Chapter 21
Occupational Health Risks for Healthcare Workers

Walter Popp

Key points

- Healthcare workers are exposed to biological, chemical, physical, ergonomic, and psychosocial hazards.
- Hepatitis B, hepatitis C, human immunodeficiency virus, and tuberculosis pose the greatest risk of infection to healthcare workers.
- Infection with hepatitis B virus is preventable with immunisation; all healthcare workers should be vaccinated against hepatitis B.
- Written standard procedures on how to manage needlestick injuries should be available and known to all staff.
- Occupational medicine and infection prevention and control may be performed by the same person in low resource countries.

Background

Health care facilities around the world employ over 59 million workers[1] who are exposed to many health hazards including:

- Biological: tuberculosis (TB), Hepatitis B and C, human immunodeficiency virus (HIV)
- Chemical: disinfectants, ethylene oxide, antineoplastic agents, anaesthetic gases, latex (in gloves causing allergies)
- Physical: noise, radiation, falls
- Ergonomic: heavy lifting, musculoskeletal disorders
- Psychosocial: shift work, violence, stress, and burn-out.

Each year, 3 million healthcare workers (HCW) are exposed to bloodborne pathogens through a percutaneous route; 2 million are known to be exposed to hepatitis B, 900,000 to hepatitis C, and 170,000 to HIV. However underreporting of injuries can reach 40-75%, so there may be many more unreported. Known exposures result in 15,000, 70,000, and 1,000 infections, respectively, and > 90% of these infections occur in developing countries.[2] Needlestick injuries, which cause 95% of HIV seroconversions in HCWs, are preventable by practical and low-cost measures. Infection with hepatitis B virus is 95% preventable with immunisation, however less than 20% of HCWs in some regions of the world have received all three vaccine doses needed for immunity.[1]

Prevention

Basic principles

Occupational medicine and infection prevention and control may be performed by the same person in low resource countries, although separate departments are preferred. To reduce occupational risks to healthcare staff:

- Conduct a written risk assessment for staff regarding physical, chemical, biological, ergonomic, and psychosocial hazards.
- Review the risk assessment annually to determine if the risks have changed or whether there are additional risks.
- Include an estimate of the degree of risk, e.g., low, medium and high (see Tables 21.1 and 21.2)

Table 21.1. Classification of biological agents into 4 groups according to their level of risk of infection*

Risk group	Description	Examples
1	Biological agent unlikely to cause human disease	Bacteria in yoghurt Yeast in beer
2	Biological agent that can cause human disease and might be a hazard to workers; it is unlikely to spread to the community; there is usually effective prophylaxis or treatment available	Most bacteria Nearly all moulds Most viruses
3	Biological agent that can cause severe human disease and present a serious hazard to workers; it may present a risk of spreading to the community, but there is usually effective prophylaxis or treatment available	Hepatitis B Hepatitis C Human immunodeficiency virus Tuberculosis
4	Biological agent that causes severe human disease and is a serious hazard to workers; it may present a high risk of spreading to the community; there is usually no effective prophylaxis or treatment available	Lassa virus Severe acute respiratory syndrome?

*According to Directive 2000/54/EC of the European Parliament and of the Council.[3]

Table 21.2. Risks for transmission of infectious agents in health care settings and risk reduction strategies for employee to patient and patient to employee transmission

Infection	Transmission in general	Risk of transmission evaluation		Risk classification of biological agents*	Main risk	Vaccine available	Post-exposure prophylaxis (PEP)
		Staff to patient	Patient to staff				
Cholera	Faecal-oral, contaminated water	Rare	Rare	2	Stool contact	Yes	
Conjunctivitis, viral (e.g., adenovirus)	Contact with eye secretions and contaminated objects	High	High	2	Hand contact and touching eye	No	No
Cytomegalovirus (CMV)	Contact with urine, saliva, breast milk, cervical secretions, and semen from infected person who is actively shedding virus	Rare	Rare	2	Contact with body fluids, especially saliva, blood, and urine	No	No
Diphtheria	By droplets, also by contact	No data	Rare	2	Close face to face exposure, cough	Yes	PEP with antibiotic should be discussed
Haemorrhagic fever (Ebola, Marburg, Lassa virus)	Bloodborne; some question of contact transmission	Negligible	Moderate	4	Blood splash on mucous membrane	No	Antivirals should be discussed
Hepatitis A	Person-to-person by faecal-oral route; infected food handlers with poor personal hygiene can contaminate food	Rare	Rare	2	Stool contact	Yes	Immune globulin

