PROLEPSIS

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"OSH+ for the European Agriculture sector - Stimulating growth in rural areas through capacity building for providers (and beneficiaries) of occupational medicine and OSH services"

Module 10 - Infectious Diseases for employees working in agriculture

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Aims and Objectives of this Module

By the end of this module, participants will:

- be able to list the most important and more frequent pathogens affecting workers in agriculture
- be able to outline the relevant diseases and the relevant treatment options
- know about prevention strategies and personal protective measures for each pathogen
- know key public health issues involved with the particular disease in the event of diagnosis

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Introduction

- Infectious diseases (IDs): frequent health problem in the rural population
- Farmers → occupation exposed to various pathogens
  - Prions
  - Viruses
  - Bacteria
  - Fungi
  - Parasites

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Introduction

- Patterns of migration: Catalytic effect on disease transition routes:
  - Rural → Urban
  - Rural → Abroad

- Health inequalities in rural areas:
  - Health education often lacking
  - Higher exposure to health hazards:
    - Chemicals (pesticides, fertilizers)
    - Animals (zoonotic diseases)
  - Water sanitation often poor
  - Fewer OSH physicians

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Pathogens transmitted through contact with domestic animals

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Pathogens transmitted through contact with domestic animals

- Various animals in agriculture and farming in Europe
- Farmers use animals for work, meat, milk, cheese, fur, eggs and much more
- **Europe 28 (2016)**
  - 147million **pigs**
  - 89million **bovine animals**
  - 87million **sheep**
  - 13million **goats**

High exposure to domestic animals → **Increased danger** of pathogen transmission

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Pathogens transmitted through contact with domestic animals

- Important **points for occupation history**:

  - detailed contact description with specific animal(s)

  - description of the activity, duration and frequency of contact

  - condition of the animal, if there is possibility for testing

  - who was exposed and if they can be contacted

  - local veterinarian's contact details

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Most frequently transmitted diseases

- Avian and Swine Influenza viruses
- Clamydia psittaci (Psittacosis)
- Rabies virus
- Salmonella spp (Salmonellosis)
- Pasteurella infection (Pasteurella multocida)
- Toxoplasma gondii (Toxoplasmosis)
- Bartonella henselae (Cat Scratch Disease)
- Yersinia pestis (Plague)
- Echinococcus (Echinococcosis)
- Brucella spp (Brucellosis)
- Coxiella burnettii (Q fever)
- Bacillus anthracis (Anthrax)
- Burkholderia mallei (Glanders)

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Avian and Swine Influenza viruses

What is Avian or Swine flu?	**Avian influenza (flu):** Subtypes of influenza type A, (orthomyxovirus) that primarily cause influenza in birds. Migratory aquatic birds are considered the primary reservoir. **Swine influenza:** virus subtypes circulating in pigs, e.g. A(H1N1), A(H3N2). They may be called variant, A(H3N2)v to distinguish.	
Who is at risk?	Individuals in close contact with birds or pigs are at higher risk. Exposure with sufficient virus to cause infection is usually needed (e.g. during culling, defeathering, preparing birds for cooking, living with the birds etc)	
Epidemiology	Strains of **avian influenza** range in severity of illness and contagiousness. Usually these viruses are not well transmitted from person to person, therefore clusters are usually small and often in the same family. Avian flu strains currently (2017) circulating in the EU include H5N8 and H5N6, while internationally H5N1, H7N9 and H9N9 are causing human clusters in China and other areas of the world.	**Swine influenza** cases in humans have also been occasionaly reported with varying severity. Attending fairs and peting zoos has been identified as a risk factor. Limited human-to-human transmission happens with zoonotic influenza, while human influenza is transmitted effectively from person to person (airborne, via droplets and fomites).

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Avian and Swine Influenza viruses

Incubation period	Usually 2-5 days (<7 days from exposure)
Presentation	Severity of illness is dependent upon the pathogenicity of the strain. Presentation ranges from mild to severe. The most common presentation is with flu-like symptoms, such as fever, cough, sore throat, and myalgia. Conjunctivitis, diarrhea, nausea, vomiting, altered mental status, and pneumonia have also been reported. In some cases patients progress to Acute Respiratory Distress Syndrome (ARDS) and death.
Diagnosis	Influenza can only be diagnosed by laboratory testing: via molecular testing of a throat swab. Some types or subtypes of influenza can also be diagnosed with a rapid test at the practice setting.
Treatment	Supportive care is needed. In addition, a neuraminidase inhibitor, such as oseltamivir or zanamivir, is the recommended treatment, especially if the patient has underlying diseases that increase the risk for bad outcome (e.g. extremes of age, pregnancy, pulmonary or cardiovascular diseases, immune suppression etc), similar as in seasonal influenza.
Protective Measures	Avoid contact with wild birds and feces from wild birds. Protect household poultry from contact with wild birds, if there is avian flu in the area. Cook poultry and eggs thoroughly. Advise on annual seasonal flu immunization to prevent potential coinfection with avian flu.

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Avian and Swine Influenza viruses

Key actions to protect public health	Cases of human infection with avian or zoonotic influenza are creating the possibility for reassortment of flu viruses, esp. if an avian and a human virus infect the same host. This is one of the main mechanisms of emergence of a new influenza pandemic virus. A case of human infection needs the collaboration with the local public health service and the veterinary public health (VPH) service or the local veterinarian. One health approach. If a highly pathogenic virus is detected certain biosecurity measures will be enforced, e.g. culling. OSH guidance for personal protective equipment (PPE) and follow up of persons involved is essential. Appropriate collection and testing of sick/dead birds or animals will be needed. Protection of farmed and household poultry from migratory birds is important.
Prognosis	Prognosis is largely dependent on the pathogenicity of the strain. For some strains and in certain settings (e.g. developing countries) the mortality can be as high as 30%, although usually it is closer to the one seen in seasonal influenza (<2-10%).
Where can I find more information?	http://www.who.int/influenza/en/ https://www.cdc.gov/flu/avianflu/avian-in-humans.htm https://www.cdc.gov/niosh/topics/h1n1flu/ http://ecdc.europa.eu/en/healthtopics/influenza/Pages/home.aspx https://www.gov.uk/government/publications/avian-influenza-guidance-and-algorithms-for-managing-human-cases

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Brucella spp (Brucellosis)

