unknown. The limited published case reports would indicate that there is a very low risk of HBV transmission associated with community acquired needlestick injuries.

Other healthcare setting exposures
Spring loaded lancets have been implicated in the transmission of HBV to patients as have reusable sub-dermal EEG electrodes. There is a report of transmission of HBV to a patient during an endoscopic procedure, although no biopsies were taken, but bleeding gastric ulceration was identified. The presumed source was HBeAg positive.

Cleveland et al report that HBV infection prevalence in dentists increases with longer duration in practice. Although rates in a reference control population were not included in this report, increasing prevalence with longer duration of practice indicates that there is potential for transmission to dentists during their work.

Other percutaneous exposures
There are case reports documenting the transmission of HBV among butchers. These are attributed to small hand cuts, and sharing knives, which can carry the virus on the handle. It is also thought that HBV can be transmitted via small cuts acquired in barber shops.

Body fluid exposures
HBV DNA has been detected in body fluids apart from blood, including saliva, urine, nasopharyngeal fluid, semen, cervicovaginal fluids and tears. HBV transmission can occur following exposure to non-intact skin and mucous membranes. A case report describes transmission of HBV via broken skin, following contact with saliva and nasopharyngeal fluids from the source.

Human bites
Case reports have documented HBV virus transmission via a human bite, when associated with the skin being broken.

Sexual exposures
HBsAg has been found in seminal fluid and vaginal secretions, although concentrations in these fluids are lower than in blood. The risk of transmission of HBV following sexual exposure depends on the type of exposure, the viral load of the source, and the presence of sexually transmitted infections. The prevalence of HBV in heterosexuals is increased in those with multiple sexual partners, and those who have markers for HIV or syphilis. An infection rate of 18-44.2% is seen in regular heterosexual partners of HBV infected patients. In addition, female commercial sex workers with a history of having anal intercourse had an increased risk of HBV infection. The risk of developing HBV infection is particularly high among men who have sex with men. For men who have sex with men, the prevalence of HBV infection is increased in those who have a history of an ulcerative sexually transmitted infection, chlamydia, gonorrhoea, commercial sex work, or multiple partners. There is also a significant risk associated with unprotected insertive anal intercourse.
## Hepatitis B transmission risk by exposure type

<table>
<thead>
<tr>
<th>Exposure</th>
<th>Risk per exposure (unless otherwise stated)</th>
</tr>
</thead>
</table>
| Needlestick                                   | **Exposure** Healthcare setting, patient known **Risk per exposure** HBeAg (+) = 37-62% risk of serologic evidence of infection in recipient  
                                               **HBeAg (-) = 23-37% risk of serologic evidence of infection, 1-6% clinical infection** |
| Healthcare setting, patient unknown, or patient known but serology unknown | Requires risk assessment                                                                                   |
| Community setting                              | 2 case reports only. Risk very low. Requires risk assessment. For example, if the local PWID population has a seroprevalence of 50%, the risk from a community acquired needlestick is 12-31%. Note: seroprevalence in PWID in Ireland is lower than 50% - see epidemiology section. |
| Other percutaneous injuries with blood exposure| **Exposure prone procedure by infected healthcare worker** Transmission rates vary between 6 and 15% most were before standard precautions introduced |
| Transfusion                                    | 52-69% transmission if transfused with HBsAg (+) blood |
| Human bites                                    | Risk negligible in the absence of visible blood. Case reports only. Requires risk assessment.               |
| Percutaneous exposure to other body fluids (e.g. saliva) | Very low risk. Case reports - HBeAg (+) source. Requires risk assessment.                                |
| Sexual exposures                               | **Heterosexual exposures in general** Infection rate seen in regular partners of HBV infected people       |
|                                               | Increased risk if: multiple partners, syphilis, gonorrhoea, receptive anal intercourse | |
|                                               | **Men who have sex with men** Increased risk of HBV transmission associated with ulcerative STI, gonorrhoea/chlamydia, sexual partner with HIV/AIDS, multiple sexual partners, commercial sex work, history of insertive anal intercourse |
|                                               | **Receptive oral sex (fellatio)** Possible means of transmission |

### Risk assessment
- **Type/details of injury** – as above
- **Source status** – increased risk with HBeAg, high viral load
- **Recipient status** – increased risk if immunocompromised
- **For unknown source, consider where injury occurred** – community setting versus hospital setting
  - If in hospital – consider high-risk ward/patients
  - If in community – consider prevalence of HBV and of PWID locally
EMI Guidelines - Appendix 21 Hepatitis B virus: epidemiology and transmission risks (updated May 2016)

References

toot.html,en.pdf
Maps of global distribution of hepatitis B infection

Prevalence of hepatitis B worldwide

![Map of global distribution of hepatitis B infection]


Prevalence of hepatitis B surface antigen in people who inject drugs worldwide

![Map of global distribution of hepatitis B infection in people who inject drugs]

Hepatitis C virus: epidemiology and transmission risks

Hepatitis C infection is caused by an RNA virus that was first identified in 1989. Chronic hepatitis C infection is a major cause of chronic liver disease and death throughout the world. Approximately 3% of the world’s population is infected with hepatitis C virus (HCV). Six distinct but related genotypes and multiple subtypes have been identified. In western Europe genotypes 1a and 1b are most common, followed by genotypes 3 and 2.

