VECTOR-BORNE DISEASES

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LEARNING OBJECTIVES

As a result of reading this educational module on Vector-Borne Diseases, the medical technologist will be able to:

1. Review concepts of the epidemiology of some vector-borne diseases.
2. Name the vector, host or reservoir, causative agent, geographic distribution and availability of a vaccine of the diseases presented.

INTRODUCTION

The World Health Organization (WHO) reports that vector-borne diseases account for over 17% of all infectious diseases worldwide. Vector-borne diseases are major public health concern. Globally, every year there are more than 1 billion cases and over 1 million deaths from vector-borne diseases such as dengue, malaria, Chagas disease, yellow fever, Zika and chikungunya, among others.

Vectors are living organisms that can transmit infectious diseases between humans or from animals to humans. Many of these vectors are bloodsucking insects, which ingest disease-producing microorganisms during a blood meal from an infected host (human or animal) and later inject it into a new host during their subsequent blood meal. Arthropod-borne viruses (arboviruses) comprise the largest class of vector-borne human pathogens.

Mosquitoes are the best known disease vector. Others include ticks, louses, flies, sandflies, fleas, triatomine (kissing) bugs and some freshwater aquatic snails. (See Table I)

Distribution of these diseases is determined by a complex dynamic of environmental and social factors. Globalization of travel and trade, unplanned urbanization, increased human traffic through isolated areas, breakdown in public health measures, poor sanitation conditions and environmental challenges such as climate change are having a significant impact on disease transmission in recent years. Some diseases, such as dengue, chikungunya, West Nile virus and Zika are emerging in countries where they were previously unknown.

Table I includes some of the vector-borne diseases. From this table were chosen six vector-borne diseases of which some key facts will be discussed.
VECTOR-BORNE DISEASES

A. **Yellow Fever**

**Geographic Distribution**

Sub-Saharan Africa and tropical South America.

**Transmission**

Yellow fever is an acute viral hemorrhagic disease transmitted by infected mosquitoes. The "yellow" in the name refers to the jaundice that affects some patients. Yellow fever virus (YFV) is an RNA virus that belongs to the genus *Flavivirus*. It is related to West Nile, St. Louis encephalitis, and Japanese encephalitis viruses. Yellow fever virus is transmitted to people primarily through the bite of infected *Aedes* or *Haemagogus* species mosquitoes. Mosquitoes acquire the virus by feeding on infected primates (human or non-human) and then can transmit the virus to other primates (human or non-human). People infected with yellow fever virus are infectious to mosquitoes shortly before the onset of fever and up to 5 days after onset.

**Symptoms**

- The majority of persons infected with yellow fever virus have no illness or only mild illness.
- In persons who develop symptoms, the incubation period (time from infection until illness) is typically 3–6 days.
- The initial symptoms include sudden onset of fever, chills, severe headache, back pain, general body aches, nausea, and vomiting, fatigue, and weakness. Most persons improve after the initial presentation.
- After a brief remission of hours to a day, roughly 15% of cases progress to develop a more severe form of the disease. The severe form is characterized by high fever, jaundice, bleeding, gastrointestinal hemorrhages (black vomit) and eventually shock and failure of multiple organs.

**Laboratory Diagnosis**

- In early stages: RT-PCR testing of viral mRNA on blood and other samples.
- In later stages: ELISA and Plaque-reduction neutralization tests (PRNT)

**Treatment**

- No specific treatments have been found to benefit patients with yellow fever. Whenever possible, yellow fever patients should be hospitalized for supportive care and close observation.
- Treatment is directed at symptomatic relief or life-saving interventions. Rest, fluids, and use of pain relievers and medication to reduce fever may relieve symptoms of aching and fever.
- Care should be taken to avoid certain medications, such as aspirin or other nonsteroidal anti-inflammatory drugs (e.g. ibuprofen, naproxen), which may increase the risk of bleeding.
• Yellow fever patients should be protected from further mosquitoes exposure (staying indoors and/or under a mosquitoes net) for up to 5 days after the onset of fever. This way, yellow fever virus in their bloodstream will be unavailable to uninfected mosquitoes, thus breaking the transmission cycle and reducing risk to the persons around them.

Other

• The majority of infected persons will be asymptomatic or have mild disease with complete recovery.
• In persons who become symptomatic but recover, weakness and fatigue may last several months.
• Among those who develop severe disease, 20–50% may die.
• Those who recover from yellow fever generally have lasting immunity against subsequent infection.

