

## Annexe 1

### **Listing of diseases related to water and environmental sanitation**

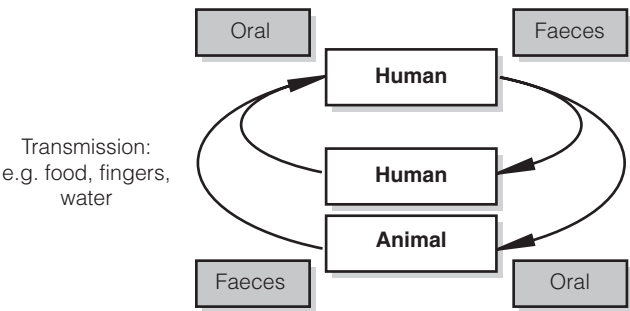


**Bacterial enteritis, Campylobacter enteritis, Diarrhoea, Gastroenteritis**

A diarrhoeal disease with fever. Often the diarrhoea contains blood (dysentery). Usually a disease of infants. The infection will often be transmitted by domestic animals.

- Pathogen** : *Campylobacter jejuni*, *C.coli* <sup>(3)</sup> (Bacterium)
- Distribution** : worldwide <sup>(15)</sup>
- Symptoms** : an infection with acute diarrhoea, often with blood and mucus <sup>(35)</sup>, abdominal pain, malaise, vomiting <sup>(3)</sup>. Fever is intermittent or relapsing <sup>(4)</sup>. In developing countries most cases occur in children under 2 years of age <sup>(3)</sup>
- Severity** : the severity is variable <sup>(3)</sup>, complications do occur but are rare <sup>(44)</sup>
- Incubation period** : 2 to 5 days <sup>(16)</sup>
- Duration** : often 2 to 5 days, usually no more than 10 days <sup>(3)</sup>. Up to 20% of the people who get sick have a relapse, or prolonged illness <sup>(44)</sup>
- Communicability** : cases who are not treated can be carriers of the pathogen for up to 7 weeks. Animals can be permanent carriers <sup>(3)</sup>

**Transmission cycle** <sup>(3)</sup>



- Transmission** : transmission takes place through contaminated food, water, or through contact with infected animals. The infective dose is around 500 bacteria <sup>(16)</sup>
- Reservoir** : humans, cattle, poultry, swine, sheep, cats, dogs, rodents, birds. Animals (especially poultry and cattle) <sup>(3)</sup> are the major reservoir for the pathogen. *C.jejuni* can survive for up to 5 weeks in milk or water at 4°C <sup>(16)</sup>
- Vector/int. host** : none
- Water-related** : water-washed and water-borne (in developing countries transmission often occurs through surface water contaminated by animals) <sup>(16)</sup>
- Excreta-related** : faecal-oral <sup>(15)</sup>
- Environment** : an environment with poor sanitation, poor personal hygiene <sup>(44)</sup>, inadequate water availability, use of water of poor quality, close contact between food or people and reservoir animals (e.g. poultry, cattle, goats and dogs) <sup>(16)</sup>
- Risk in disaster** : the infection is a risk where poor sanitation is combined with mass feeding<sup>(3)</sup>
- Remarks** : an estimated 5-14% of all diarrhoea worldwide is caused by *C.jejuni* <sup>(3)</sup>

## CONTROLLING AND PREVENTING DISEASE

Preventative measures	Potential effect
Improving the quality of drinking water	(++) <sup>(29)</sup>
Improving water availability	(+++)
Improving handwashing practise <sup>(3)</sup>	(+++) <sup>(73)</sup>
Improvement of sanitation	(++) <sup>(73)</sup>
Improving food hygiene (especially dairy products and poultry)	(++) <sup>(73)</sup>
Care in contact with domestic animals (especially poultry or their faeces and puppies/kittens with diarrhoea) <sup>(3)</sup>	(++) <sup>(73)</sup>
Health and hygiene promotion	

People with symptoms should not handle food or come in close contact with institutionalised persons<sup>(1)</sup>

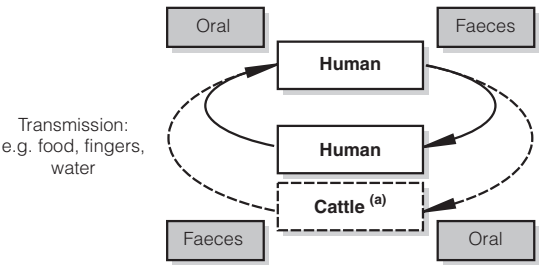
**Epidemic measures :** groups of patients should be reported to health authorities. If feasible the source of infection should be determined and eliminated<sup>(3)</sup>

**Bacterial enteritis (caused by *Escherichia coli*), Diarrhoea, Gastroenteritis**

A diarrhoeal infection with a wide range of symptoms. The infection can be severe, and one group of *E.coli* is able to cause dysentery outbreaks.

- Pathogen** : *Escherichia coli* <sup>(15)</sup> (Bacterium).  
The bacteria *E.coli* is naturally present in human intestines. Most strains (groups) of *E.coli* are harmless, but some strains can cause intestinal infections <sup>(45)</sup>
- Distribution** : worldwide <sup>(15)</sup>
- Symptoms** : depends on the group of bacteria which cause the infection: from bloody diarrhoea, caused by *E.coli* 0157:H7, which has the potential of causing outbreaks, and which could be mistaken for shigellosis (dysentery outbreaks) <sup>(47)</sup>; to watery diarrhoea, abdominal cramps, vomiting, and fever <sup>(3)</sup>. Children under 5 are particularly affected <sup>(44)</sup>
- Severity** : depends on the strains of the bacteria. The infection can be fatal. Children are especially at risk <sup>(3)</sup>
- Incubation period** : 9 hours to 8 days, depending on the strain causing the infection <sup>(3)</sup>
- Duration** : 1 to 10 days, depending on the strain <sup>(44)</sup>
- Communicability** : *E.coli* 0157:H7 can be excreted by children for up to 3 weeks. For the other categories communicability may be prolonged <sup>(3)</sup>

**Transmission cycle <sup>(3)</sup>**



<sup>(a)</sup> : cattle is a reservoir for *E.coli* 0157:H7

<sup>(a)</sup> : cattle is a reservoir for *E.coli* 0157:H7

- Transmission** : through the ingestion of contaminated food or water, or through contact with an infected person. For *E.coli* 0157:H7, contact with cattle. The infective dose of *E.coli* 0157:H7 is very low <sup>(3)</sup>
- Reservoir** : for most strains: only humans <sup>(3)</sup>, though dogs are mentioned as a potential reservoir <sup>(73)</sup>. *E.coli* can multiply outside the host on food. Cattle is a reservoir for *E.coli* 0157:H7 <sup>(3)</sup>
- Vector/int. host** : none
- Water-related** : water-washed and water-borne <sup>(15)</sup>
- Excreta-related** : faecal-oral <sup>(15)</sup>
- Environment** : an environment with inadequate sanitation, poor personal hygiene, poor water availability, poor drinking water quality <sup>(44)</sup>

## CONTROLLING AND PREVENTING DISEASE

- Risk in disaster** : *E.coli* 0157:H7 can cause outbreaks <sup>(47)</sup>
- Remarks** : *E.coli* is one of the most common causes of diarrhoea in humans. In some surveys up to 30% of the cases of gastroenteritis are attributed to it <sup>(16)</sup>. *E.coli* is estimated to be the cause of 70% of travellers diarrhoea <sup>(4)</sup>. *E.coli* occurs naturally in the normal intestinal flora, and is often used as indicator for faecal contamination of drinking water

Preventative measures	Potential effect
Improving the quality of drinking water	(++) <sup>(29)</sup>
Improving water availability	(+++)
Improving handwashing practise <sup>(3)</sup>	(+++) <sup>(73)</sup>
Improvement of sanitation	(+) <sup>(73)</sup>
Improving food hygiene	(++) <sup>(73)</sup>
Health and hygiene promotion <sup>(3)</sup>	

People who are sick should not handle food, or work with institutionalised persons <sup>(3)</sup>.

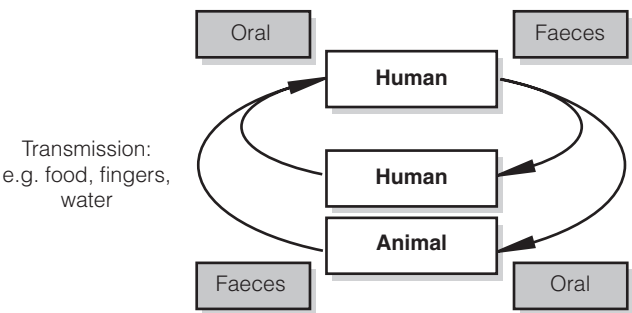
**Epidemic measures** : in outbreaks the source of infection should be searched for and eliminated <sup>(3)</sup>

**Bacterial enteritis, Salmonellosis, Diarrhoea, Gastroenteritis**

An acute diarrhoeal disease. Outbreaks of salmonellosis are often food-borne.

<b>Pathogen</b>	: <i>Salmonella</i> spp. <sup>(15)</sup> (Bacterium)
<b>Distribution</b>	: worldwide <sup>(3)</sup>
<b>Symptoms</b>	: diarrhoea, headache, nausea, abdominal pain, fever, vomiting <sup>(3)</sup> . The infection is rare in adults <sup>(16)</sup>
<b>Severity</b>	: the infection can be severe, but fatal infections are rare in a healthy adult population. Children and the weak are most at risk <sup>(3)</sup> . The number of bacteria which cause the initial infection influences the outcome of the disease <sup>(16)</sup>
<b>Incubation period</b>	: 6 hours to 3 days <sup>(3)</sup>
<b>Duration</b>	: symptoms usually last for several days <sup>(3)</sup>
<b>Communicability</b>	: usually several weeks. Chronic human carriers are rare, still, 5% of the infected children will pass bacteria for over one year. In animals chronic carriers are more common than in humans <sup>(3)</sup>

**Transmission cycle <sup>(3)</sup>**



<b>Transmission</b>	: cattle, pigs, poultry, dogs, cats, birds, and turtles, are potential reservoirs of the pathogen. Sick people or carriers are also important sources of the pathogen. Usually transmission occurs through contaminated animal products (poultry, meat, egg). Other ways of transmission are contaminated water (though water-borne transmission is rare) <sup>(16)</sup> , or contact with infected persons or animals. Transmission through contaminated hands can be important. The bacteria can multiply in infected food (especially milk) <sup>(3)</sup> . The infective dose is from very small to high <sup>(16)</sup>
<b>Reservoir</b>	: human, dogs, cats, cattle, pigs, poultry, rodents, turtles, tortoises <sup>(3)</sup>
<b>Vector/int. host</b>	: none
<b>Water-related</b>	: water-washed and water-borne <sup>(15)</sup>
<b>Excreta-related</b>	: faecal-oral
<b>Environment</b>	: an environment with inadequate sanitation, poor water availability, poor personal hygiene, and poor food hygiene
<b>Risk in disaster</b>	: the infection is a risk where poor sanitation is combined with mass feeding <sup>(3)</sup>
<b>Remarks</b>	: -

## CONTROLLING AND PREVENTING DISEASE

Preventative measures	Potential effect
Improving the quality of drinking water	(++) <sup>(29)</sup>
Improving water availability	(++)
Improving handwashing practise	(+++) <sup>(73)</sup>
Improvement of sanitation	(++) <sup>(73)</sup>
Improving food hygiene (especially animal products) <sup>(3)</sup>	(++) <sup>(73)</sup>
Care in contact with domestic animals <sup>(3)</sup>	
Health and hygiene promotion	

Adequate food hygiene during the slaughtering of animals, and the preparation and distribution of food is important. Cooked food and raw meat should not be brought into contact with each other<sup>(16)</sup>. People who are sick should not handle food, or care for institutionalised persons. Individuals handling food should have clean fingernails<sup>(3)</sup>

**Epidemic measures :** the source of the infection should be identified, and dealt with<sup>(3)</sup>

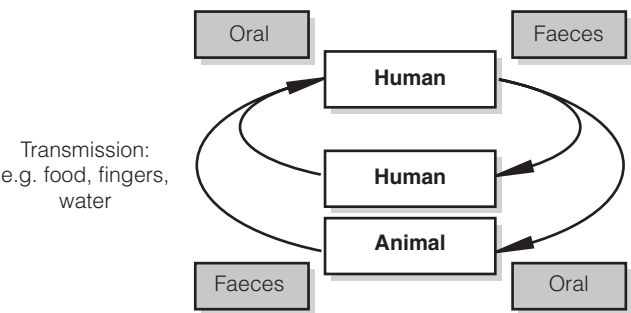


**Bacterial enteritis, Yersiniosis, Diarrhoea, Gastroenteritis**

An acute diarrhoeal disease which sometimes produces bloodstained faeces.

<b>Pathogen</b>	: <i>Yersina enterocolitica</i> , <i>Y.pseudotuberculosis</i> <sup>(3)</sup> (Bacterium)
<b>Distribution</b>	: worldwide <sup>(15)</sup> . The infection is more common in temperate climates than in the tropics <sup>(16)</sup>
<b>Symptoms</b>	: acute diarrhoea, in 25% of the cases bloodstains are found in the diarrhoea <sup>(16)</sup> . Adults frequently have pains in joints. The infection can display symptoms of acute appendicitis. Yersiniosis is most common in younger people <sup>(3)</sup>
<b>Severity</b>	: -
<b>Incubation period</b>	: 3 to 7 days <sup>(73)</sup>
<b>Duration</b>	: usually 2 to 3 weeks <sup>(3)</sup>
<b>Communicability</b>	: in untreated cases, up to 3 months. Prolonged asymptomatic carriers are reported <sup>(3)</sup>

**Transmission cycle** <sup>(3)</sup>



<b>Transmission</b>	: occurs through consumption of contaminated food or water <sup>(73)</sup> , or through contact with infected persons (this is rare <sup>(16)</sup> ) or animals. As the pharynx of pigs can be heavily infected, pork can be contaminated during slaughtering <sup>(3)</sup> . The infective dose is medium to high <sup>(15)</sup>
<b>Reservoir</b>	: the pig is the main reservoir of <i>Y.enterocolitica</i> . Other reservoirs are humans, dogs, cats, birds, rodents, and other mammals <sup>(3)</sup>
<b>Vector/int. host</b>	: none
<b>Water-related</b>	: water-washed and water-borne <sup>(15)</sup>
<b>Excreta-related</b>	: faecal-oral
<b>Environment</b>	: an environment where close contact between domestic animals and people, poor food hygiene <sup>(3)</sup> , and/or poor personal hygiene exist
<b>Risk in disaster</b>	: usually not a problem <sup>(3)</sup>
<b>Remarks</b>	: Surveys have shown that less than 1% of the cases with acute diarrhoea are caused by yersiniosis <sup>(16)</sup>

## CONTROLLING AND PREVENTING DISEASE

Preventative measures	Potential effect
Improving the quality of drinking water	(++) <sup>(73)</sup>
Improving water availability	(++-)
Improving handwashing practise <sup>(3)</sup>	(+++) <sup>(73)</sup>
Improvement of sanitation (human and animal)	(+) <sup>(73)</sup>
Improving food hygiene (especially food with pork)	(++) <sup>(73)</sup>
Care in contact with domestic animals <sup>(3)</sup>	
Health and hygiene promotion <sup>(3)</sup>	

Infected people should not handle food or care for institutionalised persons<sup>(3)</sup>

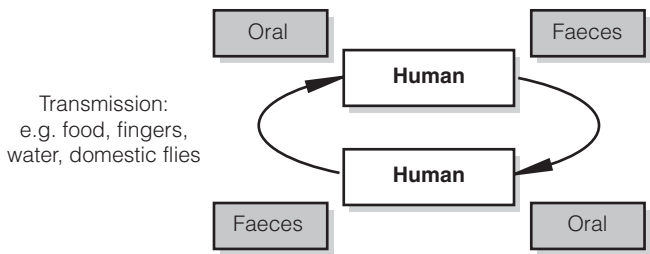
**Epidemic measures :** groups of patients should be reported to health authorities. The source of infection should be determined and eliminated<sup>(3)</sup>

**Bacillary dysentery, Shigellosis**

The most important infection causing dysentery <sup>(83)</sup>. The infection is a disease of poor and crowded communities <sup>(16)</sup>. Shigellosis has the ability to cause large outbreaks, especially in displaced populations <sup>(47)</sup>.

- Pathogen** : *Shigella* spp. <sup>(15)</sup> (Bacterium)
- Distribution** : worldwide <sup>(3)</sup>
- Symptoms** : typical symptoms are bloody diarrhoea with mucus, cramps, and fever. Still, shigellosis will often present itself as watery stools <sup>(3)</sup>. The number of stools can be up to 100 per day. Many infections in adults are asymptomatic. Where the disease is endemic, most infections occur in children under 10 years of age <sup>(16)</sup>
- Severity** : depends of the host and the pathogen. The case fatality rate of hospitalised people can vary from negligible to 20%.  
Most at risk of severe illness are children, the elderly, and the undernourished <sup>(3)</sup>
- Incubation period** : 1 to 7 days <sup>(73)</sup>
- Duration** : the illness will usually last 4 to 7 days <sup>(3)</sup>
- Communicability** : if untreated, usually up to 1 month after the illness. The carrier state exists, but is rare. Medical treatment will usually reduce the duration of communicability to a few days <sup>(3)</sup>

**Transmission cycle <sup>(3)</sup>**



- Transmission** : shigellosis is highly contagious. Transmission takes place through ingestion of contaminated material. Ingestion of 10 to 100 bacteria can be enough to cause infection <sup>(16)</sup>. Transmission through close contact between carriers or recovering patients and susceptible persons is common <sup>(4, 47)</sup>. Domestic flies can play a role in transmission of *Shigella* spp. <sup>(16)</sup>. Excreta of the sick contain 10<sup>5</sup> to 10<sup>8</sup> bacteria per gram <sup>(44)</sup>. The bacteria can multiply in food, which increases the chance of food-borne transmission <sup>(3)</sup>
- Reservoir** : human <sup>(16)</sup>
- Vector/int. host** : domestic flies can act as mechanical vector <sup>(3)</sup>
- Water-related** : water-washed and water-borne <sup>(15)</sup>
- Excreta-related** : faecal-oral <sup>(16)</sup>
- Environment** : where the population has a poor personal hygiene (poor availability of water), lives in crowded conditions, and where sanitation is inadequate <sup>(3)</sup>; another risk factor is the use of drinking water of poor quality <sup>(44)</sup>

## CONTROLLING AND PREVENTING DISEASE

- Risk in disaster** : a serious risk where overcrowding is combined with poor personal hygiene and poor sanitation <sup>(4)</sup>
- Outbreaks** : the signs for potential outbreaks are an unexpected increase of cases of dysentery in a population, or an increase in the number of death caused by bloody diarrhoea. In an outbreak, all age groups will be attacked (contrary to endemic shigellosis, which mainly occurs in children). Epidemic dysentery is caused by Sd1 (*Shigella Dysenteriae* type 1) which has a case fatality rate of 5 to 15% <sup>(83)</sup>. With appropriate treatment this can be reduced to 2 to 5% or lower <sup>(47)</sup>.
- In a stable population around 5% <sup>(47)</sup> to over 10% <sup>(16)</sup> of the total population can be expected to develop the disease. Of the sick around 10% will need hospitalisation <sup>(47)</sup>.
- In a refugee setting however, over 30% of the population may fall ill, with weekly attack rates of 2 to 10% of the total population. The total attack rate seems to be related to population density <sup>(47)</sup>
- Remarks** : In many places *Shigella* spp. is responsible for 5 to 10% of normally occurring diarrhoeal diseases <sup>(4)</sup>. *Shigella* is estimated to be responsible for around 600,000 deaths per year worldwide, most of which are children.
- It must be assumed that only a small proportion of the total number of cases will be reported <sup>(3)</sup>.
- The pathogen can develop resistance to antibiotics during an epidemic <sup>(83)</sup>

Preventative measures	Potential effect
Improving the quality of drinking water	(++) <sup>(29)</sup>
Improving water availability	(+++)
Availability of soap	(++) <sup>(47)</sup>
Improving handwashing practise	(+++) <sup>(73)</sup>
Improvement of sanitation	(++) <sup>(73)</sup>
Improving food hygiene (especially dairy products)	(++) <sup>(73)</sup>
Control of domestic flies <sup>(73)</sup> (see Annexe 3)	
Health and hygiene promotion <sup>(3)</sup>	

People who are infected should not handle food, or care for institutionalised persons or children. Fingernails should be kept clean and short <sup>(3)</sup>

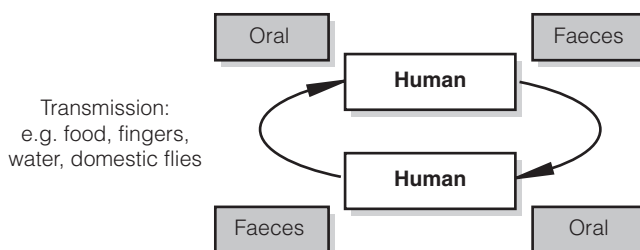
**Epidemic measures** : groups of patients should be reported to the health authorities, the source of infection should be determined and reacted upon <sup>(3)</sup>. During large outbreaks the places where dysentery cases are treated should be isolated from other health services <sup>(47)</sup>. Management of the outbreak should be similar to that of cholera <sup>(73)</sup>. If malnutrition is a problem, sufficient food should be made available. If people have no easy access to soap, it must be made available if appropriate <sup>(47)</sup>.

## Cholera

A diarrhoeal disease with a potential of causing large outbreaks. The disease is a serious health threat where poor sanitation, crowding and poor hygiene exist.

<b>Pathogen</b>	: <i>Vibrio cholerae</i> <sup>(15)</sup> (Bacterium) There are two biotypes (categories) of <i>V.cholerae</i> : the classical biotype, and the El Tor biotype which has now largely replaced the classical biotype. The El Tor biotype tends to become endemic if it has reached a location with poor personal hygiene and poor sanitation, while the classical biotype tends to strike and disappear <sup>(2)</sup>
<b>Distribution</b>	: all developing countries <sup>(3)</sup>
<b>Symptoms</b>	: severe cases will develop acute diarrhoea with rice-watery stools, often combined with vomiting <sup>(3)</sup> . Most infections will not show any symptoms though. Infections with the classical biotype will have around 5 carriers for every symptomatic case. Infections with the El Tor biotype will have 30 to 50 carriers for every symptomatic case <sup>(16)</sup> . Of those who develop the disease, 90% will have a mild or moderately severe illness <sup>(83)</sup> with diarrhoea <sup>(3)</sup> . Of the people who develop typical cholera normally less than 10% will suffer from moderate to severe dehydration. Where the infection is highly endemic, it is mainly a disease of young children <sup>(83)</sup>
<b>Severity</b>	: severe cases can die within hours. If not treated, 50% of those developing the severe form can die. With proper treatment this can be reduced to below 1% <sup>(3)</sup>
<b>Incubation period</b>	: 1 to 5 days <sup>(73)</sup>
<b>Duration</b>	: the disease lasts for up to one week <sup>(2)</sup>
<b>Communicability</b>	: infected persons without symptoms will discharge bacteria for up to 2 weeks <sup>(83)</sup> . The sick will often discharge pathogens for up to some days after recovery. Some persons will become carriers for several months. Chronic carriers do exist but are very rare. If antibiotics are effective against the type of <i>V.cholerae</i> causing infection, treating people with these will reduce the period of communicability <sup>(3)</sup>

### Transmission cycle <sup>(2)</sup>



<b>Transmission</b>	: the main mode of transmission is through contaminated food or drinking water. As well faeces as vomit are infectious <sup>(2)</sup> . Cholera is rarely transmitted directly from person to person <sup>(83)</sup> . Transmission of the disease through drinking water seems to be less common with the El Tor biotype than with the classical biotype <sup>(2)</sup> . Persons with asymptomatic infections play an important role in the transmission of the infection <sup>(83)</sup> .
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## CONTROLLING AND PREVENTING DISEASE

### Reservoir

- The usual infective dose is  $10^6$  to  $10^8$  bacteria, though with some persons  $10^3$  may suffice. A severe case can excrete  $10^7$  to  $10^9$  *Vibrio*/ml of diarrhoea while an asymptomatic case may shed  $10^2$  to  $10^5$  *Vibrio*/mg of faeces <sup>(73)</sup>.
- : humans are the only host <sup>(16)</sup>, marine shellfish and plankton can be reservoirs <sup>(83)</sup>, and *V.cholerae* can survive in association with these reservoirs for several months. Some information on the viability of the bacteria in food <sup>(16)</sup>:

	<i>Time of survival (in days)</i>	
	<i>At 30 to 31°C</i>	<i>At 5 to 10°C</i>
Fruits	1-3	3-5
Cereal	1-3	3-5
Cooked foods	2-5	3-5
Fresh vegetables	1-7	7-10
Fish and seafood	2-5	7-14
Milk and dairy products	7-14	more than 14

### Vector/int. host Water-related Excreta-related Environment

- : domestic flies are a possible mechanical vector <sup>(47)</sup>
- : water-washed and water-borne <sup>(3)</sup>
- : faecal-oral <sup>(3)</sup>
- : an environment with poor personal hygiene (poor availability of water), inadequate sanitation <sup>(2)</sup>, and a population living in crowded conditions <sup>(3)</sup>. Where people use drinking water of poor quality <sup>(73)</sup>. Where cholera is endemic, it tends to be a disease of the poor <sup>(3)</sup>.

### Risk in disaster

- : a serious risk where the disease is endemic, overcrowded conditions, and where sanitation is poor <sup>(3)</sup>

### Outbreaks

- : where an outbreak is likely, the preparation must start well before an outbreak occurs. In a refugee setting a number of precautions must be taken: an early detection system must be operational and units where cholera cases can be treated must be planned. When the risk of an outbreak increases, material to deal with the outbreak should be present and cemeteries must be planned. Medical personnel should be trained in detecting cases and dealing with them. The population should receive health and hygiene promotion <sup>(47)</sup>.  
The attack rates in a population will depend on the level of overcrowding, the situation concerning sanitation, and the level of immunity in the population. In a refugee setting, around 5% of the population can be assumed to develop a severe form, though higher attack rates are possible. In Goma (1994) 8% of the total population was struck. In a refugee camp an epidemic will generally last 3 weeks to 3 months.  
In an open setting, 1-2% of the total population can be expected to develop a severe form of the disease <sup>(47)</sup>.  
Some information on logistics: in a refugee setting around  $\frac{3}{4}$  of the severe cases will need 8 litres of Ringer Lactate (intravenous rehydration fluids) <sup>(47)</sup>. The needs of a patient in fluids can sometimes be over 20 litres per day <sup>(73)</sup>. Large quantities of ORS (Oral Rehydration Salts) should be available. In an open setting the requirements will be lower than those in a refugee setting <sup>(47)</sup>.

## ANNEXE 1: LISTING OF DISEASES

To calculate the number of beds needed in a displaced population (assuming the outbreak will last around 1 month and 5% of the population is severely ill) (adapted from 47):

$$\text{Number of beds needed} = \frac{\text{Population at risk}}{200}$$

In an open setting the number of beds needed would probably be around 20% of what would be needed in a refugee setting

**Remarks :** the disease must be notified to the WHO in Geneva <sup>(73)</sup>. Although this is often practised, a strict isolation of patients is not necessary for health reasons <sup>(3)</sup> (as long as the wastes are disposed of hygienically)

Preventative measures	Potential effect
Improving the quality of drinking water	(+ + +) <sup>(29)</sup>
Improving water availability	(+ + +)
Improving handwashing practise	(+ + +) <sup>(73)</sup>
Improvement of sanitation	(+ +) <sup>(73)</sup>
Improvement of food hygiene (especially marine animals and salad)	(+ +) <sup>(73)</sup>
Control of domestic flies where contaminated waste is present <sup>(47)</sup> (see Annexe 3)	
Prompt and hygienic burial of the dead <sup>(73)</sup>	
Health and hygiene promotion <sup>(3)</sup>	

Corpses of people who died of cholera should be disinfected. Travel restrictions are not effective in preventing the disease <sup>(47)</sup>, neither are the restrictions of food movements <sup>(3)</sup>.

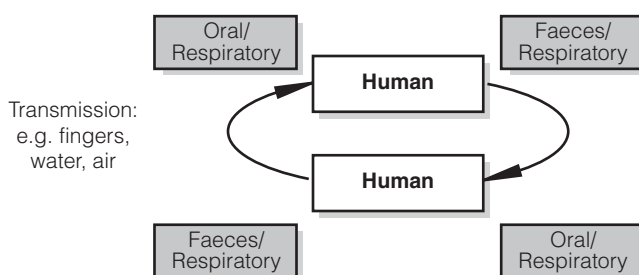
**Epidemic measures :** if feasible, the source of the outbreak should be determined and eliminated. Treatment facilities separated from other health services should be arranged to be able to deal adequately with the potentially large numbers of cases. Drinking water should be chlorinated. Where possible, sanitation should be improved <sup>(3)</sup>. If soap is not easily available to the population, it should be supplied <sup>(47)</sup> if feasible and adequate.

## ***Viral enteritis, Acute viral gastroenteritis, Viral diarrhoea, Diarrhoea***

An acute diarrhoeal disease. Relatively little is known on the transmission of the disease and its prevention.

<b>Pathogen</b>	: rotavirus <sup>(15)</sup> (virus)
<b>Distribution</b>	: the infection occurs worldwide <sup>(15)</sup>
<b>Symptoms</b>	: often asymptomatic. Symptoms are watery diarrhoea, vomiting and fever <sup>(3)</sup> . The infection affects mainly 4 month to 3 year olds <sup>(16)</sup>
<b>Severity</b>	: the infection is often severe and can be life-threatening <sup>(3)</sup>
<b>Incubation period</b>	: 2 to 3 days <sup>(44)</sup>
<b>Duration</b>	: usually 4 to 6 days <sup>(3)</sup> but illness of up to 3 weeks does occur <sup>(16)</sup>
<b>Communicability</b>	: literature does not agree on the period of communicability; possibly longer periods <sup>(3,16)</sup>

### **Transmission cycle <sup>(3)</sup>**



<b>Transmission</b>	: transmission from person to person is probably the main way the pathogen is spread <sup>(3)</sup> . Water-borne transmission does occur <sup>(16)</sup> . Rotavirus can be present in lung secretions and respiratory transmission is possible <sup>(3,73)</sup> . In tropical zones the disease occurs throughout the year with a slight increase in the cool period. In temperate zones the infection occurs in the colder seasons <sup>(3)</sup> . The infective dose is $10^2$ to $10^4$ viruses. An infected person can excrete $10^{11}$ pathogens per ml of faeces <sup>(16)</sup>
<b>Reservoir</b>	: humans are the only known reservoir <sup>(3)</sup>
<b>Vector/int. host</b>	: none
<b>Water-related</b>	: water-borne <sup>(16)</sup>
<b>Excreta-related</b>	: faecal-oral <sup>(73)</sup>
<b>Environment</b>	: unknown. The infection often occurs in institutions like school or hospitals <sup>(44)</sup>
<b>Risk in disaster</b>	: the infection could be a potential risk <sup>(3)</sup>
<b>Remarks</b>	: rotavirus is responsible for about 1/3 of the cases of diarrhoea in children under 5 years admitted in hospital. It is estimated that rotavirus causes 870,000 deaths each year <sup>(3)</sup> . Even though the infection affects mostly children, outbreaks involving adults can occur if new strains of rotavirus are introduced in a susceptible population <sup>(3)</sup> .



## ANNEXE 1: LISTING OF DISEASES

**Prevent. measures :** effective preventative measures are not obvious <sup>(3)</sup>. The infection is as frequent in developing countries as in developed countries, and it is therefore unlikely that improved personal and environmental hygiene could prevent the infection <sup>(16)</sup>

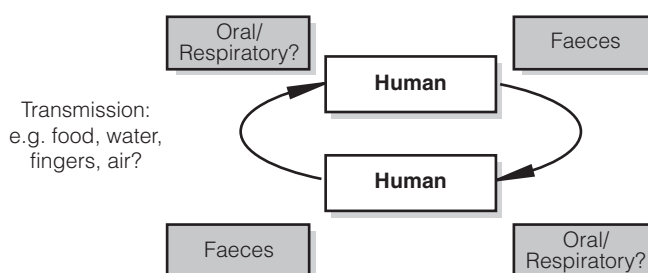
**Epidemic measures :** if possible, the source of infection should be identified <sup>(3)</sup>

## ***Viral enteritis (epidemic), Viral gastroenteropathy, Acute viral gastroenteritis, Viral diarrhoea, Diarrhoea***

A diarrhoeal disease. Usually the disease is mild to moderately severe.

<b>Pathogen</b>	: several viruses (e.g. Norwalk agent) <sup>(3)</sup>
<b>Distribution</b>	: the distribution is worldwide <sup>(3)</sup>
<b>Symptoms</b>	: diarrhoea, abdominal pain, malaise, headache, vomiting <sup>(3)</sup>
<b>Severity</b>	: the infection is usually of mild to moderate severity <sup>(3)</sup>
<b>Incubation period</b>	: usually 1 to 2 days <sup>(3)</sup>
<b>Duration</b>	: intestinal problems normally last for up to 2 days <sup>(3)</sup>
<b>Communicability</b>	: communicability is up to 2 days after the diarrhoea ends <sup>(3)</sup>

### **Transmission cycle <sup>(3)</sup>**



<b>Transmission</b>	: probably faecal-oral transmission. Food and water have been linked to outbreaks. Airborne spread is suggested <sup>(3)</sup>
<b>Reservoir</b>	: only humans have been identified as reservoir <sup>(3)</sup>
<b>Vector/int. host</b>	: none
<b>Water-related</b>	: the infection is probably water-borne and water-washed <sup>(3)</sup>
<b>Excreta-related</b>	: most likely faecal-oral <sup>(3)</sup>
<b>Environment</b>	: -
<b>Risk in disaster</b>	: the infection can a potential problem <sup>(3)</sup>
<b>Remarks</b>	: it is believed that 40% of non-bacterial diarrhoea is caused by Norwalk agent <sup>(4)</sup>

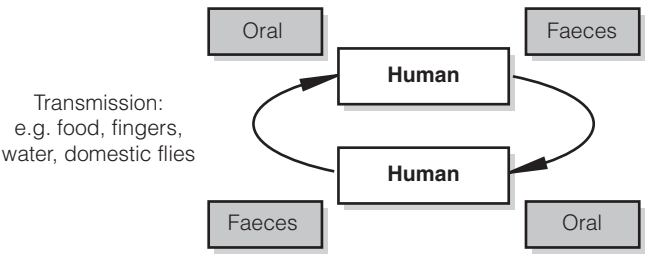
<b>Preventative measures</b>	<b>Potential effect</b>
Improving the quality of drinking water	
Improving water availability	(+) <sup>(29)</sup>
Improving handwashing practise	(+)
Improvement of sanitation	(+) <sup>(73)</sup>
Improving food hygiene	(+) <sup>(73)</sup>
Health and hygiene promotion <sup>(3)</sup>	

**Epidemic measures** : if possible, the source of infection should be identified and eliminated <sup>(3)</sup>

Dysentery (amoebic), Amoebiasis

A very common diarrhoeal infection. A typical symptom is gradually developing bloody diarrhoea. Where sanitation is poor, over 50% of the population may be carrier of the pathogen.

- Pathogen** : *Entamoeba histolytica* <sup>(15)</sup> (Protozoon).  
Amoeba can be found in two forms: a parasitic (fragile) form and an infective (resistant) cyst <sup>(4)</sup>
- Distribution** : the infection occurs worldwide <sup>(15)</sup>
- Symptoms** : most infections are asymptomatic. In tests only 1 out of 5 persons who ingested amoebic cysts developed amoebic dysentery. 3 out of the 5 persons developed an asymptomatic infection.  
Typical symptoms are gradually developing diarrhoea <sup>(2)</sup> with blood/mucus, abdominal discomfort, fever, and chills. Sometimes diarrhoea and constipation alternate <sup>(3)</sup>. A small percentage of the asymptomatic carriers will develop amoebiasis in a later stage <sup>(44)</sup>. Amoebiasis is rare in children under 5 years of age <sup>(3)</sup>
- Severity** : usually the infection is not very serious. Dangerous complications can sometimes occur though <sup>(74)</sup>
- Incubation period** : 2 to 4 weeks <sup>(73)</sup>
- Duration** : if the patient is not treated, the infection can last for up to 5 years (if the person is not re-infected). Symptomatic attacks usually last up to 6 weeks, and symptoms can reappear for years. In some infections the person with amoebiasis will have bloody diarrhoea for years <sup>(2)</sup>
- Communicability** : the period of communicability can be years <sup>(3)</sup>
- Transmission cycle** <sup>(3)</sup>



- Transmission** : transmission is faecal-oral, mainly through ingestion of contaminated food. Water-borne transmission is less common <sup>(2)</sup>. Asymptomatic carriers are the main source of transmission <sup>(3)</sup>. Where sanitation is poor, over half the population can be carrier of the pathogen <sup>(4)</sup>. Where amoebiasis is endemic, outbreaks are uncommon <sup>(2)</sup>.  
The infective dose of the pathogen is low <sup>(15)</sup>
- Reservoir** : human carriers without symptoms are the main reservoir <sup>(16)</sup>. Humans are the only known reservoirs <sup>(3)</sup>.  
In faeces cysts can remain infective for at least 8 days at 34-38°C, and for up to one month at 10°C <sup>(16)</sup>. In water they can survive for weeks <sup>(4)</sup>. Cysts are also relatively resistant in seawater, sewage and wet soil. On the surface of hands, cysts will survive for one minute, while under fingernails they can remain viable for up to 45 minutes <sup>(16)</sup>

## CONTROLLING AND PREVENTING DISEASE

<b>Vector/int. host</b>	: domestic flies can function as mechanical vectors, and can carry the cysts for up to 5 hours <sup>(73)</sup>
<b>Water-related</b>	: water-washed and water-borne <sup>(15)</sup>
<b>Excreta-related</b>	: faecal-oral
<b>Environment</b>	: common in an environment with poor personal hygiene, inadequate sanitation <sup>(2)</sup> , poor food hygiene, and use of drinking water of poor quality <sup>(16)</sup> . The infection can be a problem in mental institutions <sup>(3)</sup>
<b>Risk in disaster</b>	: the disease could be a potential problem <sup>(3)</sup>
<b>Remarks</b>	: It is estimated that around 480,000,000 people are infected worldwide, and that the infection causes around 100,000 deaths per year <sup>(44)</sup> .

Preventative measures	Potential effect
Improving the quality of drinking water	
Improving water availability	(++) <sup>(29)</sup>
Improving handwashing practise	(++) <sup>(73)</sup>
Improvement of sanitation	(++) <sup>(73)</sup>
Improving food hygiene	(+) <sup>(73)</sup>
Control of domestic flies <sup>(73)</sup> (see Annexe 3)	
Health and hygiene promotion <sup>(3)</sup>	

Cysts are killed at temperatures over 50°C <sup>(3)</sup>. Chlorination of drinking water at normal concentrations is not very effective against cysts <sup>(3)</sup>. A chlorine concentration of over 3.5 mg/l is needed to kill the cysts (recommended chlorine concentration for drinking water: 0.2-0.5 mg/l at distribution point). Iodine is more effective against the pathogen than chlorine <sup>(73)</sup>.

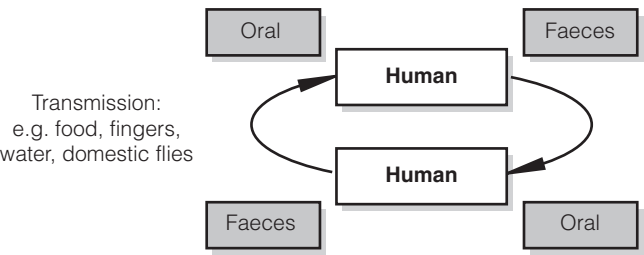
**Epidemic measures** : the source of infection should be identified, and dealt with <sup>(3)</sup>

**Giardia enteritis, Giardiasis**

A common diarrhoeal infection.

- Pathogen** : *Giardia lamblia* <sup>(15)</sup> (Protozoon)  
*Giardia* exists in the form of infective, resistant cysts (the form which transmits the infection), and parasitic trophozoites (the form which causes the disease) <sup>(4)</sup>
- Distribution** : the infection occurs worldwide <sup>(3)</sup>
- Symptoms** : 25 to 50% of the persons infected with *Giardia* will develop a symptomatic infection <sup>(44)</sup>. Symptoms are chronic diarrhoea, flatulence, and abdominal cramps <sup>(3)</sup>. Where giardiasis is endemic, the disease will be most common in infants and young children <sup>(16)</sup>, and adults will rarely have symptomatic infections <sup>(2)</sup>
- Severity** : the infection can be severe, though this is uncommon <sup>(2)</sup>
- Incubation period** : 5 to 20 days <sup>(73)</sup>
- Duration** : normally symptoms will last for up to some months; then the infected person will become an asymptomatic carrier <sup>(2)</sup>
- Communicability** : as long as the infection lasts transmission can occur, this will usually be for months <sup>(3)</sup>

**Transmission cycle** <sup>(3)</sup>



- Transmission** : faecal-oral. Transmission seems to occur mainly through hand to mouth contact <sup>(3)</sup>. Water-borne and food-borne transmission do take place, but are probably less common than transmission through contaminated hands <sup>(16)</sup>. Still, water-borne outbreaks have occurred where people have used contaminated water supplies <sup>(2)</sup>; and small food-borne outbreaks have happened <sup>(3)</sup>.  
The infective dose is 10 to 100 cysts <sup>(16)</sup>
- Reservoir** : the main reservoirs are humans and contaminated surface water <sup>(16)</sup>. An animal reservoir seems to exist <sup>(3)</sup>, but its role in human infections is not clear <sup>(16)</sup>. The cysts of *Giardia* are resistant, and in cold water they can remain viable for months <sup>(44)</sup>
- Vector/int. host** : none
- Water-related** : water-washed and water-borne <sup>(15)</sup>
- Excreta-related** : faecal-oral <sup>(44)</sup>
- Environment** : a common infection where sanitation is poor <sup>(2)</sup>, personal hygiene is inadequate, and the quality of drinking water is poor <sup>(16)</sup>
- Risk in disaster** : the infection will normally not be a risk <sup>(3)</sup>

## CONTROLLING AND PREVENTING DISEASE

**Remarks** : Where *Giardia* is highly endemic most infections are asymptomatic. In developing countries 20 to 30% of the population may be infected <sup>(3)</sup>

Preventative measures	Potential effect
Improving the quality of drinking water	(++) <sup>(2)</sup>
Improve water availability	(++) <sup>(29)</sup>
Improving handwashing practise	
Improvement of sanitation	(+) <sup>(73)</sup>
Improving food hygiene	(+) <sup>(73)</sup>
Health and hygiene promotion <sup>(3)</sup>	

Normal chlorination of drinking water is not effective against giardia cysts <sup>(73)</sup>.

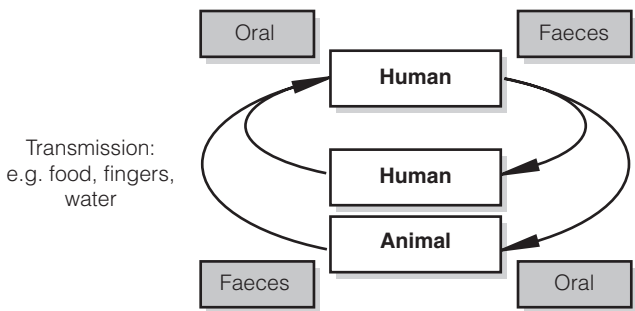
**Epidemic measures** : if clustered cases occur, the source of infection should be determined and dealt with <sup>(3)</sup>

Cryptosporidiosis

A diarrhoeal disease which is common in developing countries.

