NEBOSH International Diploma in Occupational Health & Safety

UNIT IB

INTERNATIONAL MANAGEMENT OF HAZARDOUS AGENTS IN THE WORKPLACE

ELEMENT IB5: BIOLOGICAL AGENTS

SAMPLE MATERIAL

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Types and Properties of Biological Agents

Key Information

- Biological agents are micro-organisms, cell cultures, or human endoparasites which may cause infection, allergy, toxicity or a similar health hazard.
- The three types of biological agent of concern are fungi, bacteria and viruses. These are all microscopically small entities passed to humans from other humans, animals or environmental sources.
- Many biological agents have special properties that complicate the risk that they present, namely:
  - A rapid mutation rate.
  - An incubation period.
  - Infectiousness.
  - The ability to multiply rapidly.

In this first section of the element a short introduction to biological agents is presented. The element then focuses on the specific requirements for assessing and controlling the risks inherent in work with potential for exposure to these agents.

Definition

The ILO defines a biological agent as:

> *"any micro-organism, cell culture, or human endoparasite, which may cause any infection, allergy, toxicity or otherwise create a hazard to human health. These include viruses and bacteria which can cause infection and disease, dangerous plants and animals (for example parasites or insects), biologically contaminated dusts, or wastes from humans and animals."*

Source: **Health, Safety and Environment: A series of trade union education manuals for agricultural workers (Manual 4, Fact Sheet 2). Copyright © International Labour Organisation 2004**

Types of Biological Agent

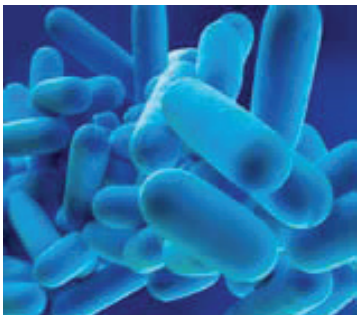
Though the definition of the term 'biological agent' is very broad and encompasses many different forms of entity, this element will focus on three principal types of biological agent: fungi, bacteria and viruses.

- **Fungi**

  Fungi include moulds and yeasts. Some fungi are able to cause infection on or inside the human body (e.g. athlete's foot). Some fungi produce toxins (mycotoxins) that are harmful to humans. Fungi reproduce by forming spores that are released, dispersed and find a suitable environment to grow in. Inhalation of large numbers of these tiny spores can cause lung disease, such as Farmer's Lung. Generally most fungi are harmless in an occupational context.

- **Bacteria**

  Bacteria are simple single-celled organisms. They vary widely in shape and many have a tail (flagella) that allows them to move through liquid. Some form hardy spores that can survive adverse conditions such as heat, cold and lack of water (e.g. bacillus anthracis, the bacteria responsible for anthrax).



Legionella Bacteria
Source: IACL 27 Legionnaires' disease – A guide for employers, HSE, 2001 (http://www.hse.gov.uk/pubns/iacl27.pdf)

Bacteria grow in virtually every environment on the planet, from water and soil to deep ocean and subterranean rock. There are approximately ten times as many bacteria growing in or on the typical human body as there are human cells. Most of these do not cause disease because of the immune system. Some (e.g. certain gut bacteria) are actually beneficial. Some bacteria can cause disease (e.g. **Legionnaires' disease** is caused by the Legionella bacterium). Antibiotics such as penicillin can be used to treat most bacterial infections.

- **Viruses**

  Viruses are micro-organisms but are not strictly alive. They are self-replicating molecules (genetic material contained in a protein shell) that invade host cells, take control of the cell to produce more viruses, and then release these viruses to repeat the cycle. Virus particles are much smaller than fungal and bacterial cells. Hepatitis and Acquired Immune Deficiency Syndrome (AIDS) are two diseases of occupational significance that are caused by viruses present in human body fluids. Viral infections are usually prevented or halted by the body's immune system. This immune response takes time to come into effect, however, so there is often a period of illness before the body's defences become effective (an effect seen every time you catch a cold). Some viral infections are so severe that the immune system cannot respond effectively and serious disease or death results (e.g. smallpox). Some viral infections are not dealt with effectively by the body and so can persist (e.g. Human Immunodeficiency Virus (HIV), the causative agent of AIDS).