Transmission

HCV is transmitted by blood and now occurs primarily through injecting drug use, and less frequently through sex with an infected partner, occupational exposure, and maternal-foetal transmission. In some cases no risk factors can be identified. Transfusion-related HCV infection is rare now since the introduction of routine screening of blood for HCV antibodies in the early 1990s.

Clinical information

In general, acute HCV infection is relatively mild, with only 20-30% of infected persons developing symptoms or clinically evident acute infection. In most persons who become infected with HCV, viraemia persists. Antibody to HCV (anti-HCV) is present in acute, chronic and resolved infection. HCV RNA/HCV Ag is an indication of HCV viraemia. Chronic HCV infection is marked by persistence of HCV RNA for at least 6 months after onset of infection. Spontaneous resolution after 6 or 12 months of infection is unusual. Between 55 and 85% of those infected develop chronic infection. Chronically infected people are at risk for progressive liver disease characterised by hepatocellular inflammation, hepatic fibrosis, cirrhosis and hepatocellular carcinoma (HCC). These complications develop only in a proportion of patients and only after many years or decades of infection. It has been estimated that up to 20% of chronically infected individuals will develop cirrhosis of the liver over a 20 to 25 year period, and that, of patients with cirrhosis, approximately 3% to 4% will develop HCC per year. Factors that have been shown to be associated with progression of liver fibrosis include older age at infection, male gender, genetic factors, metabolic factors (steatosis, diabetes and obesity), co-infection with human immunodeficiency virus (HIV) or hepatitis B, duration of infection, and alcohol intake.

Highly effective all-oral treatment with direct-acting antivirals is now available in Ireland. This eradicates the virus in over 90% of cases.

Prevalence of HCV infection in Ireland, Europe and the world

Ireland

A previous study has estimated that the prevalence of chronic HCV infection in Ireland is 0.5-1.2%. This study took undiagnosed cases into account. More recent estimates of levels of undiagnosed hepatitis C in Ireland indicate the overall prevalence of hepatitis C in Ireland is more likely to be between 0.5 and 0.7% (23,000 to 32,000). This is similar to other countries in northern Europe and in line with the WHO estimate of <1%. However, it is more prevalent in certain sub-groups of the population, in particular people who inject drugs (PWID) and prisoners. HCV may also be more prevalent in immigrants to Ireland from endemic countries.

Blood donors

Of 313,019 first time blood donors tested by the IBTS between 1997 and 2015, 48 (0.015%) were found to be HCV positive. (Personal communication, Dr Joan O’Riordan, IBTS, July 2016).

Asylum seekers

Screening of asylum seekers in the HSE eastern region 1999-2003 found a prevalence of anti-HCV of 1.5%. A reception centre in HSE East, reported that 1% of those tested under the voluntary health screening programme, between 2004 and 2012, were positive for chronic HCV infection.

Prisoners and people who inject drugs

Studies of PWID in prisons and PWID attending methadone clinics, specialist addiction treatment centres and GPs have estimated the HCV prevalence in this population to be between 62% and 81%.

A national cross sectional survey of Irish prisoners in 1998 showed a prevalence of anti-HCV of 37% of all prisoners, and of 81.3% in prisoners who were prisoners who inject drugs.

More recently, a 2011 prison study found that 54% of prisoners with a history of injecting heroin were anti-HCV positive and 41.5% of prisoners with a history of injecting any drugs were anti-HCV positive.
**Trends in HCV in Ireland**

Hepatitis C became a notifiable disease in Ireland in 2004. Between 2004 and 2015, 13,478 cases were notified. The highest annual number of notifications was in 2007 (n=1539). There has been a significant decrease in recent years and 678 cases were notified in 2015. Two thirds of cases were male and most were young to middle aged adults (median age: 34 years, mean age: 36.1 years). Where risk factor information was available, over 80% of cases between 2007 and 2015, were among people who inject drugs.9

**HCV in Europe**

In Europe, HCV infection shows a significant increasing trend in reported numbers. Every year there are 27,000 to 29,000 newly diagnosed cases in the EU/EEA.16

A recent systematic literature review of HCV prevalence in Europe, based on information from 14 countries, reported a prevalence range of 0.4-3.5%.16 The prevalence is higher in the southern part of Europe. Countries with high prevalence (more than 2%) include Italy, Romania and Spain. Medium prevalence was observed in Bulgaria, France, Greece, and Poland. Countries with low prevalence (less than 1%) include Belgium, Germany, the Netherlands, Sweden, and the United Kingdom.15

