Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Chapter 67

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Occupational infections

The traditional model of infectious disease causation is the epidemiologic triangle. It has three components: an external agent, a susceptible host and environmental factors that bring the host and the agent together to produce an infection.[1]

Occupational infections are defined by two of these components. Particular infectious agents or organisms may be associated with a workplace or occupational setting and specific work activities may predispose the worker to exposure, resulting in an occupational infection.

THE IMPORTANCE OF OCCUPATIONAL INFECTIONS

Although difficult to quantify, occupational infections are probably uncommon when compared to those that result from non-occupational activities or environments.

Infections can only be confidently attributed to occupational exposure as a result of careful epidemiologic investigation. Case reports, surveillance data and cross-sectional surveys may lead to a hypothesis that a particular infection is diagnosed more commonly in one or other group of workers. However, in order to accurately estimate an odds ratio or relative risk, a carefully designed, adequately powered, case-control or cohort study will be required. Assuming that bias and confounding factors can be adequately controlled, it may then be possible to satisfy the Bradford Hill criteria for causation. Few infections have been subject to this rigorous approach.

In the individual case where an occupational infection is suspected, it is important to take an adequate occupational history. A workplace visit to assess the system of work can help confirm the likelihood of the infection being acquired through workplace factors.[2] A high index of suspicion will ensure that occupational infections are not missed. If an occupational source is not recognized, there will be a continuing risk to other workers in the same work area, and the affected individual may be at risk of re-infection on return to work, especially if full immunity following the initial infection does not occur.

A number of occupational infections that are of historical interest in developed countries are still found in less developed parts of the world, and staff who are traveling to work in those areas may acquire these infections. As the working environment becomes ever more complex, there is the potential for new occupational infections to emerge.

Infections acquired occupationally may spread to other workers or the workers' families or social contacts. As with any infection, occupational infections are controlled by controlling the source of infection, its route of transmission and by protecting susceptible persons. Most occupational infections can be prevented if appropriate measures are implemented. Some occupational infections, especially those for which vaccines are available (e.g. hepatitis B), are more amenable to prevention than others (e.g. hepatitis C). Health education and preventive programs in the workplace provide a good system for minimizing the risk of occupational infections. The largest employer in the United Kingdom – i.e. the National Health Service – has a requirement for every health-care facility to have access to an occupational health service. This has helped in reducing the burden of occupationally acquired infections in the health-care community.[3] The system is not as well developed in other industries where there is a recognized risk of occupational infections (e.g. in farming).

This chapter is written from a United Kingdom perspective and describes the arrangements and structures for public health and occupational health practice that will be found in the UK. Similar arrangements can be expected in most industrialized countries. For example, the US Centers for Disease Control and Prevention (CDC) have published guidelines for preventing the transmission of infectious diseases in the health-care workplace. These are available at http://www.cdc.gov/ncidod/dhqp/worker.html.

The US National Institute for Occupational Safety and Health (NIOSH), which is part of CDC, has published research and recommendations on most aspects of work-related injury and illness including infections (see http://www.cdc.gov/niosh/topics/diseases.html).

The Australian Safety and Compensation Council (ASCC) provides policy advice on all aspects of occupational health and safety to allow local legislators to enact and enforce laws. A recent ASCC report focuses on the more common and important infections associated with occupations in Australia.[4]

CLASSIFICATION OF OCCUPATIONAL INFECTIONS

Mode of transmission, occupations and examples of infections are outlined in Table 67.1.

SURVEILLANCE OF OCCUPATIONAL INFECTIONS

Surveillance of occupationally acquired infection is problematic. A range of data sources are available. The examples described here are from the United Kingdom but similar systems may be found in other countries.

It is a legal requirement for clinicians to notify certain specified infectious diseases to local health authorities. The current list of notifiable infections for the UK covers common infections (including viral hepatitis and tuberculosis) that may be occupationally acquired, as well as rarities such as leptospirosis, rabies and anthrax. Microbiology laboratories also report micro-organisms of public health significance to local health authorities. Outputs from these surveillance schemes can be viewed at http://www.hpa.org.uk/infections/topics_az/noids/menu.htm.

