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Management of sharps injuries in the healthcare setting

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Sharps injuries are common in the healthcare setting. Between 2004 and 2013 a total of 4830 healthcare associated occupational exposures to body fluid were reported in the UK, 71% of these for percutaneous injuries.¹ As the reporting system is likely to have recorded only cases with an important exposure, the actual burden of sharps injuries is likely to be much higher. Healthcare workers need to be familiar with immediate management both for themselves if they become injured and for assisting injured colleagues. Many healthcare workers do not know how to manage a sharps injury,² particularly if this occurs out of hours. This review presents a summary of the immediate management of sharps injuries and outlines the risk assessment and management strategies to prevent the transmission of HIV, hepatitis B virus, and hepatitis C virus.

What is a sharps injury?

A sharps injury occurs when a sharp object such as a needle, a scalpel, bone fragments, or teeth penetrate(s) the skin. A splash of body fluid to mucous membrane or non-intact skin is another form of exposure to body fluids that could have a similar consequence.

Where do sharps injuries occur?

Healthcare related sharps injuries are not confined to hospitals, with 3-7% occurring outside.¹ The most commonly reported injuries are associated with venepuncture. Injuries to nurses and healthcare assistants accounted for 42% of all reports, whereas doctors and dental professions accounted for 41% and 5%, respectively.¹ Worryingly, ancillary healthcare workers without direct patient contact were also injured by inappropriate disposal of sharps.

What are the risks associated with sharps injuries?

Apart from the trauma of the injury itself, a major concern with sharps injuries is the risk of infection. In Western countries the three most common blood borne infections usually associated with transmission through sharps injuries are HIV, hepatitis B virus, and hepatitis C virus. Rarely, other

SOURCES AND SELECTION CRITERIA

We searched PubMed and the Cochrane Library for articles published over the past 20 years using the terms “sharps injury”, “needle stick injury”, and “body fluid exposure” and hand selected the most relevant and appropriate articles. To search for relevant UK national guidelines we also accessed the UK Department of Health and Public Health England (formerly Health Protection Agency) websites. We consulted guidelines from the World Health Organization, Centers for Disease Control and Prevention, British HIV Association, and British Society for Sexual Health and HIV.

infections such as malaria,³ human T cell leukaemia viruses (types I and II),⁴ and haemorrhagic fever viruses, such as Ebola virus,⁵ may be implicated. The risks of transmission of hepatitis B virus (when positive for HB e antigen), hepatitis C virus, and HIV through sharps injuries are often quoted as 1:3, 1:30, and 1:300, respectively.^{6,7} Mucosal exposure to body fluid carries a much lower risk (<1:1000 for HIV).⁷

The actual risk of transmission during an incident depends on several factors, such as the type of injury, the viral load of the source patient, the immune status of the recipient, and risk reduction strategies implemented in the healthcare setting. Since 1997 there has only been one documented case in the UK of HIV seroconversion in a healthcare worker after an occupational exposure.⁸ Despite hepatitis B virus being highly infectious, no transmission by sharps injuries has been reported in the UK in the past 10 years. This probably relates to the high percentage of healthcare workers who are immunised against hepatitis B virus. Hepatitis C virus is most commonly associated with sharps injuries, with the virus involved in 50% of all reported cases. Since 1997 a total of 21 hepatitis C virus seroconversions in healthcare workers have been reported in the UK.¹

As these infections have a relatively long incubation period, of as much as 3-6 months, the psychological impact and associated anxiety of potential infection during the follow-up period should not be underestimated.⁹

Box 1 | Immediate first aid after exposure to body fluid (based on UK guidelines)⁷

- Gently encourage bleeding in the puncture site
- Wash the injured area with soap and water
- Do not scrub the site or use antiseptic agents
- Cover the wound with an impermeable dressing after cleansing
- In the case of mucosal exposure, wash the exposed area copiously with water or normal saline
- If contact lenses are worn, wash the eyes with water or normal saline both before and after removing the lenses

