

# Infectious risks to healthcare workers

Exposure to pathogens that may be transmitted to healthcare workers may be accidental, such as needlestick injuries, or incidental in the course of daily work practice. Infection control precautions and preventive measures are the key to reducing the risk of acquiring infections through occupational exposure.

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Awareness of potential infectious risks to healthcare workers has increased over the past two decades. This has come about, at least in part, because of the risk posed by fatal infections such as HIV being transmitted to healthcare workers and also because of the availability of preventive measures. The transmission of many infections through occupational accidents has decreased because of universal precautions that are now in place but exposure to pathogens still occurs. Many clinicians have become complacent about these pathogens.

The transmission of some infections can now be prevented by vaccination, such as hepatitis B and varicella. However, others, such as HIV

infection and tuberculosis, require immediate action to try to minimise the risk of infection following a known exposure.

Although there are many infections that may be transmitted to healthcare workers, this article will focus on a selection of these, especially those for which there are new preventive measures or interventions (Table 1).

## Modes of transmission

Healthcare workers may acquire pathogens through the following types of exposure:

- direct exposure to bloodborne pathogens by needlestick injury or blood splash – e.g. HIV, cytomegalovirus (CMV) and hepatitis B and

## IN SUMMARY

- A number of infectious diseases are now virtually preventable by vaccination. These include hepatitis B and varicella.
- Following a course of hepatitis B vaccination, the serological status of an exposed healthcare worker should be checked. If positive, no further action is necessary (currently, no boosters are recommended).
- Most percutaneous exposures to blood can be prevented by education and basic measures such as not resheathing needles and the appropriate disposal of 'sharps'.
- Following a needlestick injury, specific prophylaxis in relation to HIV may be necessary. Specialist advice (either via a needlestick hotline or from a teaching hospital) is recommended.
- A number of infections that are spread by direct contact, such as those caused by *Staphylococcus aureus*, herpes simplex virus and hepatitis A virus, can be prevented by standard universal precautions such as routine handwashing and wearing of gloves.
- Ongoing reinforcement of infection control measures is vital in avoiding occupational exposures to infections.

continued

- hepatitis C viruses (Figure 1)
- inhalation of respiratory droplets containing pathogens – e.g. *Mycobacterium tuberculosis*, varicella–zoster virus, parvovirus B19 (the causative agent of erythema infectiosum), *Bordetella pertussis*, influenza virus and *Neisseria meningitidis*
- direct contact with secretions or tissues infected with pathogens – e.g. herpes simplex virus, CMV, *Staphylococcus aureus*, hepatitis A virus, varicella–zoster virus and the scabies mite.

### Bloodborne infections

#### Hepatitis B

Hepatitis B is probably the most common bloodborne disease transmitted to healthcare workers. Hepatitis B virus can be transmitted by percutaneous, cutaneous or mucocutaneous exposure to infected blood. The overall risk of transmission of

hepatitis B to a nonimmune person is about one in 50 following a needlestick injury (95% confidence interval [CI], 1 to 6%). The risk is about 2% if the source blood is hepatitis B surface antigen-positive, and increases to 22 to 40% if the source blood is positive for either or both of e-antigen and HBV-DNA.

Recent statistics show there are 300,000 new hepatitis B infections per year in the USA.<sup>1</sup> Theoretically, almost all transmission of this virus could now be prevented by vaccination – which is now at least 75% effective, and probably closer to 90%. Each year in the USA, 10,000 to 20,000 healthcare workers are infected with hepatitis B and up to 300 die from it, despite a relatively safe vaccine being available.<sup>2</sup> A recent report from the USA found that 23% of healthcare workers were unvaccinated.<sup>3</sup>

There are several hepatitis B vaccines available in Australia for vaccination of adults (Engerix B, H-B-Vax II, Twinrix [also contains hepatitis A vaccine]). Vaccination against hepatitis B is now incorporated into the childhood immunisation schedule.<sup>4</sup>

The current recommendations for hepatitis B vaccinated healthcare workers who have serologically proven immunity is that no boosters are necessary after exposure to blood that may contain hepatitis B virus.<sup>4</sup> If healthcare workers have proven seroconversion following

immunisation, they do not need a booster following an exposure, even if antibody titres have become undetectable, as the exposure itself should reboost antibody titres. The postexposure guidelines are complex for healthcare workers who have not been vaccinated against hepatitis B or who are unsure of their immune status. The guidelines are summarised in Table 2.