What is Brucella spp (Brucellosis)?	**Brucellosis** is a bacterial zoonotic disease caused by *Brucella,* mostly *Brucella melitensis*, *B. abortus*, *B. suis* and *B. canis*	
Who is at risk?	Farmers, veterinarians, slaughterhouse workers and others in contact with farm animals. The most common route of transmission is via occupational exposure, therefore males are more at risk	
Epidemiology	Cattle, swine, sheep, goats, dogs, wild animals (boars, deer, elks, camels, coyotes) and newly recognised in marine animals (dolphins, whales, seals etc) are the reservoir. Although found worldwide, Mediterranean and Middle East countries, Africa, central America, India and SE Asia are high risk areas.	Exposure occurs through multiple routes: •consumption of raw milk and unpasteurised dairy products (esp. soft cheese) •inhalation of the bacteria in the laboratory, the dust from areas contaminated by birth fluids or excreta, in meat processing factories •accidental inoculation of the animal vaccine strain •rarely human-to-human transmission

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Brucella spp (Brucellosis)

Incubation period	Usually 1-2 months (5-60 days)
Presentation	Infection can be insidious, usually presenting with intermittent fever with chills, headache, sweats, arthralgia, weight loss and depression. Complications include osteomyelitis and arthritis, orchitis and epididymitis, neurobrucellosis and endocarditis, which is the most severe and sometimes fatal.
Diagnosis	Brucellosis is diagnosed with a combination of serologic testing, PCR and cultures from blood, bone marrow or other samples.
Treatment	The recommended treatment is doxycycline and rifampin or streptomycin for 6 weeks.
Protective Measures	•Pasteurise milk and dairy products •Education of the public, high-risk occupations and hunters on consumption of dairy products and meat, •disposal of animal remains and products and good hygiene practices in premises with animals •Practice good hygiene when dealing with farm animals.

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Brucella spp (Brucellosis)

Key actions to protect public health	•Brucellosis cases should be reported to local public health officials. Foodborne and occupational outbreaks are common and are investigated following “one health” perspective jointly by human and veterinary public health professionals. •Brucella spp is included in the agents with potential for deliberate release due to the low infectious dose (10-100 organisms) and the possibility of exposure via aerosols. •Animal immunization programmes in endemic areas are important to control the disease.
Prognosis	Most individuals recover with appropriate treatment. However, there are complications, a chronic form of the disease and the case fatality of untreated cases may be up to 2%.
Where can I find more information?	ECDC: https://ecdc.europa.eu/en/brucellosis CDC, Atlanta: https://www.cdc.gov/brucellosis/index.html Control of Communicable Diseases Manual, 19th ed, DL Heymann Editor, APHA [Brucellosis]

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Coxiella burnettii (Q fever)

What is Coxiella burnettii (Q fever)?	**Q fever** is a bacterial zoonotic disease caused by Coxiella burnetii.	
Who is at risk?	Farmers, veterinarians, slaughterhouse workers and others in contact with farm animals. The most common route of transmission is via occupational exposure. Individuals living or traveling to endemic countries.	
Epidemiology	Sheep, goats, cats, dogs, cattle, birds and ticks are reservoirs. The bacteria can be shed in the animal's milk, urine, feces, or during birthing (placenta etc). Animals can be asymptomatic and shed massive amounts of bacteria.	Exposure occurs through multiple routes: •inhalation of the bacteria in dust from areas contaminated by birth fluids or excreta, in meat processing factories, in necropsy rooms •consumption of contaminated food, water, or dairy products •transplacental from mother to embryo, in utero.

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Coxiella burnettii (Q fever)

Incubation period	Typically 2-3 weeks (3-30 days)
Presentation	Infection can be from non-symptomatic, to mild non-specific or severe. Presentation is variable. Symptomatic patients most commonly present with influenza-like symptoms, including sudden onset of high-grade fever, fatigue, severe headache, cough, and myalgia. Some patients may develop pneumonia and/or hepatitis. Adults and men are more likely to show symptoms as compared to children and women. Complications include meningitis, encephalitis or chronic Q fever, which can manifest as persistent localized infection, such as endocarditis, pericarditis, myocarditis, osteomyelitis, vascular infection.
Diagnosis	Q fever is diagnosed with serologic testing, PCR and cultures from bone biopsies, cardiac valves, and vascular samples.
Treatment	The recommended treatment is doxycycline for non-pregnant adults and children, and trimethoprim-sulfamethoxazole for pregnant women. Fatigue after infection should be treated with supportive care
Protective Measures	•Pasteurise milk and dairy products •Education of high-risk occupations on disinfection, handling and disposal of animal products and good hygiene practices in premises with animals •Practice good hygiene when dealing with farm animals

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Coxiella burnettii (Q fever)

Key actions to protect public health	•Coxiella is highly resistant to disinfectants and environmental conditions, therefore included in the high-risk agents for deliberate release •Q fever cases should be reported to local public health officials. Outbreaks have been reported both as occupational exposure as well as in the surrounding geographical areas (airborne transmission downwind) •An inactivated vaccine is used in Australia
Prognosis	Most individuals fully recover without permanent damage. However, there are complications and Q fever may be fatal.
Where can I find more information?	ECDC: ecdc.europa.eu/en/healthtopics/q_fever/Pages/index.aspx CDC, Atlanta: www.cdc.gov/qfever/ Control of Communicable Diseases Manual, 19th ed, DL Heymann Editor, APHA [Q Fever] Raoult, D. (2017). Clinical manifestations and diagnosis of Q fever. In: UpToDate, Post TW (Ed), UpToDate, Waltham, MA. (Accessed June 26, 2017)

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Bacillus anthracis (Anthrax)

What is Bacillus anthracis (Anthrax)?	**Anthrax** is a bacterial zoonotic disease caused by *Bacillus anthracis*.
Who is at risk?	Farmers, veterinarians, slaughterhouse workers, wool sorters, weavers, workers who process hides (esp. goat hides) or bones, agricultural and wildlife workers. The most common route of exposure for natural infections is via occupational exposure.
Epidemiology	Cattle, sheep, goats and in general herbivores are reservoirs, usually in sub-saharan Africa, Central and South America, South and East Europe. Exposure occurs through multiple routes: •exposure of a skin lesion •inhalation of the spores during processing of animal products •consumption of contaminated meat.

