Unit 3: Infectious Diseases

Introduction

▶ Read the text and choose the correct word to make sense:

> Infectious diseases were the *leading / usual* cause of death throughout the world during the XXth century. Medical, social and educational *improvements / trends* got them under control. But nowadays, we are seeing a *rise / decrease* in these sorts of diseases again.

Historically, they were considered a kind of punishment for our sins and even for the sins of our neighbours. Take the example of syphilis, that was called the "French disease" in Italy and Germany, the "Italian disease" in France, the "Spanish disease" in Holland, the "Polish disease" in Russia, the "Christian disease" in Turkey and the "British disease" in Tahiti. For sure, they had good reasons but …

Lesson 3.1 – Epidemiology

Communicable diseases are illnesses caused by microorganisms and transmitted from an infected person or animal to another person or animal. Epidemiology is the study of the distribution of health and disease in order to know the factors related to them and apply this knowledge to prevent diseases and other health problems.

Activity 1 – Warming up: emerging infectious diseases

Throughout the XXth century there were important improvements in sanitation, housing, and nutrition as well as the introduction and use of antibiotics and vaccines. As a result, there were great reductions in **morbidity** (quantity of disease) and **mortality** from communicable diseases.

But nowadays things are changing and the number of cases of infections thought under control has increased at the same time as new infectious diseases continue appearing.

▶ You have 6 of these emerging diseases in the box below and some factors involved in their increased emergence in the table. Write the name of the disease in the cell of the corresponding factor. In some cases, there is more than one choice. Discuss the possibilities with your partners.
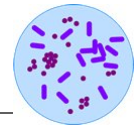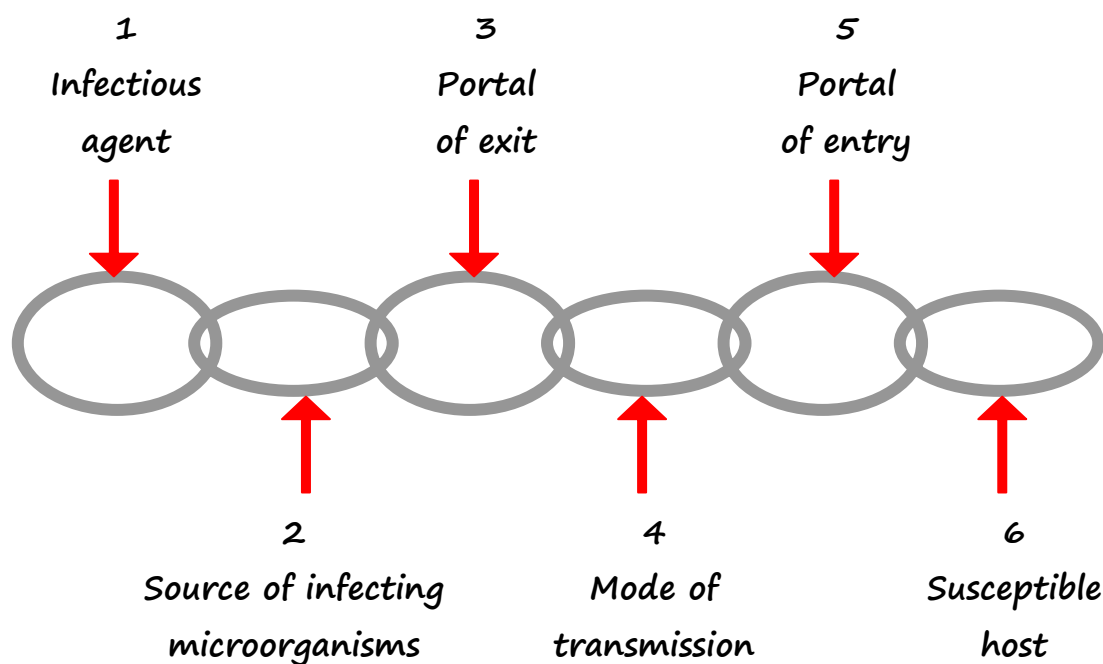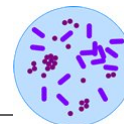
| Chlamydia infection | Swine flu | AIDS |
| Tuberculosis | Diphtheria | SARS |

Factors favouring disease	Infectious diseases favoured
Some effective interventions stopped	
Changes in sexual behaviour	
Injected drug use	
Immunodepression (AIDS, chemotherapy, immunosuppressive therapy)	
Evolution of microbes	
Easy travelling	

Activity 2 – Chain of transmission

The **chain of transmission** is the way all infectious diseases spread. It is an orderly series of **links** that results in transmission of a communicable disease. There are 6 necessary links that appear in the diagram:

1
Infectious agent

3
Portal of exit

5
Portal of entry

2
Source of infecting microorganisms

4
Mode of transmission

6
Susceptible host

▶ Match the correct definition for each link. Write the name of the link in the corresponding cell.