Sources of Biological Agents

Pathogenic (disease-causing) biological agents come from three main sources; humans, animals and the environment.

Jargon Buster

Pathogen

A biological agent capable of causing disease.

- **Human sources** – many fungal, bacterial and viral infections are passed from person to person. This can happen by transfer of body fluids (e.g. **Viral Hepatitis** can be transferred by a needlestick injury), by droplet infection (e.g. **Tuberculosis** (TB) can be spread by coughing and sneezing) or by physical cross-contamination (e.g. '**Flu**' virus can be spread by touching the nose and then touching a surface that others then come into contact with).
- **Animal sources** – some serious fungal, bacterial and viral infections are passed from animals to humans. This can happen by the same general mechanisms as for person-to-person infection. For example:
  - **Rabies** is a viral disease that can be passed from infected animals to people, usually via a bite.
  - **Leptospirosis** is a bacterial disease spread by coming into contact with water or surfaces contaminated with an infected animal's urine (e.g. rat urine).

  A disease that can pass from animals to humans is referred to as a zoonosis (or zoonose or zoonotic disease).
- **Environmental sources** – some serious occupational diseases originate in the general environment rather than coming from a human or animal source. A classic example of this is Legionnaires' disease (or legionellosis) caused by the Legionella bacterium, which occurs naturally in damp soil and water courses.

Properties of Biological Agents

It is possible to think of biological agents as being simply another form of chemical agent. In the UK, for example, the **Control of Substances Hazardous to Health (COSHH) Regulations** define biological agents as a type of **hazardous substance**, in effect putting them in the same category as hazardous chemicals.

This simple approach can be a little misleading however, because biological agents can have the following **special properties**:

- **Rapid mutation** – like all living organisms, biological agents are subject to mutation; their genetic code changes over time, changing the characteristics of the organism. However, unlike many organisms, some biological agents have a very high mutation rate. This means that their genetic code and their characteristics change quickly, making it very difficult for the human body to effectively recognise and attack them. HIV, for example, is very difficult for the body to combat because the virus is constantly changing.
- **Incubation period** – there is usually a time delay between infection (when a person catches a disease) and when the first signs and symptoms of the disease become apparent. This incubation period can range from 1-3 days (for 'Flu) to many years (perhaps 30-50 years for Creutzfeldt–Jakob disease (CJD)). This means that the presence of a biological agent may not be readily detectable and that a link between the source of an infection and the symptoms of the disease may not be made.
- **Infectious** – it is often the case that a person (or animal) suffering from a disease is infectious, i.e. capable of spreading the agent to others. Many diseases spread by making the carrier infectious. When this is the case, an infected person poses a risk to:
  - Their colleagues.
  - Others that they might come into direct contact with.
  - In some cases, the community at large. Tuberculosis is an example of a highly infectious disease that can spread within the community.

Some diseases are not infectious, e.g. Legionnaires' disease is not passed from one person to another. In some cases, a person may be infected with a disease and become infectious without showing any signs or symptoms of the disease (they are asymptomatic); they become a carrier, capable of spreading the disease, but unaware of their infectious state. Hepatitis C is an example of this type of disease.

- **Rapid multiplication** – micro-organisms can multiply very rapidly when environmental conditions are right. For example, the E. coli bacterium (a gut bacterium) is capable of multiplying at a rate greater than one cell division every 30 minutes. Though this may not sound impressive, it becomes more so when you consider that in a 24 hour period one bacterium can multiply to become over 200,000,000,000,000. It does not take long for a small number of agents (that might not present a risk of infection) to multiply to become large numbers that are capable of overcoming the body's defences to cause infection.

In general with biological agents, there will not be a simple dose-response relationship of the kind that exists for chemical substances, and risk may be high even at small exposures.

More...

Several authorities have websites with useful information relating to biological agents:

http://www.hse.gov.uk

http://www.defra.gov.uk

http://www.hpa.org.uk

Dozens of websites also have background information on micro-organisms.

Revision Questions

1. How does the ILO define a biological agent?
2. What are the three main categories of micro-organism?

(Suggested Answers are at the end of the book.)