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Bacillus anthracis (Anthrax)

Incubation period	Usually 1-7 days (can extend up to 60 days)	
Presentation	Infection can present as cutaneous, pulmonary or gastrointestinal anthrax. •**Cutaneous anthrax** refers to a single painless ulcer with significant edema and a black eschar. 95% of natural infection is cutaneous and is usually due to occupational exposure through a skin lysis. Cutaneous anthrax may be complicated with septicaemia. •**Pulmonary anthrax** usually starts with non specific influenza-like illness, which progresses to respiratory distress, hypoxemia, shock, cyanosis. It is a result of the inhalation of anthrax spores. Hemorrhagic meningitis is a frequent complication, and patients are invariably critically ill. •**Gastrointestinal anthrax** is the most rare form and results from ingestion of meat from infected animals. Abdominal distress with pain, fever, vomiting and diarrhea can progress to systemic symptoms and septicaemia.	
Diagnosis	Anthrax is diagnosed with direct smear, serologic testing, PCR and cultures from blood, discharge or lesions.	
Treatment	The recommended treatment includes fluoroquinolone, with at least one from penicillins, macrolides, rifampicin, linezolid, doxycycline, aminoglycosides.	
Protective Measures	•Pasteurise milk and dairy products •Education of high-risk occupations on disinfection, handling and disposal of animal products and good hygiene practices in premises with animals. •Susceptible animals in areas with anthrax transmission should be vaccinated.	•Practice good hygiene when dealing with farm animals. •Appropriate ventilation is needed when processing raw animal products.

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Bacillus anthracis (Anthrax)

Key actions to protect public health	•Anthrax spores are extremely resistant to disinfectants and environmental conditions. Anthrax is considered a very high-risk agent for deliberate release and has been used to this purpose (2001-USA). •Anthrax cases should be immediately reported to local public health officials. Outbreaks have been reported both as occupational exposure as well as in the surrounding geographical areas (airborne transmission downwind). •Two different anthrax vaccines are used in UK and the USA and in China and Russia.
Prognosis	All clinical forms of anthrax, but esp. pulmonary anthrax carry significant mortality (cutaneous untreated up to 5-20%, pulmonary >85%, gastrointestinal up to 60%).
Where can I find more information?	ECDC: https://ecdc.europa.eu/en/anthrax CDC, Atlanta: https://www.cdc.gov/anthrax/index.html Control of Communicable Diseases Manual, 19th ed, DL Heymann Editor, APHA [Anthrax]

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Pathogens transmitted through contact with wildlife

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Pathogens transmitted through contact with wildlife

- Engaging more frequently in outdoor occupational or recreational activities
  - close contact with wildlife

- Lyme disease (Lyme borreliosis, LB): transmitted through the bites of ticks
  - Grassy fields
  - Forests
  - Gardens

- Estimated: 65,000 cases reported in Europe every year (WHO, 2014)

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Pathogens transmitted through contact with wildlife

- Important **points for occupation history**:

  - detailed contact description with specific animal(s)

  - description of the activity, duration and frequency of contact

  - condition of the animal, if there is possibility for its capture and/or testing

  - who was exposed and if they can be contacted

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Most frequently transmitted diseases

Avian Influenza

Psittacosis

Rabies

Tularemia

Plague

Leptospirosis

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Rabies

What is Rabies?	**Rabies** is a lethal viral zoonotic disease which affects mammals in certain areas of the world.
Who is at risk?	Children are recognised as particularly high risk group as they tend to play with stray animals, wild or domesticated. Veterinarians (autopsies on animals who died undiagnosed, work in rabies elimination programmes), other veterinary public health staff, park rangers etc Hunters and wildlife
Epidemiology	Rabies is transmitted through contact with saliva or nervous tissue of an infected animal. There have been cases of transmission through non-bite exposure, such as through the transplantation of an infected organ or even the inhalation of aerosolized virus. Globally, rabies is most commonly acquired from the bite of an infected dog, although it can be spread by any mammal. Other common reservoirs include also bats, skunks, cats, cattle and jackals. Rabies in wildlife (mainly red foxes) is encountered in many EU countries, but in general not in stray animals. In contrast in developing countries stray animals are a significant risk.

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Rabies

Incubation period	On average 1-3 months, but it can be longer.	
Presentation	From the site of infection, the rabies virus moves in a retrograde direction through nerve tissue toward the dorsal root ganglia, spinal cord, and brain. First symptoms resemble an acute flu-like illness and sometimes paresthesias beginning at the site of infection. After 2-10 days, encephalitic or paralytic rabies develops. Most infected patients will develop encephalitic rabies characterized by cerebral dysfunction, hyperactivity, anxiety, confusion, agitation, delirium, hallucinations, insomnia, hydrophobia, aerophobia, and dysphagia. Paralytic rabies is characterized by ascending flaccid paralysis. Coma follows neurologic syndrome. Patients usually die 2 weeks after the onset of coma.	
Diagnosis	Diagnosis can be confirmed using samples from serum, saliva, CSF, or skin for PCR, detection of the virus with immunofluorescent staining (CNS post mortem), or presence of anti-rabies antibodies.	
Treatment	Rabies is almost invariably fatal for all mammals including humans, once symptoms begin. Post-exposure prophylaxis with anti-rabies vaccines and depending on the case with Rabies immunoglobulin, is the only available prevention measure. Wounds should be immediately cleaned and washed with soap and water for 15 min, as soon as possible after the bite.	
Protective Measures	•Prophylactic immunization is recommended for high risk professionals e.g. veterinary public health, park rangers, hunters, wildlife keepers etc. •Vaccinate pets and working animals, e.g. shepherd and hunting dogs.	•Avoid contact with wild animals. •Prevent pets from contact with wild animals. •Vaccinate and control stray animals.

