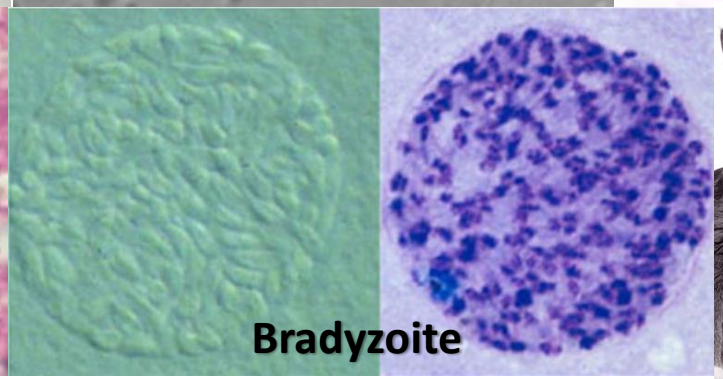
Universiti Islam Antarabangsa Sultan Abdul Halim Mu'adzam Shah

جَامِعَةُ السُّلْطَانِ عَبْدِ الْحَلِيمِ مُعَظَّمِ شَاهِ الْإِسْلَامِيَّةُ الْعَالَمِيَّةُ

Sultan Abdul Halim Mu'adzam Shah International Islamic University



Blood & Tissue Protozoa I: Sporozoa
Toxoplasma gondii

Topic Learning Outcomes

At the end of the lecture, students will be able to:

1. Define toxoplasmosis & describe their importance and distribution.
2. Name the causative species, its morphology & hosts.
3. Outline the life cycle of *Toxoplasma gondii* & identify the various stages.
4. Explain the transmission and pathogenesis and state the clinical features.
5. Explain the importance of congenital transmission of toxoplasmosis.
6. Outline the methods of diagnosis.
7. State the principle of treatment, prevention & control.
8. State some interesting facts about toxoplasmosis.

Definition

- Toxoplasmosis is an infectious disease caused by *Toxoplasma gondii*.
- It invades muscles and intestinal epithelium.
- It can be transmitted by infected animals, especially cats, often by contact with cat faeces.
- It is a zoonotic disease.

Importance

- Until recently its notoriety was in its ability to cause severe disease in a developing foetus.
- Now it is an important pathogen in immunocompromised individuals such as patients with AIDS.

Geographical Distribution

- Objectives
- Definition
- Importance
- **Distribution**
- Morphology
- Hosts
- Life Cycle
- Transmission
- Pathogenesis
  - Acute
  - Subacute
  - Chronic
- Symptoms
- Congenital
- Diagnosis
- Prevention
- Treatment
- Facts?

- Worldwide.
- Infection is highest in hot and humid climates and lower altitudes.
- Affects over 200 species of birds, reptiles and mammals.

Morphology

- Objectives
- Definition
- Importance
- Distribution
- **Morphology**
- Hosts
- Life Cycle
- Transmission
- Pathogenesis
  - Acute
  - Subacute
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- Symptoms
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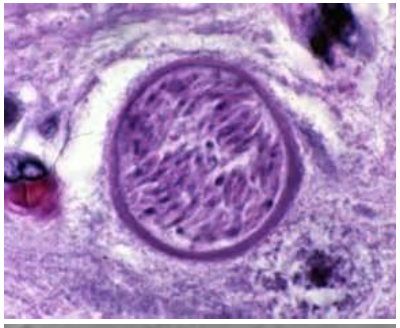
- Diagnosis
- Prevention
- Treatment
- Facts?

- *T. gondii* occurs in 4 forms:

