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%.\(^6\) 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.\(^8\) 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 <10^4 genome equivalents/ml are allowed to continue working unrestricted. Transmission of HBV via a percutaneous route is considered unlikely at HBV DNA levels below 10^7 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

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<thead>
<tr>
<th>Exposure</th>
<th>Risk per exposure (unless otherwise stated)</th>
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<tbody>
<tr>
<td><strong>Needlestick</strong></td>
<td><strong>Healthcare setting, patient known</strong></td>
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<td>HBeAg (+) = 37-62% risk of serologic evidence of infection in recipient</td>
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<td></td>
<td>HBeAg (-) = 23-37% risk of serologic evidence of infection, 1-6% clinical infection⁴</td>
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<tr>
<td><strong>Healthcare setting, patient unknown, or patient known but serology unknown</strong></td>
<td>Requires risk assessment</td>
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| **Community setting** | 2 case reports only.²⁵,²⁶ 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%.⁵² (Note: seroprevalence in PWID in Ireland is lower than 50% - see epidemiology section).
| **Other percutaneous injuries with blood exposure** | **Healthcare sharp (e.g. lancet)** |
| | Risk per exposure unknown. 36.8%-42%²⁷ developed HBV after repeat exposures. |
| **Exposure prone procedure by infected healthcare worker** | Transmission rates vary between 6 and 15%⁵⁴ - most were before standard precautions introduced |
| **Transfusion** | 52-69% transmission if transfused with HBsAg (+) blood⁵⁵ |
| **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.⁸⁸ Requires risk assessment. |
| **Sexual exposures** | **Heterosexual exposures in general** |
| | 18%-40%-47 - 44.2%-⁴⁸ infection rate seen in regular partners of HBV infected people |
| | Increased risk if: multiple partners⁴²,⁴⁴, syphilis⁴⁴,⁴⁵,⁵⁶, gonorrhoea⁵⁶, receptive anal intercourse⁴⁵ |
| **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 work⁵⁰, history of insertive anal intercourse⁵¹ |
| **Receptive oral sex (fellatio)** | Possible means of transmission⁵⁷ |

### 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
References