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Rabies

Key actions to protect public health	•Educate public on dog behavior and bite prevention, especially for children. •Animal and human rabies cases should be reported immediately to local public health professionals. In the EU countries rabies eliminations programmes are supported by veterinary public health. •Be aware of accessibility of rabies post-exposure prophylaxis in your area of responsibility.
Prognosis	Rabies infection is preventable with the existing post-exposure prophylaxis, provided it is promptly and appropriately delivered. However, if symptoms develop, rabies is almost always fatal.
Where can I find more information?	CDC, Atlanta: www.cdc.gov/rabies/ WHO: www.who.int/mediacentre/factsheets/fs099/en/ DeMaria, A. (2016). Clinical manifestations and diagnosis of rabies. In: UpToDate, Post TW (Ed), Up ToDate, Waltham, MA. (Accessed on June 21, 2017.) Animal bites and rabies. Health Library. Johns Hopkins Medicine. Accessed June 21, 2017. http://www.hopkinsmedicine.org/healthlibrary/conditions/travel_medicine/animal_bites_and_rabies_85,p00819/

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Food and waterborne diseases

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Food and waterborne diseases

- Pathogens transmitted via food or water
- Common causes of outbreaks in the community
- Rural/agricultural communities often use wells or water reservoirs
- Food products (milk, cheese, meat etc) prepared at household
  - Away from industrialized environment
  - Potential risk of infection
  - Parasites may multiply and survive → transmitted to humans

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Food and waterborne diseases

- Important **points for occupation history**:

  - detailed consumption history

  - who was exposed and if they can be contacted

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Most frequently transmitted diseases

Salmonella (Salmonelosis)

Shigella (Shigellosis)

Listeria (Listeriosis)

E. coli

Botulinum Toxin- Botulism

<u>Food & Water borne Parasites</u>

Trichinella

Giardiasis

Cyclospora

Naegleria infection

Taenia infections

Entameoba histolytica (Amoebiasis)

Hepatitis A

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Salmonella

What is Salmonella?	**Salmonella** is a type of *Enterobacteriaceae*. Serotypes are classified as either non-typhoidal or typhoidal. Non-typhoidal salmonella is more common, and is one of the leading causes of diarrhea worldwide. Typhoidal *Salmonella* causes typhoid fever.
Who is at risk?	**Non-typhoidal *Salmonella***: Infants, young children, the elderly, infants who are not breast fed, and those who are immunocompromised. **Typhoidal *Salmonella***: Children in endemic countries and travelers to endemic countries
Epidemiology	**Non-typhoidal *Salmonella***: *Salmonella* is commonly found in domestic and wild animals. It is spread to humans through the consumption of contaminated food of animal origin, but can also spread between persons via the fecal-oral route. Infection is more common during the summer months. **Typhoidal *Salmonella***: Typhoid fever most common in countries with poor sanitation. It is spread through the consumption of contaminated food and water. Humans are the only reservoir of the *Typhi* serotype. In endemic countries, it more common in children than adults.

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Salmonella

Incubation period	The incubation period for non-typhoidal *Salmonella* is usually 8-72 hours after exposure. The incubation period for typhoidal *Salmonella* usually 5-21 days after exposure.
Presentation	**Non-typhoidal *Salmonella*:** Salmonellosis usually presents as a nondescript gastroenteritis causing diarrhea, nausea, vomiting, fever, and abdominal cramps. Associated constitutional symptoms include fever, fatigue, malaise, chills, weight loss, and headache. Diarrhea is sometimes bloody. Complications are rare, but include bacteremia that can lead to endocarditis, mycotic aneurysm, and osteomyelitis. Infants are at increased risk of developing meningitis. Adults over 50 are at increased risk of developing endovascular disease, arteritis, and aortitis following bacteremia. **Typhoidal *Salmonella*.** Presentations are defined as either non-complicated or complicated. Patients with acute non-complicated disease may present with fever, diarrhea, constipation, headache, malaise, and exanthema. Complicated typhoid fever can cause intestinal perforation, peritonitis, delirium, meningitis, encephalomyelitis, Guillain-Barre, neuritis, and psychosis. The following disease progression has been documented: First, patients present with rising fever, usually accompanied by chills, and bacteremia. Subsequent abdominal pain and exanthema on the trunk and abdomen develop during the second week of infection. In the third week, patients present with hepatosplenomegaly and intestinal bleeding. Complications include septic shock and impaired consciousness. Severe cases can lead to death.
Diagnosis	**Non-typhoidal *Salmonella*** can be diagnosed by stool culture, but is only done if the patient is at increased risk of developing complications or if the illness has not resolved. It takes 48-72 hours to isolate *Salmonella* from the stool culture. Clinical treatment and management of *Salmonella* infection usually does not rely on definitive diagnosis. **Typhoidal *Salmonella*** is diagnosed by culture. The most sensitive diagnostic test is a bone marrow culture. Less sensitive, but less invasive samples can be taken from blood, stool, urine, macule, or duodenal contents.

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Salmonella

Treatment	**Non-typhoidal *Salmonella*** infections are usually self-limiting, with fever resolving within 72 hours and diarrhea within 10 days. Therefore, most cases go undiagnosed and untreated. Antibiotic treatment is not given to immunocompetent treatment between the ages of 1-50. Antibiotic resistant strains of salmonella are on the rise. Supportive therapy, such as oral rehydration and replenishment of electrolytes, is very important in preventing dehydration. Antibiotic treatment should be considered for the following: those experiencing severe illness, defined as having severe diarrhea (more than 9-10 stools per day), high or persistent fever, or a need for hospitalization; infants; adults over 50; immunocompromised patients; and patients with cardiac, valvular, endovalvular, or joint abnormalities. Fluoroquinolones are the first line treatment. The course of treatment in immunocompetent individuals is usually 3-7 days, but can last months in those who are immunocompromised. **Typhoidal *Salmonella*** treatment with antibiotics is very important. Antibiotics should be administered even if symptoms have disappeared. Fluoroquinolones, such as ciprofloxacin, are regarded as the best treatment for typhoid fever. However, many strains have become resistant to fluoroquinolones. For patients infected by fluoroquinolone resistant *Salmonella typhi*, azithromycin is recommended. For cases that have resulted in severe systemic illness or altered mental status, dexamethasone is recommended. Another course of antibiotics should be administered if patients relapse.
Protective measures	**Non-typhoidal *Salmonella*:** It is important to properly cook food, avoid unpasteurized milk and milk products, clean cooking utensils, and practice good personal hygiene. Farmers should wear dedicated clothing and shoes when out in the barn or fields. This clothing should be removed upon leaving. House pets should not be allowed in the barn. Veterinarians can be used to diagnose and treat infected livestock. **Typhoidal *Salmonella***: Two vaccines are available to protect against the *Salmonella typhi*: a live attenuated vaccine that is administered orally and an injectable polysaccharide vaccine. These vaccines are recommended for individuals traveling to endemic countries.