The most severely affected population groups are people who inject drugs, haemodialysis patients, persons living with HIV, inmates, and immigrants from high-endemic regions. Reported numbers are likely to reflect the current testing and screening practices in countries rather than the real incidence of infection. The reported number is an underestimate of the real occurrence of HCV due to the asymptomatic nature of the infection.15

Maps of HCV prevalence in different population groups by country in Europe are available in the ECDC Technical Report.16

**Global HCV distribution**

The estimated global prevalence of HCV is 2-3%.17, 18 Countries with the highest reported prevalence rates are located in Africa and Asia. China has a reported seroprevalence of 3.2%. One community-based survey in India reported an overall rate of 0.9%. Indonesia's rate is 2.1% in serosurveys of voluntary blood donors. The seroprevalence in Pakistan is reported to range from 2.4% to 6.5%. Egypt has the highest reported seroprevalence rate, 22%.17 Areas of lower prevalence include North America, northern and western Europe, and Australia.

The predominant source of new HCV infections in developed countries over the past few decades is injecting drug use. In developing countries, unsafe therapeutic injections and transfusions are likely to be the major modes of transmission.17 Anti-HCV prevalence in PWID globally varies greatly, from 9.8% to 97.4%.19 (See map, appendix 24).

**Transmission risks**

**Needlestick injuries**

There is a wide range of reported estimates for the risk of transmission of HCV after a needlestick or sharps injury from a source patient – between 0 and 10%.20-22 The estimated risk from a needlestick injury from a source with detectable HCV RNA is 6.1%.23 The risk of developing HCV is greater after an injury with a hollow-bore needle21, or deep injuries24, compared with other injuries. Also, one study showed an 11-fold increase in transmission of HCV from source patients with viral load >6 log10 copies/ml, compared with source patients with viral load ≤4 log10 copies/ml following percutaneous exposure.24 The risk of transmission is also influenced by whether the source is co-infected with HIV (see section below).

In cold temperatures, HCV can survive in syringes for many days in laboratory studies.25 The clinical implications of this are unknown, but the risk of becoming infected with HCV from an abandoned syringe depends on the prevalence of HCV in the local community. There are case reports of HCV transmission from needlestick injuries in the community26, but as the exact incidence of injuries in the community is not known, the risk of transmission from such injuries cannot be accurately quantified.

**Other percutaneous exposures**

The risk of acquiring HCV during an operation performed by an infected surgeon is reported to be between 0 and 3.7%.27,28,29 In general the risk of contracting HCV following an injury from an unknown source is negligible.30

Sharps in the workplace, other than in the healthcare setting, such as razors and meat slicers have also been implicated in the transmission of HCV.31, 32

There is an increased incidence of HCV in those who have a tattoo, with a pooled odds ratio of 2.73 (95% CI 2.38-3.15). Large tattoos, and those received in non-professional locations are associated with the greatest risk.33

**Splashes/mucocutaneous exposures**

Several case reports have been published describing the transmission of HCV following a splash of blood into the eye of the recipient.34,35 Also, transmission of HCV has occurred following splashes of infected blood onto broken skin.36 The exact risk associated with these exposures is unknown.
**Exposure to saliva (including injuries caused by human bites)**

HCV RNA has been demonstrated in saliva.\(^37, 38\) Case reports describe transmission of HCV following human bites, but precise details of the nature of the bites, and whether blood was present in the mouth of the biter, or whether skin was broken at the time of the bite, are not known.\(^39\) Inoculation with saliva has caused transmission of the virus in experimental studies.\(^40, 41\)

Studies in dentists indicate a low incidence of nosocomial transmission of HCV.\(^42\) It is also thought, however, that HCV can be transmitted via sharing a toothbrush with an index case.\(^38, 43\)

**Sexual exposures**

In general, transmission of HCV via sexual contact is inefficient in stable monogamous heterosexual couples.\(^44\) There is evidence, however, of a low rate of transmission of HCV between discordant heterosexual couples and a prevalence of 2-6% of anti-HCV in the non-index partner.\(^44-46\) Higher prevalence of anti-HCV has been observed in those with multiple sexual partners, in the absence of other risks, such as PWID or recipients of blood products, as further evidence of the plausibility of sexual transmission.\(^47, 48\) If a risk is present, it is likely to be very low, and a rate of transmission per heterosexual exposure has not been calculated.