Assessment and Control of Risk

Key Information

- Generally, exposure to biological agents can be grouped into three categories:
  - Exposure resulting from a deliberate intention to work with a biological agent.
  - Exposure which arises out of the work activity, but is incidental to it.
  - Exposure which does not arise out of the work activity itself.

  Regulations only apply to the first two categories.
- Occupational diseases of note caused by biological agents include Cryptosporidiosis, Farmer's Lung, Hepatitis, AIDS, Legionellosis, Leptospirosis, *E. coli* infection, zoonoses, MRSA, *C. diff* and emerging health issues.
- Biological agents may be classified according to the risk they pose to health. For example, the Approved List of Biological Agents published in the UK is a list of pathogens classified into Hazard Groups according to four criteria: their ability to cause human disease; the hazard they present to workers; the likelihood of spread to the community; and the availability of prophylaxis and treatment.
- The WHO Laboratory Biosafety Manual lists factors to consider when undertaking a risk assessment of potential exposure to biological agents in laboratory work. It also outlines the requirements for laboratories at different Biosafety Levels.
- General control methods can be applied to biological agents: containment including the use of microbiological safety cabinets; sharps control; vaccination; decontamination and disinfection; effluent and waste disposal; personal hygiene measures; and PPE.
- The specification of workrooms to a Containment Level and the Class of microbiological safety cabinet used in rooms are often determined by reference to the Hazard Group classification of the agent being worked with.

Intentional Work and Incidental Exposure

Generally there are three categories of exposure to biological agents:

- Exposure resulting from a **deliberate intention** to work with a biological agent, i.e. work with biological agents that involves research, development, teaching or diagnosis.
- Exposure which arises out of the work activity, but is **incidental** to it, i.e. the activity does not involve direct work with the agent itself. For example, health care, food production, agriculture, refuse disposal and work in sewage purification.
- Exposure which **does not arise out of the work activity itself**, for example where one employee catches a respiratory infection from another. This might be thought of as an exposure resulting from normal life, in that it could and would occur simply as a result of living in the community.

Regulatory frameworks only apply to the first two categories of exposure described above because **health and safety legislation** covers only those circumstances where risks of exposure are **work-related** and not those where they have no direct connection with the work being done.

Diseases Caused by Biological Agents

This section considers a range of diseases caused by biological agents, together with the occupational contexts of exposure and the preventive measures commonly applied.

Topic Focus

Zoonoses

Zoonoses (or zoonotic diseases) are those that can be transferred to humans from animals. Several types of zoonoses will be outlined in this element, such as Leptospirosis, E. coli 0157 and Cryptosporidiosis. Other zoonoses briefly mentioned include Rabies, Orf and Anthrax. There are many more.

Occupations at risk from zoonoses will vary depending on the disease in question, but clearly people whose work brings them intentionally or incidentally into close proximity with animals will be at risk from one or several zoonotic diseases. For example:

- Farm workers.
- Vets.
- Zoo workers.
- Pet shop workers.
- Sewage workers.
- Construction workers.

Though control measures will vary depending on circumstances, the general preventive measures described later for Leptospirosis and E. coli are relevant to all zoonoses.

More...

The UK HSE website has a wealth of information and short guides on various zoonotic diseases available at:

http://www.hse.gov.uk/biosafety/diseases/zoonoses.htm

Cryptosporidiosis

Cryptosporidiosis is a parasitic infection caused by the protozoa Cryptosporidium parvum. The common symptoms are watery diarrhoea and abdominal pain with 'Flu-like symptoms. Those who contract the infection usually get better of their own accord but in certain cases, such as in young children and the immuno-compromised, the infection can be very severe and potentially fatal. The disease is contracted by the faecal-oral route including contact with infected persons and animals (particularly calves, lambs and goats). Outbreaks have been associated with public water supplies, contaminated food, and petting farms. The disease is a particular risk to agricultural workers.

Preventive measures include:

- Minimising the risk of infection by keeping carriers (both people and animals) healthy.
- Avoiding or reducing contact with animals.
- Wearing suitable protective clothing such as overalls when handling carriers, especially if they are sick, and gloves and a waterproof apron if handling potentially infected material such as mud or sewage.
- Good personal hygiene such as hand-washing and drying before eating, drinking or smoking.
- Immediate washing and drying of cuts and grazes and use of waterproof dressings.

