

CHAPTER 15

Causes and spread of infection



You have a duty of care to protect the service users you work with, and other workers, from harm, including harm from infectious disease. To do this you need to understand the causes of infection and how infection is spread from one person to another. Once you have a clear understanding of where infections come from and how they are spread, you can take the necessary actions to reduce the likelihood of service users you support becoming infected.

Links to other units

Along with other health and safety issues, the information in this chapter should inform daily practice, so it links to many of the units that make up the Diploma.

In order to understand the causes and spread of infection you need to understand:

- what is meant by the term ‘infection’
- how infection is spread from person to person
- the means (routes) by which the body becomes infected
- how the body can be affected by bacteria, viruses, pathogenic fungi and infectious parasites
- the chain of infection.

Key terms



Microscopic means so small as to be visible only with a microscope.

Pathogen is a bacterium, virus, or other micro-organism that can cause disease. Not all bacteria, viruses or other micro-organisms are pathogenic; they will not all cause disease in humans.

Bacteria are microscopic organisms, some types of which are pathogenic. Bacteria are made up of just one cell and are capable of reproducing themselves.

Virus is a pathogenic microscopic organism. Viruses cannot multiply on their own, so they have to invade a ‘host’ cell.

Pathogenic fungi are yeasts and moulds which can infect humans.

Parasites are organisms that live on other organisms.

THE CAUSES OF INFECTION

Infection is harm caused by micro-organisms, which are often referred to as ‘germs’. Micro-organisms (microbes) are living organisms so small that they cannot be seen without the use of a very powerful microscope – they are **microscopic**. Micro-organisms that cause infection are known as **pathogens**. **Bacteria, viruses, pathogenic fungi** and **parasites** are all examples of micro-organisms that can cause infection.

THE DIFFERENCES BETWEEN BACTERIA, VIRUSES, FUNGI AND PARASITES

The different kinds of micro-organisms have different characteristics.

BACTERIA

Bacteria are classified into different groups and can be pathogenic (capable of causing illness) or non-pathogenic (not likely to cause illness). Different types of bacteria are identified by their varying shapes.

Bacteria are simple organisms, made up of just one cell, and are capable of reproducing by themselves. They do this through a process of growing to twice their original size and splitting into two; those two cells then split into two more, and so on. This may appear to be a very simple process; however, conditions have to be right for it to happen and for the bacteria to be viable. Under the right conditions they can divide and multiply rapidly. The term used for this process is binary fission.

Bacteria exist everywhere, including inside and on our bodies. Most of them are completely harmless and some of them are very useful. For example, most strains of *Escherichia coli* (E. coli) are required as part of



the normal gut **flora**, as it has beneficial functions such as helping with the production of vitamin K2. Bacteria in the large intestine help with the final stages of digestion.

However, some bacteria are pathogenic and can cause diseases, either because they end up in the wrong place in the body, or simply because they are 'designed' to invade us. Some bacterial infections can make people very ill, while others have a fairly mild effect. Different streptococcal infections which are caused by strains (or varieties) of the bacterium *Streptococcus* can range from being mild, such as a sore throat, to life-threatening, as in necrotising fasciitis (in the latter they are often called 'flesh-eating' bacteria). Group A *Streptococcus* is commonly found on the skin and inside the throat, and in many people does not cause any symptoms at all. It is important to note that bacteria may have non-pathogenic and pathogenic strains. As mentioned above, most strains of *E. coli* do not cause us harm, but the strain known as *E. coli* O157:H7 can cause food poisoning if ingested.

Bacteria tend to be vulnerable to an **antibiotic**, which is why people who have a bacterial infection are often prescribed antibiotics. It is important to understand that bacteria can become resistant to antibiotics as a result of several factors:

- Bacteria can mutate and eventually become resistant to specific antibiotics.
- If a person is treated with an antibiotic it is possible for that antibiotic to destroy harmless bacteria that live in and on the person, and this allows harmful bacteria to multiply and take their place.
- It is believed that the over-use of antibiotics in recent years has played a large part in antibiotic **resistance**, and the rise of what are often called 'superbugs', such as methicillin-resistant *Staphylococcus aureus* (MRSA).

Nowadays, doctors and GPs have to think carefully before prescribing antibiotics. Officials at Public Health England (PHE) remind GPs that many patients do not benefit from antibiotics even if the patients themselves think that they do. Health officials have acknowledged the pressure on GPs to prescribe, but have warned them that it adds to the cycle of antibiotic resistance.

PHE and the Royal College of General Practitioners have issued guidance to help GPs explain to patients when antibiotics are not needed. The TARGET antibiotics toolkit can be seen at <http://www.rcgp.org.uk/TARGETantibiotics/>.

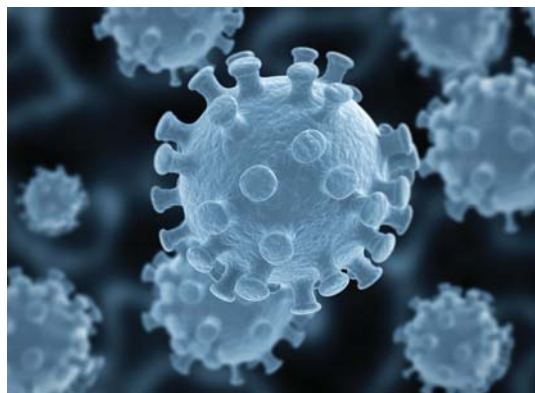
Key term

Flora are microorganisms that normally inhabit the body without causing harm.

Key terms

Antibiotic is a substance from a micro-organism that is used to destroy other micro-organisms or prevent their growth.