Definitions	Link
An agent that may produce infection. It includes **bacteria**, **viruses**, **fungi**, **parasites** and **prions**, as a new nonliving agent.	
A way to enter the new host. It may be the same way as used to exit, that is: respiratory tract, gastrointestinal tract, skin and mucous membranes and blood.	
A way out of the body. It may be through the respiratory tract, the gastrointestinal tract, the skin and mucous membranes and the blood.	
Any person who is at risk of infection. Individual host factors may increase the risk, for example: babies and elderly, malnutrition, immunodepression, etc.	
The source where microorganisms persist and spread. Infection is the entry and multiplication of an infectious agent in the body. This may result in disease and the person becomes **sick,** or not and we call this state of **carrier**. Both states may transmit the disease.	
How the infectious agent travels from one host to another. It may be through contact, airborne routes, contaminated objects etc.	

Some authors include a link called **Reservoir**: it is a place where the agent may survive and spread to the Source of infection, but not a source of infection by itself. Sometimes there isn't a reservoir. For example: a washbasin is an important reservoir for microorganisms but an unlikely source of infection.


Activity 3 – Groups at risk

Susceptibility depends on a series of individual and external factors. Certain circumstances increase the risk of the host.

Qualify the probability of contracting an infectious disease for each case using the modal verbs in the word bank below.

    a. A 11-month old baby whose brother has an extended rash and has been diagnosed with rubella.

       The baby still hasn´t been vaccinated and she _____ catch rubella.
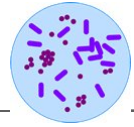
b. A boy whose classmate has contracted meningitis. They don't seat very close together in class.

The boy _____ catch meningitis.

c. A soldier has developed jaundice and has been diagnosed of hepatitis A. He is worried about passing the disease on to his colleagues.

His colleagues _____ become infected if he doesn't wash his hands when

he goes to the toilet.

d. A patient has been receiving chemotherapy and his white blood count is very low. Now his wife has caught flu.

He _____ catch it too.

Modal verbs of probability:

