Zoonosis caused by bacteria

Brucellosis
The brucellosis appear in human beings and animals and is caused by gram negative bacteria *Brucella*. The disease is also called Morbus Bang or Malta fever in man. The occurrence of brucellosis is linked with its spread in animals, especially in farm animals. It emerges in Western European and Mediterranean countries as well as in Africa, Asia and Latin America. The transmission happens via direct contact with secretes of conjunctives or skins lesions of infected animals. Furthermore, an infection can occur via contaminated raw milk. After an inconspicuous prodromal state of lassitude and undulating fever, manifold manifestations in organs, f. ex. arthritis, hepatitis, orchitis, pyelonephritis follow.

Campylobacter infections
Several species of *Campylobacter* cause infectious diseases in human beings and animals. Infected people mostly develop acute diarrhoea including fever, ague, headache and body pain. Generally all people can be affected, but in children under 5 years age and in people working with animals, it is piled. The infection occurs mostly orally after eating contaminated food (raw poultry or pork, raw milk), drinking contaminated water or touching the excrements of infected animals. 3 or 5 days after the infection, fever, ague and lassitude appear. Serious diarrhoea, at first pulpily, liquid, later on containing blood, bile, sanies or mucus, follow. Complications within other organs are possible.

Ehrlichiosis
Different *Ehrlichia*-species cause acute general illness in man. *Ehrlichia* are spread worldwide, different tick species are known as vectors and are often considered as infection source. The disease occurs mainly in dogs but also in diverse other domestic and wild animals. In human beings, it is distinguished between a monocytic and a granulocytic form. Alterations are to be found in the stomach, the intestine, kidneys, CNS, marrow, liver etc. respectively. But most infections take course asymptotically or under unspecific general symptoms. Symptoms appearing are headache, myalgia, arthralgia, nausea, pancytopenia, dysfunction of kidney or liver. Elderly or chronically diseased people occasionally die.

Enterohaemorrhagic *Escherichia coli*
Shigatoxin producing *Escherichia coli* (EHEC) cause diseases of human beings that reach from slight diarrhoea to severe haemorrhagic colitis. 10 % of the concerned children beyond 10 years age develop a haemolytic-uraemic syndrome (HUS) which is a life-threatening complication, adults can have a thrombotic-thromocytopenic purpura (TPP). The number of cases increases every year in America, Europe, Asia and Africa. People mostly contract via raw or underdone food, especially underdone beef ground meat, raw milk, furthermore via contact with ruminants. Also the human-to-human transmission plays a role. The clinical appearance shows bloody diarrhoea with colic, nausea and fever for 4 to 10 days. The complications HUS and TPP develop about one
week later and are dominated by the insufficiency of the kidneys. The lethality is 3 - 5 %.

**Leptospirosis**
Different serovars of *Leptospira interrogans* cause an acute general infectious disease in man and animals. Carriers of leptospira are rodents as well as farm animals (pig, cattle, horse) and small animals (dog). The man contracts via skin lesions, f. ex. from bites, or via mucosal lesions during bathing in contaminated water. In the first phase (septicaemia) dominate fever, headache and muscle aches, whilst after a symptom-free phase (5 - 7 days) icterus, oliguria, meningitis, ecchymosis, intestinal haemorrhages or gastrointestinal dysfunctions occur. The iridocyclitis is regarded as a late disease. If icterus develops, the lethality increases from 1 % to 15 - 25 %.

**Listeriosis**
This disease, caused by *Listeria monocytogenes*, is transmitted mainly by food, less by animals. The bacterium is spread worldwide and ubiquitary. The soil and low-grade silages serve as reservoir, moreover the pathogen is found in the intestine of farm animals, different domestic, zoo and fur-bearing animals. The transmission paths are manifold: direct contact to infected animals (placenta removal), dirt or smear infections via conjunctives, contaminated surface water, aerogenic or oral infection via raw milk. Beyond human beings different forms of the disease exist: listeriosis of the pregnant including stillbirth or preterm birth; listeriosis of the newborn including meningitis, encephalitis or meningoencephalitis (high lethality); glandular form resembling influenza; local form including papular efflorescences at the skin etc.

**Glanders**
*Burkholderia mallei* occurs in equids and can be found casually in man. In Europe, cases are only known in Turkey, whereas in Mongolia, China, India, the Philippines, Indonesia, Iraq and Iran glanders still is wide spread. Mainly persons that have contact to horses, fall ill and get infected via direct contact with contagious secret via mucosa or skin lesions. The disease containing skin ulcers and high fever causes death of intoxication, whilst the chronic form generates again and again abscesses and has a lethality of 50%.