- Pathogen** : *Cryptosporidium parvum* <sup>(3)</sup> (protozoon).  
The two forms of *Cryptosporidium* are infective cysts which are passed in stools, and the parasitic sporozoites <sup>(4)</sup>
- Distribution** : the infection occurs worldwide <sup>(15)</sup>
- Symptoms** : asymptomatic infections are common. Symptoms are (often watery) diarrhoea, abdominal pain with cramps, and sometimes fever and vomiting. The disease is most common in children under 2 years of age <sup>(3)</sup>
- Severity** : usually not severe, though the disease can lead to death in imunodeficient persons <sup>(3)</sup>
- Incubation period** : 1 to 12 days, usually one week <sup>(73)</sup>
- Duration** : repeating attacks over a maximum of one month in otherwise healthy persons <sup>(54)</sup>
- Communicability** : the period of communicability can be up to 6 months <sup>(73)</sup>

Transmission cycle <sup>(3)</sup>



- Transmission** : the transmission is faecal-oral: person to person, animal to person, water-borne, or food-borne. Asymptomatic persons are a source of transmission of the pathogen <sup>(3)</sup>. Outbreaks have occurred where the supply of drinking water has been contaminated <sup>(16)</sup>.  
The infective dose is very low <sup>(73)</sup>
- Reservoir** : reservoirs are humans, cattle, sheep, dogs, cats, poultry, fish and reptiles <sup>(73)</sup>.  
The cysts of *Cryptosporidium* are very resistant. In a moist environment they can remain infective for up to 6 months <sup>(3)</sup>
- Vector/int. host** : none
- Water-related** : the infection is water-washed and water-borne <sup>(3)</sup>
- Excreta-related** : faecal-oral <sup>(73)</sup>
- Environment** : the infection can mainly be found in conditions of poor personal hygiene and poor quality of drinking water <sup>(73)</sup>. Persons working closely with animals are especially at risk. The infection is common where people are institutionalised <sup>(3)</sup>
- Risk in disaster** : normally not a problem <sup>(3)</sup>

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**Remarks** : In developing countries the infection can be responsible for 4 to 17% of the cases of childhood diarrhoea <sup>(16)</sup>, and the pathogen may be found in the stools of in 3 to 20% of the population <sup>(3)</sup>

Preventative measures	Potential effect
Improving the quality of drinking water <sup>(73)</sup>	
Improving water availability	
Improving handwashing practise <sup>(3)</sup>	
Improvement of sanitation (human and animal) <sup>(3)</sup>	
Improving food hygiene	
Care in contact with domestic animals <sup>(73)</sup>	
Health and hygiene promotion <sup>(3)</sup>	

Persons with an infection should not handle food, or work with institutionalised people. Chlorination of drinking water will not kill the pathogen <sup>(3)</sup>.

**Epidemic measures** : if cases occur in clusters, the source of infection should be determined, and eliminated <sup>(3)</sup>

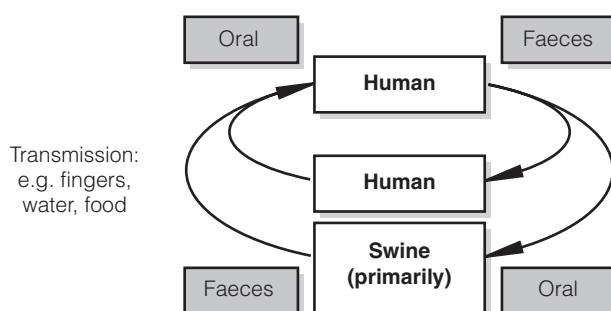


## ***Dysentery (Balantidial), Balantidiasis***

A relatively rare diarrhoeal disease. The source of human infection is usually pigs.

<b>Pathogen</b>	: <i>Balantidium coli</i> <sup>(15)</sup> (Protozoon)
<b>Distribution</b>	: the distribution is worldwide <sup>(15)</sup>
<b>Symptoms</b>	: up to 80% of the infections are believed to be asymptomatic <sup>(16)</sup> . Typical symptoms are diarrhoea (with or without blood), nausea, and vomiting <sup>(3)</sup>
<b>Severity</b>	: the infection can be life-threatening in a weak person <sup>(3)</sup> if not treated <sup>(16)</sup>
<b>Incubation period</b>	: days <sup>(73)</sup>
<b>Duration</b>	: -
<b>Communicability</b>	: the period of communicability lasts the entire period of infection <sup>(3)</sup>

### **Transmission cycle <sup>(3)</sup>**



<b>Transmission</b>	: transmission is faecal-oral. Pigs seem to be the main source of infection <sup>(2)</sup> . Single cases occur through hand to mouth contact, or through ingestion of contaminated water or food. Outbreaks are often water-borne <sup>(3)</sup> . The infective dose is low <sup>(15)</sup>
<b>Reservoir</b>	: the main reservoir transmitting the disease to people are pigs. Other reservoirs are humans, rodents <sup>(2)</sup> and primates <sup>(3)</sup> . Cysts of <i>B.coli</i> are rapidly destroyed in hot and dry conditions but can survive for several weeks in a moist environment <sup>(16)</sup>
<b>Vector/int. host</b>	: none
<b>Water-related</b>	: water-washed and water-borne <sup>(15)</sup>
<b>Excreta-related</b>	: faecal-oral <sup>(15)</sup>
<b>Environment</b>	: an environment with close contact between pigs and humans <sup>(16)</sup> . Use of poor quality drinking water; where personal hygiene is poor and sanitation inadequate <sup>(3)</sup>
<b>Risk in disaster</b>	: the infection does not pose a large risk <sup>(3)</sup>
<b>Remarks</b>	: the disease is relatively rare in humans <sup>(3)</sup> . In some places 40 to 90% of the pigs are thought to be carriers of the pathogen <sup>(16)</sup>

## CONTROLLING AND PREVENTING DISEASE

Preventative measures	Potential effect
Improving the quality of drinking water <sup>(3)</sup>	
Improving water availability	
Improving handwashing practise <sup>(3)</sup>	
Improvement of sanitation (human and swine faeces) <sup>(2)</sup>	
Improving food hygiene <sup>(3)</sup>	
Care in contact with pigs <sup>(16)</sup>	
health and hygiene promotion <sup>(3)</sup>	
Chlorination of drinking water is not effective in killing the cysts of <i>B.coli</i> <sup>(3)</sup>	

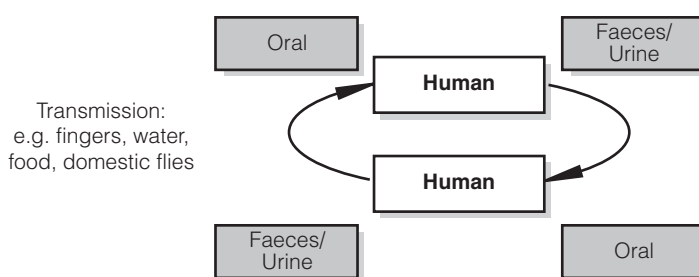
**Epidemic measures :** if a group of infections appears, the source of infection should be looked for and eliminated <sup>(3)</sup>

## ***Typhoid, Enteric fever, Typhoid fever/Paratyphoid, Paratyphoid fever***

Faecal-oral diseases that cause sustained fever. Typhoid is more severe and more easily transmitted than paratyphoid. (Small) outbreaks can occur. Permanent carriers do exist and play an important role in transmission.

<b>Pathogen</b>	: typhoid: <i>Salmonella typhi</i> paratyphoid: <i>Salmonella paratyphi</i> <sup>(3)</sup> (Bacteria)
<b>Distribution</b>	: typhoid and paratyphoid have a worldwide distribution <sup>(15)</sup>
<b>Symptoms</b>	: mild infections are frequent. Typical symptoms are: sustained fever, headache, enlarged spleen, malaise, sometimes a rash, disorientation, and loss of appetite. In adults constipation is more common than diarrhoea <sup>(3)</sup> . Typhoid can produce stools with blood <sup>(4)</sup> . In endemic areas typhoid is most common in the age-group 5-19 years <sup>(3)</sup>
<b>Severity</b>	: before antibiotics, the mortality rate of typhoid was over 10%. If the infection is treated adequately, mortality rates should be under 1% <sup>(4)</sup> . Paratyphoid is milder than typhoid, and has a much lower fatality rate <sup>(3)</sup>
<b>Incubation period</b>	: for typhoid: 1 to 3 weeks, though it can be up to 3 months. The time depends on the number of pathogens that cause infection <sup>(3)</sup> . For paratyphoid: 1 to 10 days <sup>(73)</sup>
<b>Duration</b>	: typhoid: usually around 3 weeks. Relapses occur in 5 to 10% of the untreated cases, and may be up to 20% in treated cases <sup>(3)</sup> . Paratyphoid: up to 3 weeks or longer <sup>(2)</sup> relapses do occur in around 3 to 4% of the cases <sup>(3)</sup>
<b>Communicability</b>	: Typhoid: 2 to 5 % of the untreated cases will turn into chronic carriers <sup>(3)</sup> (who do not necessarily have a history of being sick <sup>(4)</sup> ). Permanent carriers in paratyphoid exist, but are less common than in typhoid fever <sup>(3)</sup> . Urinary carriers excreting pathogens after the third month of infection are rare, except in persons with urinary schistosomiasis <sup>(16)</sup>

### **Transmission cycle <sup>(3)</sup>**



<b>Transmission</b>	: transmission occurs through ingestion of food or water contaminated with faeces or urine of a patient or carrier <sup>(16)</sup> . Carriers play an important role in the transmission of the infections <sup>(73)</sup> . If <i>S.typhi</i> or <i>S.paratyphi</i> contaminate food, for example through domestic flies, or dirty hands, they can multiply <sup>(73)</sup> . Where human excreta is used as fertiliser, raw fruit and vegetables are important vehicles of transmission. Shellfish from coastal waters polluted by sewage can be a danger <sup>(16)</sup> . Typhoid has a much lower infective dose than
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## CONTROLLING AND PREVENTING DISEASE

paratyphoid <sup>(3)</sup> (the infective dose of typhoid is  $10^3$  to  $10^9$  bacteria <sup>(73)</sup>). The higher the ingested dose of bacteria is, the higher the attack rate will be <sup>(2)</sup>. While typhoid is more frequently transmitted by water than by food <sup>(4)</sup>, paratyphoid is less often water-borne as it has a high infective dose <sup>(16)</sup>. In an outbreak of typhoid fever the number of cases can be expected to double every 2 weeks <sup>(47)</sup>.

- Reservoir** : humans are the only reservoir for typhoid, and the normal reservoir for paratyphoid. Domestic animals can be a sporadic reservoir for paratyphoid <sup>(3)</sup>.
- In fresh water *S.typhi* can survive for up to 4 weeks, in raw sewage possibly for over 5 weeks <sup>(73)</sup>. *S.typhi* can survive in sea water, which makes seafood dangerous <sup>(4)</sup>.
- Vector/int. host** : domestic flies can be mechanical vectors <sup>(3)</sup>
- Water-related** : both infections are water-washed and water-borne <sup>(15)</sup>
- Excreta-related** : faecal/urinary-oral <sup>(73)</sup>
- Environment** : an environment with poor personal hygiene, inadequate sanitation <sup>(2)</sup>, poor quality of drinking water, and inadequate food hygiene <sup>(45)</sup>
- Risk in disaster** : large outbreaks are unusual, but smaller outbreaks or single cases can appear over longer periods <sup>(47)</sup>. The infections can be a problem where sanitation is inadequate, and the quality of water poor <sup>(3)</sup>. Typhoid is often a problem after disasters involving flooding <sup>(74)</sup>
- Remarks** : every year roughly 17,000,000 cases of typhoid occur worldwide, of whom around 600,000 will die <sup>(3)</sup>

Preventative measures	Potential effect
Improving the quality of drinking water	(+ + +) <sup>(29)</sup>
Improving water availability	(+ + +)
Improving handwashing practise	(+ + +) <sup>(73)</sup>
Improvement of sanitation	(+ +) <sup>(73)</sup>
Improving food hygiene (especially dairy products and shellfish)	(+ +) <sup>(73)</sup>
Control of food, and persons who handle food <sup>(73)</sup>	
Control of domestic flies <sup>(73)</sup> (see Annexe 3)	
Health and hygiene promotion <sup>(73)</sup>	

Carriers should not handle food or work with institutionalised persons <sup>(3)</sup>. Fingernails should be kept short and clean <sup>(73)</sup>. Pasteurisation of milk at 60°C is effective in killing typhoid bacteria <sup>(73)</sup>.

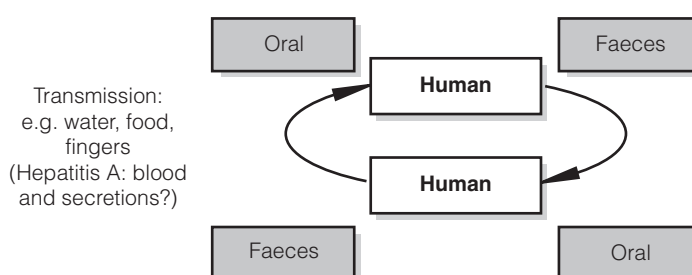
**Epidemic measures** : the ultimate source of infection is always a person <sup>(16)</sup>. If possible this source of infection should be identified and dealt with. Food believed to play a role in transmission should be avoided. Water used for drinking should be chlorinated <sup>(3)</sup>

## ***Hepatitis A, Infectious hepatitis or Jaundice/Hepatitis E, Non-A non-B hepatitis***

Faecal-oral diseases with fever and jaundice. Hepatitis E occurs mainly in outbreaks, and is very dangerous to pregnant woman.

<b>Pathogen</b>	: Hepatitis A virus Hepatitis E virus (viruses)
<b>Distribution</b>	: both diseases have a worldwide distribution <sup>(15,3)</sup>
<b>Symptoms</b>	: many asymptomatic infections occur <sup>(73)</sup> . Typical symptoms are fever, loss of appetite, jaundice <sup>(3)</sup> (yellowing of skin or whites of the eyes <sup>(45)</sup> ), and depression <sup>(3)</sup>
<b>Severity</b>	: the severity of the illness can range from mild to severely disabling for months. The average case fatality rate in both diseases is normally less than 1 per 1,000 cases. The diseases become more dangerous with age: persons over 50 have a case fatality rate of 27 per 1000. A particularity of hepatitis E is that it is very dangerous to pregnant women, in whom a case fatality rate of up to 20% may occur <sup>(3)</sup>
<b>Incubation period</b>	: the incubation period for hepatitis A is 15 to 50 days <sup>(73)</sup> ; for hepatitis E the incubation period is 15 to 64 days <sup>(3)</sup>
<b>Duration</b>	: the duration of the diseases range from one week to several months <sup>(3)</sup>
<b>Communicability</b>	: the period of communicability for hepatitis A is usually up to the first week of onset of jaundice. The period of communicability for hepatitis E is not known <sup>(3)</sup>

### **Transmission cycle <sup>(3)</sup>**



<b>Transmission</b>	: transmission occurs through the ingestion of contaminated water or food <sup>(73)</sup> . Transmission from person to person is possible <sup>(4)</sup> . Faeces of people in the incubation period of hepatitis A contain very large numbers of viruses <sup>(16)</sup> . Outbreaks of hepatitis A are uncommon as people are normally infected at an early age and develop immunity <sup>(73)</sup> . The risk of an outbreak increases though if part of the population is not immune because of improved sanitation and personal hygiene <sup>(3)</sup> . The carrier state in hepatitis A is not important. Salads, cold meat and raw seafood are often implied in the transmission of hepatitis A <sup>(73)</sup> . Hepatitis A can possibly be transmitted through blood and secretions <sup>(4)</sup> . Hepatitis E occurs mainly in outbreaks <sup>(73)</sup> , with the highest attack rates in young adults. Outbreaks of hepatitis E are often caused by water-borne transmission <sup>(3)</sup> . The infective doses for the infections are high <sup>(73)</sup>
<b>Reservoir</b>	: humans are the main reservoir for the hepatitis A virus. In exceptional cases

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	primates can be a reservoir. The reservoirs for the hepatitis E virus are not known, and animal reservoirs are possible. The virus can be transmitted to certain primates and pigs <sup>(3)</sup>
<b>Vector/int. host</b>	: none
<b>Water-related</b>	: the infections are water-washed and water-borne <sup>(15)</sup>
<b>Excreta-related</b>	: faecal-oral
<b>Environment</b>	: the diseases occur where people have poor personal hygiene, inadequate sanitation, live under crowded conditions, and have drinking water of poor quality <sup>(3)</sup>
<b>Risk in disaster</b>	: a potential problem where crowding, poor sanitation and poor water supply occur <sup>(3)</sup> . Hepatitis E will probably pose the largest risk.
<b>Remarks</b>	: people who have been infected with hepatitis A are probably immune for life <sup>(3)</sup> , though there are indications that people can be re-infected if they ingest a large quantity of pathogens <sup>(73)</sup> .

Preventative measures	Potential effect
Improving the quality of drinking water <sup>(73)</sup>	
Improving water availability	(+) <sup>(29)</sup>
Improving handwashing practise <sup>(73)</sup>	
Improvement of sanitation	(+) <sup>(73)</sup>
Improving food hygiene	(+) <sup>(73)</sup>
Health and hygiene promotion <sup>(3)</sup>	

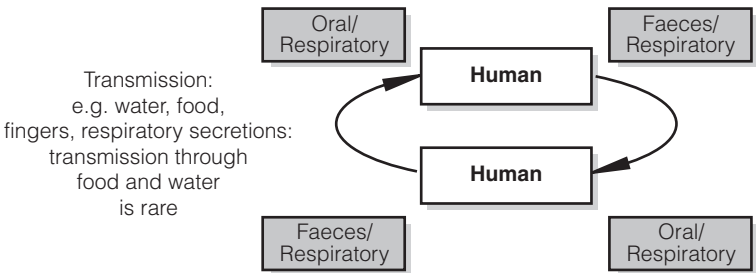
**Epidemic measures :** the source of infection should be determined and dealt with. Personal hygiene, sanitation and the quality of the drinking water should be brought up to standard <sup>(3)</sup>

**Polio, Acute poliomyelitis**

A highly contagious faecal-oral disease. The infection has disappeared from most parts of the world. A typical symptom which appears in a small number of infected persons is lasting paralysis.

- Pathogen** : Poliovirus <sup>(15)</sup> (virus)
- Distribution** : until recently the infection was endemic worldwide <sup>(16)</sup>. It has disappeared from most areas as a result of immunisation campaigns. The infection is still a problem in certain African and Asian countries <sup>(3)</sup>
- Symptoms** : the majority of the infections are asymptomatic or just a mild illness. Symptoms are fever, general malaise, and headache. Paralysis only occurs in some of the cases <sup>(73)</sup>
- Severity** : if infection takes place at a young age, about 1% of the cases will develop some form of paralysis. The risk of paralysis becomes larger with an increasing age of the infected person <sup>(73)</sup>
- Incubation period** : 5 to 30 days <sup>(73)</sup>
- Duration** : the illness lasts from some days to months. The paralysis is permanent <sup>(44)</sup>
- Communicability** : probably up to 6 weeks, though longer is possible <sup>(3)</sup>

**Transmission cycle <sup>(3)</sup>**



- Transmission** : poliomyelitis is a very contagious infection <sup>(4)</sup>, and is mainly spread by direct person to person contact. Respiratory transmission is possible, and can be important if sanitation is adequate <sup>(3)</sup> or during outbreaks <sup>(47)</sup>. It is rare that food or water are associated with transmission <sup>(3)</sup>. Transmission of poliomyelitis will stop in a population when 80 to 85% of the people have been immunised successfully <sup>(50)</sup>.  
The infective dose of the infection is low <sup>(15)</sup>
- Reservoir** : human <sup>(3)</sup>
- Vector/int. host** : none
- Water-related** : water-washed and sporadically water-borne <sup>(15)</sup>
- Excreta-related** : faecal-oral
- Environment** : the disease is linked to poor personal hygiene <sup>(73)</sup>. In the tropics a small seasonal increase in cases can be expected in the hot and rainy season. Outbreaks can occur in regions where people have a low immunity to the infection (either because they have not been immunised, or because the infection is not endemic) <sup>(3)</sup>.
- Risk in disaster** : a potential problem where crowding, poor sanitation, and poor personal hygiene are found in a non-immune population <sup>(3, 73)</sup>

## CONTROLLING AND PREVENTING DISEASE

**Remarks** : to prevent epidemic poliomyelitis, improved sanitation should be accompanied by good immunisation coverage; otherwise there is a risk of creating a non-immune population in which an epidemic could develop <sup>(73)</sup>

Preventative measures	Potential effect
Improving water availability	(+) <sup>(29)</sup>
Improving handwashing practise	
Improvement of sanitation (after immunisation of the population) <sup>(73)</sup>	
Improved food hygiene	(+) <sup>(73)</sup>
Mass immunisation (vaccination)	(+++) <sup>(3)</sup>
Health and hygiene promotion <sup>(3)</sup>	

**Epidemic measures** : mass immunisation (vaccination) <sup>(3)</sup>

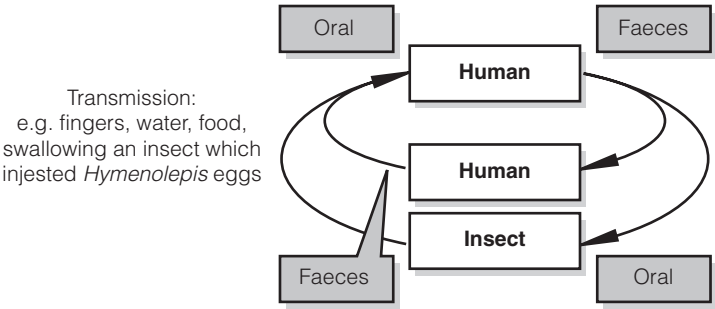


**Tapeworm (dwarf), *Hymenolepis***

A usually asymptomatic faecal-oral disease.

- Pathogen** : *Hymenolepis nana* <sup>(15)</sup> (Helminth).  
*Hymenolepis* is a tapeworm. The adult worm is roughly 40 mm long and lives in the human intestine <sup>(44)</sup>
- Distribution** : the infection occurs worldwide <sup>(15)</sup>
- Symptoms** : the infection is usually asymptomatic. Heavy infections can cause abdominal pains, occasionally with diarrhoea <sup>(3)</sup>
- Severity** : the infection is mild <sup>(3)</sup>
- Incubation period** : the incubation period is variable <sup>(3)</sup>
- Duration** : the infection can last for several years <sup>(3)</sup>
- Communicability** : communicability can be years <sup>(3)</sup>

**Transmission cycle** <sup>(3)</sup>



- Transmission** : faecal-oral. The eggs are often directly infective when excreted. Transmission is water-borne, food-borne, or hand to mouth <sup>(3)</sup>. Insects (e.g. fleas <sup>(45)</sup>) which ingested eggs of *Hymenolepis* can transmit the pathogen when swallowed <sup>(3)</sup>
- Reservoir** : humans, mice could play a role as a reservoir, insects <sup>(3)</sup>
- Vector/int. host** : contaminated insects could transmit the pathogen if ingested <sup>(3)</sup>
- Water-related** : water-washed and water-borne <sup>(15)</sup>
- Excreta-related** : faecal-oral <sup>(15)</sup>
- Environment** : more common in warm and dry climates <sup>(3)</sup>
- Risk in disaster** : the infection is not a risk in a disaster <sup>(3)</sup>
- Remarks** : -

## CONTROLLING AND PREVENTING DISEASE

Preventative measures	Potential effect
Improving the quality of drinking water <sup>(3)</sup>	
Improving water availability	(+) <sup>(29)</sup>
Improving handwashing practise <sup>(3)</sup>	
Improvement of sanitation	(+) <sup>(73)</sup>
Improving of food hygiene	(+) <sup>(73)</sup>
Control of rodents <sup>(3)</sup>	
Health and hygiene promotion <sup>(3)</sup>	

**Epidemic measures :** -

## ***Pinworm infection, Enterobiasis, Oxyuriasis***

An 'anal-oral' infection with mild symptoms.

<b>Pathogen</b>	: <i>Enterobius vermicularis</i> <sup>(15)</sup> (Helminth)
<b>Gen. description</b>	: enterobiasis is caused by a thin, white worm with a length of about 10 mm <sup>(74)</sup> . The infection is common and occurs worldwide. It is often asymptomatic. Symptoms are anal itching and irritability. The infection is mild <sup>(3)</sup> . Infection occurs mainly in children <sup>(4)</sup> and under crowded conditions <sup>(16)</sup>
<b>Transmission</b>	: the eggs are not excreted through faeces. The female worm leaves the body through the anus to deposit her eggs outside the body <sup>(73)</sup> . The eggs become infective within a few hours <sup>(3)</sup> . The activity of the female worm causes an itch. When the infected person scratches, the eggs are picked up by the fingers <sup>(73)</sup> . Transmission is hand to mouth. Anything that becomes contaminated (clothing, bedding, food) can transmit the pathogen. Airborne transmission is possible <sup>(3)</sup>
<b>Reservoir</b>	: humans are the only host. Eggs can survive for up to 2 weeks outside the host <sup>(3)</sup>
<b>Water-related</b>	: the infection is water-washed <sup>(73)</sup>

<b>Preventative measures</b>	<b>Potential effect</b>
Improving water availability	(+) <sup>(29)</sup>
Improving handwashing practise <sup>(73)</sup>	
Washing of clothing and bedding <sup>(73)</sup>	
Improvement of cleanliness of sanitation <sup>(3)</sup>	
Health and hygiene promotion <sup>(3)</sup>	

Long fingernails can more easily gather eggs and should therefore be kept short <sup>(3)</sup>

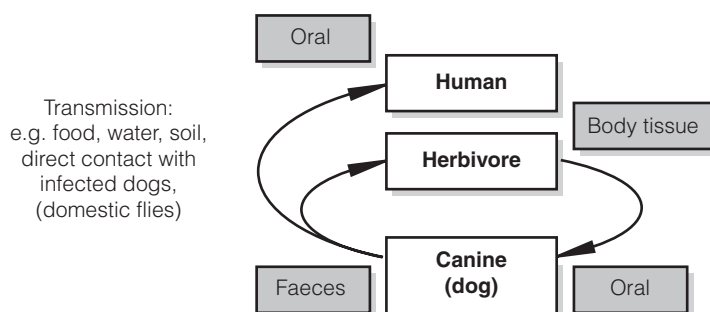
**Epidemic measures** : systematic treatment of cases, their family, and other contacts <sup>(3)</sup>

## ***Hydatid (cystic) disease, Unilocular echinococcosis***

The source of this potentially severe infection is dog faeces (or faeces of other canines). Transmission of the disease is faecal dog – human oral.

<b>Pathogen</b>	: <i>Echinococcus granulosus</i> <sup>(3)</sup> (Helminth) <sup>(73)</sup> . The 3 to 6 mm long tapeworms live in the small intestine of the dog <sup>(2)</sup> . People are infected by the infective embryos of the worm which can form cysts in the human body <sup>(3)</sup> .
<b>Distribution</b>	: the infection occurs worldwide <sup>(3)</sup>
<b>Symptoms</b>	: cysts form in the body. The cysts are usually 1 to 7cm in diameter <sup>(3)</sup> , but larger cysts are possible. The symptoms will vary with the organs affected <sup>(44)</sup> , and the size and numbers of cysts. Symptoms are similar to those of a slow growing tumour <sup>(3)</sup> . 66% Of the cysts are formed in the liver, 10% in the lungs, 7% in the brain, other organs may be affected <sup>(73)</sup>
<b>Severity</b>	: the infection is severe and can be fatal <sup>(2)</sup>
<b>Incubation period</b>	: from 12 months <sup>(3)</sup> up to 20 years <sup>(44)</sup>
<b>Duration</b>	: prolonged
<b>Communicability</b>	: the infection in a dog lasts for around 6 months, but tapeworms may survive for up to 3 years <sup>(3)</sup>

### **Transmission cycle <sup>(3)</sup>**



<b>Transmission</b>	: dogs or wild canines excrete infective eggs. The normal transmission cycle involves herbivores (e.g. sheep, cattle) who ingest the eggs, and develop cysts in their body. When the herbivores are eaten by dogs, the tapeworms will develop in the intestines of the dog, completing the transmission cycle <sup>(2)</sup> .  The eggs excreted by dogs and canines can cause an infection in humans which is similar to the infection in herbivores. People can be infected by the eggs through food, drinking water <sup>(73)</sup> , soil, or any other object contaminated by dog faeces <sup>(3)</sup> . Transmission is possible through direct close contact with dogs (through touching their fur, or being licked) <sup>(73)</sup> . Occasionally domestic flies have transmitted the pathogen <sup>(3)</sup>
<b>Reservoir</b>	: the reservoirs of the adult worm are canines: dogs, jackals, and wolves <sup>(73)</sup> . The infective eggs can survive for several months in the environment <sup>(3)</sup>

## ANNEXE 1: LISTING OF DISEASES

<b>Vector/int. host</b>	: the normal intermediate hosts are sheep, pigs, goats, cattle, camels, horses and other herbivorous animals <sup>(73)</sup> . Humans function as an intermediate host, but are a dead end in the transmission cycle
<b>Water-related</b>	: water-washed <sup>(3)</sup> and water-borne <sup>(73)</sup>
<b>Excreta-related</b>	: the pathogen leaves canines (dogs) through their faeces <sup>(73)</sup> . The infection is canine faecal - human oral
<b>Environment</b>	: the infection occurs mainly where sheep and cattle are reared <sup>(2)</sup> and people and dogs live in close association <sup>(73)</sup>
<b>Risk in disaster</b>	: the infection is not a priority in disasters <sup>(3)</sup>
<b>Remarks</b>	: the pathogen is common in the Turkana region in Kenya <sup>(73)</sup>

Preventative measures	Potential effect
Improving water availability	(+ +) <sup>(29)</sup>
Improving handwashing practise <sup>(3)</sup>	
Dogs should be controlled (wild and stray dogs should be eliminated, domestic dogs at risk should regularly be treated against worms, dogs should not be fed potentially infective body parts of herbivores) <sup>(3)</sup>	
Dogs should be kept away from potentially infective carcasses <sup>(3)</sup>	
Dogs should be kept away from water sources and food gardens <sup>(73)</sup>	
Health and hygiene promotion <sup>(3)</sup>	

**Epidemic measures :** control of dogs (elimination of wild and stray dogs and treatment of domestic dogs), slaughtering of reservoir animals should be controlled so that dogs have no access to any parts of the carcass <sup>(3)</sup>.

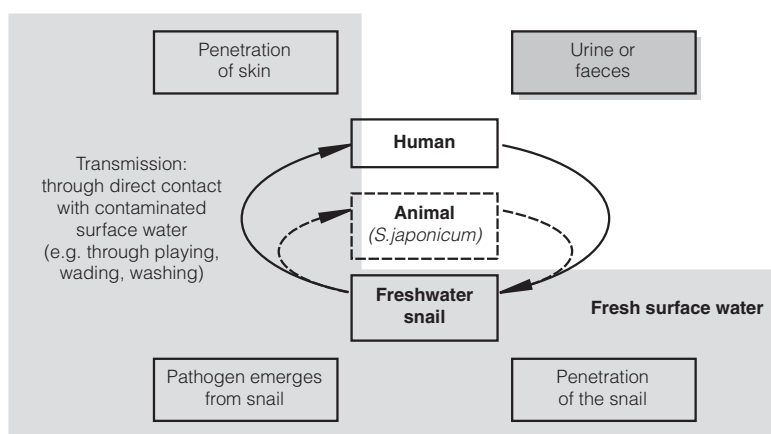
## Schistosomiasis, Bilharziasis

A very common infection affecting around 200,000,000 people worldwide. The infection is associated with engineering schemes like irrigation systems and artificial lakes.

<b>Pathogen</b>	<p>: <i>Schistosoma</i> spp. (Helminth)</p> <p>The blood flukes causing this infection are 10 to 20 mm long. Male and female fluke live in association, 'coupled together' <sup>(2)</sup>.</p> <p>Several species infect humans:</p> <p><i>Schistosoma haematobium</i> (which causes urinary schistosomiasis), the adult flukes live in veins surrounding the bladder.</p> <p><i>Schistosoma mansoni</i>, <i>S.japonicum</i> and other <i>Schistosoma</i>, whose adult flukes live in veins in the intestines <sup>(3)</sup></p>
<b>Distribution</b>	<p>: <i>S.haematobium</i>: is found in Africa and the Middle-east</p> <p><i>S.mansoni</i>: occurs in Africa, the Middle East and the north-eastern part of South America</p> <p><i>S.japonicum</i>: is limited to China, Taiwan, the Philippines, Indonesia and Celebes</p> <p>Other <i>Schistosoma</i>: are found in South-east Asia and Africa <sup>(3)</sup></p>
<b>Symptoms</b>	<p>: many infections are asymptomatic, and symptoms are often ignored by people <sup>(16)</sup>. The main health problems from schistosomiasis are caused by the eggs produced by the flukes. If these eggs become trapped (over 50% are) <sup>(73)</sup>, they can cause small scars in tissue <sup>(2)</sup>. The symptoms of the infection are linked to the number and the location of the trapped eggs. The main symptoms are:</p> <p><i>S.haematobium</i>: urinary problems including blood in urine, painful urination <sup>(3)</sup>, and reduced bladder capacity <sup>(2)</sup>.</p> <p>Other <i>Schistosoma</i>: intestinal problems including diarrhoea, enlarged liver and spleen, and intestinal pain <sup>(3)</sup>.</p> <p>Occurrence in age-groups: <i>S.haematobium</i> is most common in 10 to 14 year olds; <i>S.mansoni</i> has a peak prevalence at 10 to 24 years; and <i>S.japonicum</i> does not seem to have a typical age-distribution <sup>(16)</sup></p>
<b>Severity</b>	<p>: the severity of the infection is usually related to the number of flukes causing the infection <sup>(16)</sup>. <i>S.japonicum</i> is in general more severe than the other <i>Schistosoma</i> <sup>(73)</sup>. In the majority of cases the infection is not severe, but (fatal) complications do occur <sup>(2)</sup></p>
<b>Incubation period</b>	<p>: the incubation period is variable <sup>(73)</sup></p>
<b>Duration</b>	<p>: the flukes normally live for 3 to 5 years, but some survive for up to 30 years <sup>(2)</sup>. Reinfection will often occur though</p>
<b>Communicability</b>	<p>: people with infections can release eggs (infective to snails) for over 10 years, or the time the infection lasts. Snails remain infected for life and can release infective cercariae for up to 3 months <sup>(3)</sup></p>

## ANNEXE 1: LISTING OF DISEASES

### Transmission cycle <sup>(73)</sup>



### Transmission

- : The eggs of persons infected with *S. haematobium* leave the body through urine. The eggs of the other *Schistosoma* leave the body through faeces <sup>(73)</sup>. In fresh water, the eggs can turn into miracidia, which can infect specific freshwater snails that serve as intermediate hosts. In the snails the miracidia will multiply, and turn into cercariae (this process takes a few weeks) <sup>(2)</sup>. One single miracidium can multiply into many thousands of cercariae <sup>(16)</sup>. The cercariae emerge from the infected snails; *S. haematobium* and *S. mansoni* at mid-day to late afternoon, and *S. japonicum* late in the evening. The longer the period between emergence from the snail and infection of a person, the smaller the chance of successfully infecting a person <sup>(73)</sup>. Cercariae are able to survive for up to 48 hours in water <sup>(16)</sup>. The pathogen needs water temperatures between 10°C and 30°C <sup>(73)</sup>. People are infected when a cercarium penetrates the skin which is in direct contact with infective fresh water <sup>(2)</sup>

### Reservoir

- : *S. haematobium*: humans are the only reservoir.  
*S. mansoni*: humans are the main reservoir, though animal hosts are possible.  
*S. japonicum*: humans are an important reservoir, but in addition animals can serve as a reservoir to the pathogen. Some important reservoirs are dogs, cattle, pigs, rats, and water buffaloes.  
 Children are particularly important as reservoirs as the infection is most common in this age-group and because of their behaviour <sup>(16)</sup>

### Vector/int. host

- : freshwater aquatic snails are the intermediate hosts for schistosomiasis. The genera that act as intermediate host:  
*S. haematobium*: the genus *Bulinus* (preferring still, or very slow moving water).  
*S. mansoni*: most commonly the genus *Biomphalaria* (which can live in slow flowing water, generally occurring in streams and irrigation systems).  
*S. japonicum*: usually the genera *Oncomelania* (an amphibious snail) and *Tricula* <sup>(15)</sup>.  
 Usually only 1 to 2% of the snails are infected. As these snails discharge high numbers of cercariae (up to 3,000 per day), the potential to infect people remains high <sup>(73)</sup>. The snails which transmit *Schistosoma* can survive for up to months outside water, which takes the infection from one wet season to another <sup>(16,73)</sup>. The snails can reproduce themselves very rapidly; one snail can grow out into an infective colony within 60 days <sup>(73)</sup>

## CONTROLLING AND PREVENTING DISEASE

<b>Water-related</b>	: the infection is water-based. The pathogen penetrates the skin in contact with contaminated fresh surface water <sup>(15)</sup>
<b>Excreta-related</b>	: <i>S.haematobium</i> is excreted by urine. The other <i>Schistosoma</i> are excreted through faeces <sup>(73)</sup>
<b>Environment</b>	: the infection is most common in rural areas of developing countries, but is not limited to this environment <sup>(16)</sup> . As the snails adapt themselves easily, they can be found in a wide variety of water bodies. From lakes and seasonal or temporary ponds, to rice-fields or slow-flowing streams <sup>(73)</sup> . The infection has become a large problem around many man-made structures like artificial lakes and irrigation schemes <sup>(15)</sup>
<b>Risk in disaster</b>	: the infection will not be an urgent problem in an emergency <sup>(47)</sup>
<b>Remarks</b>	: the dynamics of transmission can change rapidly in an endemic area where a water resource development scheme is taking place <sup>(16)</sup> . The distribution of the pathogens in a mass of water is not necessarily regular; while the pathogen may be present in one zone, it may be absent in another. The distribution depending on the presence of snails <sup>(73)</sup> . It is estimated that 200,000,000 persons are infected worldwide <sup>(16)</sup> , and that the infection could cause up to 1,000,000 deaths per year <sup>(59)</sup> . In many regions the occurrence of the infection is on the rise <sup>(15)</sup>

Preventative measures	Potential effect
Reducing water contact (through health and hygiene promotion and water supply)	(+ + +) <sup>(29)</sup>
Improvement of sanitation	(+) <sup>(73)</sup>
Control of freshwater snails (through engineering, biological and chemical measures) <sup>(73)</sup>	
Mass treatment of infections <sup>(73)</sup>	
Health and hygiene promotion <sup>(73)</sup>	

The effect of improving sanitation is often limited as only a few infected persons need to contaminate the surface water to maintain an infected snail population <sup>(73)</sup>.

As the snails can reproduce very quickly, the use of chemical control of snails as only measure will usually not be very effective. It can be effective however where the environment can be controlled, and in combination with treatment of infected persons <sup>(2)</sup>

**Epidemic measures** : mass treatment <sup>(73)</sup>, reducing the contact of the population with contaminated water <sup>(3)</sup>

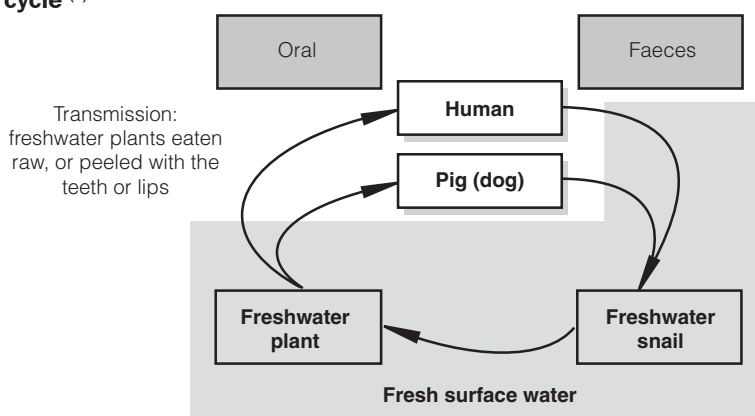


## ***Fasciolopsiasis, Giant intestinal fluke infection***

An infection which has to go through two water-based intermediate hosts: a freshwater snail and a freshwater plant. Reservoirs of the pathogen are pigs and people, who are infected when ingesting the cysts which are found on uncooked freshwater plants.

- Pathogen** : *Fasciolopsis buski* <sup>(15)</sup> (Helminth)  
The fluke causing the infection is up to 7.5 cm long and lives in the upper parts of the small intestine <sup>(2)</sup>
- Distribution** : the infection occurs in the south of China, India, Bangladesh, Thailand, Malaysia, Borneo, Myanmar and Sumatra <sup>(16)</sup>
- Symptoms** : usually the infection is asymptomatic <sup>(16)</sup>. Symptoms are diarrhoea alternated with constipation, and swelling of face or legs. Sometimes flukes are passed in stool or vomit <sup>(3)</sup>. If the infection is heavy (hundreds - thousands of worms), symptoms may be more severe. Children over 5 years of age are most affected <sup>(16)</sup>
- Severity** : in heavy infections the flukes can cause severe health problems <sup>(16)</sup>, and in weakened children the infection may be fatal <sup>(73)</sup>
- Incubation period** : 3 months <sup>(73)</sup>
- Duration** : around 1 year <sup>(3)</sup>
- Communicability** : if untreated, eggs are probably shed for around 1 year <sup>(3)</sup>

### **Transmission cycle <sup>(3)</sup>**



- Transmission** : the eggs of the fluke leave the body through faeces. The eggs will produce miracidia after a development of 3 to 7 weeks in fresh water <sup>(3)</sup>. These miracidia can infect freshwater snails. The pathogens multiply in the snail, and are released as cercaria. The cercaria form cysts on water plants (e.g. water caltrop, water chestnut, water bamboo) <sup>(73)</sup>. If these plants are eaten raw, or peeled with teeth or lips while still raw, the cysts can be ingested, and infection can follow <sup>(3)</sup>
- Reservoir** : reservoirs of the pathogen are pigs, humans, and occasionally dogs <sup>(3)</sup>
- Vector/int. host** : the pathogen has to go through developmental stages in two intermediate hosts. The first is a freshwater snail of the genus *Segmentina*. After a development in the snail the pathogen has to form a cyst on freshwater plants <sup>(73)</sup>

## CONTROLLING AND PREVENTING DISEASE

<b>Water-related</b>	: the intermediate hosts of the pathogen are water-based <sup>(15)</sup>
<b>Excreta-related</b>	: the pathogen leaves the host through faeces <sup>(15)</sup>
<b>Environment</b>	: the infection is most common where human and animal excreta are used to grow freshwater plants <sup>(2)</sup> , and where these plants are eaten raw <sup>(16)</sup> or the raw plants are peeled with the teeth <sup>(73)</sup> . The infection is more common where pigs are kept <sup>(3)</sup>
<b>Risk in disaster</b>	: the infection will not be a problem in case of a disaster <sup>(3)</sup>
<b>Remarks</b>	: where the infection is endemic, it can be expected that around 20% of the population is infected <sup>(16)</sup>

Preventative measures	Potential effect
Improving sanitation	(+) <sup>(73)</sup>
Not using human and pig excreta to enrich ponds from which freshwater plants are harvested <sup>(16)</sup>	
Improve the hygiene in the preparation of freshwater plants (drying or submerging the plants in boiling water will kill the cysts) <sup>(3)</sup>	(+++) <sup>(73)</sup>
Control of pigs. Pigs should be kept away from cultivation ponds <sup>(73)</sup> and should not be fed freshwater plants <sup>(3)</sup>	
Health and hygiene promotion <sup>(3)</sup>	

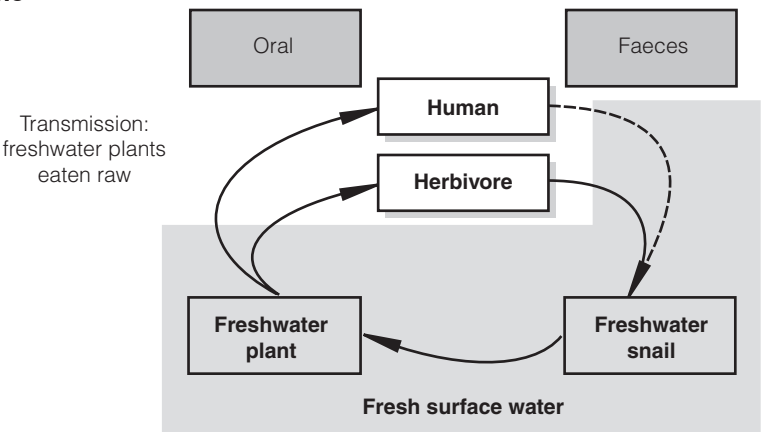
**Epidemic measures :** improve sanitation, identification of plants that play a role in transmission, and health and hygiene promotion <sup>(3)</sup>

**Fascioliasis, Sheep liver fluke infection**

An infection with two water-based intermediate hosts: a freshwater snail and freshwater plant. Infection follows the ingestion of uncooked water plants.