Prevention

• Avoid mosquitoes bites
• Control of mosquitoes population
• Get vaccinated
  o Vaccination is recommended for persons aged ≥9 months that are traveling to or living in areas at risk YFV transmission in South America and Africa. Yellow fever vaccine may be required for entry in certain countries. The yellow fever vaccine certification required for entry in certain countries is valid after 10 days of vaccine administration.

B. West Nile Encephalitis

Geographic Distribution

Africa, Europe, Central Asia and North America.

Transmission

West Nile virus (WNV) is most commonly transmitted to humans by mosquitoes. In nature, West Nile virus cycles between mosquitoes (especially Culex species) and birds. Some infected birds, can develop high levels of the virus in their bloodstream and mosquitoes can become infected by biting these infected birds. After about a week, infected mosquitoes can pass the virus to more birds when they bite. Mosquitoes with West Nile virus also bite and infect people, horses and other mammals. However, humans, horses and other mammals are ‘dead end’ hosts. This means that they do not develop high levels of virus in their bloodstream, and cannot pass the virus on to other biting mosquitoes.
Additional routes of human infection have also been documented. It is important to note that these methods of transmission represent a very small proportion of cases:

- Blood transfusions
- Organ transplants
- Exposure in a laboratory setting
- From mother to baby during pregnancy, delivery, or breastfeeding

Symptoms

Most people infected with WNV will have no symptoms.
- About 1 in 5 people who are infected will develop fever, headache, tiredness, and body aches, occasionally with a skin rash on the trunk of the body and swollen lymph glands usually lasting only a few days.
- Encephalitis, meningitis, or meningoencephalitis occurs in approximately 1% of infected individuals.
- Individuals older than 50 years and the immunocompromised are at higher risk for serious disease.

Laboratory Diagnosis

RT-PCR

Treatment

- No vaccine or specific antiviral treatments for West Nile virus infection are available.
- Over-the-counter pain relievers can be used to reduce fever and relieve some symptoms
- In severe cases, patients often need to be hospitalized to receive supportive treatment, such as intravenous fluids, pain medication, and nursing care.

Prevention

The most effective way to avoid West Nile virus disease is to prevent mosquitoes bites.

C. Lyme Disease

Geographic Distribution

Worldwide distribution

Transmission

Lyme disease is caused by the spirochetes belonging to the *Borrelia* species complex and is transmitted to humans through the bite of infected *Ixodes* ticks. Lyme disease was first recorded in 1977 when an unusual cluster of children were diagnosed with arthritis in a town by the name Lyme in Connecticut.
Ticks can attach to any part of the human body but are often found in hard-to-see areas such as the groin, armpits, and scalp. In most cases, the tick must be attached for 36 to 48 hours or more before the Lyme disease bacterium can be transmitted.

Most humans are infected through the bites of immature ticks called nymphs. Nymphs are tiny (less than 2 mm) and difficult to see; they feed during the spring and summer months. Adult ticks can also transmit Lyme disease bacteria, but they are much larger and are more likely to be discovered and removed before they have had time to transmit the bacteria. Adult *Ixodes* ticks are most active during the cooler months of the year.

**Symptoms**

Untreated Lyme disease can produce a wide range of symptoms, depending on the stage of infection.

◊ **Early Signs and Symptoms (3 to 30 days after tick bite)**

- Fever, chills, headache, fatigue, muscle and joint aches, and swollen lymph nodes
- Erythematous cutaneous lesion - Erythema migrans (EM) rash:

  ![Image](http://www.cdc.gov/lyme/signs_symptoms/index.html)

  - Occurs in approximately 70 to 80 percent of infected persons
  - Begins at the site of a tick bite after a delay of 3 to 30 days (average is about 7 days)
  - Expands gradually over a period of days reaching up to 12 inches or more (30 cm) across
  - May feel warm to the touch but is rarely itchy or painful
  - Sometimes clears as it enlarges, resulting in a target or “bull’s-eye” appearance
  - May appear on any area of the body

◊ **Later Signs and Symptoms (days to months after tick bite)**

- Severe headaches and neck stiffness
- Additional EM rashes on other areas of the body
• Arthritis with severe joint pain and swelling, particularly the knees and other large joints.
• Facial or Bell's palsy (loss of muscle tone or droop on one or both sides of the face)
• Intermittent pain in tendons, muscles, joints, and bones
• Heart palpitations or an irregular heart beat (Lyme carditis)
• Episodes of dizziness or shortness of breath
• Inflammation of the brain and spinal cord
• Nerve pain
• Shooting pains, numbness, or tingling in the hands or feet
• Problems with short-term memory

Laboratory Diagnosis

The Center for Disease Control and Prevention (CDC) currently recommends a two-step process when testing blood for evidence of antibodies against the Lyme disease bacteria. Both steps can be done using the same blood sample.