The implications for healthcare workers of becoming infected with hepatitis B virus are huge, both professionally and personally, with major restrictions often being imposed upon their ability to practice medicine, especially if involved in procedural work.

#### Hepatitis C

Hepatitis C virus has a slightly lower infectivity than hepatitis B virus, but the risk of transmission of hepatitis C following needlestick injury is 3 to 10%, and there is no effective vaccine or prophylactic measure.

The risk from a deep needlestick injury with a hollow needle from a PCR-positive patient (i.e. a patient who has a positive result in the polymerase chain reaction assay for hepatitis C virus RNA) is about 6%. The risk is lower from a hepatitis C virus antibody (anti-HCV)-positive only (i.e. PCR-negative) patient. One recent Japanese study did, however, find transmission of hepatitis C even from PCR-negative patients.<sup>5</sup>

**Table 1. Infections acquired through occupational exposure**

#### Bloodborne infections

- Hepatitis B
- Hepatitis C
- HIV infection
- Cytomegalovirus infection

#### Respiratory droplet borne infections

- Varicella–zoster
- Tuberculosis
- Meningococcal infection
- Influenza
- Erythema infectiosum

#### Infections spread by infected tissues or secretions

- Herpes
- Staphylococcal infections
- Hepatitis A
- Scabies
- Cytomegalovirus infection
- Varicella–zoster



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Figure 1. Needlestick injuries can occur during blood sampling.

**Table 2. Postexposure guidelines to prevent hepatitis B infection**

Exposed person	Source HBsAg* positive	Source status unknown
Previous hepatitis B vaccination, known responder	No action generally necessary	No action generally necessary
Previous hepatitis B vaccination, known nonresponder	Give two doses of HBIG† or one dose of HBIG and one dose of hepatitis B vaccine	If high risk exposure, treat as for HBsAg positive source If low to moderate risk exposure, initiate revaccination
Previous hepatitis B vaccination, response unknown	Test for hepatitis B virus antibody. If adequate level, no treatment necessary. If inadequate level, give one dose of HBIG and booster dose of hepatitis B vaccine	Test for hepatitis B virus antibody. If adequate level, no treatment necessary. If inadequate level, give one dose of HBIG and booster dose of hepatitis B vaccine
No previous hepatitis B vaccination	Give HBIG and first dose of hepatitis B vaccine	Initiate hepatitis B vaccination

\* HBsAg = hepatitis B surface antigen; † HBIG = hepatitis B immunoglobulin.

### Hepatitis D

Hepatitis D virus can only cause infection in the presence of hepatitis B infection, which may be pre-existing (superinfection) or coexisting (coinfection). Hepatitis D virus is uncommon but highly infective.

### HIV infection

In countries such as those in sub-Saharan Africa, the ever-increasing number of HIV-infected patients in the community means that the risk of exposure for health-care workers is very real and prominent. In Australia, the risk is much less but still present, and postexposure prophylaxis needs prompt institution for maximal efficacy.

The quoted figure for the risk of transmission of HIV following needlestick injury of a health-care worker is generally about 0.3% overall (95% CI, 0.2 to 0.8%). The risk after a mucous membrane exposure to blood is 0.09% (95% CI, 0.006 to 0.5%).<sup>6</sup> The risk from occupational

exposure to secretions such as saliva, tears, sweat, urine, faeces and breast milk is thought to be minimal unless these fluids are visibly bloodstained.

Data from the Centers for Disease Control and Prevention revealed that, up to June 1997, 52 health-care workers in the USA had been reported to have an HIV seroconversion after a documented incident (47 of these were blood exposures, one was to bloody fluid, one to an unspecified fluid and three to virus in a laboratory).<sup>7</sup> Of these, 45 were percutaneous, five were mucocutaneous and one both. Of the percutaneous incidents, 41 involved a hollow needle, two involved a glass vial, one a scalpel and one an unknown sharp object. An additional 114 possible occupational transmissions were also reported.

Most accidents involve punctures or cuts from needles. Resheathing of needles is often involved and many incidents are preventable by education and the use of devices to prevent resheathing.