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Salmonella

Key actions to protect public health	Farmers should not use fecal waste as fertilizer and should prevent fecal contamination of fields. Feeders and waterers should be designed to keep manure out. Farmers should clean tools and equipment appropriately. Food handlers should be sure to separate raw and cooked foods, cook food thoroughly, store food at safe temperatures, clean cooking utensils, and use clean water. Provide clean water or build protected water sources in developing countries. Build sanitary systems for safe disposal of human waste in developing countries.
Prognosis	**Non-Typhoidal *Salmonella*** infection is usually self-limiting. Mortality is very rare. **Typhoidal *Salmonella*** can cause serious and life threatening illness if not treated immediately.
Where can I find more information?	http://ecdc.europa.eu/en/healthtopics/salmonellosis http://www.who.int/immunization/diseases/typhoid/en/ http://www.who.int/rpc/TFGuideWHO.pdf / World Health Organization (2016). Salmonella (non-typhoidal). Media Centre. http://www.who.int/mediacentre/factsheets/fs139/en/. www.cdc.gov/shigella http://www.who.int/mediacentre/factsheets/fs139/en/ Hohmann, E. (2017). Nontyphoidal Salmonella: Gastrointestinal infection and carriage. In: UpToDate, Post TW (Ed), UpToDate, Waltham, MA. (Accessed on June 14, 2017.)

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Listeria (Listeriosis)

What is Listeria (Listeriosis)?	***Listeria monocytogenes*** is a bacteria that most commonly found in soil. It can cause mild gastroenteritis in immunocompetent individuals, but can be very serious in pregnant women and other at-risk groups.
Who is at risk?	Populations most at risk are neonates, immunocompromised patients, older adults, and pregnant women.
Epidemiology	*Listeria* is most commonly transmitted to humans through the consumption of contaminated food or water. The bacteria can spread from mother to child by crossing the placenta or at childbirth. *Listeria* most often lives in soil, but is also found in animal feed, feces of humans and animals, water, and dust. Therefore, it can easily contaminate fruits and vegetables. Infection is more common during the summer months. Cutaneous infection has been reported in farmers working with infected livestock.

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Listeria (Listeriosis)

Incubation period	The incubation period for Listeria gastroenteritis varies between 6 hours and 10 days, with an average period of 24 hours. The incubation period for invasive listeriosis averages 11 days, but can be as long as 28 days.
Presentation	In immunocompetent individuals, *Listeria* does not usually cause infection. Upon consumption of a high dose of the bacteria, these individuals may present with a nondescript febrile gastroenteritis that is self-limiting and usually resolves within 2 days without treatment. Symptoms include nausea, vomiting, diarrhea, fever, myalgia, arthralgia, headache, and fatigue. Serious complications can arise in at-risk groups. Invasive listeriosis is rare and can be fatal. It can cause sepsis, meningitis, and meningoencephalitis. Although less common, *Listeria* can also cause brain abscesses and rhombencephalitis. Infection during pregnancy can cause miscarriage, stillbirth, preterm labor, and sepsis or meningitis in the baby.
Diagnosis	Acute febrile gastroenteritis cause by *Listeria* is rarely diagnosed. Invasive listeriosis can be diagnosed by a blood or CSF culture. MRI with contrast is used to detect *Listeria* lesions in the cerebellum, brainstem, and cortex.
Treatment	For immunocompetent individuals presenting with febrile gastroenteritis, treatment is not recommended. Supportive therapy, such as oral rehydration, can help prevent dehydration. If symptoms do not resolve, oral ampicillin or trimethoprim-sulfamethoxazole can be administered. First line treatment for invasive listeriosis occurring in at-risk populations is oral ampicillin or trimethoprim-sulfamethoxazole. Infected pregnant women should be given intravenous ampicillin. Asymptomatic pregnant women do not need to be treated, but should be carefully monitored.

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Listeria (Listeriosis)

Protective measures	•Thoroughly cook meat before consumption. •Thoroughly wash raw vegetables and fruit before consumption. •Thoroughly wash cooking utensils. •Do not consume unpasteurized milk or milk products. Pregnant women should avoid soft cheeses. •Clean refrigerators periodically. •Refrigerate leftovers within two hours. Keep leftovers no longer than four days. Reheat leftovers to 74 degrees Celsius before consuming.
Key actions to protect public health	Provide pregnant women with educational materials on how to avoid listeria infection and what to do if infection is suspected. Educate the public on proper handwashing techniques. Install handwashing stations, especially near public swimming facilities.
Prognosis	Without treatment, immunocompetent individuals usually do not experience any symptoms. At risk groups, especially pregnant women, need antibiotic treatment to prevent serious and life threatening complications.
Where can I find more information?	WHO: www.who.int/ith/diseases/listeriosis/en/ ECDC: ecdc.europa.eu/en/healthtopics/listeriosis/Pages/index.aspx CDC, Atlanta: www.cdc.gov/listeria/index.html

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Cyclospora

What is Cyclospora?	**Cyclosporiasis** is an intestinal infection caused by the parasite *Cyclospora cayetanensis.*
Who is at risk?	Travelers to endemic countries and HIV/AIDS patients are at the highest risk of infection. Children, the elderly, and HIV/AIDS patients are at risk for the most severe presentation of symptoms.
Epidemiology	Infection is usually acquired through the ingestion of contaminated food or water, and rarely spreads via the fecal-oral route

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Cyclospora

Incubation period	7 days	
Presentation	Infection requires a low infectious dose, but may be asymptomatic. Watery diarrhea is the most common symptom, and has been characterized as bloody, mucoid, and explosive. Patients may also present with anorexia, nausea, weight loss, abdominal cramps, flatulence, fever, and fatigue. Children, the elderly, and HIV/AIDS patients may present with more severe symptoms. After treatment, patients may relapse.	
Diagnosis	Cyclosporiasis is diagnosed via the detection of *Cyclospora* oocytes in a stool sample. PCR analysis of a stool sample can also be used.	
Treatment	Trimethoprim-sulfamethoxazole is the recommended treatment for cyclosporiasis, although most individuals will recover without treatment. A higher dose and longer course may be needed for HIV/AIDS patients. Supportive therapy, such as oral rehydration, may prevent dehydration.	
Protective Measures	Avoid food or water potentially contaminated with human waste.	Thoroughly wash raw vegetables and fruit before consumption.