THE BOTTOM LINE

- First aid should be undertaken as soon as possible and a risk assessment needs to be carried out urgently by an appropriately trained individual
- If post-exposure prophylaxis is deemed necessary this should begin as soon as possible without waiting for the test results of the source patient
- Post-exposure prophylaxis using antiretroviral drugs within the hour after injury can considerably reduce the risk of HIV transmission
- Hepatitis B vaccine is highly effective in the prevention of hepatitis B; all healthcare workers should be immunised against the virus
- Despite the lack of post-exposure prophylaxis to hepatitis C, such exposure should be followed up vigorously as treatment has a high success rate

Box 2 | Risk assessment based on injury type (adapted from UK guidelines⁶ and case-control studies^{10,11})

High risk exposures

- Deep percutaneous injury
- Freshly used sharps
- Visible blood on sharps
- Needle used on source's blood vessels

Low risk exposures

- Superficial injury, exposure through broken skin, mucosal exposure
- Old discarded sharps
- No visible blood on sharps
- Needle not used on blood vessels—for example, suturing, subcutaneous injection needles

Exposures with no or minimal risk

- Skin not breached
- Contact of body fluid with intact skin
- Contact with saliva (non-dental), urine, vomit, or faeces that is not visibly blood stained
- Needle not used on a patient before injury

What should be done immediately after a sharps injury?

First aid should be performed on-site immediately after a sharps injury (box 1).

How is a risk assessment performed?

Prompt reporting of injuries is necessary so that a risk assessment can be carried out urgently by an appropriately trained individual (other than the exposed worker) who is familiar with the local management pathway. The arrangement for the provision of post-exposure advice varies between hospitals and time of day. All healthcare workers should be familiar with local policy.

The first step in risk assessment is to establish the type of injury (box 2). In the case of bites, it is important to establish whether the source patient has been bleeding from the mouth—for example, from a fight.

The next step is to consider the body fluid involved (box 3). An exposure is considered clinically important if the injury carries a risk and the body fluid is considered high risk. Where the injury does not carry a risk or the body fluid is not high risk, no further action is required other than a review of vaccine history for hepatitis B virus and the offer of vaccination if indicated.¹² The risk of transmission of a blood borne virus is related to the volume of blood transferred; thus hollow bore needles carry more risk than solid instruments. A case-control study identified high risk factors for transmission of HIV from an infected source patient after a sharps injury as a device visibly contaminated with blood, a cannula that has been inserted in the source patient's artery or vein, a deep injury, and a source patient with a high plasma viral load (for example, at the time of seroconversion) or in the advanced stages of untreated HIV infection (box 4).¹⁰

What blood tests are required for source patients and recipients?

If the risk assessment indicates that a clinically important exposure to body fluid has occurred, the status of the source patient's blood borne viruses should be established. In some cases it may be possible to ascertain this from the source patient's medical records. If the blood borne virus status is not known, appropriate arrangements should be made, with the consent of the source patient, either to test an existing blood sample or to take a fresh sample for testing.¹³ Box 5 lists the recommended tests. Immediate management and prophylaxis should be offered based on the initial risk assessment and should not be delayed while waiting the results of blood tests.

A baseline serum sample should be taken from the recipient and stored for potential retrospective testing. If the hepatitis B virus immunity status of the recipient is not already known, the baseline sample can be tested for antihepatitis B surface antibody to guide further immunisation against hepatitis B virus. Further blood borne virus testing of the recipient at this stage is unnecessary, as this only reflects the status of the recipient at the time of testing and not whether transmission has occurred.

What consent is required?

In addition to obtaining the source patient's consent for blood borne virus testing, consent should also be sought for disclosure of the test results to the occupational health ser-

vice and the injured healthcare worker. If the source patient is deemed not to have capacity to consent, the tests cannot be performed, as this is for the benefit of a third party and not in the patient's own best interests.¹³ Next of kin cannot give consent on behalf of a patient, unless the patient is deceased, or a child, in which case the parents or guardians may give consent. The recipient of the sharps injury should not approach the source patient for consent as this may influence the source patient's decision and could invalidate the consent. If the incident happened during a procedure where sedation or anaesthesia was given, the source patient should be given sufficient time to recover capacity. If there are practical obstacles to obtaining consent promptly, the decision for starting post-exposure prophylaxis should be based on the information available at the time.

When should post-exposure prophylaxis for HIV be started?