The first step uses EIA (enzyme immunoassay) or rarely, an IFA (indirect immunofluorescence assay). If this first step is negative, no further testing of the specimen is recommended, but if the first step is positive or indeterminate (sometimes called "equivocal"), the second step should be performed. The second step uses Western blot test. Results are considered positive only if the EIA/IFA and the immunoblot are both positive.

The two steps of Lyme disease testing are designed to be done together. CDC does not recommend skipping the first test and just doing the Western blot. Doing so will increase the frequency of false positive results and may lead to misdiagnosis and improper treatment.

Treatment

Patients treated with appropriate antibiotics in the early stages of Lyme disease usually recover rapidly and completely. Antibiotics commonly used for oral treatment include doxycycline, amoxicillin, or cefuroxime axetil. Patients with certain neurological or cardiac forms of illness may require intravenous treatment with drugs such as ceftriaxone or penicillin.

Prevention

• Using insect repellent
• Removing ticks promptly
• Applying pesticides
• Reducing tick habitat
D. **Tularemia**

**Geographic Distribution**

Worldwide

In the United States infections have been reported from all states (most common in Oklahoma, Missouri and Arkansas), except Hawaii.

**Transmission**

Tularemia is a disease of animals and humans caused by the bacterium *Francisella tularensis*. It can enter the human body through the skin, eyes, mouth, or lungs. Rabbits, hares, and rodents are especially susceptible and often die in large numbers during outbreaks. Humans can become infected through several routes, including:

- Tick and deer fly bites
- Skin contact with infected animals
- Ingestion of contaminated water
- Inhalation of contaminated aerosols or agricultural dusts
- Laboratory exposure

*Francisella tularensis* is highly infectious when grown in culture, and laboratory-acquired infections have been documented. The isolation of *F. tularensis* from clinical specimens, especially if unanticipated, can generate concern among laboratory workers about possible exposure. **Workers who report sniffing a culture plate or conducting procedures that generate aerosols are probably at greater risk than those who simply worked with the organism on the bench.**

In addition, *F. tularensis* is considered a biologic weapon.

**Symptoms**

Tularemia can be difficult to diagnose. It is a rare disease, and the symptoms can be mistaken for other, more common, illnesses. For this reason, it is important to share with the health care provider any likely exposures, such as tick and deer fly bites, or contact with sick or dead animals.

The signs and symptoms of tularemia vary depending on how the bacteria enter the body. Illness ranges from mild to life-threatening. All forms are accompanied by fever, which can be as high as 104 °F. Main forms of this disease are listed below:

- **Ulceroglandular** This is the most common form of tularemia and usually occurs following a tick or deer fly bite or after handling of an infected animal. A skin ulcer appears at the site where the bacteria entered the body. The ulcer is accompanied by swelling of regional lymph glands, usually in the armpit or groin.
- **Glandular** Similar to ulceroglandular tularemia but without an ulcer. Also generally acquired through the bite of an infected tick or deer fly or from handling sick or dead animals.

- **Oculoglandular** This form occurs when the bacteria enter through the eye. This can occur when a person is butchering an infected animal and touches his or her eyes. Symptoms include irritation and inflammation of the eye and swelling of lymph glands in front of the ear.

- **Oropharyngeal** This form results from eating or drinking contaminated food or water. Patients with oropharyngeal tularemia may have sore throat, mouth ulcers, tonsillitis, and swelling of lymph glands in the neck.

- **Pneumonic** This is the most serious form of tularemia. Symptoms include cough, chest pain, and difficulty breathing. This form results from breathing dusts or aerosols containing the organism. It can also occur when other forms of tularemia (e.g. ulceroglandular) are left untreated and the bacteria spread through the bloodstream to the lungs.