Resistance is the ability of a micro-organism to withstand an antimicrobial agent.



Key terms

DNA (Deoxyribonucleic acid) is sometimes called 'the blueprint of life' because it contains the code for building organisms.

RNA (Ribonucleic acid) acts as a messenger of the above mentioned code when new cells are formed.

VIRUSES

Viruses are much smaller than bacteria, and more complex. They can survive out of the body for a time. Viruses are not affected by antibiotics, which is why antibiotics are not prescribed for viral infections. There are, however, antiviral drugs available to treat some infections. Viruses cannot multiply on their own, so they have to invade a 'host' cell and take over its machinery in order to be able to make more virus particles. They do this by latching on to human cells and getting inside them. Viruses consist of genetic materials (**DNA** or **RNA**) surrounded by a protective coat of protein.

The cells of the mucous membranes, such as those lining the respiratory passages we breathe through, are particularly open to virus attacks because they are not covered by protective skin. As well as all cold and flu infections and most coughs and sore throats, viruses are also the cause of many serious infectious diseases. In order to get rid of a virus, the cell which has been invaded by the virus must be killed, which results in damage to the cells themselves. For this reason doctors can only control the symptoms of a viral infection, but to date medical research has found no cures.

When a virus invades the body, the immune system releases white blood cells. These cells produce antibodies, which cover the virus's protein coat and prevent it from attaching itself to the cell. White blood cells also destroy infected cells and thus kill the virus before it can reproduce. Unfortunately, some viruses such as measles, influenza and mononucleosis (glandular fever) weaken the immune system for a period of time.



PATHOGENIC FUNGI

Pathogenic fungi can be either yeast or moulds, including yeasts (single-celled), and mushrooms and moulds (multi-celled). A fungus is a simple plant-like organism. Unlike plants, fungi do not make their own food. Some species of fungi get their nutrition by breaking down the remains of dead plants or animals. Others are parasites. Examples of fungal infections include athlete's foot, thrush and ringworm. Fungal infections are not often the cause of healthcare-acquired infections; however, it is possible for an individual to acquire an infection such as ringworm in a healthcare environment.

PARASITES

Some parasites are very complex; many are pathogenic and cause infection and can be spread from person to person. Parasites usually enter the body through the mouth or the skin. For example, threadworms, sometimes known as pinworms, are small, white, thread-like worms a few millimetres long that live in the human gut. The female worm lays eggs around the anus, which often leads to itching and scratching. Eggs can then become stuck to fingertips or under the fingernails and can be transferred to other people, food, children’s toys, kitchen utensils or even toothbrushes. Other people then come into contact with the eggs, and if they touch their mouths and swallow the eggs they become infected with the threadworm.

Scabies is a contagious disease caused by tiny mites (*Sarcoptes scabiei*). The main symptom of scabies is itching caused by the mite burrowing under the skin. Scabies is spread by skin-to-skin contact with an infected person; this is the most common method. It can also be spread by sharing clothes, infected linen, towels and so on with an infected person.



COMMON ILLNESSES AND INFECTIONS
CAUSED BY BACTERIA, VIRUSES, FUNGI AND
PARASITES

The following table is not an exhaustive list, but is provided to further illustrate the types of illnesses that are caused by micro-organisms.

Condition	Type of micro-organism	Outlines of transmission
Acquired Immune Deficiency Syndrome (AIDS)	Virus	AIDS is the final stages of HIV (Human Immunodeficiency Virus). Most common modes of transmission are unprotected sex, sharing infected needles, HIV-positive mother to baby during pregnancy, birth or breastfeeding.
Bronchiolitis	Virus	Mostly common in babies and young children. Mode of infection is usually droplet infection from infected people sneezing and coughing.

Key term  **Transmission** means passing an infectious disease from one person to another.

Condition	Type of micro-organism	Outlines of transmission
Chickenpox	Virus	Common childhood illness. Mode of transmission is that it spreads through the air in tiny droplets – fifteen minutes in the same room as an infected person is likely to lead to infection; also spread through skin contact with the blisters.
Chlamydia	Bacteria	Mode of transmission is unprotected sex or from an infected mother to a baby during birth.
Cold and flu	Virus	Can be spread by droplet infection, or the unwashed hands of an infected person touching surfaces.
Cold sores	Virus	Modes of transmission include skin-to-skin, eg kissing, and sharing items such as cups, towels or any other item that has made contact with the cold sore.
Diphtheria	Bacteria	The most common mode of transmission is droplet infection; since the vaccination programme started in 1940 this once-common cause of death in the UK is now rare. Since 1896 there have been 15 cases reported in England and Wales. It is, however, still common in some other areas of the world.
Dysentery	Bacteria or parasite	There are two main types of dysentery; the most common type in the UK is caused by the <i>Shigella</i> bacteria. Amoebic dysentery is caused by an amoeba (single-celled parasite) called <i>Entamoeba histolytica</i> , which is mainly found in tropical areas. Both types of dysentery are commonly passed on through poor hygiene, and people often become infected by eating contaminated food.