Recent outbreaks of acute HCV among HIV-positive MSM who deny PWID suggest that the epidemiology of HCV transmission is changing in this population. In several European countries as well as in the United States and Australia, HCV has unexpectedly emerged as an STI among HIV-positive MSM. Longitudinal cohort studies have confirmed a marked increase in HCV incidence among HIV-positive MSM, but not HIV-negative MSM, after the year 2000.\(^49\) Studies in Australia, UK, Switzerland and the Netherlands have reported an incidence of HCV infection ranging from 0.6 to 0.9/100 person years in HIV positive MSM who were not PWID.\(^50\)

**Exposure to other body fluids**

HCV RNA has been identified in blood, saliva\(^37\), bile\(^51\), sweat\(^52\), semen\(^53\), and cervicovaginal secretions.\(^54\) The infective potential of cervicovaginal secretions is questioned\(^55\), but may increase during menstruation.\(^54\)

**Transmission of infection following exposure to a source with HIV and HCV**

The risk of developing HCV infection after simultaneous exposure to HIV and HCV is estimated at 2.8%\(^56\) (in this study, no one developed HIV after simultaneous exposure). 100% of patients who received an injection drawn from a vial contaminated with HIV and HCV developed acute HCV infection, but no one developed HIV.\(^57\)

HIV and HCV transmission from a patient to a healthcare worker occurred after contact with the patient’s emesis, faeces and urine, to non-intact skin on the healthcare worker’s hands.\(^58\)

A case report describes the transmission of HCV, but not HIV, via a human bite to the hand from a source co-infected with HIV and HCV.\(^59\) Although the recipient had a wound on his hand prior to the bite, it is not known whether there was blood in the mouth of the source at the time of the incident. Studies have not shown an increased incidence of HCV RNA in saliva of co-infected patients compared to those infected with only HCV.\(^60\)

The odds ratio of sexual transmission of HCV increased in women co-infected with HIV or another sexually transmitted infection (adjusted odds ratio 3.3-3.9) or homosexual men co-infected with HIV (adjusted odds ratio 4.1-5.7).\(^61\)

There is an increased incidence of HCV-antibodies in patients who had acquired HIV via heterosexual transmission, than in those who had developed HIV from a different exposure.\(^62\)

HIV status does not seem to influence the presence of HCV in semen in men co-infected with HCV and HIV.\(^63\) HCV RNA is detected more frequently in cervicovaginal fluid from women co-infected with HIV, than in those not infected with HIV\(^64\), especially if HCV viremia is present, or if HIV RNA is also found in the cervicovaginal secretions.
### Hepatitis C transmission risk by exposure type

<table>
<thead>
<tr>
<th>Exposure</th>
<th>Risk per exposure (unless otherwise stated)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Needlestick</strong></td>
<td></td>
</tr>
<tr>
<td>Healthcare setting, source patient (serology) known</td>
<td>0-10%.20-22 Average 1.8%65</td>
</tr>
<tr>
<td></td>
<td>Increased risk if - hollow needle21, deep injuries 24, co-infection with HIV56, high viral load.24</td>
</tr>
<tr>
<td>Healthcare setting, source patient unknown, or unable to test source patient (serology unknown)</td>
<td>Unknown source – negligible risk.30</td>
</tr>
<tr>
<td></td>
<td>Risk assessment required</td>
</tr>
<tr>
<td><strong>Community setting</strong></td>
<td>Risk not accurately determined.26 Risk assessment required. If local PWID population has a seroprevalence of 50-90%, the estimated risk of HCV transmission in a community needlestick injury is 1.62%.66</td>
</tr>
<tr>
<td><strong>Exposure prone procedure by infected healthcare worker</strong></td>
<td>0-3.7%.27, 28, 29 Risk may increase to 6% for certain procedures, e.g. open heart surgery.28 Risk assessment required.</td>
</tr>
<tr>
<td><strong>Non healthcare related occupational sharp injuries</strong></td>
<td>Risk not accurately determined, but transmission possible.30, 32 Risk assessment required.</td>
</tr>
<tr>
<td><strong>Tattoos</strong></td>
<td>Risk not accurately determined. Pooled odds ratio 2.73 (95% CI 2.38-3.15)33</td>
</tr>
<tr>
<td></td>
<td>Risk assessment required. Increased risk if larger tattoos or tattoos in non-professional locations</td>
</tr>
<tr>
<td><strong>Mucous membrane exposure to blood</strong></td>
<td>Very low risk. Case reports only.34, 35 Risk assessment required</td>
</tr>
<tr>
<td><strong>Intact skin exposed to blood</strong></td>
<td>No recognised risk</td>
</tr>
<tr>
<td><strong>Non-intact skin, body fluid exposure</strong></td>
<td>Very low risk. Case report describes transmission of HIV and HCV from co-infected source.58 Risk assessment required.</td>
</tr>
<tr>
<td><strong>Human bite injuries</strong></td>
<td>Very low risk. Case reports only.39 Risk assessment required. Possible higher risk of transmission of HCV than HIV if the source patient is co-infected with HCV and HIV.60</td>
</tr>
<tr>
<td><strong>Sexual exposures</strong></td>
<td></td>
</tr>
<tr>
<td>Heterosexual exposures in general</td>
<td>Inefficient transmission61, but transmission possible as seen in stable heterosexual relationships44-46, and in those with history of multiple sexual partners.47, 48 Possible increased risk of transmission if source co-infected with HIV61</td>
</tr>
<tr>
<td>MSM</td>
<td>Inefficient transmission.62, 68 Co-infection with HIV increases the risk of transmission61, 69-71</td>
</tr>
</tbody>
</table>