- **Typhoidal** This form is characterized by any combination of the general symptoms (without the localizing symptoms of other syndromes)

### Laboratory Diagnosis

- Microscopy is limited by the fact the organisms are extremely small and frequently overlooked in clinical specimens.

- Culture on cysteine-supplemented media (e.g. chocolate agar, buffered charcoal yeast extract agar) is sensitive if prolonged incubation is used.

- Serology can be used to confirm clinical diagnosis; fourfold increase in titer or single titer ≥ 1:160; high titers can persist for months to years.

### Treatment

Antibiotics used to treat tularemia include streptomycin, gentamicin, doxycycline, and ciprofloxacin. Treatment usually lasts 10 to 21 days depending on the stage of illness and the medication used. Although symptoms may last for several weeks, most patients completely recover.

### Prevention

- Use insect repellents
- Wear long pants, long sleeves, and long socks to keep ticks and deer flies off your skin.
- Remove attached ticks promptly with fine-tipped tweezers.
- Don’t drink untreated surface water.
- Don’t mow over sick or dead animals.
- Use gloves when handling hunted animals, especially rabbits, muskrats, prairie dogs, and other rodents.
- Cook game meat thoroughly before eating.
E. Malaria

Geographic Distribution

Africa, Latin America, parts of the Caribbean, Asia (including South Asia, Southeast Asia, and the Middle East), Eastern Europe, and the South Pacific.

Transmission

Malaria is caused by Plasmodium parasites. The parasites are spread to people through the bites of infected female Anopheles mosquitoes. There are 5 parasite species (see Table I) that cause malaria in humans, and 2 of these species – *P. falciparum* and *P. vivax* – pose the greatest threat.

- *P. falciparum* is the most prevalent malaria parasite on the African continent. It is responsible for most malaria-related deaths globally.
- *P. vivax* is the dominant malaria parasite in most countries outside of sub-Saharan Africa.

The long lifespan and strong human-biting habit of the African vector species is the main reason why nearly 90% of the world's malaria cases are in Africa.

Biology

The natural ecology of malaria involves malaria parasites infecting successively two types of hosts: humans and female Anopheles mosquitoes. In humans, the parasites grow and multiply first in the liver cells and then in the red cells of the blood. In the blood, successive broods of parasites grow inside the red cells and destroy them, releasing daughter parasites ("merozoites") that continue the cycle by invading other red cells.

The blood stage parasites are those that cause the symptoms of malaria. When certain forms of blood stage parasites ("gametocytes") are picked up by a female Anopheles mosquitoes during a blood meal, they start another, different cycle of growth and multiplication in the mosquitoes.

After 10-18 days, the parasites are found (as "sporozoites") in the mosquito's salivary glands. When the Anopheles mosquito takes a blood meal on another human, the sporozoites are injected with the mosquito's saliva and start another human infection when they parasitize the liver cells.

Thus the mosquito carries the disease from one human to another (acting as a "vector"). Differently from the human host, the mosquitoes vector does not suffer from the presence of the parasites.
Symptoms

Malaria is an acute febrile illness. In a non-immune individual, symptoms appear 7 days or more (usually 10–15 days) after the infective mosquitoes bite. The first symptoms – fever, headache, chills and vomiting – may be mild and difficult to recognize as malaria. If not treated within 24 hours, *P. falciparum* malaria can progress to severe illness, often leading to death.

Children with severe malaria frequently develop one or more of the following symptoms: severe anemia, respiratory distress in relation to metabolic acidosis, or cerebral malaria. In adults, multi-organ involvement is also frequent. In malaria endemic areas, people may develop partial immunity, allowing asymptomatic infections to occur.

Laboratory Diagnosis

- Smear microscopy remains the gold standard for malaria diagnosis.
- Rapid diagnostic tests (RDTs) offer a useful alternative to microscopy in situations where reliable microscopic diagnosis is not immediately available. Although RDTs can detect malaria antigens within minutes, they cannot determine the species, are less sensitive for diagnosis, and cannot quantify parasitemia. In addition, CDC recommends that positive and negative results always be confirmed by microscopy.
- PCR

Treatment

Treatment of malaria depends on many factors including disease severity, the species of malaria parasite causing the infection and the part of the world in which the infection was acquired. The latter two characteristics help determine the probability that the organism is resistant to certain antimalarial drugs. Additional factors such as age, weight, and pregnancy status may limit the available options for malaria treatment.