1. Tachyzoite



2. Bradyzoite

} Asexual *schizogony*

3. Oocyst

4. Sporozoites

} Sexual *gametogony or sporogony*

Host

- Objectives
- Definition
- Importance
- Distribution
- Morphology
- **Hosts**
- Life Cycle
- Transmission
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  - Acute
  - Subacute
  - Chronic
- Symptoms
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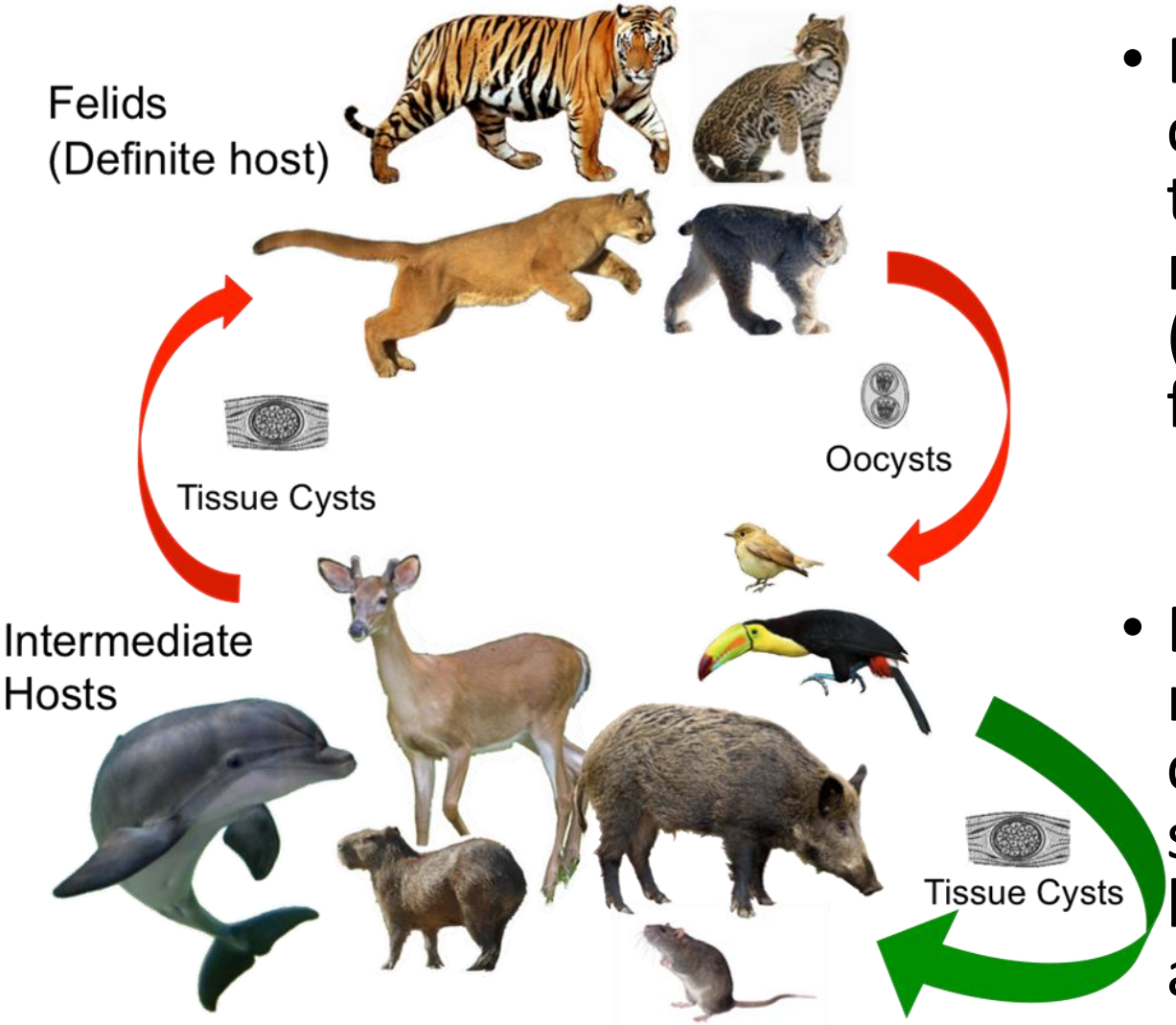
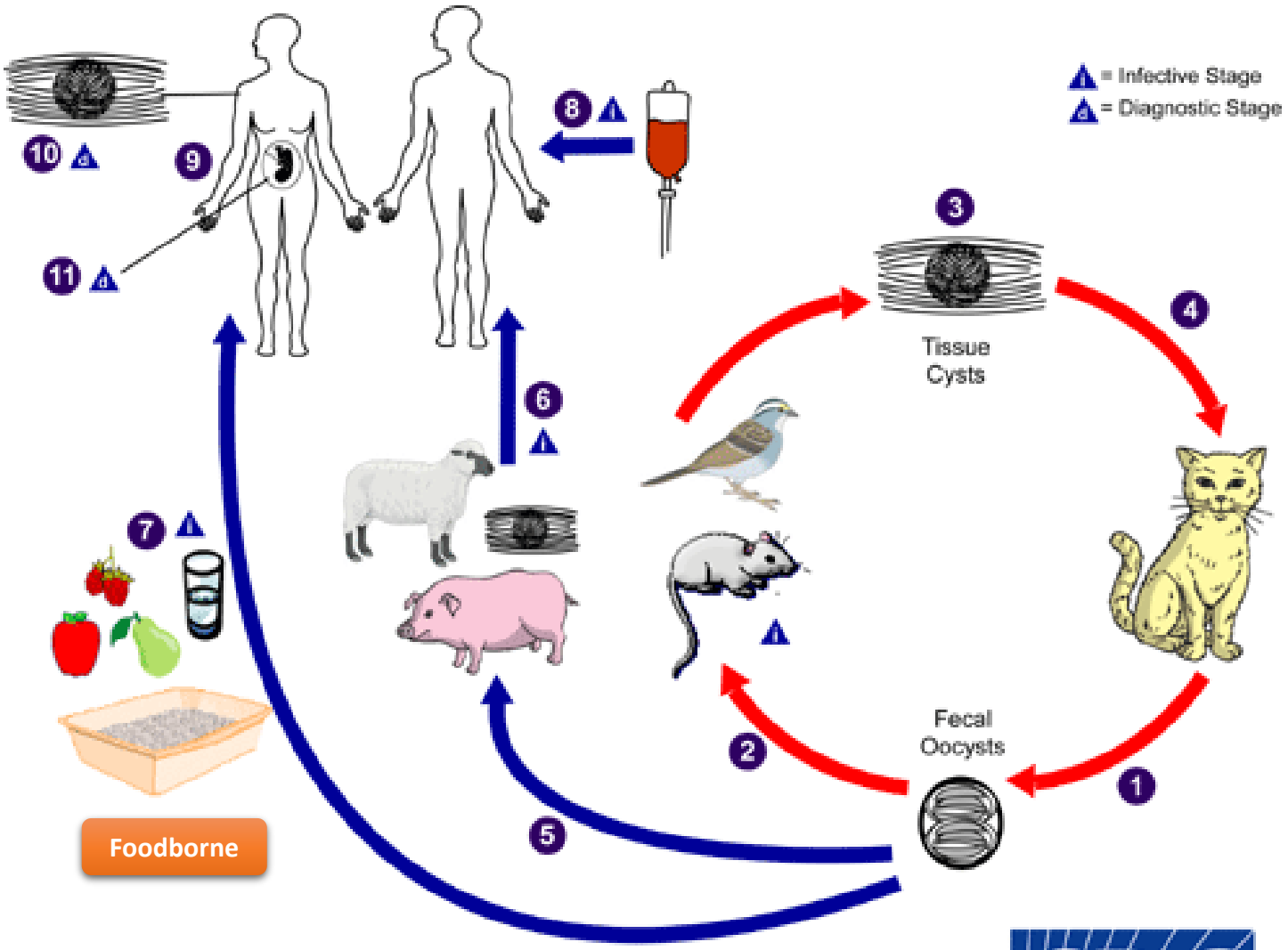
- Facts?