**Note:** In England, between 1997 and 2007, there were only 14 reported cases of HCV transmission from a patient to a healthcare worker, with a transmission rate calculated as 1.6%.72

**Risk assessment**

- Type/details of injury – as above
- Source status – increased risk with high viral load
- Recipient status – increased risk if immunocompromised
- For unknown source, consider where injury occurred – community setting versus hospital setting
  - If in hospital – consider high-risk ward/patients
  - If in community – consider prevalence of HCV and of PWID locally
- Consider where the needle was found and the temperature of environment – longer virus survival in cold temperatures thus potential increased risk of transmission.26
Hepatitis C transmission risk by exposure type

Exposure Risk per exposure (unless otherwise stated)

- Needlestick
  - Healthcare setting, source patient (serology) 0-10%.20-22 Average 1.8%
  - Healthcare setting, source patient unknown, or unable to test source patient (serology unknown) Risk assessment required
  - Community setting Risk not accurately determined.26 Risk assessment required. if local PWID population has a seroprevalence of 50-90%, the estimated risk of HCV transmission in a community needlestick injury is 1.62%.66

- Exposure prone procedure by infected healthcare worker 0-3.7%.27, 28, 29 Risk may increase to 6% for certain procedures, e.g. open heart surgery.28 Risk assessment required.

- Non healthcare related occupational sharp injuries Risk not accurately determined, but transmission possible.31, 32 Risk assessment required.

- tattoos Risk not accurately determined. Pooled odds ratio 2.73 (95% CI 2.38-3.15)33 Risk assessment required. increased risk if larger tattoos or tattoos in non-professional locations

- Mucous membrane exposure to blood Very low risk. Case reports only.34, 35 Risk assessment required

- intact skin exposed to blood No recognised risk

- Non-intact skin, body fluid exposure Very low risk. Case report describes transmission of HIV and HCV from co-infected source.58 Risk assessment required.

- Human bite injuries Very low risk.39. Case reports only. Risk assessment required. Possible higher risk of transmission of HCV than HIV if the source

- Sexual exposures Heterosexual exposures in general inefficient transmission61, but transmission possible as seen in stable heterosexual relationships44-46, and in those with history of

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Maps of global distribution of hepatitis C infection

Prevalence of hepatitis C worldwide


Prevalence of anti-hepatitis C among people who inject drugs worldwide

Human immunodeficiency virus: epidemiology and transmission risks

General details
The HIV virus was discovered in 1983. There are currently two groups of viruses which have been isolated (HIV type 1 and HIV type 2), collectively known as HIV (human immunodeficiency virus). In general, HIV type 2 is not found outside western and central Africa. HIV type 1 is identified globally. Following infection, the host's cells transfer the virus to the local immune system, including T-cells, macrophages and dendritic cells. Within 10-12 days of infection, HIV RNA can be detected in blood by PCR.

During this acute infection (also referred to as primary HIV infection, or the seroconversion illness), HIV RNA levels peak, before declining over subsequent weeks. Antibodies to HIV usually develop within 3-5 weeks of becoming infected. The time period between becoming infected and developing antibodies is referred to as the serological “window period”.

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Clinical information
The symptoms of acute HIV infection can last for between 7 and 10 days. The patient may complain of symptoms resembling the “flu”, or mononucleosis infection. Typical symptoms include fever, maculopapular rash, oral ulcers, lymphadenopathy, arthralgia, pharyngitis, malaise, weight loss and myalgia. Once these acute symptoms resolve, most patient enter an asymptomatic phase. This asymptomatic phase can last more than 10 years.

When CD4+ lymphocyte levels drop below 200-350 cells/μl, the patient is at increased risk of developing opportunistic infections, including pneumocystis pneumonia, oesophageal candidiasis, cerebral toxoplasmosis, and cytomegalovirus, amongst others. These infections, along with cancers such as Kaposi sarcoma, are referred to as AIDS defining conditions.

Transmission
HIV has been isolated from semen, cervical secretions, lymphocytes, cell-free plasma, cerebrospinal fluid, tears, saliva, urine and breast milk. This does not mean, however, that these fluids all transmit infection since the concentration of virus in them varies considerably. Particularly infectious are semen, blood, and possibly cervical secretions. The risk of transmission increases with the burden of HIV (i.e. the HIV viral load) in the inoculum.

