Study Session 2  The Effects of Poor Sanitation and Waste Management
Introduction

Many people in Ethiopia have limited knowledge and understanding of the good hygiene practices that reduce the health risks from poor sanitation and waste management. The Health Extension Programme (HEP) was established by the Ethiopian government in 2004 to address this problem within the broader aim of creating a healthy society and providing accessible health care at community level. Initially the HEP focused on rural communities but this has since been extended to pastoral areas and, in 2010, to urban communities. An important part of the programme is to improve hygiene and environmental sanitation and give people information about good health and hygiene practices (Health Extension and Education Center, 2007). Creating a healthy society also depends on improvements to sanitation and waste management and as an urban WASH worker you will be supporting this activity.

In this study session you will learn about the risks to people’s health and to the environment that result from poor sanitation and waste management. You will also look at ways of reducing these risks.

Learning Outcomes for Study Session 2

When you have studied this session, you should be able to:

2.1 Define and use correctly each of the terms printed in **bold**. (SAQ 2.1)

2.2 Name the main groups of human pathogens and give examples of the diseases they cause. (SAQ 2.1)

2.3 Briefly describe how sanitation and waste management affect human health and explain how good hygiene can prevent disease transmission. (SAQ 2.2)

2.4 Describe the influence of sanitation and waste management on education, the economy and the environment. (SAQ 2.3)

2.1 Health effects of poor sanitation and waste management

Ethiopia’s urban and peri-urban areas are characterised by poor sanitation conditions, indiscriminate dumping of wastes and open urination and defecation. (**Peri-urban areas** are the areas surrounding a town between the urban and rural areas. They are often settled in by migrants from the countryside who suffer from extreme poverty, overcrowding and a lack of sanitation facilities.) Urban and peri-urban pollution and overcrowding create significant vulnerabilities for the overall urban population, particularly the poor. Diarrhoeal disease is one of the leading causes of **morbidity** (illness) and **mortality** (death) in developing countries, especially among children younger than five years of age. It is estimated that up to 60% of the current disease burden in Ethiopia is attributable to poor sanitation and 15% of deaths are due to diarrhoea (MoH, 2005).
Many human infections are spread through contact with human excreta. Bacteria, viruses, protozoa and parasitic worms cause many diseases that are spread by direct contact with faeces or indirectly via contaminated food and soil. These different types of pathogens or infectious agents are described in Box 2.1. Diseases may also be transmitted through a carrier organism or vector. **Vectors** are organisms that do not cause diseases themselves, but carry or transmit disease-causing agents. For example, mosquitoes carry the protozoa that cause malaria and infect people with the disease through mosquito bites. Other examples of disease vectors are lice, ticks, fleas and rats.

**Box 2.1 Main types of infectious agents**

- **Bacteria** are very simple microscopic organisms. Some types of bacteria are essential to human life, playing a part in the digestive system. Others have other benefits, such as decomposing wastes. Pathogenic bacteria are responsible for many diseases, including tuberculosis and pneumonia and several waterborne diseases such as typhoid and cholera (Figure 2.1).

- **Viruses** are not living organisms themselves but are infectious agents able to invade cells and cause them to manufacture more virus material. Polio, HIV/AIDS, influenza and rotavirus are examples of diseases caused by viral infections.

- **Protozoa** are the simplest members of the animal kingdom. They are microscopic, consist of a single cell and are found in water, soil and the sea. Some types are beneficial to humans, breaking down pollutants in water, but others are parasitic, causing diseases including malaria, amoebic dysentery (Figure 2.2) and sleeping sickness.

- **Parasitic worms** live inside the bodies of their human host, usually in the intestines. There are several different types of parasitic worm including tapeworms, flukes and roundworms. Roundworms, also known as nematodes, include Ascaris, hookworm and whipworm (Figures 2.3 and 2.4). Most worm infections are not fatal, but they do cause long-term debilitating illness. Parasitic worms are sometimes collectively known as **helminths**. Note however, that there are many types of worm that are not parasitic or harmful in any way. For example, earthworms decompose dead plant matter and improve soil structure and fertility.
2.1 Health effects of poor sanitation and waste management

Figure 2.1 *Vibrio cholerae*: the bacteria responsible for cholera (0.5–0.8 µm wide and 1.4–2.6 µm long).