- Pathogen** : *Fasciola hepatica* and *Fasciola gigantica* (helminths)  
*F.gigantica* is less common than *F.hepatica*. The infection is caused by 3 cm long flukes living in the bile ducts <sup>(3)</sup>
- Distribution** : *F.hepatica* occurs in South America, the Caribbean, the Middle East, Asia, Australia and Europe.  
*F.gigantica* is found in Africa, the western parts of the Pacific, and Hawaii <sup>(3)</sup>
- Symptoms** : pain in the liver region, enlargement of the liver, jaundice <sup>(3)</sup>
- Severity** : the infection can cause considerable liver damage <sup>(73)</sup> and serious anaemia <sup>(2)</sup>
- Incubation period** : the incubation period is variable <sup>(3)</sup>
- Duration** : the infection persists <sup>(3)</sup>
- Communicability** : prolonged <sup>(3)</sup>

**Transmission cycle** <sup>(3)</sup>



- Transmission** : the pathogen leaves the body through faeces in the form of eggs. These eggs release miracidia after a development of 2 weeks in fresh water <sup>(3)</sup>. The miracidia infect freshwater snails <sup>(73)</sup>, in which they go through a development, multiply, and form cercariae. These cercariae will attach to freshwater plants and become cysts. Infection follows the ingestion of freshwater plants containing these cysts <sup>(3)</sup>
- Reservoir** : the reservoirs of *F.hepatica* are usually sheep, cattle and goats <sup>(73)</sup>. The reservoirs of *F.gigantica* are cattle, water buffalo, and other large herbivores. People are infected accidentally and do not play an important role as reservoir <sup>(3)</sup>
- Vector/int. host** : the intermediate hosts of the pathogen are freshwater snails (*Lymnaea* spp.) and water-plants living in fresh water <sup>(73)</sup> (e.g. watercress) <sup>(2)</sup>
- Water-related** : the intermediate hosts are water-based <sup>(73)</sup>
- Excreta-related** : the pathogen leaves the host through faeces <sup>(73)</sup>
- Environment** : the infection is more common where sheep or other reservoir animals live in close association with humans <sup>(73)</sup>

## CONTROLLING AND PREVENTING DISEASE

**Risk in disaster** : the infection is not a problem in disasters <sup>(3)</sup>

**Remarks** : -

### Preventative measures

### Potential effect

Care in disposal of faeces of reservoir animals (faeces should not be used to fertilise water plants) <sup>(3)</sup>

If appropriate, control of freshwater snails <sup>(3)</sup>

Care in consumption of water plants (e.g. watercress) <sup>(3)</sup>

Health and hygiene promotion <sup>(3)</sup>

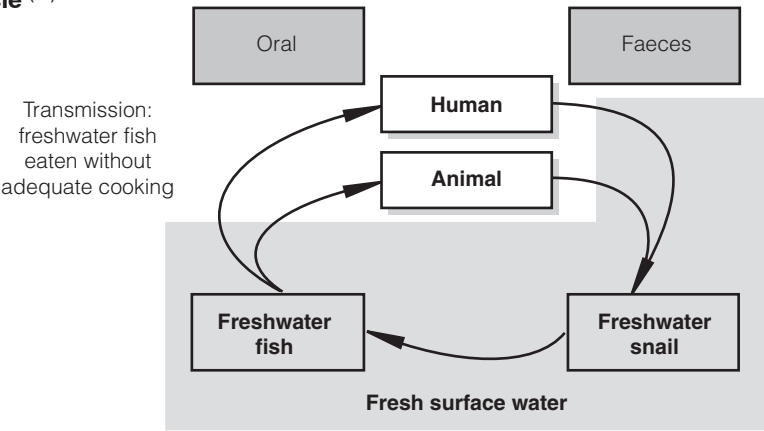
**Epidemic measures** : the source of infection should be determined and dealt with <sup>(3)</sup>

**Clonorchiasis, Chinese liver fluke disease, Oriental liver fluke disease/  
Opisthorchiasis, Cat liver fluke infection**

Two similar infections with two water-based intermediate hosts: freshwater snails and freshwater fish. People are infected by eating poorly cooked fish.

- Pathogen** : Clonorchiasis is caused by *Clonorchis sinensis* (*Opisthorchis sinensis*) <sup>(73)</sup>. The fluke causing infection is 10 to 25 mm long <sup>(2)</sup>.  
Opisthorchiasis is caused by *Opisthorchis felineus* and *Opisthorchis viverrini* <sup>(3)</sup>. These flukes are around 10 mm long.  
The pathogens are helminths which live in the bile passages <sup>(2)</sup>
- Distribution** : *C.sinensis*: can be found in South-east Asia, China, Japan, Taiwan and Korea <sup>(3)</sup>.  
*O.felineus*: occurs in Eastern Europe; mainly Poland and Russia <sup>(2)</sup>.  
*O.viverrini*: is found in South-east Asia, especially in Thailand <sup>(3)</sup>
- Symptoms** : most infections show no specific symptoms <sup>(16)</sup>. Symptoms are diarrhoea, abdominal discomfort, and loss of appetite. In a later stage, liver problems can occur.  
Where *C.sinensis* is endemic, it is most common in adults over 30 years of age <sup>(3)</sup>
- Severity** : the infection is usually mild, but complications are possible <sup>(3)</sup>
- Incubation period** : months <sup>(73)</sup>
- Duration** : the duration of infection of clonorchiasis can be up to 30 years or longer <sup>(3)</sup>
- Communicability** : *Clonorchis* can survive for 20 to 50 years in an infected person. During this time eggs are passed in stools <sup>(4)</sup>

**Transmission cycle <sup>(73)</sup>**



- Transmission** : the infected host sheds the eggs from the pathogen through faeces. When these eggs are ingested by a freshwater snail, the pathogen will multiply in the snail, and cercariae will be released in the water <sup>(3)</sup>. The cercariae will actively seek freshwater fish, and encyst in its flesh or under its scales <sup>(73)</sup>. When people ingest the infective fish raw or undercooked, infection occurs <sup>(16)</sup>. Smoking or pickling the fish will not necessarily kill the pathogen <sup>(73)</sup>
- Reservoir** : the reservoirs of the pathogen are humans, dogs, cats, pigs, rats, and other animals which eat fish <sup>(3)</sup>

## CONTROLLING AND PREVENTING DISEASE

<b>Vector/int. host</b>	: the intermediate hosts are freshwater snails ( <i>Bulimus</i> spp., <i>Bithynia</i> spp. and <i>Parafossarulus</i> spp.) <sup>(73)</sup> and freshwater fish (many species are potential intermediate hosts) <sup>(3)</sup>
<b>Water-related</b>	: the intermediate hosts are water-based <sup>(15)</sup>
<b>Excreta-related</b>	: the pathogen leaves the host through faeces <sup>(73)</sup>
<b>Environment</b>	: where fish is eaten without adequate preparation
<b>Risk in disaster</b>	: the infections are not a problem in disasters <sup>(3)</sup>
<b>Remarks</b>	: an estimated 30,000,000 are infected with <i>C.sinensis</i> <sup>(73)</sup> and over 20,000,000 people are believed to be infected with <i>Opisthorchis</i> <sup>(16)</sup> . In parts of Northern Thailand, over 50% of the population is infected with <i>O. viverrini</i> . Pla ra, fermented fish eaten in Northern Thailand, will not transmit the pathogen <sup>(2)</sup>

Preventative measures	Potential effect
Improving sanitation (if possible human and animal sanitation) <sup>(3)</sup>	(+) <sup>(73)</sup>
Where possible the practise of raising fish in ponds receiving excreta as fertiliser should be prohibited <sup>(3)</sup>	
Improve preparation practices of freshwater fish	(+ + +) <sup>(73)</sup>
Control of domestic animals (reservoir animals should be kept away from fishponds)	
Health and hygiene promotion <sup>(3)</sup>	

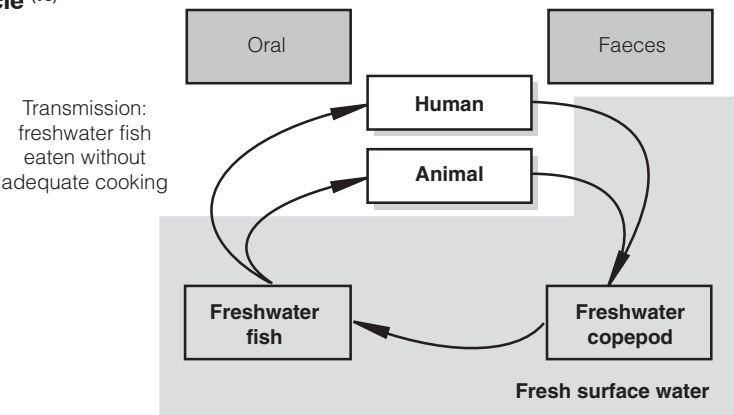
**Epidemic measures :** search for the source of the outbreak, and eliminate it <sup>(3)</sup>

Tapeworm (fish) *Diphyllbothriasis*

A usually mild infection transmitted to humans through poorly prepared freshwater fish.

- Pathogen** : several species of *Diphyllbothrium* <sup>(15)</sup> (Helminth)  
The pathogen is a tapeworm of up to 10 metres long <sup>(44)</sup> living in the intestines <sup>(73)</sup>
- Gen. description** : the infection occurs in sub-arctic, temperate and tropical regions. In general infections are asymptomatic. Persons frequently carry several worms, and occasionally infections of over 100 worms do occur <sup>(16)</sup>. Even though these worms take an important amount of nutrients, the main problem is the absorption of vitamin B<sub>12</sub> by the pathogen <sup>(73)</sup>. In 1 to 2% of the infections this develops into a deficiency of vitamin B<sub>12</sub> <sup>(44)</sup> which can lead to anaemia. The tapeworms can survive for several years <sup>(3)</sup>

Transmission cycle <sup>(73)</sup>



- Transmission** : the pathogen leaves the body through faeces. When the eggs come in contact with water, a coracidium emerges, which is ingested by a copepod. When the copepod is eaten by a fish, the pathogen works its way into the muscles of the fish. Infection of people follows when this fish is eaten without proper cooking <sup>(73)</sup>
- Reservoir** : the most important reservoir of the pathogen are humans <sup>(16)</sup>. Other reservoirs are dogs, cats <sup>(73)</sup>, pigs, other fish-eating mammals <sup>(3)</sup>, and birds <sup>(16)</sup>
- Vector/int. host** : the intermediate hosts are freshwater copepods (species of *Cyclops* and *Diatomus*) and freshwater fish (e.g. pike, salmon, perch, turbot) <sup>(3)</sup>
- Water-related** : the intermediate hosts are water-related <sup>(16)</sup>
- Excreta-related** : the pathogen leaves the host through faeces <sup>(73)</sup>
- Environment** : the infection is generally found in cooler regions, close to lakes <sup>(73)</sup>
- Remarks** : it is believed that 13,000,000 are infected worldwide <sup>(73)</sup>

## CONTROLLING AND PREVENTING DISEASE

Preventative measures	Potential effect
Improving sanitation	(+) <sup>(73)</sup>
Correct preparation of freshwater fish (the pathogen is killed at 56° for 5 minutes or –18° for 24 hours) <sup>(73)</sup>	(+++ ) <sup>(73)</sup>
Mass detection and treatment of infections <sup>(16)</sup>	
health and hygiene promotion <sup>(16)</sup>	

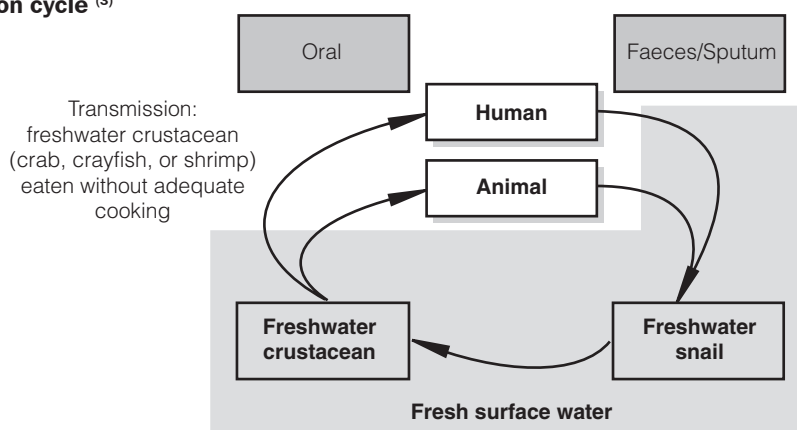


## ***Paragonimiasis, Lung fluke disease***

A pathogen which has to go through two water-based intermediate hosts: a freshwater snail and a freshwater crustacean (freshwater crab, crayfish, or shrimp). Infection occurs through eating inadequately prepared infective crustaceans.

- Pathogen** : *Paragonimus* spp. <sup>(3)</sup> (Helminth)  
the pathogen is a fluke with a length of about 10 mm living in the lungs <sup>(2)</sup>
- Distribution** : the infection occurs in the far East, South-east Asia, Oceania, West Africa <sup>(2)</sup>, and South, Central and North America. The infection is most common in Asia <sup>(3)</sup>
- Symptoms** : the symptoms are coughing, chest pain, and sputum (lung secretions) with orange-brown flecks <sup>(3)</sup>. The infection can be mistaken for tuberculosis <sup>(2)</sup>
- Severity** : the infection can be severe if the flukes develop in other organs than the lungs <sup>(2)</sup>, and deaths are reported <sup>(16)</sup>. In the lungs, only heavy and repeated infections will cause problems in the lung function <sup>(2)</sup>
- Incubation period** : variable, but normally long <sup>(3)</sup>
- Duration** : the flukes may live for up to 20 years <sup>(16)</sup>
- Communicability** : eggs may be discharged by a person for up to 20 years <sup>(3)</sup>

### **Transmission cycle <sup>(3)</sup>**



- Transmission** : eggs leave the body through sputum or faeces. Miracidia are released from the eggs after 2 to 4 weeks. These miracidia infect freshwater snails. In the snail a development of around 2 months will take place before cercariae emerge. The cercariae penetrate the body of crabs, crayfish <sup>(3)</sup>, or shrimps <sup>(16)</sup> and form cysts. When infected crustaceans are eaten without proper cooking, infection can follow <sup>(3)</sup>. Ingestion of the cysts during preparation of the crustaceans is possible <sup>(16)</sup>
- Reservoir** : the main reservoirs of the infection are wild and domestic cats <sup>(16)</sup>. Dogs can play an important role as reservoir too <sup>(73)</sup>. Other reservoirs are humans, pigs and wild carnivores <sup>(3)</sup>
- Vector/int. host** : freshwater snails (*Semisulcospira*, *Thiara*, *Aroapyrgus* and other genera) <sup>(3)</sup>, and freshwater crabs, crayfish <sup>(73)</sup> and shrimps are the intermediate hosts of the pathogen <sup>(16)</sup>
- Water-related** : the intermediate hosts are water-based <sup>(2)</sup>
- Excreta-related** : the pathogens leaves the body through faeces if sputum is swallowed <sup>(73)</sup>

## CONTROLLING AND PREVENTING DISEASE

<b>Environment</b>	: the infection is likely to occur in endemic regions where freshwater crabs, crayfish or shrimps are eaten without adequate cooking
<b>Risk in disaster</b>	: the infection is not a priority in disasters <sup>(3)</sup>
<b>Remarks</b>	: in China around 10,000,000 people are believed to be infected. In Ecuador the number of infections is estimated at 500,000 <sup>(3)</sup>

Preventative measures	Potential effect
Improvement of sanitation	(+) <sup>(73)</sup>
Safe disposal of sputum <sup>(3)</sup>	
Improve preparation of freshwater crustaceans (crabs, crayfish and shrimps) <sup>(16)</sup>	(+++) <sup>(73)</sup>
Control of reservoir animals <sup>(3)</sup>	
Control of freshwater snails where appropriate <sup>(3)</sup>	
Health and hygiene promotion <sup>(3)</sup>	

As carnivores play an important role as reservoir, the effect of improved sanitation as only measure is limited. The most effective preventive measure is correct preparation of Crustaceans. Pickling processes are often not effective in killing the pathogen <sup>(2)</sup>.

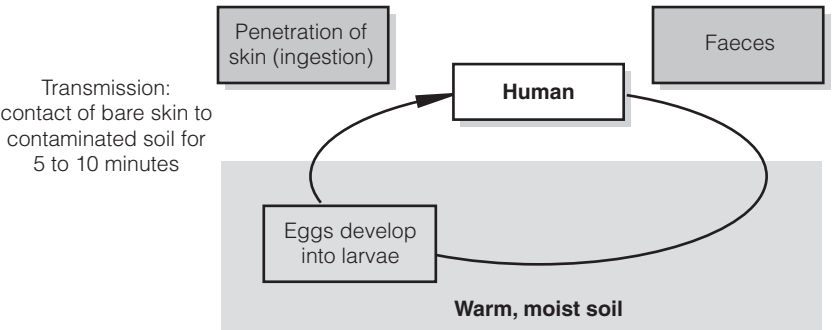
**Epidemic measures :** the source of the infection should be determined and dealt with <sup>(3)</sup>

Hookworm disease, Ancylostomiasis, Necatoriasis

A very common infection; ¼ of the world’s population is estimated to be infected with this pathogen. People become infected when larvae which developed in soil penetrate bare skin.

- Pathogen** : *Ancylostoma duodenale*, *Necator americanus*, and *Ancylostoma ceylanicum*<sup>(3)</sup> (Helminths).  
Hookworms are 5 to 13 mm long worms which live in the small intestine. Every worm taps 0.03 to 0.3 ml of blood per day<sup>(44)</sup>
- Distribution** : *A.duodenale* and *N.americanus* cover jointly more or less the entire world, but are most common in tropical and subtropical zones. *A.ceylanicum* is found in South-east Asia<sup>(3)</sup>
- Symptoms** : light infections are usually asymptomatic<sup>(3)</sup>. Symptoms are tiredness, breathlessness, pain in muscles, and pale skin<sup>(2)</sup> caused by anaemia (low levels of haemoglobin in the blood)<sup>(3)</sup>
- Severity** : the severity of the infection depends on the number of worms; the more there are, the higher the blood loss they cause<sup>(16)</sup>. Light infections are usually no problem. Heavy infections can lead to severe disability, death is uncommon however<sup>(3)</sup>. The infection poses the biggest health threat to growing children and pregnant women<sup>(73)</sup>
- Incubation period** : weeks to months<sup>(73)</sup>
- Duration** : the worms can survive in the human body for 5 to 6 years<sup>(16)</sup>, reinfection will be common
- Communicability** : eggs can be passed for several years<sup>(3)</sup>

Transmission cycle<sup>(73)</sup>



- Transmission** : the eggs excreted by an infected person will develop into larvae in the soil. These larvae cause infection in humans by penetrating (intact) skin. A contact time of 5 to 10 minutes of the skin with the infected soil is necessary for successful penetration<sup>(44)</sup>. In addition to penetrating the skin, *Ancylostoma* can be transmitted by ingestion of the developed larvae<sup>(3)</sup>
- Reservoir** : man is the only reservoir for *A.duodenale* and *N.americanus*<sup>(16)</sup>. Dogs and cats are reservoirs for *A.ceylanicum*<sup>(3)</sup>. In warm and damp soil the infective form can live for several months<sup>(73)</sup> though up to 2 years is mentioned<sup>(16)</sup>
- Vector/int. host** : none
- Water-related** : no
- Excreta-related** : the pathogen leaves the body through faeces<sup>(2)</sup>

## CONTROLLING AND PREVENTING DISEASE

- Environment** : the infection is common where inadequate sanitation occurs in a warm and wet climate <sup>(3)</sup>. The ideal environment for the pathogen outside the host is moist, shaded, humus-rich soil at a temperature of 25°C to 30°C <sup>(73)</sup>. In cooler or drier climates transmission may be seasonal in the hot or wet season <sup>(16)</sup>. Where the climate is unfavourable, the infection can occur where conditions are warm and humid, for example in mines <sup>(3)</sup>. If human faeces are used as fertiliser, the risk of infection is high <sup>(16)</sup>. Latrines must be kept clean; if excreta can soil the floor of latrines, these can become foci for transmission of hookworm <sup>(9,57)</sup>
- Risk in disaster** : the infection will not be an urgent problem in a disaster <sup>(3)</sup>
- Remarks** : it is believed that around 25% of the world's population is infected with hookworm <sup>(4)</sup>

Preventative measures	Potential effect
Improvement of sanitation (sanitation should be clean)	(+ + +) <sup>(73)</sup>
Care should be taken in use of excreta as fertiliser <sup>(16)</sup>	
Wearing closed shoes <sup>(2)</sup>	
Mass treatment (effective in reducing the number of cases quickly, not in preventing reinfection) <sup>(73)</sup>	(+ + +) <sup>(26)</sup>
Health and hygiene promotion <sup>(3)</sup>	

The number of eggs released by a single female worm can be up to 35,000. Persons with heavy infections can be host to 1,000 worms <sup>(16)</sup>. This means that the potential of contamination of the environment is huge. As it is unlikely that everybody will use the sanitary structures correctly, improved sanitation as only preventive measure is usually not very effective if many people remain infected. Improved sanitation as preventative measure is very important to reduce the reinfection of people though, and a combination of mass treatment and improved sanitation is very effective in reducing the infection in a population (a reduction of 80% is mentioned) <sup>(26)</sup>.

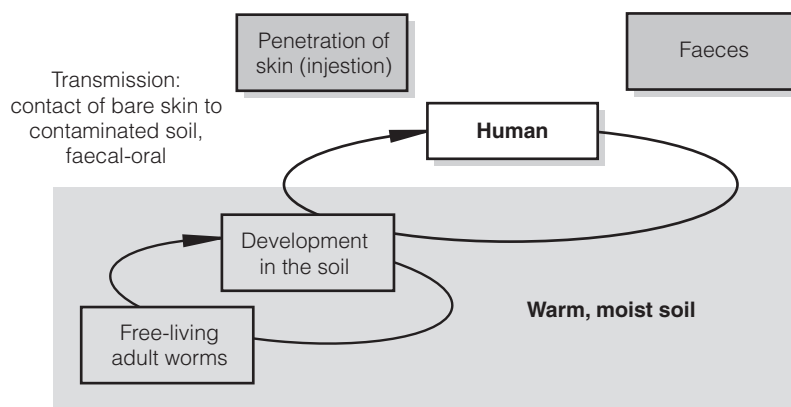
- Epidemic measures** : a combination of mass treatment, health and hygiene promotion and improvement of sanitation <sup>(3)</sup>

## ***Threadworm infection, Strongyloidiasis,***

A pathogen which leaves the body through faeces, and develops in warm and moist soil. The pathogen can either go through its reproductive adult form in the human body, or in soil.

- Pathogen** : *Strongyloides stercoralis*, *S. fülleborni* <sup>(3)</sup> (Helminth)  
The adult worms are 2 mm long and live in the small intestine of people, or in soil <sup>(2)</sup>
- Distribution** : (roughly) worldwide <sup>(3)</sup>
- Symptoms** : most infections are asymptomatic <sup>(16)</sup>. Symptoms are upper abdominal pain, diarrhoea <sup>(2)</sup>, nausea <sup>(3)</sup>, and loss of weight <sup>(2)</sup>
- Severity** : most infections are mild <sup>(2)</sup>. Hyper-infection does occur in rare cases, and can be fatal <sup>(44)</sup>. Most at risk are people who are undernourished or suffer from other illnesses <sup>(16)</sup>
- Incubation period** : variable <sup>(73)</sup>
- Duration** : the infection can last decades if autoinfection occurs (40 years is mentioned) <sup>(2)</sup>
- Communicability** : as long as the infection lasts <sup>(3)</sup>

### **Transmission cycle** <sup>(73)</sup>



- Transmission** : the eggs hatch in the intestine of the person <sup>(4)</sup>, to form rhabditiform larvae which leave the body through faeces. Either the rhabditiform larvae develop directly into infective filariform larvae, or they start a free-living cycle. The free-living cycle occurs when the larvae are in warm and moist soil <sup>(2)</sup>. The larvae will become adults which can reproduce <sup>(73)</sup>. This cycle outside the human body can be repeated many times <sup>(2)</sup>.  
People are usually infected by filariform larvae in soil which penetrate the skin <sup>(44)</sup>. Autoinfection can occur: rhabditiform larvae penetrate the intestinal mucous membrane without leaving the body. Faecal-oral transmission is also possible <sup>(73)</sup>
- Reservoir** : humans and soil are the most important reservoirs. On rare occasions dogs and cats do transmit a similar infection to humans. In Africa, primates can be a reservoir for *S. fülleborni* <sup>(3)</sup>.  
Infective larvae can remain viable in suitable soil for many weeks. Larvae will not survive in dry conditions, or temperatures under 8°, or over 40° <sup>(16)</sup>

## CONTROLLING AND PREVENTING DISEASE

<b>Vector/int. host</b>	: none
<b>Water-related</b>	: no, though the risk of faecal-oral transmission is probably slightly reduced by improving handwashing practise
<b>Excreta-related</b>	: larvae leave the body through faeces. Faecal-oral transmission is possible, but this is not the usual way of spreading <sup>(44)</sup>
<b>Environment</b>	: The infection flourishes in warm and wet regions <sup>(3)</sup> with overcrowding <sup>(16)</sup> . Although the pathogen can be found in an environment similar to hookworm <sup>(4)</sup> , <i>Strongyloides</i> prefers wetter conditions <sup>(2)</sup>
<b>Risk in disaster</b>	: the infection is not a risk in disasters <sup>(3)</sup>
<b>Remarks</b>	: the disease is common in parts of tropical Brazil, Colombia and South-east Asia <sup>(16)</sup>

Preventative measures	Potential effect
Improvement of sanitation (sanitation should be clean)	(+ + +) <sup>(73)</sup>
Wearing closed shoes <sup>(3)</sup>	
Health and hygiene promotion <sup>(73)</sup>	

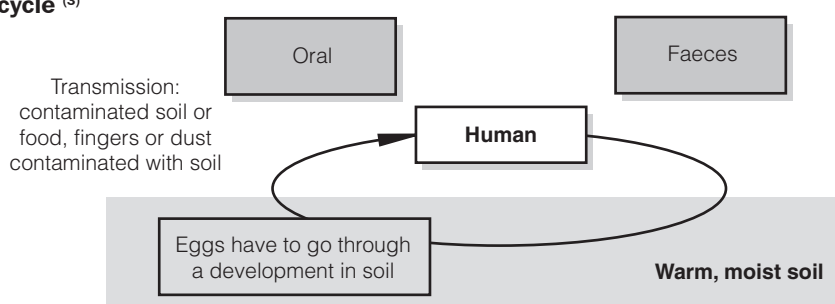
**Epidemic measures** : the infection is not epidemic <sup>(3)</sup>

## Roundworm infection, Ascariasis

A very common disease; one billion people are estimated to be infected. The pathogen leaves the body through faeces. Infection occurs through ingestion of contaminated soil. The eggs are very resistant and can survive for years in suitable soil.

- Pathogen** : *Ascaris lumbricoides* <sup>(15)</sup> (Helminth)  
The cream-coloured worms are 15 to 40 cm long, and live in the small intestine. The worms feed on the contents of the intestines <sup>(2)</sup>
- Distribution** : the infection occurs worldwide <sup>(15)</sup>
- Symptoms** : most infections are asymptomatic. Sometimes worms are excreted. Children between 3 and 8 years old are usually most affected <sup>(3)</sup>
- Severity** : the infection is normally mild. The severity will depend on the number of worms causing the infection <sup>(2)</sup>. The worms take up nutrients which should have benefited the infected person <sup>(73)</sup>; and heavy infections will worsen nutritional insufficiencies <sup>(3)</sup>.  
In 0.05 to 0.2% of the infections more severe (potentially fatal) complications occur <sup>(44)</sup>
- Incubation period** : 10 to 20 days <sup>(73)</sup>
- Duration** : adult worms usually live around 1 year, but up to 2 years is possible <sup>(3)</sup>.  
Reinfection is likely to occur
- Communicability** : people shed eggs as long as infection lasts <sup>(3)</sup>

### Transmission cycle <sup>(3)</sup>



- Transmission** : female worms discharge around 200,000 eggs per day <sup>(2)</sup>. These eggs leave the body through faeces. Eggs become infective after a development of 2 to 3 weeks <sup>(3)</sup> in warm <sup>(44)</sup>, shady, and damp soil <sup>(16)</sup>. A person is infected after ingestion of eggs from contaminated soil. Infection can occur when children play around the house <sup>(16)</sup> or when food gets contaminated by soil. Hands contaminated with soil play an important role in transmission too <sup>(16)</sup>. Feet can take contaminated soil into the house. Contaminated dust can also play a role in transmission <sup>(3)</sup>. Outbreaks have occurred where raw sewage or waste-water were used for irrigation, and where contaminated vegetables were imported <sup>(16)</sup>
- Reservoir** : humans. The infective eggs are very resistant to drying or cold <sup>(73)</sup> and can remain infective for years in soil <sup>(3)</sup>. Temperatures over 45°C or direct sunlight will kill the eggs <sup>(16)</sup>.  
A similar infection of pigs (*A.suum*) can infect humans <sup>(2)</sup>, but this is rare <sup>(3)</sup>

## CONTROLLING AND PREVENTING DISEASE

<b>Vector/int. host</b>	: cockroaches and other animals can serve as mechanical vectors by ingesting, and excreting viable eggs <sup>(16)</sup>
<b>Water-related</b>	: the infection is water-washed <sup>(73)</sup>
<b>Excreta-related</b>	: eggs leave the body through faeces <sup>(2)</sup>
<b>Environment</b>	: the infection is most common in moist, tropical zones <sup>(3)</sup> in a population with poor personal hygiene, inadequate sanitation, and poor food hygiene <sup>(73)</sup> . Where the climate is drier, the period of transmission is limited to the rainy season <sup>(16)</sup>
<b>Risk in disaster</b>	: roundworm infection will not be a priority in a disaster <sup>(3)</sup>
<b>Remarks</b>	: the infection is very common, and it is estimated that one billion people are infected worldwide <sup>(73)</sup> . In parts of Africa 95% of the population are infected <sup>(16)</sup>

Preventative measures	Potential effect
Improving water availability	(++) <sup>(29)</sup>
Improve handwashing practise	(++) <sup>(73)</sup>
Improvement of sanitation	(+++) <sup>(73)</sup>
Care should be taken in use of excreta as fertiliser <sup>(16)</sup> or contact with composted excreta <sup>(57)</sup>	
Improving food hygiene	(+) <sup>(73)</sup>
Mass treatment (especially of children) <sup>(2)</sup>	(+++) <sup>(26)</sup>
Health and hygiene promotion <sup>(3)</sup>	

Increased water availability has been associated with a reduction of 12 to 37% in hookworm infection; improved water availability combined with improved sanitation with a reduction of around 29%; and improved water availability and sanitation in combination with mass treatment has been associated with a reduction of 80% in roundworm infection <sup>(26)</sup>. Mass treatment alone will result in a short term reduction in the number of infections, but will not be effective on the long run, as the cause of infection has not been removed.

**Epidemic measures :** mass treatment, health and hygiene promotion, and improved sanitation <sup>(2, 3)</sup>

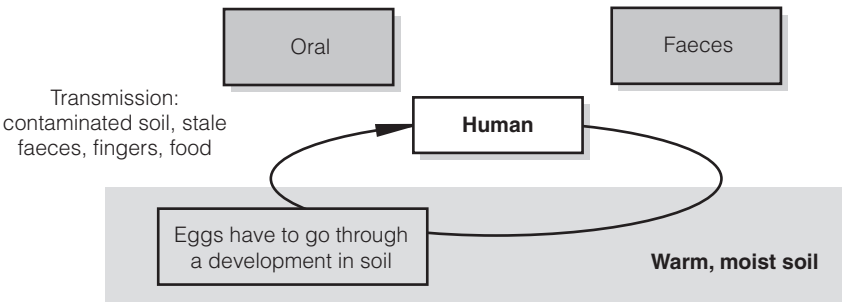


Whipworm infection, Trichuriasis

A very common, usually mild, infection. The pathogen leaves the body through faeces, develops in soil into an infective form, and infects people through the oral route.

- Pathogen** : *Trichuris trichiura* <sup>(15)</sup> (Helminth)  
The greyish-white <sup>(16)</sup> worm is 2 to 5 cm long and lives in the large intestine, where it feeds on tissue juices <sup>(2)</sup>
- Distribution** : the infection occurs worldwide <sup>(15)</sup>
- Symptoms** : most infections are asymptomatic <sup>(2)</sup>. Symptoms are abdominal pain and diarrhoea <sup>(4)</sup>.  
Because of their behaviour children are most at risk of infection <sup>(16)</sup>
- Severity** : the infection is usually mild. In heavy infections dysentery (bloody stools with mucus), rectal prolapse (the rectum comes out of the anus), and retarded growth can occur <sup>(3)</sup>
- Incubation period** : no incubation period can be given <sup>(73)</sup>. It takes the worms 3 months to mature after being ingested <sup>(2)</sup>
- Duration** : the duration of the infection can be several years <sup>(3)</sup>
- Communicability** : several years <sup>(3)</sup>

Transmission cycle <sup>(73)</sup>



- Transmission** : the pathogen leaves the human body through faeces. In warm, moist soil the eggs will become infective after a development of 2 weeks <sup>(2)</sup>. Infection occurs when the infective eggs from stale faeces or contaminated soil are ingested by a person. Transmission is often through hand to mouth contact <sup>(16)</sup>, or through contaminated food <sup>(73)</sup>
- Reservoir** : primarily humans and soil. The eggs in the soil are resistant to low temperatures, but need moisture to survive <sup>(16)</sup>. Pigs can be infected with a similar worm (*T.suis*) which is able to infect humans <sup>(2,16)</sup>
- Vector/int. host** : none
- Water-related** : the infection is water-washed <sup>(73)</sup>
- Excreta-related** : the eggs leave the body through faeces <sup>(73)</sup>
- Environment** : the infection is common where poor sanitation is combined with high rainfall and humidity, and dense shade <sup>(16)</sup>. In urban slums the infection can become a public health problem <sup>(2)</sup>. Persons who handle pigs have a higher incidence of the infection <sup>(16)</sup>
- Risk in disaster** : the infection is not a problem in disasters <sup>(3)</sup>
- Remarks** : the infection is very common, and over 500,000,000 people are estimated to be infected <sup>(73)</sup>

## CONTROLLING AND PREVENTING DISEASE

Preventative measures	Potential effect
Improving water availability	(+) <sup>(29)</sup>
Improve handwashing practise <sup>(3)</sup>	
Improvement of sanitation	(+) <sup>(73)</sup>
Improving food hygiene	(+) <sup>(73)</sup>
Mass treatment <sup>(16)</sup> (if the infection is a severe problem)	
Health and hygiene promotion <sup>(3)</sup>	

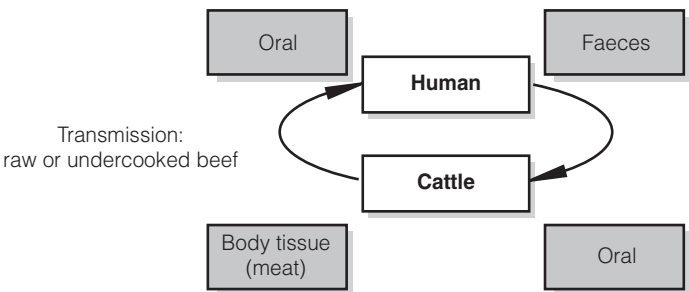
**Epidemic measures :** the infection is not epidemic <sup>(3)</sup>

Tapeworm (beef), Taeniasis

A mild infection which is transmitted through eating poorly cooked beef.

- Pathogen** : *Taenia saginata* <sup>(15)</sup> (Helminth)  
The infection is caused by a tapeworm which lives in the small intestine, and which can become up to 10 m long <sup>(2)</sup>
- Distribution** : the infection occurs worldwide <sup>(3)</sup>
- Symptoms** : the infections are usually asymptomatic <sup>(16)</sup>. Symptoms are insomnia, loss of weight, abdominal pain, and finding segments of worms in faeces <sup>(3)</sup>. People who are infected will often carry several worms <sup>(16)</sup>
- Severity** : the infection is usually mild <sup>(73)</sup>
- Incubation period** : 10 to 14 weeks <sup>(73)</sup>
- Duration** : worms may survive for 30 years or longer <sup>(3)</sup>
- Communicability** : the period of communicability is as long as the tapeworm persists, which can be over 30 years <sup>(3)</sup>

Transmission cycle <sup>(3)</sup>



- Transmission** : the eggs leave the host through faeces, either individually, or in complete segments of the worm <sup>(2)</sup>. Cattle is infected by ingesting the eggs. After ingestion, the pathogen will implant itself in the flesh of the cow as cysticerci <sup>(3)</sup>. Cattle can become infected when its pastures are polluted with human faeces, or by drinking water contaminated with sewage <sup>(73)</sup>. Birds can play a role in taking the pathogen from sewage outflows to pastures <sup>(2)</sup>. Possibly domestic flies can play a role in the transmission of the eggs to cattle <sup>(73)</sup>. People are infected through ingesting raw or undercooked beef containing the pathogen <sup>(3)</sup>
- Reservoir** : humans are the only definitive host of the pathogen <sup>(16)</sup>. The eggs can survive for months in the environment <sup>(3)</sup>
- Vector/int. host** : cattle is the intermediate host of the pathogen <sup>(2)</sup>
- Water-related** : no
- Excreta-related** : the pathogen leaves the human body through faeces <sup>(2)</sup>
- Environment** : the pathogen is often found in areas of cattle breeding <sup>(44)</sup>. The infection is common in poorer areas where beef is eaten raw, or without proper cooking <sup>(16)</sup>
- Risk in disaster** : the infection is not a priority in disasters <sup>(3)</sup>
- Remarks** : it is estimated that over 60,000,000 people are infected worldwide <sup>(73)</sup>. The infection is very common in the highlands of Ethiopia <sup>(16)</sup>

## CONTROLLING AND PREVENTING DISEASE

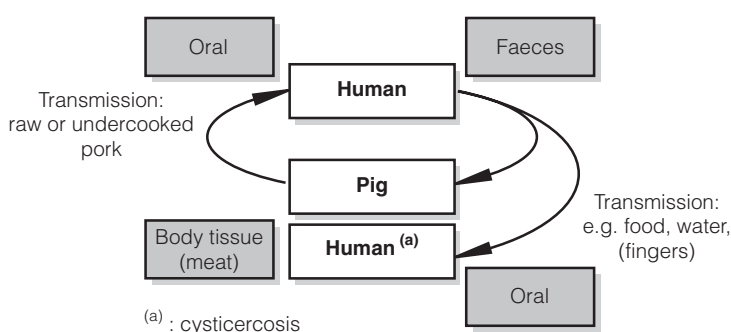
Preventative measures	Potential effect
Improving sanitation (assuring cattle can not come in contact with human excreta, care in disposal of sewage)	(+ + +) <sup>(73)</sup>
Correct preparation of beef (beef will be safe after a minimum of 5 minutes at over 56°C <sup>(4)</sup> or 7 to 10 days at -20°C <sup>(44)</sup> )	(+ + +) <sup>(73)</sup>
Inspection of meat	(+) <sup>(3)</sup>
Health and hygiene promotion <sup>(3)</sup>	

**Epidemic measures :** -

## Tapeworm (pig) , Taeniasis, Cysticercosis

This pathogen causes two different infections. The first infection is by the adult tapeworm which is transmitted through eating improperly cooked pork. Although this infection is mild, the hosts and their contacts are at serious risk of cysticercosis. Cysticercosis is the second infection caused by the pathogen. It is caused by the larvae of the worm, is transmitted through the faecal-oral route, and is potentially a severe disease.