Prevention

Malaria elimination: defined as the interruption of local transmission of a specified malaria parasite in a defined geographical area.
F. **Chagas Disease (American trypanosomiasis)**

*T. cruzi* trypomastigote in a thin blood smear stained with Giemsa.


**Geographic Distribution**

Latin American countries

**Transmission**

In Latin America, *T. cruzi* parasites are mainly transmitted by contact with feces/urine of infected blood-sucking triatomine bugs. These bugs typically live in the wall or roof cracks of poorly-constructed homes in rural or suburban areas. Normally they hide during the day and become active at night when they feed on human blood. They usually bite an exposed area of skin such as the face, and the bug defecates close to the bite. The parasites enter the body when the person instinctively smears the bug feces or urine into the bite, the eyes, the mouth, or into any skin break.

*T. cruzi* can also be transmitted by:

- consumption of food contaminated with *T. cruzi* through, for example, contact with infected triatomine bug feces or urine;
- blood transfusion from infected donors;
- passage from an infected mother to her newborn during pregnancy or childbirth;
- organ transplants using organs from infected donors; and
- laboratory accidents

**Symptoms**

Chagas disease presents itself in two phases. The initial, acute phase lasts for about 2 months after infection. During the acute phase, a high number of parasites circulate in the blood but in most cases symptoms are absent or mild. In less than 50% of people bitten by a triatomine bug, characteristic first visible signs can be a skin lesion or a purplish swelling of the lids of one eye. Additionally they can present fever, headache, enlarged lymph glands, pallor, muscle pain, difficulty in breathing, swelling, and abdominal or chest pain.

During the chronic phase, the parasites are hidden mainly in the heart and digestive muscles. Up to 30% of patients suffer from cardiac disorders and up to 10% suffer from digestive (typically enlargement of the esophagus or colon), neurological or mixed alterations. In later
years the infection can lead to sudden death or heart failure caused by progressive destruction of the heart muscle and its nervous system.

**Laboratory Diagnosis**

The diagnosis of Chagas disease can be made by observation of the parasite in a blood smear by microscopic examination. A thick and thin blood smear are made and stained for visualization of parasites. However, a blood smear works well only in the acute phase of infection when parasites are seen circulating in blood.

Diagnosis of chronic Chagas disease is made after consideration of the patient's clinical findings, as well as by the likelihood of being infected, such as having lived in an endemic country. Diagnosis is generally made by testing with at least two different serologic tests (most commonly, ELISA, immunoblot, and immunofluorescent antibody test).

PCR testing may also help detect acute infection, but is not a useful diagnostic test for chronic-phase infections since parasites are not detectable in the peripheral blood during this phase.

**Treatment**

Antitrypanosomal drug treatment is always recommended for acute, early congenital, and reactivated *T. cruzi* infection and for chronic *T. cruzi* infection in children aged <18 years old. In adults, treatment is usually recommended. In the United States, treatment drugs (benznidazole and nifurtimox) are provided only by CDC under investigational protocols.

**Prevention**

Vector control is the most effective method of prevention in Latin America. Blood screening is necessary to prevent infection through transfusion and organ transplantation.