- Domestic cats and their relatives (Felidae family).
- Birds, rodents, cows, sheep, humans and other mammals .

Life Cycle



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http://www.dpd.cdc.gov/dpdx

Transmission

- Objectives
- Definition
- Importance
- Distribution
- Morphology
- Hosts
- Life Cycle
- **Transmission**
- Pathogenesis
  - Acute
  - Subacute
  - Chronic
- Symptoms
- Congenital
- Diagnosis
- Prevention
- Treatment
- Facts?

- Humans can become infected by:
  - Ingesting undercooked meat containing tissue cysts.
  - Ingesting food or water contaminated with cat faeces or other faeces-contaminated materials (eg, soil) or contact with a pet cat's litter.
- Rarely, human infection results from blood transfusion or organ transplantation.
- Rarely, transplacental transmission from mother to fetus occurs.

Pathogenesis

- Objectives
- Definition
- Importance
- Distribution
- Morphology
- Hosts
- Life Cycle
- Transmission
- **Pathogenesis**
  - Acute
  - Subacute
  - Chronic
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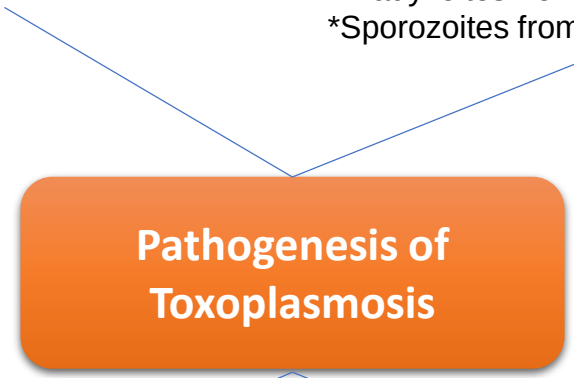
- Diagnosis
- Prevention
- Treatment
- Facts?



1. Ingestion
- ❖cysts in infected meat
- ❖oocysts in food contaminated with cat faeces

2. Penetration
intestinal epithelial cells

3. Multiplication
intestine
*Bradyzoites from tissue cyst
*Sporozoites from oocyst

4. Invasion
- ❖mesenteric lymph nodes
- ❖distant organs

through lymphatic system blood

5. Necrosis
- ❖intestinal
- ❖mesenteric lymph nodes

*caused by intracellular multiplication of tachyzoites

Pathogenesis

- Objectives
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  - Acute
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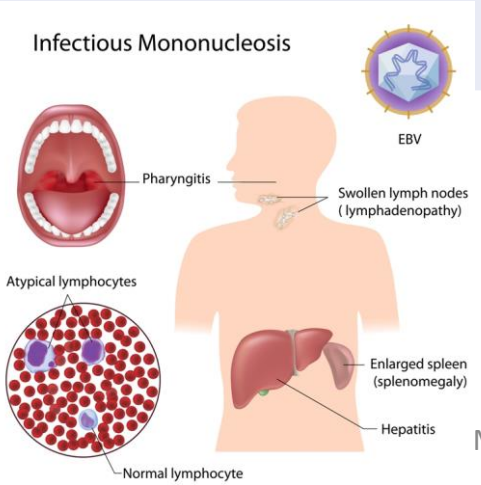
- Treatment
- Facts?

ACUTE	SUBACUTE	CHRONIC
Causes painful swollen lymph glands in the cervical, supraclavicular, and iguinal areas. In heavy acute infections the organism can be found free in the blood and peritoneal exudate.	Causes extensive lesions in the lungs, liver, heart, brain, and eyes	Occurs when the host's immune system decreases the formation of tachyzoites. Opportunistic infection in AIDS patients.
Symptoms - flu-like.		Symptoms - blindness, blind spots, paralysis and myocarditis



Symptoms

- Objectives
- Definition
- Importance
- Distribution
- Morphology
- Hosts
- Life Cycle
- Transmission
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  - Acute
  - Subacute
  - Chronic
- **Symptoms**
- Congenital
- Diagnosis
- Prevention
- Treatment
- Facts?

- The parasite remains in the body in an inactive state. It can become reactivated if the person becomes immunosuppressed.
- Immunosuppressed patients may have central nervous system disease (encephalitis).

Congenital

- Objectives
- Definition
- Importance
- Distribution
- Morphology
- Hosts
- Life Cycle
- Transmission
- Pathogenesis
  - Acute
  - Subacute
  - Chronic
- Symptoms
- **Congenital**
- Diagnosis
- Prevention
- Treatment
- Facts?

- A woman who is newly infected with *Toxoplasma* during pregnancy can pass it to her unborn child via congenital infection. The woman may not have symptoms, but there can be severe consequences for the unborn child, such as diseases of the nervous system and eyes.
- Generally if a woman has been infected before becoming pregnant, the unborn child will be protected because the mother has developed immunity. If a woman is pregnant and becomes newly infected with *Toxoplasma* during or just before pregnancy, she can pass the infection to her unborn baby. The damage to the unborn child is often more severe the earlier the transmission occurs.

Congenital

- Objectives
- Definition
- Importance
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- Morphology
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- Symptoms
- **Congenital**
- Diagnosis
- Prevention
- Treatment
- Facts?

- a miscarriage
- a stillborn child
- a child born with signs of toxoplasmosis (e.g., abnormal enlargement (hydrocephalus) or smallness of the head).
- Infants infected before birth often show no symptoms at birth but develop them later in life with potential vision loss, mental disability, and seizures.
- In the human host, the parasites form tissue cysts, most commonly in skeletal muscle, myocardium, brain, and eyes; these cysts may remain throughout the life of the host.