**Anthrax (Splenic fever)**
*Bacillus anthracis* is spread worldwide and known as zoonosis for a long time. Its spores can survive in the ground for decades. The disease is spread not only sporadically, but even endemic in the less developed countries of Southeast-Asia, the Middle East and South America. Mostly ruminants and horses, only very rarely pigs and carnivores fall ill. The infection happens by infected animals and animal products via small skin lesions, but also via inhalation of dust containing spores. Anthrax occurs in man in different forms, whereas anthrax of the skin is the most common: an anthrax at the entrance spot occurs including bad general condition and is - without treatment - lethal for 10 - 20 % of the cases. Anthrax of the lungs, showing a sudden grave bronchopneumonia, and anthrax of the intestine, showing perforation of anthraces in the small intestine and following peritonitis, lead to death within 2 - 3 days.
**Pasteurellosis**
People get infected by *Pasteurella multocida (P.)*, but also *P. dagmatis, P. canis* or *P. haemolytica*. Infections of Pasteurella are spread worldwide in wild and domestic animals. People contract via small animals as well as farm animals, zoo and wild animals. People who work with animals are particularly at risk. The transmission mostly happens via wound infection, whereas the wound inflames and hurts. In the following, phlegmons or abscesses in the subdermis, infections of the tendon sheath, the tendon and bones occur, followed by necrosis, periostitis and osteomyelitis.

**Plague (Pest)**
This dangerous zoonosis is caused by the pathogen *Yersinia pestis* and belongs even today to the epidemics that need quarantine. All kinds of wild rodents are known as reservoirs. Whereas Europe and Australia are free of the pest, it is detected in Asia, Africa and even in the USA. Especially hunters, farmers, shepherds and tourists are at risk. The transmission occurs mainly by the stitch of the rat's flea or of other ectoparasites. Aerogenic or oral infections are either possible. The bubonic plague shows apart from fever and bad general condition painfully swollen lymph nodes which form bubons (boils). After the penetration of the lymph nodes, a sepsis occurs that leads to death. The pulmonary plague takes a shorter process und shows a confluencing bronchopneumonia with sputum, later on cardiac insufficiency und circulation collapse (20 % lethality even with chemotherapy). Furthermore a dermal plague and a moderate form of the bubonic plague are known.

**Rat bite fever**
This disease is spread worldwide, but rarely. The pathogens *Spirillum minus* and *Streptobacillus moniliformis* are transmitted by the bite of a rat onto channel or crop workers and stockmen. At the spot of the bite painful, purple infiltrations develop that become ulceracies (*S. minus*). Fever and symptoms of a general infection occur involving recurrent fever, diarrhoea, nausea and myalgias. Even endo- or myocarditis, hepatitis and meningitis are found, the lethality is low. Regarding *S. moniliformis*, first of all, a dark red, morbilliform exanthema develops followed by painful arthritis and at last an angina with severe dysphagia and laryngitis causing cough and hoarseness. Complications are also possible, but the lethality is 10 %.

Zoonosis caused by virus

**Japanese encephalitis**
This flavivirus infection is transmitted by mosquitoes of the species *Culex* und *Aedes*. In Asia the disease is endemic as well as epidemic. Domestic animals, birds, bats etc. contract with the virus. The disease often is lethal. In the beginning, there is an uncharacteristic prodromal stadium followed by the first phase including meningeal symptoms, cramps, ataxia, tremor, pareses. Under bad circumstances, the neurological symptoms increase, furthermore cardiac and respiratory problems develop. Sometimes permanent damages like motoric defects or parkinsonism occur.
**Dengue fever**
The dengue virus (flavivirus) is spread worldwide and causes the most common arbovirus infection of human beings (30 to 50 million cases per year). In Germany, most infections are introduced from Southeast Asia, especially from Thailand. The disease mostly proceeds mildly including fever, myalgia, arthralgia, lymphadenopathy, exanthema and leucopenia. Sometimes severe forms occur like the Dengue Haemorrhagic fever and the Dengue shock syndrome.

**TRANSMISSION**

Dengue viruses are transmitted to humans through the bites of infective female *Aedes* mosquitoes. Mosquitoes generally acquire the virus while feeding on the blood of an infected person. After virus incubation for 8-10 days, an infected mosquito is capable, during probing and blood feeding, of transmitting the virus, to susceptible individuals for the rest of its life. Infected female mosquitoes may also transmit the virus to their offspring by transovarial (via the eggs) transmission, but the role of this in sustaining transmission of virus to humans has not yet been delineated.

Humans are the main amplifying host of the virus, although studies have shown that in some parts of the world monkeys may become infected and perhaps serve as a source of virus for uninfected mosquitoes. The virus circulates in the blood of infected humans for two to seven days, at approximately the same time as they have fever; *Aedes* mosquitoes may acquire the virus when they feed on an individual during this period.