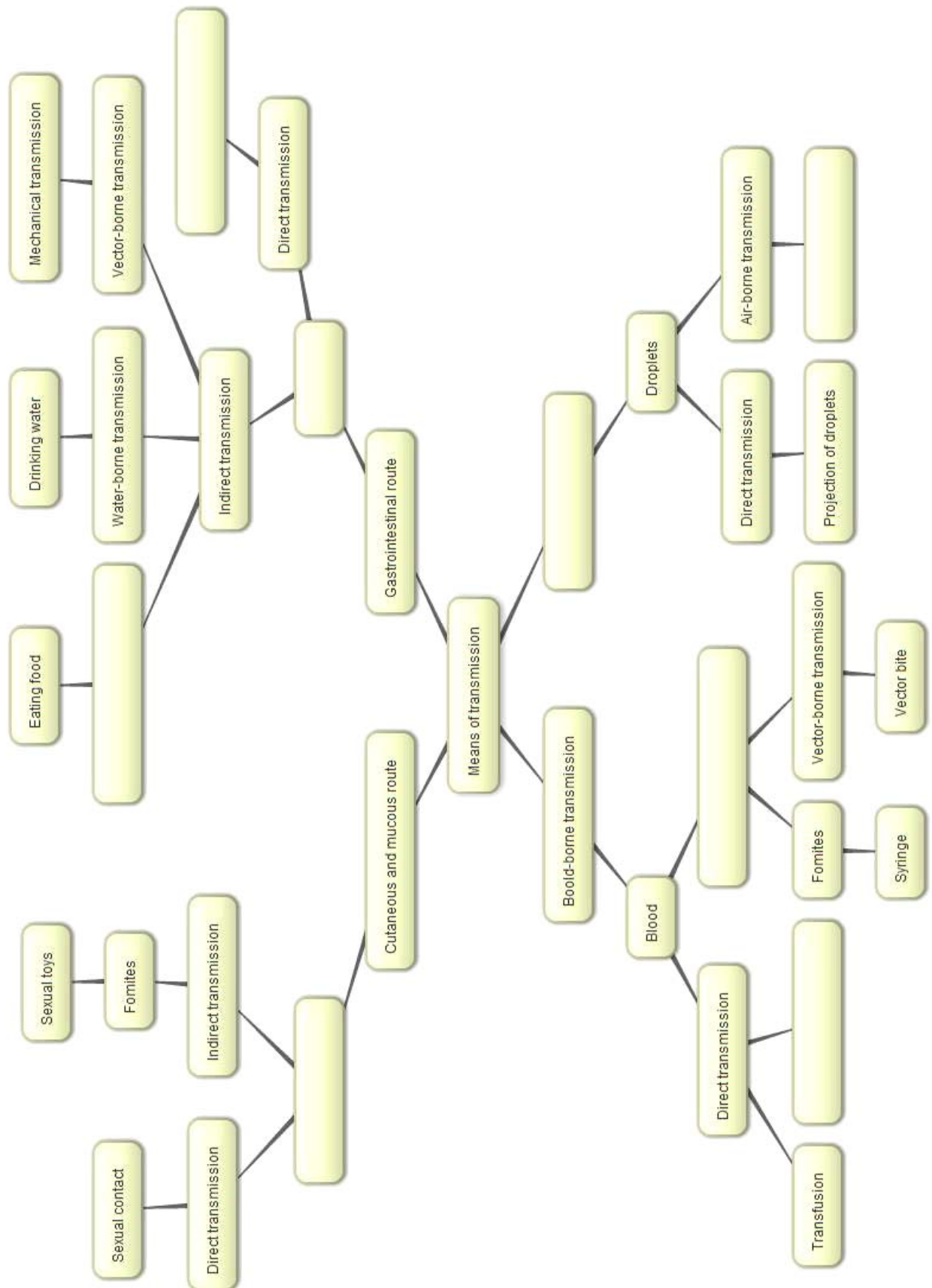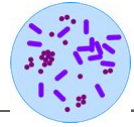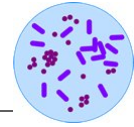|	
100%	will, will certainly
	will probably
50%	might, could, may
	will probably not
0%	will certainly not

Image 1: Rash

Image 2: Jaundice

Activity 4 – Means of transmission

The three links involved in transmission (portal of exit, mode of transmission and portal of entry) constitute the **means of transmission** of an infectious disease. An infectious agent may be transmitted by more than one means. And sometimes, the portal of entry has nothing to do with the place where the agent settles and the symptoms it causes.

Complete the mind map below about means of transmission by using the labels on the box. Use the text on the following page to help you:

Food-borne transmission	Faecal-oral transmission
Respiratory route	Indirect transmission
Sexual secretion	Inhaling droplets
Faeces	Vertical transmission

Mechanical transmission

Vector-borne transmission

Direct transmission

Drinking water

Water-borne transmission

Indirect transmission

Eating food

Gastrointestinal route

Droplets

Air-borne transmission

Direct transmission

Projection of droplets

Means of transmission

Cutaneous and mucous route

Boold-borne transmission

Blood

Vector-borne transmission

Vector bite

Fomites

Syringe

Sexual toys

Fomites

Indirect transmission

Direct transmission

Sexual contact

Direct transmission

Transfusion

To describe the mean of transmission of a disease, we have to apply different concepts:

1. **Transmission routes**
   According to portals of exit and entry, we classify diseases in four transmission routes. Each route represents an anatomical location. The main are:
   a. Gastrointestinal route
   b. Respiratory route
   c. Cutaneous or mucous route
   d. Blood-borne route

2. **Vehicle for transmission**
   Each transmission route requires a **vehicle** to hold the infectious agent. Infectious agents are contained in excreta or secretions. Depending on the anatomical location, main vehicles for exit or entry may be:
   a. Faeces
   b. Respiratory secretions
   c. Sexual secretions
   d. Blood