Infection	Transmission in general	Risk of transmission evaluation		Risk classification of biological agents*	Main risk	Vaccine available	Post-exposure prophylaxis (PEP)
		Staff to patient	Patient to staff				
Hepatitis B	Via percutaneous, mucosal, and nonintact skin contact with blood, semen, vaginal secretions, and bloody fluids	Low	Moderate	3	Needlestick injury	Yes	Hepatitis B immune globulin (HBIG)
Hepatitis C	Via percutaneous, mucosal, and nonintact skin contact with blood, semen, vaginal secretions, and bloody fluids	Low	Moderate	3	Needlestick injury	No	No
Herpes simplex	Contact with virus in saliva of carriers; contact with vesicle fluid	Rare	Low	2	Contact with infected site	No	No
Human immunodeficiency virus (HIV)	Primarily via percutaneous contact with blood; mucosal or nonintact skin contact with blood; semen, vaginal secretions, and bloody body fluids less likely to transmit	Rare	Low	3	Needlestick injury		Antivirals must be provided within hours!

Infection	Transmission in general	Risk of transmission evaluation		Risk classification of biological agents*	Main risk	Vaccine available	Post-exposure prophylaxis (PEP)
		Staff to patient	Patient to staff				
Influenza	Droplet spread; direct droplet transmission or droplet to contact transmission of respiratory secretions of infected patients	Moderate	Moderate	2	Close contact with patient (Within 3 feet from coughing/ sneezing)	Yes	Antivirals normally not recommended
Measles	Airborne; direct airborne transmission or airborne to contact transmission of respiratory secretions of infected person	High	High	2	Inhaling or contact with the patient's respiratory secretions	Yes	Immune globulin
Meningococcal infection	Droplet spread; direct droplet transmission or droplet to contact transmission of respiratory secretions of infected patients		Rare	2	Close contact; face to face	Yes (tetravalent A, C, W135, and Y)	Antibiotic after close contact
Mumps	Droplet spread; direct droplet transmission or droplet to contact transmission of respiratory secretions of infected patients	Moderate	Moderate	2	Close contact with patient (Within 3 feet from coughing/ sneezing)	Yes	

Infection	Transmission in general	Risk of transmission evaluation		Risk classification of biological agents*	Main risk	Vaccine available	Post-exposure prophylaxis (PEP)
		Staff to patient	Patient to staff				
Methicillin-resistant *S. aureus* (MRSA)	Direct and indirect contact	Rare	Rare	2	Skin contact	No	No
Norovirus	Faecal-oral (direct or indirect contact with patient's stool)	High	High	2	Stool contact	No	No
Pertussis	Droplet spread; direct droplet transmission or droplet to contact transmission of respiratory secretions of infected patients	Moderate	Moderate	2	Cough	Yes	Macrolides
Polio	Faecal-oral	Rare	Rare	2		Yes	
Rabies	Animal bite	Rare	Rare	3	Bites	Yes	Yes
Respiratory syncytial virus (RSV)	Droplet contact or direct contact with respiratory secretions	Moderate	Moderate				
Rotavirus	Person-to-person via faecal-oral route	Moderate	Moderate	2	Stool contact		

Infection	Transmission in general	Risk of transmission evaluation		Risk classification of biological agents*	Main risk	Vaccine available	Post-exposure prophylaxis (PEP)
		Staff to patient	Patient to staff				
Rubella	Droplet contact or direct contact with respiratory secretions; airborne transmission not demonstrated.	Moderate	Moderate	2		Yes	
Salmonella or Shigella	Person-to-person via faecal-oral route; via contaminated food or water; food handlers with poor personal hygiene can contaminate food	Low	Low	2	Stool contact		
Severe acute respiratory syndrome (SARS)	Droplets, contact	Medium	Medium	3	Cough	No	No
Scabies	Direct skin-to-skin contact with infested person	Low	Low		Skin contact		
Streptococcus, Group A	Droplet contact or direct contact with oral secretions or drainage from infected wounds	Rare	No data	2			
Syphilis	Direct contact with lesions of primary or secondary syphilis	No data	Rare	2	Direct contact with skin or mucous membrane lesions		Antibiotics possible