Figure 2.2 *Entamoeba histolytica*: the protozoa that causes amoebic dysentery (up to 60 µm in size).
2.1 Health effects of poor sanitation and waste management

Figure 2.3 Ascaris lumbricoides or roundworm: these intestinal parasites can be very large – up to 35 cm long.

Figure 2.4 Trichuris trichiura or whipworm: these can reach 4 cm in length.

Table 2.1 lists some of the diseases that are caused by the many different types of pathogens and are linked to poor sanitation and waste management.

Table 2.1 Health problems associated with poor sanitation and management of wastes.

<table>
<thead>
<tr>
<th>Disease-causing agent</th>
<th>Disease</th>
<th>Description</th>
</tr>
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</table>
### Diarrhoeal diseases

<table>
<thead>
<tr>
<th>Bacteria</th>
<th>Shigellosis</th>
<th>Causes abdominal pains and diarrhoea (see below).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typhoid</td>
<td>Mild to severe fever lasting from a few days to several weeks.</td>
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</tr>
<tr>
<td>Cholera</td>
<td>An infection of the intestines that can cause watery diarrhoea leading to dehydration.</td>
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</tr>
<tr>
<td>Diarrhoeal diseases</td>
<td>Production of frequent watery faeces that can lead to dehydration. Can be fatal, particularly among young children.</td>
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<tr>
<td></td>
<td>Diarrhoea is a symptom of several other diseases in this table.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Viruses</th>
<th>Hepatitis A</th>
<th>An infection of the liver that can cause pain, diarrhoea and jaundice.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Polio</td>
<td>Can cause temporary or permanent muscle weakness, and sometimes death.</td>
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</table>

<table>
<thead>
<tr>
<th>Protozoa</th>
<th>Amoebiasis (also known as amoebic dysentery)</th>
<th>Infection that can occur up to several years after exposure to the protozoa. Can cause mild to severe diarrhoea and liver damage.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Giardiasis</td>
<td>Infection of the small intestine. It is usually symptomless but can have a variety of intestinal symptoms, such as chronic diarrhoea, abdominal cramps, gas production and frequent loose, pale and greasy stools.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parasitic worms</th>
<th>Ascariasis (roundworm)</th>
<th>One in four of the world’s population has this infection, which can lead to weight loss, malnutrition and anaemia. It is very common in Ethiopia.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hookworm infection</td>
<td>Two species of nematodes that inhabit the small intestine, from where they suck blood, leading to anaemia.</td>
</tr>
<tr>
<td></td>
<td>Tapeworm infection</td>
<td>A worm that normally lives in the intestines which can cause anaemia and malnutrition. This is usually spread through eating improperly cooked food that contains the worm or its eggs.</td>
</tr>
<tr>
<td></td>
<td>Bilharzia or schistosomiasis</td>
<td>A disease caused by the Schistosoma worm that can cause diarrhoea and blood in the urine and faeces. In the long term, it can lead to liver and kidney damage.</td>
</tr>
</tbody>
</table>

### 2.2 Routes for disease transmission

Most infections occur through the **faecal-oral route** where pathogens enter a person’s mouth through ingesting (eating or drinking) contaminated food or water, or when contaminated fingers are placed in the mouth. The different transmission routes are shown in Figure 2.5, which is known as the ‘F diagram’. Pathogens contained in faeces enter a new host (a person’s body) through the ‘Fs’ – fluids, fingers, flies or fields/floors. Effective sanitation, clean water and good hygiene behaviour provide barriers to this transmission.
Sanitation (using a latrine), safe water supply and good hygiene are barriers to disease transmission.

The faeces (on the left of the diagram) comes from an infected person. The new host (on the right of the diagram) could be any man, woman or child who is not currently infected with the disease. Infections can be transmitted from faeces to the new host as follows:

- Infection from *fluids* usually involves drinking or cooking with water contaminated with faecal organisms.
- In the *fingers* pathway, a person ingests the organisms (usually during eating) if they have come into contact with faeces and have not washed their hands properly afterwards. This contact can occur from defecation, from cleaning a child’s bottom, from touching dirty surfaces or eating food prepared in an unhygienic manner.
- *Flies* and cockroaches often thrive on excreta. If they land on food they can transfer faecal matter that can be subsequently ingested by a person.
- *Field* (or soil) infection can occur by the ingestion of unwashed raw vegetables and fruit grown in soil contaminated with faeces. Contaminated soil may be transported by feet or shoes for long distances. Infections can also be transmitted through dirty *floors*, perhaps if food is dropped on the floor and then picked up and eaten.