3. **Modes of transmission**
   This refers to the mechanisms that link portals of exit and entry between the source of agents and the new host. There are three mechanisms:

   a. **Direct transmission** refers to direct body contact. It exists for example in:
      ○ sexual intercourse
      ○ direct projection of droplets into the eye, nose, or mouth
      ○ transmission on hands (important in health care settings)
      ○ faecal-oral transmission (faecal hands)
      ○ vertical transmission: perinatal during childbirth or transplacental during pregnancy
      ○ blood exposure by transfusion

   b. **Indirect transmission** may occur through a vehicle. Vehicles are:
      - **Water** and we describe diseases as **water-borne diseases**. Transmission occurs when drinking contaminated water.
      - **Food** and we describe them as **food-borne diseases**. Transmission occurs when eating contaminated food.
      - **Vectors** and we describe them as **vector-borne diseases**. Animals such as arthropods, rats etc, can transmit the disease by bite, sting or just mechanical transmission of disease agents.
      - **Fomites** are contaminated objects. Transmission occurs when sharing hypodermic syringes or by needle-prick.

   c. **Airborne transmission** may occur when inhaling particles of dust or droplets from the source of infection. It is the usual mechanism for respiratory secretions discharged when coughing or sneezing.
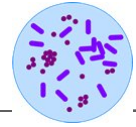
Activity 5 – Applied chains of transmission

Read the fact sheets of SARS (severe acute respiratory syndrome) and hepatitis B. Identify the elements of the transmission chain and complete the table below. You have to distinguish among the different possibilities that exist for each disease:

SARS is a viral respiratory illness caused by a coronavirus. Official name is SARS-associated coronavirus (SARS-CoV). It was first reported in Asia in 2003 and in a few months, the illness spread to more than twenty countries all over the world before the pandemic was contained. All the patients had travelled to countries with SARS.The viruses seem to spread by close person-to-person contact. The virus that causes SARS is thought to be transmitted by droplet spread. Respiratory droplets produced when an infected person coughs or sneezes are propelled a short distance through the air and deposited on the mucous membranes of the mouth, nose, or eyes of persons who are nearby, or on a close surface. The virus also can spread when a person touches a surface or object contaminated with infectious droplets and then touches his or her mouth, nose, or eye(s). In addition, it is possible that the SARS virus might spread more broadly through the air (airborne spread) or by other ways that are not now known.

Hepatitis B is a liver disease caused by the hepatitis B virus (HBV). The virus can cause lifelong infection and serious disease.
Hepatitis B virus can be found in body fluids in general. It is spread by direct contact with infected body fluids; usually by needl- stick injury, sexual contact, blood transfusion, and perinatal transmission.
The symptoms of hepatitis B include jaundice, fatigue, fever, and nausea. Up to 50 percent of adults who have acute infection do not have any symptoms. There are no special medicines or antibiotics that can be used to treat a person that is acutely infected once the symptoms appear. Generally, bed rest is all that is needed. Interferon is the most effective treatment for chronic HBV infection and is successful in 25 to 50 percent of cases.
Chronic hepatitis B carriers should follow standard hygienic practices to ensure that close contacts are not directly contaminated by his or her blood or other body fluids. Carriers must not share personal hygiene items that may become contaminated with blood. In addition, susceptible household members, particularly sexual partners, should be immunized with hepatitis B vaccine.
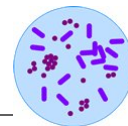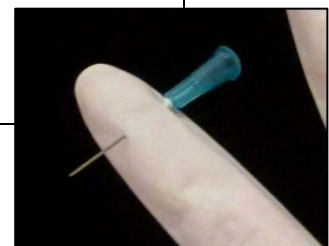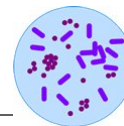A safe and effective vaccine to prevent hepatitis B is available.

Image: needle-stick injury

		SARS	Hepatitis B
	Infectious agent		
	Source of microorganisms		
Means of transmission A	**Portal of exit** (transmission routes and vehicles for transmission)	Respiratory route: respiratory droplets	Blood-borne route: blood and body fluids
	Mode of transmission		
	Portal of entry (transmission routes and vehicles for transmission)		
Means of transmission B	**Portal of exit** (transmission routes and vehicles for transmission)		
	Mode of transmission	Indirect: droplets deposited on inanimated surfaces	Direct: sexual intercourse, perinatal transmission
	Portal of entry (transmission routes and vehicles for transmission)		
Means of transmission C	**Portal of exit** (transmission routes and vehicles for transmission)		Blood-borne route: blood and body fluids
	Mode of transmission		Indirect: objects contaminated by blood or body fluids
	Portal of entry (transmission routes and vehicles for transmission)	Respiratory route: inhalation of droplets	
	Susceptible host	Respiratory illness	

Lesson 3.2 – Intervention Measures

The aim of intervention measures is to break a link in the chain of transmission of diseases to prevent the transfer of microorganisms. If any link in the chain is broken, there is no infection.