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Cyclospora

Key actions to protect public health	Cyclospora has caused a number of large outbreaks in recent years in Europe and the USA, usually connected to fresh fruits or produce watered with human waste Appropriate disposal of human waste should be implemented and its use as a fertiliser avoided
Prognosis	*Cyclospora* infections usually resolve without any permanent damage.
Where can I find more information?	CDC, Atlanta: www.cdc.gov/parasites/cyclosporiasis/gen_info/faqs.html Weller, F. & Leder, Karin (2017). Cyclospora infection. In: UpToDate, Post TW (Ed), UpToDate, Waltham, MA. (Accessed on June 19, 2017.)

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Hepatitis A

What is Hepatitis A?	**Hepatitis A (HAV)** is a picornavirus that infects the liver.
Who is at risk?	HAV is a common cause of food- and water-borne outbreaks connected to different foodstuff e.g. chives, fruit etc Travellers to endemic countries, men who have sex with men, drug users, and individuals working with primates.
Epidemiology	HAV is transmitted via the consumption of contaminated food or water and from person via the fecal-oral route. In developed countries, outbreaks are typically due to consumption of contaminated shellfish or vegetables.

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Hepatitis A

Incubation period	The average incubation period is 28 days	
Presentation	HAV is usually self-limiting. It usually presents as sudden onset of fever, fatigue, anorexia, vomiting, abdominal pain, dark urine, pale stools, hepatomegaly, jaundice, and arthralgia. Typically older adults experience more severe symptoms. The majority of infections in children and some in adults are asymptomatic. Complications include cholestatic hepatitis, relapsing hepatitis, and autoimmune hepatitis. The disease does not become chronic	
Diagnosis	Diagnosis is usually via the presence of IgM anti-HAV antibodies	
Treatment	There is no specific treatment for HAV. Vaccination can prevent infection. Infected individuals should consult health care professional about their current medications; medications metabolized by cytochrome P450 system can cause liver damage.	
Protective Measures	There is a safe and effective vaccine against HAV, which is included in the National Immunization Programmes of many EU MS.	Frequent and proper hand washing to prevent fecal-oral transmission.

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Hepatitis A

Key actions to protect public health	Immunization campaigns, esp. for high risk population groups. Farmers should not use fecal waste as fertilizer and should prevent fecal contamination of fields. Feeders and waterers should be designed to keep manure out. Farmers should clean tools and equipment appropriately. Food handlers should be sure to separate raw and cooked foods, cook food thoroughly, store food at safe temperatures, and use clean water. Provide clean water or build protected water sources in developing countries. Build sanitary systems for safe disposal of human waste in developing countries. Educate the public on proper hand washing techniques.
Prognosis	The majority of HAV infections resolve without any permanent damage
Where can I find more information?	ECDC-Hepatitis A: https://ecdc.europa.eu/en/hepatitis-a CDC, Atlanta- Viral Hepatitis: https://www.cdc.gov/hepatitis/index.htm Control of Communicable Diseases Manual, 19th ed, DL Heymann Editor, APHA [Hepatitis, Viral]

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Pathogens transmitted through contact with the farm environment

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Vector borne diseases (VBDs)

- Disease vectors: insects (mosquitoes, ticks etc) in the farm environment
- More common in rural environment
- High morbidity and mortality
  - Increasing due to climate change and expansion of vector habitat
- Last 2 decades → 1/3 recorded events of IDs, due to vectors
- Farmers and agricultural workers: higher exposure rates due to work and leisure time
- Transmitted through bites or lesions on the skin

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Most frequently transmitted Vector borne diseases (VBDs)

Malaria

Arbo-viral infections

Plague

Tick Borne Infections

Leishmania spp. (Leishmaniasis)

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Malaria

What is Malaria?	**Malaria** is caused by the parasite *Plasmodium*, transmitted to humans by the female *Anopheles* mosquito. Five are the most common species of *Plasmodium* affecting humans, of which *Plasmodium vivax* and *Plasmodium falciparum* are the most frequent.
Who is at risk?	**Persons at risk** include: farmers and their families, farm workers (esp. if migrants), other people living in the farm or working in the farm garden. Although the vector bites other animals it does not cause disease in farm animals (e.g. sheep).
Epidemiology	European Union (EU) member states (MS) are malaria free since 2015, although small clusters and sporadic cases of appear in various countries. Some hunders of imported malaria cases are recorded annually in EU MS mostly in travellers visiting friends and family (VFFs) in malaria endemic countries. *P. vivax* is prevalent in Asia and South America, while P. falciparum is endemic in Sub-saharan Africa.

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Malaria

Incubation period	Incubation period differs according to species: *P. vivax* 12-18 days (usually, although it can be significantly longer) and *P. falciparum* 7-14 days.	
Presentation	Malaria presents with nonspecific clinical symptoms. Previously not exposed persons usually have episodes of chills followed by high fever, which resolve with singificant sweating and malaise. In addition patients usually have headache, myalgias and arthralgias and sometimes even cough, vomiting or diarrhea. Cyclic pattern of fever may not be recognizable. Persons coming from malaria endemic countries are partially immune and therefore present with mild symptoms often going unrecognized, e.g. low grade fever and headache. Signs: anemia, jaundice, splenomegaly, hepatomegaly.	
Diagnosis	Golden diagnostic standard remains light microscopy, although Rapid Detection Tests (RDTs) have proven valuable field tools for the diagnosis of malaria.	
Treatment	Depends on the species: *P. falciparum*: artemisinin combination (3 days) *P. vivax:* chloroquine (2 days) or artemisinin (3 days) and primaquine (14 days)	
Protective Measures	Awareness about the disease in the public and mostly in the health professionals should be high. Advise all persons at risk in vulnerable areas to use mosquito repellents on exposed skin and on clothing, Install window & door screens,	Prefer light coloured long-sleeved shirts and pants, avoid watering plants in the evening, Use mosquito nets for the beds of young infants <6mos) and pregnant women.