Farmer's Lung

Straw and hay quickly become mouldy if stored wet. The moisture encourages the rapid growth of green-grey dusty **moulds** which produce clouds of spores when handled. The average size of these spores is about one micron so when inhaled they penetrate to the alveoli. It has been estimated that a farm worker handling mouldy hay may inhale as many as a million spores a minute. The disease Farmer's Lung is the result of hypersensitivity due to an antigen present in the dust of this mouldy hay.

Short term effects include:

- Irritation of the nose and eyes.
- Acute bronchitis with cough and phlegm.
- Acute Farmer's Lung with fever, headache, chest tightness, breathlessness and weight loss.
- Acute occupational asthma with chest tightness and wheezing.
- Grain fever with shivering, headache, fever and general aches and pains.

Long-term effects include:

- Chronic bronchitis with cough, phlegm and shortness of breath.
- Chronic Farmer's Lung with increasing shortness of breath and weight loss.
- Chronic occupational asthma with persistent chest tightness and wheezing.
- Damage to the heart.

Preventive measures include:

- Avoiding the creation of dust when working.
- Using farm machinery that has been selected to contain dust as far as possible.
- Adequate ventilation when handling straw, etc. indoors (perhaps by use of local exhaust ventilation or dilution ventilation).

- Good housekeeping practices where materials are being handled. In particular, using industrial vacuum cleaners rather than brushing to remove excess dust from the floors, walls, etc.
- Good personal hygiene, such as keeping clothing and hair dust-free by wearing overalls or disposable protective clothing.
- In certain instances, using suitable respiratory protective equipment (RPE).

Psittacosis

Farmer's lung is caused by the inhalation of biological dust containing mould spores. A similar transmission route can cause the disease **Psittacosis**, through inhalation of aerosols (e.g. respiratory secretions, dried faecal or feather dust) from infected birds such as parrots, budgerigars, pigeons and doves. As a consequence, it can be an occupational disease of poultry farmers, veterinarians, zoo and pet-shop employees, or others whose occupation places them at risk of exposure.

Psittacosis typically causes influenza-like symptoms, and can lead to severe pneumonia and non-respiratory health problems. Human disease is often mild or moderate, but can be severe in elderly persons or those with a weakened immune system. Psittacosis can be difficult to diagnose and mild cases often go unreported.

More...

The UK HSE information sheet AS5 *Farmer's Lung* is available from:

http://www.hse.gov.uk/pubns/as5.pdf

Biological agents may cause an allergic reaction in an individual so that subsequent exposure causes an extreme reaction, which may cause respiratory difficulties such as asthma and/or a skin reaction such as dermatitis. Many individuals develop an allergy to animal hairs which manifests itself as sneezing and difficulty in breathing. Skin contact may cause the symptoms of dermatitis. Farmer's Lung is a good example of this **biological sensitisation**. Workers exposed to animal faeces and hair/fur are particularly at risk from this form of ill-health.

Hepatitis

There are at least five types of viral Hepatitis, all caused by different viruses – types A, B, C, D and E. Hepatitis A is usually contracted by the faecal-oral route. The other types are blood-borne viruses transmitted by contact with contaminated body fluids. In recent years, infectious Hepatitis has become the most common occupational disease amongst medical staff; those at risk include doctors, surgeons, nurses and ancillary staff such as hospital porters. Refuse disposal operatives form another group increasingly at risk from this severe form of jaundice. Infection amongst health workers is a result of contact with blood or excreta of patients suffering from viral Hepatitis or in whom the disease is still in its incubation stage. Hospital porters and refuse disposal operatives appear to be at risk from carelessly discarded syringes and other "sharps" in disposable plastic sacks. The problem is becoming more severe with the increase in drug addiction and the use of shared needles (a practice which is also thought to be responsible for the spread of HIV-AIDS among drug users).

The course of the disease is very much like that of Leptospirosis (see later), but is usually much less severe and normally self-limiting, with recovery in about six weeks. In about 5% of cases chronic infectious Hepatitis follows, leading to cirrhosis, liver cancer and possibly death. Some individuals infected with Hepatitis (in particular type C) do not show symptoms but still carry and transmit the disease.