Measures may be applied on infectious diseases in two different contexts: as systematic measures to avoid the **occurrence** of the disease and as special measures in case of **outbreak** to avoid the **spread**.

Activity 1 – Disease reporting system

To decide about the convenience of undertaking some intervention measure, it is necessary to know about the occurrence of disease. The surveillance is carried out by means of a **disease reporting system**. Clinicians have to report cases of infectious diseases to health authorities and they will elaborate statistics that help to prioritize actions.

The diagram below represents the occurrence of Norovirus infection among the babies in a nursery during an outbreak last week. Coloured cells represent the days of illness of each ill baby.

		Mon	Tues	Wed	Thurs	Fri	Sat	Sun	
Baby 1	▒	▒	▒						
Baby 2		▒	▒	▒	▒				
Baby 3		▒	▒						
Baby 4		▒	▒	▒					
Baby 5			▒	▒					
Baby 6				▒	▒				
Baby 7				▒	▒	▒			
Baby 8					▒	▒	▒		
Baby 9						▒			
Baby 10							▒	▒	▒

To describe an outbreak we use two main statistical measures: **prevalence** and **incidence.** For the nursery outbreak, on Monday, the prevalence was of 4 cases and the incidence was of 3 cases. Write the missing word in the definitions below:

- ○ _____ of a disease is the number of new cases of a disease that

  occur in a defined population during a specific period of time. It gives an idea of the speed

  of spread.
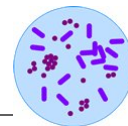
○ _____ is the number of diseases present in a particular population at a particular time. It gives an idea of the moment.

Complete the chart and the missing words in the conclusions.

|	Prevalence	Incidence
Monday	4	3
Tuesday		
Wednesday		
Thursday		
Friday		
Saturday		
Sunday		

○ The outbreak has affected _____ babies at the moment

○ The peak of the outbreak was on _____

○ The outbreak has been slowing down since _____

○ The outbreak may had been contained from _____

Activity 2 – Measures relating to the source of infection

Treatment of persons with communicable diseases with specific medication is an effective measure to kill the agent. The sick become non infectious after some time taking the drug.

Contacts of ill persons should be identified to be treated. Preventive treatment may be applied when there has been a possible contagion but there are no symptoms yet. It is called **chemoprophylaxis** and is often used in persons who have been exposed to sexually transmitted diseases, tuberculosis, meningitis or others.

The importance of treatment becomes evident in the following statistics that refer to AIDS diagnosed in children in Catalonia in the period from 1986 to 2006 (source CEESCAT). Data are presented in a line graph. Complete the missing words in the text that describes the graph. You may use the word bank below to help you.
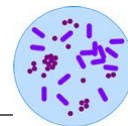
We have time **on the X-axis** and absolute number of newborn cases **on the Y-axis**.
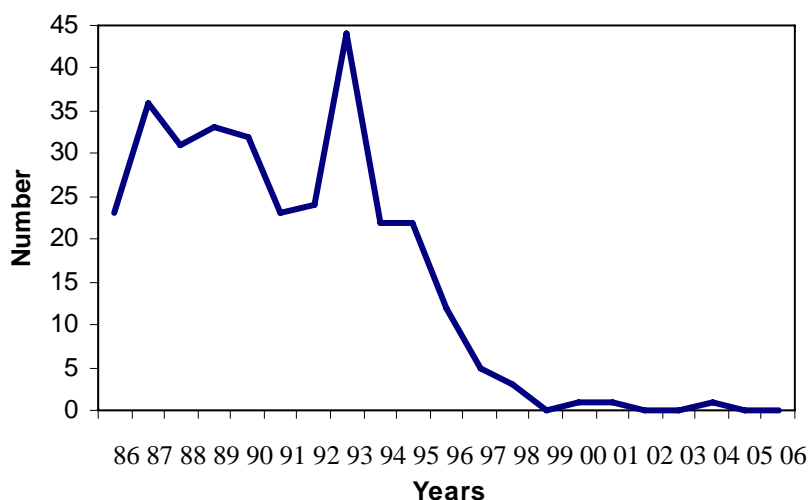
The overall number of cases of paediatric AIDS _____ because in 1996

AZT chemoprophylaxis was included for HIV infected pregnant women. In 1993, the number of

cases _____ and reached _____. With AZT therapy, it

has had a quick _____ and even some years dropped to zero with

combined therapy prophylaxis. From then up to now, the number of cases remained

_____ and we may say this is the trend in the future.

| increases slightly, slowly	increases sharply, quickly	remain stationary	decreases slightly, slowly	decreases sharply, quickly	reaches a peak

Activity 3 – Measures relating to the means of transmission

There are a wide range of factors that may have some influence on the spread of diseases.