Table 67.1 Occupational infections

Mode of transmission	Occupations	Examples of infections
Contact with animals and animal products (zoonoses)	*Source of infection and route of transmission*: Contact with material from infected animals, by inhalation, ingestion, bite or scratch Contact with contaminated animal product (carcasses, placental tissue, hair, wool or hides) from endemic area Contact with animal excreta by fecal–oral or percutaneous route or in water *Occupation types*: Farm worker[1] Poultry worker Veterinarian Butcher Slaughterman Wool and leather worker Zoo worker Animal handler Sewage worker	*Salmonella* Cryptosporidiosis *Escherichia coli* O157 *Campylobacter* *Yersinia* Brucellosis Leptospirosis Q fever Psittacosis Ovine chlamydia Cat-scratch fever Pasteurellosis *Capnocytophaga canimorsus* Anthrax Rabies *Echinococcus* Schistosomiasis Avian influenza Newcastle disease *Streptococcus suis* B-virus infection Monkeypox Glanders Hendra and Nipah viral diseases Rat bite fevers Rodents main reservoir, transmission by inhalation of excreta: • arenaviral hemorrhagic fevers • hantavirus infection • lymphocytic choriomeningitis • Lassa fever Exposure to sewage is not a risk factor for *Helicobacter pylori* or hepatitis A or E viruses in sewage workers who are properly trained and provided with personal protective equipment[2,3]
Exposure to vectors	*Source of infection and route of transmission*: Exposure to tick, flea, or mites through work in infested area or in rodent-infested building *Occupation types*: Farm worker Forestry worker Overseas worker Pest control worker	Borrelia infections (Lyme disease, relapsing fever) Babesiosis Ehrlichiosis Tularemia Plague Scrub typhus Typhus Tick-borne rickettsial infections Bartonella infection Arthropod-borne viral fevers (Over 100 arboviruses cause disease in humans, often as an incidental host in a zoonotic cycle. Infection can occur in those working in endemic areas and also through laboratory exposure) (see Chapter 164)
Care of patients	*Source of infection and route of transmission*: Contact with patients, respiratory or blood-borne Contact with human excreta Skin-to-skin contact with infected patient	HIV Hepatitis B Hepatitis C Staphylococcal infection, e.g. methicillin-resistant *Staphylococcus aureus* (MRSA), Panton–Valentine leukocidin (PVL)

Table 67.1 Occupational infections—cont'd

Mode of transmission	Occupations	Examples of infections
	Occupation types: Health-care worker[4,5] Dental worker Embalmer Teacher[6] Sewage worker Laboratory worker	Typhoid/paratyphoid Hepatitis A Cryptosporidiosis Norovirus Tuberculosis Mycoplasma infection Scabies West Nile virus infection[7] Influenza Measles Mumps Meningococcus Parvovirus[8] Cytomegalovirus[9] There is some evidence that working in a child day-care centre is associated with higher seroprevalence of antibodies to cytomegalovirus infection but not erythrovirus (formerly parvovirus) B19 infection, although both of these infections are common in the general population[10] Pertussis Varicella Rubella Adenovirus Diphtheria Ebola–Marburg viral infection Lassa fever Monkeypox Severe acute respiratory syndrome (SARS)
Environmental sources, exposure to soil	*Source of infection and route of transmission*: Ploughing, digging or excavating soil in endemic area Contact with dust containing rodent feces, bird roosts, chicken coops or bat-inhabited caves in endemic area *Occupation types*: Building cleaning worker Construction worker Archaeologist	Tetanus Listeria Histoplasmosis Coccidioidomycosis Paracoccidioidomycosis Blastomycosis Hookworm
Occupational skin infections	*Source of infection and route of transmission*: Cleaning pools or aquarium Dental work in patients' mouths Barefoot contact with contaminated soil in endemic area Working continuously with wet hands Touching infected farm animals, plants containing thorns, splinters or sphagnum moss, infected meat or poultry, infected fish or shellfish *Occupation types*: Dental worker Farm worker Veterinarian Florist Slaughterer Butcher Fisherman Aquarium worker	Orf Ringworm Herpetic whitlow Erysipeloid *Mycobacterium marinum* skin infection Viral warts *Candida paronychia* Chromomycosis Cutaneous larva migrans Sporotrichosis *Vibrio vulnificus* infection Cutaneous anthrax

In neither of these systems is the occupation of the case requested or recorded. Local and national health authorities may enhance the data that are collected as part of case investigation and management, and this may include occupation and other relevant risk factors. However, such additional data are not consistently collated, analyzed or disseminated and, when available, are susceptible to ascertainment and reporting bias.

To overcome these shortcomings, active surveillance of selected occupationally acquired infections is carried out by the Surveillance of Infectious Diseases at Work (SIDAW) Project at the University of Manchester. Data are contributed by local public health staff each month. Most reports relate to diarrheal disease and scabies in health-care workers but legionellosis, tuberculosis and cutaneous anthrax have been reported.