<b>Pathogen</b>	: <i>Taenia solium</i> <sup>(15)</sup> (Helminth) The adult tapeworm can become up to 7m long <sup>(45)</sup> and lives in the small intestine <sup>(2)</sup> . Humans can be infected by the larvae of the tapeworm which can form cysts anywhere in the body <sup>(3)</sup>
<b>Distribution</b>	: the infection occurs worldwide <sup>(3)</sup> ; but is common in Africa, India, Indonesia, Mexico, Chile and Russia <sup>(73)</sup>
<b>Symptoms</b>	: people can have two forms of infection: infection by the adult worm, or by the larval stage of the pathogen which causes cysticercosis (cysts in body tissues). Infections by the adult worm are usually asymptomatic <sup>(16)</sup> . Symptoms are insomnia, loss of weight, abdominal pain, and finding segments of worms in faeces <sup>(3)</sup> . Cysticercosis can be asymptomatic. When the brain is affected, epilepsy <sup>(2)</sup> and psychiatric problems can result <sup>(3)</sup>
<b>Severity</b>	: the infection with the adult worm is mild <sup>(2)</sup> , but the hosts and people close to them are at risk of cysticercosis <sup>(16)</sup> . Cysticercosis is potentially a severe and dangerous infection <sup>(2)</sup>
<b>Incubation period</b>	: infections with adult worms: 8 to 12 weeks <sup>(73)</sup> . Cysticercosis has an incubation period which ranges from days, to over 10 years <sup>(3)</sup>
<b>Duration</b>	: worms may survive for 30 years or longer <sup>(3)</sup>
<b>Communicability</b>	: as long as the tapeworm persists, which can be over 30 years <sup>(3)</sup>
<b>Transmission cycle</b> <sup>(3)</sup>	



<b>Transmission</b>	: the eggs leave the human body through faeces <sup>(2)</sup> . Pigs are infected by ingesting these eggs through eating human faeces, or ingesting water or food contaminated with human faeces or sewage. The ingested eggs will implant themselves in the flesh of the pig as cysticerci. People are infected with the adult tapeworm when raw or undercooked pork containing the pathogen is eaten <sup>(3)</sup> .
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## CONTROLLING AND PREVENTING DISEASE

	The eggs excreted by a person are directly infective through the faecal-oral route. This results in cysticercosis. The eggs can either infect the host carrying the adult worm, or persons around the host <sup>(73)</sup>
<b>Reservoir</b>	: humans are the only definitive host of the pathogen <sup>(16)</sup> . The eggs can survive in the environment for months <sup>(3)</sup>
<b>Vector/int. host</b>	: the intermediate host of the pathogen is the pig. In cysticercosis people function as intermediate host (though they are a dead end in the transmission cycle) <sup>(2)</sup>
<b>Water-related</b>	: cysticercosis is water-washed <sup>(3)</sup> and water-borne <sup>(73)</sup>
<b>Excreta-related</b>	: the pathogen leaves the human body through faeces <sup>(2)</sup> . Cysticercosis is spread through the faecal-oral route <sup>(73)</sup>
<b>Environment</b>	: the infection can occur where pigs have access to human faeces, or to food or water contaminated by human faeces or sewage, and where pork is eaten without adequate preparation
<b>Risk in disaster</b>	: the infection is not a priority in disasters <sup>(3)</sup>
<b>Remarks</b>	: pork tapeworm is less common than beef tapeworm <sup>(2)</sup>

Preventative measures	Potential effect
Cysticercosis: improving water availability	
Cysticercosis: improve handwashing practise <sup>(3)</sup>	
Improving sanitation (pigs and humans must not have access to human faeces (either direct, or through sewage))	(+ + +) <sup>(73)</sup>
Correct preparation of pork (pork will be safe after a minimum of 5 minutes at over 56°C <sup>(4)</sup> or 7 to 10 days at -20°C <sup>(44)</sup> )	(+ + +) <sup>(73)</sup>
Inspection of meat	(+) <sup>(3)</sup>
People with the infection should be treated <sup>(3)</sup>	
Health and hygiene promotion <sup>(3)</sup>	

**Epidemic measures :** -

Weil's disease, Leptospirosis

A usually mild infection which is mainly transmitted through skin contact with water or other material contaminated with urine of infected animals.

- Pathogen

Distribution

Symptoms

Severity

Incubation period

Duration

Communicability
- : *Leptospira* spp. <sup>(15)</sup> (Bacterium)

: the infection occurs worldwide <sup>(15)</sup>

: the majority of the infections are asymptomatic, or too mild to diagnose <sup>(3)</sup>. Symptoms will often be similar to influenza <sup>(16)</sup>: fever, headache, chills, malaise, muscular pain in legs, and vomiting <sup>(3)</sup>. Severe cases can result in jaundice and kidney failure <sup>(16)</sup>

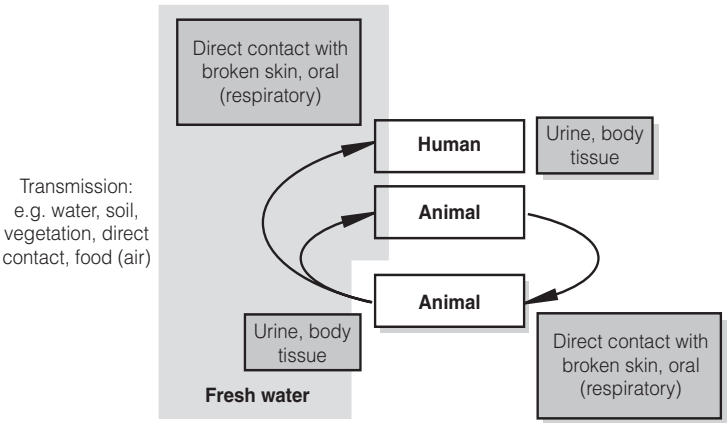
: severe infections are rare <sup>(16)</sup>, but can be fatal <sup>(3)</sup>

: 4 to 18 days <sup>(73)</sup>

: the duration of the illness ranges from some days to 3 weeks, though longer is possible <sup>(3)</sup>

: communicability is usually up to 1 month after illness, but can possibly be up to 11 months. Animals which are carriers can be infective for life <sup>(3)</sup>

Transmission cycle <sup>(3)</sup>



- Transmission

Reservoir
- : transmission occurs mainly when abraded or broken skin, or mucous membranes, come in contact with water, moist soil, or vegetation contaminated with the urine of infected animals. Direct contact with urine or body tissue of infected animals can transmit the pathogen too. Sporadically transmission occurs through food contaminated with urine of rats carrying the infection, inhaling droplets of contaminated fluids <sup>(3)</sup> or the bite of an infected rat <sup>(16)</sup>. Transmission from person to person is uncommon <sup>(3)</sup>

: rats and rodents are the main reservoir <sup>(73)</sup> and pose the largest risk for transmission to humans. However, most mammals can become carriers and spread the infection <sup>(16)</sup>. Some other important reservoirs are pigs, cattle, dogs, and many wild mammals. Humans are not important as reservoir <sup>(3)</sup>.

## CONTROLLING AND PREVENTING DISEASE

The pathogen can survive for longer periods in a moist, non-acidic environment. In fresh water with a pH of about 7, survival of *Leptospira* can be up to 4 weeks. In a pH of 5, the pathogen will survive for up to 2 days. *Leptospira* will not survive in saline water <sup>(16)</sup> and is sensitive to chlorine <sup>(73)</sup>

<b>Vector/int. host</b>	: the disease is spread through animals (the main risk comes from rats); these are final hosts and not vectors or intermediate hosts
<b>Water-related</b>	: water contaminated with infected urine plays an important role in the transmission of the disease <sup>(3)</sup>
<b>Excreta-related</b>	: the pathogen is mainly spread through contact with urine from infected animals <sup>(16)</sup>
<b>Environment</b>	: the infection is common where rats are numerous and the environment is favourable <sup>(73)</sup> . The infection is a hazard to people in direct contact with fresh water, urine, or body tissues of animals <sup>(3)</sup> , and is linked to specific occupations like workers in sugar-cane plantations or rice-paddies, mine workers, farmers, people working with fish, in canals, or in sewerage systems <sup>(73)</sup>
<b>Risk in disaster</b>	: the infection could be a potential problem in regions with a high water table, or where flooding has occurred <sup>(3)</sup>
<b>Remarks</b>	: -

Preventative measures	Potential effect
Improving the quality of water people come in contact with; workers who come in contact with fresh surface water must be properly protected	(+ + +) <sup>(29)</sup>
Improving food hygiene (protection of food from rats)	(+ +) <sup>(73)</sup>
Control of rats and rodents, especially where transmission is likely (where food is stored, animals butchered, where domestic animals are kept) <sup>(73)</sup>	
Control of domestic animals <sup>(73)</sup>	
Health and hygiene promotion <sup>(3)</sup>	

Care should be taken with the disposal of urine of patients <sup>(4)</sup>

**Epidemic measures** : the source of infection should be determined and, if possible, dealt with <sup>(3)</sup>

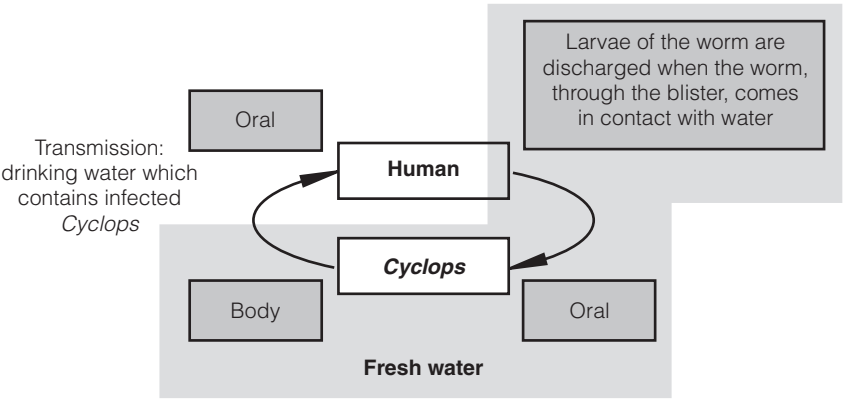


Guinea-worm infection, Dracunculiasis, Dracontiasis

Guinea-worm is the only pathogen transmitted exclusively by drinking contaminated water (all other water-borne infections can be transmitted in several other ways). The infection can result in severe complications. In the past decade the number of infections in the world has reduced strongly.

- Pathogen** : *Dracunculus medinensis* <sup>(15)</sup> (Helminth)  
The infection is caused by the female worm which can be over 1m long <sup>(2)</sup>
- Distribution** : the WHO reports in 1999 the presence of guinea-worm in: Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Côte d'Ivoire, Ethiopia, Ghana, Kenya, Mali, Mauritania, Niger, Nigeria, Senegal, Sudan, Togo, Uganda and Yemen <sup>(84)</sup>
- Symptoms** : fever and localised complaints like swellings, itching, and local pains <sup>(2)</sup>. A blister containing a worm will appear <sup>(3)</sup>, usually on the legs. Worms which are not removed will calcify in the body <sup>(2)</sup>.  
Most affected are people in the age group of 15 to 40 years <sup>(16)</sup>
- Severity** : the infection can be the cause of severe illness and disability <sup>(44)</sup>. Worms entering in joints may cause arthritis. Adequate removal of the worm will reduce the risks of complications <sup>(2)</sup>. In up to 50% or more of the cases <sup>(16)</sup> secondary, potentially life-threatening infections of the blister can occur <sup>(2)</sup>
- Incubation period** : around 12 months <sup>(3)</sup>
- Duration** : several weeks if no complications occur
- Communicability** : people who harbour the worm can contaminate water from the moment the blister bursts to (generally) 2 to 3 weeks after. Copepods are infective for around 3 weeks after infection, then they will die <sup>(3)</sup>

Transmission cycle <sup>(3)</sup>



- Transmission** : the blister containing the female worm will burst when in contact with water <sup>(16)</sup>. The worm emerges, and discharges its larvae into the fresh water. When these larvae are ingested by *Cyclops*, infection of the copepod can follow <sup>(73)</sup>. In *Cyclops* the pathogen has to go through a development of 12 to 14 days before it can infect humans <sup>(3)</sup>. People become infected when they drink water containing the infective *Cyclops* <sup>(73)</sup>. Most infections occur during a few months of the year <sup>(16)</sup>

## CONTROLLING AND PREVENTING DISEASE

<b>Reservoir</b>	: humans are the only reservoir of the infection <sup>(3)</sup>
<b>Vector/int. host</b>	: the intermediate hosts are copepods of the genus <i>Cyclops</i> <sup>(2)</sup> . These are small crustaceans (water fleas) which are barely visible to the eye.
<b>Water-related</b>	: the intermediate host is water-based <sup>(73)</sup> and the pathogen is water-borne
<b>Excreta-related</b>	: no
<b>Environment</b>	: the infection is associated with small water sources in semi-arid countries <sup>(16)</sup> . Usually the pathogen is found in rural areas <sup>(44)</sup> where stagnant surface water is used as source of water <sup>(3)</sup> . Water sources where people have to stand in the water are particularly unsafe <sup>(2)</sup> . In arid regions transmission occurs in the rainy season when there is an availability of surface water. In wet regions transmission is most common in the dry season, when only a limited number of water-sources are available <sup>(16)</sup>
<b>Risk in disaster</b>	: the infection is not a priority in a disaster. If the pathogen is present in the population, control of the infection could be started when the emergency phase is dealt with <sup>(47)</sup>
<b>Remarks</b>	: the infection typically appears in the agricultural season <sup>(84)</sup> . As a large part of the farmers may be disabled by the infection, the agricultural production may be severely reduced because of the disease <sup>(16)</sup> . Progress is being made in the WHO programme of eradication of guinea-worm infection <sup>(2)</sup> , therefore the geographical distribution of the infection is likely to change in the years to come. In 1989 the number of cases were estimated at 1,000,000; in 1997 it was estimated at less than 80,000 cases <sup>(84)</sup>

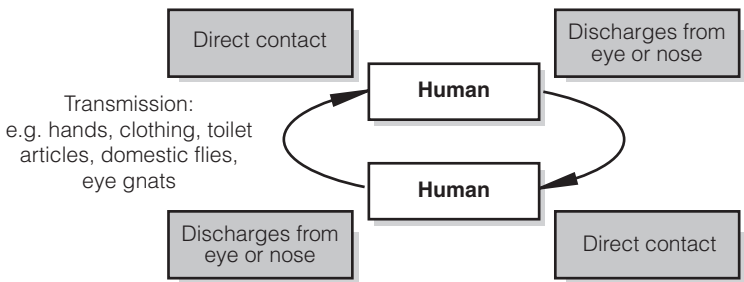
Preventative measures	Potential effect
Improving the quality of drinking water (the water can easily be filtered as <i>Cyclops</i> is rather large (a mesh size of 0.1mm is sufficient <sup>(3)</sup> , the same side of the filter should always be 'up'))	(+ + +) <sup>(26)</sup>
Water sources for drinking water should not allow used or spilt water to flow back <sup>(73)</sup>	
Persons with the active infection should not enter into water used for drinking water <sup>(3)</sup>	
Control of <i>Cyclops</i> with the insecticide 'temefos' <sup>(3)</sup>	
Health and hygiene promotion <sup>(3)</sup>	
<b>Epidemic measures</b> : search for sources of infection and deal with them; health and hygiene promotion, assure drinking water quality <sup>(3)</sup>	

Conjunctivitis

Infections which affect the eyes and are transmitted through direct contact. Large outbreaks are possible where the population has poor personal hygiene and lives in overcrowded conditions.

- Pathogen** : the infection can be caused by several types of bacteria (acute bacterial conjunctivitis); adenoviruses (adenoviral keratoconjunctivitis, adenoviral haemorrhagic conjunctivitis) and picarnoviruses (enteroviral haemorrhagic conjunctivitis)
- Distribution** : the infections occur worldwide <sup>(3)</sup>
- Symptoms** : acute bacterial conjunctivitis: irritation, purulent discharge from the eye <sup>(4)</sup>, swelling of the eyelids. Children under 5 are most affected.  
keratoconjunctivitis: sudden onset, swelling of the eyelids, pain, photophobia, and blurred vision.  
haemorrhagic conjunctivitis: swollen eyelids, bleedings on the eyes <sup>(3)</sup>, eye discharges are clear <sup>(4)</sup>
- Severity** : most infections are not severe <sup>(3)</sup>
- Incubation period** : acute bacterial conjunctivitis: 1 to 3 days  
keratoconjunctivitis: 5 to 12 days or longer  
haemorrhagic conjunctivitis: 12 hours to 12 days <sup>(3)</sup>
- Duration** : the conjunctivitis lasts between some days and some weeks <sup>(3)</sup>
- Communicability** : communicability of the infection is variable; normally up to 2 weeks, or as long as the infection lasts <sup>(3)</sup>

Transmission cycle <sup>(3)</sup>



- Transmission** : the pathogens leave the body through discharges of the eyes or nose. These discharges can transmit the infection to a susceptible person through hands, contaminated material (especially if used around eyes), or domestic flies and eye gnats. The importance of domestic flies or eye gnats in transmission is not entirely clear <sup>(3)</sup>. Epidemics can take place where the environment is favourable to transmission <sup>(73)</sup>. Attack rates of up to 50% in the population are possible <sup>(3,47)</sup>
- Reservoir** : humans are the only reservoir of the pathogens <sup>(3)</sup>
- Vector/int. host** : domestic flies and eye gnats can be mechanical vectors <sup>(3)</sup>
- Water-related** : the infections are water-washed <sup>(73)</sup>
- Excreta-related** : not directly; poor sanitation may increase the population of domestic flies

## CONTROLLING AND PREVENTING DISEASE

- Environment** : the infection occurs especially where crowding, poor personal hygiene (as well poor handwashing as inadequate hygiene of clothes and other materials), exposure to wind and dust, and poor sanitation (risk of domestic fly breeding) are found <sup>(47)</sup>
- Risk in disaster** : the infection will not be a priority in a disaster. Epidemics are possible where overcrowding is combined with poor personal hygiene <sup>(47)</sup>
- Remarks** : it may be necessary to provide separate treatment facilities during outbreaks <sup>(3)</sup>.  
Chlamydial conjunctivitis (which is not trachoma) is an infection which is transmitted sexually, or from mother to new-born baby. Obviously the transmission cycle and preventative measures of this infection will be different

Preventative measures	Potential effect
Improving water availability	(+ + +) <sup>(29)</sup>
Improve handwashing practise <sup>(3)</sup>	
Hygiene of clothes and other objects used around eyes <sup>(73)</sup>	
Improvement of sanitation	
Control of domestic flies or eye gnats (where these are suspected to play a role in transmission) <sup>(3)</sup> (for control of domestic flies, see Annexe 3)	
Children with active infection may have to be barred from school <sup>(3)</sup>	
Treatment of cases <sup>(3)</sup>	
If possible, overcrowding should be avoided <sup>(3)</sup>	
Health and hygiene promotion <sup>(3)</sup>	

- Epidemic measures** : make sure that people have access to water and soap to allow adequate personal hygiene. Cases and close contacts must be treated rapidly, if necessary in separate facilities. Health and hygiene promotion, and where appropriate, control of domestic flies <sup>(3)</sup>

Trachoma

An infection affecting the eye. The disease is the most common cause of preventable blindness in the world. Transmission is through direct contact with contaminated hands, domestic flies, clothing, or other objects.

- Pathogen

Distribution

Symptoms

Severity

Incubation period

Duration

Communicability
- : *Chlamydia trachomatis* <sup>(3)</sup> (Bacterium)

: the infection occurs worldwide <sup>(3)</sup>

: the infection starts of as keratoconjunctivitis <sup>(73)</sup>, followed by scarring of the conjunctiva. Severe cases can develop deformed eyelids. The eye-lashes are turned inward, which can, over time, lead to blindness <sup>(3)</sup>. The highest rate of infection is in young children <sup>(44)</sup>

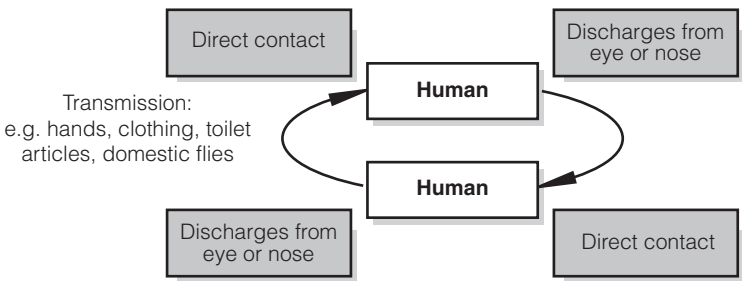
: frequent reinfection is needed to create severe lifelong disease <sup>(3)</sup>

: 5 to 12 days <sup>(73)</sup>

: single infections can last for some years. The infection can be continuous through reinfection <sup>(3)</sup>

: the period of communicability can be a few years <sup>(3)</sup>. The disease is not infectious in its later stages <sup>(73)</sup>

Transmission cycle <sup>(3)</sup>



- Transmission

Reservoir

Vector/int. host

Water-related

Excreta-related

Environment
- : the pathogen is found in eye <sup>(73)</sup> or nasal discharges. Infection occurs through contact with these discharges <sup>(3)</sup>. Transmission of the infection is through hands, clothing or other objects, and domestic flies. A common way of transmission is rubbing infected eyes of a child with a cloth or hands. The pathogen is carried over when the cloth or hand is used on a susceptible person without proper cleaning or washing. Where the infection is endemic, up to 90% can be infected by the age of 3 years <sup>(73)</sup>

: humans are the only reservoir <sup>(3)</sup>

: domestic flies are a mechanical vector for the pathogen <sup>(16)</sup>

: the infection is water-washed <sup>(73)</sup>

: not directly; inadequate sanitation can increase the domestic fly population <sup>(16)</sup>

: the infection is most common in poor, rural communities <sup>(3)</sup>. The typical environment for trachoma is: poor personal hygiene, crowded conditions, a dry and dusty environment, and inadequate sanitation (human and animal) which results in a large domestic fly population <sup>(16)</sup>

## CONTROLLING AND PREVENTING DISEASE

- Risk in disaster** : the infection is not an urgent problem in case of a disaster <sup>(3)</sup>
- Remarks** : trachoma is the most important cause of preventable blindness in many regions in the world <sup>(44)</sup>. It is believed that 150,000,000 people are affected by the infection. Around 5,500,000 people are estimated to be blind, or at risk of becoming blind because of the infection <sup>(16)</sup>

Preventative measures	Potential effect
Improving water availability	(+ +) <sup>(29)</sup>
Improve handwashing practise and washing of face <sup>(3)</sup>	
Hygiene of clothes and other objects used around eyes <sup>(29)</sup>	
Improvement of sanitation	(+) <sup>(29)</sup>
Control of domestic flies <sup>(29)</sup>	
Search for cases and their treatment <sup>(4)</sup>	
Health and hygiene promotion <sup>(3)</sup>	

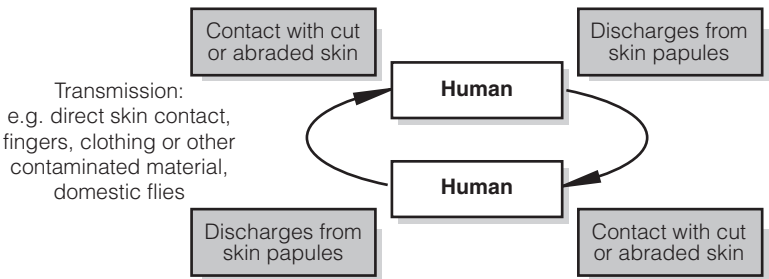
**Epidemic measures** : health and hygiene promotion in combination with improved water availability, improved sanitation, and mass treatment.

**Yaws, *Frambesia tropica***

An infection which can be crippling and disfiguring. Transmission occurs when pathogens from the infectious skin papules of an infected person come in contact with abraded skin of a susceptible person.

<b>Pathogen</b>	: <i>Treponema pallidum</i> , subspecies <i>pertenue</i> <sup>(3)</sup> (Bacterium)
<b>Distribution</b>	: the infection occurs in Africa, Asia and South-America. The occurrence follows roughly the equator, with additional pockets in India and South-east Asia <sup>(73)</sup>
<b>Symptoms</b>	: the infection starts with one papule (nipple-like structure) on the skin. The papule disappears, and after a period of weeks to months more papules emerge all over the body <sup>(73)</sup> . In 10 to 20% of untreated cases large destruction of skin and bones will occur 5 years or more after initial infection <sup>(3)</sup> . The infection affects mostly children between 2 and 15 years of age <sup>(16)</sup>
<b>Severity</b>	: the disease is rarely fatal, but can be very crippling and disfiguring <sup>(3)</sup>
<b>Incubation period</b>	: 2 to 8 weeks <sup>(73)</sup>
<b>Duration</b>	: the disease will last years, with symptomatic and asymptomatic periods <sup>(3)</sup> . The effects of the disease can be lasting <sup>(73)</sup>
<b>Communicability</b>	: the papules secrete a liquid which is highly contagious. Communicability will be as long as these papules exist <sup>(73)</sup> . In the later (destructive) phase of the disease, communicability has usually ceased <sup>(3)</sup>

**Transmission cycle <sup>(3)</sup>**



<b>Transmission</b>	: the pathogens are found in the liquid which is discharged from the papules. This liquid is highly contagious and infection can occur when it is brought in contact with damaged skin <sup>(73)</sup> . Transmission occurs either by direct skin contact, by infected material, or domestic flies. The pathogen can not penetrate intact skin <sup>(16)</sup>
<b>Reservoir</b>	: reservoirs are humans and possibly primates <sup>(73)</sup>
<b>Vector/int. host</b>	: domestic flies are possibly a mechanical vector <sup>(16)</sup>
<b>Water-related</b>	: the infection is water-washed <sup>(73)</sup>
<b>Excreta-related</b>	: not directly. Inadequate sanitation can increase the number of domestic flies
<b>Environment</b>	: the infection is found in the warm and humid tropics. It is most common in rural areas <sup>(16)</sup> in large crowded families with poor personal hygiene <sup>(73)</sup> . In endemic zones infectious yaws is more common in the rainy season <sup>(16)</sup>
<b>Risk in disaster</b>	: the infection will not be a priority in a disaster <sup>(3)</sup>
<b>Remarks</b>	: -

## CONTROLLING AND PREVENTING DISEASE

Preventative measures	Potential effect
Improving water availability	(+ +) <sup>(29)</sup>
Improving handwashing practise	
Improve hygiene of body and clothes <sup>(73)</sup>	
Improvement of sanitation (reduction of domestic flies)	
Control of domestic flies <sup>(73)</sup> (see Annexe 3)	
Infected persons and their contacts should be treated <sup>(3)</sup>	
Health and hygiene promotion <sup>(3)</sup>	

Cases and their contacts should be searched for and treated. When the active disease occurs in over 10% of the population, treatment of the entire population is justified <sup>(3)</sup>.

**Epidemic measures :** provide mass treatment and surveillance <sup>(3)</sup>



## ***Leprosy, Hansen's disease***

An infection which can potentially be very disabling and disfiguring. As the transmission route, and the role water plays in prevention of the infection are not clear, a summary listing is presented.

<b>Pathogen</b>	: <i>Mycobacterium leprae</i> <sup>(3)</sup> (Bacterium)
<b>Gen. description</b>	: an infection which occurs in Asia, tropical Africa, and South America <sup>(3)</sup> . The infection is often asymptomatic. If symptoms develop: nerve and skin damage <sup>(2)</sup> . Leprosy can result in serious disablement and disfigurement. The incubation period is 1 to 20 years. The infection is associated with poverty, crowding <sup>(2)</sup> , close contact with infected persons <sup>(3)</sup> , and poor personal hygiene <sup>(73)</sup>
<b>Transmission</b>	: how transmission occurs is not entirely clear. Probably via close contact with infected persons <sup>(3)</sup> (50% of the cases have had close contact with an affected person <sup>(4)</sup> ). Nasal discharges could play a role in transmission <sup>(3)</sup> . If there are more than 10 cases per 10,000 people, leprosy is seen as an important public health problem. Transmission in a population is believed to stop if there are less than 5 cases per 10,000 persons <sup>(2)</sup>
<b>Reservoir</b>	: humans, in rare occasions armadillos <sup>(2)</sup> . <i>Mycobacterium</i> appears to be present in soil <sup>(4)</sup>
<b>Water-related</b>	: the infection is possibly water-washed <sup>(29)</sup>
<b>Risk in disaster</b>	: the treatment of leprosy takes years and should be continuous; disasters can disrupt the treatment scheme <sup>(2)</sup>
<b>Remarks</b>	: in 1997 the WHO estimated the number of cases at 1,150,000 <sup>(84)</sup>

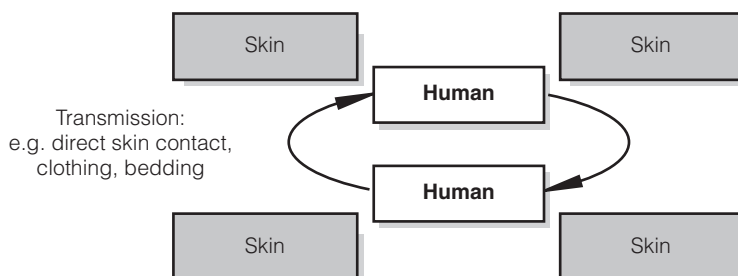
<b>Preventative measures</b>	<b>Potential effect</b>
Improving water availability is mentioned <sup>(29)</sup>	
Improved hygiene of the body is mentioned <sup>(73)</sup>	
Active detection of cases and their treatment <sup>(3)</sup>	
Health and hygiene promotion <sup>(3)</sup>	

## Scabies, *Sarcoptes scabiei*, Acariasis

An infection which affects the skin. The disease is linked to poor personal hygiene and crowding. Transmission is through direct contact.

<b>Pathogen</b>	: <i>Sarcoptes scabiei</i> <sup>(3)</sup> (mite) The infection is caused by a mite of 0.3 to 0.4 mm long <sup>(16)</sup> which makes burrows in the skin <sup>(73)</sup>
<b>Distribution</b>	: the infection occurs worldwide <sup>(47)</sup>
<b>Symptoms</b>	: symptoms are small linear burrows dug by the mite <sup>(3)</sup> , raised spots or small blisters on the skin (especially on wrists and hands), and itching <sup>(73)</sup> . Secondary infections are common <sup>(2)</sup> . 'Norwegian scabies' is a form of the infection with extensive scaling and crusting <sup>(3)</sup> . Children are most affected <sup>(16)</sup>
<b>Severity</b>	: though very uncomfortable, the infection itself is not severe <sup>(3)</sup> . Complications can be caused by secondary infections though <sup>(47)</sup>
<b>Incubation period</b>	: 2 to 6 weeks <sup>(73)</sup> for people infected for the first time. Persons who have been infected before will show symptoms 1 to 4 days after being infected <sup>(3)</sup>
<b>Duration</b>	: months
<b>Communicability</b>	: the infection is very contagious <sup>(47)</sup> . The infected person can spread the pathogen until treated successfully <sup>(3)</sup>

### Transmission cycle <sup>(3)</sup>



<b>Transmission</b>	: the infection is spread by a fertilised female mite <sup>(16)</sup> . The skin of an affected person is infective. Direct skin to skin contact will be the most common way of transmission. Transmission through clothing or bedding occurs, but is less common as the mites can only survive for a short period of time outside the human body <sup>(4)</sup> . An exception is 'Norwegian scabies', where the risk of transmission through clothes and bedding is high. It takes mites 2½ minutes to 'dig' into the skin <sup>(3)</sup>
<b>Reservoir</b>	: humans are the only reservoir <sup>(3)</sup>
<b>Vector/int. host</b>	: none
<b>Water-related</b>	: the infection is water-washed <sup>(73)</sup>
<b>Excreta-related</b>	: no

## ANNEXE 1: LISTING OF DISEASES

- Environment** : the pathogen is most common in conditions of poverty, overcrowding <sup>(3)</sup>, and poor personal hygiene. The infection occurs in all climates, but is widespread in the tropics <sup>(16)</sup>
- Risk in disaster** : the infection is a potential problem, especially in conditions of overcrowding and poor personal hygiene <sup>(47)</sup>
- Remarks** : A fully developed case of scabies may be infected with as little as 20 adult mites or even less <sup>(16)</sup>

Preventative measures	Potential effect
Improving water availability	(+ + +) <sup>(29)</sup>
Improving hygiene of body, clothes and bedding <sup>(73)</sup>	
Searching for cases and their contacts and treatment of these <sup>(3)</sup>	
Health and hygiene promotion <sup>(3)</sup>	

Treatment of individual cases is not enough, and all contacts (e.g. school, village) should be treated <sup>(73)</sup>. Where possible, 'Tetmosol soap' should be used <sup>(3)</sup>.

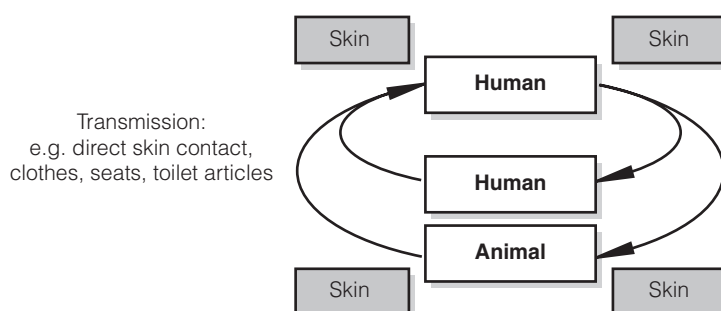
**Epidemic measures** : mass treatment and health and hygiene promotion <sup>(3)</sup>. If the infection is an important public health problem distribution of soap may be useful <sup>(47)</sup>

## Ringworm, *Tinea (capitis, favosa, corporis, barbae)*, *Dermatophytosis*, *Dermatomycosis*

A fungal infection spread by direct and indirect contact.

<b>Pathogen</b>	: <i>Microsporum</i> spp., <i>Trichophyton</i> spp., <i>Epidermophyton floccosum</i> <sup>(3)</sup> (Fungi) <sup>(73)</sup>
	The infection is caused by several fungi (moulds) adapted to live on human skin <sup>(16)</sup>
<b>Distribution</b>	: the infections occur worldwide <sup>(3)</sup>
<b>Symptoms</b>	: asymptomatic infections do occur <sup>(44)</sup> . <i>Tinea corporis</i> (ringworm) is found on the body, with a growing, ring-shaped mark. <i>Tinea capitis</i> occurs on the scalp in the form of small raised spots <sup>(3)</sup> , scaling, and baldness. <i>Tinea favosa</i> shows as yellowish, cup-like crusts. <i>Tinea barbae</i> occurs on bearded area <sup>(44)</sup> and results in scaling and baldness <sup>(3)</sup>
<b>Severity</b>	: the infection is not severe
<b>Incubation period</b>	: 4 to 14 days <sup>(73)</sup>
<b>Duration</b>	: -
<b>Communicability</b>	: as long as symptoms remain <sup>(3)</sup>

### Transmission cycle <sup>(3)</sup>



<b>Transmission</b>	: transmission occurs when the skin of a susceptible person comes into contact with the pathogen. Transmission can be direct through skin contact, or indirect through contaminated floors, seats, benches, toilet articles <sup>(3)</sup> , or clothes <sup>(73)</sup>
<b>Reservoir</b>	: reservoirs are humans, dogs, cats, cattle, other animals, and soil. Contaminated material can stay infectious for long periods <sup>(3)</sup>
<b>Vector/int. host</b>	: none
<b>Water-related</b>	: the infection is water-washed <sup>(73)</sup>
<b>Excreta-related</b>	: no
<b>Environment</b>	: common in most tropical countries. Especially in an environment with high humidity <sup>(16)</sup> and elevated temperatures <sup>(3)</sup> .
<b>Risk in disaster</b>	: the infection is not a priority in disasters <sup>(3)</sup>
<b>Remarks</b>	: -

## ANNEXE 1: LISTING OF DISEASES

Preventative measures	Potential effect
Improving water availability	(+ +) <sup>(29)</sup>
Improved hygiene of body and clothes <sup>(29)</sup>	
Care in contact with domestic animals <sup>(3)</sup>	
Search for cases and treatment <sup>(3)</sup>	
Health and hygiene promotion <sup>(3)</sup>	

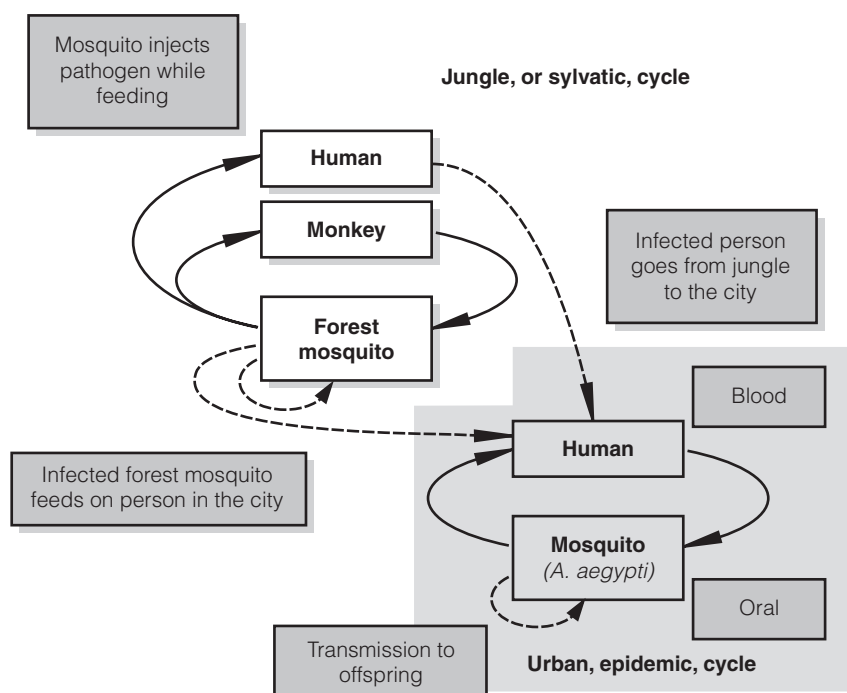
**Epidemic measures :** health and hygiene promotion and improvement of personal hygiene <sup>(3)</sup>

## Yellow fever

An infection transmitted by mosquitoes. There are two transmission cycles, the first occurs in the jungle and involves monkeys and forest mosquitoes, people become infected incidentally. The second, epidemic, cycle can occur when infected persons or mosquitoes are introduced in an urban environment.

<b>Pathogen</b>	: Yellow fever virus <sup>(73)</sup> (virus)
<b>Distribution</b>	: sub-Sahara Africa, Southern and Central America <sup>(44)</sup> . Because of control of <i>Ae.aegypti</i> , epidemic urban yellow fever has not occurred in America since decades <sup>(16)</sup> .
<b>Symptoms</b>	: asymptomatic infections are common, especially where the infection is endemic <sup>(16)</sup> . Symptoms are fever, headache, backache, nausea, vomiting, and jaundice <sup>(3)</sup> . In severe cases internal bleedings can occur <sup>(73)</sup> . In endemic areas the infection occurs mainly in childhood <sup>(16)</sup>
<b>Severity</b>	: where the infection is endemic the case fatality rate is under 5% <sup>(3)</sup> . In epidemics the case fatality rate can be 50% <sup>(73)</sup>
<b>Incubation period</b>	: 3 to 6 days <sup>(73)</sup>
<b>Duration</b>	: a mild attack will last some days. The severe form may last up to 2 weeks <sup>(44)</sup>
<b>Communicability</b>	: people are infective for mosquitoes during the first 3 to 5 days of the illness <sup>(3)</sup> . Lifelong immunity to the pathogen follows after infection <sup>(16)</sup> . Mosquitoes, once infected, remain infective for life <sup>(3)</sup>

### Transmission cycle <sup>(73)</sup>



## ANNEXE 1: LISTING OF DISEASES

Two transmission cycles exist: the sylvatic cycle and the urban, epidemic, cycle. The sylvatic cycle occurs in the jungle. This cycle involves monkeys and forest mosquitoes. Monkeys are usually not affected by the infection (if monkeys start dying however, it could be an indication that the infection will spread to humans soon) <sup>(73)</sup>. Man does not play an essential role in the sylvatic cycle <sup>(3)</sup>. In this cycle people are infected incidentally when they get bitten by infected forest mosquitoes, either because they went into the jungle and got bitten (most common), or because forest mosquitoes leave the jungle <sup>(73)</sup>. When an infected person goes back to the city, or when infected forest mosquitoes infect someone in the urban environment, the urban, epidemic, cycle can begin. This cycle involves humans and the mosquito *Aedes aegypti* <sup>(3)</sup>. Large outbreaks can occur where *Aedes aegypti* is found in large numbers with many non-immune persons <sup>(16)</sup>.

<b>Transmission</b>	: mosquitoes are infected when they feed on the blood of a person or monkey who carries the infection <sup>(73)</sup> . At 37°C mosquitoes will become infective 4 days after biting an infected person; at 18°C this will be prolonged to 18 days <sup>(16)</sup> . Transmission to a person occurs through the bite of an infected mosquito <sup>(73)</sup> .
<b>Reservoir</b>	: monkeys are the reservoir for the rural cycle. The reservoir for the urban cycle are humans <sup>(73)</sup> . As infected mosquitoes can pass the pathogen to their offspring, they too are a reservoir of the pathogen. This transmission from mosquito to its young ensures that the infection can be passed on between the rainy seasons <sup>(83)</sup>
<b>Vector/int. host</b>	: mosquitoes are the vector of the disease: in rural environment in Africa <i>Aedes</i> spp. serves as vector; while in America <i>Aedes</i> spp. and <i>Haemagogus</i> spp. are the main vectors. In urban environment <i>Aedes aegypti</i> is the main vector <sup>(73)</sup>
<b>Water-related</b>	: the infection is spread by a water-related insect vector <sup>(15)</sup>
<b>Excreta-related</b>	: no
<b>Environment</b>	: the infection occurs in the tropics. In the rural, or sylvatic, cycle the infection is most common in males working in forested areas <sup>(3)</sup> . By cutting forests man encourages transmission of the infection to humans <sup>(16)</sup> . Epidemic or urban yellow fever can occur where the mosquito <i>Aedes aegypti</i> and enough non-immune people are present. The infection is linked to the rainy season <sup>(44)</sup>
<b>Risk in disaster</b>	: the infection could be a problem in disasters <sup>(47)</sup>
<b>Remarks</b>	: the WHO estimates that there are 200,000 cases of yellow fever per year resulting in 30,000 deaths <sup>(83)</sup> One confirmed urban case is considered an outbreak <sup>(83)</sup> and occurrence of the infection should be notified to the WHO <sup>(3)</sup> .

## CONTROLLING AND PREVENTING DISEASE

Preventative measures	Potential effect
Urban epidemic yellow fever:	
Control of <i>Aedes aegypti</i> (see Annexe 3)	(+ + +) <sup>(2)</sup>
Immunisation <sup>(3)</sup>	
Patients should be isolated from mosquitoes <sup>(16)</sup>	
Health and hygiene promotion	
Rural of sylvatic yellow fever:	
Immunisation <sup>(3)</sup>	
Avoiding being bitten by mosquitoes <sup>(3)</sup>	
Patients should be isolated from mosquitoes <sup>(16)</sup>	
Health and hygiene promotion	

To prevent an epidemic, at least 80% of the population must be immunised <sup>(83)</sup>.

**Epidemic measures :** mass immunisation and vector control <sup>(3)</sup>

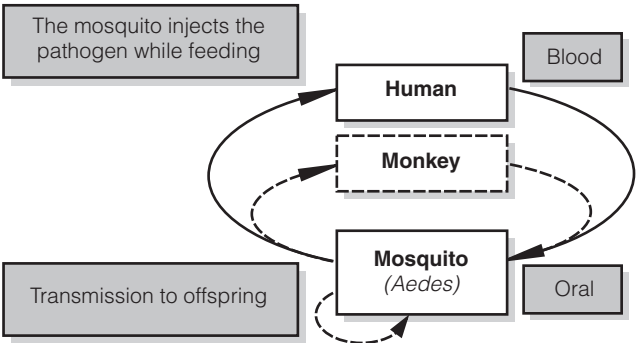


**Dengue fever, Dengue haemorrhagic fever, Breakbone fever**

A mosquito-borne infection. The infection is seen as the most important Arbovirus (arthropod-borne virus) worldwide and can cause large, explosive outbreaks. Dengue fever is less dangerous than dengue haemorrhagic fever which can have a case fatality rate of 50%.