**REFERENCES**

1. CDC: [www.cdc.gov](http://www.cdc.gov)
3. WHO: [www.who.int](http://www.who.int)
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<thead>
<tr>
<th>DISEASE</th>
<th>VECTOR</th>
<th>HOST/ RESERVOIR</th>
<th>CAUSATIVE AGENT</th>
<th>CAUSATIVE AGENT GENUS</th>
<th>GEOGRAPHIC DISTRIBUTION</th>
<th>MAJOR DISEASE MANIFESTATION</th>
<th>VACCINE</th>
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<tbody>
<tr>
<td>Dengue fever and dengue hemorrhagic fever</td>
<td><em>Aedes</em> mosquitoes</td>
<td>Humans, monkeys</td>
<td>Dengue virus</td>
<td><em>Flavivirus</em></td>
<td>Tropical, subtropical regions around the world</td>
<td>Muscle, joint pain, dengue hemorrhagic fever, dengue shock syndrome</td>
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<td>Yellow fever</td>
<td><em>Aedes</em> and <em>Haemogogus</em> spp. mosquitoes</td>
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<td>Chikungunya fever</td>
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<td><em>Alphavirus</em></td>
<td>Africa, Asia, Europe, the Oceania and Pacific Islands, Americas</td>
<td>Fever, arthralgia, arthritis</td>
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<td>Fever, rash, joint pain, or conjunctivitis</td>
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<td>Japanese encephalitis</td>
<td><em>Culex</em> mosquitoes</td>
<td>Pigs, wading birds</td>
<td>Japanese encephalitis virus</td>
<td><em>Flavivirus</em></td>
<td>Asia, western Pacific</td>
<td>Encephalitis, seizures in children</td>
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<td>West Nile encephalitis</td>
<td><em>Culex</em> mosquitoes</td>
<td>Birds</td>
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<td>Africa, Europe, Central Asia, North America</td>
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<td>Crimean-Congo Hemorrhagic fever</td>
<td><em>Ixodid</em> ticks (genus <em>Hyalomma</em>)</td>
<td>Numerous wild and domestic animals, such as cattle, goats, sheep and hares</td>
<td>Nairovirus</td>
<td><em>Nairovirus</em></td>
<td>Eastern and southern Europe, Mediterranean, northwestern China, central Asia, Africa, the Middle East and the Indian subcontinent</td>
<td>Hemorrhagic fever,</td>
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<td>DISEASE</td>
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<td>HOST/ RESERVOIR</td>
<td>CAUSATIVE AGENT</td>
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<td>Tick-borne encephalitis</td>
<td><em>Ixodes</em> sp. ticks</td>
<td>Small rodents/ <em>Ixodes</em> spp. ticks</td>
<td>Tick-borne encephalitis virus</td>
<td><em>Flavivirus</em></td>
<td>Europe, the former Soviet Union, Asia</td>
<td>Encephalitis</td>
<td>No in the USA Available in other countries</td>
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<td>Powassan encephalitis</td>
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<td>Powassan virus</td>
<td><em>Flavivirus</em></td>
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<td><strong>BACTERIAS</strong></td>
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<td>Lyme disease</td>
<td><em>Ixodes</em> ticks</td>
<td>Mice, deer, domestic pets, hard ticks</td>
<td>Spirochets: <em>B. burgdoferi</em>, other <em>Borrelia</em> species</td>
<td><em>Borrelia</em></td>
<td>Worldwide distribution</td>
<td>Erythema migrans, cardiac, neurologic, or rheumatologic abnormalities</td>
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<td>Relapsing fever (epidemic)</td>
<td><strong>Epidemic:</strong> human body louse <em>Pediculus humanus</em></td>
<td>Human</td>
<td>Spirochete: <em>B. recurrentis</em></td>
<td><em>Borrelia</em></td>
<td>Ethiopia, Rwanda, Andean foothills</td>
<td>Fever and septicemia separated by afebrile periods</td>
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<td>Relapsing fever (endemic)</td>
<td><strong>Endemic:</strong> <em>Ornithodoros</em> soft ticks</td>
<td>Rodents, small mammals, soft ticks</td>
<td>Spirochets: <em>Borrelia</em> spp.</td>
<td><em>Borrelia</em></td>
<td>Worldwide, western part of the United States</td>
<td>Fever and septicemia separated by afebrile periods</td>
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<td>DISEASE</td>
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<tr>
<td>Rocky Mountain spotted fever</td>
<td>Hard ticks (dog and wood tick)</td>
<td>Rodents</td>
<td>Rickettsia rickettsii</td>
<td>Rickettsia</td>
<td>North, Central and South America</td>
<td>Fever, rash, headache</td>
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<td>Tularemia</td>
<td>Ticks (dog and wood) and deer flies (Chrysops spp)</td>