The evidence for efficacy of post-exposure prophylaxis in preventing transmission of HIV is limited.¹⁵ Transmission of simian immunodeficiency virus in macaques was shown to be prevented by tenofovir when given within 24 hours of inoculation and continued for four weeks.¹⁶ Treatment efficacy was reduced if there was a delay between inoculation and treatment and if the duration of treatment was shortened. The use of post-exposure prophylaxis in an occupational health setting was based on an observational study, which showed that the use of zidovudine reduced the risk of transmission after exposure by 80%.¹⁰ Table 1 summarises the recommended use of post-exposure prophylaxis based on risk assessment.

Although the risk of HIV transmission is increased if patients have a high viral load, it is not clear what the risk of transmission is if the viral load is undetectable. In such cases the risk is thought to be low although not zero.¹⁷ Guidelines from the United States recommend that post-exposure prophylaxis should be offered even when source patients have undetectable viral loads.¹⁸ In the UK a discussion with

Box 3 | Body fluids and risk for transmission of blood borne viruses (in alphabetical order, based on UK guidelines^{6,7})

High risk body fluids

- Amniotic fluid
- Blood
- Cerebrospinal fluid
- Exudative or other tissue fluid from burns or skin lesions
- Human breast milk
- Pericardial fluid
- Peritoneal fluid
- Pleural fluid
- Saliva in association with dentistry (likely to be contaminated with blood, even when not visibly so)
- Semen
- Synovial fluid
- Unfixed human tissues and organs
- Vaginal secretions

Low risk body fluids (unless visibly blood stained)

- Saliva (non-dentistry associated)
- Stool
- Urine
- Vomit

the recipient about the balance between the risk of transmission and the side effects of post-exposure prophylaxis is recommended. Post-exposure prophylaxis is generally not recommended if the viral load is less than 200 copies/mL but could be offered if the recipient is anxious about the risk.¹⁹ Thus the final decision on whether or not post-exposure prophylaxis should be used should be made with full engagement of the recipient.

The antiretroviral agents recommended for post-exposure prophylaxis differ between the guidelines from different countries. Table 2 summarises the recommended agents and their possible side effects. The current agents recommended in the UK are well tolerated, with few side effects, can be taken at any time of the day, and can be stored at room temperature. Pregnancy is not a contraindication, although the possible risk and benefits to the fetus should be discussed with the recipient. Advice from a specialist experienced in the management of HIV in pregnancy should be sought.

UK guidelines recommend starting post-exposure prophylaxis as soon as possible and no later than 72 hours after exposure, and to continue for 28 days.⁷ If the source patient's HIV test result is negative, post-exposure prophylaxis can be discontinued. Before starting post-exposure prophylaxis a full drug history should be obtained from the recipient because of potential interactions between antiretroviral agents and other drugs. An excellent resource for checking drug interactions is available online.²² Post-exposure prophylaxis may need to be adjusted if the source patient is suspected of having or known to have resistance against one or more components of the standard post-exposure prophylaxis. Such problems should be discussed with local HIV experts or the HIV doctor treating the source patient, although this should not delay post-exposure prophylaxis.

How can the transmission of hepatitis B virus be prevented?

The vaccine against hepatitis B virus can be given shortly after exposure either as the first dose of a primary course or as a booster. Table 3 shows the strategy for offering vaccination against hepatitis B virus after a sharps injury based on vaccination history, previous response to vaccination, type of exposure, and the hepatitis B virus status of the source patient. The additional use of hepatitis B immunoglobulin aims to provide passive immunity if the source patient is known to be at high risk of hepatitis B virus infection and the recipient has not been previously adequately immunised or is a known non-responder to the vaccine—that is, those with a documented absence of hepatitis B surface antibodies after a full course of hepatitis B vaccination.¹² The ideal time frame for use of post-exposure hepatitis B immunoglobulin is within 48 hours of exposure, although it can be considered up to one week.¹²

What can be done about exposure to hepatitis C virus?