- Pathogen** : Dengue virus <sup>(15)</sup> (virus)  
There are 4 different serotypes of dengue viruses, which can all cause dengue fever and dengue haemorrhagic fever <sup>(3)</sup>.  
The cause of dengue haemorrhagic fever is not entirely clear as it is caused by the same viruses as dengue fever. It is believed that the disease occurs as a reaction of the body to a new serotype of dengue virus in people who have been infected with another serotype of virus before <sup>(2)</sup>
- Distribution** : dengue fever occurs more or less worldwide  
Dengue haemorrhagic fever occurs in South and South-east Asia, China, India, and Central and South America <sup>(3)</sup>
- Symptoms** : asymptomatic infections are common <sup>(47)</sup>. Symptoms for dengue fever are fever, headache, severe joint/muscle pain <sup>(2)</sup>, minor bleedings, and skin rashes <sup>(3)</sup>. In endemic areas the infection affects mostly children <sup>(16)</sup>.  
The symptoms of dengue haemorrhagic fever are fever, shock and bleedings <sup>(3)</sup>. The infection is most frequent in children under 10 years of age <sup>(4)</sup>
- Severity** : Dengue fever is normally not fatal <sup>(4)</sup>. The disease is usually more severe in adults than in children.  
Contrary to dengue fever, dengue haemorrhagic fever is a potentially fatal disease which, if untreated, can have a case fatality rate of up to 50%. With adequate treatment this can be brought down to 1 to 2% <sup>(3)</sup>
- Incubation period** : 3 to 15 days <sup>(73)</sup>
- Duration** : the infection normally lasts for up to some weeks <sup>(44)</sup>
- Communicability** : people can infect mosquitoes as long as fever persists. After infection people become immune to the serotype which infected them, but not to the other serotypes. Mosquitoes, once infected, remain infective for life <sup>(3)</sup>

**Transmission cycle <sup>(3)</sup>**



- Transmission** : Mosquitoes become infective 8 to 12 days after feeding on a person carrying the virus <sup>(3)</sup>. People are infected through the bite of an infected mosquito <sup>(73)</sup>. Large, explosive, outbreaks are possible <sup>(3)</sup>. Especially where *Aedes aegypti*

## CONTROLLING AND PREVENTING DISEASE

occurs in urban zones with high population densities <sup>(2)</sup>. In epidemics attack rates of susceptible people are often 40 to 50%, but can be up to 90% <sup>(83)</sup>. As there are 4 serotypes of viruses which can all cause epidemics in a population, previous outbreaks do not necessarily mean that the population is immune to the infection <sup>(16)</sup>

<b>Reservoir</b>	: humans are the main reservoir of the pathogen <sup>(2)</sup> . Monkeys can be reservoirs in South-east Asia and West Africa <sup>(3)</sup> . It seems that mosquitoes can transmit the pathogen to their offspring, but the role of this in the transmission of the pathogen is not clear <sup>(16)</sup>
<b>Vector/int. host</b>	: Mosquitoes are the vector of the infection. Different species of <i>Aedes</i> are vectors, with <i>Aedes aegypti</i> being the most important <sup>(3)</sup> . <i>Ae.albopictus</i> and <i>Ae.scutellaris</i> are other important vectors of the infection <sup>(73)</sup>
<b>Water-related</b>	: the infection is spread by a water-related insect vector <sup>(15)</sup>
<b>Excreta-related</b>	: no
<b>Environment</b>	: transmission occurs throughout the year. In many areas there is an increase of cases in the rainy season <sup>(16)</sup> . Outbreaks are possible where the vectors are present in a susceptible population. Outbreaks occur as well in urban as in rural environment <sup>(3)</sup>
<b>Risk in disaster</b>	: the infection can be a risk in case of a disaster <sup>(47)</sup>
<b>Remarks</b>	: the WHO estimates the number of cases per year at 50,000,000 <sup>(83)</sup> . Dengue fever is seen as the most important arthropod-borne viral disease (Arboviral infection) of the moment. It is expected that in the future the number of cases will increase <sup>(47)</sup>

Preventative measures	Potential effect
Control of <i>Ae.aegypti</i> <sup>(16)</sup> (see Annexe 3)	
Patients should be isolated from mosquitoes <sup>(16)</sup>	
Health and hygiene promotion <sup>(3)</sup>	

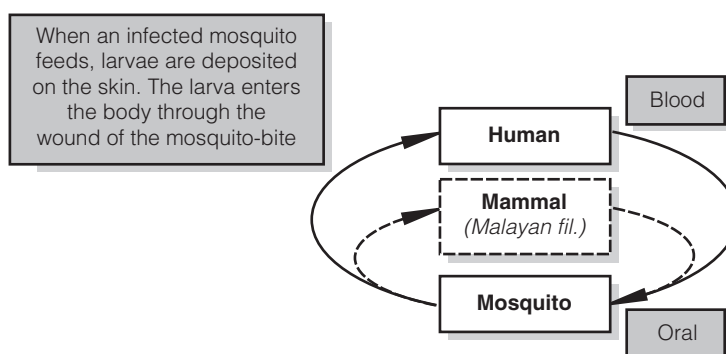
**Epidemic measures :** control of mosquitoes <sup>(3)</sup>

## ***Filariasis, Bancroftian filariasis, Malayan filariasis, Elephantiasis***

A mosquito-borne infection. Severe infections can result in elephantiasis.

<b>Pathogen</b>	: <i>Wuchereria bancrofti</i> causes bancroftian filariasis <i>Brugia Malayi</i> causes Malayan filariasis <sup>(15)</sup> (Helminths) The worms causing the infections are up to 10 cm long and live in the lymphatic system <sup>(2)</sup>
<b>Distribution</b>	: <i>W.bancrofti</i> : the infection occurs in Asia, Africa, the Pacific islands, South and Central America <sup>(3)</sup> <i>B.Malayi</i> : the infection can be found in India, South-east Asia and China <sup>(15)</sup>
<b>Symptoms</b>	: asymptomatic infections are common <sup>(3)</sup> . Symptoms are intermittent attacks of fever, enlarged lymph nodes, and swellings that do not recede. Severe cases can develop elephantiasis (permanent enlargement of scrotum, leg, breast, or arm) <sup>(2)</sup>
<b>Severity</b>	: the infection is rarely fatal, but can cause severe disability. Malayan filariasis is usually less severe than bancroftian filariasis <sup>(2)</sup>
<b>Incubation period</b>	: 3 to 12 months <sup>(73)</sup>
<b>Duration</b>	: the life span of the worms is up to 12 years <sup>(73)</sup> , but 20 years is mentioned <sup>(16)</sup> . The disease can cause permanent disfigurement and disablement <sup>(2)</sup>
<b>Communicability</b>	: the time the worms continue to shed microfilariae is not clear. Periods mentioned are from 2½ years <sup>(73)</sup> to 20 years (it is the microfilariae which infect the mosquitoes) <sup>(16)</sup>

### **Transmission cycle <sup>(73)</sup>**



<b>Transmission</b>	: the worms in the lymphatic system produce microfilariae which are present in the blood of an infected person. When a mosquito ingests microfilariae in a blood meal, it will become infected <sup>(73)</sup> . The mosquito becomes infective to people from 10 days after the infective blood meal <sup>(16)</sup> up to 21 days in colder temperatures. When an infected mosquito bites a person, the larva of the worm will emerge and be deposited on the skin. The larva will have to find its way (generally through the wound of the mosquito bite) in the human body. It is estimated that around 15,500 infective bites are needed to result in a reproducing couple of worms <sup>(73)</sup> .
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## CONTROLLING AND PREVENTING DISEASE

<b>Reservoir</b>	In general no more than 40 to 50% of the population is infected <sup>(16)</sup> : <i>W.bancrofti</i> : humans are the only reservoir <sup>(3)</sup> <i>B.Malayi</i> : reservoirs are humans, rodents, monkeys <sup>(15)</sup> , and cats <sup>(3)</sup>
<b>Vector/int. host</b>	: mosquitoes are the vector of the infection. <i>W.bancrofti</i> : in the urban environment the main vector is <i>Culex quinquefasciatus</i> <sup>(2)</sup> . In rural environment in Asia and Africa <i>Anopheles</i> is the main vector. In the South pacific islands <i>Aedes</i> is an important vector <sup>(16)</sup> . <i>B.Malayi</i> : the main vector is <i>Mansonia</i> . In towns <i>Anopheles</i> plays a role in transmission <sup>(2)</sup> . <i>Aedes</i> plays a role in the transmission of the infection too <sup>(3)</sup>
<b>Water-related</b>	: the infection is transmitted by a water-related insect vector <sup>(15)</sup>
<b>Excreta-related</b>	: <i>W.bancrofti</i> : one of the mosquitoes transmitting the infection is an excreta-related insect vector ( <i>Culex quinquefasciatus</i> ) <sup>(73)</sup>
<b>Environment</b>	: the infection occurs mainly in hot and humid climates <sup>(16)</sup> . The temperature range for transmission is between 17°C and 32°C, with an optimum of 26°C <sup>(73)</sup> . Pollution of freshwater and inadequate sanitation are favourable for the urban vector of bancroftian filariasis <i>Culex quinquefasciatus</i> <sup>(16)</sup>
<b>Risk in disaster</b>	: the infection will not be a priority in case of a disaster <sup>(3)</sup>
<b>Remarks</b>	: it is estimated that 250,000,000 people are infected with <i>W. bancrofti</i> worldwide <sup>(73)</sup> . 90% Of the infections occur in Asia <sup>(2)</sup>

Preventative measures	Potential effect
Installation of piped water supplies and its adequate maintenance	(+) <sup>(29)</sup>
Excreta in sanitary structures should be inaccessible to mosquitoes <sup>(73)</sup> ( <i>C.quinquefasciatus</i> in bancroftian filariasis)	(+) <sup>(73)</sup>
Control of mosquitoes which are responsible for transmission <sup>(73)</sup> (see Annexe 3)	
Mass treatment is the main method of control <sup>(73)</sup>	
Health and hygiene promotion <sup>(3)</sup>	

Vector control methods will only show a reduction in infections after 2 to 3 years. Where *Anopheles* is the vector, mosquito control will have to be maintained for 10 years, or mass treatment for at least 5 years, for the infection to disappear.

Where *Culex* is responsible for transmission, control is more difficult. This because *Culex* is more easily infected with the pathogen than *Anopheles*. A limited reduction in exposure to mosquitoes can be effective in reducing infection in a population <sup>(73)</sup>.

**Epidemic measures** : mass treatment and vector control <sup>(16)</sup> (it will take time before the effects will show) <sup>(3)</sup>

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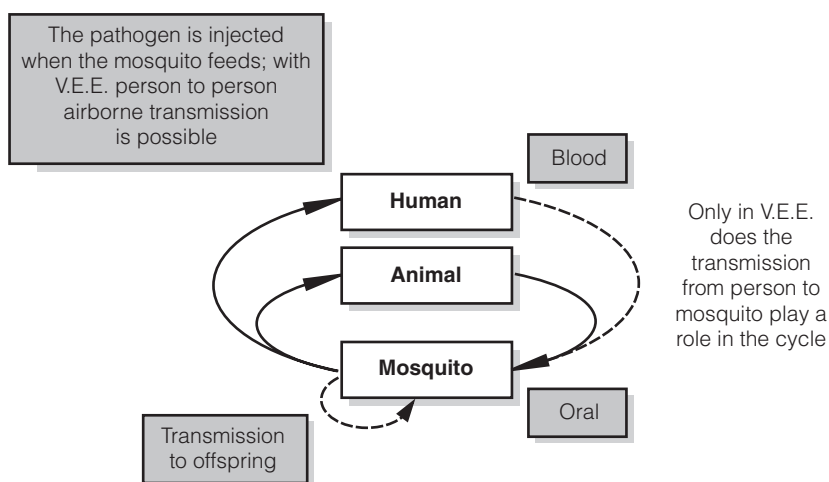
***Encephalitis (Mosquito-borne arboviral): Japanese encephalitis/ Murray Valley encephalitis/ St. Louis encephalitis/ Rocio encephalitis/ Eastern equine encephalitis/ Western equine encephalitis/ Venezuelan equine encephalitis***

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A group of mosquito-borne infections. The infections can be severe, and can present as encephalitis.

<b>Pathogen</b>	: several arboviruses (arthropod-borne viruses) named after the infection they cause <sup>(3)</sup>
<b>Distribution</b>	: Japanese encephalitis (J.E.): South-east Asia, East Asia, India, Sri Lanka, former USSR <sup>(73)</sup> , and the Pacific islands. Murray valley encephalitis (M.V.E.): Australia and New Guinea. St. Louis encephalitis (S.L.E.): Trinidad, Jamaica, Panama, Brazil, and North America. Rocio encephalitis (R.E.): Brazil <sup>(3)</sup> . Eastern equine encephalitis (E.E.E.): North America, Central America, South America, and the Caribbean islands. Western equine encephalitis (W.E.E.): North America, Central America, and South America. Venezuelan equine encephalitis (V.E.E.): northern South America, Central America, the Caribbean, and the USA <sup>(73)</sup>
<b>Symptoms</b>	: most infections are asymptomatic. In J.E.: 1 infection in 1,000 is symptomatic <sup>(44)</sup> ; E.E.E.: in adults 1 out of 4-50 infections are symptomatic, in children this is 1 out of 2-8; W.E.E. in adult less than 1 in 1,000 infections are symptomatic, in children 1 in 8-50 <sup>(16)</sup> . Symptoms are headache, high fever, and coma <sup>(73)</sup> . Severe cases will develop encephalitis <sup>(3)</sup>
<b>Severity</b>	: the case fatality rate for J.E. can be up to 50% <sup>(16)</sup> , M.V.E. up to 60% <sup>(73)</sup> , for E.E.E. it can be 50 to 80% <sup>(44)</sup> , while for W.E.E. the case fatality rate is 10% <sup>(16)</sup> . Children and older people are most at risk <sup>(73)</sup> . V.E.E. can be fatal, and the infection is especially dangerous in the malnourished <sup>(16)</sup>
<b>Incubation period</b>	: all infections have incubation periods of 5 to 15 days except for V.E.E. which has an incubation period of 2 to 6 days <sup>(3,73)</sup>
<b>Duration</b>	: V.E.E. usually lasts 3 to 5 days <sup>(3)</sup>
<b>Communicability</b>	: only in V.E.E. will people be infectious to mosquitoes. For all these infections mosquitoes remain infective for life <sup>(3)</sup>

## Transmission cycle <sup>(3)</sup>



## Transmission

: mosquitoes are infected by feeding on an infected host, or by receiving the pathogen from their parents <sup>(3)</sup>. The normal transmission cycles of all these infections are between animals and mosquitoes <sup>(2)</sup>. Infections in persons are accidental, as are infections in horses for J.E., E.E.E., W.E.E., and V.E.E. <sup>(16)</sup>. With all infections, except V.E.E., it is unusual that humans (or horses) infect mosquitoes <sup>(3)</sup>. In J.E. birds can spread the infection from the rural to the urban environment. Human infection occurs if there is a high density of mosquitoes. In W.E.E. outbreaks in horses often precede outbreaks in humans <sup>(16)</sup>.

The pathogens are transmitted to people when an infected mosquito takes a blood meal.

With V.E.E. mosquitoes can be infected by people and horses, and transmission is possible from person to person through air-borne droplets <sup>(3)</sup>

## Reservoir

: J.E.: birds and pigs <sup>(3)</sup>

M.V.E.: birds

S.L..E.: birds

R.E.: not certain, possibly birds <sup>(73)</sup>

E.E.E.: wild and domestic birds <sup>(16)</sup> and rodents <sup>(73)</sup>

W.E.E.: wild and domestic birds <sup>(16)</sup>

For these infections humans do not play a role as reservoirs. For J.E., E.E.E., and W.E.E. horses can develop the infection, but are not important as reservoir <sup>(3)</sup>.

V.E.E.: mainly rodents. Contrary to the other infections, people and horses do play a role as reservoir for the pathogen for this infection <sup>(3)</sup>. Over 150 animal species can be infected with the pathogen <sup>(16)</sup>

## Vector/int. host

: Mosquitoes are the vectors of the infection.

J.E.: *Culex tritaeniorhynchus* is the main vector of the infection in North Asia and Japan. In the eastern parts of the former USSR the main vector is *C.pipiens*, in Malaysia *C.gelidus*, and in India *C.vishnui* <sup>(16)</sup>

M.V.E.: *Culex annulirostris*

## ANNEXE 1: LISTING OF DISEASES

	S.L.E.: <i>Culex tarsalis</i> , other species of <i>Culex</i>
	R.E.: probably mosquitoes <sup>(73)</sup>
	E.E.E.: <i>Culiseta melanura</i> , <i>c.morsitans</i> , <i>Aedes sollicitans</i> , <i>Ae.taeniorhynchus</i> <sup>(16)</sup> , and species of <i>Culex</i> <sup>(73)</sup>
	W.E.E.: <i>Culex tarsalis</i> , and <i>Culiseta melanura</i> where <i>C.tarsalis</i> does not occur <sup>(16)</sup>
	V.E.E.: species from <i>Culex</i> , <i>Anopheles</i> <sup>(16)</sup> , and others <sup>(3)</sup>
<b>Water-related</b>	: the infection is transmitted by a water-related insect vector <sup>(73)</sup>
<b>Excreta-related</b>	: some <i>Culex</i> spp. are excreta-related insect vectors
<b>Environment</b>	: J.E. is associated to rice fields and to keeping pigs <sup>(73)</sup> . E.E.E. has been linked to a presence of salt marches and swamps <sup>(16)</sup>
<b>Risk in disaster</b>	: the infections are probably not a risk in disasters <sup>(3)</sup>
<b>Remarks</b>	: E.E.E. can cause a high mortality in wild and domestic birds. Most infected horses die within a few days <sup>(16)</sup>

Preventative measures	Potential effect
Control of mosquitoes <sup>(3)</sup> (see Annexe 3)	
Keeping domestic animals at a distance from living quarters (birds, pigs) <sup>(3)</sup>	
For J.E. immunisation is possible <sup>(47)</sup>	
For J.E. immunisation of pigs is a possibility <sup>(3)</sup>	
For V.E.E. immunisation of horses could be an option <sup>(3)</sup>	
Health and hygiene promotion <sup>(3)</sup>	

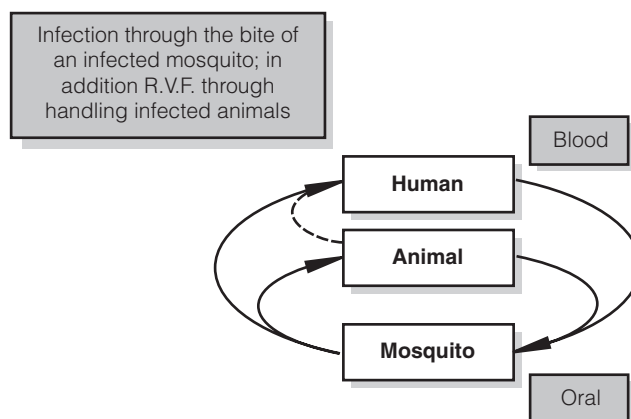
**Epidemic measures :** vector control <sup>(3)</sup>

## Arboviral fevers mosquito-borne: Rift valley fever/ West Nile fever/ Bwamba virus disease/ Group C virus fever/ Oropouche virus disease

Mosquito-borne infections. The infections usually present themselves as fevers. Some of these infections can result in outbreaks.

<b>Pathogen</b>	: the infections are caused by arboviruses specific to the infection <sup>(3)</sup>
<b>Distribution</b>	: Rift valley fever (R.V.F.): Africa <sup>(73)</sup> West Nile fever (W.N.F.): Africa, South-east Asia, and France <sup>(2)</sup> Bwamba virus disease (B.V.D.): Africa Group C virus fever (G.C.V.F.): occurs in the tropical parts of South America, Panama, and Trinidad <sup>(3)</sup> Oropouche virus disease (O.V.D.): South America and Trinidad <sup>(73)</sup>
<b>Symptoms</b>	: asymptomatic infections are common <sup>(3)</sup> . General symptoms are headache, fever and, malaise <sup>(73)</sup> . Often a light form of conjunctivitis will occur. Infections of R.V.F. may show eye problems, meningitis, and bleedings <sup>(3)</sup> . In W.N.F. a skin rash is common; and inflammation of the brain and its membranes (meningoencephalitis) may occur. Meningoencephalitis is possible in O.V.D.. In endemic areas the infections are most common in children <sup>(73)</sup>
<b>Severity</b>	: variable <sup>(3)</sup>
<b>Incubation period</b>	: 3 to 12 days <sup>(73)</sup>
<b>Duration</b>	: usually up to one week <sup>(3)</sup>
<b>Communicability</b>	: mosquitoes remain probably infected for life <sup>(3)</sup>

### Transmission cycle <sup>(3)</sup>



<b>Transmission</b>	: people get infected through the bite of an infective mosquito. R.V.F. and O.V.D. can cause larger outbreaks <sup>(3)</sup>
<b>Reservoir</b>	: R.V.F.: domestic animals <sup>(73)</sup> (e.g. sheep) <sup>(3)</sup> W.N.F.: birds <sup>(73)</sup> B.V.D.: unknown G.C.V.F.: rodents <sup>(3)</sup> O.V.D.: monkeys, sloths, and birds <sup>(73)</sup>
<b>Vector/int. host</b>	: the vectors of these infections are mosquitoes: R.V.F.: several species of <i>Aedes</i> ( <i>Ae.caballus</i> <sup>(73)</sup> , <i>Ae.mcintoshi</i> <sup>(3)</sup> ), and <i>Culex</i> ( <i>C.quinquefasciatus</i> , <i>C.theileri</i> ) <sup>(73)</sup>



## ANNEXE 1: LISTING OF DISEASES

	W.N.F.: <i>Culex</i> spp. <sup>(73)</sup>
	B.V.D.: <i>Aedes</i> spp.
	G.C.V.F.: species of <i>Aedes</i> and <i>Culex</i> <sup>(3)</sup>
	O.V.D.: possibly <i>Culicoides</i> <sup>(73)</sup>
<b>Water-related</b>	: the infections are transmitted by water-related insect vectors <sup>(3)</sup>
<b>Excreta-related</b>	: <i>Culex quinquefasciatus</i> is an excreta-related insect vector
<b>Environment</b>	: the infections are most common in rural areas; though outbreaks have occurred in urban areas with R.V.F. and O.V.D.. R.V.F. is often linked to the butchering of infected animals <sup>(3)</sup>
<b>Risk in disaster</b>	: usually the infections will not be a risk in disasters <sup>(3)</sup>
<b>Remarks</b>	: -

Preventative measures	Potential effect
Control of mosquitoes <sup>(3)</sup> (see Annexe 3)	
Cases should be isolated from mosquitoes <sup>(3)</sup>	
For R.V.F.: care should be taken in handling infected animals <sup>(3)</sup>	
For R.V.F.: sheep, goats and cattle can be immunised <sup>(3)</sup>	
Health and hygiene promotion <sup>(3)</sup>	

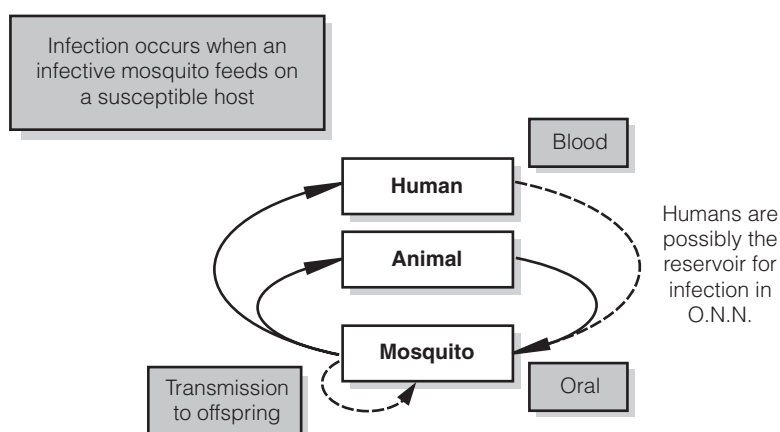
**Epidemic measures :** control of mosquitoes; for R.V.F. immunise sheep, goats and cattle <sup>(3)</sup>

## **Arboviral arthritis mosquito-borne: Chikungunya virus disease/ O'nyong-nyong/ Sindbis virus disease, Ockelbo virus disease/ Mayaro virus disease/ Ross river fever**

Mosquito-borne infections. Typical symptoms of these infections are fever and arthritis.

<b>Pathogen</b>	: arboviruses specific to the infections <sup>(3)</sup>
<b>Distribution</b>	: Chikungunya virus disease (C.V.D.): Africa, India, Sri Lanka, South-east Asia <sup>(73)</sup> , and the Philippines <sup>(3)</sup> . O'nyong-nyong (O.N.N.): sub-Saharan Africa <sup>(2)</sup> . Sindbis virus disease (S.V.D.): throughout the old world and Australia. Mayaro virus disease (M.V.D.): occurs in the northern parts of South America <sup>(3)</sup> . Ross river fever (R.R.F): the Pacific islands, Australia and New Zealand <sup>(73)</sup>
<b>Symptoms</b>	: symptoms are fever with arthritis (inflammation of the joints). Skin rashes are common. In India and South-east Asia C.V.D. can cause bleedings <sup>(3)</sup>
<b>Severity</b>	: -
<b>Incubation period</b>	: 3 to 12 days <sup>(73)</sup>
<b>Duration</b>	: the arthritis can last days to months <sup>(3)</sup>
<b>Communicability</b>	: mosquitoes are infective for life <sup>(2)</sup>

### **Transmission cycle <sup>(3)</sup>**



<b>Transmission</b>	: mosquitoes either receive the pathogen from their parents, or are infected when feeding on an infected host. People are infected when bitten by an infective mosquito. R.R.F. can cause major outbreaks <sup>(3)</sup>
<b>Reservoir</b>	: C.V.D.: rodents, baboons, monkeys and bats O.N.N.: possibly humans <sup>(73)</sup> S.V.D.: birds <sup>(3)</sup> M.V.D.: - R.R.F.: rodents <sup>(73)</sup>

## ANNEXE 1: LISTING OF DISEASES

	with most of these infections mosquitoes can transmit the infections to their offspring, which makes them reservoirs of the pathogens <sup>(3)</sup>
<b>Vector/int. host</b>	: the vector of these infections are mosquitoes: C.V.D.: <i>Aedes aegypti</i> , <i>Ae.africanus</i> , <i>Ae.luteocephalus</i> , <i>Culex</i> spp. <sup>(73)</sup> O.N.N.: species of <i>Anopheles</i> <sup>(3)</sup> ( <i>A.gambiae</i> , <i>A.funestus</i> ) <sup>(73)</sup> S.V.D.: <i>Culex</i> spp. M.V.D.: <i>Mansonia</i> spp. and <i>Haemagogus</i> spp. R.R.F.: <i>Culex annulirostris</i> , <i>Aedes vigilax</i> , <i>Ae.polynesiensis</i> , and other <i>Aedes</i> spp. <sup>(3)</sup>
<b>Water-related</b>	: the infections are transmitted by water-related insect vectors <sup>(3)</sup>
<b>Excreta-related</b>	: some may be excreta-related insect vectors
<b>Environment</b>	: where the right mosquito vector is found
<b>Risk in disaster</b>	: these infections will not be a priority in case of a disaster <sup>(3)</sup>
<b>Remarks</b>	: -

Preventative measures	Potential effect
Control of mosquitoes <sup>(3)</sup> (see Annexe 3)	
Health and hygiene promotion <sup>(3)</sup>	

**Epidemic measures :** control of mosquitoes <sup>(3)</sup>

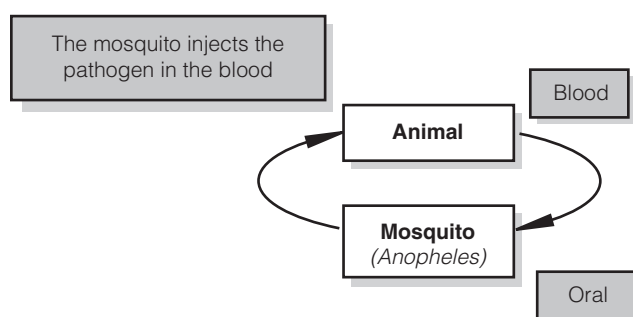
## Malaria

A mosquito-borne infection. Every year an estimated 300,000,000 cases occur <sup>(73)</sup>. Large outbreaks are possible in non-immune populations.

<b>Pathogen</b>	: <i>Plasmodium falciparum</i> ( <i>P.falc.</i> ), <i>Plasmodium vivax</i> ( <i>P.viv.</i> ), <i>Plasmodium malariae</i> ( <i>P.mal.</i> ), and <i>Plasmodium ovale</i> ( <i>P.oval.</i> ) (protozoa) <sup>(73)</sup>
<b>Distribution</b>	: <i>P.falc.</i> : worldwide in the tropics and subtropics <sup>(3)</sup> . <i>P.viv.</i> : worldwide in temperate zones, the subtropics, and the tropics <sup>(73)</sup> . The infection is rare in sub-Saharan Africa <sup>(16)</sup> . <i>P.mal.</i> : in most areas where malaria occurs <sup>(16)</sup> . The pathogen is most common in Africa <sup>(44)</sup> . <i>P.oval.</i> : rare outside West Africa <sup>(16)</sup>
<b>Symptoms</b>	: where malaria is common, people will have built a resistance to the pathogen, and many infections will be light or asymptomatic. Some of the general symptoms of a malaria attack are shivering, peaks of fever, anaemia, enlarged spleen, and jaundice. <i>P.falc.</i> can cause severe jaundice, delirium, convulsions <sup>(2)</sup> , shock, and coma. Infections of <i>P.viv.</i> , <i>P.mal.</i> , and <i>P.oval.</i> show recurrent peaks in fever with 1, 2, or 3 day intervals <sup>(3)</sup> . If untreated, relapses can occur. Attacks of <i>P.falc.</i> can reoccur in the year following the initial infection. Relapses are possible for over 30 years with <i>P.mal.</i> . Relapses of <i>P.viv.</i> and <i>P.oval.</i> may occur for up to 5 years, even if the infection was treated <sup>(2)</sup>
<b>Severity</b>	: attacks of <i>P.falc.</i> are usually the most severe, and almost all deaths and severe illnesses are caused by this pathogen <sup>(16)</sup> . Most at risk are young children who have not yet developed an immunity, pregnant women, and non-immune people <sup>(73)</sup> . In non-immune persons the case fatality rate for <i>P.falc.</i> is over 10% <sup>(3)</sup> . Severe disease with <i>P.viv.</i> , <i>P.mal.</i> , and <i>P.oval.</i> are unusual <sup>(16)</sup> ; still, fatal infections can occur in weakened people <sup>(3)</sup>
<b>Incubation period</b>	: <i>P.falc.</i> : 7 to 14 days <sup>(3)</sup> . <i>P.viv.</i> : 12 to 17 days. In temperate climates the incubation period may be prolonged to up to 9 months. <i>P.mal.</i> : 18 to 40 days <sup>(73)</sup> . <i>P.oval.</i> : usually 8 to 14 days. The incubation period may be delayed with 10 months or longer <sup>(3)</sup>
<b>Duration</b>	: usually the illness will last for one week to one month. Relapses can occur though <sup>(3)</sup> , especially if the infection was not treated <sup>(2)</sup>
<b>Communicability</b>	: mosquitoes can be infected by humans for a relatively long period if the infection was not treated: <i>P.falc.</i> for up to 1 year, <i>P.viv.</i> for 1 to 2 years, <i>P.mal.</i> for up to 3 years. Mosquitoes remain infective for life <sup>(3)</sup>

## ANNEXE 1: LISTING OF DISEASES

### Transmission cycle <sup>(73)</sup>



<b>Transmission</b>	<p>: <i>Anopheles</i> mosquitoes pick the pathogen up when feeding on an infected person. The time it takes before the mosquito becomes infective varies with temperature. The colder the environment, the longer the mosquito takes to become infective:</p> <p><i>P.falc.</i> takes 9 days at 30°C and 20 days at 20°C.  <i>P.viv.</i> takes 7 days at 30°C and 16 days at 20°C.  <i>P.mal.</i> takes 15 days at 30°C and 30 days at 20°C.</p> <p>This should be compared to the average life expectancy of a mosquito which is shorter than 30 days <sup>(73)</sup>.</p> <p>A person is infected when bitten by an infective mosquito.</p> <p>People will build up a resistance to severe malaria if they are regularly exposed <sup>(2)</sup>. Where transmission rates of <i>P.falc.</i> are high, local adults will never develop severe malaria. Where transmission rates are lower, severe illness will occur at all ages <sup>(16)</sup>. The immunity which is built up will be lost in some years if the individual does not come into contact with the pathogen during this time <sup>(2)</sup>. If transmission is possible all year round, endemic malaria will occur. If transmission is only possible every few years (e.g. because of exceptional climatic circumstances), there will be a large risk of outbreaks <sup>(73)</sup>.</p>
<b>Reservoir</b>	: people are the only important reservoir for malaria <sup>(3)</sup>
<b>Vector/int. host</b>	<p>: the vectors of the infection are <i>Anopheles</i> mosquitoes <sup>(3)</sup>.</p> <p>How effective the mosquito is in transmitting the pathogen depends on its length of survival, its preferred source of blood (only man, or preferably animal and incidentally man) and other factors. All anopheles feed at night-time, making this the dangerous period. Mosquitoes can adapt to long-term changes in environment, like lighting and use of insecticides <sup>(73)</sup>.</p>
<b>Water-related</b>	: malaria is transmitted by a water-related insect vector <sup>(73)</sup>
<b>Excreta-related</b>	: no
<b>Environment</b>	<p>: transmission occurs only at temperatures between 16°C and 33°C and at altitudes below 2,000 metres <sup>(16)</sup>. Temperatures below which the pathogen can not be maintained: <i>P.falc.</i> below 19°C, <i>P.viv.</i> below 17°C, <i>P.mal.</i> below 20°C <sup>(73)</sup>. High humidity is favourable to the vector. Malaria is often a seasonal infection with a peak in the rainy season. If the rains are too intense the number of mosquitoes will reduce though. Transmission of malaria is influenced by many factors related to the population, the vectors, and the environment. Changes in use of land and deforestation can have important effects on transmission <sup>(16)</sup></p>
<b>Risk in disaster</b>	: the infection is a risk in case of disasters <sup>(3)</sup>

## CONTROLLING AND PREVENTING DISEASE

**Remarks** : every year an estimated 3,000,000 people are killed by malaria <sup>(73)</sup>. Most of these deaths are children in Africa. The number of cases of malaria in the world is increasing <sup>(16)</sup>. *P.falc.* has in many areas built up a resistance to commonly used anti-malarial drugs <sup>(44)</sup>.

Preventative measures	Potential effect
Installing piped water and maintenance of the system	(+) <sup>(29)</sup>
Control of mosquitoes (see Annexe 3)	(+++) <sup>(47)</sup>
Health and hygiene promotion <sup>(73)</sup>	

The most effective measures of vector control will depend on the mosquitoes which transmit malaria, the environment in which transmission occurs, and the population affected. A good understanding of the local circumstances will be needed to plan an appropriate mosquito control programme <sup>(73)</sup>.

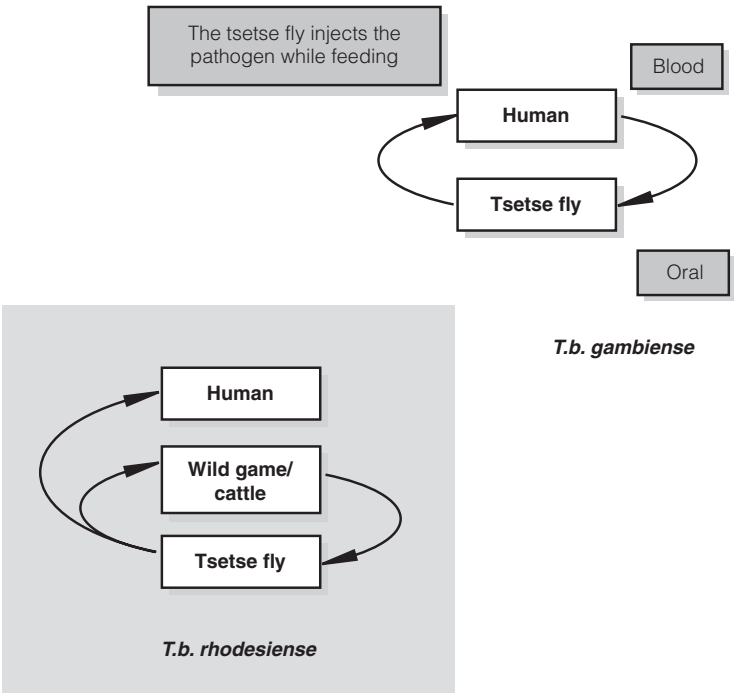
**Epidemic measures** : vector control and treatment of cases <sup>(3)</sup>

Trypanosomiasis (African), Sleeping sickness

Infections transmitted by the tsetse fly. Two types of infections exist, a more chronic infection which is found in tropical western and Central Africa, and an acute infection found in tropical eastern and southern Africa. Both infections will lead to death if untreated.

- Pathogen** : *Trypanosoma brucei gambiense* (*T.b.gam.*) and *Trypanosoma brucei rhodesiense* (*T.b.rhod.*) <sup>(3)</sup> (Protozoa)
- Distribution** : *T.b.gam.*: occurs usually in tropical western and Central Africa <sup>(3)</sup>.  
*T.b.rhod.*: is found in tropical eastern and southern Africa <sup>(2)</sup>
- Symptoms** : *T.b.gam.* is a more chronic disease than *T.b.rhod.*, which is an acute infection <sup>(73)</sup>. Sometimes there is a boil resulting from an inflammation at the site of the bite (less common in *T.b.gam.*). Symptoms of *T.b.gam.* are fever, enlarged lymph glands, change in behaviour, restlessness followed by almost continuous sleeping, coma, and death. *T.b.rhod.* shows similar symptoms, but evolves much quicker <sup>(2)</sup>
- Severity** : with both infections the host will die of the illness if not treated <sup>(3)</sup>
- Incubation period** : *T.b.gam.*: several months to years.  
*T.b.rhod.*: 3 days to some weeks <sup>(3)</sup>
- Duration** : *T.b.gam.*: sometimes the infected person dies after a short period <sup>(2)</sup>, but usually death comes after years <sup>(47)</sup>  
*T.b.rhod.*: death will follow in weeks to months <sup>(44)</sup>
- Communicability** : as long as the pathogen can be found in the blood, the fly can become infected when feeding on a host. The fly becomes infective 12 to 30 days after the infective bite. The tsetse fly remains infective for life <sup>(3)</sup>

Transmission cycle <sup>(3,73)</sup>



## CONTROLLING AND PREVENTING DISEASE

<b>Transmission</b>	: when a tsetse fly feeds on an infected person or animal, it can become infected. When the fly feeds on a susceptible person, the pathogen will be transmitted <sup>(73)</sup> . In endemic regions 0.1 to 2% of the population can be infected. In epidemics this can be up to 70%. Outbreaks can occur when infected persons or flies move into a new zone, or when contact between humans and tsetse flies is intensified <sup>(3)</sup> . Outbreaks in <i>T.g.rhod.</i> are less common <sup>(2)</sup> , but an indication that one is developing is when children and women start being affected <sup>(73)</sup> .
<b>Reservoir</b>	: <i>T.b.gam.</i> : humans are the main reservoir. Pigs and other animals are possible reservoirs, but their role in transmission is minor <sup>(2)</sup> . <i>T.b.rhod.</i> : the normal reservoir are wild game and cattle. Humans are less important as reservoirs <sup>(3)</sup>
<b>Vector/int. host</b>	: the vector for the infections is the tsetse fly ( <i>Glossina</i> spp.) <sup>(3)</sup> . <i>T.b.gam.</i> : is transmitted by tsetse flies which breed and live in forest which edges rivers; the riverine tsetse flies of the <i>Glossina palpalis</i> group <sup>(2)</sup> . People or animals coming close to the river are attacked. <i>T.b.rhod.</i> : is transmitted by tsetse flies that move in open forest and savannah; mainly <i>Glossina morsitans</i> , which are not confined to water. The percentage of infected flies is usually small <sup>(73)</sup>
<b>Water-related</b>	: <i>T.b.gam.</i> has a water-related insect vector <sup>(16)</sup>
<b>Excreta-related</b>	: no
<b>Environment</b>	: <i>T.b.gam.</i> : is usually linked to rivers (water collection points, washing sites, river crossings) <sup>(16)</sup> , or lakes. The flies occur in forest galleries (up to 20 metres from the river banks) along rivers, streams or lakes <sup>(2)</sup> . Women are often most affected because of their contact to this zone (e.g. washing clothes) <sup>(73)</sup> . Transmission occurs particularly at the end of the dry season. <i>T.b.rhod.</i> : is linked to open forest and savannah <sup>(16)</sup> . Most affected are people who are in contact with forest and savannah; usually men who work there <sup>(73)</sup>
<b>Risk in disaster</b>	: the infection could be a problem when people move into a place where the vector and the pathogen are present <sup>(73)</sup>
<b>Remarks</b>	: the total number of cases of African trypanosomiasis ( <i>T.b.gam.</i> and <i>T.b.rhod.</i> totalled) is estimated at 20,000 to 50,000 per year <sup>(16)</sup>

Preventative measures	Potential effect
Reducing the need for people to come in contact with the river (install a convenient alternative source of water). Only effective against <i>T.b.gam.</i>	(+ + +) <sup>(29)</sup>
Active search for cases and their treatment <sup>(2)</sup> This is more effective in outbreaks of <i>T.b.gam.</i> than in outbreaks of <i>T.b.rhod.</i> as the infection is less acute	(+ +) <sup>(2)</sup>
Control of tsetse flies (see Annexe 3)	
Health and hygiene promotion <sup>(47)</sup>	

**Epidemic measures** : active case finding and treatment, and control of tsetse flies <sup>(3)</sup>

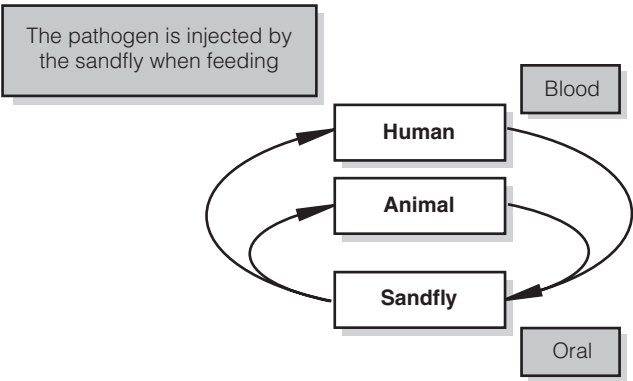


***Leishmaniasis cutaneous and muco-cutaneous (Oriental sore)/ Visceral leishmaniasis (Kala-azar)***

Infections transmitted by sandflies.