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Malaria

Key actions to protect public health	Malaria belongs to the notifiable diseases in EU countries and should be reported to PH authorities, which may also provide you entomological surveillance information for your area of responsibility. You may be asked to assist in a focus investigation in the estimated area of exposure of the case. Persons diagnosed with malaria should be protected from mosquito bites until about 24hrs after starting treatment.
Prognosis	Appropriate treatment results in full recovery usually within 24hrs of treatment onset. Eradication treatment with primaquine for the hypnozoites of *P. vivax* is of great importance for public health. Primaquine should be started only if G6PD levels are normal.
Where can I find more information?	ECDC, Malaria: https://ecdc.europa.eu/en/malaria CDC, Atlanta- Malaria: https://www.cdc.gov/malaria/ WHO, Malaria: http://www.who.int/malaria/en/

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Arbo-viral infections

What are Arbo-viral infections ?	**West Nile Virus (WNV**) infection, is a viral syndrome transmitted via the common mosquito (*Culex spp).*
Who is at risk?	Rural populations in general are at a higher risk for contact with infected mosquitoes due to longer exposures, however WNV is also circulating in urban environments. The elderly are up to 7 times more at risk to develop encephalitis compared to younger patients. Children are most likely to manifest the West Nile Fever syndrome. Populations living in flooded areas during the spring to fall months are also at risk as flood water is an abundant breeding site for mosquitoes.
Epidemiology	WNV was initially identified in Africa, however it is maintained in nature in a cycle between mosquitoes and migratory birds, which can carry the virus without symptoms. Horses and humans are considered incidental hosts, who cannot transmit it to mosquitoes. It has emerged in the last 15 years in the USA and Canada and in many EU countries (Romania, Greece, Serbia, Italy, Spain etc)

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Arbo-viral infections

Incubation period	2-14 days	
Presentation	WNV infections is mostly asymptomatic (up to 80%). About 15-18% infected persons can exhibit fever, fatigue, myalgia, maculopapular rash, even vomiting and diarrhea. Neurological symptoms consistent with encephalitis usually present in 1/145-150 infected persons. Some patients may also exhibit polio-like flaccid paralysis.	
Diagnosis	The virus is detected using serology (IgM) in serum or CSF and PCR or culture.	
Treatment	No specific treatment or vaccine exist. Supportive therapy is needed.	
Protective Measures	Awareness of the public and health professionals should be high. Advise all persons at risk in vulnerable areas to use mosquito repellents on exposed skin and on clothing Install window & door screens and yellow coloured light in the outside areas	prefer light coloured long-sleeved shirts and pants avoid watering plants in the evening

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Arbo-viral infections

Key actions to protect public health	WNV is a notifiable disease in most EU countries. Entomological surveillance may be required in the area along with the advised mosquito control programmes Specific blood safety measures are also recommended in the EU in the areas where WNV in circulating.
Prognosis	WNV infection usually resolves although long term sequelae are reported in up to 10% of cases. Encephalitis can be fatal especially since patients are elderly and have underlying morbidity.
Where can I find more information?	ECDC- WNV: https://ecdc.europa.eu/en/west-nile-fever Control of Communicable Diseases Manual, 19th ed, DL Heymann Editor, APHA [Arthropodborne Viral Encephalitides] CDC- Atlanta, WNV: https://www.cdc.gov/westnile/

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Pathogens in the dust

- Many organisms evolved to survive in adverse conditions:
  - Drought
  - High temperature
  - Dry atmosphere

- Prefer farms/rural environments, due to changes in weather throughout the year

- Health hazard to:
  - Farmers and agricultural workers
  - People/Communities living downwind of a farm

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Most frequently transmitted IDs through exposure to pathogens in the dust

Hanta virus

Aspergillus (Aspergillosis)

Bacillous anthracis (Anthrax)

Coxiella burnetti (Q Fever)

Brucella spp (Brucellosis)

Psittacosis

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Hanta virus

What is Hanta virus?	**Hantaviruses** are rodent-borne Bunyaviridae that cause human disease with varying severity.
Who is at risk?	Those in contact with rodents or rodent excrement. This includes construction workers, cleaners, rural populations, campers, and hunters.
Epidemiology	More than 25 viruses are currently known, Seoul virus circulating worldwide, Puumala mostly in Europe, Hantaan mostly in Asia and the Balkans and Dobrava in the Balkans Hantaviruses are circulating mostly in the Americas. The virus is spread to humans through inhalation of aerosolized particles or contact with rodent feces, urine, or saliva. There is no documented human-to-human transmission or arthropod transmission.

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Hanta virus

Incubation period	Average is 2-4 weeks (2 days - 2 months)	
Presentation	Hantaviruses can cause hemorrhagic fever with renal syndrome or hantavirus pulmonary syndrome. Hemorrhagic fever with renal syndrome first presents with headache, abdominal pain, back pain, chills, fever, nausea, and blurred vision. The syndrome progresses to cause low blood pressure, acute shock, vascular leakage, respiratory failure, and acute kidney failure. It can be fatal. Hantavirus cardiopulmonary syndrome causes severe respiratory infection. The first symptoms include fever, fatigue, myalgia, nausea, vomiting, and diarrhea. It then progresses to cause cough and shortness of breath as lungs become fluid-filled. Shock, coagulopathy, pulmonary edema, bronchorrhea, and arrhythmias can be fatal.	
Diagnosis	Diagnosis is a combination of the clinical syndrome and serologic testing, such as immunofluorescent assays or ELISA (IgM).	
Treatment	Prompt treatment with ribavirin and supportive therapy, with careful fluid and electrolyte management and dialysis, if needed, are usually effective. Supportive therapy, such as respiratory assistance, is recommended for individuals with hantavirus pulmonary syndrome.	
Protective Measures	Avoid contact with rodents and rodent excrement. Food should be stored in rodent-proof conditions. Clean and air out buildings that are not regularly used.	Personal protective equipment (masks) should be worn for cleaning out areas, silos, rooms infested with rodents. Avoid sweeping or vacuuming, rather use wet mops and cloths moistened with disinfectant (e.g. diluted bleach)

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Hanta virus

Key actions to protect public health	Hantavirus infections should be reported as outbreaks in particular sites have been identified. Increase awareness of hantavirus infections in rural populations, campers, hikers etc.
Prognosis	Supportive treatment is needed, while mortality is between 5-15%. Puumala virus in Central Europe carries much lower mortality around 1%.
Where can I find more information?	Control of Communicable Diseases Manual, 19th ed, DL Heymann Editor, APHA [Hantaviral diseases] ECDC- Hanta Virus: ecdc.europa.eu/en/hantavirus-infection/facts CDC- Atlana, Hanta Virus: www.cdc.gov/hantavirus/index.html Mustonen, J. (2016) Renal involvement with hantavirus infection (hemorrhagic fever with renal syndrome). In: UpToDate, Post TW (Ed), UpToDate, Waltham, MA. (Accessed on June 26, 2017.)