The commonest mode of transmission of the virus throughout the world is by sexual intercourse. Other methods of transmission are through receipt of infected blood or blood products, donated organs, and semen. Transmission also occurs through the sharing or reuse of contaminated needles by people who inject drugs (PWID) or for therapeutic procedures, and from mother to child. The virus is also transmitted through breast milk. Healthcare workers (HCW) can be infected through needlestick injuries, and skin and mucosal exposure to infected blood or body fluids.

Prevalence of HIV infection in Ireland, Europe and the world
Ireland
HIV became a notifiable disease in Ireland in September 2011. Case based reporting of HIV cases has been in place since 2001. In 2014, a total of 377 newly diagnosed cases were reported in Ireland, a rate of 8.2/100,000. The highest proportion was attributed to MSM exposure (49%), followed by heterosexual transmission (33%), and PWID (7%). Of the 377 cases, 36.3% were born in Ireland and 53.8% were born abroad.

Annual numbers of new diagnoses of HIV in Ireland have fluctuated between 300 and 400 over the past decade. In recent years there has been a change in the predominant modes of transmission – the annual number of new cases among PWID has decreased each year since 2004, up to 2013; the annual number of cases attributed to heterosexual transmission has decreased from a peak in 2003; and the number of cases in MSM continues to rise year on year since 2005.
Blood donors
Of 313,019 first time blood donors tested by the IBTS between 1997 and 2015, 14 (0.0045%) were found to be HIV positive. (Personal communication, Dr Joan O’Riordan, IBTS, July 2016).

Pregnant women
HIV screening is offered routinely to all pregnant women in Ireland under a voluntary antenatal HIV testing programme that was introduced in 1999. In 2014, the national reported uptake of HIV antenatal screening (from 17 hospitals) was 99.9%, the rate was 100% in 16 of the hospitals. The HIV prevalence rate among pregnant women in Ireland was 0.15% in 2014, slightly higher than the rate in 2013 (0.14%). The prevalence of HIV infection among pregnant women varied among HSE areas, ranging from 0.05% in HSE West to 0.23% in HSE Dublin Northeast.

Prisoners and injecting drug users
In 1997, 17% of a group of PWID in the HSE eastern region, who were attending methadone clinics, tested positive for HIV infection. A cross sectional study of 307 opiate users attending 21 addiction treatment centres in the HSE eastern region was carried out in 2001. The prevalence of anti-HIV was 11%. In 2001, the largest tertiary centre for HIV infection in Dublin reported a five-fold increase in new HIV diagnoses in PWID between 1995 and 2000. A study carried out among socially excluded drug users in 10 European cities in 1998-2000 found a self-reported HIV positive prevalence of 24.6% in Dublin, the second highest of the cities.

In 2014, 27 new HIV diagnoses (7%) were among people who inject drugs (PWID), representing a 29% increase in the number of diagnoses in 2013 (21). 89% of the cases were resident in HSE East at diagnosis and many of the infections were recently acquired at time of diagnosis. Injection of newer street drugs, including “snow blow”, amongst homeless, chaotic PWID were common factors in these individuals.

A national cross sectional survey of Irish prisoners in 1998 showed a prevalence of anti-HIV of 2%. The prevalence was 3.5% in prisoners who were PWID.

Asylum seekers
Screening of asylum seekers in the HSE eastern region 2000-2003 found a prevalence of anti-HIV of 2.2%.

HIV infection in Europe
In 2013, 29,157 HIV diagnoses were reported by 30 EU/EEA countries with a rate of 5.7 / 100,000 population. The male-to-female ratio was 3.3. Young people aged 15-24 accounted for 11% of all HIV diagnoses reported by this varied widely from 6% in Norway to 25% in Romania.

MSM accounted for 42% of diagnoses while heterosexual transmission accounted for 32%. Transmission due to injecting drugs accounted for 5% of diagnoses and for nearly 20% of the cases, the transmission mode was unknown.

Global HIV distribution
At the end of 2010, an estimated 34 million people were living with HIV globally. The annual number of people newly infected with HIV continues to decline, although there is stark regional variation. In sub-Saharan Africa, where most of the people newly infected with HIV live, the incidence peaked in 1996-1998. However, the annual number of people newly infected with HIV has risen in the Middle East and North Africa in the past decade. And in Eastern Europe and Central Asia, where the incidence had slowed drastically in the early 2000s, the incidence has been accelerating again since 2008.

The prevalence of HIV among adults (15-49 years) by world (WHO) region is estimated to be as follows: Africa (4.5%), Americas (0.5%), Eastern Mediterranean (0.1%), European (0.4%), South-East Asia (0.3%), Western Pacific (0.1%).