Other occupational surveillance schemes also occasionally report occupational infections. Outputs from these surveillance schemes can be viewed at http://www.hse.gov.uk/statistics/indexoftables.htm.

Acute illnesses due to biologic agents encountered during a specified work activity – for example Lyme disease, Q fever, rabies, *Streptococcus suis*, tetanus, tuberculosis, anthrax, brucellosis, avian chlamydiosis, ovine chlamydiosis, hepatitis, legionellosis and leptospirosis – are reportable to the Health and Safety Executive under Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995 (RIDDOR 95).[5] This legal requirement to notify is intended to provide information on trends and to facilitate prevention. More information and links to outputs can be viewed at http://www.hse.gov.uk/statistics/sources.htm. Reports on infections are infrequent.

The Industrial Injuries Disablement Benefit (IIDB) Scheme provides benefits to employees if they develop a prescribed occupational disease. Diseases are prescribed when there is a recognized risk to workers in an occupation and where the risk is uncommon or absent in the general population. For some occupational diseases there is a strong association with occupation and the disease may rarely occur outside work (e.g. mesothelioma, coal miner's pneumoconiosis). However, most infections are common in the general population and it is difficult to establish a causal link with the occupation. In lay terms an infection will be attributed to an occupation if it is *more likely than not* to be caused by that occupation. In epidemiologic terms this means an attributable fraction (the proportion of the additional risk that can be attributed to the exposure in the exposed population) of 50% or more which equates to a relative risk of 2 (a doubling of the background risk caused by exposure).

Prescribed infections include:

- anthrax where work involves contact with animals infected with anthrax, or the handling of animal products or residues;
- glanders where work involves contact with equine animals or their carcasses;
- leptospirosis where work involves places liable to be infested by rodents or other small mammals, handling dogs, or contact with pigs or bovine animals or meat products;
- hepatitis A virus infection where work involves contact with raw sewage; and
- hepatitis B or C virus infection where work involves contact with human blood products or other sources.

Ancylostomiasis where work involves work in or about a mine is included in the list of UK prescribed diseases, although there is scant evidence that mining carries an increased risk of hookworm infestation. Earlier observations indicated a risk of anemia in Cornish tin miners, attributed to a lack of toilet facilities in the mines leading to spread of hookworm infestation.[6] Interestingly, this risk was not seen in coal mines. It has also not been reported as a risk in tin mines in other countries (e.g. Malaysia), even though hookworm infestation in the tropics is prevalent. The methods used for tin mining in different countries can, however, be different.[7] Most of the coal mines and tin mines in the UK are now closed, although ancylostomiasis remains on the prescribed diseases list. A complete list of prescribed infections can be viewed at http://www.dwp.gov.uk/advisers/db1/appendix/appendix1.asp.

The UK Labour Force Survey (LFS) is a national survey of 52 000 households on self-reported work-related illness. THOR-GP is a UK-wide surveillance scheme in which 270 participating general practitioners report cases of work-related ill health. Participants make a judgment as to whether a new case should be attributed to work on the balance of probabilities. Additional information and links to outputs can be viewed at http://www.hse.gov.uk/statistics/sources.htm. Again, reports on infections are infrequent.

PREVENTION AND CONTROL OF OCCUPATIONAL INFECTIONS

The control of any occupational infection requires a detailed knowledge of its epidemiology, clinical features, reservoir, mode of transmission, incubation period and communicable period. To prevent and control infection, measures are necessary to eliminate the source of infection and the route of transmission. Susceptible workers can be offered protection with antibiotics or immunization.

The Control of Substances Hazardous to Health (COSHH) Regulations 2002 require employers to assess the risks from exposure to all hazardous substances (including biologic agents) and to implement measures to protect workers and others from those risks as far as is reasonably practicable.[8] Following a workplace risk assessment, exposure to potential infection should be eliminated by changing working practices and removing hazardous products or waste. Residual risk is controlled by promoting good occupational hygiene and environmental hygiene, and by focusing on design and engineering controls. Staff training and provision and use of personal protective equipment (PPE) are key measures (Table 67.2).