- Name two vectors involved in faecal-oral disease transmission.
- Flies and cockroaches are two examples of vectors that can carry pathogens from faeces on to food that is then eaten.

There are other disease vectors linked to poor sanitation and waste management. For example, piles of food waste and other garbage not only provide good breeding sites for flies but they also encourage rats. Rats can contaminate food stores and also carry fleas. Poor personal hygiene also contributes to disease transmission. Infrequent or inadequate washing of the body and clothes can encourage external body parasites such as fleas and lice, which may carry typhus.

An important example of a disease that is closely related to poor sanitation but is not transmitted by ingestion of contaminated food or water is schistosomiasis, also known as
bliharzia. Schistosomiasis is widely distributed in Ethiopia (Dufera et al., 2014). The disease is caused by a parasitic worm that has a complicated life cycle. Its primary host is humans, but its secondary host is a type of freshwater snail. The disease is linked to poor sanitation because it is caused by the faecal contamination of water. However, the worm gets into the body not by the faecal-oral route, but by penetrating through the skin when someone washes, swims or stands in water inhabited by infected snails.

2.3 Safeguarding health with good hygiene

In some of the later study sessions we will look at technologies that can reduce the health impacts of poor sanitation and waste management. This study session concentrates on simple practices that can be carried out by everyone to reduce these risks. These practices generally relate to good hygiene, which means any practice that prevents the spread of disease-causing organisms or substances that cause harm to humans.

2.3.1 Handwashing

Everyone should wash their hands thoroughly at certain critical times, as listed in Box 2.2. Washing should be done using clean water that has not been used by anyone else and with soap or a soap substitute such as ash. Ideally, the water should be hot. After washing, the hands should be dried using a clean cloth or allowed to dry in the air.

Box 2.2 Critical times for handwashing

The occasions in everyday activity when hands should be washed include:

- after using the latrine or toilet (or disposing of human or animal faeces)
- after cleaning a child’s bottom or changing a baby’s nappy and disposing of the faeces
- after contact with blood or body fluids (e.g. vomit)
- immediately after touching raw food, especially meat, when preparing meals
- before preparing and handling cooked or ready-to-eat food
- before eating food or feeding children
- after contact with contaminated surfaces (e.g. rubbish bins, cleaning cloths, food-contaminated surfaces)
- after handling pets and domestic animals
- after wiping or blowing the nose or sneezing into the hands
- after handling soiled tissues (your own or others’, e.g. children).

This list is frequently summarised as five critical times, which are:

- after using the latrine
- after cleaning a child’s bottom
2.3.2 Food hygiene

Many diseases are caused by eating food that has been contaminated with an infectious agent, usually from faeces. If these diseases lead to diarrhoea or vomiting they are easily spread further if sanitation provision is poor. Food hygiene refers to practices and behaviours that can prevent contamination. For example, food and water should be stored in the home in closed containers to prevent contact with flies, rodents and other vectors. These containers should not be used for any other purpose and must be kept clean. Raw and cooked meats should not be stored together, and meat and dairy produce should be kept in a cool place, ideally in a refrigerator. Food should be prepared on clean surfaces and cooked at the correct temperature for the required time. Particular care should be taken over meat, poultry, fish and dairy produce.

2.3.3 Control of vectors

As mentioned above, all food should be stored in a way that it is not accessible to flies, rodents and other potential vectors. Storing wastes properly is also an important way of controlling vectors. Food waste should be disposed of immediately or stored in a closed container before disposal to discourage the presence of flies, etc. Household solid waste storage containers should be emptied frequently. If the waste is disposed of in a pit it should be covered with soil immediately.

Waste management can also play a part in controlling mosquitoes. Mosquitoes need water to breed, but they can also do this successfully in very small temporary puddles of rainwater. Plastic bags and other plastic waste that is carelessly discarded can hold enough water to enable mosquitoes to reproduce. Collecting and disposing of plastic correctly by burial or burning ensures this opportunity for mosquito breeding is removed.