Infection	Transmission in general	Risk of transmission evaluation		Risk classification of biological agents*	Main risk	Vaccine available	Post-exposure prophylaxis (PEP)
		Staff to patient	Patient to staff				
Tetanus	Bites, skin wounds	No data	No data	2		Yes	Immune globulin
Tuberculosis (TB)	Airborne transmission from sources with active pulmonary or laryngeal tuberculosis; susceptible person must inhale airborne droplet nuclei to become infected	Low to high	Low to high	3	Cough	BCG - Bacille Calmette Guérin	Isoniazid (INH) for treatment of latent TB infection; 4 drug regimen for active TB
Typhus	Faecal-oral	Low	Low	3	Stool contact	Yes (IM, SC, oral)	
Varicella, Chickenpox, disseminated zoster Localised varicella-zoster (shingles)	Contact with vesicles; droplet or airborne spread from respiratory tract of acute cases and perhaps from disseminated zoster Contact with vesicles	High moderate	High moderate	2		Yes	Varicella-zoster immune globulin (VZIG)
Yellow fever	Mosquito bites	Negligible	Rare			Yes	No

* Risk classification according to Directive 2000/54/EG[3]

Try to reduce the risks to HCWs using the following order of activities:

1. Eliminate the hazard – for example:
   - Reduce the number of injections by providing more oral medication[4-5]
   - Assign a central hospital for treating highly infective patients (e.g., tuberculosis) – for community.
2. Try to remove or isolate the hazard – for example:
   - Use safety needles (single-use needles designed to retract or cover the sharp end immediately after use).
   - Transport blood specimens in leak- and puncture-resistant boxes and use puncture-resistant waste boxes for discarding sharp items and needles.
3. Organisational measures - organise work so that the exposure is reduced - for example:
   - Reduce the number of staff members who care for a patient with TB or methicillin-resistant *S. aureus* (MRSA).
   - Train staff regularly in safe working condition practices.
   - Establish an occupational safety committee. In small hospitals this committee may be the infection prevention and control committee.
   - Consider every patient to be potentially infected with hepatitis B or C or HIV and be prepared – work with strict adherence to Standard Precautions/Routine Practices.
   - Audit compliance periodically focusing on prevention measures.
4. Evaluate use of personal protective equipment (PPE) – for example:
   - Gloves: Discard and change between patients. Use only once whenever possible or disinfect 2-3 times maximum.
   - Gowns: Use if spills/splashes are possible; change between patients. Single-use gowns are preferred. If gowns are used several times, e.g., during a shift time, put on the gown and remove it without touching the outer potentially contaminated side.
   - Eye goggles or face shields: Use if spills/splashes to the face are possible. Disinfect regularly and if visibly soiled.
   - Masks and respirators: N95/FFP respirators that have a tight face seal should be used if there is a risk of exposure to airborne pathogens. When these items are not available, surgical masks

are the best alternative, especially against droplet infection. Self-constructed, washable, and reusable textile masks provided some protection against severe acute respiratory syndrome, and may be a better than no protection.

- Develop written standard operating procedures for medium and high-risk activities. These may be identical to infection prevention and control procedures; however they should include staff protection and vaccination recommendations.

Provide a medical examination for all HCWs:

- The examination should include a physical examination and medical history for all new staff performed by an experienced physician.
- Results of the examination should be documented.
- HCW examination records and other health information should be kept confidential and stored in a secure place.
- Provide vaccinations for all staff. The following vaccinations are strongly recommended for all non-immune HCWs:
    - Hepatitis B
    - Influenza
    - Mumps/Measles/Rubella/Varicella/Pertussis (specially for staff working with children)
    - Poliovirus
    - Tetanus, Diphtheria (as a routine adult vaccination)
- All injuries should be documented in the respective staff member's medical record.
- Repeat the examination periodically, e.g., every 3 years.