Diagnostic

- Objectives
- Definition
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- Congenital
- **Diagnosis**
- Prevention
- Treatment
- Facts?

- **Serologic testing** (A test that measures immunoglobulin G (IgG) is used to determine if a person has been infected).
- **Polymerase chain reaction** (PCR) also is useful to identify T. gondii DNA in CSF, amniotic fluid, infant peripheral blood, and urine to definitively establish the diagnosis.
- **ELISA**
- Direct observation of the parasite in stained tissue sections, cerebrospinal fluid (CSF), blood, or other **biopsy** material such as placenta and tissues of fetus and newborn. These techniques are used less frequently because of the difficulty of obtaining these specimens.

Prevention and Control

Action situation	Prevention measures
Cat contact	Wash hands carefully after stroking a cat Wear gloves when changing cat litter Change litter frequently and wash the tray with hot water (> 60° C) Avoid litter in the kitchen
Meals	Cook the meat well-done or stew Avoid microwave cooking for meat Avoid raw vegetables at restaurants Avoid raw shellfish Avoid raw goat milk
Preparation of meals	Wash vegetables, fruits and herbs thoroughly, especially if they grow close to the ground Wash hands, knives, any containers and table thoroughly after meat manipulation or cutting
Water	Prefer mineral water to tap water
Gardening or outdoor activities	Wash hands thoroughly and brush nails after any outdoor activities in contact with soil Wear gloves for gardening Avoid ingestion of water during recreation activities in lakes or rivers

Treatment

- Objectives
- Definition
- Importance
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- Congenital
- Diagnosis
- Prevention
- **Treatment**
- Facts?

- **Pyrimethamine (Daraprim)**

  Side effects: bone marrow suppression and liver toxicity, folic acid antagonist.
- **Sulfadiazine**: used if unborn child is infected.
- **Spiramycin**: used to treat pregnant women. Reduces risk to child. Still experimental in the U.S.

Interesting facts

- Objectives
- Definition
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- Diagnosis
- Prevention
- Treatment
- **Facts?**

1. Infections in rats and mice can lead to them losing their fear of cats and indeed being drawn to cats.
2. Infected male humans have a six fold increased risk of a traffic accident due in part to slower reaction times.
3. Prevalence is affected by climate and climate change may affect its overall prevalence.
4. Countries where raw meat is more commonly consumed have higher rates of the infection, unsurprisingly.
5. Epidemiological studies link infectious agents of *Toxoplasma gondii* to schizophrenia.

Humans are most likely to get infected with *Toxoplasma gondii* from

A. handling of an infected cat.
B. eating food contaminated with oocysts.
C. eating undercooked meat containing tissue cysts.
D. blood transfusion or organs transplant.
E. mothers by transplacental transmission.

Oocyst of Toxoplasma is found in:

A. Brain of chronic patients
B. Human faeces
C. Cat tissue
D. Cat faeces
E. Rat faeces

Which parasitic form is related to congenital toxoplasmosis?

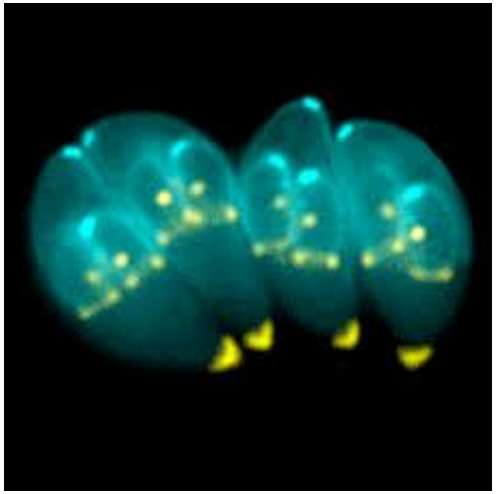
A. Tachyzoite
B. Trophozoite
C. Bradyzoite
D. Oocyst
E. Sporozoite