Table 67.2 Control of occupational infection

Controlling the source of infection	In the case of zoonoses, best practice should be observed with respect to animal husbandry, biosecurity of animal houses, feed and water, hygiene of animal houses and equipment, inspection, testing and certification and quarantine. Codes of practice are available and some of these are backed by legal measures In the case of human sources, prompt action is needed to isolate the case while infectious and to treat if possible to render the case noninfectious.
Controlling the route of transmission	Guidelines are available which detail the measures that should be implemented to prevent transmission, including handwashing and use of appropriate personal protective equipment. In the health-care workplace, standard precautions are widely promoted in addition to enhanced measures for specific infections
Protecting susceptible workers	Antibiotic or antiviral chemoprophylaxis may be required. All staff should be up to date with their routine immunizations (tetanus; diphtheria; polio; measles, mumps and rubella). Immunization is cost-effective for some groups of workers, particularly health-care workers and laboratory workers. Health warning cards may be issued to at-risk workers

Immunization

All workers should be fully immunized according to the routine immunization schedule.[9] In UK this comprises diphtheria; tetanus; pertussis; polio; measles, mumps and rubella (MMR); *Haemophilus influenzae* b (Hib); meningitis C (MenC) and pneumococcal vaccines. See: http://www.immunisation.nhs.uk/Immunisation_Schedule for further details.

In addition, selective immunization may be recommended for groups of workers at increased risk[10] (Table 67.3).

Immunization for laboratory and pathology staff

Laboratory and pathology staff handle pathogens or potentially infected specimens, and mortuary staff are potentially exposed to infected cadavers.[11] Other laboratory personnel include cleaners, porters and administrative staff. Guidelines for morticians and embalmers can be viewed at http://www.hpa.org.uk/webw/HPAweb&HPAwebStandard/HPAweb_C/1200660060264?p=1200660029736.

All staff should have had all routinely recommended immunizations, which in the UK include tetanus, diphtheria, polio, MMR and MenC. Staff handling fecal specimens who may be exposed to polio viruses should have a reinforcing polio immunization every 10 years. Staff who may be exposed to diphtheria should have antibody levels tested 3 months after immunization. The recommended level is 0.01 IU/ml for those involved in routine diagnostic testing and 0.1 IU/ml for those exposed to toxigenic strains. A reinforcing dose is recommended every 10 years. Additional recommendations for laboratory and pathology staff are summarized in Table 67.4.

Table 67.4 Immunization of laboratory and pathology staff against specific occupational infections

Bacille Calmette–Guérin (BCG)	Recommended for microbiology and pathology staff, mortuary staff and others at high risk
Hepatitis B	Recommended for laboratory staff who have direct contact with patients' blood or tissues. Antibody levels should be checked after immunization
Hepatitis A, Japanese encephalitis, cholera, meningococcal serogroups A, C, Y, W135, smallpox, tick-borne encephalitis, typhoid, yellow fever, influenza, varicella, anthrax, rabies	Recommended for staff handling or carrying out research on specific organisms and those working in reference laboratories or infectious disease hospitals

Table 67.3 Immunization for groups of workers at increased risk

Immunization	Occupational groups
Anthrax	Those handling imported infected animal products or working with infected animals
Cholera	Relief or disaster aid workers
Diphtheria, polio, tetanus	Laboratory and health-care workers who may be exposed in the course of their work in laboratories and clinical infectious disease units
Hepatitis A	Laboratory workers who work with hepatitis A virus, staff of large residential institutions for those with learning difficulties, sewage workers, people who work with primates Consider for food packagers and handlers, staff in day-care facilities and some other categories of health-care workers based on risk assessment
Hepatitis B	Health-care workers in the UK and overseas, including students and trainees who have direct contact with patients' blood or tissues, laboratory staff who handle material that may contain the virus, staff of residential accommodation for those with learning difficulties, morticians and embalmers, prison service staff in contact with prisoners Consider for other staff groups such as the police and fire and rescue services based on risk of exposure
Influenza	Health and social care staff directly involved in patient care
Japanese encephalitis	Laboratory staff who may be exposed to the virus
Measles, mumps, rubella (MMR)	Health-care staff should be immune to measles, mumps and rubella for their own benefit and also to prevent them from spreading infection to patients
Rabies	Pre-exposure immunization should be offered to laboratory workers handling the virus, those who may handle imported animals, people who regularly handle bats in the UK, those working abroad whose work may bring them into contact with rabid animals and health-care workers who may be exposed to body fluids from a patient with rabies
Smallpox	Workers in laboratories where pox viruses (such as monkeypox or genetically modified vaccinia) are handled. Not recommended for people exhuming bodies in crypts
Tick-borne encephalitis (TBE)	In endemic areas recommended for those engaged in forestry, woodcutting, farming and the military. Recommended for laboratory workers who may be exposed to TBE
Tuberculosis	Bacille Calmette–Guérin (BCG) recommended for unvaccinated, tuberculin-negative persons aged under 35 with increased risk of exposure to persons with tuberculosis, including health-care workers, laboratory staff, veterinary and abattoir workers (who may handle infected animal species), prison staff, staff of care homes, staff of hostels for homeless people and refugees