Low Resource Issues

In low resource countries, special interest should be focused on preventing needlestick injuries. The two most important causes of these injuries are recapping of needles and unsafe handling of sharps waste. Other causes include:

- Overuse of injections
- Lack of supplies (disposable syringes, safer needle devices, sharps-disposal containers)
- Failure to place needles in sharps containers immediately after injection

- Passing instruments from hand to hand, e.g., in operating theatres
- Lack of awareness of the problem and lack of training for staff

Hepatitis B, hepatitis C, HIV, and TB pose the greatest risks of infection to HCWs in low resource countries. The risk of transmission from an infected patient to a HCW by a needlestick injury is around:[5-8]

- 30% for hepatitis B
- 3% for hepatitis C
- 0.3% for HIV

Surveillance of needlestick or sharp injuries may help identify problem areas/devices and be used in educating staff. After each needlestick or sharp injury:

- A co-worker should immediately be called to help.
- Ideally, any skin wound should be disinfected using alcohol or alcohol-based hand rub (use of alcohol will cause pain). If alcohol is not available, wash extensively with soap and water.
- For mucous membrane exposure, only water douching/ washing may be realistic (alternatives: iodine, chlorhexidine, or octenidin preparations).
- After disinfection, the risk of transmission should be assessed. The risk may be increased with deep wounds, visible blood on the device, a blood-filled needle, and a high viral load status of the index/source patient (if known).

Specific prevention practices

Hepatitis B

The risk of infection with hepatitis B virus (HBV) can be avoided by decreasing exposure to blood and body fluids and through vaccination. Post-exposure prophylaxis (PEP) varies with the immune status of the HCW.

- An unvaccinated HCW should receive both hepatitis B immune globulin (HBIG) + HBV vaccination
- Previously vaccinated and known antibody responder HCW: no treatment
- Previously vaccinated, known non-responder HCW: should receive both HBIG + HBV vaccination (a second vaccine series)

or 2 doses of HBIG one month apart

- HCWs whose antibody response is unknown: test the HCW for antibody and administer HBIG + HBV vaccination if results are inadequate (<10mIU/ml).

Hepatitis C

There is currently no recommended PEP for hepatitis C virus (HCV). Perform baseline and follow-up testing for anti-HCV and alanine aminotransferase (ALT) up to six months after exposure. Perform HCV RNA testing at 4-6 weeks if an earlier diagnosis of HCV infection is desired. Staff members who develop hepatitis C should be treated after seroconversion.

Human immunodeficiency virus

PEP against HIV should be started as soon as possible, preferably within 2-24 hours, not after 72 hours. Problems with HIV PEP include:

- Proof of HIV transmission is only possible using PCR testing, which is only available in highly developed laboratories.
- PEP must be given within hours of exposure.
- Contraindications (e.g., pregnancy) should be considered.
- There is a high rate of side effects (and a high rate of dropouts in taking the drugs).
- Medication must be taken for at least 4 weeks.

HIV PEP may not be available in some countries; therefore, attention should be given to using PPE and safe practices to avoid injuries. Seek expert consultation if viral resistance is suspected. In case no PEP is available:

- Perform HIV antibody testing for at least six months post-exposure (e.g., at baseline, six weeks, three months, and six months).
- Perform HIV antibody testing if an illness compatible with an acute retroviral syndrome occurs.
- Advise exposed persons to use precautions to prevent secondary transmission during the follow-up period.

Tuberculosis

Some measures to control healthcare-associated TB transmission (ventilation systems, isolation rooms, personal protective equipment) may be beyond the resources of low-income countries.[9] The following measures may reduce the risk of transmission:

- Establish a TB control committee.
- Increase awareness about TB among HIV-positive patients.
- Place patients with suspected TB or with an abnormal chest radiograph in an isolation room with door closed and a special ventilation system (natural or artificial).[10]
- Restrict sputum induction procedures and aerosolised pentamidine treatments to TB isolation rooms.
- Assign an adequate number of trained staff to perform routine and urgent acid-fast bacilli smears on a daily basis.
- Initial anti-TB treatment regimens should include four drugs.
- Patients in TB isolation rooms should only be allowed to leave their rooms when medically necessary and *must* always wear a surgical mask when outside the room.
- Place automatic closing devices on all TB isolation room doors.
- Continue isolation of TB patients until at least three negative acid-fast bacilli sputum smears are obtained.
- Forbid immunocompromised staff from contact with, or caring for, patients with TB.
- Ensure that all HCWs entering a TB isolation room wear a N95/FFP mask (or – if not available - at least a surgical mask).
- Perform routine tuberculin testing for tuberculin negative staff. In case of tuberculin conversion: Rule out active tuberculosis and treat HCW for latent TB infection.
- Each HCW has to inform a designated person on the TB control committee (or occupational heath staff) if a cough for longer than 3 weeks has not responded to a course of antibiotics.
- Treat HCWs as soon as active TB is confirmed.

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Further Reading

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