- Pathogen** : *Leishmania* spp. <sup>(3)</sup> (Protozoa)  
Different species of *Leishmania* will cause different types of leishmaniasis. The types of leishmaniasis are cutaneous leishmaniasis (cut.l.), muco-cutaneous leishmaniasis (muc.l) and visceral leishmaniasis (vis.l.) <sup>(73)</sup>
- Distribution** : cut.l.: Africa, South and Central America, southern Europe, Middle-East to India <sup>(73)</sup>, and China <sup>(3)</sup>.  
muc.l.: Central and South America <sup>(73)</sup>.  
vis.l.: Africa, India, Bangladesh, Pakistan, South and Central America, China, southern Europe, and the southern parts of ex-USSR <sup>(2)</sup>
- Symptoms** : cut.l.: a papule which turns into an ulcer <sup>(3)</sup>.  
muc.l.: the disease evolves out of cutaneous leishmaniasis <sup>(3)</sup> and affects the mucous membranes in the nose <sup>(73)</sup>.  
vis.l.: fever, sweating, enlargement of spleen and liver, anaemia <sup>(2)</sup>, and progressive weakness <sup>(3)</sup>
- Severity** : cut.l. and muc.l.: the infections can result in disfigurement <sup>(73)</sup>.  
vis.l.: has a case fatality rate of 90% if not treated. If treated, the case fatality rate drops to below 10% <sup>(4)</sup>
- Incubation period** : cut.l. and muc.l. : have an incubation period of one week to months.  
vis.l.: the incubation period is usually 2 to 6 months <sup>(3)</sup>, but can be anything between 2 weeks and years <sup>(2)</sup>
- Duration** : cut.l. and muc.l.: the infection can last for years <sup>(3,73)</sup>  
vis.l.: persons can survive for over 2 years <sup>(2)</sup>
- Communicability** : untreated persons can be infective to sandflies for up to 2 years, or as long as the infection lasts <sup>(3)</sup>

**Transmission cycle <sup>(3)</sup>**



- Transmission** : the sandfly takes up the pathogen when feeding on an infected animal or person. It takes a minimum of 8 days for the sandfly to become infective <sup>(3)</sup>. A person will be infected by the bite of an infective sandfly. Sandflies usually bite in the period between dusk and dawn <sup>(2)</sup>, or in shady or overcast conditions <sup>(73)</sup>.  
The infection is usually sporadic <sup>(73)</sup> but outbreaks do occur <sup>(2)</sup>

## CONTROLLING AND PREVENTING DISEASE

<b>Reservoir</b>	: reservoirs are humans, rodents, dogs, jackals, foxes <sup>(73)</sup> , and sloths <sup>(3)</sup> . The importance of the reservoir in the transmission cycle varies from region to region <sup>(2)</sup>
<b>Vector/int. host</b>	: the vector of the infection is the sandfly; in Africa, Asia and Europe: <i>Phlebotomus</i> spp., in South and Central America: <i>Lutzomyia</i> spp.. Adult sandflies live for around 2 weeks. Sandflies stay low to the ground, and can not fly in windy conditions <sup>(73)</sup> . Sandflies breed in moist and dark places (like cracks in masonry, caves, termite mounds, rubble) <sup>(2)</sup> . Usually they will not be found more than 200 m from their breeding place <sup>(2)</sup> , but wind can take them further <sup>(16)</sup>
<b>Water-related</b>	: no
<b>Excreta-related</b>	: no
<b>Environment</b>	: the infection is more linked to a rural environment than to an urban environment. In Central and South America the disease is connected to people working or living in forested areas <sup>(3)</sup>
<b>Risk in disaster</b>	: can be a problem if a population enters an endemic region <sup>(47)</sup>
<b>Remarks</b>	: Every year there are an estimated 1,500,000 cases of cutaneous leishmaniasis and 500,000 cases of visceral leishmaniasis <sup>(85)</sup>

Preventative measures	Potential effect
Adequate solid waste management (in Africa, Asia and Europe) <sup>(3)</sup>	
Control of sandflies <sup>(3)</sup> (see Annexe 3)	
Control of reservoir animal (dog, rodents) <sup>(3)</sup>	(+ + +) <sup>(16,73)</sup>
Systematic case finding and treatment	(+ + +) <sup>(16)</sup>
Health and hygiene promotion <sup>(3)</sup>	

Sandflies are very susceptible to residual insecticides.

Like other vector-borne infections, occurrence of leishmaniasis in the population is the result of a dynamic interaction between persons, vectors, reservoir animals, and the environment. Control of the disease by active case finding and treatment has been very effective in some areas, and unsuccessful in others <sup>(16)</sup>. Control of dogs or rodents have proven very effective in some places <sup>(3,73)</sup>, but may be inappropriate in others. A good understanding of the dynamics of transmission will be needed before effective control of the infection is possible.

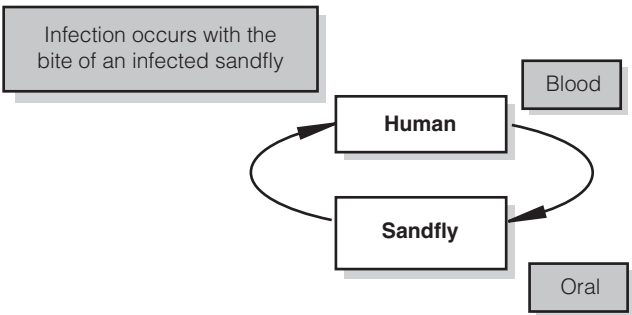
**Epidemic measures** : treatment of cases, and control of sandflies and animal reservoirs <sup>(3)</sup>

**Bartonellosis, Oroya fever, Verruga peruana, Carrión disease**

An infection transmitted by sandflies. The infection occurs in Colombia, Peru, and Ecuador in mountain valleys. The infection has two distinctive forms.

- Pathogen** : *Bartonella bacilliformis* <sup>(3)</sup> (Bacterium)
- Gen. information** : the infection occurs in Colombia, Peru and Ecuador <sup>(16)</sup> in mountain valleys of the Andes <sup>(3)</sup> at altitudes between 800 and 3,000 metres above sea level. The infection is most common between January and April <sup>(16)</sup>. Asymptomatic infections do occur. The illness is milder in children than in adults <sup>(3)</sup>. The disease can show itself in two distinctive forms. Oroya fever, with as symptoms malaise, anaemia, and severe pains in head, joints, and bones <sup>(16)</sup>. The case fatality rate of Oroya fever is 10 to 90% <sup>(3)</sup>. The other form is Verruga peruane, which often follows Oroya fever. The symptoms are severe pains, fever, and eruptions of the skin <sup>(16)</sup>. Verruga peruane is rarely fatal <sup>(3)</sup>. The two forms of disease can occur at the same time <sup>(16)</sup>. The incubation period is usually 16 to 22 days <sup>(73)</sup>, but can be as much as 4 months. People can be infective to sandflies for years <sup>(3)</sup>

**Transmission cycle** <sup>(3)</sup>



- Transmission** : the sandflies are infected when biting a person carrying the pathogen. The pathogen is transmitted when the sandfly feeds on a person <sup>(3)</sup>. Outbreaks of the infection can occur <sup>(16)</sup>
- Reservoir** : humans are the only reservoir. Where the infection is endemic, 5% of the population may be asymptomatic carrier of the pathogen <sup>(3)</sup>.
- Vector/int. host** : the vector of the infection is the sandfly (*Lutzomyia* spp.). The flies feed at night <sup>(16)</sup>
- Risk in disaster** : could be a problem if people are placed in an endemic area <sup>(16)</sup>

Preventative measures	Potential effect
Avoiding endemic areas at night <sup>(3)</sup>	
Control of sandflies <sup>(3)</sup> (see Annexe 3)	
Infected persons should be isolated from sandflies <sup>(3)</sup>	
Health and hygiene promotion	

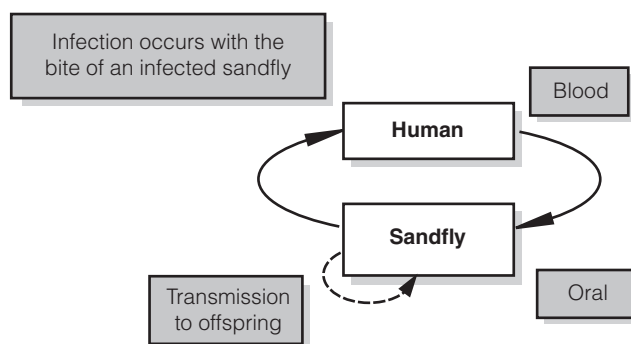
**Epidemic measures** : search for cases and control of sandflies <sup>(3)</sup>

## Arboviral fevers sandfly-borne: Sandfly fever, Phlebotomus fever/ Changuinola virus disease/ Vesicular stomatitis virus disease

Infections transmitted by sandflies. The illnesses last only some days and are not fatal. Outbreaks are possible if non-immune people enter endemic areas.

- Pathogen** : several arboviruses <sup>(3)</sup>
- Gen. description** : the infections occur in the Mediterranean, the Middle-east <sup>(16)</sup>, Africa, Asia towards Myanmar and China, and Central and South America. They can be found in the (sub)tropics with hot and dry seasons <sup>(3)</sup>. The infections occur in the warm period <sup>(45)</sup>. The incubation period is 3 to 6 days <sup>(73)</sup>, and the period of illness usually last 2 to 4 days <sup>(44)</sup>. Symptoms are fever, malaise, nausea, headache, and pains in limbs and back. The local population is relatively resistant to the infections <sup>(3)</sup>. The infections are not fatal <sup>(16)</sup>

### Transmission cycle <sup>(3)</sup>



- Transmission** : sandflies are infected either through biting an infected person, or by receiving the infection from its parents <sup>(16)</sup>. Sandflies become infective one week after biting an infected person. People are infected by the bite of an infective sandfly <sup>(3)</sup>. Outbreaks can occur when non-immune people enter into an endemic area <sup>(16)</sup>
- Reservoir** : the main reservoirs are humans and sandflies. Sandflies can transmit the pathogens to their offspring <sup>(16)</sup>. Rodents can be potential reservoirs <sup>(3)</sup>
- Vector/int. host** : the main vector is the common sandfly (*Phlebotomus papatasi*). This sandfly bites at night. The sandfly *Sergentomyia* spp. is a probable vector. In Central and South America the vectors are sandflies belonging to *Lutzomyia*. Sandflies remain infective for life (up to one month) <sup>(3)</sup>

### Preventative measures

### Potential effect

Adequate solid waste management (in Africa, Asia and Europe) <sup>(3)</sup>

Control of sandflies <sup>(3)</sup> (see Annexe 3)

Health and hygiene promotion

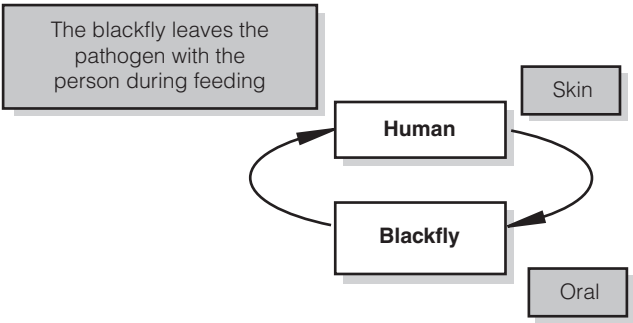
**Epidemic measures** : control of sandflies and health and hygiene promotion <sup>(3)</sup>

**Onchocerciasis, River blindness**

An infection transmitted by blackflies. The infection is associated with fast-flowing rivers. The pathogen can cause blindness. The socio-economic consequences of the disease are important as it has pushed people to abandon fertile areas.

- Pathogen** : *Onchocerca volvulus* <sup>(15)</sup> (Helminth)  
The worms are up to 50 cm long and live under the skin, either free-living or in nodules <sup>(2)</sup>
- Distribution** : the infection occurs in tropical Africa, southern Mexico, Guatemala, Venezuela, Colombia, Ecuador, Brazil, and Yemen <sup>(3)</sup>. More than 95% of the cases occur in Africa, and over 30% in Nigeria <sup>(16)</sup>
- Symptoms** : adult worms will usually not cause any symptoms other than creating nodules. It is the microfilariae shed by the worms which cause symptoms. Mild infections may be asymptomatic. Symptoms are itching and skin rash; heavy infections will lead to loss of pigment and loss of elasticity of skin <sup>(2)</sup>. Infections can result in blindness, but this may take up to 20 to 30 years before it occurs. Not every case will develop damage to the eye <sup>(44)</sup>.  
Men in working age are most affected <sup>(16)</sup>
- Severity** : the infection can cause blindness <sup>(3)</sup>
- Incubation period** : 6 to 12 months <sup>(73)</sup>
- Duration** : worms can survive for up to 20 years <sup>(2)</sup>
- Communicability** : man can be infective to the blackfly for up to 15 years <sup>(3)</sup>

**Transmission cycle** <sup>(73)</sup>



- Transmission** : the adult worms shed microfilariae which are found in the skin of the host. When blackflies feed on a person microfilariae will infect the vector <sup>(3)</sup>. It will take around 7 days before the fly will become infective to humans <sup>(16)</sup>. When an infective fly feeds on a person infection can take place <sup>(3)</sup>
- Reservoir** : humans are the only reservoir of importance <sup>(3)</sup>
- Vector/int. host** : the vector of the infection is the blackfly (*Simulium* spp.) <sup>(73)</sup>. The flies lay their eggs in fast-flowing, oxygenated rivers (turbulent, 'white' rivers). And can travel long distances, normally 5 to 10 km from the river. The chances of being bitten are largest close to breeding sites. The flies feed at dusk and dawn <sup>(16)</sup>
- Water-related** : the infection is transmitted by a water-related insect vector
- Excreta-related** : no

## CONTROLLING AND PREVENTING DISEASE

<b>Environment</b>	: close to turbulent streams. During the rainy season flies may search for new sites to breed. In the dry season they stay close to permanent streams <sup>(16)</sup>
<b>Risk in disaster</b>	: the infection will not be a priority in a disaster <sup>(3)</sup>
<b>Remarks</b>	: it is estimated that around 18,000,000 people are infected, with around 360,000 people permanently blinded by the disease. Up to 15% of the population living near fast flowing rivers may be infected <sup>(16)</sup> . The disease has a big socio-economic impact on society as it has often pushed people to abandon fertile soils <sup>(3)</sup> .

Preventative measures	Potential effect
Supply the population with an alternative source of water (avoid contact to river)	(+) <sup>(29)</sup>
Control of blackflies <sup>(73)</sup> (see Annexe 3)	
Search for cases and treatment <sup>(3)</sup>	
Health and hygiene promotion <sup>(3)</sup>	

As the blackfly can travel great distances (up to 80 km in a day), control measures using chemical vector control will need to cover large areas and be conducted over longer periods to have a lasting effect <sup>(2,16)</sup>.

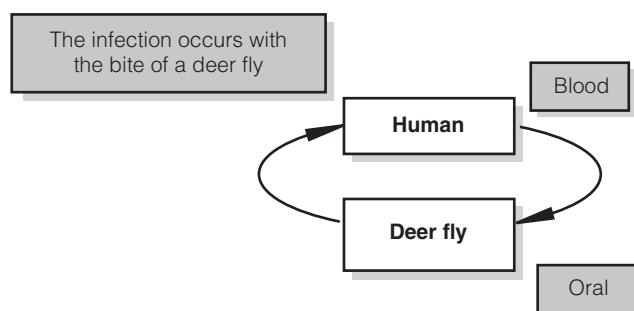
**Epidemic measures** : treatment of cases, control of blackflies <sup>(3)</sup>

## ***Loiasis, Loa loa infection, Eye worm disease, Calabar swelling***

A mild infection transmitted by tabanid flies. The public health importance of the pathogen is limited.

- Pathogen** : *Loa loa* <sup>(15)</sup> (Helminth)
- Gen. description** : loiasis is an infection caused by 30 to 70 mm long worms which live under the skin <sup>(2)</sup>. The infection is found in West and Central Africa <sup>(73)</sup>. The infection is relatively mild <sup>(2)</sup>, with usual symptoms being localised itching and transient swellings ('Calabar swelling') <sup>(3)</sup>. Occasionally the worm can be seen passing through the eye under the conjunctiva (which is harmless) <sup>(73)</sup>. The incubation period is usually years, but can be 4 months <sup>(3)</sup>. Worms can survive in the body for 17 years or more <sup>(16)</sup>, and can be infective for *Chrysops* for the same time <sup>(3)</sup>

### **Transmission cycle** <sup>(3)</sup>



- Transmission** : *Chrysops* is infected when it feeds on the blood of a person carrying microfilariae shed by a fertilised worm. After 10 to 12 days the fly becomes infective to humans. Human infection occurs when the pathogens enter the body through a bite of the fly <sup>(3)</sup>
- Reservoir** : humans are the only reservoir <sup>(3)</sup>
- Vector/int. host** : the vector of the pathogen is the tabanid fly <sup>(73)</sup> or deer fly (*Chrysops* spp.) <sup>(3)</sup>. Breeding sites of the flies are linked to forest streams. Biting will generally be within 200 m of the breeding site. The flies attack during the day but not in the open sun <sup>(2)</sup>
- Water-related Environment** : the vector is a water-related insect vector <sup>(2)</sup>
- Remarks** : it is a rural disease <sup>(73)</sup>, occurring in rain forests, or swamp forest areas <sup>(16)</sup>
- : In some villages in the Congo River basin up to 90% of the population is infected with the pathogen <sup>(3)</sup>

### **Preventative measures**

### **Potential effect**

Control of the flies (chemical vector control is usually not efficient, control by avoidance of the flies is more effective) <sup>(3,16)</sup>

Health and hygiene promotion <sup>(3)</sup>

## Trypanosomiasis (American), Chagas disease

An infection spread by reduviid bugs. The infection is associated with poor quality housing (poverty). The pathogen only occurs in Central and South America. The disease commonly results in disability and death.

**Pathogen** : *Trypanosoma cruzi* <sup>(15)</sup> (Protozoon)

**Distribution** : Central and South America <sup>(73)</sup>

**Symptoms** : asymptomatic infections are common <sup>(2)</sup>. Symptoms are fever, malaise, affected lymph system, and enlarged liver and spleen <sup>(3)</sup>. Many people will initially not show any symptoms, but will develop complications years after the infective bite occurred <sup>(2)</sup>

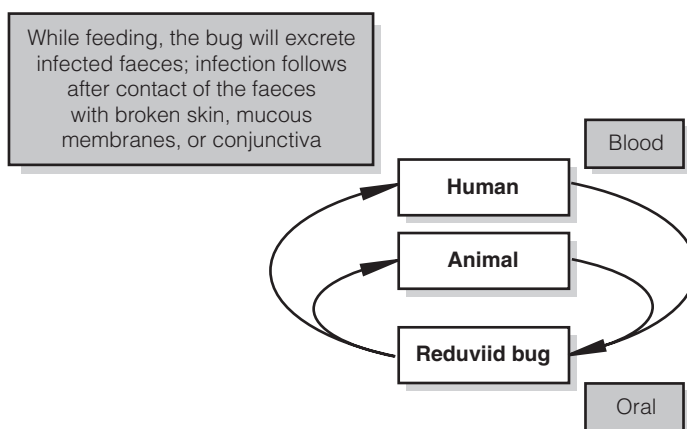
**Severity** : the infection commonly results in disability or death <sup>(73)</sup>

**Incubation period** : 5 to 14 days <sup>(3)</sup>

**Duration** : the duration of the infection is variable; months to years <sup>(44)</sup>

**Communicability** : as long as the infection lasts the bug can take up the pathogen. Infected bugs remain infective for life. The bugs can live for up to 2 years <sup>(3)</sup>

### Transmission cycle <sup>(3)</sup>



**Transmission** : A bug becomes infected when feeding on a host. The reduviid bug will become infective to people 10 to 30 days after biting the host. When feeding, the bug will excrete, and it is in these excreta that the pathogens are found. Infection occurs when the excreta of the infected bug come in contact with broken skin (e.g. the bite wound), mucous membranes, or conjunctiva <sup>(3)</sup>. It is possible that excreta from bugs are infective when ingested <sup>(73)</sup>, this route of transmission will not be very common though

**Reservoir** : reservoirs are humans and many wild or domestic animals. Dogs can introduce the pathogen from the 'wild cycle' which occurs outside the house to the 'domestic cycle' which occurs inside the house. In Central America the rat is an important reservoir <sup>(73)</sup>. In Argentina goats may play a role in transmission. Animals which can be infected, but whose role in the transmission cycle are limited, are cats, pigs, cattle, and horses <sup>(16)</sup>



## ANNEXE 1: LISTING OF DISEASES

<b>Vector/int. host</b>	: the vector is the reduviid bug ( <i>Reduviidae</i> spp.), also called kissing bug or assassin bug <sup>(2)</sup> . The bugs live in rural (poor) houses; cracked mud walls and thick palm roofs are ideal hiding places <sup>(16)</sup> . One single hut may contain thousands of reduviid bugs <sup>(2)</sup>
<b>Water-related</b>	: no
<b>Excreta-related</b>	: no
<b>Environment</b>	: the infection is linked to poverty <sup>(73)</sup> . The quality of the housing and the presence of bugs are related. Walls with cracks, thatched roofs <sup>(16)</sup> , and reservoir animals living in or close to the house <sup>(73)</sup> are all risk factors
<b>Risk in disaster</b>	: the infection will normally not be a priority in disasters <sup>(3)</sup>
<b>Remarks</b>	: it is estimated that 10,000,000 people are infected with the pathogen <sup>(44)</sup>

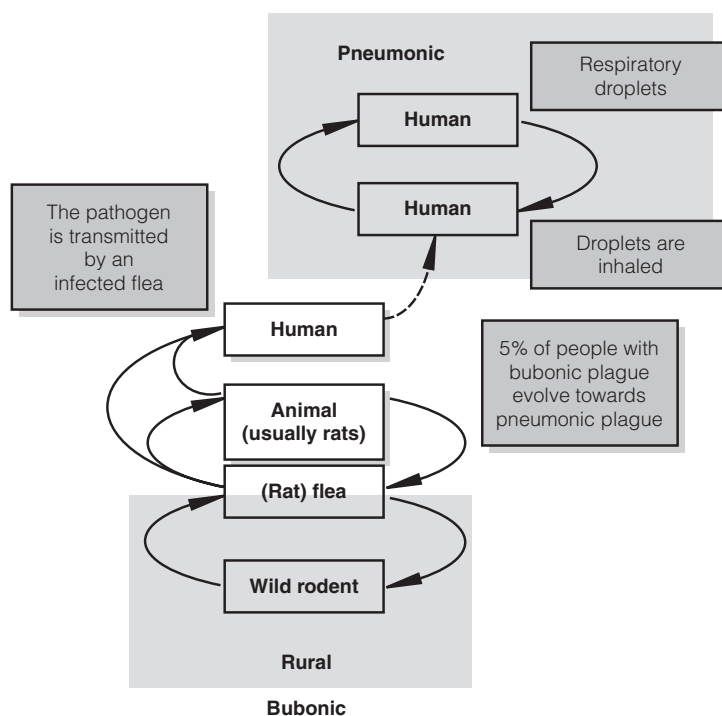
Preventative measures	Potential effect
Control of reduviid bugs <sup>(3)</sup> (see Annexe 3)	
Control of reservoir animals living close to man (dogs, rats) <sup>(73)</sup>	
Adapt housing of people <sup>(2)</sup>	
Health and hygiene promotion <sup>(3)</sup>	

**Epidemic measures** : control of reduviid bugs and reservoir animals <sup>(3)</sup>

## Plague, *Yersinia pestis*

A flea-borne infection. The disease is severe, and outbreaks can occur. In many regions the disease is naturally present in a wild rodent–flea cycle, where this cycle is disturbed, people can get infected.

<b>Pathogen</b>	: <i>Yersinia pestis</i> <sup>(3)</sup> (Bacterium)
<b>Distribution</b>	: southern, eastern, and western Africa, Asia, South America, USA <sup>(73)</sup>
<b>Symptoms</b>	: asymptomatic infections do occur. Different forms of plague exist <sup>(47)</sup> : Bubonic plague (Bub.P): fever, chills, pains in muscles, formation of bubo (inflamed lymph nodes) which swell, are tender, and may burst and discharge pus <sup>(3)</sup> . 90% Of the cases with plague will develop this type of infection <sup>(16)</sup> . About 5% of those who develop Bub.P. will progress into pneumonic plague <sup>(73)</sup> . Pneumonic plague (Pne.P): affects the lungs. Septicemic plague (Sep.P): can evolve out of other types of infections, the infection affects other organs through blood <sup>(3)</sup>
<b>Severity</b>	: Bub.P. : has a case fatality rate of 50 to 60% <sup>(3)</sup> ; with adequate treatment this can be reduced to below 5% <sup>(4)</sup> . Pne.P and Sep.P. are always fatal if untreated <sup>(47)</sup>
<b>Incubation period</b>	: 1 to 7 days <sup>(3)</sup>
<b>Duration</b>	: death follows after some days in Pne.P. and Sep.P. <sup>(73)</sup>
<b>Communicability</b>	: pus coming out of bubo is infective. Fleas can remain infective for months <sup>(3)</sup>
<b>Transmission cycle</b> <sup>(3,73)</sup>	
<b>Transmission</b>	: the normal transmission cycle takes place between wild resistant rodents



## ANNEXE 1: LISTING OF DISEASES

and fleas, this is the sylvatic or rural cycle <sup>(3)</sup>. When domestic rats enter into this cycle, infected fleas can colonise them. As these rats are less resistant to the infection than wild rodents, they will die, leaving the fleas without a source of food <sup>(73)</sup> (a sudden die-off of domestic rats can be an indication that a human outbreak is going to occur) <sup>(16)</sup>. Domestic rats live normally close to humans, and the infective fleas will search for new sources of blood, transmitting the infection to people when feeding on them <sup>(73)</sup>.

Domestic animals may take wild rodent fleas into the human environment <sup>(3)</sup>. Another way of transmitting the infection is through direct contact with body tissues of infected animals <sup>(3)</sup>. Pne.P. can be spread through air-borne transmission and is highly contagious <sup>(47)</sup>

<b>Reservoir</b>	: the domestic black rat ( <i>Rattus rattus</i> ) and the brown sewer rat ( <i>R.norvegicus</i> ) are the main reservoirs which transmit the infection to humans <sup>(16)</sup> . Other animals which can play a role as reservoir are mice, other rodents, dogs, camels, monkeys, rabbits <sup>(73)</sup> , cats, and wild carnivores <sup>(3)</sup> . Over 340 animal species can be infected with the pathogen <sup>(73)</sup> . The pathogen can survive for months in the cool, damp environment of animal burrows. In dry conditions they may survive for a few days, but longer in dried blood or secretions. They are killed after being for 15 minutes at 56°C or by being exposed to direct sunlight for 4 hours <sup>(16)</sup>
<b>Vector/int. host</b>	: fleas are the vector of the infection. The most important is <i>Xenopsylla cheopsis</i> (a rat flea) <sup>(3)</sup> , though <i>X.brasiliensis</i> and <i>X.astia</i> are implied too <sup>(73)</sup> . In the Andes region in South America the human flea ( <i>Pulex irritans</i> ) plays a role in transmission <sup>(3)</sup> .
<b>Water-related</b>	: the infection is water-washed <sup>(73)</sup>
<b>Excreta-related</b>	: no
<b>Environment</b>	: presence of the pathogen in the rural cycle is obviously a risk factor <sup>(73)</sup> . The infection is more likely to occur in rural areas. Crowding and unhygienic conditions are risk factors, as are occupations like hunting or trapping <sup>(3)</sup> . The disease is associated with war and civil disturbance <sup>(73)</sup> . Most cases occur in the warm and dry season <sup>(16)</sup>
<b>Risk in disaster</b>	: the infection is a risk where the disease is endemic, in conditions of overcrowding and poor environmental hygiene <sup>(3)</sup>
<b>Remarks</b>	: the infection should be notified to the WHO <sup>(3)</sup> . Sporadic cases in endemic areas do not necessarily indicate an outbreak. The pathogen occurs in the rural cycle between wild rodents and fleas in many regions. In some of these regions, humans are not infected while in others outbreaks have occurred <sup>(73)</sup>

## CONTROLLING AND PREVENTING DISEASE

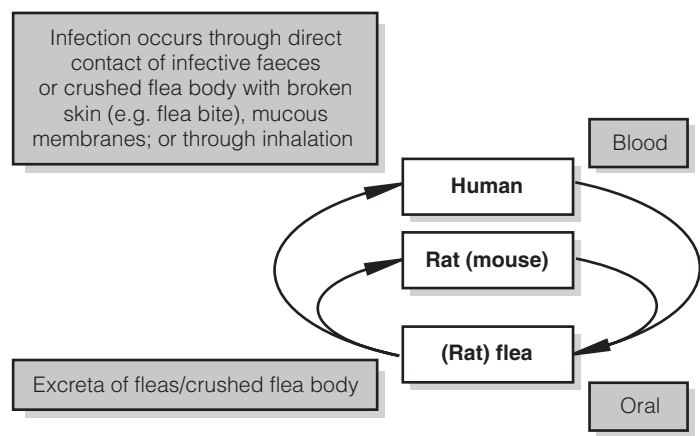
Preventative measures	Potential effect
Improving water availability	(+ +) <sup>(29)</sup>
Improving hygiene of body and clothes <sup>(73)</sup>	
Control of fleas <sup>(47)</sup> (see Annexe 3)	
When dealing with refugees or displaced people, new arrivals should be dusted against fleas (people and their luggage) <sup>(47)</sup>	
Cases and contacts of cases should be dusted with insecticide against fleas <sup>(47)</sup>	
Control of rats (after successful flea control! If rats carrying infected fleas are killed, the disease can spread easily to people) <sup>(73)</sup> (see Annexe 3)	
Improving solid waste management and storage of food (rat control) <sup>(3)</sup>	
Care in handling dead animals that could be infected <sup>(3)</sup>	
People or animals that died or are suspected to have died of plague should be buried or burnt, and handled in a safe way <sup>(73)</sup>	
Persons with pneumonic plague should be strictly isolated <sup>(3)</sup>	
Contacts of people with pneumonic plague should receive treatment <sup>(47)</sup>	
Workers at risk should be protected against fleas <sup>(3)</sup>	
Health and hygiene promotion <sup>(73)</sup>	
<b>Epidemic measures :</b> search for cases and treat them, health and hygiene promotion, flea control, control of rats after successful control of fleas, protection and/or treatment of contacts, protection of workers against fleas <sup>(3)</sup>	

***Typhus (murine) fever, Flea-borne typhus, Endemic typhus fever***

A flea-borne infection which should not be confused with epidemic louse-borne typhus fever or scrub typhus. The infection is generally endemic, and has a low mortality.

- Pathogen** : *Rickettsia mooseri* <sup>(73)</sup> (Rickettsia)  
**Distribution** : the pathogen is found worldwide <sup>(3)</sup>
- Symptoms** : fever, rash <sup>(73)</sup>, headache, and chills <sup>(3)</sup>  
**Severity** : the case fatality rate is 1% to 2% <sup>(16)</sup>  
**Incubation period** : 1 to 2 weeks <sup>(73)</sup>  
**Duration** : the illness lasts 7 to 10 days <sup>(73)</sup>  
**Communicability** : infected fleas remain infective for life (fleas can live for up to 1 year) <sup>(3)</sup>

**Transmission cycle** <sup>(3,73)</sup>



- Transmission** : fleas become infected by feeding on a host <sup>(73)</sup>. It is the excreta of the fleas which contain the pathogen. The infective excreta can infect a person by contaminating the flea bite or other wound <sup>(3)</sup>, mucous membranes, or conjunctiva. The faeces are infective too if inhaled by a person. Which transmission route is most common is not clear. In addition, the body of the flea is infective, and crushed fleas are as dangerous as their faeces. Crushing fleas between teeth can result in infection <sup>(73)</sup>.  
The infection is generally an endemic infection, with sporadic cases occurring <sup>(3)</sup>
- Reservoir** : the main reservoirs of the pathogen are the domestic black rat (*Rattus rattus*) and the sewer brown rat (*R. norvegicus*) <sup>(73)</sup>. Mice can play a role as a reservoir for human infection. Rodents do not suffer seriously from the infection <sup>(16)</sup>. In addition to rodents, the infection occurs in cats, opossums, shrews, and skunks, their role as a reservoir of the infection is minor though <sup>(73)</sup>
- Vector/int. host** : the main vector of the infection is the rat flea (*Xenopsylla cheopsis*) <sup>(3)</sup>. Other vectors which have been found to carry the pathogen are the human flea (*Pulex irritans*), lice (this is not epidemic louse-borne typhus), mites (this is

## CONTROLLING AND PREVENTING DISEASE

not scrub typhus), and ticks. These will generally not be very important in the transmission of the infection <sup>(73)</sup>. In some places cat fleas (*Ctenocephalides felis*) could be the vector of a similar infection, the importance of this vector will be limited though <sup>(3)</sup>

<b>Water-related</b>	: the infection is water-washed <sup>(73)</sup>
<b>Excreta-related</b>	: no
<b>Environment</b>	: the infection is linked to an urban environment <sup>(73)</sup> where people and rats (or mice) live in close association <sup>(3)</sup> . People in close contact with rats or mice are most at risk (e.g. workers in granaries, food stores, breweries, shops, or garbage workers). The domestic environment may be a risk too <sup>(16)</sup>
<b>Risk in disaster</b>	: where people and rats live closely together cases are likely to occur <sup>(3)</sup> . The infection will not be a priority in the initial emergency phase <sup>(47)</sup>
<b>Remarks</b>	: -

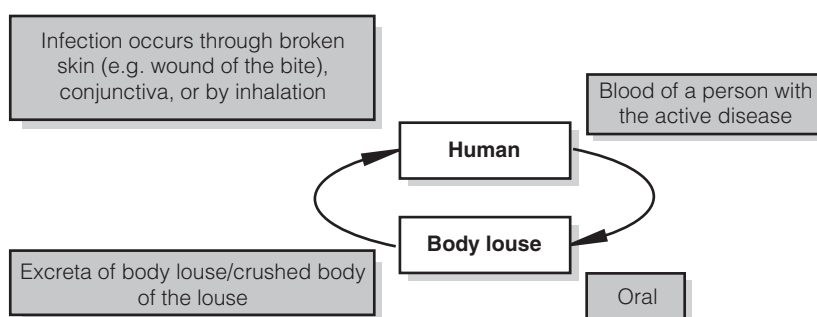
Preventative measures	Potential effect
Improving water availability	(++) <sup>(73)</sup>
Improving hygiene of body and clothes <sup>(73)</sup>	
Control of fleas <sup>(3)</sup> (see Annexe 3)	
After successful flea control, control of rats and mice <sup>(3)</sup> (see Annexe 3)	
Buildings should be rat-proof <sup>(73)</sup> ; especially grain-stores and other food-stores <sup>(16)</sup>	
Workers at risk should be protected against fleas (e.g. garbage workers) <sup>(16)</sup>	
Health and hygiene promotion <sup>(3)</sup>	
<b>Epidemic measures</b> : control of fleas <sup>(3)</sup> , after successful control of fleas, control of rats/mice <sup>(73)</sup>	

## ***Typhus (epidemic louse-borne) fever, Louse-borne typhus, Classic typhus fever***

A louse-borne infection with a high case fatality rate. Where people live in crowded conditions, have poor personal hygiene, and are infested with lice, the infection can cause outbreaks. Where these conditions exist, preventative measures should be taken before an outbreak occurs. The infection should not be mistaken for endemic typhus fever or scrub typhus.

<b>Pathogen</b>	: <i>Rickettsia prowazekii</i> <sup>(3)</sup> (Rickettsia)
<b>Distribution</b>	: the infection occurs worldwide <sup>(3)</sup>
<b>Symptoms</b>	: mild infections do occur <sup>(3)</sup> . Symptoms are headache, continuous high fever, shivering, general pains <sup>(73)</sup> , and skin rash <sup>(3)</sup>
<b>Severity</b>	: the severity of the disease ranges from mild to fatal <sup>(3)</sup> . Untreated cases have a case fatality rate of 10 to 60% <sup>(44)</sup>
<b>Incubation period</b>	: 1 to 2 weeks, shorter if the infecting dose is large <sup>(73)</sup>
<b>Duration</b>	: the duration of the illness is around 2 weeks <sup>(3)</sup>
<b>Communicability</b>	: people are infective to lice probably up to 2 to 3 days after fever has disappeared <sup>(3)</sup> . Long-term carriers of the pathogen probably exist <sup>(16)</sup> in the form of recurrent typhus, or Brill-Zinsser disease. The infected person can be a carrier for decades <sup>(73)</sup> . The lice will die of the infection 2 weeks after the infective bite <sup>(3)</sup>

### **Transmission cycle <sup>(73)</sup>**



<b>Transmission</b>	: lice are infected when feeding on a person with the active disease. As well the excreta as the body of the louse are infective. If infective louse faeces, or crushed lice, come in contact with broken skin (e.g. the biting wound), infection can follow <sup>(3)</sup> . Crushing lice between teeth is dangerous. Inhaling dried faeces of lice is a potential transmission route, as is contact of the conjunctiva with the infective excreta of the lice <sup>(73)</sup>
<b>Reservoir</b>	: humans are probably the only reservoir <sup>(73)</sup> . <i>Rickettsia</i> in dead lice can remain infective for weeks <sup>(3)</sup> . The pathogen can remain viable for over 100 days in louse faeces <sup>(73)</sup>

## CONTROLLING AND PREVENTING DISEASE

<b>Vector/int. host</b>	: the main vector transmitting the infection is the body louse ( <i>Pediculus humanus corporis</i> ). Other lice ( <i>Phthirus pubis</i> and <i>Pediculus humanus capitis</i> ) are possibly involved in transmission. Body lice live between underclothing and body, and lay eggs in the seams of clothing. Adult lice which have no access to a blood meal die within 10 days, and clothes which have not been worn for 1 month will be free of adults and eggs. Body lice can not survive if clothes are frequently washed or changed. Ironing, and washing clothes at over 60°C, will kill the lice. Lice do not support high ambient temperatures <sup>(73)</sup>
<b>Water-related</b>	: the infection is water-washed <sup>(3)</sup>
<b>Excreta-related</b>	: no
<b>Environment</b>	: epidemic louse-borne typhus fever is a risk where a combination of crowding <sup>(84)</sup> , cold weather (people wear more clothes), poor personal hygiene, and infestation of the population with body louse occurs <sup>(3)</sup> . The infection is associated with mountainous areas (cold weather) <sup>(15)</sup> , war, and famine <sup>(3)</sup>
<b>Risk in disaster</b>	: the infection is a serious risk in circumstances of overcrowding, poor personal hygiene, and if body louse is present in the population. If people carry body louse, the population should be treated against the vector before the first cases occur <sup>(47)</sup>
<b>Remarks</b>	: the infection is under surveillance by the WHO <sup>(73)</sup>

Preventative measures	Potential effect
Improve water availability	(+ +) <sup>(29)</sup>
If appropriate, soap can be made available <sup>(47)</sup>	
Improve hygiene of clothes and body <sup>(73)</sup>	
Control of body louse <sup>(3)</sup> (see Annexe 3)	
If displaced people are infested with lice they should be treated with residual insecticides. This should be done before cases occur <sup>(47)</sup>	
Refugees and displaced people entering camps should be checked for lice if the risk of an outbreak is present <sup>(47)</sup>	
Cases, contacts, and their clothes and houses should be deloused <sup>(221, 241)</sup>	
If possible, contacts of cases should be put under observation <sup>(3)</sup>	
People at risk can, if appropriate, receive preventative treatment <sup>(16)</sup>	
Health and hygiene promotion <sup>(3)</sup>	

**Epidemic measures :** control of body louse, search for the source of the outbreak <sup>(3)</sup>

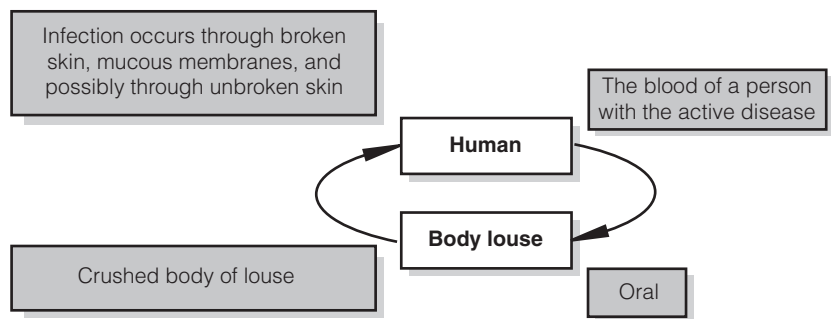


Relapsing louse-borne fever

A louse-borne infection. The infection usually occurs in outbreaks and can have high case fatality rates. The infection is a risk in places of overcrowding, poor personal hygiene, and where the population carries lice. Preventative measures against lice should be taken before an outbreak occurs. The infection should not be mistaken for tick-borne relapsing fever.

- Pathogen** : *Borrelia recurrentis* <sup>(15)</sup> (Bacterium)
- Distribution** : the infection occurs in Africa, Asia, and South America <sup>(3)</sup>. Endemic areas are the highlands of Ethiopia, Burundi, North-west Africa, East Africa, China, India, Peru, and Bolivia <sup>(16)</sup>
- Symptoms** : asymptomatic infections do occur <sup>(16)</sup>. Symptoms are chills, high fever, headache, and vomiting <sup>(4)</sup>. If the infection is not treated relapses can occur <sup>(44)</sup> (normally 1 to 2) <sup>(2)</sup>
- Severity** : the case fatality rate in untreated persons is usually 2 to 9%, though in epidemics case fatality rates of up to 70% have occurred <sup>(16)</sup>
- Incubation period** : 5 to 15 days, usually 8 days <sup>(3)</sup>
- Duration** : the total duration of the illness is 13 to 16 days <sup>(3)</sup>
- Communicability** : lice remain infective for life (which can be up to 40 days) <sup>(3)</sup>

Transmission cycle <sup>(73)</sup>



- Transmission** : Lice take up the pathogen by feeding on a person who is ill <sup>(73)</sup>. Lice will become infective 4 to 5 days after biting the host <sup>(3)</sup>. The pathogen is present in the body of the louse, which must be crushed and brought in contact with the bite wound, an abrasion <sup>(3)</sup>, or mucous membranes for infection to take place. Possibly the pathogen can cause infection through unbroken skin. Crushing lice between teeth or fingernails is dangerous.
- Outbreaks of louse-borne relapsing fever occur under similar circumstances as outbreaks of epidemic louse-borne typhus, and sometimes the two infections occur at the same time <sup>(73)</sup>.
- If relapsing fever is transmitted by lice, it is usually epidemic (contrary to tick-borne relapsing fever which is endemic) <sup>(3)</sup>. Endemic occurrence of the infection is possible though <sup>(2)</sup>
- Reservoir** : humans are the only reservoir <sup>(3)</sup>

## CONTROLLING AND PREVENTING DISEASE

<b>Vector/int. host</b>	: the main vector is the body louse ( <i>Pediculus humanus corporis</i> ) <sup>(2)</sup> . Body lice are maintained between clothing and body. Eggs are deposited in the seams of clothing. Body lice will not survive if clothes are frequently washed or changed. Ironing clothes and washing them at over 60°C will kill the lice. Body louse does not support high ambient temperatures <sup>(73)</sup> . The head louse ( <i>Pediculus humanus capitis</i> ) can play a role in transmission <sup>(16)</sup> , but this is rare <sup>(2)</sup>
<b>Water-related</b>	: the infection is water-washed <sup>(47)</sup>
<b>Excreta-related</b>	: no
<b>Environment</b>	: the infection is one of overcrowding, poor personal hygiene, and cold climate (people wearing clothes). In the tropics it is encountered in mountainous areas <sup>(16)</sup>
<b>Risk in disaster</b>	: the infection is a major risk in disasters. If people carry body lice, the population should be treated against lice before the first cases occur <sup>(47)</sup>
<b>Remarks</b>	: the infection is under surveillance by the WHO <sup>(3)</sup>

Preventative measures	Potential effect
Improve water availability	(+ +) <sup>(29)</sup>
If appropriate, soap can be made available <sup>(47)</sup>	
Improve hygiene of clothes and body <sup>(73)</sup>	
Control of body louse <sup>(3)</sup> (see Annexe 3)	
If displaced people are carrying lice: treatment with residual insecticides. This should be done before cases occur <sup>(47)</sup>	
Refugees and displaced people entering camps should be checked for lice if the risk of an outbreak is present <sup>(47)</sup>	
Cases, contacts, and their clothes and houses should be deloused <sup>(3)</sup>	
People at risk can, if appropriate, receive preventative treatment <sup>(16)</sup>	
Health and hygiene promotion <sup>(3)</sup>	

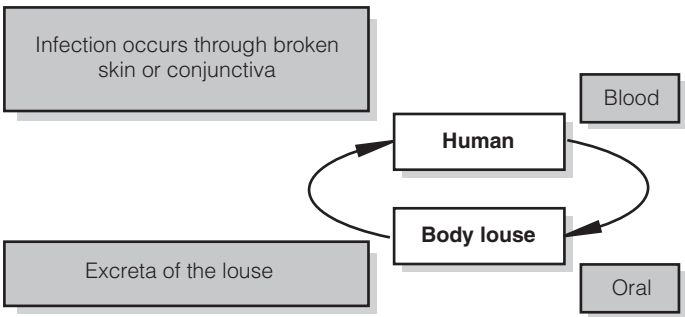
**Epidemic measures :** control of body louse <sup>(73)</sup>

Trench fever

A usually fairly mild louse-borne infection. Occurrence of the disease is an indication of a risk for outbreaks of epidemic louse-borne typhus or louse-borne relapsing fever.