A case-control study found that the risk of hepatitis C virus transmission after percutaneous exposure increased with deep injuries and procedures involving hollow bore needles placed in a source patient's blood vessel.¹¹ Hepatitis C virus has also been found to have prolonged survival in syringes with a high residual void volume.²³ The risk of hepatitis C virus transmission increases significantly if

Box 4 | Risk assessment of source patient (based on UK guidelines⁷ and case-control studies^{10 11})

High risk source

- Known to be infected with one or more blood borne viruses (viral load and treatment status unknown)
- Known to have a detectable viral load for one or more blood borne viruses
- Unknown viral load but known to have advanced or untreated blood borne virus infection
- Blood borne virus status unknown but had known risk factors*

Low risk source

- Ongoing risk factors for blood borne viruses and recent blood test results were negative for all three blood borne viruses
- Infected with a blood borne virus but known to have a fully suppressed viral load
- Unknown viral load but receiving long term antiviral treatment for blood borne virus with good adherence and known to be stable
- Blood borne virus status unknown but had no known risk factors for such viruses

Source with no or minimal risk

- A recent blood test† result was negative for all three blood borne viruses

*Examples of risk factors: intravenous drug use, men who have sex with men, commercial sex workers, origin from high prevalence areas for HIV, hepatitis B virus, or hepatitis C virus.

†Can be arranged from source patient after consent if no recent results for blood borne viruses are available. However, management should not be delayed while waiting for results.

Box 5 | Recommended investigations in source patient after consent (based on expert opinion)

- Combined HIV antigen and antibody (fourth generation HIV immunoassay)
- Hepatitis B surface antigen
- Hepatitis C antibody*
- Other additional investigations could be added if a specific transmissible infectious condition is suspected—for example, malaria, human T cell leukaemia virus

*Testing for hepatitis C virus RNA or antigen should also be considered if source patient is at high risk for hepatitis C virus. This is because hepatitis C virus antibody may be negative during acute infection and may remain negative for more than 12 months in immunocompromised patients.¹⁴

Table 1 | Recommendation for HIV post-exposure prophylaxis based on HIV status of source patient and nature of incident (based on UK guidelines⁷)

Incident risk and nature of exposure	Status of source patient*	
	No or low risk for HIV	High risk or known to be HIV positive
Minimal risk incident or low risk exposure		
Post-exposure prophylaxis	Not recommended	Not recommended
Follow-up	Not required	Not required
Low risk incident and high risk exposure		
Post-exposure prophylaxis	Not recommended	Considered†
Follow-up	Not required	Advisable
High risk incident and high risk exposure		
Post-exposure prophylaxis	Not recommended	Recommended
Follow-up	Not required	Required

*Where it is not possible to identify the source patient, a risk assessment should be conducted, including circumstances of exposure and epidemiological likelihood of HIV being present. Use of post-exposure prophylaxis is unlikely to be justified in most such exposures.

†Could be offered after a thorough discussion of risk.

Table 2 | Recommended antiretroviral agents for HIV post-exposure prophylaxis after sharps injuries (based on US,¹⁸ UK,²⁰ and WHO²¹ guidelines)

Source of guidelines and recommendations	Potential side effects
UK and USA	
Truvada (245 mg tenofovir disoproxil fumarate and 200 mg emtricitabine) one tablet daily	Rare, but important side effects include acute renal failure and proximal renal tubulopathy (Fanconi's syndrome)
Raltegravir 400 mg twice daily	Rare, but include insomnia, diarrhoea, and nausea and vomiting
World Health Organization	
2 nucleoside reverse transcriptase inhibitors: tenofovir+lamivudine or emtricitabine	Rare, but important side effects of tenofovir include acute renal failure and proximal renal tubulopathy (Fanconi's syndrome)
Kaletra (200 mg lopinavir and 50 mg ritonavir) or other ritonavir boosted protease inhibitor	Rare, but include rash, diarrhoea, nausea and vomiting, and abnormal liver function test results