Condition	Type of micro-organism	Outlines of transmission
Glandular fever	Virus	Mostly infects young adults. Common modes of transmission are kissing, droplet infection from infected people coughing and sneezing, and sharing eating and drinking utensils such as cups, glasses and unwashed forks and spoons.
Hepatitis A/B/C	Virus	Hepatitis A is caused by faecal contamination. Hepatitis B can be passed on through sexual contact, infected needles and from mother to baby. Hepatitis C is blood-borne so can be passed on by infected blood, contaminated needles, needle-stick injuries and from mother to unborn child.
Impetigo	Bacteria	This is an infection of the top layers of skin caused by bacteria getting into the skin when it is damaged, for example, by insect bites, tiny cuts and grazes. The mode of transmission is by contact with blister fluid either from direct skin contact or by cross-contamination from objects that have touched the blister fluid such as face cloths, towels, clothing or toys.
Measles	Virus	Modes of transmission are droplet infection, either by breathing in the droplets when an infected person has coughed or sneezed or by touching contaminated surfaces where droplets have fallen and then touching the mouth or nose area.
Mumps	Virus	Same as measles, above.
Norovirus (winter vomiting bug)	Virus	Caused by a group of viruses called noroviruses, this is the most common cause of stomach bugs in England and Wales. Modes of transmission are person-to-person, consuming contaminated food or water, and touching contaminated surfaces or objects.

Condition	Type of micro-organism	Outlines of transmission
Poliomyelitis (polio)	Virus	Poliomyelitis (polio) is a highly infectious vaccine-preventable disease. It invades the nervous system, and can cause total paralysis in a matter of hours. It can strike at any age, but mainly affects children under three.
Pneumonia	Virus or bacteria or fungus	Pneumonia means inflammation of the lungs usually caused by an infection.
Ringworm	Fungus	Can affect skin, nails and hair. The mode of transmission is by touching an infected person, animal or infected object or surface, eg shared towels or farm gates.
Rubella (German measles)	Virus	Direct contact and droplet infection breathed in when an infected person coughs or sneezes are the common modes of transmission.
Scabies	Parasite (scabies mite)	Contagious, very itchy skin disorder leading to a rash caused by the microscopic mite burrowing under the skin to lay eggs. The mode of transmission is skin-to-skin contact, eg prolonged hand-holding.
Scarlet fever	Bacteria	Caused by the same Streptococcus bacteria that causes impetigo. These bacteria are commonly found on the skin and in the throat, where they do not cause any problems. Unfortunately under certain circumstances they cause disease. Scarlet fever is highly contagious and is transmitted via airborne droplets from coughing and sneezing, and by direct contact with mucus or saliva from an infected person or items contaminated by droplets or saliva/ mucus such as drinking vessels or eating utensils.

Condition	Type of micro-organism	Outlines of transmission
Tetanus	Bacteria	Tetanus occurs when a flesh wound becomes contaminated. The bacteria live in soil, house dust and animal and human waste.
<i>Tinea pedis</i> (athlete's foot)	Fungus	Spreads easily from person to person on towels, clothing and foot contact surfaces. The fungi survive and multiply in warm humid areas such as swimming pools, changing rooms and showers.
Tuberculosis	Bacteria	Spread by inhaling droplets from the coughs and sneezes of an infected person. Most commonly affects the lungs, but can affect any part of the body.
Warts and verrucas	Virus	Very contagious; modes of transmission are skin to skin and contact with infected objects or surfaces such as the areas around swimming pools.
Whooping cough	Bacteria	Spread by inhaling droplets from the coughs and sneezes of an infected person.

TYPES OF INFECTION

The following are terms commonly used to describe how and where microbes are affecting a person's body:

- **Systemic infection.** This is when the infection caused by a pathogen has spread through the body to several organs in different systems of the body, for example, the digestive, respiratory or circulatory systems.
- **Localised infection.** This is an infection that is confined or restricted to a specific location of the body, for example, an infected wound.

Colonisation versus infection

Infection means that the organism is present and is causing illness. Colonisation means that the organism is present in or on the body but is not causing illness. When someone is exposed to a micro-organism

such as MRSA or *Clostridium difficile*, they can become colonised. This means that the organism takes up residence harmlessly (for example, on the skin, in the nose or in the bowel) but does not cause an infection. This colonisation may:

- continue harmlessly indefinitely
- clear spontaneously
- develop into an infection.



Sometimes it is possible and indeed necessary to use medical treatments to help the colonisation clear faster, for example, before an operation can take place. For this reason screening for MRSA often takes place prior to elective surgery, for example, in day cases having routine surgery.

THE TRANSMISSION OF INFECTION

Micro-organisms that cause infection may originate from:

- ourselves (**endogenous**) micro-organisms which transfer from one site on the body to another site where they invade and cause infection
- other people (**exogenous**) via hands, equipment, etc
- the environment, including contaminated food, contaminated equipment, contaminated surfaces, contaminated laundry, clinical waste and dust.

Key terms



Endogenous means originating from within.

Exogenous means originating from an external source.



The difference between infectious and non-infectious disease is that infectious disease can be spread from person to person. Infection can pass from person to person by cross-contamination (cross-infection, indirect contamination) or by direct contact (direct contamination).

Cross-contamination is where the pathogenic organisms are moved from their source to another location and then to a person. Sharing contaminated objects such as a bedpan or hairbrush can lead to cross-contamination, as can misusing cleaning equipment, for example, by using cleaning cloths in more than one location. Remember, hands are the most common vehicles of cross-infection.

It is very important to remember that some people are more susceptible to infection than others. For instance older people, babies and children are more susceptible, as are people with lowered immunity due to illness or existing health conditions.

One of the reasons that the organisms that cause infections spread so easily is because they cannot be seen by the naked eye. For that reason we need to be aware of how to minimise the conditions for

their growth and how they get into our bodies. With this information we can start to minimise the chances of transmission of infections. Bacteria live on or in just about every material and environment on this planet: from soil, to water, to air; from inside home environments, to arctic ice. Every living creature, including humans, is covered with bacteria. Some microbes live on the skin and offer protection from harmful agents. The drier areas of the body, such as the back and forearm, have few microbes; moist areas, such as the armpit, have many more. Each square centimetre of skin averages about 100,000 bacteria. The forearms, which tend to be dry, average approximately 1,000 bacteria per square centimetre, while the armpits may have many millions per square centimetre.