- Pathogen** : *Bartonella quintana* (*Rochalimaea quintana*) <sup>(3)</sup> (Bacterium) <sup>(73)</sup>
- Distribution** : the infection is found in Ethiopia, Burundi, North Africa <sup>(3)</sup>, Mexico <sup>(16)</sup>, Bolivia, Canada, Poland, former USSR <sup>(3)</sup>, China, and Japan <sup>(16)</sup>
- Symptoms** : mild infections are common. Symptoms are fever, headache, malaise, pains, enlarged liver and spleen, and sometimes a skin rash <sup>(3)</sup>. Recurring attacks may occur for up to 10 years <sup>(4)</sup>
- Severity** : the severity of the infection is variable <sup>(3)</sup> but usually fairly mild <sup>(16)</sup>. The disease is not fatal <sup>(3)</sup>
- Incubation period** : 7 to 30 days <sup>(73)</sup>
- Duration** : the duration of the illness varies, and relapses are possible <sup>(3)</sup>
- Communicability** : humans can infect lice for years. Body lice stay infective for life (lice live approximately 5 weeks after hatching) <sup>(3)</sup>

Transmission cycle <sup>(3,4)</sup>



- Transmission** : lice are infected by ingesting blood containing the pathogen. Their excreta become infective 5 to 12 days after their infective blood meal. People are infected when infective louse-faeces come in contact with broken skin (e.g. the bite-wound) <sup>(3)</sup>, or the conjunctiva <sup>(4)</sup>
- Reservoir** : humans are the reservoir of the pathogen <sup>(3)</sup>. Though it is possible that rodents act as a reservoir <sup>(16)</sup>
- Vector/int. host** : the vector of the pathogen is the human body louse <sup>(16)</sup> (*Pediculus humanus corporis*) <sup>(3)</sup>
- Water-related** : the infection is water-washed <sup>(73)</sup>
- Excreta-related** : no
- Environment** : the infection occurs where people have poor personal hygiene, live in overcrowded circumstances, and are carriers of body louse <sup>(3)</sup>
- Risk in disaster** : there is a risk where louse-infested people live in crowded conditions <sup>(3)</sup>
- Remarks** : -

## CONTROLLING AND PREVENTING DISEASE

Preventative measures	Potential effect
Improving water availability	(+ +) <sup>(29)</sup>
Improving hygiene of clothes and body <sup>(73)</sup>	
Control of body louse <sup>(3)</sup> (see Annexe 3)	
Health and hygiene promotion	

If trench fever occurs in a population, there is a risk of outbreaks of epidemic louse-borne typhus fever and louse-borne relapsing fever <sup>(3)</sup>. If body louse is a problem in a population, a rapid control of the vector is very important <sup>(47)</sup>

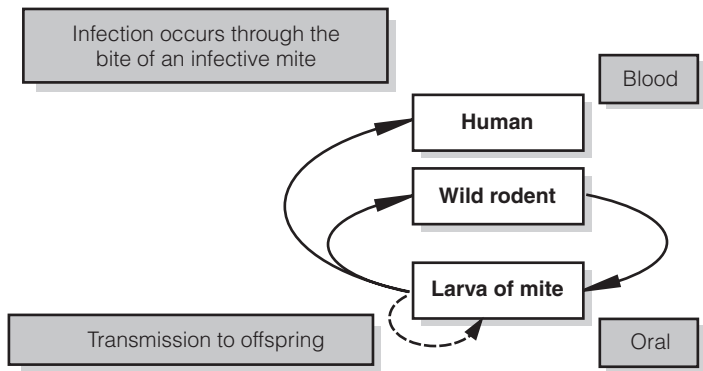
**Epidemic measures :** control of body louse <sup>(3)</sup>

**Typhus (mite-borne) fever, Scrub typhus, Tsutsugamushi disease, Rural typhus**

An infection transmitted by the larvae of mites. The infection occurs in Asia, and is generally very localised in ‘typhus islands’. The infection is often severe and can cause large outbreaks if susceptible people are brought into these ‘typhus islands’.

- Pathogen** : *Rickettsia tsutsugamushi* (*Rickettsia orientalis*) <sup>(3)</sup> (*Rickettsia*)
- Distribution** : the pathogen occurs in Central, eastern, and South-east Asia <sup>(3)</sup>, and Australia <sup>(44)</sup>
- Symptoms** : a skin ulcer will form where the larval mite was attached. Other symptoms are fever, malaise, headache, enlarged spleen, conjunctivitis, rash, delirium, and deafness <sup>(2)</sup>
- Severity** : the case fatality rate in untreated cases is 1 to 60 % <sup>(3)</sup>
- Incubation period** : 1 to 3 weeks <sup>(73)</sup>; usually 10 to 12 days <sup>(3)</sup>
- Duration** : around 2 weeks <sup>(3)</sup>
- Communicability** : mites remain infective over several generations <sup>(2)</sup>

**Transmission cycle** <sup>(73)</sup>



- Transmission** : mites acquire the pathogen either from their parents, or by feeding on an infected rodent <sup>(73)</sup>. The rodents and mites live together in specific zones: ‘typhus islands’ <sup>(3)</sup>. The extent of this ‘community’ is limited to where the rodents are present <sup>(73)</sup>. When people enter into these zones they can get infected if bitten by the infective larva of the mite <sup>(2)</sup>. In military operations up to 50% of the soldiers have been infected <sup>(3)</sup>
- Reservoir** : reservoirs for the pathogens are wild rodents <sup>(16)</sup>. Mites are important as reservoirs as they can pass the infection to their offspring. The infection can be maintained in mites without reinfection from an infected rodent for several generations <sup>(2)</sup>
- Vector/int. host** : the vector of the infection are the larvae of mites (*Leptotrombidium akamushi*, *L. deliensis* and related species) <sup>(3)</sup>. The mites live in transitional or fringe zones <sup>(73)</sup>

## CONTROLLING AND PREVENTING DISEASE

<b>Water-related</b>	: no
<b>Excreta-related</b>	: no
<b>Environment</b>	: the infection occurs in rural zones where the pathogen, mites, and rodents coexist. These areas can be small (measured in some square metres) <sup>(3)</sup> or large. They are almost always created by human activity <sup>(73)</sup> ; e.g. where jungle has been cut and been replaced by scrub <sup>(2)</sup> (jungle grass) <sup>(16)</sup> . Infection occurs to an altitude of up to 3,500 metres above sea level <sup>(3)</sup>
<b>Risk in disaster</b>	: the infection is a risk if people are placed close to 'typhus islands' <sup>(3)</sup>
<b>Remarks</b>	: -

Preventative measures	Potential effect
Avoiding known 'typhus islands' <sup>(47)</sup>	
Personal protection against the mites (wearing covering clothing impregnated with insecticides or repellents <sup>(73)</sup> , repellents to skin <sup>(3)</sup> )	
If a 'typhus island' must be rendered safe, the undergrowth or scrub should be cleared and burnt; and left to dry completely <sup>(73)</sup> or treated with residual insecticides <sup>(2)</sup>	
Health and hygiene promotion	

Control of rodents does not have a direct effect as the mite transmits the pathogen to its offspring <sup>(2)</sup>

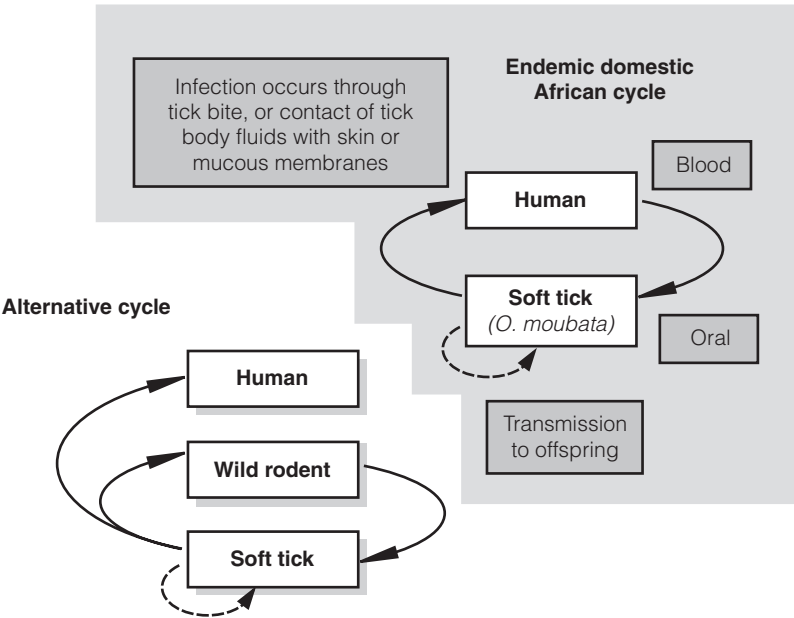
**Epidemic measures** : control of mites by personal protection and clearing of areas containing the mites <sup>(3)</sup>

Relapsing tick-borne fever

A tick-borne infection which should not be confused with louse-borne relapsing fever. The infection is endemic in Africa.

- Pathogen** : in Africa caused by *Borrelia duttoni*; elsewhere other species are responsible<sup>(2)</sup> (Rickettsia)
- Distribution** : the infection occurs in the whole of tropical Africa<sup>(3)</sup>, where the infection is endemic<sup>(73)</sup>. The infection occurs in foci in northern Africa, the Middle-east, and Central Asia up to China, Central America, South America, Spain, Portugal<sup>(16)</sup>, and northern America<sup>(3)</sup>
- Symptoms** : infections may be asymptomatic<sup>(2)</sup>. Symptoms are fever and headache, usually lasting 4-5 days. An attack of fever will reoccur after an interval of 2 days to 3 weeks<sup>(16)</sup> (usually 7 to 10 days)<sup>(73)</sup>. These attacks will repeat themselves 3 to 6 times (in Africa up to 11 times)<sup>(16)</sup>.  
Where the infection is endemic, it is mainly a disease of babies, young children, and pregnant women<sup>(73)</sup>
- Severity** : the case fatality rate of the infection is low<sup>(16)</sup>
- Incubation period** : 3 to 10 days<sup>(73)</sup>, though may be up to 14 days<sup>(16)</sup>
- Duration** : illness lasts for as long as relapses occur
- Communicability** : ticks remain infective for life<sup>(3)</sup> (they can live for over 5 years<sup>(73)</sup>)

Transmission cycle<sup>(73)</sup>



## CONTROLLING AND PREVENTING DISEASE

two transmission cycles occur: in Africa the infection is endemic and the cycle is between people and domestic ticks. Elsewhere an alternative cycle exists; the infection is normally transmitted between rodents and ticks, and people are infected by chance. If contact becomes more intense a cycle similar to the African endemic cycle may occur <sup>(73)</sup>.

<b>Transmission</b>	: Ticks are infected by feeding on infected blood, or receive the infection from their parents <sup>(73)</sup> . The infection is transmitted to humans through the bite of an infective tick <sup>(3)</sup> . Body fluids of the ticks are infective too, and infection can occur through contact with mucous membranes, conjunctiva, or intact skin <sup>(16)</sup> . Limited outbreaks are possible <sup>(16)</sup>
<b>Reservoir</b>	: in the endemic domestic African cycle reservoirs are humans and ticks <sup>(73)</sup> . In the alternative cycle the normal reservoirs are wild rodents and ticks. The ticks transmit the pathogen to their offspring <sup>(3)</sup> , and the infection can be maintained in ticks for at least 5 generations <sup>(2)</sup>
<b>Vector/int. host</b>	: in the endemic domestic African cycle the vector is the soft tick <i>Ornithodoros moubata</i> which lives in cracks and fissures in houses. The ticks can survive 5 years without blood, which means that empty houses can remain infested with ticks for years <sup>(73)</sup> . For the alternative cycle; in Africa: <i>O.hispanica</i> ; in the Near East and Middle East: <i>O.tholozani</i> ; in Central and South America: <i>O.rudis</i> and <i>O.talaje</i> ; and in the USA: <i>O.hermsi</i> and <i>O.turicata</i> . The ticks usually feed at night <sup>(3)</sup>
<b>Water-related</b>	: no
<b>Excreta-related</b>	: no
<b>Environment</b>	: in the endemic domestic African cycle the infection occurs in houses which allow ticks to hide in cracks in walls and floors. In the alternative rodent-tick cycle people become infected in caves or shelters which are inhabited by rodents, or close to rodent burrows <sup>(73)</sup>
<b>Risk in disaster</b>	: the infection is not a priority in a disaster <sup>(47)</sup>
<b>Remarks</b>	: -

Preventative measures	Potential effect
Chemical and environmental control of ticks <sup>(3,47)</sup>	
Using personal protection methods (repellents <sup>(3)</sup> , mosquito net <sup>(73)</sup> )	
Structures should be made rodent-proof to prevent rodents and their ticks from settling <sup>(3)</sup>	
Houses of cases should be treated against ticks <sup>(73)</sup>	
Health and hygiene promotion <sup>(3)</sup>	

Once ticks have infested a house it is very difficult to get rid of them <sup>(73)</sup>

**Epidemic measures :** control of ticks <sup>(3)</sup>



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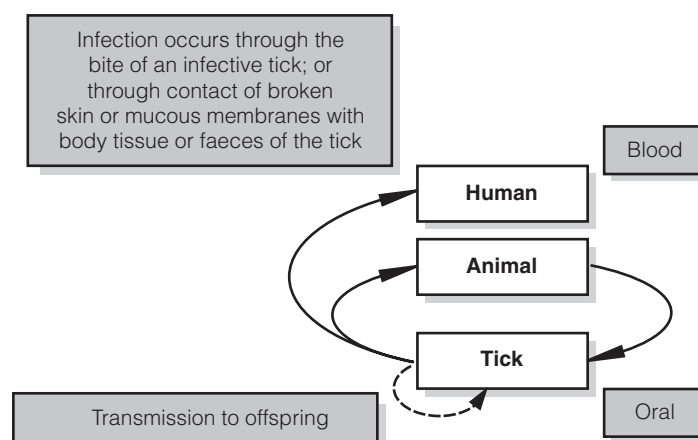
***Typhus – African tick, Boutonneuse fever, Kenya tick typhus, India tick typhus, Mediterranean tick typhus, Mediterranean spotted fever/ Siberian tick typhus, North Asian tick fever/ Queensland tick typhus***

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Infections spread by ticks.

- Pathogen** : African tick typhus (Afr.T.T.): *Rickettsia conorii* and closely related *Rickettsia*.  
Siberian tick typhus (Sib.T.T.): *Rickettsia sibirica*.  
Queensland tick typhus (Que.T.T.): *Rickettsia australis* <sup>(3)</sup> (*Rickettsia*)
- Distribution** : Afr.T.T.: Africa, the Mediterranean, the Middle-east, India <sup>(16)</sup>, and possibly Mexico.  
Sib.T.T.: the Asian parts of the former USSR, Mongolia, and China.  
Que.T.T.: Australia <sup>(3)</sup>
- Symptoms** : mild infections do occur. Occasionally a small black ulcer is visible where the tick was attached <sup>(3)</sup>. Other symptoms are a skin rash and fever <sup>(2)</sup>
- Severity** : the infections have a negligible case fatality rate <sup>(210,221)</sup>
- Incubation period** : Afr.T.T.: usually 5 to 7 days.  
Sib.T.T.: 2 to 7 days.  
Que.T.T.: 7 to 10 days <sup>(3)</sup>
- Duration** : in some cases the illness can last up to 2 weeks <sup>(3)</sup>
- Communicability** : the ticks remain infective for life (about 18 months) <sup>(3)</sup>

**Transmission cycle** <sup>(3)</sup>



- Transmission** : the tick can either receive the infection from its parents, or by feeding on an infected animal. People are usually infected when a tick bites. Crushed ticks, or tick excreta, can cause infection when in contact with broken skin or mucous membranes. The tick must be attached for at least 4 to 6 hours before the pathogen is able to cause infection <sup>(3)</sup>
- Reservoir** : the reservoirs for all infections are rodents <sup>(2,3)</sup>, dogs <sup>(3,16)</sup>, and other animals. Ticks are a reservoir as they can transmit the infection to their offspring <sup>(3)</sup>

## CONTROLLING AND PREVENTING DISEASE

<b>Vector/int. host</b>	: the vectors for these infections are ticks: Afr.T.T.: <i>Haemaphysalis leachi</i> , <i>Amblyomma hebraeum</i> , <i>Rhipicephalus appendiculatus</i> , <i>Boophilus decoloratus</i> , <i>Hyalomma aegyptium</i> . In the Mediterranean the vector is the brown dog tick ( <i>Rhipicephalus sanguineus</i> ). Sib.T.T.: <i>Dermacentor</i> spp. and <i>Haemaphysalis</i> spp.. Que.T.T.: <i>Ixodes holocyclus</i> <sup>(3)</sup>
<b>Water-related</b>	: no
<b>Excreta-related</b>	: no
<b>Environment</b>	: where people are at risk of ticks
<b>Risk in disaster</b>	: the infections will normally not be a problem in disasters <sup>(3)</sup>
<b>Remarks</b>	: -

Preventative measures	Potential effect
Control of ticks <sup>(3)</sup>	
The entire body should be searched every 3 to 4 hours in a risk area <sup>(3)</sup>	
Clothing should cover skin, repellents can be used <sup>(3)</sup>	
Avoiding areas with many ticks <sup>(3)</sup>	
Removing ticks from dogs <sup>(3)</sup>	
Health and hygiene promotion <sup>(3)</sup>	

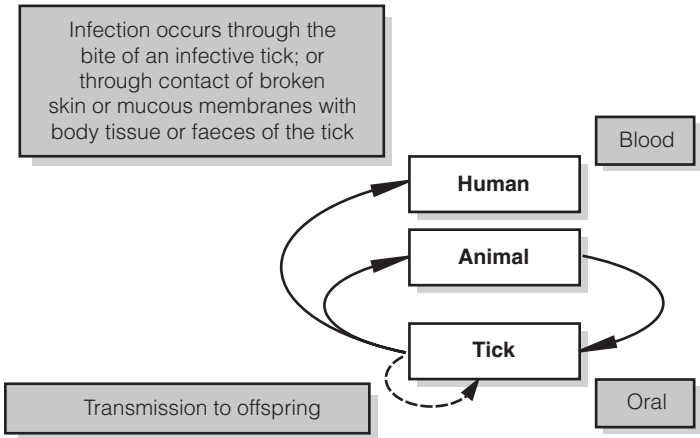
**Epidemic measures :** control and avoidance of ticks <sup>(3)</sup>

***Typhus (tick-borne) fever, Rocky mountain spotted fever***

An infection transmitted by ticks. The pathogen causes a potentially dangerous illness. The infection only occurs in South, Central, and North America.

- Pathogen** : *Rickettsia rickettsii* <sup>(3)</sup> (Rickettsia) <sup>(73)</sup>
- Distribution** : the infection can be found in South, Central, and North America <sup>(73)</sup>
- Symptoms** : sudden onset of fever, malaise, headache, muscle pains, and skin rash <sup>(73)</sup>
- Severity** : the case fatality rate is between 13 and 25%; with adequate treatment this can be brought down to below 5% <sup>(3)</sup>
- Incubation period** : 3 to 13 days <sup>(73)</sup>
- Duration** : the illness lasts several weeks <sup>(44)</sup>
- Communicability** : ticks remain infective for life <sup>(3)</sup>

**Transmission cycle** <sup>(3,73)</sup>



- Transmission** : ticks can pass the pathogen to their offspring, and are either infected in this way, or when feeding on a host <sup>(73)</sup>. Humans are infected by the bite of a tick (a tick must be attached for at least 4 hours to transmit the pathogen), or through contact of tick faeces, or a crushed tick, with broken skin or mucous membranes <sup>(3)</sup>
- Reservoir** : rodents and other small mammals are the main reservoir <sup>(45)</sup>. Dogs are a potential reservoir <sup>(3)</sup>. As the ticks transmit the infection to their offspring they serve as a reservoir to the pathogen <sup>(16)</sup>
- Vector/int. host** : the vector of the infection are ticks: in Central and South America the main vector is *Amblyomma cajennense* <sup>(3)</sup>; in Mexico: *Rhipicephalus sanguineas* <sup>(44)</sup>. In the USA, the American dog tick (*Dermacentor variabilis*), the Rocky Mountain wood tick (*D. andersoni*) and occasionally the Lone Star tick (*Amblyomma americanum*) play a role in transmission <sup>(3)</sup>
- Water-related** : no
- Excreta-related** : no
- Environment** : where contact with ticks is likely

## CONTROLLING AND PREVENTING DISEASE

**Risk in disaster** : the infection is not a priority in a disaster <sup>(3)</sup>

**Remarks** : -

### Preventative measures

### Potential effect

Avoidance of tick-infested areas <sup>(73)</sup>

Search the entire body regularly when in an area at risk <sup>(3)</sup>

Control of ticks <sup>(3)</sup>

Control of dogs <sup>(73)</sup>

Health and hygiene promotion <sup>(3)</sup>

**Epidemic measures** : control of ticks <sup>(3)</sup>

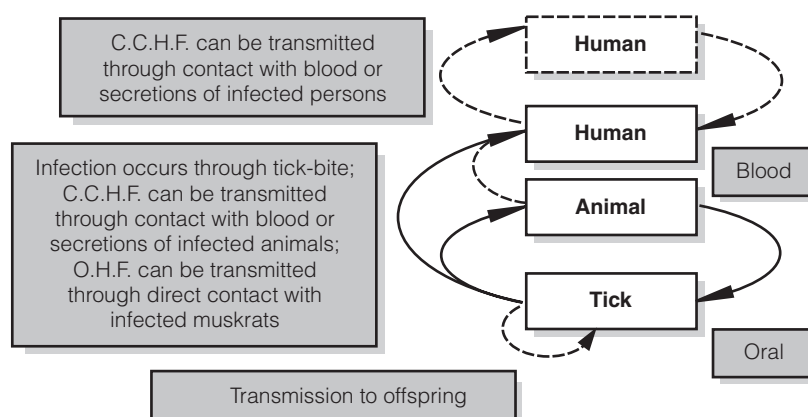
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**Haemorrhagic fevers: (Tick-borne arboviral), Crimean-Congo haemorrhagic fever, Central Asian haemorrhagic fever/ Omsk haemorrhagic fever/ Kyasanur forest disease**


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Infections transmitted by ticks. Severe cases can show bleedings.

<b>Pathogen</b>	: Crimean-Congo haemorrhagic fever virus, Omsk haemorrhagic fever virus and Kyasanur forest disease virus <sup>(3)</sup>
<b>Distribution</b>	: Crimean-Congo haemorrhagic fever (C.C.H.F): tropical and South Africa, the former USSR, the southern parts of eastern Europe, Middle-east, Pakistan, and China <sup>(3)</sup> . Omsk haemorrhagic fever (O.H.F.): the Omsk region in Siberia <sup>(16)</sup> . Kyasanur forest disease (K.F.D.): the Kyasanur forest in India <sup>(3)</sup>
<b>Symptoms</b>	: C.C.H.F.: asymptomatic infections do occur <sup>(16)</sup> . Symptoms are fever, malaise, pains, skin rash, possibly bleeding from gums, nose and intestines <sup>(3)</sup> . In Africa cases with bleeding are rare <sup>(16)</sup> O.H.F. and K.F.D. : symptoms are chills, headache, fever, pains, conjunctivitis is common, diarrhoea, and vomiting. Severe cases may develop bleeding. Cases of K.F.D. sometimes develop problems in the central nervous system <sup>(3)</sup>
<b>Severity</b>	: C.C.H.F.: the case fatality rate is between 2% <sup>(3)</sup> and 30% to 50%. The higher fatality rates tend to occur in outbreaks. In Africa deaths due to the infection are uncommon. O.H.F.: the case fatality rate is 1% to 3% <sup>(16)</sup> . K.F.D.: the case fatality rate is estimated at 1% to 10% <sup>(3)</sup>
<b>Incubation period</b>	: C.C.H.F.: transmission through a tick-bite: 1 to 3 days (with a maximum of 9 days); transmission through contact with infected blood, secretions, or body tissues: 5 to 6 days (with a maximum of 13 days) <sup>(83)</sup> . O.H.F.: usually 3 to 8 days <sup>(3)</sup> . K.F.D.: 3 to 12 days <sup>(73)</sup>
<b>Duration</b>	: the illnesses may last for weeks. Complete recovery may take a long time <sup>(3)</sup>
<b>Communicability</b>	: ticks remain infective for life <sup>(3)</sup>
<b>Transmission cycle</b> <sup>(3,16)</sup>	



## CONTROLLING AND PREVENTING DISEASE

<b>Transmission</b>	: ticks are infected either through their parents, or by feeding on an infected host. The infections are transmitted to people through the bite of an infective tick. C.C.H.F. can be transmitted through contact with blood and secretions of infected persons or reservoir animals <sup>(3)</sup> . Persons commonly acquire O.H.F. through direct contact with infected muskrats. The possibility of air-borne transmission is suspected with C.C.H.F. and O.H.F. Outbreaks are possible with all of the infections. Epidemics of C.C.H.F. can occur in endemic areas. For O.H.F. there is risk of an outbreak if there is a high mortality in muskrats <sup>(16)</sup>
<b>Reservoir</b>	: C.C.H.F.: hares, birds, and domestic animals (sheep, goats, cattle) <sup>(3)</sup> . O.H.F.: the main reservoir is the muskrat, but other rodents serve as reservoirs too <sup>(16)</sup> . K.F.D.: probably rodents, shrews, and monkeys <sup>(3)</sup> . Ticks transmit the pathogens to their offspring, and are therefore reservoirs <sup>(3,16)</sup>
<b>Vector/int. host</b>	: ticks are the vector of these infections: C.C.H.F.: <i>Hyalomma marginatum</i> , <i>H.anatolicum</i> , possibly other ticks <sup>(3)</sup> . O.H.F.: <i>Dermacentor pictus</i> and <i>D.marginatus</i> <sup>(16)</sup> . K.F.D.: probably <i>Haemaphysalis spinigera</i> <sup>(3)</sup>
<b>Water-related</b>	: no
<b>Excreta-related</b>	: no
<b>Environment</b>	: C.C.H.F.: most cases occur in persons working closely with animals, medical personnel working with infected persons, and close contacts of cases <sup>(3)</sup> . O.H.F.: most at risk are trappers and people working in water-courses <sup>(16)</sup> . K.F.D.: the infection occurs mainly in the dry season in young men who come in contact with the forest <sup>(3)</sup>
<b>Risk in disaster</b>	: the infections will not be a priority in disasters <sup>(3)</sup>
<b>Remarks</b>	: -

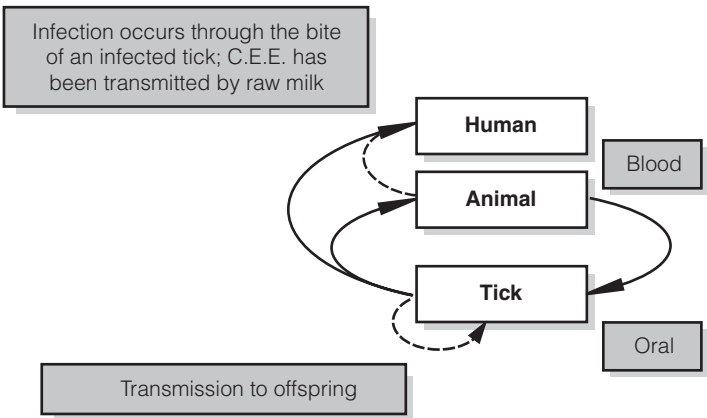
Preventative measures	Potential effect
Avoidance of tick-infested areas <sup>(3)</sup>	
Search the entire body regularly when in an area at risk <sup>(3)</sup>	
Control of ticks <sup>(3)</sup>	
With C.C.H.F. people at risk can be vaccinated <sup>(73)</sup>	
Patients with C.C.H.F. must be kept in strict isolation <sup>(16)</sup>	
Health and hygiene promotion <sup>(3)</sup>	

**Epidemic measures :** control of ticks <sup>(3)</sup>

**Encephalitis (Tick-borne arboviral): Far eastern tick-borne encephalitis, Russian spring-summer encephalitis / Central European tick-borne encephalitis/ Powassan virus encephalitis**

Infections transmitted by ticks. The pathogens occur in the former USSR, Europe, and northern America

<b>Pathogen</b>	: a group of closely related arboviruses <sup>(3)</sup>
<b>Distribution</b>	: Far eastern tick-borne encephalitis (F.E.E.): mainly in the far eastern parts of the former USSR. Central European tick-borne encephalitis (C.E.E.): mainly in Europe. Powassan virus encephalitis (P.V.E.): Russia, the USA, and Canada <sup>(3)</sup>
<b>Symptoms</b>	: symptoms are fever, headache, disorientation, and meningitis. F.E.E. can result in epilepsy and paralysis <sup>(3)</sup>
<b>Severity</b>	: F.E.E.: the case fatality rate can be up to 30%. C.E.E.: the case fatality rate is around 3% <sup>(16)</sup> . P.V.E.: has a case fatality rate of around 10% <sup>(3)</sup>
<b>Incubation period</b>	: 7 to 14 days <sup>(73)</sup>
<b>Duration</b>	: illness will last several weeks <sup>(3)</sup>
<b>Communicability</b>	: infected ticks remain infective for life <sup>(3)</sup>
<b>Transmission cycle</b> <sup>(3)</sup>	



<b>Transmission</b>	: ticks are infected either by receiving the pathogen from their parents, or by feeding on an infected host. Humans are infected when an infective tick feeds on them. C.E.E. has been transmitted by ingesting raw milk <sup>(3)</sup> . Outbreaks can occur after periods in which voles have been numerous <sup>(16)</sup>
<b>Reservoir</b>	: the reservoirs of the infections are rodents, other mammals, and birds <sup>(3)</sup> . Infected ticks can pass the pathogens to their offspring and are therefore a reservoir <sup>(221, 241)</sup>
<b>Vector/int. host</b>	: the vectors of the infections are ticks: in the eastern parts of the former USSR mainly <i>Ixodes persulcatus</i> , in the western parts of the former USSR and Europe the main vector is <i>I.ricinus</i> , and in the USA and Canada <i>I.cookei</i> <sup>(3)</sup>

## CONTROLLING AND PREVENTING DISEASE

<b>Water-related</b>	: no
<b>Excreta-related</b>	: no
<b>Environment</b>	: F.E.E. occurs mainly in spring and early summer, and is an infection of the forest and taiga. C.E.E. is associated with forests and occurs in late spring to early autumn <sup>(16)</sup> . P.V.E. can mainly be found in rural or forested zones <sup>(3)</sup>
<b>Risk in disaster</b>	: the infections will not be a priority in a disaster <sup>(3)</sup>
<b>Remarks</b>	: -

Preventative measures	Potential effect
Avoidance of tick-infested areas <sup>(3)</sup>	
the entire body should be regularly searched for ticks when in an area at risk <sup>(3)</sup>	
Control of ticks <sup>(3)</sup>	
Immunisation is possible <sup>(3)</sup>	
Where C.E.E. occurs milk should be pasteurised <sup>(3)</sup>	
Health and hygiene promotion <sup>(3)</sup>	
<b>Epidemic measures</b> : control of ticks <sup>(3)</sup>	

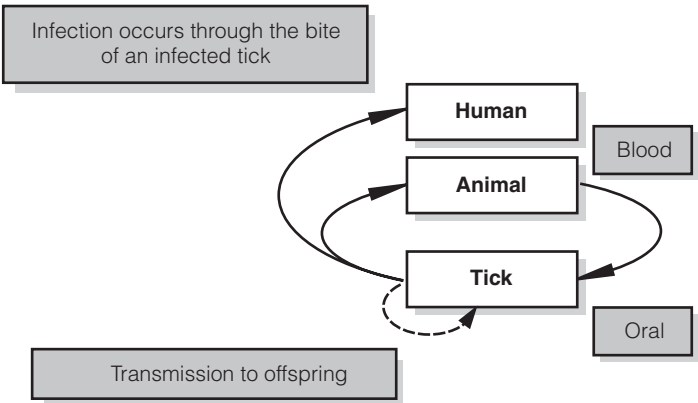


**Lyme disease, Lyme borreliosis**

An infections transmitted by ticks. The pathogen occurs in the former USSR, China, Japan, Europe, and northern America.

- Pathogen** : *Borrelia burgdorferi* <sup>(3)</sup> (Bacterium)
- Gen. description** : an infection which occurs in the former USSR, China, Japan, Europe, and northern America. Symptoms are: an expanding red mark (ring-shaped) at the place of the tick-bite, malaise, fever, headache, and pains in muscles. Weeks to months after the bite, problems in the nervous system may arise <sup>(3)</sup>. Intermittent arthritis will occur in 60% of the cases <sup>(45)</sup>. The incubation period (for the red mark) is 3 to 30 days <sup>(73)</sup>. If untreated, the infection can last for years and result in severe chronic health problems <sup>(3)</sup>

**Transmission cycle** <sup>(3)</sup>



- Transmission** : ticks are infected either through their parents or by feeding on an infected host. Humans are infected through an infective tick-bite. In tests ticks had to be attached for over 24 hours to animals before transmission of the pathogen occurred <sup>(3)</sup>
- Reservoir** : the reservoirs of the infection are rodents and other animals. Dogs, cattle, and horses can develop the illness. Ticks serve as reservoirs as they can transmit the pathogen to their offspring <sup>(3)</sup>
- Vector/int. host** : the vectors of the infections are ticks: in Asia *Ixodes persulcatus*, in Europe *I. ricinus*, and in the USA *I. pacificus* and *I. scapularis* <sup>(3)</sup>
- Environment** : infection usually occurs in summer (when the ticks are most active) <sup>(3)</sup>

## CONTROLLING AND PREVENTING DISEASE

### Preventative measures

### Potential effect

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Avoidance of tick-infested areas <sup>(3)</sup>

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Regularly search the entire body for ticks when in an area at risk <sup>(3)</sup>

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Control of ticks <sup>(3)</sup>

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Health and hygiene promotion <sup>(3)</sup>

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**Epidemic measures :** control of ticks <sup>(3)</sup>

## Annexe 2

### **Summary tables of infections related to water and environmental sanitation** (excluding vector-borne infections)

## CONTROLLING AND PREVENTING DISEASE

Table A2.1: Faecal-oral infections

Infection	Occurrence				Measures of control							
	Africa	Asia	Central and/or S. America	Animal reservoir	Improving water quality	Improving water availability	Improving handwashing	Improving sanitation	Improving food hygiene	Control of domestic animals	Control of domestic flies	Additional measures
Faecal-oral diseases	✓	✓	✓	++	+++	+++	++	++	p	p		
Diarrhoeal diseases	✓	✓	✓	++	+++	+++	++	++	p			
Campylobacter enteritis	✓	✓	✓	++	+++	+++	++	++	++	-		
Bacterial enteritis*	✓	✓	✓	++	+++	+++	+	++	-			
Salmonellosis	✓	✓	✓	++	+++	+++	++	++	n.s.	-		
Yersiniosis	✓	✓	✓	++	+++	+++	+	++	n.s.	-		
Bacillary dysentery	✓	✓	-	++	+++	+++	++	++	-	n.s.		
Cholera	✓	✓	-	+++	+++	+++	+++	++	-	n.s. <sup>(a)</sup>	care in handling, and burial, of the dead	

+++ : very effective; ++ : effective; + : some effect; n.s.: extent of effectiveness is not specified; p: possible, depending on the pathogen ; - : no, or not effective

<sup>(a)</sup>: where contaminated wastes are present\*caused by *E.coli*

Table A2.1: Faecal-oral infections (continued)

Infection	Occurrence			Measures of control						
	Africa	Asia	Central and/or S. America	?	?	?	?	?	?	?
Rotaviral enteritis	✓	✓	✓	–	?	?	?	?	?	?
Epidemic viral gastroenteropathy	✓	✓	✓	–	n.s.	??	n.s.?	+	–	–
Amoebiasis	✓	✓	✓	–	n.s.	++	++	+	–	n.s.
Giardiasis	✓	✓	✓	–	++	++	++	+	–	–
Cryptosporidiosis	✓	✓	✓	✓	n.s.	n.s.	n.s.	n.s.	n.s.	–
Balantidiasis	✓	✓	✓	✓	n.s.	n.s.	n.s.	n.s.	n.s.	–
(para-) typhoid fever	✓	✓	✓	–	+++	+++	+++	++	–	n.s.
Hepatitis A and E	✓	✓	✓	–	n.s.	??	n.s.?	+	–	–
Polio myelitis	✓	✓	–	–	–	?+	n.s.?	+	–	–
+++ : very effective; ++ : effective; + : some effect; n.s.: extent of effectiveness is not specified; ? : uncertain – : no, or not effective										

Table A2.1: Faecal-oral infections (continued)

Infection	Occurrence				Measures of control							
	Africa	Asia	Central and/or S. America	Animal reservoir	Improving water quality	Improving handwashing	Improving sanitation	Improving food hygiene	Control of domestic animals	Control of domestic flies	Additional measures	
Hymenolepiasis	✓	✓	✓	—	n.s.	+	+	+	?	n.s. <sup>(a)</sup>	—	
Pinworm infection	✓	✓	✓	—	—	+	+	n.s.	—	—	hygiene of bedding and clothes	
Hydatid disease	✓	✓	✓	✓ <sup>(b)</sup>	—	++	++	n.s. <sup>(b)</sup>	n.s.	n.s. <sup>(b)</sup>	—	
Cysticercosis	✓	✓	✓	—	—	++	++	n.s.	n.s.	—	—	
+++ : very effective; ++ : effective; + : some effect; n.s.: extent of effectiveness is not specified; - : no, or not effective												

+++ : very effective; ++ : effective; + : some effect; n.s.: extent of effectiveness is not specified; – : no, or not effective

<sup>(a)</sup>: possibly mice

<sup>(b)</sup>: dogs

**Table A2.2: Water-based helminths (schistosomiasis and water-based helminths with 2 intermediate hosts)**

Infection	Occurrence				Measures of control						
	Africa	Asia	Central and/or S. America	Animal reservoir	Reducing water contact	Improving sanitation	Control of freshwater snails	Mass treatment	Additional measures		
<b>Schistosomiasis</b>	✓	✓	✓ <sup>(a)</sup>	+++	+	–	n.s.	–	n.s.		
<b>Fasciolopsiasis</b>	–	✓	✓	–	(b) +	+++	n.s. <sup>(b)</sup>	–	–		
<b>Fascioliasis</b>	✓	✓	✓	–	n.s. <sup>(c)</sup>	n.s.	n.s.	–	–		
<b>Clonorchiasis/Opisthorchiasis</b>	–	✓	–	–	+	+++	n.s.	–	–		
<b>Diphyllobothriasis</b>	✓	✓	✓	–	+	+++	–	–	n.s.		
<b>Paragonimiasis</b>	✓	✓	✓	–	+	+++	n.s.	–	care in disposal of sputum		
+++ : very effective; ++ : effective; + : some effect; n.s.: extent of effectiveness is not specified; – : no, or not effective											

<sup>(a)</sup>: for *S.japonicum*

<sup>(b)</sup>: pigs

<sup>(c)</sup>: domestic animals

Table A2.3: Soil-transmitted helminths

Infection	Occurrence				Measures of control						
	Africa	Asia	Central and/or S. America	Animal reservoir	Improving water availability	Improving handwashing	Improving sanitation	Improving food hygiene	Wearing closed shoes	Mass treatment	Additional measures
Hookworm disease	✓	✓	✓	-	+++	+	+++	+	+	+	
Strongyloidiasis	✓	✓	✓	-	+++	-	+	+++	-		
Roundworm infection	✓	✓	✓	-	+++	++	+	-	+++	+	
Trichuriasis	✓	✓	✓	-	+	+	+	-	n.s.		
+++ : very effective; ++ : effective; + : some effect; n.s.: extent of effectiveness is not specified; - : no, or not effective											



**Table A2.4: Beef and pork tapeworm**

Infection	Occurrence				Measures of control	
	Africa	Asia	Central and/or S. America	Animal reservoir	Improving sanitation	Additional measures
Beef tapeworm	✓	✓	✓	+	+	Measures against cysticercosis can be found under faecal-oral infections
Pork tapeworm	✓	✓	+	+	+	

**Table A2.5: Leptospirosis and guinea-worm infection**

Infection	Occurrence				Measures of control	
	Africa	Asia	Central and/or S. America	Animal reservoir	Improving water quality at source	Additional measures
Leptospirosis	✓	✓	✓	+	+	control of rodents
Guinea-worm infection	✓	(a)	+	+	+	control of <i>Cyclops</i> spp.

+++ : very effective; ++ : effective; + : some effect; n.s.: extent of effectiveness is not specified; - : no, or not effective

(a): in Yemen

Table A2.6: Infections transmitted through direct contact

Infection	Occurrence			Measures of control					
	Africa	Asia	Central and/or S. America	Improving water availability	Improving hygiene of body and clothes	Care in dealing with domestic animals	Control of domestic flies	Treatment of cases	Additional measures
Conjunctivitis	✓	✓	–	+++	n.s.	n.s.	–	n.s.	n.s.
Trachoma	✓	✓	–	++	n.s.	n.s.	–	n.s.	n.s.
Yaws	✓	✓	–	++	–	n.s.	–	n.s.	n.s.
Leprosy	✓	✓	–	p	–	p	–	–	n.s.
Scabies	✓	✓	–	+++	–	n.s.	–	–	n.s.
Tinea	✓	✓	✓	++	n.s.	n.s.	n.s.	–	n.s.
+++ : very effective; ++ : effective; + : some effect; n.s.: extent of effectiveness is not specified; p : possibly effective – : no, or not effective									

## Annexe 3

### **Summary tables of vector-borne infections, vectors and their control**

## CONTROLLING AND PREVENTING DISEASE

Table A3.1: Vector-borne infections with their vectors <sup>(3,73)</sup>

Infection	Mosquito	Tsetse fly	Sandfly	Blackfly	Deer fly	Reduvid bug	Flea	Body louse	Mite	Tick
Yellow fever	Ae									
Dengue fever	Ae									
Filariasis	Ae; Cu; Ma; An									
Mosquito-borne arboviral encephalitis	Cu									
Mosquito-borne arboviral fevers	Ae; Cu									
Mosquito-borne arboviral arthritis	Ae; Cu; Ma; An									
Malaria	An									
Sleeping sickness	✓									
Leishmaniasis		✓								
Bartonellosis		✓								
Sandfly-borne arboviral fevers		✓								
River blindness			✓							
Loiasis				✓						
American trypanosomiasis					✓					

Mosquito: Ae (*Aedes* spp.); Cu (*Culex* spp.); Ma (*Mansonia* spp.); An (*Anopheles* spp.)