Managing sharps injuries

illustrations by Katie Jessop

1 First aid

Gently encourage bleeding

Wash with soap and water

Wash eyes before and after removing contact lenses

Cover with impermeable dressing

Mucosal exposure wash copiously with water or saline

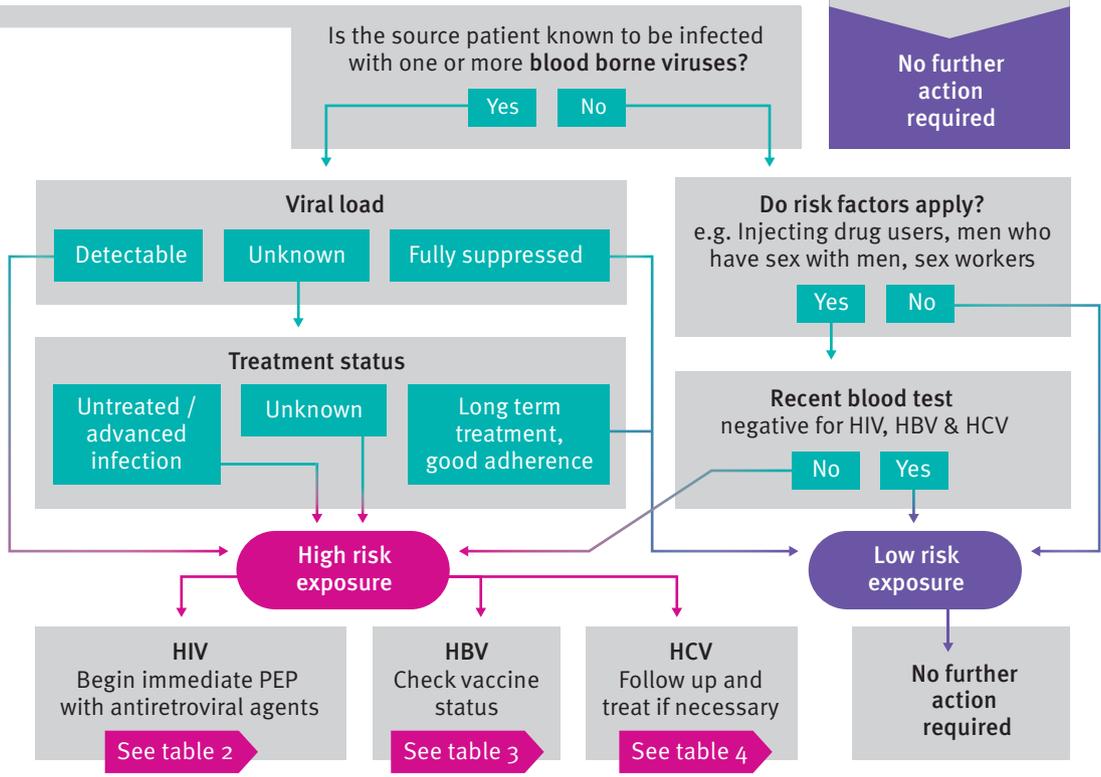
Don't scrub wound
Don't use antiseptic

2 Assess incident risk

Incident risk:	High	Low	Minimal
Injury	Deep	Superficial	No skin breach
Needle use	Intravascular	Suturing/ Subcutaneous	Not used on patient
Age of sharps	Recently used	Old, discarded	Contact with low risk fluids: • Saliva • Urine • Vomit • Faeces
Blood on sharps	Visible	Not visible	

3 Assess source patient

for blood borne viruses. HIV, hepatitis B (HBV) and hepatitis C (HCV) are the most common. Post-exposure prophylaxis (PEP) and/or follow up treatment may be required.



WILL STAHL-TIMMINS

Table 3 | Hepatitis B management algorithm based on vaccination history of recipient (based on UK immunisation guidelines¹²)

Hepatitis B vaccination history of recipient	≤1 dose of vaccine or uncertain vaccination history		≥2 doses of vaccine	
	Unknown	Unknown	Known vaccine responder	Known vaccine non-responder
High risk exposure, source patient positive for hepatitis B surface antigen	Accelerated vaccine* course+1 dose of hepatitis B immunoglobulin†	2 doses of vaccine at 0 and 1 month	Consider booster vaccine dose	2 doses of hepatitis B immunoglobulin† at 0 and 1 month; consider booster vaccine dose
High risk exposure, hepatitis B surface antigen status of source patient unknown	Accelerated vaccine* course	1 dose of vaccine	Consider booster vaccine dose	2 doses of hepatitis B immunoglobulin† at 0 and 1 month; consider booster vaccine dose
Source patient negative for hepatitis B surface antigen or low risk exposure (regardless of hepatitis B surface antigen status)	Initiate vaccine course	Complete vaccine course	Consider booster vaccine dose	No hepatitis B immunoglobulin; consider booster vaccine dose

*Doses spaced at 0, 1, and 2 months with booster dose at 12 months.
†Hepatitis B immunoglobulin 500 units intramuscularly per dose.