According to the F diagram (Figure 2.5), which of the three barriers to faecal-oral disease transmission would be most effective in preventing infection?

- The three barriers in the F diagram are sanitation (using a latrine), safe water supply and good hygiene, specifically handwashing. The first two are effective barriers to some of the steps in disease transmission, but hygiene cuts across all the lines of transmission. If the person who is the potential new host washes their hands at all critical times, this will be the single most effective method of preventing infection.

You have seen how poor sanitation and waste management can contribute to the spread of many different communicable diseases. The following sections describe how these negative effects on health can have further impacts on education and the economy.
2.4 Impacts on children and education

Diseases linked to poor sanitation and hygiene have a significant impact on children’s health and education. 38% of Ethiopian school children are infected with parasitic worms (Mahmud et al. 2015). These infections contribute to malnutrition because the parasites prevent the child’s body from absorbing nutrients from the food that they eat. Long-term malnutrition retards children’s physical and intellectual development. The Young Lives survey (2014) reported that around 30% of Ethiopian children are stunted, which is a sign of long-term malnutrition. (Stunted means that a child’s height is less than expected for their age.)

Children are frequently ill as a result of parasites and other infections, which leads to poor school attendance and performance. Furthermore, if the school attended by an infected child does not have good sanitation and handwashing facilities the infections are likely to spread to healthy children.

There are also social impacts of poor sanitation provision in schools. An absence of latrines with separate facilities for girls and boys means that post-pubescent girls are more likely to stop attending schools, especially when menstruating (this is covered in Study Session 12). When healthy children attend a school with well segregated sanitation facilities, they are present more regularly and are better learners. This, in turn, makes them better able to find jobs that demand higher-level skills on finishing school; an advantage to them, their families and the community as a whole. This contributes to wider economic benefits, as discussed in the following section.

2.5 Impacts on the economy

A healthy community has many economic advantages over an unhealthy one. If people are healthy they will spend less money on health care and the loss of work days due to diarrhoea and other related infections is reduced. Illness can affect both the sick person and their family, for example when women have to take time off work to care for sick children.

Improving solid waste management has economic advantages in addition to the health advantages discussed above. Consider the following example.

It is said that a firm that throws something away pays towards it three times over. Imagine a firm that uses raw materials and puts them through a manufacturing process to make a final product. First, the firm has to pay its suppliers for the raw materials. Secondly, it pays its staff to transform the raw materials into products, and pays for the water and energy that it uses. Finally, the firm has to pay for disposal of what it throws away. So a firm that reduces the amount of waste it produces makes savings in all three areas.

A firm that uses basic materials such as glass or metal faces large energy bills for the processes required in converting these materials into products. But if they follow the principles of the 3 Rs (reduce, reuse and recycle) and substitute some of their input raw material with scrap glass or metal, they can reduce their energy bills and buy less raw materials. These materials are often imported, so using recycled scrap reduces Ethiopia’s expenditure abroad, which benefits the national economy as well as individual firms.
There are further benefits from recycling. The initial stages in the recycling process (collecting material from households and businesses) is labour-intensive and provides employment for the poorest people in society. Giving them an income improves their health, which, in turn, reduces the country’s healthcare expenditure.

- A householder in an urban area goes shopping for food. How can they apply the 3 Rs when it comes to packaging materials?
  - They can reduce packaging waste by buying loose fruit and vegetables rather than pre-packaged goods.
  - The can reuse carrier bags to take the shopping home rather than picking up new bags each time they shop.
  - They can recycle by taking any glass or metal food containers to collection points or by giving them to people who earn their living by collecting recyclable wastes.

2.6 Impacts on the environment

What do we mean by ‘the environment’? You may think of it as your immediate surroundings in the town or kebele where you live or work. However, it can also mean the wider natural world on a much larger, even global, scale. Poor sanitation and waste management have direct impacts on the local environment, but human practices can also have broader consequences.

There are obvious local environmental benefits from improved sanitation. This means that defecation only takes place in properly constructed latrines, areas of land are not contaminated with faeces and watercourses no longer act as sewers. This in turn allows plant life, fish and other aquatic organisms to flourish.

Improving waste management improves the local environment and also benefits the national and even the global environment. Good waste management means less litter in the streets and in the neighbourhood of waste disposal sites (Figure 2.6). It also reduces the smell in the streets from decomposing wastes.
Figure 2.6 Carelessly discarding plastic bags and other solid wastes has a negative visual impact and is hazardous to grazing animals.