Discuss in groups the influence of the factors listed to interfere in the means of transmission of infectious diseases. They appear at the end of the activity. Write them in the chart and classify them according the kind of factor they are and if it they represent a risk or a preventive action. Suggest how the negative factors could be improved. Write your conclusions to report orally to the class. Use the discussion frame to start.
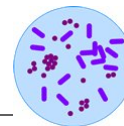
Individual issues		Improvement by means of …
Preventive		
Risk		
Environmental issues		
Preventive		
Risk		
Health habits issues		
Preventive		
Risk		
Socioeconomic issues		
Preventive		
Risk		
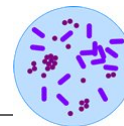
Factors of transmission to be discussed:

- Covering coughs and sneezes
- Immunodeficiency
- Safe drinking water
- Crowded living conditions
- Food-handler card
- Washing hands after using the toilet
- Drinking just milked milk

- Wash vegetables
- Sewage disposal
- Undernourishment
- Use of condoms
- Flies
- Mid cooking food
- Use of mosquito nets
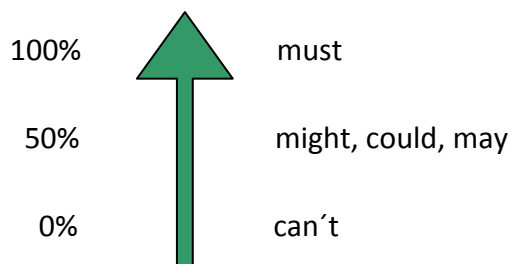

Discussion frame

There are some infectious disease that may be transmitted by _____

This factor may favour transmission by _____ route

We may improve _____ by _____

By doing _____ spread of the disease could/should/might/must
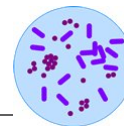
decrease because _____

Modal verbs of deduction:

100%		must
50%	⬆	might, could, may
0%		can´t

Activity 4 – Measures relating to the susceptible host

Some communicable diseases can be prevented by **vaccination,** which helps you develop immunity. Vaccination timelines may vary from one country to another, depending on the most prevalent diseases there and their causal agents.

Read the text about the situation of diphtheria in the former Soviet Union in the 90s (based on CDC: http://www.cdc.gov/ncidod/eid/vol7no1/netesov.htm). Then discuss in groups the reasons for what happened and what the Russian health authorities did wrong.

In the former Soviet Union, diphtheria was controlled through vaccination. In the early 1990s, there was a large increase in cases. A major cause of this was the low vaccination coverage because vaccination was no longer recommended by the Russian health authorities. As a result, by 1994, the disease rate had increased almost 30-fold. Since then, a mass vaccination campaign has been implemented and the current trend shows a sharp decrease in diphtheria that has returned its rate to the levels recorded in the early 1990s (see table below). It demonstrates one circumstance is associated with the other.

Table. *Selected reportable diseases, Russian Federation, 1990-1999 and January-June 2000*

Disease	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Diphtheria	0.98	1.53	2.65	10.25	26.9	24.1	9.2	2.76	0.98	0.6	0.23

Rates per 100,000 population

Discussion frame

1. What reasons might have the Russian health authorities had to stop vaccination?
2. Was diphtheria eradicated when they decided to stop vaccination? Differentiate between eradication and elimination.
3. What are the requirements needed to declare a disease "eradicated"?
4. Are considerations about number of cases enough?
5. Does vaccination have some disadvantage?
   Vaccination has some minor disadvantages like …... There exists a controversy as well about ….
6. What is the role of international organizations? What is WHO?

Search for information on:
   ○ http://www.nih.go.jp/JJID/57/1.pdf (smallpox case)
   ○ http://www.cdc.gov/mmwr/preview/mmwrhtml/su48a7.htm