Vaccinations are available for Hepatitis types A and B (but not for C). Some antiviral drugs, such as interferon, are available for chronic cases.

Preventative measures include:

- Prohibition of eating, drinking, smoking and the application of cosmetics in working areas where there is a risk of contamination.
- Prevention of puncture wounds, cuts and abrasions, especially in the presence of blood and body fluids.
- Avoiding the use of, or exposure to, sharps such as needles, glass, metal, etc. If exposure is unavoidable, take care when handling and disposing of sharps.
- Using devices incorporating safety features, such as safer needle devices and blunt-ended scissors.
- Covering all breaks in exposed skin by using waterproof dressings and suitable gloves.
- Protecting the eyes and mouth by using a visor/goggles/safety spectacles and a mask, where splashing is possible.
- Avoiding contamination by using water-resistant protective clothing.
- Wearing rubber boots or plastic disposable overshoes when the floor or ground is likely to be contaminated.
- Using good basic hygiene practices, such as hand washing.
- Using appropriate decontamination and waste disposal procedures.

More...

The UK HSE guidance document INDG342 *Blood-Borne Viruses in the Workplace* is available from:

http://www.hse.gov.uk/pubns/indg342.pdf

General information and advice regarding Hepatitis is also available from the National Health Service (NHS) in the UK and the World Health Organisation (WHO):

http://www.nhs.uk/conditions/Hepatitis/Pages/Introduction.aspx

http://www.who.int/topics/hepatitis/en/

Human Immunodeficiency Virus (HIV)

Human Immunodeficiency Virus (HIV) is the virus responsible for **Acquired Immune Deficiency Syndrome (AIDS)**. HIV attacks the immune system by which the human body can resist infection. An infected individual may not show any signs of illness for several years. Once the HIV virus has weakened the immune system sufficiently, the person will then become prone to infection and disease (such as pneumonia and cancer). There is no vaccine or cure, though anti-viral drugs are effective in combating the effects of the disease in many cases. The virus is found in most body fluids but is relatively delicate and can be killed by heat and chemicals. It has a low infectivity and transmission is thought to be more likely with repeated exposure to infection rather than a single contact.

Occupational risk comes from accidental inoculation or contamination of a cut or abrasion with the blood or body fluids of an infected person. Various studies of groups around the world who have been occupationally exposed to HIV-positive people, usually by accidental inoculation, have revealed only a handful of occupationally acquired infections. Doctors, nurses, dentists, laboratory and hospital support staff are identified as workers who can be at some risk, since they may come into close contact with body fluids and hence face the possibility of infection through an exposed cut or by accidental injection. Other workers possibly at risk might include community welfare, custodial and emergency service workers. Thousands of health care workers have come into direct contact with HIV-infected blood and body fluids through needlestick injuries and other accidents, but only a very small number of occupationally acquired infections have been reported.

Since HIV is a blood-borne pathogen, the **preventive measures** are similar to those for Hepatitis listed previously.

More...

General information and advice regarding HIV and AIDS is available from the National Health Service (NHS) in the UK and the World Health Organisation (WHO) from:

http://www.nhs.uk/conditions/HIV/Pages/Introduction.aspx

http://www.who.int/topics/hiv_aids/en/

Legionellosis

The bacterium, *Legionella pneumophila*, is responsible for two important occupational diseases; Legionnaires' Disease and Pontiac Fever. Legionellosis is the generic term used to cover **Legionnaires' Disease** and Pontiac Fever.

The first identified outbreak of Legionnaires' Disease occurred among people who had attended a Pennsylvanian State Convention of the American Legion in 1976. Delegates subsequently suffered respiratory illness and the bacterium *Legionella pneumophila* was isolated from lung specimens.

Legionnaires' Disease is a type of pneumonia. As well as affecting the lungs it may also have serious effects on other organs of the body. Infection is caused by inhaling airborne droplets or particles containing viable *Legionella*, which are small enough to pass deep into the lungs and be deposited in the alveoli.

The disease usually has an incubation period of three to six days. Males are more likely to be affected than females by a ratio of 3 to 1. Most reported cases occur in the 40 to 70 year age group. Although healthy individuals may develop Legionnaires' Disease, people at greatest risk include smokers, alcoholics and patients with cancer, chronic respiratory disease or kidney disease. The case-fatality rate is approximately 12%.