Table 67.5 Selected infections with occupational significance

Infection	Description of infection in humans and public health importance	Risk factors, source and route of transmission	Surveillance/occurrence	Prevention and control
Brucellosis	Zoonosis. Acute febrile illness, fever or unknown origin or chronic bone or joint infection	Different species found in goats, sheep, cattle, pigs, dogs Contact with infected animals, animal tissues or consumption of unpasteurized milk Infectious aerosols occur in abattoirs No human-to-human spread	Approximately 20 cases reported annually in England and Wales (E&W) in recent years but still common worldwide Farmers and veterinarians at risk Prevalence of *Brucella* antibodies is elevated in Tanzanian abattoir workers[11]	Eliminate infection from domestic animals by testing, slaughter and immunization Pasteurize milk Precautions for those handling infected animals No immunization for humans
Varicella	Viral infection producing characteristic rash Occurs mainly in children; may have serious sequelae in adults, pregnancy and the immunocompromised	Direct and respiratory spread from human cases	Common; epidemics every 1–2 years 90% of adults are naturally immune as a result of childhood infection	Health-care staff with varicella and nonimmune health-care staff who have been exposed to varicella require active management to prevent spread to vulnerable patients Immunization is available and may be used universally or selectively In E&W varicella immunization is recommended for susceptible health-care workers who have direct contact with patients
Human seasonal influenza	Acute viral respiratory illness caused by influenza A or B viruses New strains may produce winter epidemics of varying size and severity Outbreaks can occur in hospitals, schools, prisons and other closed communities High attack rate with potential for staff absenteeism	Spread by respiratory secretions from human cases by large droplet or direct spread. Spread by airborne aerosol may also occur	Worldwide distribution In the UK in recent years primary care consultation rates for influenza-like illness have peaked at about 30/100 000 per week in January or February. In epidemic years rates may be 200/100 000 per week or higher	Affected staff should stay away from work during the infectious period (approximately 5 days in adults) Hygiene measures may reduce spread through coughing and contaminated hands and environmental surfaces. Guidelines on PPE should be followed Vaccines active against prevalent strains are manufactured each year and are used selectively Antivirals are available for treatment and prophylaxis and guidelines on their use have been published Annual immunization is recommended for health-care workers directly involved in patient care
Avian influenza	Zoonosis mainly affecting wild waterfowl and domestic poultry, caused by avian strains of influenza A virus Potential for transformation of avian strains into new human pandemic strain by genetic intermixing with seasonal human strains	Spread to humans occurs rarely through close contact with material from affected poultry or other birds Disease may be a severe respiratory illness (H5N1) or conjunctivitis (H7N2, H7N3)	Since 2003, H5N1 has been endemic in poultry worldwide The disease is rare in humans, albeit with a high case-fatality rate. To date 14 countries have reported 361 human cases of H5N1 with 221 deaths	Avian influenza is controlled in poultry by surveillance, testing and culling affected flocks Workers involved in culling activities should be provided with appropriate PPE; they should receive antiviral prophylaxis, seasonal influenza immunization and medical follow-up Detailed guidelines are available http://www.hpa.org.uk