CONDITIONS NEEDED FOR THE GROWTH OF MICRO-ORGANISMS

To multiply and reproduce, pathogenic micro-organisms require the following:

- moisture
- nutrients
- temperature
- time.

Moisture

Like most living things, bacteria must have moisture to stay alive. Bacteria will not multiply in dry areas, but as soon as liquid is added, for instance to dried food like powdered milk and dried eggs, the products will provide ideal conditions for bacteria to multiply. However, if enough salt or sugar have been added to foods such as bacon, savoury biscuits, jam and confectionery, this will absorb the available moisture in the food so the bacteria cannot multiply as easily. It is not only moist foods that provide the right environment for bacteria, though. Moist skin or damp areas of an environment will also provide the right atmosphere for bacterial growth.

Nutrients

Bacteria, like all living things, need nutrients to survive. Different types of food-poisoning bacteria can live on a range of foods, but most prefer food that is moist and high in protein such as meat, poultry, eggs, shellfish, milk and dairy products, cooked rice, pasta, or any product made from these foods.

All these foods are subject to bacterial growth even after they have been cooked and served cold later. This is why such ready-to-eat items are classified as high-risk foods.



KEY POINT

Photosynthesis is the process by which some organisms use sunlight to synthesize nutrients from carbon dioxide and water.

Bacteria will live on and in people, plants and soil, and they take nutrition from everything from sugar and starch to sunlight, sulphur and iron. Some bacteria are photosynthetic – they can make their own food from sunlight, just like plants. Also like plants, they give off oxygen. Other bacteria absorb food from the material they live on or in. Some of these bacteria can live off unusual substances such as the elements iron or sulphur. The microbes that live in your gut absorb nutrients from the food you've digested.

Temperature

Most food-poisoning bacteria multiply at temperatures between 5°C and 63°C, which is why this range of temperatures is often called the 'danger zone'. Ambient temperatures (room temperatures) are generally within the danger zone. The ideal temperature for bacteria to multiply is around 37°C, which is the average human body temperature. When food is kept at temperatures colder than 5°C and hotter than 63°C bacterial growth slows down or stops, but most bacteria can survive cold temperatures and resume multiplication when conditions are more suitable. Freezing will make most bacteria dormant, but it does not kill them, so when frozen food is thawed it is just as susceptible to risks as fresh food.

Time

When bacteria are left in warm conditions on the right type of nutrient with adequate moisture, they will reproduce quickly. For example, most types of food-poisoning bacteria take around 10 to 20 minutes to multiply.

VIRUSES

In order for a virus to multiply it needs to latch on and invade an appropriate host cell of an animal or plant. Once it is within the 'host' cell it takes over its machinery and makes more virus particles. The cells of the mucous membranes, such as those lining the respiratory passages that we breathe through, are particularly open to virus attacks because they are not covered by protective skin.

MAIN ROUTES OF INFECTION

There are four main routes of infection, or ways in which infections enter our bodies:

- *The respiratory tract (nose, windpipe, lungs).* Airborne pathogens such as those causing coughs and colds can be inhaled.
- *Broken skin.* One of the functions of the skin is to provide protection against infection. This includes the mucous membrane of the nose and mouth. If skin is broken by bites, scratches,

puncture wounds or dry chapped skin that breaks down, this provides a route for infection to enter the body.

- *The digestive tract.* Infected products such as food and drink can be swallowed, often affecting the bowels or stomach.
- *The urinary tract and reproductive system.* Infections may remain localised or enter the bloodstream. One of the problems with catheterisation is the possibility of bacteria being carried into the urinary tract during the catheterisation procedure.

COMMON CAUSES OF THE SPREAD OF INFECTION

The most common causes of spread of infections in a health and social care environment are:

- lack of or poor hand hygiene
- lack of or poor cleaning procedures
- lack of, or incorrect use of, personal protective equipment (PPE) such as gloves and aprons
- contaminated bed linen or clothing
- infected food handlers – remember, this includes not only those who prepare food but also those who serve food or support people to eat and drink
- airborne infection (such as colds and flu).

Some of these are described in more detail below.

Lack of or poor hand hygiene

People carry millions of microbes on their hands. Most are harmless, but some can cause illnesses such as colds, flu, diarrhoea, hepatitis and E. coli infection when we forget to wash our hands, or don't wash them properly. We can spread these germs to other people, or give them to ourselves by touching our eyes, mouths, noses or cuts on our bodies. Microbes can also be picked up from objects such as doorknobs, taps, and wheelchair handles touched by other people who have not washed their hands. Think about all the things you touch each day and how many people may have touched them before you.

The Hand Hygiene Campaign – Give Soap a Chance states that some bacteria and viruses can stay alive on our hands for up to three hours. They can be spread to all the things touched during that time, including food and other people, so good hand hygiene is of the utmost importance. On its website, NHS Choices, the National Health Service gives a wealth of information about how long micro-organisms can live outside of the body. For instance, cold viruses can survive on



indoor surfaces for more than seven days; however, their ability to cause an infection starts to decrease after 24 hours. Also, 40% of cold-causing viruses remain infectious on hands after one hour. Washing hands reduces the number of micro-organisms on our hands and helps prevent the spread of infection.