Table 4 | Suggested follow-up schedules after high risk sharps injuries (based on UK guidelines⁷ for HIV and expert opinions for hepatitis B virus and hepatitis C virus)

Blood borne virus risk in source patient	Within first 12 weeks	Week 12*	Week 24
Hepatitis B virus	Attendance for hepatitis B vaccination with or without second dose of hepatitis B immunoglobulin according to recommended schedule	Test for hepatitis B surface antigen and hepatitis B surface antibody	Not routinely recommended unless hepatitis B immunoglobulin was given
Hepatitis C virus	Test for hepatitis C virus RNA at week 6	Test for hepatitis C virus antibody and hepatitis C virus RNA	Not routinely recommended unless risk of hepatitis C virus transmission is high

*If HIV post-exposure prophylaxis has been started, week 12 is calculated from end of post-exposure prophylaxis.

ADDITIONAL EDUCATIONAL RESOURCES

Resources for healthcare professionals

Health and Safety Executive. Sharps injuries—what you need to do (www.hse.gov.uk/healthservices/needlesticks/actions.htm)
—provides a perspective from the regulatory aspect of sharps injury

NHS Choices. What should I do if I injure myself with a used needle? (www.nhs.uk/chq/Pages/2557.aspx?CategoryID=72)
—provides a concise and practical approach to needlestick injury; also useful for non-healthcare workers

Royal College of Nursing. Needlestick and sharps injuries (www.rcn.org.uk/support/the_working_environment/health_and_safety/needlestick_and_sharps_injuries)
—has a link to the Royal College of Nursing guidance on sharps safety

Patient.co.uk. Needlestick injury (www.patient.co.uk/doctor/needlestick-injury)
—provides good tips on how to prevent sharps injury

Health Education England. e-learning for Healthcare (<http://www.e-lfh.org.uk/>)
—several e-learning modules under Pathology (PATH)/e-Path 07-Virology provide useful information on prevention and management of sharps injury: 07_052 Sharps Injuries; 07_060 HBV; 07_104 HIV prevention

Medscape (<http://emedicine.medscape.com/article/782611-overview>)
—a comprehensive overview of the American approach to management of exposure to body fluids

HIV-drug interaction.org (www.hiv-druginteractions.org)
—maintained by the University of Liverpool, which provides a clinically useful, up to date and evidence based drug-drug interaction resource, freely available to healthcare workers, patients, and researchers

How is care accessed in different healthcare settings?

Local policy should clearly identify which department to contact during and out of normal working hours. The emergency department is usually the location for immediate access to advice, medicines, and vaccines, although in some hospitals additional post-exposure prophylaxis packs are stored in strategic locations such as operating theatres or delivery suites.

In the community setting or in dental practices, the initial management of the injury has to be started on-site, immediately after the incident. A system to enable injured healthcare workers to access urgent expert advice should be locally agreed. As this occurs in an outpatient setting, it is important that source patients should be assessed before discharge and consent obtained for any potential blood tests. Hepatitis B virus vaccines are widely available in general practice, but access to HIV post-exposure prophylaxis would require a visit to the local emergency department. Because of the need to start these drugs early, attendance at an emergency department should not be delayed if this is deemed necessary after risk assessment.

How should injured healthcare workers be followed up?

After important exposure to body fluid, recipients should be followed up for at least 12 weeks. Table 4 summarises the testing required and timing of follow-up. Healthcare workers who have sustained a high risk injury and receive post-exposure prophylaxis should not be considered infectious and should be reassured that it is safe for them to return to clinical work, including performing procedures that are prone to exposure.²⁶ They should, however, be advised to use barrier contraception and to avoid blood or tissue donations, pregnancy, and breast feeding, especially during the first six to 12 weeks after exposure.¹⁸

the source has a high viral load,¹¹ whereas those with an undetectable viral load are unlikely to be infectious.²⁴

Currently no vaccine or post-exposure prophylaxis is effective in the prevention of hepatitis C virus transmission. However, treatment of acute hepatitis C infection is known to be highly effective.²⁵ Early detection of hepatitis C virus transmission and referral to an appropriate specialist for assessment and treatment is therefore essential.