**Table 3. Classification of exposures for transmission of HIV and hepatitis B and C viruses**

### Percutaneous exposure to blood

#### High risk

- Large volume of blood that has a high virus titre, e.g. deep injury, large hollow needle previously in source patient's vessel

#### No increase in risk

- Small volume of blood
- Blood with low virus titre

### Other percutaneous exposures

#### Significant risk

- Fluids containing visible blood
- Other potentially infectious fluids – such as semen, vaginal secretions, CSF, synovial, pleural, peritoneal, pericardial and amniotic fluids
- Potentially infectious tissue – such as lymph node, liver, lung or colon biopsies

### Mucous membrane exposures

#### Significant risk

Exposure of eyes or mouth to:

- Blood
- Fluid containing blood
- Other potentially infectious body fluids

### Skin exposures

#### Significant risk

Exposure of nonintact skin to:

- Blood
- Blood-stained fluids
- Other potentially infectious body fluids

### Postexposure prophylaxis

Postexposure prophylaxis has been shown to reduce the risk of transmission of HIV by about 79 to 81% (retrospective case control).<sup>7</sup> Whether an occupational exposure has a high or significant risk for infection transmission and therefore warrants postexposure prophylaxis depends on many factors (Table 3). It is

continued

recommended for high risk percutaneous exposures (especially deep needlestick injuries with hollow needles on which blood is visible). Specialist advice is often necessary to assess the degree of risk and the need for prophylaxis. Generally no postexposure prophylaxis is necessary following contact with nonbloody saliva, tears, sweat, urine, faeces or breast milk.

The rationale behind postexposure prophylaxis is modification of viral replication; it should, therefore, be commenced as soon as possible, preferably within one to two hours and certainly within 24 to 72 hours.

The appropriate regimen often depends on the characteristics and treatment history of the source patient and specialist consultation is usually necessary. Zidovudine (Retrovir) alone is now considered less than optimal to prevent transmission. Two drugs, usually zidovudine and lamivudine (Combivir), are recommended, sometimes with the addition of a third, such as a non-nucleoside reverse transcriptase inhibitor (e.g. nevirapine [Viramune]) or a protease inhibitor (e.g. indinavir [Crixivan]). The choice of drug depends on the severity and type of exposure, the viral load and the drug history of the source. In some countries, such as the USA, postexposure prophylaxis may be overused. Side effects related to the drugs are not uncommon and near-fatal hepatotoxicity related to nevirapine has occurred.

The management of pregnant healthcare workers following a needlestick injury from an HIV-positive patient is difficult since many of these drugs have not been assessed for use in pregnancy and may have significant side effects, e.g. anaemia.

Serology testing is recommended at six weeks, three months, six months and if any possible seroconversion illness occurs. The social and professional ramifications of an exposure to HIV are often great, and counselling is necessary about safe sex and avoidance of exposure-prone procedures while awaiting results.

**Behaviour modification**

Various behaviour modifications are important following a significant HIV exposure. These are listed in Table 4.

**Further advice**

Specialist advice should be sought if a healthcare worker is unsure of what action to take when a needlestick injury occurs. The Needlestick Hotline can be contacted on freecall 1800 804 823, and further information and general post-exposure algorithms are available from health departments in most States.

**CMV infection**

CMV is another virus that may be spread by blood. However, in practice, contact with infectious urine or faeces is a more common source of infection (particularly

in the community). High rates of secretion of CMV are found in the urine of infected neonates and babies younger than 6 months, and also in immunosuppressed patients. Studies have not found a correlation between health professionals at high risk and seroconversion.

CMV infection is generally self-limiting, although there may be problems if the primary infection occurs during pregnancy. About 60 to 80% of adults are already infected, but there is an argument for all pregnant healthcare workers to have their immune status tested, and if seronegative, avoid circumstances which put them at high risk of exposure (such as contact with urine of babies or work with immunocompromised patients).

**Droplet borne infections  
Varicella-zoster**

Varicella-zoster virus can cause a severe primary infection in adults, and infection during pregnancy can have major ramifications for the fetus (Figure 2). Congenital defects occur in up to 2% of babies whose mothers have primary varicella infection during pregnancy, and problems can range from congenital chickenpox to, more rarely, fetal varicella syndrome, which may include limb hypoplasia, scars, muscle atrophy, microcephaly, psychomotor retardation and eye abnormalities.

Spread may be airborne or via direct contact with lesions. Patients are generally

**Table 4. Recommended behaviour modifications after a significant HIV exposure**

**Remember**

- Do not donate blood or blood products
- Protect sexual partners
- Seek advice about pregnancy or breastfeeding
- Do not share injecting drug equipment
- Modify work practices involving exposure prone procedures when the exposure has been high risk or there is clinical seroconversion



Figure 2. Adult affected by chickenpox on the forehead.