The following are examples of the types of microbes that can be spread on the hands of health and social care workers:

- *Staphylococcus aureus* (including MRSA)
- *Streptococcus pyogenes* (Group A Streptococci)
- *Pseudomonas* – a bacterium found in soil and water, likely to infect people with underlying health problems staying in hospital
- *Clostridium difficile* – a bacterial infection that affects the digestive system, most commonly affecting people staying in hospital
- *Candida* – fungi which live on all surfaces of our bodies; under certain conditions, they can cause infections such as vaginal thrush, oral thrush, skin and nappy rash
- rotavirus – a common cause of diarrhoea and sickness
- adenovirus – a common cause of respiratory tract infections and gastroenteritis, especially in young children; adenoviruses can also cause conjunctivitis and cystitis
- hepatitis A virus
- norovirus.

DID YOU KNOW?

- Around 20% of women and 40% of men don't wash their hands after using a public toilet.
- According to research carried out in the United States of America and presented to the International Association for Food Protection conference in San Diego in July 2002, 90% of germs on hands are found under the nails.
- A right-handed person tends to wash their left hand more thoroughly than their right hand, and vice versa.
- The number of bacteria can double in 20 minutes, and after one day without hand washing a single bacterium can multiply 2 billion, trillion times.
- There are between 2 million and 10 million bacteria between the fingertip and the elbow.
- The number of microbes on your fingertips doubles after you use the toilet.
- Pathogens can stay alive on hands for up to three hours.
- Millions of germs hide under watches and bracelets, and there could be as many germs under a ring as there are people in Europe.

(Foodink, Food and Drink Federation)

Hand hygiene is of utmost importance. It is important that you are fully aware of your employer's laid-down policies and procedures relating to hand hygiene, including which resources should be used for the various activities carried out during the course of your daily duties.

Generally, washing hands with liquid soap and water is sufficient as you go about your daily activities. Nowadays, hand rub containing alcohol is available at the entrance to hospital wards and residential support services. It is important that staff and visitors use it on entering and exiting such facilities. If you are supporting a service user from a social care environment into a clinical setting such as a hospital you must remember that your duty of care still applies, and that you have a responsibility to ensure that correct hand hygiene is adhered to by you, the person you are supporting and anyone else involved in the service user's support and health care.

The Code of Practice on prevention and control of infections published by the Department of Health within The Health and Social Care Act states that service providers must ensure that there is adequate provision of hand-washing facilities, and anti-microbial hand rubs where appropriate. This clearly indicates the importance of hand washing with soap and water. However, according to the National Institute for Health and Care Excellence (NICE) in its Clinical Guidelines, hand rubs containing 60% isopropyl alcohol and conforming to the current British Standard are the recommended products for ensuring effective hand hygiene, except when:

- hands are visibly soiled
- the patient is experiencing vomiting and/or diarrhoea
- there is direct hand contact with any body fluids, ie if gloves have not been worn
- there is an outbreak of norovirus, *Clostridium difficile* or other diarrhoeal illnesses.

In these instances hands should always be cleaned with liquid soap and warm running water.

Hand washing with soap and water

It takes at least 15 seconds to wash your hands thoroughly (about the same amount of time as it takes to sing 'Happy Birthday' through twice). The correct method for hand washing is covered in more detail in Chapter 14.

Damp hands spread 1,000 times more germs than dry hands. Clean towels should be available at all times – dirty towels mean exposing the skin to more dirt and the risk of infection. Ideally, ‘single-use’ disposable towels should be used, as the use of ‘communal’ towels can lead to contamination.

When using hand gel, apply gel to dry hands and follow steps 3–9 as shown above, ensuring that enough gel is applied. Refer to Chapter 14 for more information on how to wash your hands correctly.

REFLECT

What tasks do health and social care workers in your work environment carry out that require hand washing prior to starting the task and after completion of the task?



Lack of or poor cleaning procedures

If there is a lack of cleaning procedures in place, or they are poor, you and the service users you support can become infected. Pathogenic organisms can be moved from their source and into the environment, and cross-contamination can happen by people passing microbes from one area to another either by their hands or by cleaning equipment such as mops and cloths. For example, taps and door handles can harbour a multitude of micro-organisms, as can wheelchair handles and telephone receivers. In fact, any hand contact surface can be a breeding ground for pathogens.

If the correct methods are not used for cleaning the environment, be that in a hospital ward/department or residential/day services setting, micro-organisms may be transmitted from one site to another. For this reason it is important to follow laid-down processes and procedures using colour-coded cleaning equipment, which after use is decontaminated or disposed of in the correct manner.

REFLECT

- What surfaces are there in your work environment that could harbour harmful microbes? What measures are there in place to ensure that such risks are kept to a minimum?
- What antibacterial/viral cleaning materials do you have in your work environment, and what measures are there in place to ensure that everyone knows how to use them effectively?
- What measures are there in place where you work to ensure that no cross-contamination occurs due to inappropriate use of cleaning equipment?
- If you needed to clean up a spillage of urine from the floor of a toilet, what equipment (including PPE) would you use?
- Do you have a spillage kit at work to use in the case of blood spillage? If so, where is it kept – and could you explain to a new member of staff how and when to use it?

CASE STUDY

Silas is a home care worker. He recognises that service users have the right to live in a **non-clinical** environment, and he also knows about infection control. As he does not want to take away service users' dignity by refusing to use their soap and terry cotton towels, he always carries with him the bacterial hand gel provided by his employing agency. He uses the hand gel very discreetly before entering and after exiting people's homes in addition to using their own facilities.



- Name two infections that can be spread by sharing towels.
- What is the recommended percentage of isopropyl alcohol for hand gel to contain?