Estimates of HIV prevalence globally among those with a history of PWID vary. This paper by Mathers et al presents detailed tables of prevalence of PWID and of HIV in PWID by world region. The largest numbers of injectors were found in China, the USA and Russia, where mid-estimates of HIV prevalence among injectors were 12%, 16% and 37% respectively (see maps, appendix 26).
Transmission risks

Needlestick injuries

Following a needlestick injury with a needle contaminated with blood from a source known to have HIV, the risk of becoming infected with HIV is thought to be between 0.1% and 0.36%. The risk from needlestick injuries in the community is more difficult to estimate and the exact incidence of needlestick injuries and the transmission rate is unknown. Intravenous drug injections carry a higher risk, with the risk of HIV transmission estimated to be between 0.63% and 2.4% per injection. The risk from a community needlestick where the source is unknown is estimated to be between 0.003 and 0.05%, if the local PWID seropositivity is approximately 1%.

Several factors influence the rate of transmission. In a study of occupationally associated needlestick injuries, seroconversion was associated with factors including whether the needle or device was visibly contaminated with blood (odds ratio 10, 95% CI 4.6-23), the injury was deep (OR 15, 95% CI 8-26), or if the injury was sustained by a large gauge hollow bore needle (OR 14, 95% CI 4.9-39). The health of the source patient is also relevant. If the source patient has AIDS, the odds ratio for transmission of HIV is 1.9 (95% CI 0.8-4.6). It has been demonstrated that if the source patient died within 2 months of the needlestick injury, the odds ratio for transmission increased to 4.8 (95% CI 2.3-10).

Post-exposure prophylaxis (PEP) is thought to reduce seroconversion by up to 81% (95% CI 48-94%). Commencing PEP early after the injury provides the greatest benefit. In animal studies, administration of PEP within 36 hours prevented seroconversion. In animals who received PEP at 72 hours after exposure, 25% seroconverted. In contrast, 75% of the animals who did not receive any PEP seroconverted by 4 weeks post exposure. Additionally, treatment is most effective when continued for 28 days. There are documented case reports of HCWs who have become infected with HIV following occupational exposure, despite use of PEP, which in one case was commenced within 30 minutes.

Blood splashes

The risk of transmission associated with splash injuries is less than the risk associated with needlestick injuries, and HIV seroconversion following splashes of blood to intact skin has not been reported. The risk of HIV transmission associated with exposure of non-intact skin and mucous membrane exposure to HIV infected fluid is possible, but the risk is very low. Pooled data provided an estimated risk for transmission of HIV via mucous membrane exposure at 0.09%, based on one seroconversion from more than 1000 documented exposures.

Human bites

Infection with HIV after a bite from a patient with HIV “is biologically possible, but remains unlikely”. Cases of transmission have been reported in case reports, but the exact risk of transmission is unknown, and thought to be very low. In the cases reported, blood was present in the mouth of the biter, and the skin of the recipient was broken. PEP is recommended if a patient has been bitten by someone known to be HIV-positive, with a high viral load, if the bite breaks the skin.

Although there are reports of HIV transmission from a dentist who had AIDS to patients, it has never been demonstrated that the dentist acquired HIV from any of his patients. Cases of other dentists and dental health practitioners who developed HIV after presumed occupational contact are reported, but no evidence exists to demonstrate the exact mode of transmission. Given that injuries to dentists during procedures are common, at a reported rate of 0.9 per 1000 procedures, and there are no documented transmissions of HIV to dentists from patients, the rate of transmission overall is very low.

Sexual exposures

The risk of transmission of HIV following sexual exposure depends on the type of exposure, the viral load of the source, the susceptibility of the host, and the presence of sexually transmitted infections in either the source or the recipient. If the index partner also has a genitourinary infection, for instance, the risk of transmission is approximately doubled. If the recipient has a genitourinary infection, the risk of acquiring HIV is also elevated. Effective antiretroviral therapy has been shown to be protective in preventing sexual transmission of HIV in a landmark randomised controlled trial and a “real world” cohort study. The PARTNER study has demonstrated this to be true in male/female and male/male sexual encounters across a range of sexual activities, including unprotected receptive vaginal and anal intercourse.

Heterosexual exposures

Overall the risk of transmission of HIV, per unprotected coital act, for receptive vaginal sex and insertive vaginal sex is 1 in 1000 and 1 in 1219 respectively. Correct use of a condom reduces the risk of transmission by 93%-100%. Circumcision has been shown to significantly reduce HIV acquisition in heterosexual males in high prevalence settings. The risk of
transmission is greater during the initial two and a half months of infection.\textsuperscript{36,43} The cumulative incidence of transmission of HIV to females in couples who practice unprotected anal intercourse is reported as 27.8\%, compared to 11.7\% transmission to females who do not report anal intercourse.\textsuperscript{37} Transmission is very unlikely if the source of the exposure is on effective antiretroviral treatment.\textsuperscript{38,39}