Table A3.1: Vector-borne infections with their vectors (continued) <sup>(3,73)</sup>

Infection										
	Mosquito	Tsetse fly	Sandfly	Blackfly	Deer fly	Redwired bug	Flea	Body louse	Mite	Tick
Plague						✓				
Murine typhus fever						✓	Oc.	Oc.	Oc.	
Louse-borne typhus fever							✓			
Louse-borne relapsing fever							✓			
Trench fever							✓			
Scrub typhus								✓		
Tick-borne relapsing fever									✓	
... tick typhus									✓	
Tick-borne typhus fever									✓	
Tick-borne arboviral haemorrhagic fever									✓	
Tick-borne arboviral encephalitis									✓	
Lyme disease									✓	

... tick typhus: African tick typhus, Siberian tick typhus, Queensland tick typhus  
Oc.: occasional transmission is possible.

## CONTROLLING AND PREVENTING DISEASE

**Table A3.2: The vectors and their characteristics (rats have been included) (from 61,67,77,80)**

Vector	I/O <sup>(a)</sup>	D/N <sup>(b)</sup>	Breeding sites	Resting sites	Range	Additional information
<b>Mosquito</b> <i>Aedes</i> spp.	I/O	D	water bodies with fluctuating water levels, containers in refuse, water storage tanks, usually clean water	most species outdoors, but <i>Aedes aegypti</i> in and around houses	0.1-0.8 km	eggs can withstand desiccation for months. Generation cycle: 8-10 days
<b>Mosquito</b> <i>Culex</i> spp.	I/O	N	organically polluted water: latrines, septic tanks, blocked drains	indoors and outdoors in sheltered, shaded places	0.1-0.8 km	Generation cycle: 8-10 days
<b>Mosquito</b> <i>Mansonia</i> spp.	I/O	N	water bodies with permanent vegetation: swamps, ponds, canals	usually outdoors	?	
<b>Mosquito</b> <i>Anopheles</i> spp.	I/O	N	lakes, pools, puddles, slow-flowing streams; often in sunlight and with vegetation, clean water	indoors and outdoors in sheltered places	2 km	Generation cycle: 10-14 days
<b>Tsetse fly</b> ( <i>Glossina</i> spp.)	O	D	in shaded moist soil: under bushes, logs, stones, leaf litter	in shaded places in forests, vegetation	2-4 km	Generation cycle: 60 days
<b>Sandfly</b> ( <i>Phlebotomus</i> spp.; <i>Lutzomyia</i> spp.)	I/O	D/N	humus-rich damp soil; deep cracks in soil, rodent burrows, termite hills	shaded, sheltered, humid places	200 m	Generation cycle: 6-8 weeks
<b>Blackfly</b> ( <i>Simulium</i> spp.)	O	D	fast-flowing, shallow, 'white water' in rivers and streams	outdoors	10 km	Generation cycle: 2-3 weeks
<b>Reduviid bug</b> ( <i>Triatoma</i> spp.)	I	N	cracks in walls, other indoor hiding places	cracks in walls or floors, furniture, thatched roofs	10-20 m	The bugs can survive for up to 4 months without a blood meal. Generation cycle: 6-24 months

<sup>(a)</sup> I/O: the biting place is indoors (I) or outdoors (O)<sup>(b)</sup> D/N: the time of activity is during the day (D) or during the night (N)

n/a: not applicable

**Table A3.2: The vectors and their characteristics (continued)** (from 61, 67, 77, 80)

Vector	I/O <sup>(a)</sup>	D/N <sup>(b)</sup>	Breeding sites	Resting sites	Range	Additional information
<b>Flea</b> ( <i>Xenopsylla</i> spp.; <i>Pulex irritans</i> )	I	D/N	close to sleeping and resting place of the host; in cracks in walls or floors, animal burrows	animals, beds, clothing	n/a	vector fleas are associated with rats; may survive for up to 1 year in vacant houses. Generation cycle: 8 weeks
<b>Body louse</b> ( <i>Pediculus humanus corporis</i> )	n/a	D/N	seams in clothing	clothes	n/a	can only survive for up to 1 week off people. Generation cycle: 3 weeks
<b>Mite</b> ( <i>Leptotrombidium</i> spp.)	O	D	often artificially created environments: where jungle has been replaced by scrubs, jungle grass	often artificially created environments: where jungle has been replaced by scrubs, jungle grass	n/a	
<b>Tick</b> (many different types)	I/O	D	depending on the sort	indoors: cracks in walls, floors and furniture; outdoors: sheltered places	n/a	different ticks can act as vector of different diseases
<b>Domestic fly</b> ( <i>Musca</i> spp.)	n/a	D	organic material: faeces, corpses, food	outdoors and indoors	5 km	domestic flies are mechanical vectors. Generation cycle: 7-14 days
<b>Cockroach</b> (several types)	n/a	N	sheltered, warm and damp places	sheltered, warm and damp places	?	Generation cycle: 2-3 months
<b>Rat</b> ( <i>Rattus</i> spp.)	n/a	N	buildings, burrows, sewers, refuse dumps	buildings, burrows, sewers, refuse dumps	50-80 m	Generation cycle: 3-4 months

<sup>(a)</sup> I/O: the biting place is indoors (I) or outdoors (O)<sup>(b)</sup> D/N: the time of activity is during the day (D) or during the night (N)

n/a: not applicable

## CONTROLLING AND PREVENTING DISEASE

**Table A3.3: Preventative measures against vectors (rats have been included)** (adapted from 21,61,67,73,77,78)

Vector	Use of repellents, protective clothes	Use of bednets	Improve personal hygiene	Improve sanitation	Improve drainage	Improve solid waste management	Improve food storage	Clear land housing	Clear aquatic vegetation	Changing flow velocity	Chemical control	Traps	Additional measures
<b>Mosquito: <i>Aedes</i></b>	++	+	++	++	++	-	++	+	+	+	-	(a)	
<b>Mosquito: <i>Culex</i></b>	++	++	++	++	++	-	++	+	+	+	-		
<b>Mosquito: <i>Mansonia</i></b>	++	++	+	-	-	-	++	+	+	-	-	(b)	
<b>Mosquito: <i>Anopheles</i></b>	++	++	++	++	-	-	++	+	+	+	-	(b), (c)	
<b>Tsetse fly</b>	+	-	-	-	-	-	++	-	-	+	++		
<b>Sandfly</b>	++	++	n.s.	n.s.	n.s.	-	++	-	-	++	-	(d)	
<b>Blackfly</b>	++	-	-	-	-	-	-	-	+	++	-	(e)	
++ : effective; + : limited effect; n.s. : extent of effectiveness is not specified; - : not effective													

<sup>(1)</sup>: increasing velocities in streams, rivers, channels<sup>(2)</sup>: modifying streams so that the creation of 'white', turbulent water is avoided

(a): fill up, remove, cover or repair all 'vessels' in the domestic area (e.g. old tyres, buckets, domestic water storage reservoirs, barrels, gutters, holes in construction blocks, old cars or machines)

(b): introduce larvivorous fish

(c): it is sometimes possible to divert mosquitoes to domestic animals

(d): destruction of rodent colonies; avoiding places where sandflies rest or breed

(e): avoidance of areas where the blackfly is abundant (e.g. rapids in streams)



**Table A3.3: Preventative measures against vectors (continued)** (adapted from 21, 61, 67, 73, 77, 78)

Vector											
	Use of repellents, protective clothes	Use of bednets	Improve personal hygiene	Improve sanitation	Improve drainage	Improve solid waste management	Improve food storage	Improve housing	Clear land vegetation	Clear aquatic vegetation	
<b>Reduviid bug</b>	-	+	-	-	n.s.	-	++	n.s.	-	-	
<b>Flea</b>	++	-	-	-	++	-	++	-	-	-	(f)
<b>Body louse</b>	-	-	-	-	-	-	-	-	-	-	(g)
<b>Mite</b>	++	-	-	-	-	-	-	+	-	-	(h)
<b>Tick</b>	++	++ <sup>(3)</sup>	-	-	-	-	n.s. <sup>(3)</sup>	n.s.	-	-	(i)
<b>Domestic fly</b>	-	++ <sup>(4)</sup>	++	n.s.	++	n.s.	+	-	-	-	++
<b>Cockroach</b>	-	++ <sup>(4)</sup>	n.s.	n.s.	++	n.s.	+	-	-	-	n.s.
<b>Rat<sup>(5)</sup></b>	-	-	n.s.	n.s.	++	n.s.	++ <sup>(a)</sup>	n.s.	-	-	++
++ : effective; + : limited effect; n.s. : extent of effectiveness is not specified; - : not effective											

<sup>(3)</sup>: only effective against soft ticks (the vector of tick-borne relapsing fever) which live in the house<sup>(4)</sup>: correct use of fly-nets will prevent flies and cockroaches from reaching food or babies<sup>(5)</sup>: where flea-borne infections (plague, murine typhus fever) are present, or a risk, fleas must be successfully controlled before rat control begins

(f): improve hygiene of the house

(g): clothing has to be cleaned and treated with insecticide; mass treatment is necessary; treatment of bedding

(h): avoid 'mite islands'

(i): check body after visiting tick-infested areas; treating domestic animals with insecticide



## Annexe 4

### **Chlorination of drinking-water**

## Chlorination of drinking water

In this annexe we will show how the chlorine demand of water can be determined, and how to calculate the amount of chlorine that should be added in the treatment of a batch of water, and in a continuous supply.

Materials needed:

- Turbidity tube (preferably)
- Chlorine-generating product (e.g. HTH)
- Tablespoon (or other object which contains around 15 ml)
- Measuring jug
- Non-metallic vessels (e.g. plastic buckets) with a volume of 5 litres or more
- Syringe (without needle)
- Pooltester with DPD1 tablets
- A watch
- Possibly a calculator

### Assessing whether the raw water can be chlorinated directly

The water which is going to be treated should be relatively limpid (transparent). Suspended matter in the water can protect pathogens from the effect of chlorine, and chlorination will only be effective if the water contains little suspended material.

The amount of suspended matter in the water can be determined by measuring its turbidity. This can be done with a turbidity tube. A turbidity tube is a closed tube with a mark on the bottom. The tube is completely filled with water and the mark is observed through the water in the tube. The water is tipped out in small quantities until the mark is just visible. The turbidity of the water is determined by reading up to where the water comes on the scale on the side of the tube.

If no turbidity tube is available, the turbidity is probably acceptable if a small black cross on a white background is visible through about 0.6 metres of water (this is a turbidity of roughly 5 NTU).

Although chlorination is relatively effective at a turbidity of up to 20 NTU, the water should normally have a turbidity below 5 NTU <sup>(21)</sup>. If the turbidity of the water is higher, than some form of treatment (e.g. sedimentation, rough filtration, coagulation) will be necessary to remove the suspended material.

It should be remembered that the turbidity of surface water will normally fluctuate with the seasons.

### The mother solution and chlorine-generating products

The most appropriate way of chlorinating water is usually by adding a mother solution to the raw water. A mother solution is a solution with a specific percentage of chlorine. Often a mother solution with a chlorine content of 1% (containing 10 grams of chlorine per litre) is used.

The mother solution is made by mixing the chemical which generates chlorine with water. How much of the chemical is needed to make a 1% solution will depend on its chlorine content. Table A4.1 present some common chlorine-generating products with their form, their chlorine content in percentage, and how 1 litre of mother solution of 1% chlorine can be made.

**Table A4.1. Common chlorine-generating products with some of their characteristics**

<i><b>Product</b></i>	<i><b>Form</b></i>	<i><b>Chlorine content</b></i>	<i><b>How to make 1 litre of mother solution</b></i>
High Test Hypochlorite (HTH)	granules	± 70 %	Mix 15 gram (± 1 tablespoon <sup>(a)</sup> ) with 1 litre of water
Bleaching powder	powder	± 30 %	Mix 33 grams (± 2 tablespoons <sup>(a)</sup> ) with 1 litre of water
Liquid laundry bleach	liquid	± 5 %	Mix 200 ml of liquid bleach with 800 ml of water

<sup>(a)</sup>: 1 tablespoon has a volume of 15 ml

If other chlorine-generating products are used, the quantity of product needed to make one litre of a 1% mother solution can be calculated with the formula:

$$Qty = 10 \times \left( \frac{100}{Cl_{cont}} \right)$$

**Qty** : amount of product needed to make 1 litre of a 1% mother solution (in grams or ml)

**Cl<sub>cont</sub>** : chlorine content of the product (in %)

Thus if stabilised tropical bleach would be used with a chlorine content of 25%, the amount that would have to be dissolved in 1 litre of water to make a 1% mother solution is  $(10 \times 100/25) = 40$  grams.

Chlorine-generating products do not support being exposed to light, air, metal, or high temperatures. They should therefore be stored in dark, covered, non-metallic containers in a cool place. As they can emit chlorine gas, the storage room should be well ventilated.

### **Determining the chlorine demand of the raw water**

The amount of mother solution that is needed to chlorinate the raw water will have to be determined by experimentation.

A number of non-metallic vessels (e.g. plastic buckets or jerrycans) are filled with a known amount of the raw water (e.g. 4 buckets filled with 10 litres of water). Specific amounts of mother solution are added to each of the buckets with a syringe (e.g. 0.5 ml, 1.0 ml, 1.5 ml and 2 ml). The water is well mixed, and left for 30 minutes.

After 30 minutes no more chlorine should be lost to consumed or combined residual chlorine, and the content of free residual chlorine of the water can be determined with a pooltester. A DPD1 tablet is added to the water in a pooltester, and the tester is closed and vigorously shaken to dissolve the tablet. Chlorine in the water will turn the water pink; the more chlorine there is, the darker the colour. The content in free residual chlorine is determined by comparing the colour of the water with a colour scale. We are looking for the dose which results in a free residual chlorine content of 0.2-0.5 mg/l.

Imagine that our series would give the results:

<b>Bucket</b>	<b>Mother solution added to 10 litres</b>	<b>Free residual chlorine (in mg/l)</b>
1	1.5 ml	0 mg/l
2	2.0 ml	0 mg/l
3	2.5 ml	0.1 mg/l
4	3.0 ml	0.5 mg/l

In this case a dose of 2.7 ml to 3.0 ml of mother solution per 10 litres of raw water would normally be adequate to reach a free residual chlorine content of 0.2-0.5 mg/l.

This method gives a rough indication of the chlorine demand of the raw water. The free residual chlorine should be 0.2-0.5 mg/l at the point of distribution. As the content of free residual chlorine may reduce during distribution, we may want

to have a higher content of free residual chlorine when the water leaves the treatment plant.

The content of the free residual chlorine in chlorinated water will have to be tested continuously to make sure that treatment is still adequate. The chlorine demand of the raw water will often not be constant over time.

### Chlorinating a batch of water

If a batch of water has to be treated, the amount of mother solution that is needed can be calculated with the formula:

$$Ms_{bat} = \left( \frac{Vol_{bat}}{Vol_{test}} \right) \times Ms_{test}$$

- $Ms_{bat}$  : the amount of mother solution required to chlorinate the batch of raw water (in ml)  
 $Vol_{bat}$  : the volume of the batch of water which has to be treated (in litres)  
 $Vol_{test}$  : the volume of water that was used in the test (in litres)  
 $Ms_{test}$  : the amount of mother solution which was required to chlorinate the water in the test (in ml)

Thus, if in our example we need a free residual chlorine content of 0.5 mg/l, and we want to treat the water in a reservoir of 15m<sup>3</sup> (15,000 litres), the amount of mother solution we would have to add would be (15,000/10 x 3) = 4,500 ml (= 4.5 litres).

### Chlorinating a continuous supply of water

If a continuous supply of water has to be chlorinated, the amount of mother solution that has to be added per unit of time can be calculated with the formula:

$$Rate_{Ms} = \left( \frac{Flow_{sup}}{Vol_{test}} \right) \times Ms_{test}$$

- $Rate_{Ms}$  : the rate at which mother solution has to be added to the supply (in ml/second)  
 $Flow_{sup}$  : the flow of the supply of raw water (in litres/second)  
 $Vol_{test}$  : the volume of water that was used in the test (in litres)

$Ms_{\text{test}}$  : the amount of mother solution which was required to chlorinate the water in the test (in ml)

If we would want to treat the raw water of our example in a system with continuous supply which has to deliver 1.67 litres/second (100 litres/minute), the mother solution would have to be added to the raw water at a rate of  $(1.67/10 \times 3) = 0.5$  ml/second.



## Annexe 5

### **Sizing pits for pit latrines and determining their infiltration capacity**

## Calculating the size of pits for latrines, and assessing their infiltration capacity

In this annexe we will look at how we can calculate the size of a pit of a pit latrine, and we present a method for assessing how much liquid could be discharged in the pit.

Materials needed:

- Ruler which allows to measure in mm
- A transparent jar with cover
- A watch which indicates seconds
- Possibly a calculator

### Determining the required size of a pit

The liquids in the pit will normally infiltrate into the soil, and excreta and anal cleansing material will decompose over time. What stays behind in the pit are decomposed solids.

To determine what volume a pit will have to be, we have to know how much of these solids (sludge) will accumulate during its period of use. Table E.1 presents estimates on how much solids will accumulate in pits used under different circumstances. These are the sludge accumulation rates.

**Table A5.1. Approximate sludge accumulation rates in pit latrines <sup>(30)</sup>**

<b>Anal cleansing material</b>	<b>Wet pit <sup>(a)</sup></b>	<b>Dry pit <sup>(b)</sup></b>
<b>Water</b>	40 l/p/y (0.04 m <sup>3</sup> /p/y)	60 l/p/y (0.06 m <sup>3</sup> /p/y)
<b>Solid material (e.g. stones, corncobs)</b>	60 l/p/y (0.06 m <sup>3</sup> /p/y)	90 l/p/y (0.09 m <sup>3</sup> /p/y)

(a) : a pit in which the excreta are in the (ground)water

(b) : a pit in which the excreta are not in liquid

l/p/y : litres per person per year

m<sup>3</sup>/p/y : cubic metres per person per year

The values presented in table A5.1 are values that can be used when designing a latrine which will be used for several years.

It takes time for the solids to decompose, and the sludge will accumulate at a higher rate over the short term. If a latrine is designed for short term use, the accumulation rates from table E.1 will have to be multiplied by 1½.

The volume of the sludge that will accumulate over the design life (i.e. the total time over which the pit will be used) can be calculated with the formula <sup>(30)</sup>:

$$V_s = R \times P \times N$$

$V_s$  : approximate volume of sludge that will be produced (in m<sup>3</sup>)

$R$  : estimated sludge accumulation rate per person (see table E.1 (in m<sup>3</sup>/p/y))

$P$  : the average number of people using the latrine over the design life

$N$  : the design life of the pit (in years)

A family of 6, who would build a latrine with a dry pit, and who would use water for anal cleansing, would accumulate over a period of 15 years a volume of around  $(0.06 \times 6 \times 15) = 5.4 \text{ m}^3$ .

Two additional things have to be taken into account when sizing the pit that has to be dug: the pit should be taken out of use when the level of the sludge in the pit has reached 0.5 metres below the slab <sup>(57)</sup>, and if the pit needs to be lined, the lining may take an important volume.

Thus, if in our example a rectangular pit would be dug of 1.6 x 1.4 metres, and it would have to be lined from the bottom to the top<sup>1</sup> with blocks 0.1 metres wide, the pit would only have an effective size of around 1.4 x 1.2 metres (we lose the width of the blocks on two sides). The horizontal surface of the pit would be  $(1.4 \text{ m} \times 1.2 \text{ m}) = 1.68 \text{ m}^2$ . To be able to contain 5.4 m<sup>3</sup> of sludge, the pit would need to be  $(5.4 \text{ m}^3 / 1.68 \text{ m}^2) = 3.2$  metres deep. As the top 0.5 metres of the pit can not be used, the total depth of the pit should be  $(3.2 \text{ m} + 0.5 \text{ m}) = 3.7$  metres.

### Determining the infiltration capacity of the pit

To avoid that a structure will flow over, the infiltration capacity of the pit needs to be sufficient to allow all the liquid to seep away. The infiltration capacity of a pit depends mainly on the type of the liquid, the surface area which allows infiltration, and the soil type.

The liquid that seeps out of a latrine pit will cause a partial blockage of the pores in the soil. This means that the infiltration capacity of a pit used for excreta will be

<sup>1</sup> Only the top 0.5 metres of a lining should be completely sealed. Below this, the lining should have sufficient openings to allow the liquid to seep into the surrounding soil

much lower than the infiltration capacity of an identical pit used for clean water. The figures we present here take into account this reduced capacity of infiltration of the soil.

The bottom of the pit will most probably clog up and become impermeable. Therefore only the vertical sides of the pit will be used to calculate the infiltration capacity <sup>(30)</sup>.

The area of the pit which allows infiltration is the surface area of the bare soil. An impermeable lining (e.g. bricks, blocks, concrete) hinders infiltration. Only the openings in the lining should therefore be used to determine the surface of the infiltration area.

Liquid infiltrates into the soil because its hydraulic gradient is higher than that of the water in the surrounding soil. Therefore only the surface of the pit above the water table should be used to calculate the infiltration area <sup>(57)</sup>.

In other words, the effective infiltration area is all bare soil on the vertical sides of a pit which are above the groundwater table (and below 0.5 metres under the slab).

In our example the actual size of the pit is 1.4 x 1.2 x 3.7 metres. As the top 0.5 metres of the pit should not be used, the effective depth of the pit is 3.2 metres. The pit will thus have two sides of 1.4 x 3.2 metres, and two sides of 1.2 x 3.2 metres. This gives a total surface area of  $((2 \times (1.4 \times 3.2)) + (2 \times (1.2 \times 3.2))) = 16.6 \text{ m}^2$ . If the blocks are laid in a honeycomb structure which leaves  $\frac{1}{4}$  of the soil exposed, the effective area of infiltration will be  $(\frac{1}{4} \times 16.6 \text{ m}^2) = 4.2 \text{ m}^2$ . As the pit is dry, all this area is used.

(However, if during the wet season there is 1.5 metres of water in the pit, the effective depth of the pit would be  $(3.2 - 1.5 \text{ m}) = 1.7 \text{ metres}$ . The effective size of the pit would be  $((2 \times (1.4 \times 1.7)) + (2 \times (1.2 \times 1.7))) = 8.8 \text{ m}^2$ , and the area of infiltration  $(\frac{1}{4} \times 8.8 \text{ m}^2) = 2.2 \text{ m}^2$ ).

To estimate the potential infiltration capacity of the soil the following method can be used.

A transparent jar is half filled with soil, and topped up to three quarters with water. The jar is shaken vigorously to bring all soil in suspension and to break up all soil (no lumps of soil should be left). The jar is placed on a flat surface and the time taken. A mark is made to where the particles have settled after 25 seconds; this part are stones and sand. A second mark is made after 60 seconds, this part is silt. After 24 hours, clay will have settled out.

If the sample contains sand, silt and clay, three layers will have been identified. An estimate of the percentages of the different categories of particles can be found with the formula:

$$\text{Per}_{\text{lay}} = \left( \frac{\text{Th}_{\text{lay}}}{\text{Th}_{\text{tot}}} \right) \times 100 \%$$

$\text{Per}_{\text{lay}}$  : percentage of the specific category of particles

$\text{Th}_{\text{lay}}$  : thickness of the specific layer (in mm)

$\text{Th}_{\text{tot}}$  : total thickness of all layers (in mm)

There are four possibilities <sup>(adapted from 249,268,281)</sup>:

<b>Sand</b>	<b>Silt</b>	<b>Clay</b>	<b>Infiltration capacity (in litres per m<sup>2</sup> per day)</b>
-	-	over 40%	under 10 l/m <sup>2</sup> /d
-	over 50%	20-40%	around 10 l/m <sup>2</sup> /d
over 50%	under 50%	under 20%	around 25 l/m <sup>2</sup> /d
over 90%	-	-	around 33 l/m <sup>2</sup> /d

- : percentage is unimportant

If we would find in our test a layer of sand of 31 mm, silt 20 mm, and clay 6 mm (total thickness of all layers: 57 mm), then the percentages of the different particles would be: sand ((31/57 mm) x 100%) = 54%; silt ((20/57 mm) x 100%) = 35%; and clay ((6/57 mm) x 100%) = 11%. This would mean that the infiltration capacity of our soil would probably be around 25 l/m<sup>2</sup>/d.

The infiltration capacity of a pit can be calculated with the formula:

$$\text{lc}_{\text{pit}} = \text{A}_{\text{pit}} \times \text{lc}_{\text{soil}}$$

$\text{lc}_{\text{pit}}$  : infiltration capacity of the pit (in litres/day)

$\text{A}_{\text{pit}}$  : effective surface of infiltration of the soil (in m<sup>2</sup>)

$\text{lc}_{\text{soil}}$  : the infiltration capacity of the soil (in litres/m<sup>2</sup>/day)

In the latrine of our example, the pit could deal with a supply of around (4.2 m<sup>2</sup> x 25 l/m<sup>2</sup>/d) = 105 litres per day. This means that if the local water usage is around 15 litres per person per day, it would be acceptable for the 6 users to dispose of their wastewater in the latrine. If the water supply would be upgraded though, the latrine would probably not be able to cope with the wastewater.



## Annexe 6

### **Designing a simple drainage system for stormwater**

## Designing a simple stormwater drainage system

In this annexe we present a method to estimate how much stormwater a catchment area will produce, and how a drain can be sized to remove this water.

This method can be used to design a simple drainage system, or to determine whether a proposed drainage system is realistic.

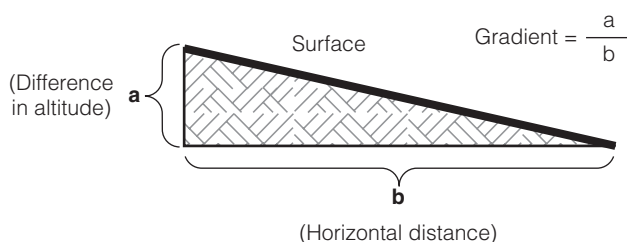
Materials needed:

- A map of the catchment area with gradient lines, or a study of the catchment area from which it is possible to calculate its gradients and boundaries
- Ruler
- Paper with gridlines
- A calculator with the option 'y to the power x' ( $y^x$ )
- Preferably the IDF-curves (intensity-duration-frequency curves) of the zone studied

### Analysis of the catchment area

First the catchment area with its boundaries will have to be identified on the map. A catchment area is the entire surface that will discharge its stormwater to one point (the discharge point). As water always flows from high to low, it is possible to identify the catchment area on a map with the aid of the gradient lines. Once the catchment area is identified, its surface must be estimated. This can be done by transferring the contours of a catchment area on paper with gridlines, and counting the grids.

Now the average gradient in the catchment area has to be identified. This can be done on the map with the aid of the gradient lines and the horizontal distances. Figure A6.1 shows how to determine the gradient in a terrain. Usually the average gradient of the terrain can be taken.



**Figure A6.1. The gradient of a terrain**



The next step is to assess the surface of the terrain. This information is needed to determine the runoff coefficient of the area. The runoff coefficient is that part of the rainwater which becomes stormwater; a runoff coefficient of 0.8 means that 80% of the rainfall will turn into stormwater. The runoff coefficient depends on the type of terrain, and its slope. Future changes in the terrain must be anticipated in the design of the drainage system to avoid problems at a later date. If no other values are available, the values from table A6.1 can be used.

**Table A6.1. Runoff coefficients of different types of terrain (these values are approximate figures assuming a low soil permeability) (adapted from 49)**

Terrain type	Runoff coefficient	
	Gradient < 0.05 (flat terrain)	Gradient > 0.05 (steep terrain)
Forest and pastures	0.4	0.6
Cultivated land	0.6	0.8
Residential areas and light industry	0.7	0.8
Dense construction and heavy industry	1.0	1.0

### Determining the rainfall intensity for which the system is designed

If no local IDF-curves (intensity-duration-frequency curve) are available, a rainfall intensity of 100 mm per hour can be assumed (this value is for tropical countries, with catchment areas smaller than 150 ha)<sup>(17)</sup>. If no IDF curves can be found, the reader can skip directly to the section *Calculating the amount of water the catchment area will produce*

If the IDF curves of the area can be obtained, these should be used. IDF curves show the rainfall intensity (in mm per hour) against the duration of the rains (in minutes) for specific return periods. Several curves from different return periods may be presented in one graph. A curve with a return period of 1 year will show the worst storm that will on average occur every year, a curve with a return period of 2 years is the worst storm that can be expected in a 2 year period, and so on.

To know which value to take from the IDF curve, the time of concentration has to be calculated. The time of concentration is the time the water needs to flow from the furthest point in the catchment area to the point where it will leave the area (the

discharge point). The time of concentration is determined with the formula <sup>(49)</sup>:

$$T_{\text{con}} = 0.02 \times (L_{\text{max}})^{0.77} \times (S_{\text{av}})^{-0.383}$$

- $T_{\text{con}}$  : the time of concentration (in minutes)  
 $L_{\text{max}}$  : the maximum length of flow in the catchment (in metres)  
 $S_{\text{av}}$  : the average gradient of the catchment area

If the furthest point of our catchment area is at a distance of 500 metres from the discharge point, and the difference in altitude between this point and the discharge point is 10 metres, then the time of concentration would be around  $(0.02 \times (500)^{0.77} \times (10/500)^{-0.383}) = 11$  minutes.

The curve with the appropriate return period is chosen (for residential areas often the curve with a 2 year return period <sup>(39)</sup>).

We look for the rainfall intensity on the chosen curve, at the duration of a storm equal to the time of concentration which we calculated.

### Calculating the amount of water the catchment area will produce

The amount of stormwater the catchment will produce can be determined with the formula <sup>(adapted from 49)</sup>:

$$Q_{\text{des}} = 2.8 \times C \times i \times A$$

- $Q_{\text{des}}$  : the design peak runoff rate, or the maximum flow of stormwater the system will be designed for (in litres per second)  
 $C$  : the runoff coefficient (see table F.1)  
 $i$  : the rainfall intensity at the time of concentration read from the chosen IDF curve; if no IDF curves are available, a value of 100 mm/h can be taken (in mm/h)  
 $A$  : the surface area of the catchment area (in ha (10,000 m<sup>2</sup>))

Thus, if our catchment area would be a residential area, with a surface of 12 ha, a gradient of 0.02, and a rainfall intensity of 100 mm/h, then the design peak runoff rate would be around  $(2.8 \times 0.7 \times 100 \times 12) = 2350$  litres per second.

It should be remembered that this figure is not a fixed value. Every once in a while storms will occur which produce more water than the drainage system can deal with (normally, on average, periods just above the return period). The larger the

capacity of the system (the longer the return period the system is designed for) the less often it will overflow, and the higher its costs.

### Sizing a drain to cope with the design peak runoff rate

With the design peak runoff rate known, we will have to plan where the drains will be installed. A drainage system must be planned together with other structures like roads and buildings to assure they are all adapted to one another.

Unlined drains are at risk of erosion, and should therefore have a relatively low gradient to control the velocity of the stormwater. Gradients in unlined drains should probably not exceed 0.005 (1 metre drop in 200 metres horizontal distance). In less stable soil unlined drains should be made with a slope less steep than 1/2 (see figure A6.2), in more cohesive material a steeper slope could be used<sup>(17)</sup>.

The size of the drain can be calculated with the formula<sup>(17)</sup>:

$$Q = 1000 \times \left( \frac{A \times (R)^{0.67} \times (S)^{0.5}}{N} \right)$$

Q : the capacity of discharge of the drain (in l/s)

A : the cross section of the flow (in m<sup>2</sup>)

R : the hydraulic radius of the drain (see figure F.3, in m)

S : the gradient of the drain

N : Manning's roughness coefficient: for earth drains, 0.025; brick drains,

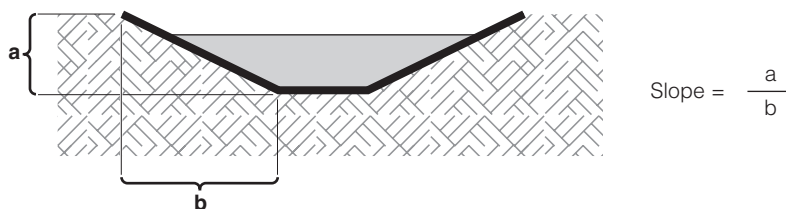
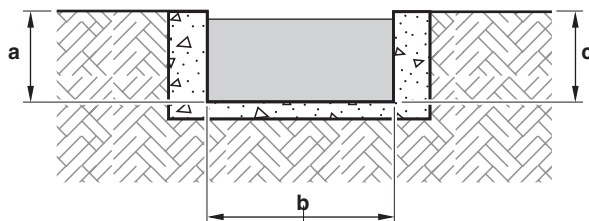


Figure A6.2. Section of an unlined drain in less stable soil

the hydraulic radius is the surface area of the cross section of the flow/the total length of the contact between water and drain;

$$\text{Hydraulic radius} = (a \times b) / (a + b + c)$$



**Figure A6.3. The hydraulic radius**

A completely filled, rectangular, smooth concrete drain of 1.5 m by 0.7 m, with a gradient of 0.005, can in ideal circumstances discharge around  $(1000 \times ((1.5 \times 0.7) \times ((1.5 \times 0.7 / (1.5 + 0.7 + 0.7))^{0.67} \times (0.005)^{0.5}) / 0.015) = 2500$  litres per second.

This calculation will probably have to be repeated a number of times to find the adequate size of drain <sup>(17)</sup>.

Some reserve will be needed so that the drain is not completely filled with water, and because the calculated discharge rate does not take into account deposited solids, and lack of maintenance, which will usually reduce the efficiency of the system <sup>(39)</sup>.

## Annexe 7

### **Minimum emergency standards**

## Priorities and standards in emergency situations

In this annexe we present the requirements for survival, and the minimum standards in service in WES required by a population living in an unstable situation (e.g. after a natural disaster, internally displaced persons, refugees).

### Survival level

Table A7.1 presents the minimum requirements so that healthy people can survive in the short term. This is an absolute minimum, and a rapid improvement, possibly within days, will be necessary to prevent a rapid deterioration of the health situation in a population. The survival levels do not cover the special needs of the sick, the wounded, or the undernourished.

## CONTROLLING AND PREVENTING DISEASE

**Table A7.1. The minimum immediate requirements for survival of healthy people in an emergency**

Water and personal hygiene	Sanitation	Environmental sanitation	Other possible needs
<ul style="list-style-type: none"> <li>■ A water supply of 3 to 5 litres per person per day is needed, providing water of reasonable quality, accessible to all <sup>(21)</sup>.</li> <li>■ Every household should have water containers which provide a storage capacity of 3 litres per person or more. If the water supply is unreliable, or access to water poor, people will need a larger storage capacity.</li> </ul>		<p><b>Drainage</b></p> <ul style="list-style-type: none"> <li>■ People must be located so that stormwater or floodwater is not a direct threat to them.</li> </ul>	<ul style="list-style-type: none"> <li>■ Adequate protection from the elements (blankets, clothing, material to make shelters) <sup>(47)</sup> §</li> <li>■ Adequate supply of food</li> <li>■ Cooking pots and fuel <sup>(66)</sup></li> <li>■ People must be located so that they are not under direct threat (e.g. hostile population, landmines)</li> </ul> <p><b>Parallel to survival</b></p> <ul style="list-style-type: none"> <li>■ Setting up of a co-ordination system to deal with the emergency.</li> <li>■ Assessment of the situation <sup>(47)</sup></li> </ul>

**The minimum standards of service in emergencies**

Certain standards of service must be provided to limit the health risks of people in an emergency. Table A7.2 presents the standards that should be aimed for in WES in an emergency. These standards must be achieved as quickly as the situation allows.

Medical personnel will have to set up a surveillance system of disease to identify oncoming epidemics and important health problems in the population. Emergency supplies needed in the case of epidemics have to be present locally, and local medical personnel have to be trained in advance on how to cope with outbreaks.

Table A7.2. The minimum standards in water and (environmental) sanitation in an emergency		
Water and personal hygiene	Sanitation	Environmental sanitation
<p><b>Water supply</b></p> <ul style="list-style-type: none"><li>■ Existing water sources must be protected.</li><li>■ A water supply of 15 litres per person per day should be accessible to all.</li></ul> <p>The maximum distance to the water points should be &lt;150 metres.</p> <p>The maximum number of people per tap should be: 200-250.</p> <p>The maximum number of taps per distribution point: 6-8.</p> <p>The maximum number of people per handpump: 500-750.</p>	<ul style="list-style-type: none"><li>■ People must be discouraged from defecating in, or close to, streams, ponds, any other source of water, or on agricultural land with crops <sup>(64)</sup>.</li><li>■ Structures that deal with the excreta will have to be installed.</li></ul> <p>Usually it is not possible to construct adequate structures in sufficient numbers immediately, and therefore the situation will have to be improved gradually.</p>	<p><b>Drainage</b></p> <ul style="list-style-type: none"><li>■ The site must have adequate drainage which rapidly removes stormwater <sup>(66)</sup>.</li><li>■ An adequate system of dealing with waste water from water points, leakage, domestic waste water and waste water from communal structures must be present. Waste water from water points can usually be led into vegetation.</li></ul>

Table A7.2. The minimum standards in water and (environmental) sanitation in an emergency (continued)

<b>Water and personal hygiene</b>	<b>Sanitation</b>	<b>Environmental sanitation</b>
<ul style="list-style-type: none"> <li>■ The water quality must be reasonable to start with, and be improved as soon as possible. It is often better to have enough water of intermediate quality than to have little water of high quality. At the beginning of the distribution system, a free residual chlorine content of 0.6-1.0 mg/litre is usually adequate to obtain water with a free residual chlorine content of 0.3-0.5 mg/litre at the distribution point <sup>(47)</sup>.</li> </ul> <p><b>Water storage</b></p> <ul style="list-style-type: none"> <li>■ Every household must have a minimum of 2 water collection vessels of 10-20 litres and an additional storage capacity of 20 litres. The vessels should have a narrow neck and be covered.</li> </ul>	<ul style="list-style-type: none"> <li>■ The sanitary structures that can be used (in order of low preference (but ease to install) to high preference (but more demanding to install)):               <ul style="list-style-type: none"> <li>– open defecation fields</li> <li>– trench defecation fields</li> <li>– communal trench latrines</li> <li>– communal pit or borehole latrines</li> <li>– household pit latrines <sup>(21)</sup></li> </ul> </li> </ul> <p>Gradually the structures will have to be improved, depending on the feasibility (e.g. start with trench defecation field, than communal pit latrines, than household pit latrines).</p> <p>In communal structures personnel for cleaning and maintenance will have to be employed.</p> <p>The sexes should be separated in communal structures, and the issues of safety to women must be addressed.</p> <p>Public latrines must be installed in public places.</p> <p>All structures need some kind of water source for handwashing, anal cleansing, cleaning of the structure and flushing.</p>	<ul style="list-style-type: none"> <li>■ If waste water containing solids is led into a soakaway, it must be strained or led through a silt trap. If the waste water led into a soakaway contains grease or soap, it should be led through a grease-trap.</li> <li>■ No unwanted open water should be present close to, or in, the camp.</li> <li>■ Tools needed to maintain the drainage system should be provided <sup>(47)</sup>.</li> </ul> <p><b>Solid waste management</b></p> <ul style="list-style-type: none"> <li>■ Where domestic refuse is not buried or burnt 'on-plot', waste will have to be collected every day, or every other day, to avoid attracting flies or rats. Every 10 households will need one container of 100 litres to collect and store the waste.</li> </ul> <p>The container should be within 15 metres of the dwelling. If a communal waste pit is used, it should not be more than 100 metres from the dwelling.</p>
		<ul style="list-style-type: none"> <li>■ There have to be adequate waste collection points on markets and slaughtering areas. These wastes should be collected daily <sup>(66)</sup>.</li> <li>■ Wastes should be disposed of in a pit. Every day it should be covered by at least 0.15 metres of soil, and the ultimate layer of soil should be at least 0.5 metres thick.</li> </ul>



Table A7.2. The minimum standards in water and (environmental) sanitation in an emergency (continued)

Water and personal hygiene	Sanitation	Environmental sanitation
<p><b>Personal hygiene</b></p> <ul style="list-style-type: none"> <li>■ A minimum of 250 grams of soap must be available per person per month.</li> <li>■ If household bathing facilities are not available, communal facilities will be needed. These should be culturally acceptable, and the sexes must be separated.</li> <li>■ Communal laundry facilities may be required. Women must be able to wash undergarments and sanitary cloths in privacy.</li> <li>■ A minimum of 1 washing basin per 100 people is needed <sup>(66)</sup>.</li> </ul> <p><b>Other</b></p> <ul style="list-style-type: none"> <li>■ If diarrhoeal diseases are a risk, Oral Rehydration Therapy (ORT) units must be set up. The minimum is one ORT unit per health structure. In case of a diarrhoeal outbreak, decentralised ORT units are needed <sup>(47)</sup>.</li> </ul>	<ul style="list-style-type: none"> <li>■ The latrines should be technically sound and acceptable to all users. Initially 1 latrine, or metre of trench, per 50 to 100 users must be installed <sup>(47)</sup>, as soon as possible this must be improved to 1 latrine per 20 users.</li> <li>■ Latrines should if possible not be further away than 50 metres from dwellings <sup>(66)</sup>.</li> <li>■ Water sources used for drinking should not be at risk from sanitary structures.</li> <li>■ Often anal cleansing material will have to be provided. In defecation fields, soil to cover faeces may have to be given to users.</li> </ul>	<ul style="list-style-type: none"> <li>■ Medical wastes must be properly disposed of by incineration and/or disposal in a deep protected pit.</li> </ul> <p><b>Disposal of the dead</b></p> <ul style="list-style-type: none"> <li>■ Usually the health hazard associated with dead bodies is negligible <sup>(66)</sup>, but during epidemics of cholera, plague, or louse-borne typhus fever, dead bodies must be dealt with adequately <sup>(21)</sup>.</li> <li>■ Graveyards or mass graves should be located at least 30 metres from a groundwater source used for drinking.</li> <li>■ Cemeteries should be planned early. Possibly cloth or other material needed for burial or cremation have to be provided to the family <sup>(66)</sup>.</li> </ul> <p><b>Vector control</b></p> <ul style="list-style-type: none"> <li>■ Where the population is infested with body louse, they must be deloused.</li> <li>■ Where possible the environment should be made unfavourable to vectors or intermediate hosts (e.g. through drainage and solid waste management).</li> <li>■ If adequate and feasible, people have to be supplied with material that allows them to protect themselves against vectors (e.g. impregnated mosquito nets) <sup>(47)</sup>.</li> </ul>