Contamination of food

Bacteria can cause food-borne illness. When food is kept warm, between the temperatures of 5°C and 63°C, these bacteria can grow rapidly and reach dangerous levels within hours.

The incubation period (the time that elapses between eating the food and feeling unwell) varies with each type of organism, and in some cases can be as much as 10 to 15 days. It is important to realise, therefore, that the last meal eaten may not be the cause of the symptoms. The government publishes a wealth of information about

KEY POINT

Incubation is the time from the moment of exposure to an infectious agent until signs and symptoms of the disease appear.

types of food-borne illnesses, symptoms and incubation times in their PHE guidance sheets, which can be found at www.hpa.org.uk.

The Food Standards Agency (FSA) identifies the following as the main causes of food poisoning and food-borne illness:

- not cooking food thoroughly (particularly poultry, pork, burgers, sausages and kebabs)
- not correctly storing food that needs to be chilled at below 5°C
- leaving cooked food for too long at warm temperatures
- someone who is ill or who has dirty hands touching food
- eating food that has passed its use-by date
- cross-contamination (the spread of bacteria, such as *E. coli*, from contaminated foods), for example, bacteria-harboring juices of raw meat dripping on to foodstuffs that will be eaten without cooking or processing.



Anyone can become ill as a result of food poisoning or food-borne illness, but babies, young children and older people can quickly become very ill when infected. Pregnant women, people with a pre-existing illness and anyone whose immune system is weakened can also be especially vulnerable and seriously affected by food-borne illness.

CASE STUDY

Mary is supported in her own home by Georgie. Every Monday, food that Mary has ordered online is delivered by a local supermarket. Mary takes great pride in putting away her purchases herself. Georgie has coached Mary in the importance of ensuring that raw meat is stored at the bottom of the refrigerator, ensuring that no bacteria-laden juices can drop on to and contaminate food to be eaten raw, such as cheese.

- Why is cheese likely to be a high-risk food?
- Other than ensuring that the meat is stored at the bottom of the refrigerator, what other steps should be taken to ensure that no bacteria passes from raw meat to other foodstuffs?



Contaminated linen and clothing

Workers may become infected or cause cross-contamination if they do not use PPE such as gloves and aprons, for example, when dealing with soiled linen and clothing. Special care needs to be taken if there is any risk of splashing, spraying or splattering of faeces or vomit. Even when there is no visible sign of soiling of linen and clothing, microbiological pathogens may still be present. Putting soiled linen on chairs or floors instead of into laundry bags is especially bad practice and can lead to cross-infection.



CASE STUDY

Miriam is a new support worker at a residential establishment for older people. During her second week in her new job, Miriam is stripping a bed to change the linen when her supervisor comes looking for her to discuss her induction. The supervisor asks Miriam why, as a new member of staff, she is working alone and why she is stripping the bed without wearing gloves. The supervisor points out that the person whose bed is being stripped has urinary incontinence, and that by not wearing gloves Miriam is putting herself and others at risk of infection. Miriam explains that her colleague, who she was making the beds with, was called away to deal with something else, so she had agreed to strip the beds in readiness for the two of them to make them again later. The supervisor reminds Miriam of the care plans and risk assessments for all service users that she has been shown; she also makes a note to herself that new workers should have closer supervision until they are fully conversant with the care plans and risk assessments.



- In addition to wearing gloves, what steps should be taken when dealing with soiled linen?
- Would it be acceptable to wear the same pair of gloves to strip several beds of their linen? Why?

Infected food handlers

People suffering from certain infections (mainly from bacteria and viruses) can contaminate the food they handle or the surfaces food may come into contact with. This can spread infection to other people through the food. Food-borne infections from infected food handlers result primarily in gastrointestinal infections.

The FSA is an independent government department responsible for food safety and hygiene across the UK. It works with businesses to help them produce safe food, and with Local Authorities to enforce food safety regulations. The FSA states that *Campylobacter* is the most common cause of food poisoning in the UK. It is considered to be responsible for around 460,000 cases of food poisoning, 22,000 hospitalisations and 110 deaths each year, and most of these cases come from poultry. The FSA also tells us that norovirus, commonly known as the winter vomiting bug, is the most common cause of infectious intestinal disease resulting in diarrhoea and vomiting in the UK. The Second Study of Infectious Intestinal Disease in the Community (the IID2 Study) published in September 2011 suggested that there were approximately 3 million UK cases of norovirus annually. Norovirus poses additional problems in the management of outbreaks of infection, as even very low numbers of particles can lead to infection.

Although most cases are caused by contact with an infected person, a proportion of cases are due to contaminated food and drink. There are, of course, other infections with which food handlers can contaminate food and surfaces such as *salmonella* – and *E. coli*. *Salmonella* bacteria are often found in raw meat and poultry. They can also be passed to dairy products such as eggs and unpasteurised milk.

E. coli are bacteria found in the digestive systems of many animals, including humans. Most strains are harmless but some strains can cause serious illness.

In most cases, food handlers with diarrhoea or vomiting should refrain from work for 48 hours after symptoms subside. However, in some cases different action is required. Guidance is available from the Health Protection Agency.

Infected health and social care staff

Health and social care staff, in common with any other group of workers, can become infected themselves and, along with the rest of the population, carry bacteria within and on themselves. Because of the vulnerability of service users, workers must be extra-vigilant with their own health and consider how to best protect the people they support from infection by pathogens they might be carrying.