<td>Wild mammals, domestic animals, birds, fish</td>
<td>Francisella tularensis</td>
<td>Francisella</td>
<td>Worldwide distribution. Most common in USA in Oklahoma, Missouri, Arkansas</td>
<td>Vary depending on how the bacteria enter the body. Six different forms of clinical presentation</td>
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<td>Plague</td>
<td>Fleas</td>
<td>Rats</td>
<td>Yersinia pestis</td>
<td>Yersinia</td>
<td>Africa, the former Soviet Union, the Americas and Asia.</td>
<td>Sudden onset of fever, chills, head and bodyaches and weakness, vomiting and nausea. Two forms of clinical manifestations: bubonic and pneumonic plague</td>
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<td>Anaplasmosis (previously known as human granulocytic ehrlichiosis, recently been called human granulocytic anaplasmosis)</td>
<td>Ticks</td>
<td><em>Ixodes scapularis</em>, <em>Ixodes pacificus</em></td>
<td><em>Anaplasma phagocytophilum</em></td>
<td><em>Anaplasma</em></td>
<td>North America (Upper Midwest and Northeast), Europe, Asia</td>
<td>Fever, headache, chills, and muscle aches</td>
<td>No</td>
</tr>
<tr>
<td>PARASITES</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Malaria</td>
<td>Anopheles spp. mosquitoes</td>
<td>Humans, monkeys</td>
<td><em>P. falciparum</em>, <em>P. vivax</em>, <em>P. ovale</em>, <em>P. malariae</em>, <em>P. knowlesi</em></td>
<td><em>Plasmodium</em></td>
<td>Tropical, subtropical and temperate regions</td>
<td>Fever, chills, and flu-like illness</td>
<td>No</td>
</tr>
<tr>
<td>DISEASE</td>
<td>VECTOR</td>
<td>HOST/ RESERVOIR</td>
<td>CAUSATIVE AGENT</td>
<td>CAUSATIVE AGENT GENUS</td>
<td>GEOGRAPHIC DISTRIBUTION</td>
<td>MAJOR DISEASE MANIFESTATION</td>
<td>VACCINE</td>
</tr>
<tr>
<td>-------------------------------</td>
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<tr>
<td>Lymphatic filariasis</td>
<td>Anopheles, <em>Culex</em>, <em>Aedes</em> and <em>Manson</em>ia mosquitoes</td>
<td>Human</td>
<td>Nematodes: <em>Wuchereria bancrofti</em>, <em>Brugia malayi</em>, and <em>B. timori</em></td>
<td><em>Wuchereria</em></td>
<td>Tropical, subtropical regions around the world</td>
<td>Fever, lymphangitis, lymphadenitis with chills, recurrent febrile attacks. Filarial elephantiasis</td>
<td></td>
</tr>
<tr>
<td>Leishmaniasis</td>
<td>Sandflies</td>
<td>Human</td>
<td><em>Leishmania</em> spp.</td>
<td><em>Leishmania</em></td>
<td>Parts of the tropics, subtropics, southern Europe</td>
<td>Most common form is <strong>cutaneous leishmaniasis</strong>, which causes skin sores. The other main form is <strong>visceral leishmaniasis</strong>, which affects several internal organs (usually spleen, liver, and bone marrow) and can be life threatening</td>
<td>No</td>
</tr>
<tr>
<td>Ghagas disease (American trypanosomiasis)</td>
<td>Triatomine bugs (kissing bugs)</td>
<td>Human</td>
<td><em>Trypanosoma cruzi</em></td>
<td><em>Trypanosoma</em></td>
<td>Latin American countries</td>
<td>Two disease phases: <strong>acute</strong> (fever and swelling around the site of inoculation) and <strong>chronic</strong> (20 - 30% of infected people will develop debilitating and sometimes life-threatening medical problems)</td>
<td>No</td>
</tr>
<tr>
<td>DISEASE</td>
<td>VECTOR</td>
<td>HOST/RESERVOIR</td>
<td>CAUSATIVE AGENT</td>
<td>CAUSATIVE AGENT GENUS</td>
<td>GEOGRAPHIC DISTRIBUTION</td>
<td>MAJOR DISEASE MANIFESTATION</td>
<td>VACCINE</td>
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<td>----------------------------------------------------</td>
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</tr>
<tr>
<td>Sleeping sickness</td>
<td>Tsetse flies</td>
<td>Humans</td>
<td>Trypanosoma brucei gambiense and T. b. rhodesiense</td>
<td>Trypanosoma</td>
<td>T. b. gambiense: Central Africa and in limited areas of West Africa. T. b. rhodesiense: Focal areas of eastern and southeastern Africa</td>
<td>Coma and death if untreated</td>
<td>No</td>
</tr>
<tr>
<td>(African trypanosomiasis)</td>
<td>(Glossina spp.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Domestic and wild animals (T. b. rhodesiense)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schistosomiasis</td>
<td>Water snails</td>
<td>Humans</td>
<td>Trematode worms Schistosomas spp.</td>
<td>Schistosomas</td>
<td>Tropical, subtropical regions around the world</td>
<td>Rash or itchy skin. Within 1-2 months of infection, symptoms may develop including fever, chills, cough, and muscle aches.</td>
<td>No</td>
</tr>
<tr>
<td>(bilharzia)</td>
<td></td>
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</tr>
</tbody>
</table>