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thought to be contagious from two days before the rash until all the lesions are crusted. The incubation period of varicella is usually two to three weeks. Herpes zoster (the reactivated form of varicella infection) is much less contagious but still poses a risk to nonimmune healthcare workers.

About 90% of healthcare workers will have been infected in infancy and are immune. A history of previous infection is very reliable for determining seropositivity. Also, more than 50% of those who do not give a history of childhood illness are found to be antibody-positive.

#### Varicella vaccine

Vaccination with live attenuated vaccine (Varilrix and Varivax II) is recommended for nonimmune healthcare workers. Two doses of the vaccine are necessary, given about four to eight weeks apart, and the seroconversion following full vaccination is excellent. However, many nonimmune healthcare workers remain unvaccinated.

As the vaccine is a live vaccine it has the potential to cause infection in immunocompromised people. It may be advisable for recently vaccinated healthcare workers to avoid treating immunocompromised patients for about 21 days because of the potential for transmission. There are, as yet, no formal recommendations in regard to this issue.

#### After exposure

Exposure is thought to be significant if there was household contact, face-to-face contact for longer than five minutes or contact indoors for longer than one hour.

Following a significant exposure, a healthcare worker with no past history of chickenpox or varicella vaccination should have urgent serology. One of the following options should then be taken:

- if results will take more than 72 hours, commence vaccination – otherwise await results and only give vaccine if seronegative
- if immunocompromised or pregnant,

give varicella–zoster immunoglobulin (Zoster Immunoglobulin) – when given up to 96 hours after the exposure, this has been shown to decrease the risk of infection (the usual dose recommended for people over 40 kg is 600 IU or three vials).

#### Tuberculosis

Transmission of tuberculosis to healthcare workers is not uncommon, especially from patients with AIDS and tuberculosis. Factors affecting the incidence of tuberculosis in healthcare workers include practice location, patient population and local prevalence of tuberculosis.

The disease is most commonly spread to healthcare workers by infectious airborne droplets containing the acid-fast bacillus *Mycobacterium tuberculosis* from cases of ‘open’ respiratory tuberculosis. Tuberculin conversion rates as high as 50% have been reported in staff on HIV wards. This conversion often happens before the diagnosis of tuberculosis has been made in the HIV patient.

Infection control measures for tuberculosis are complex and beyond the scope of this article. National and international guidelines are available from the relevant

departments. The major determinant, however, for infection of tuberculin-negative persons is the closeness of contact and the infectiousness of the source. Patients with sputum smears positive for acid-fast bacilli are most infectious. About 3 to 4% of infected persons with normal immune status develop active tuberculosis in the first few years, and 5 to 15% thereafter; the remainder stay asymptomatic.

Isoniazid prophylaxis is often recommended following a proven Mantoux conversion (if a chest x-ray excludes active disease), but this depends on the drug sensitivities of the bacterium infecting the source patient and may not be appropriate if the isolate is drug resistant.

Each State has specific guidelines relating to the use of BCG vaccine for high risk situations. It is not routinely recommended.

#### Meningococcal infection

*Neisseria meningitidis* carriage rates in the community are between 20 and 30%, so exposure is not uncommon even in the absence of clinical disease. Despite this, the known transmission of meningococcal infection is rare and usually follows intimate contact with oropharyngeal secretions of an infected patient, such as during cardiopulmonary resuscitation.

If a healthcare worker has contact with blood or oropharyngeal secretions of a known case of meningococcal disease, they should receive prophylaxis. Prophylaxis with any of the following regimens is thought to be adequate:

- rifampicin (Rifadin, Rimycin) 600 mg bd for two days
- ceftriaxone (Rocephin) 250 mg intramuscularly stat
- ciprofloxacin (Ciproxin) 500 mg stat.

#### Infections spread by infected tissues or secretions

##### Herpes

Transmission of herpes simplex viruses types 1 and 2 (HSV-1 and HSV-2) from



Figure 3. Herpes infection in healthcare workers typically presents as a herpetic whitlow.

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patients to healthcare workers is well documented (as is also their transmission from healthcare workers to patients). Infection in the healthcare worker usually takes the form of herpetic whitlow (Figure 3).