Initial symptoms include high fever, chills, headache and muscle pain. A dry cough soon develops and most patients suffer difficulty with breathing. About a third of patients also develop diarrhoea or vomiting and about half become confused or delirious.

Pontiac Fever is a milder, non-fatal condition with an incubation period between five hours and three days. The illness usually lasts between two and three days. The symptoms of Pontiac Fever are similar to those of moderate to severe influenza, with headache, tiredness, fever and in a small proportion of cases nausea, vomiting and coughing.

***Legionella* bacteria** are widespread in natural water sources and found in rivers, lakes, streams, mud and soil, as well as man-made water systems. To date, at least 34 different species of Legionella are recognised. *Legionella pneumophila* is the most pathogenic and is the species most commonly associated with disease outbreaks.

The following conditions have been found to affect its rate of growth:

- Water temperatures in the range of 20-45°C favour growth. It is uncommon to find proliferation below 20°C and it does not survive above 60°C. Organisms may remain dormant in cool water, multiplying only when the temperature reaches a certain level.
- The presence of sediment, sludge, limescale and organic material can act as a source of nutrients.
- Commonly encountered organisms in water systems, such as algae, amoebae and other bacteria may serve as an additional nutrient source for *Legionella*. Algal slime may provide a stable habitat for multiplication and survival.
- Incorporation of *Legionella* in slime on surfaces in contact with water can protect it from concentrations of biocides which would otherwise kill it if it were freely suspended in water.

Legionella can be identified in the laboratory from water samples but this can take up to seven days or more.

Man-made systems with a reasonably foreseeable risk of exposure to Legionella include:

- Water systems incorporating a cooling tower.
- Water systems incorporating an evaporative condenser.
- Hot and cold water systems.
- Other plant/systems containing water which is likely to exceed 20°C and which may release a spray or aerosol during operation or when being maintained (e.g. humidifiers, air washers, spa baths and pools).

Preventive measures for the control of legionellosis include:

- The appointment of a competent person to take responsibility for managing the control scheme.
- Assessment of the risks inherent in the water system in the workplace (for example, in the UK there is a requirement for this to be recorded if there are 5 or more employees).
- Preparation of a written scheme for the control of the Legionella risk, including:
  - Information on the system.
  - The responsible person.
  - The operational parameters of the water system.
  - Control methods and precautions.
  - Checks to be carried out.
- The adoption of practical controls, such as:
  - Proper control of the release of water spray.
  - Management of water temperatures and conditions to avoid those that favour the growth of Legionella and other micro-organisms.
  - Preventing water from stagnating anywhere in the system by keeping pipe lengths as short as possible and by removing redundant pipework.
  - Avoiding materials that encourage the growth of *Legionella*.
  - Keeping the system and the water in it clean.
  - Treating water to kill or limit *Legionella* growth.
- Water treatment, such as:
  - Treatment of cooling towers/systems using biocides.
  - Ultraviolet (UV) irradiation, copper/silver ionisation and ozone.
  - Storing hot water above 60°C and distributing it at above 50°C – and keeping cold water below 20°C if possible.
  - Using chlorine dioxide (chlorination) for tap water.
- Water sampling to test for *Legionella*. However, a negative result does not prove that an entire system is free of *Legionella* and a positive result may not mean that there is unacceptable risk.

More...

The UK HSE website has a wealth of information and resources on this topic, including L8 *Legionnaires' Disease: The Control of Legionella Bacteria in Water Systems - Approved Code of Practice and Guidance*, available from:

http://www.hse.gov.uk/legionnaires

Leptospirosis

Leptospirosis (often called **Weil's disease**) is caused by bacteria of the genus *Leptospira*.

Symptoms of the disease can be divided into three stages:

Stages of Leptospirosis infection	
Stage I:	Fever with 'Flu-like symptoms lasting for about a week. (It is for this reason that workers at risk should carry a card for presentation to their GP on the appearance of any 'Flu-like symptoms, so that the possibility of the onset of Weil's Disease may be considered.)
Stage II:	By the start of the second week the fever has abated and jaundice becomes more obvious (sometimes making its appearance as early as the fourth day). This toxic stage is the result of the development of antibodies in the blood and the excretion of bacteria in the urine. About 5-10% may die at this stage.
Stage III:	The convalescent period. In severe cases the jaundice may be present for three or four weeks and a second fever usually occurs lasting for up to two weeks. Recovery can take many weeks or months, with patients remaining very tired and lethargic for a considerable time.