Pandemic influenza	Global pandemics of influenza A occurred in 1918, 1957 and 1968 with high attack rates and significant morbidity and mortality, with effects on health services and other national infrastructure	Until a new pandemic strain emerges it is not possible to predict how it will behave in terms of attack rate, virulence and clinical features The World Health Organization and most national governments have published planning assumptions based on experience from previous pandemics	In the UK, planning assumptions are for a 50% clinical attack rate, with an initial wave lasting about 15 weeks with the peak in weeks 6 and 7, when 22% of cases will occur each week	In the UK, services are planning for business as usual for as long as possible Persons with influenza will be urged to stay at home, cough etiquette and enhanced hygiene will be encouraged, all affected persons will receive a course of antiviral treatment, business continuity plans will mitigate the effects of absenteeism, nonessential services will be suspended, social distancing measures may be introduced National strategic plans and detailed guidance can be viewed at http://www.dh.gov.uk
Hepatitis B and C viruses[12]	Hepatitis B is an acute viral infection of the liver. The initial illness may be severe and a chronic carrier state may develop, leading after some years to cirrhosis and hepatocellular carcinoma Hepatitis C is also a viral infection of the liver. The initial illness is often asymptomatic but 80% of those infected develop chronic infection that may result in cirrhosis and hepatocellular carcinoma	Human cases and carriers are the source of infection and transmission is by the blood-borne route. Hepatitis B is also transmitted by the sexual route and vertically from mother to infant Health-care workers and laboratory staff who are exposed to blood and tissues from infected patients are at risk. Other groups of workers such as tattooists and body piercers may also be at risk Nigerian butchers had an HBsAg seroprevalence rate of 9.4% compared with 3.3% in a control group[13] In the UK there is a reporting system for occupational exposure to blood-borne viruses	The incidence of acute hepatitis B in Europe varies from 1 to 30 per 100 000 per year. The prevalence of chronic infection varies from <1–2% Some seroprevalence studies have suggested a higher prevalence in health-care workers but this may be explained by confounding factors such as ethnicity and country of origin rather than risk of occupational exposure Reliable estimates of hepatitis C incidence are not available. Prevalence of past infection in the UK is 0.1% in blood donors and 0.2% in health-care workers In the UK there have been 11 cases of hepatitis C seroconversion in health-care workers following percutaneous exposure	Some groups of patients are screened for evidence of infection Standard infection control precautions should be followed (including use of PPE and safe handling of needles and sharp instruments) Hepatitis B vaccination is recommended for health-care workers who may have direct contact with patients' blood or body fluids. It is also recommended for workers who are at risk of injury from blood-contaminated sharp instruments, or of being deliberately injured or bitten by patients. Guidelines are available Guidelines are also available for the management of health-care workers who have had percutaneous exposures Infection may spread from health-care workers to patients and for this reason pre-employment screening has been introduced in some countries

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Table 67.5 Selected infections with occupational significance—cont'd

Infection	Description of infection in humans and public health importance	Risk factors, source and route of transmission	Surveillance/occurrence	Prevention and control
Human immunodeficiency virus[14]	A chronic viral infection which leads to depletion of CD4 lymphocytes and immunosuppression resulting in AIDS	Humans are the source of infection and spread is by the blood-borne, sexual or vertical route Health-care workers and laboratory staff who are exposed to blood and tissues from infected patients are at risk	The incidence of HIV infection in the UK is not known. The cumulative incidence of HIV infection in mid-2007 was about 90 000 and there are about 7500 new diagnoses each year The prevalence of anti-HIV varies depending on the population subgroup that is tested. In pregnant women in the UK the prevalence is between 0.5% and 5% In the UK there have been five reports of HIV seroconversion following percutaneous exposure in health-care workers	Standard infection control precautions should be followed (including use of PPE and safe handling of needles and sharp instruments) Postexposure prophylaxis (PEP) with antivirals is recommended for health-care workers who may have contact with HIV-infected patients' blood or body fluids. Guidelines are available Spread of infection from an HIV-infected health-care worker to a patient has been reported and in some countries HIV-infected health-care workers are not permitted to carry out exposure-prone surgical procedures. Guidelines are available
Tuberculosis (TB)	Infection of lungs and other organs with *Mycobacterium tuberculosis* or rarely other species including *Mycobacterium bovis* TB can cluster in health-care settings and other closed communities	Transmission is by inhalation of respiratory droplets from an infectious case Bovine TB may be contracted by consumption of milk from or contact with an infected animal	In 2006 in E&W there were 8051 cases of TB. Regional rates vary from 5 to 45 per 100 000 per year Health-care workers have twice the expected incidence of TB, allowing for age, sex and ethnic factors[15]	Infection control procedures should be followed BCG vaccine is recommended for health-care workers who may have close contact with infectious patients but not for nonclinical staff. Guidelines are available
Leptospirosis	Zoonosis with wide clinical spectrum caused by one of many serovars of *Leptospira*	Many different animal reservoirs Transmission is percutaneous from urine of affected animals	In 2006 there were 44 laboratory-confirmed cases in E&W. Most cases were recreational but seven were farmers, all of whom reported contact with livestock or rats Other risks included clearing streams or drains	Those at risk should use appropriate PPE Guidelines are available
Anthrax	Infection in humans affects skin, respiratory and gastrointestinal tract	Spread from infected animals by spores of *Bacillus anthracis* through contact with animals or animal products Spores survive in the environment	Rare. Nineteen cases reported in the UK in 1975–96 in workers handling imported infected animal products or working with infected animals	Control anthrax in livestock and disinfect imported animal products Processing of products reduces risk of infection; bone meal used as fertilizer should be sterilized; PPE should be used Immunization is available for those at risk