CASE STUDY

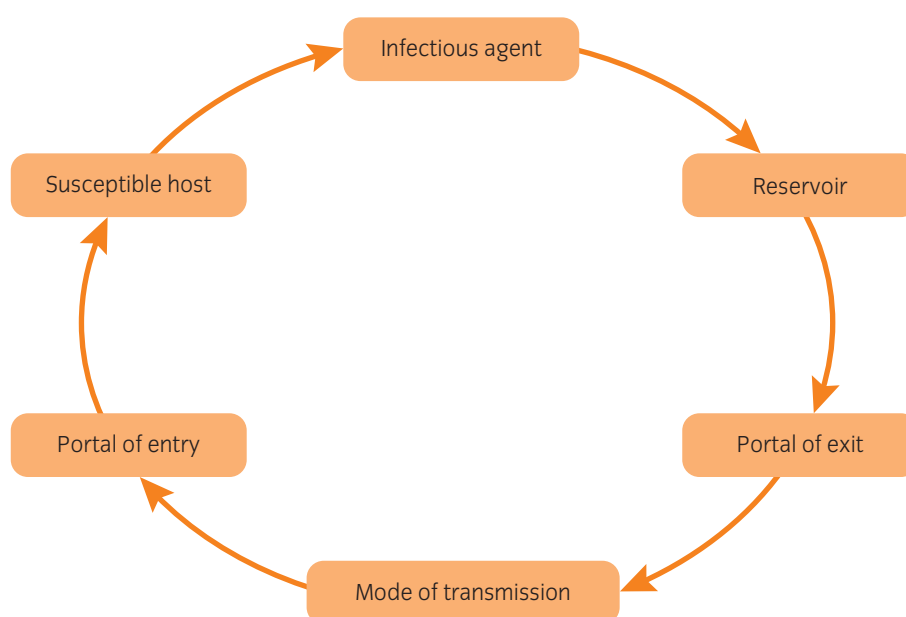
Carlos is a senior day services officer. One lunchtime he observes Raymond supporting a service user to eat his meal. Afterwards he gives Raymond some feedback. He tells Raymond how impressed he was with the way in which Raymond had treated the service user with dignity and respect, offered choices, supported them at their own pace and communicated well with them throughout the meal, using appropriate language to meet their needs. At one point during the meal Raymond had to cough, and Carlos had noted that Raymond had turned away from the service user and their food to cough, held his hand over his mouth while coughing and immediately apologised to the service user – all of this was, as Carlos said, very appropriate behaviour. Unfortunately, Raymond had not washed his hands immediately following the cough; instead he picked up a glass of water and handed it to the service user. It is almost certain that his hand was covered with bacteria, if not virus particles, from his respiratory tract.

On receiving the feedback Raymond understood his error and made a mental note never to repeat it.

- Name at least three infections that Raymond could pass to the service user by touching their glass with an unwashed hand after coughing into it.
- Name at least six daily situations at work in which you need to wash your hands.

**HOW INFECTIONS ARE SPREAD FROM PERSON TO PERSON**

The chain of infection shows how infection is spread from person to person.

The chain of infection

As stated previously, micro-organisms (eg bacteria and viruses) live in or on some parts of the body such as the skin, mouth and intestinal tract. This mixture of organisms normally found on or in the body that do not usually cause harm is referred to as the normal flora.

Some of these organisms may cause illness if they find their way into areas of the body where they don't belong. For example, if micro-organisms normally found in the bowel enter the bladder they may have the potential to cause infection. For this reason people are instructed to 'wipe towards the back' after using the toilet.

Normal skin flora which are there all the time are essential for good health and rarely causes infection. However, there are some procedures that can make people vulnerable to infection, because the micro-organisms can be carried from the surface of the skin – where they belong – into the flesh or blood vessels, where they do not belong. This may happen during surgery, insertion of catheters, or peripheral intravenous (IV) cannulation. Normal flora live naturally on the skin and are difficult to remove by routine hand hygiene techniques, although the numbers of micro-organisms will be reduced by this process.

Many other micro-organisms are acquired or deposited on the skin from other people or from the environment. These micro-organisms do not live permanently on the skin and are readily removed or destroyed by correct and frequent hand hygiene procedures.

The reservoirs of infection

The Health Protection Agency (HPA) describes a reservoir of infection as being where a micro-organism normally lives and reproduces, for example, in animals, water or food. The human body is the most common reservoir for micro-organisms. A person with an infectious disease such as salmonella, tuberculosis, polio, hepatitis A or hepatitis B may act as a source of infection to others because the micro-organisms are present in some of the body fluids and can be passed on to others.

There are two types of human reservoirs: clinical cases and carriers. Clinical cases are people who are infected with the disease agent and become ill. Because they are ill, their contacts and activities may be limited. They are also more likely to be diagnosed and treated than carriers. Carriers, on the other hand, are people who harbour infectious agents but are not ill. Carriers may present more risk for disease transmission than clinical cases, because their contacts are unaware of their infection, and their activities are not restricted by illness.

Depending on the disease, there may be different types of carriers:

- incubatory carriers
- inapparent infections

- convalescent carriers
- chronic carriers.

Incubatory carriers

These are people who are going to become ill, but begin transmitting their infection before their symptoms start. For example, in the case of measles, a person infected with measles can pass the virus to others via nasal and throat secretions a day or two before any symptoms are noticeable.

Inapparent carriers

Inapparent infections are where the individual is asymptomatic (has no symptoms of infection) but is carrying the infectious agent.

Convalescent carriers

These are people who continue to be infectious during and even after their recovery from illness. This happens with many diseases. For example, with salmonella, individuals may excrete the bacteria in faeces for several weeks and (rarely) even for a year or more. This is most common in infants and young children.