Table information compiled by Sandra Martínez, MS, MT (ASCP), May 2016

1. References:
   a. www.cdc.gov
   b. CDC Travelers’ Health: Chapter 3-Infectious Diseases Related to Travel- http://wwwn.cdc.gov/travel/yellowbook/2016/table-of-contents
   c. www.who.int
VECTOR-BORNE DISEASES TEST
Por: Lcda. Sandra Martínez, MS, MT(ASCP)

Course: 20-170-65 Date: February 1, 2017

Name: ___________________________ License#: _____________________

Envíe la hoja de preguntas debidamente contestada e identificada con su nombre y número de licencia por correo a la siguiente dirección: Colegio de Tecnólogos Médicos de PR * Programa de Educación Continua * F-1 Ave. San Patricio * Guaynabo, PR 00968 ó vía fax (787)792-6627. * Para otorgar 0.2 UEC, usted debe obtener un 80% de contestaciones correctas o más.

Answers to the questions are found in the module and Table I.

I. Match each question type with one attribute:

_____ 1. Lyme disease ________________________ a) African trypanosomiasis
_____ 2. Plague ___________________________ b) Black vomit
_____ 3. Sleeping sickness ___________________________ c) Borrelia recurrentis
_____ 4. Chagas disease ___________________________ d) Erythema migrans
_____ 5. Relapsing fever (epidemic) ___________________________ e) Bubonic manifestation
_____ 6. Crimean-Congo hemorrhagic fever ___________________________ f) Powassan virus
_____ 7. Encephalitis ___________________________ g) Kissing bugs
_____ 8. Yellow fever ___________________________ h) Nairovirus

II. Choose the best answer:

1. In the acute phase of Chagas disease is characteristic a:
   - a) Erythematous cutaneous lesion
   - b) Skin ulcer at the site of the bite
   - c) Purplish swelling of the lids of one eye
   - d) Skin rash on the trunk of the body

2. Which of the following organisms is considered a bioterrorism agent?
   - a) Francisella tularensis
   - b) Plasmodium falciparum
   - c) Erlichia chaffeensis
   - d) Trypanosoma cruzi

3. The most common form of tularemia is:
   - a) Pneumonic
   - b) Oropharyngeal
   - c) Typhoida
   - d) Ulceroglandular

4. In countries outside the African continent the most prevalent malaria parasite is:
   - a) Plasmodium ovale
   - b) Plasmodium knowlesi
   - c) Plasmodium vivax
   - d) Plasmodium malariae
5. The gold standard test for malaria diagnosis is PCR.
   a) True  
   b) False

6. A blood sample was analyzed by EIA for evidence of antibodies against Lyme disease. The result was positive. The next step should be:
   a) Confirm by IFA
   b) Confirm by Western blot
   c) Confirm by PCR
   d) No further step is required.

7. The transmission cycle of the West Nile virus by the Culex mosquitoes is human-to-vector-to-human.
   a) True  
   b) False

8. A missionary has planned a trip to Liberia. This country requires a proof of yellow fever (YF) vaccination. The missionary received the vaccine on June 15. He arrived in Liberia on June 20. The entry of the missionary to Liberia was denied because the YF vaccination is valid after _______ days of vaccine administration.
   a) 6 days (June 21 is the valid date for entry)
   b) 15 days (June 30 is the valid date for entry)
   c) 20 days (July 5 is the valid date for entry)
   d) 10 days (June 25 is the valid date for entry)

9. The causative agent of Rocky Mountain spotted fever is Rickettsia rickettsii.
   a) True  
   b) False

10. Case study retrieved from:
    A 49-year-old man from Pennsylvania receives 4 units of packed red blood cells (PRBCs)
    on January 15 while undergoing hip replacement surgery. He is again hospitalized on
    February 1 with fever, hypotension, and renal failure. Peripheral blood smears show
    malaria infection. The patient has never traveled outside the United States.
    The blood donor was born in West Africa, had lived in Europe, and then returned to West
    Africa, where he had lived for approximately 20 years before immigrating to the United
    States 2 years ago.

    A. Among the modes of malaria infection below, which one is the most likely?
    a) Infection during travel overseas.
    b) Congenital malaria
    c) Infection by local Anopheles mosquito
    d) Blood transfusion