The *Leptospira* bacteria are found in the kidneys of infected rats (and other mammals such as cattle) and are urinated out of the host animal; it is from this source that humans are infected. Infection usually occurs following contact with fresh rat urine or water that has been urinated into. The bacteria enter the body through damaged skin and through the mucous membranes of the mouth. Occupational groups at risk include:

- Sewage workers.
- River and canal workers.
- Watersports instructors.
- Construction workers.
- Agricultural workers.

Preventive measures include:

- Good pest control, such as getting rid of rats and avoiding rat infestations through good housekeeping.
- Washing cuts and grazes immediately with soap and running water.
- Covering cuts and broken skin with waterproof plasters before and during work.
- Wearing protective clothing (and laundering it).
- Good hand washing after handling animals or contaminated material.
- Good hand washing before eating, drinking or smoking.
- Early reporting of symptoms to a doctor.
- Carrying an alert card to provide additional information to the doctor about the risk.

More...

The UK HSE leaflet INDG84 Leptospirosis – Are you at risk? is available from:

http://www.hse.gov.uk/pubns/indg84.pdf

Malaria

Malaria is a tropical disease transmitted by the night-biting mosquito and is a huge worldwide problem. The World Health Organisation (WHO) estimates that there were 247 million cases and 1 million deaths in 2008, with the most affected areas including African countries close to the equator and sub-Saharan Africa.

Infected mosquitoes inject the host with parasitic organisms (plasmodia). There are different malarial parasites; the *falciparum* parasite is the most serious, resulting in serious illness or even death.

Symptoms of malaria usually appear 10-15 days after infection and include:

- Fever of over 38°C (100.4°F).
- Sweats and chills.
- Generally feeling unwell.
- Muscle pains.
- Headaches.
- Cough.
- Diarrhoea.

Falciparum symptoms are more serious and can develop within 8 days of infection. Without treatment, complications such as breathing difficulties, liver failure, fits and shock develop.

Snake Bites

Some snakes kill their prey by biting and injecting venom into their victim via hollow fangs. This venom can be highly toxic and the outcome will depend upon the species of the snake (as some are more toxic than others), the location of the bite and the amount of venom injected. Non-venomous snake bites can still result in painful injuries and infection and cause panic and anxiety.

Whilst deaths from venomous snake bites are rare in developed areas of the world, in more rural areas where medical attention is not readily available this can be more of an issue. Treatment includes the use of anti-venom to counteract the toxins in the bite.

Preventive measures include:

- Awareness of the possibility of the presence of venomous snakes.
- Identifying and avoiding areas likely to be inhabited by snakes.
- Wearing sturdy, protective footwear.

Contaminated Water

In developed nations the availability of clean, uncontaminated drinking water is something which is taken for granted. However, this is not the case worldwide. Contaminated drinking water supplies can cause illness and death due to the presence of pathogens, resulting in infections such as:

- Protozoal infections such as Cryptosporidiosis (which we have already covered).
- Parasitic infections such as tape worms.
- Bacterial infections such as cholera, *E. coli* (see next subsection) and dysentery.
- Viral infections such as Hepatitis A and gastroenteritis.

Whilst drinking of contaminated water may be avoidable through the use of bottled or sterilised supplies, it should also be noted that accidental infection is possible whilst working, swimming or bathing in contaminated water. Such infections are not limited to tropical countries – in any country, workers who are alongside rivers and lakes have the potential for infection, including rescue workers and those operating outdoor activity centres.

Escherichia Coli (E. Coli)

E. coli are bacteria that are found in the gut of humans and animals and therefore in faeces and sewage. Although most strains are harmless, there are a number that cause diarrhoea which can have serious and even fatal consequences for the very young, the elderly and those whose immune systems are compromised. People become infected through the faecal-oral route, usually because of poor hygiene procedures. School visits to farms may result in children coming into contact with E. coli through contact with farm animals.