Ovine and avian chlamydiosis (psittacosis)	Zoonosis. Potentially serious respiratory and systemic infection caused by *Chlamydophila psittaci*	Spread from psittacine birds (parrots etc.) and other mammals which may be asymptomatic by inhalation of aerosols of bird dropping and other material from infected species Human-to-human spread is very rare	Worldwide distribution 100 cases reported in E&W each year	Affected birds should be quarantined, treated or culled Caution is required when handling birds and cleaning cages
Avian and ovine chlamydiosis	Zoonosis. Respiratory infection and may lead to miscarriage in pregnancy, caused by *Chlamydophila abortus*	Spread by inhalation of aerosols from infected and aborting sheep. Cattle and goats may also be affected	Worldwide distribution, particularly in sheep-rearing countries Commonest cause of infectious abortion in sheep in the UK but human infection is rare (1–2 cases per year in E&W)	Pregnant women should not help to lamb or milk ewes; they should avoid contact with aborted or newborn lambs (and placenta) and should not handle clothing that has been in contact with ewes or lambs A live vaccine for use in sheep is available. This should not be handled by pregnant women or women of child-bearing age
Diarrheal disease	There are many causes of infectious intestinal disease. Some are zoonoses, others have only human reservoirs	Transmission is by the direct or indirect fecal–oral route.	Refer to surveillance data for specific infections. http://www.hpa.org.uk/infections/topics_az/gastro/menu.htm Norovirus infection is a common occupational infection amongst health-care staff	Infection control procedures should be followed, including handwashing and use of PPE Guidelines are available
Methicillin-resistant *Staphylococcus aureus* (MRSA)	A spectrum of infection from minor skin infection to life-threatening bacteremia caused by methicillin-resistant *S. aureus*	The reservoir is colonized or infected humans Spread is direct on hands, fomites, equipment or the environment Acquisition of MRSA infection has been described as result of occupational contact with pigs[16]	MRSA is common in hospitals and in other care settings In England in the most recent 12-month period there were 5366 cases of bacteremia, a rate of 1–2 per 10 000 hospital bed days Health-care staff may become infected or colonized with MRSA and may act as source of infection for nosocomial transmission	Infection control procedures should be followed, including handwashing and use of PPE Guidelines are available
Hepatitis A	Infection of liver caused by hepatitis A virus Asymptomatic disease is common in children; severity increases with age Improved standards of hygiene have resulted in a decline in incidence in the UK in recent years	Transmitted by the fecal–oral route through person-to-person spread or contaminated food or drink	In 2004 there were 669 cases in E&W A high proportion of adults and adolescents in developed countries are susceptible. Most cases are sporadic although clusters have been reported amongst men who have sex with men, intravenous drug users and hostel dwellers. Travel to endemic areas is also a risk factor In some studies work with sewage has been shown to be a risk factor but this has been disputed[17]	Observing appropriate infection control precautions including use of PPE will minimize occupational spread of hepatitis A infection Immunization is recommended for laboratory workers who may be exposed to hepatitis A, staff of large residential institutions for those with learning difficulties, sewage workers and people who work with primates Immunization may be considered for food packagers and handlers, staff in day-care facilities and some other categories of health-care workers based on local risk assessment