**Zoonosis caused by parasites**

**Amebiasis**
The cysts of *Entamoeba histolytica* are transmitted by contaminated water or food onto people. Dogs, monkeys and rodents serve as reservoirs for the pathogens. The disease is spread worldwide, about 10 % of the world's population carries amoeba. The symptoms reach from moderate to mucosal-bloody diarrhoea that can heal spontaneously, but can also be chronically recurrent for months and years on. The most frequent complications are metastases in the liver and/or lungs including abscesses. The abscesses in the liver tend to penetrate into the pleural cavity.

**Babesiosis**
As the man serves only as false host regarding *Babesia* species specific for animals, infections take place very rarely and are common only in the USA, Mexico and Europe. Specific tick species (*Ixodes spp.* etc.) are transmitters, so that diseases occur between May and October. Regarding immune deficient patients, the disease mostly is a fatal haemolytic anaemia, but if the immune defence is sufficient, the flu-like symptoms including anaemia and depression can heal up.

**Cryptosporidiosis**
*Cryptosporidium parvum* is an important diarrhoea causing pathogen only in calves and lambs, regarding human beings, the infection occurs mainly in immune deficient patients.
Symptoms are enterocolitis including cholera-like diarrhoea, people whose immune system is sufficient develop a self-limiting diarrhoea only.

**Malaria**
Different *Sporozoa* species transmitted by the stitch of the gnat *Anopheles* cause the clinical picture of malaria in human beings. Recording WHO, more than 300 million people worldwide fall ill every year, about 1 million people die. In Europe, in the USA and in the former Soviet Union, the disease is regarded as eradicated, its appearance is limited to the subtropics and tropics. The rhythmical occurrence of fever including progressive splenomegalia is typical. In the course of the disease, the erythrocytes are attacked and destroyed causing changes in the haemogram: Anaemia and anisocytosis, poikilocytosis and polychromasia as well as leucopenia follow. The distinct symptoms of the different forms of malaria are well described.

**Sarcosporidiosis**
Regarding the species *Sarcocystis (S.) bovihominis* and *S. suihominis*, cattle or pig, respectively, are the alternate hosts and the man is the host. The sarcosporids are spread worldwide and are transmitted by the consumption of raw cystic meat onto the human beings. The disease can occur harmlessly in form of an intestinal infection as well as in form of an acute meat intoxication including severe diarrhoea.

**Toxoplasmosis**
*Toxoplasma gondii* causes general infections in man and animals worldwide. While only cats and other felids serve as hosts, the spectrum of alternate hosts includes all warm-blooded animals and the human beings. In Europe, the seroprevalence for women is 37 - 58 %. People contract by oocyst-containing excrements of cats or by the consumption of cyst-containing raw food of animal origin. Immune sufficient persons mostly develop a clinically inapparent infection, only rarely a lymphadenopathia including fever and lassitude. A stable immunity occurs. Regarding immune deficient persons (many AIDS-patients), a chronic infection can be reactivated and can cause encephalitis. Toxoplasmosis of the eye can be achieved connatally. A special problem is this disease during pregnancy, because the first infection can result - depending on the state of maturation of the foetus - in severe handicaps of the newborn (hydrocephalus, intracerebral calcification, chorioretinitis), in aborts and premature birth.

**Fasciolasis**
People get infected mostly by the big liver fluke, *Fasciola hepatica*, that is spread worldwide especially in pluvial-rich regions. Ruminants serve as hosts, but also other animals become infected. People in South America, in Europe (France, Portugal and Spain) often fall ill, they contract by the uptake of metacercaria on water plants or in surface water. First, a perihepatitis including general symptoms (fever, lassitude) and eosinophilia develops. After the settlement of the parasites in the bile's duct, inflammations, fibroses and calcification occur there. Anaemia and anorexia develop.

**Schistosomiasis (Bilharzia)**
This disease occurs in the tropical and subtropical regions of Africa and Asia and is caused by different *Schistosoma* species. Some species are specific for human beings or animals, other occur in man and animal. Some species are specific for man or animals, other occur both in man and animals. The alternate hosts, water snails, release cercaria into the water where they invade percutaneously into the host. They migrate via the blood vessel system into the vessels of bladder or into the mesenterial vessels. Especially the egg packages cause damages by inducing a permanent formation of granuloma in the blood vessel walls. This causes increased need to urinate, hematuria and fibroid changes of the bladder wall. In the guts, obstipations, blood in the stool and fibrosis of the intestinal wall occur. Eggs that are washed away, damage liver and lungs.