One particular type of *E. coli*, O157, is particularly harmful and has been associated with several fatal outbreaks.

Preventive measures include:

- Preventing or minimising the need to handle potentially infected animals or touch potentially contaminated surfaces.
- Good hygiene practices such as hand washing after handling animals, touching potentially contaminated surfaces and before eating, drinking or smoking.
- Good hygiene in food preparation and handling areas (including eating areas).
- Use of protective clothing such as overalls and gloves.

More...

A useful guide aimed at owners, operators and managers of premises and provides guidance on practical measures that can be applied to ensure visitors' health and safety – *Preventing or controlling ill health from animal contact at visitor attractions* – is available at:

http://www.face-online.org.uk/resources/preventing-or-controlling-ill-health-from-animal-contact-at-visitor-attractions-industry-code-of-practice

MRSA and C. Difficile

- Methicillin-resistant *Staphylococcus aureus* (MRSA) and *Clostridium difficile (C. diff)* are two types of bacterial infection that are difficult to treat because they are resistant to antibiotics. MRSA is a relatively common bacterium found in the nasal cavity. If wounds become infected with the bacterium then rapid proliferation occurs, leading to tissue damage and invasion of tissues and organs. MRSA is often a hospital-acquired infection.
- *C. diff* is a gut bacterium that causes disease when antibiotics are used to treat a patient. These antibiotics kill or suppress the growth of normal gut bacteria, leaving C. diff to rapidly multiply causing diarrhoea.

More...

The UK NHS website has information and advice on both MRSA and *C. diff* infections at:

http://www.nhs.uk/conditions

Emerging Health Issues

It is in the nature of biological agents that they mutate rapidly and new strains or types of pathogen therefore emerge from time to time.

These pathogens sometimes cause serious outbreaks of disease that are locally contained but nonetheless attract media attention; for example, in the UK outbreaks of *E. coli* infection from open farms occurred in 2009.

In other instances, disease outbreaks are more widespread and have more significant impact for employers (for instance norovirus outbreaks (also referred to as Norwalk or winter vomiting virus) affecting cruise ships, workplaces and schools over recent years in the UK).

Sometimes outbreaks reach epidemic or even pandemic proportions, for example:

- The H1N1 Influenza virus pandemic of 2009.
- The Sudden Acute Respiratory Syndrome (SARS) near-pandemic of 2002-03.

These emerging health issues are of interest and consequence to various employers because of the application of health and safety law (for example, **COSHH** in the UK). The employers affected and the actions that they have to take vary depending on the nature of the health issue. For example:

- *E. coli* outbreaks on open farms are of particular interest to the employers operating those farms and teachers in charge of visiting them, since they are the two main duty holders.
- Pandemic flu is of interest to:
  - Health care employers whose staff will have to provide front line services to patients.
  - Managers of laboratories where diagnostic and research work is carried out on the virus.
  - Other employers whose staff might come into contact with symptomatic members of the public (such as local authority employees).

...u bacteria can be spread through contact with infected persons

...every case, public health and occupational health au...ties have issued guidance and information to ...prevent and limit disease. This must be studied and a...propriately applied by employers.

Hints And Tips

It is advisable for Diploma students to keep abreast of emerging health issues and ...y guidance issued by the relevant authorities.

More...

The UK NHS website provides information about all of these diseases:

http://www.nhs.uk/Conditions/Pages/hub.aspx

The World Health Organisation (WHO) provides information about issues of global interest at:

http://www.who.int/topics/en/

Information about specific diseases with occupational significance – in particular Influenza and SARS – can be found on the UK HSE website:

http://www.hse.gov.uk/biosafety/infection.htm

National/Regional Lists of Approved Classifications

National or regional authorities may classify biological agents on the basis of the risk they pose to health. In the UK, for example, the HSE have published an **Approved List of Biological Agents** that classifies pathogenic biological agents into four **Hazard Groups** according to their health risk.

This classification is achieved by considering four characteristics of the biological agent:

- Its ability to cause human disease.
- Whether it may be a hazard to workers.
- The likelihood that the disease might spread to the community.
- The availability of effective prophylaxis (preventive measures such as immunisation) and treatment.

The following table shows how each hazard classification category relates to the parameters listed above.