Continued

Table 67.5 Selected infections with occupational significance—cont'd

Infection	Description of infection in humans and public health importance	Risk factors, source and route of transmission	Surveillance/occurrence	Prevention and control
Orf[18,19]	Caused by parapoxvirus Presents as a self-limiting subacute papulovesicular cutaneous lesion usually on the hands	Associated with lambs, sheep and goats	Groups affected include farmers, children visiting farms, meat industry workers	Proper hand hygiene; use of gloves Quarantine of affected animals.
Q fever[20,21]	Caused by highly infectious bacterium *Coxiella burnetti.* Incubation period 2–3 weeks Acute cases present as high fever with malaise, myalgia, sore throat, chills, vomiting, and diarrhea. Some develop pneumonia, liver function abnormalities or hepatitis, and endocarditis 50% of infected humans are asymptomatic. Chronic cases are rare	Transmitted by inhalation of organisms in dried placental material and birth fluids from infected sheep Cattle, sheep and goats are main reservoirs Consumption of raw unpasteurized milk has been a cause of a few cases Individuals with pre-existing heart valve disease are especially vulnerable if they develop chronic Q fever	Notifiable disease in the USA and the UK Occupational groups at risk are farmers, veterinarians and abattoir workers	Vaccine available for groups at risk, and also for animals Preventive measures include proper disposal of products of conception from sheep, and quarantine of imported livestock
Nipah[22] and Hendra virus	Closely related paramyxoviruses Nipah virus causes encephalitis and both Nipah and Hendra virus cause respiratory effects High case-fatality rate	Nipah virus transmitted from infected pigs. Abattoir workers also at risk. Hendra virus from horses Certain species of fruit bats are reservoirs 2004 Nipah virus outbreak in Bangladesh suggests possible person-to-person transmission, although no specific evidence for this	First major outbreak of Nipah virus in humans reported in Malaysian pig-farmers in 1998 Hendra virus first isolated in 1994 following outbreak in horses and three cases in humans in Australia	In an outbreak, PPE advised for workers dealing with infected animals, and as a precautionary measure for health-care staff dealing with infected patients
Lyme disease	Infection with spirochaete *Borrelia burgdorferi* causing rash which may progress to polyarthritis and nervous system involvement	Deer and sheep are reservoir Transmission is bite of *Ixodes* tick	Widespread in Europe and North America In E&W in 2006 there were 768 reports	In endemic areas avoid tick bites Guidelines are available
Japanese encephalitis (JE)	JE is a mosquito-borne viral encephalitis Very common cause of childhood encephalitis in Asia Can spread in laboratory workers	Reservoir is pigs and birds Spread is by mosquito vector	There have been reports of laboratory-acquired JE virus infection	Immunization is recommended for laboratory staff who may be exposed to the virus

Rabies	Acute viral encephalomyelitis caused by Lyssavirus (classic rabies virus) or bat-related Lyssavirus	Infection is via the bite or scratch of a rabid animal Person-to-person spread does not occur although rabies has spread through corneal grafts and other transplanted tissues from infected persons	Worldwide there are 40 000–70 000 cases of rabies each year In the UK, deaths occur in people infected abroad, with 24 reports since 1902 Very rarely deaths are reported following exposure to bat-related Lyssavirus	Pre-exposure immunization with rabies vaccine should be offered to laboratory workers handling the virus, those who may handle imported animals, people who regularly handle bats in the UK, those working abroad whose work may bring them into contact with rabid animals and health-care workers who may be exposed to body fluids from a patient with rabies
Tick-borne encephalitis (TBE)	Flavivirus infection of central nervous system ranging from mild febrile illnesses to meningoencephalitis	Reservoir is small mammals, domestic livestock and birds Spread is by bite of infected tick or by ingestion of unpasteurized milk from infected animals, especially goats	The virus is restricted to parts of Central Europe and Asia Those working or traveling in forested parts of endemic areas during spring and summer are at risk	Awareness of risk areas is essential Minimize tick bites by covering arms, legs and ankles, and using insect repellents on socks and outer clothes Attached ticks should be removed as soon as possible; seek local medical advice Immunization is recommended for those engaged in forestry, woodcutting, farming and the military in endemic areas Laboratory workers who may be exposed to TBE should also be immunized
Meningococcal infection[23]	Meningitis, septicemia and rarely pericarditis and arthritis caused by *Neisseria meningitidis* Serogroups B and C are most common in the UK, overseas A, Y, W135 occur Overall mortality remains around 10% in the UK	Meningococci colonize the nasopharynx Transmission is by respiratory droplets from a person carrying the organism, usually requiring prolonged close contact	In E&W notified cases of meningococcal infection have declined from a peak of nearly 3000 cases in 1999 to 1275 cases in 2006 Seasonal epidemics of group A infection are common in sub-Saharan Africa. Epidemics of group W135 infection have occurred in association with Hajj pilgrimages to Saudi Arabia Health-care workers exposed to infected cases are at increased risk but absolute risks are very low	Persons aged under 25 years and others of any age at increased risk should be immunized with a single dose of MenC conjugate vaccine. It is also recommended for long-stay visitors to high-incidence countries who will be working with local people. This group should also be offered ACWY quadrivalent polysaccharide vaccine Health-care workers should minimize exposure by use of PPE when carrying out procedures that may produce aerosols Chemoprophylaxis is recommended if the mouth or nose is directly exposed to respiratory secretions from a case

BCG, bacille Calmette–Guérin; PPE, personal protective equipment.

CONCLUSIONS

There are many infections that can be acquired through work activities or from workplaces (Table 67.5). The recognition of occupational factors as an important component in the transmission of these infections will aid in the management of affected cases, and in prevention. Continuing vigilance for new occupational infections, advances in preventive measures and an experienced occupational health team working with infection control specialists are key to the successful prevention of these infections.

REFERENCES

References for this chapter can be found online at http://www.expertconsult.com