**Diphyllobothrium infection**

The tapeworm *Diphyllobothrium latum* can reach a length up to 20 m. The parasite occurs mainly in the moderate and sub arctic zones of the northern hemisphere and is found in Scandinavia, North America, Alaska, Russia and North China. The infection happens by the intake of infected raw fish which serve as second alternate host. The disease proceeds mostly asymptotically, but general symptoms or an anaemia generating megaloblasts may occur.

**Dipylidium infection**

*Dipylidium caninum* is the most common tapeworm of the dog in Europe. It attacks even cats and rarely human beings, mostly children. It is bound to the occurrence of fleas, because they serve as alternate hosts. The uptake of cysticercoids or of infected fleas leads to the infection. Only in case of a severe infection, colic and diarrhoea occur.

**Echinococcosis, alveolar**

Both pathogens of the echinococcosis show so different clinical pictures that they are presented separately. The alveolar echinococcosis is caused by *Echinococcus multilocularis* that is spread only in North America (Alaska, Canada, Northern States of the USA), Eurasia and Northeast Asia. Main hosts are Red and Polar foxes that are infected in the endemic areas of Germany and Switzerland up to 50 %. But also dogs and cats can be carrier of *Echinococci*. Rodents, in Europe mainly common voles and root voles, are alternate hosts. Human beings contract by the uptake of eggs of the tapeworm which cling to contaminated food or to the hands. The possibility of an aerogenic transmission is also supposed. Farm workers or hunters are predisposed. The incubation period is 5 to 15 years, because the disease becomes clinically manifest only in a very late state. Icterus and pain in the right abdomen are results of the liver's affection (alveoli that grow infiltratively). A hepatomegalia occurs compressing bile's cannels and big blood vessels. Metastases in lungs and brain cause death. The prognosis is always stern depending on the dimension of damages at the time of diagnosis.

**Hydatidosis**

The cestode larva of the dogs' tapeworm *Echinococcus granulosus* are the agents of the cystic echinococcosis. They are spread worldwide mainly in dogs, canids and felids, only rarely in house cats. Africa, Australia, South America and Asia, Canada, Alaska and parts of Europe are endemic regions of the parasite. The Mediterranean region is highly
endemic. The man contracts by the uptake of echinococcus eggs via contaminated food or hand, f. ex. after stroking ill dogs. The parasite emerges in the intestine and settles down mostly in the liver, less frequently in the lungs. The cyst which is surrounded by a capsule of connective tissue develops there. As long as this capsule is intact, no metastases occur. Symptoms like icterus and ascites only develop, when bile's cannels and blood vessels are compressed which can take years.

**Taenia infection**
The ox tapeworm *Taenia saginata saginata* uses cattle as alternate host (called *Cysticercus bovis*) and the man as host. The cestode larva are absorbed by the uptake of raw or insufficiently cooked beef and grow up in the small intestine to the adult tapeworm producing several 100,000 eggs a day. If these eggs attain to grassland (backcountry camping, sewage, flood water), they can be ingested by cattle. The cestode larva migrate from the intestine back into the muscle tissue. Discomfort is rarely, anorexia, nausea, colic, malabsorption and maldigestion is possible.

**Taeniosis solium and cysticercosis**
It must be differentiated between taeniosis and cysticercosis of the tapeworm *Taenia solium*. The man is the only host of the adult tapeworms (taenisosis), after consumption of the cestode larva via raw pork they settle in the intestine and persist for years causing daily massive excretion of eggs via the faeces. Moderate colic, obstipation and diarrhoea occur. The eggs are not only infectious for pigs, but also for people as alternate hosts. People therefore can contract themselves or other people. In the intestine larva emerge from the eggs and spread via the blood in different organs (especially in muscles and brain) where the bubble-like cysticercus develops. In the course of the decay of the latter a massive inflammation reaction starts including lymphocytic infiltrations, and this immune reaction is responsible for the clinical symptoms. As the cysticercus usually is located in the brain, convulsions, sensomotoric malfunctions or disturbance of consciousness depending on the localisation occur or else disturb the circulation of the liquor and thereby cause high pressure in the brain, chronic meningitis, infarcts of the cortex, etc.

**Coenurosis**
This disease develops by a special form of cestode larva of the tapeworm, the coenurus. It occurs only rarely in human beings. The pathogen *Taenia multiceps* is spread worldwide, hosts are canids (i.e. foxes and wolves), but in Germany the dog is contracted only rarely. The consumption of contaminated food causes infection, the emerged larva migrate into the neural tissue and form there the coenurus which can be as big as an apple. Pressure atrophy is caused including headache, swindle, cramps and central malfunction.