Applying the 3 Rs saves energy because the energy used to recycle metals, paper, glass, etc. is far less than the energy used in producing these materials from raw materials. Energy production is a major source of greenhouse gases. Greenhouse gases, such as carbon dioxide and methane, contribute to human-induced climate change that is causing the overall warming of the Earth and changing weather and rainfall patterns. Recycling (and reduction and reuse) reduce the emissions of these gases. Improving the standards of landfills also reduces greenhouse gas emissions and lowers the risk of polluting local watercourses and the surrounding land.

Summary of Study Session 2

In Study Session 2, you have learned that:

1. Many health problems are associated with poor sanitation and waste management, principally caused by contact with human faeces.
2. The main types of infectious agent responsible for communicable diseases are bacteria, viruses, protozoa and parasitic worms.
3. The F diagram shows how infectious agents from faeces can be ingested by someone who then becomes infected.
4 Poor sanitation and waste management create conditions that may encourage flies and other disease vectors.
5 Good hygiene behaviour, especially handwashing with soap at critical times, can significantly reduce health risks.
6 Diseases associated with poor sanitation affect children’s physical development and school attendance. Poor sanitation facilities in schools also affect attendance, especially for girls.
7 Healthy people are more productive, which brings economic benefits to them and to the wider community.
8 In industry, minimising the amount of waste can reduce costs throughout the manufacturing process.
9 Environmental impacts of poor sanitation and waste management at a local level include pollution of land and watercourses, the visual impact of litter, and bad odours. At a global level, applying the 3 Rs to solid waste management can reduce energy use which will reduce greenhouse gas emissions.

Self-Assessment Questions (SAQs) for Study Session 2

Now that you have completed this study session, you can assess how well you have achieved its Learning Outcomes by answering these questions.

SAQ 2.1 (tests Learning Outcomes 2.1 and 2.2)
Insert the words below into the table to match the headings.
- animals that live inside humans, usually in the intestines
- ascariasis
- bacteria
- infectious agents that invade cells
- malaria
- parasitic worms
- polio
- protozoa
- simple micro-organisms
- single-celled animals that live inside humans
- typhoid
- viruses.

<table>
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<th>What it is</th>
<th>One disease caused</th>
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Answer

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</tr>
<tr>
<td>Parasitic worms</td>
<td>Animals that live inside humans, usually in the intestines</td>
<td>Ascariasis</td>
</tr>
</tbody>
</table>

SAQ 2.2 (tests Learning Outcome 2.3)
Imagine that you are working with the mother of a two-year-old child. Use the F diagram (Figure 2.5) to give her some examples of how she could reduce the child’s exposure to faecal pathogens.

Answer
As well as ensuring the family is using water that is safe to drink, the focus should be on reducing the potential for the child to come into contact with faeces directly and indirectly. These barriers could include:

- ensuring all family members use a latrine. If the child is not old enough to use the latrine themselves, the mother or other carer should dispose of the child’s faeces in a latrine.
- ensuring all family members wash their hands at the appropriate times, especially before feeding the child. Teach the child to wash their own hands.
- not giving the child access to raw foods
- keeping food and wastes covered to reduce the problem of flies
- discouraging the child from picking things up in the street or off the floor
- discouraging the child from putting their fingers in their mouth.

SAQ 2.3 (tests Learning Outcome 2.4)
How do good sanitation and waste management practices bring a positive effect to urban inhabitants? Give examples for effects on:

- health
- education
- economic conditions
- the environment.
Answer

- **Effects on health:** Good sanitation and waste management help to keep people separate from potential sources of pathogens. They reduce the risk of contaminating water supplies with pathogens and discourage the transmission of disease.

- **Effects on education:** Healthy children have fewer days off school through illness. When they are at school, healthy children learn better than sick children. Providing good sanitation facilities encourages children to attend school, particularly girls during their menstrual periods.

- **Effects on economic conditions:** The health benefits promoted by good sanitation and waste make for a more productive community. Less money is spent on healthcare and people lose fewer days off work through caring for the sick.

- **Effects on the environment:** Good sanitation and waste management means that there will be less faeces and waste deposited in public places and less pollution of the water and soil.