Mouth-to-mouth resuscitation is another mode of transmission. Oral lesions contain large amounts of virus and are very infectious. It is reported that HSV-1 has been cultured from the hands of six out of nine adults with oral lesions, and that the isolates survived drying on skin, plastic and cloth for up to four hours. Asymptomatic shedding has also been found in up to 9.6% of seropositive adults in the absence of active lesions.<sup>8</sup>

There are no specific preventive measures other than universal precautions and hand washing following any contact.

### Staphylococcal infections

*Staphylococcus aureus* is usually thought about in the context of nosocomial infection of patients (particularly with methicillin-resistant strains), but healthcare workers may also acquire *S. aureus* from patients and act as transmitters to other patients or be at risk themselves. Carriers are much more likely to experience infection should they undergo surgery or develop an exudative skin condition. About 20 to 40% of the population are carriers of *S. aureus* at any one time. Within a general community population, 30% are prolonged carriers, 50% are intermittent, and about 20% never carry. The carriage rate is higher among healthcare workers (up to 50% in doctors and 70% in nurses) than in the general community.<sup>9</sup>

The major mechanism for prevention is regular and routine hand washing. Carriage may be treated by nasal mupirocin (Bactroban Nasal Ointment) and body washes containing triclosan (Dettol Liquid Wash, Microshield T, Oilatum Plus [contains other active ingredients as well as triclosan], pHisoHex, QV Flare Up

Bath Oil [contains other active ingredients], Sapoderm Skin Wash Lotion). These can be used on the face and body but some may be too drying in certain people.

### Hepatitis A

Hepatitis A virus can be transmitted by the faecal-oral route to healthcare workers. There have also been reports of outbreaks in healthcare workers related to contamination via contact with external biliary drainage. Those healthcare workers in settings where the infection may be endemic and contact with infected secretions is most likely, such as long term care facilities and nurseries, are most at risk.

Vaccination (Avaxim, Havrix 1440, Twinrix [hepatitis A and hepatitis B combined vaccine], Vaqta Hepatitis A Vaccine Inactivated) is recommended for these groups. In other settings, consistent vigilance and hand washing should prevent most infections.

### Scabies

A skin infection caused by the mite *Sarcoptes scabiei*, scabies is characterised by itching and a rash, which may be papular, vesicular or have tiny burrows. In immunocompromised patients, the infection may present as generalised dermatitis, and is very infectious. Transmission is by close body contact, and outbreaks have been documented involving many healthcare workers being infected from one patient.

Treatment with permethrin-containing creams or lotions (Lyclear, Quellada Scabies Treatment) is usually adequate. Contact tracing and treating may be appropriate.

### Conclusion

Although this article does not discuss each of these infections in depth, hopefully it provides an update for healthcare workers of some potential infection risks. An awareness of these infections may be enough to emphasise the need for at least

basic infection control measures.

Hepatitis A and B and varicella may be prevented by vaccination in healthcare workers known to be at risk, or those in whom infection may have tragic consequences (such as during pregnancy). Other vaccine-preventable infections that may infect healthcare workers, and which are not discussed in this article, include influenza, pertussis, measles, mumps and rubella. For healthcare workers who have not previously been vaccinated or infected, vaccination against the latter four is recommended, unless contraindicated (using a combined vaccine for diphtheria, tetanus and pertussis [Boostrix], combined live vaccines for measles, mumps and rubella [M-M-R II, Priorix] or the single vaccine for rubella [Ervevax, Meruvax II]). Influenza vaccination (Fluarix, Fluvax, Fluvirin, Vaxigrip) is recommended as a routine annual event.

Infectious risks for healthcare workers have changed throughout time. In the eighteenth century, syphilis was an occupational hazard of midwives. Now, with the advent of HIV and an increase in tuberculosis in many countries (often involving multidrug-resistant strains), the need for vigilance and adherence to standard infection control precautions has been revisited.

Some healthcare workers still unnecessarily put themselves at risk by not taking up available preventive measures (such as hepatitis B vaccination). In many cases, it is human behaviour, perhaps complicated by fatigue or the awkwardness of a room's physical setup, which results in injuries involving needles.

The social and professional consequences of acquiring HIV or hepatitis B illustrate how deviations from standard techniques are obvious folly. Ongoing reinforcement of infection control and preventive issues is the key to avoiding acquiring these infections. **MT**

*The list of references is available on request to the editorial office.*

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