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Pathogens in mud and/or flood water

- Floods or excessive watering of fields → pathogens in mud or water thrive
  - Disruption of water purification
  - Sewage system
  - Toxic waste
  - Farm/Agricultural chemicals

- Risks for clean-up crews of flooded buildings (e.g. fungi infections)

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Most frequently transmitted diseases through exposure to pathogens in mud and/or flood water

Tetanus

Burkholderia mallei (Melioidosis)

Leptospira spp (Leptospirosis)

Mosquito borne diseases

Vibrio infections

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Tetanus

What is Tetanus?	**Tetanus** is a deadly bacterial infection of the nervous system caused by the toxin released from *Clostridium tetani*.
Who is at risk?	Those who have not received the tetanus vaccine. It is endemic in developing countries. The bacteria cannot grow in healthy tissue, so those at risk have some kind of injury, infection, or ischemia. Infants of unvaccinated mothers are at risk of infection. In the case of flooding persons involved in the clean up process are at high risk due to the hazard posed by debris in the mud and flood water.
Epidemiology	Tetanus is rare in developed countries where the majority of children receive vaccination with tetanus toxoid. Tetanus is endemic in developing countries, where immunization campaigns are lacking. This and some cultural practices especially increases the risk of neonatal tetanus.

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Tetanus

Incubation	3-21 days
Presentation	Generalized tetanus is the most common and severe form of tetanus, causing tonic muscle contractions. Most patients first present with lockjaw. Spasms in other muscle groups, seizures, stiff neck, risus sardonicus, rigid abdomen, apnea, dysphagia, and tachycardia may follow muscle spasms, but patients do not lose consciousness. Therefore, patients experience extreme pain associated with muscle spasms. Patients with localized tetanus have muscle spasms near the site of infection. This usually occurs in individuals with some immunity to the toxin. It can progress to become generalized tetanus. Cephalic tetanus is caused by infection of the face or head, and is characterized by cranial nerve involvement. Neonatal tetanus most commonly occurs as a result of infection of the umbilical stump from mothers with poor immunity. Infants present with risus sardonicus, muscle spasm, and lock jaw, causing refusal to feed. Complications from tetanus infection include laryngospasms, fractures, hypertension, pulmonary embolism, aspiration pneumonia, and death.
Diagnosis	Diagnosis is made based on clinical findings and patient history.

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Tetanus

Treatment	Treatment requires hospitalization. Wounds should be properly debrided. If the patient has never received the tetanus vaccine, they should receive active immunization with tetanus toxoid. Passive immunization with human tetanus immune globulin should also be administered to neutralize unbound toxin. Toxoid and immune globulin must be administered at a different sites. If the patient has historically received the tetanus vaccine, but may not be up to date on the booster, the tetanus toxoid booster shot should be administered. Patient does not need immune globulin. Metronidazole or trimethoprim-sulfamethoxazole are the recommended antibiotic therapy. If the infection has compromised breathing, patients may need to be intubated. Benzodiazepines, muscle relaxants, and neuromuscular blocking agents can be used to treat muscle spasms. Labetalol or morphine sulfate can be used for autonomic hyperactivity.
Protective measures	Get vaccinated and regularly receive booster shots. Prophylaxis should be administered immediately upon suspected infection.

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Tetanus

Key actions for public health	Immunization campaigns, particularly for children and pregnant women Some experts warn that focusing on tetanus exposure in flooding is not appropppriate use of public health services
Prognosis	Tetanus is can be fatal without immediate treatment.
Where can I find more information?	CDC: www.cdc.gov/tetanus/index.html ECDC: www.who.int/immunization/topics/tetanus/en/ Sexton, D. (2017). Tetanus. In: UpToDate, Post TW (Ed), UpToDate, Waltham, MA. (Accessed on June 14, 2017)

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Vibrio infections

What are Vibrio infections	**Vibrio infections (vibriosis**) are a group of diseases caused by more than 12 *vibrio* bacteria that cause human disease, which is not related to cholera (caused by *Vibrio cholerae*). Among those *Vibrio vulnificus* infection is more common and connected with exposure to sea or flood water after storms, cyclones etc.
Who is at risk?	Persons with chronic liver disease and immunocompromised are at a high risk for severe infection. Occupational exposure in fishermen or shellfish farm workers is also common.
Epidemiology	Vibrios are found worldwide in brackish or marine environment. Humans are infected through eating raw shellfish (oysters) or after exposure of skin lesions (open skin wounds, abrasions etc) with flood water after storms, cyclones etc during clean up.

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Vibrio infections

Incubation period	Range from 12 -72 hours after consuming shellfish
Presentation	Vibrio infections cand be: gastroenteritis with watery diarrhea, abdominal pain and cramping, nausea and vomiting Wound infection: with redness and soft tissue infection primary septicemia with fever, hypotension and shock.
Diagnosis	Diagnosis is made through culture of stool, wound discharge or blood
Treatment	Supportive care is critical and antibiotics are used for wound infection and septicemia cases. Amputations have been reported.
Protective Measures	Awareness of possible exposures in the clean up after flooding should be maintained. Proper personal protective equipment should be used and hygiene practiced after exposure.

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Vibrio infections

Key actions to protect public health	*Vibrio* infections are usually not notifiable, although systems monitoring the growth of *Vibrio* in certain European sea environments (e.g. Baltic Sea) are in place.
Prognosis	Untreated wound or soft tissue infection or septicaemia can be fatal
Where can I find more information?	Control of Communicable Diseases Manual, 19th ed, DL Heymann Editor, APHA [Vibrio Infections] CDC- Atlanta, *Vibrio* Infections: https://www.cdc.gov/vibrio/index.html

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End of Module 10

Thank you!