Chronic carriers

These are people who continue to harbour infections for a year or longer after their recovery. For example, the chronic carrier state is not uncommon following hepatitis B infection, whether or not the person became ill, and may be lifelong.

Contaminated food may also act as a reservoir of infection. A common example of this is the presence of salmonella. If food contaminated with salmonella is not thoroughly cooked, individuals who consume it can become infected.

The environment can also be reservoir of infection if it becomes contaminated by micro-organisms shed by people with an infection. This can then spread to others. Regular cleaning minimises this risk.

Poorly maintained or incorrectly decontaminated cleaning or medical equipment can also act as a reservoir of micro-organisms. For example, inadequately maintained and shared commodes can be contaminated with micro-organisms that cause diarrhoea.

Portal of exit

This refers to the way in which the pathogen escapes from the reservoir, such as via faeces, urine, wound discharge, mucus, blood, vomit, droplet transmission by sneezing, coughing or talking.

Mode of transmission

The mode of transmission is the method by which the pathogen gets from the reservoir to the new host. This can happen by one of the following means:



Key terms

Sputum is mucus that is sometimes coughed up from the lower airways.

Vector is an organism, typically a biting insect or parasite, that transmits a disease.

- Direct contact (actual contact with an infected person).
- Indirect contact (contact with contaminated surfaces touched by the infected person, or where droplets of body fluid have landed; spread on unwashed hands). Hands play a big part in spreading infection. Micro-organisms may be present in body excretions and secretions. If hands come into contact with these, the micro-organisms may be carried from one person to another unless the hands are properly decontaminated.
- Airborne – via ‘aerosols’, or tiny infected particles from an infected person released when they cough or sneeze, which can be breathed in. The viruses responsible for colds and influenza are found in nasal secretion, saliva and **sputum**. Coughing or sneezing near another person may pass on these viruses in the droplets or aerosol produced.
- Consumption of contaminated food/water or swallowing of micro-organisms carried on the hands.
- Exposure to blood.
- **Vector**-borne (parasite bites).
- Sexual contact.

Portal of entry

Every micro-organism needs to have an entry point into the human body. Different micro-organisms have different ways of achieving this.

Portal of entry	Example infection
Ingestion – eating contaminated food.	Salmonella, a group of bacteria that can cause food poisoning.
Inhalation – micro-organisms suspended in particles of liquid are exhaled by the infected person and inhaled (breathed in) through the nose or mouth by another person.	Influenza
Blood – this can occur through punctures to the skin by contaminated sharps.	Hepatitis B
Urinary tract – organisms causing urinary tract infections may enter during poor catheter care or poor personal care.	<i>Escherichia coli</i>

Portal of entry	Example infection
Skin – via breaks in the skin, which is normally a protective barrier, for example, during surgery or through punctures made by cannulation cuts, scratches or abrasions caused by injury.	<i>Enterobacteriaceae</i>, a group of bacteria including many of the more often heard-of pathogens such as <i>salmonella</i>, <i>E. coli</i>, <i>helicobacter</i>. <i>Staphylococcus</i>, a common type of bacterium often carried on the skin and inside the nostrils and throat, which can cause mild infections of the skin such as boils and impetigo. If <i>Staphylococcus</i> bacteria get into a break in the skin, they can cause life-threatening infections, such as blood poisoning or endocarditis (an infection of the inner lining of the heart). <i>Staphylococcus epidermidis</i>
Mucous membranes (in the mouth, eyes and nose) – having no protective skin, these can be very vulnerable to micro-organisms, for example, those that cause Streptococcal throat infections.	Streptococcus, a bacterium that is commonly found on the skin or in the nose and throat.

FACTORS THAT WILL MAKE IT MORE LIKELY THAT INFECTION WILL OCCUR

Susceptibility to infection varies from person to person. Risk factors for infection include:

- age (the very young and very old are more vulnerable to infections)
- physical wellbeing
- psychological wellbeing
- hygiene
- underlying or chronic diseases or medical conditions (eg diabetes, chronic chest and heart problems, or cancer)
- other existing infections
- medical interventions (eg an indwelling medical device)
- medical therapies (eg cancer chemotherapy or steroids)
- immune status.



It is important that key factors that will make infection more likely are identified. These factors vary from one work setting to another, and according to the duties being carried out. Some activities – or lack of activities – put the worker at risk of becoming infected, others put the service user at risk, and some activities or the lack of them put both the worker and the service user at risk. The following are some examples of risk factors:

- dealing with personal care tasks
- a lack of personal hygiene
- wounds requiring treatment
- contact with body fluids
- long-term use of antibiotics
- close proximity to others, whether infected or uninfected
- age – very young or very elderly
- dirty and/or contaminated areas of the environment
- dirty and/or contaminated equipment
- dirty and/or contaminated laundry
- people who are ill
- people who are **immunocompromised**, ie where their immune system does not function properly.

Key term



Immunocompromised is where a person has impaired immunity due to disease (eg cancer) or treatment (eg corticosteroids or radiotherapy).

REFLECT

- Think about your work setting. What key factors can you identify that might make it more likely that infection will occur, and how are those factors managed?
- Can you identify any further steps that could be taken to reduce the risks?

Before going to the next chapter, take some time to consider:

- what policies and procedures you have in your work setting relating to the causes and spread of infection
- what your responsibilities are regarding stopping the spread of infection
- how you can help colleagues and others to understand the causes and spread of infection
- what you would do if you observed poor practice that might lead to the spread of infection
- if there is anything you can do to improve your own practice connected with stopping the potential spread of infection.