**Men who have sex with men (MSM)**

Overall the risk of transmission of HIV, per unprotected coital act, for receptive anal sex and insertive anal sex is 1 in 90 and 1 in 666 respectively.\textsuperscript{40} An Australian cohort study has estimated the per coital risk of HIV to be lower in circumcised MSM (0.11, 95\% CI 0.02 - 0.24) versus uncircumcised MSM (0.62, 95\% CI 0.07 - 1.68).\textsuperscript{44} Transmission is very unlikely if the source of the exposure is on effective antiretroviral treatment.\textsuperscript{39}

**Orogenital exposures**

The risk associated with orogenital contact cannot be accurately predicted, and is considered low, but not zero.\textsuperscript{45}

**Body fluid exposure**

The risk associated with exposures to non-blood stained body fluids is thought to be lower than the risk associated with blood exposures.\textsuperscript{20} HIV has been identified in semen, but this is reduced if the index patient is on treatment and blood HIV RNA is detected at <400 copies/ml.\textsuperscript{46} HIV DNA has been extracted from CSF\textsuperscript{47} and synovial fluid.\textsuperscript{48} Other fluids which it is thought could be implicated in HIV transmission are pericardial fluid, amniotic fluid, peritoneal fluid, human breast milk, vaginal secretions and pleural fluid. Unless there is visible blood present, faeces, vomitus, urine, nasal secretions, saliva, sputum, sweat and tears are not thought to have any infectious potential.\textsuperscript{49}
### HIV transmission risk by exposure type

<table>
<thead>
<tr>
<th>Exposure</th>
<th>Risk per exposure (unless otherwise stated)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Needlestick</td>
<td><strong>Healthcare setting, source patient (serology) known</strong> 0.1-0.36%, increased risk if large gauge needle, hollow needle, deep injury, visible blood on the device, needle was in patient’s artery/vein, or if the source patient has AIDS (or terminal illness).</td>
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<tr>
<td></td>
<td><strong>Healthcare setting, source patient unknown, or unable to test source</strong> Risk assessment required of the type of injury and the likely infection status of the source.</td>
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<tr>
<td></td>
<td><strong>Community needlestick</strong> Overall low risk and requires a risk assessment of the type of injury, location of the discarded needle (for example if discarded in a location where PWID are known to inject), likely age of the discarded needle and the background prevalence of HIV in the local population.</td>
</tr>
<tr>
<td>Mucous membrane exposure to blood</td>
<td>0.09% 21</td>
</tr>
<tr>
<td>Intact skin exposure to blood</td>
<td>No risk 23</td>
</tr>
<tr>
<td>Human bite</td>
<td>Very low risk. Risk assessment required. Only risk if blood in the mouth of the biter, and significant injury. No risk if no blood in mouth of biter, and exposure to saliva only. Case report suggests that if source co-infected with HCV, HCV transmission more likely than HIV transmission 50</td>
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<tr>
<td>Sexual exposure</td>
<td><strong>Heterosexual exposure (general)</strong> If source on antiretroviral therapy with suppressed viral load transmission rate = 0 (if viral load &lt; 400 copies/ml) Increased risk if source patient has recently seroconverted, e.g. within 2.5 months of seroconversion risk of transmission is estimated to be 0.0082/coital act (95% CI 0.0039-0.015) 36</td>
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<td></td>
<td><strong>Receptive vaginal intercourse</strong> Overall risk is 1 in 1000, which is increased in the presence of cervical ectopy, genital tract trauma, menstruation, genital ulcerative disease (in either partner), infectious syphilis and pregnancy. Male circumcision reduces HIV acquisition.</td>
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<tr>
<td></td>
<td><strong>Insertive vaginal intercourse</strong> Overall risk is 1 in 1219. 40</td>
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<td></td>
<td><strong>MSM unprotected receptive anal intercourse</strong> Overall risk is 1 in 90, increased risk if there is ejaculation within the rectum. The PARTNER study has demonstrated zero transmissions in HIV serodiscordant couples where the HIV positive individual is on effective antiretroviral therapy. 39</td>
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<td><strong>MSM unprotected insertive anal intercourse</strong> Overall risk is 1 in 666. The PARTNER study has demonstrated zero transmissions in HIV serodiscordant couples where the HIV positive individual is on effective antiretroviral therapy. 39</td>
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<tr>
<td></td>
<td><strong>Orogenital contact</strong> Overall very low risk, estimated to be &lt;1 in 10,000 for both receptive and insertive oral sex. 45</td>
</tr>
</tbody>
</table>

Remember
- There are only 5 reported cases of confirmed HIV transmission from a patient to a healthcare worker in the UK. 51
- There have been no such transmissions between 2004 and 2013, in the UK. 52
References

Maps of global distribution of HIV infection

Prevalence of HIV worldwide

![Prevalence of HIV worldwide](image)


Prevalence of HIV infection among people who inject drugs

![Prevalence of HIV among people who inject drugs](image)