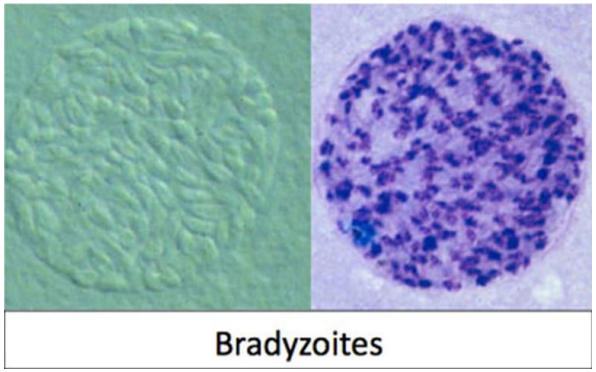
All different forms of *Toxoplasma gondii* can be present in the body of:

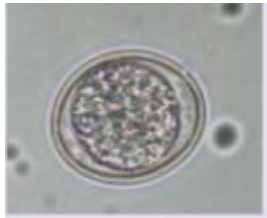
A. Human
B. Mice
C. Pigs
D. Cats
E. Dogs

Severe congenital toxoplasmosis occurs when:

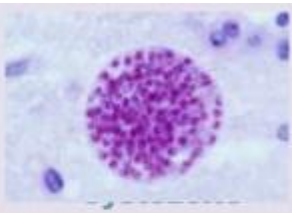
A. When women are infected long before pregnancy.
B. When women are infected just before pregnancy.
C. When women are infected long after pregnancy.
D. When women are infected just before delivery.
E. When infection occurs during delivery.

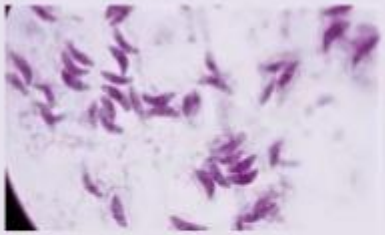


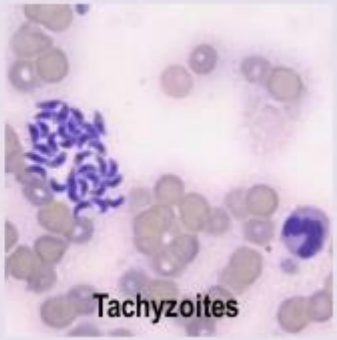


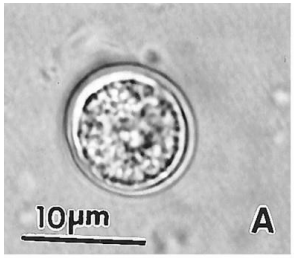

oocyst

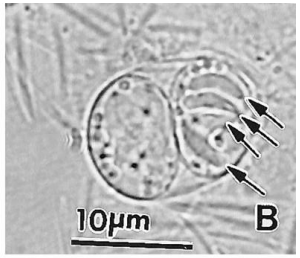

Sporulated oocyst

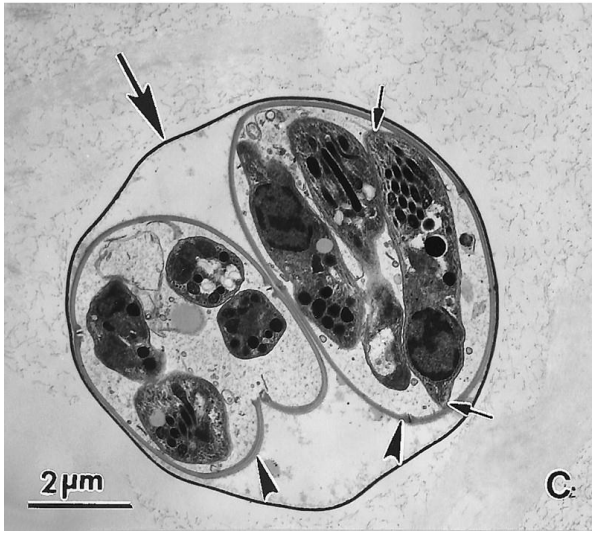

Bradyzoites within tissue cyst

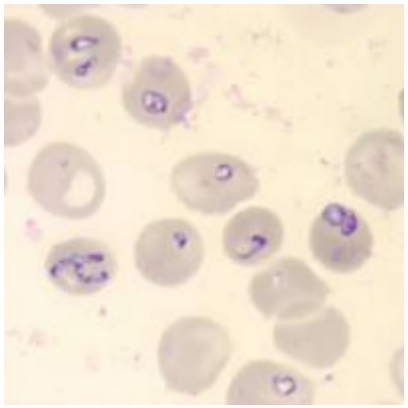
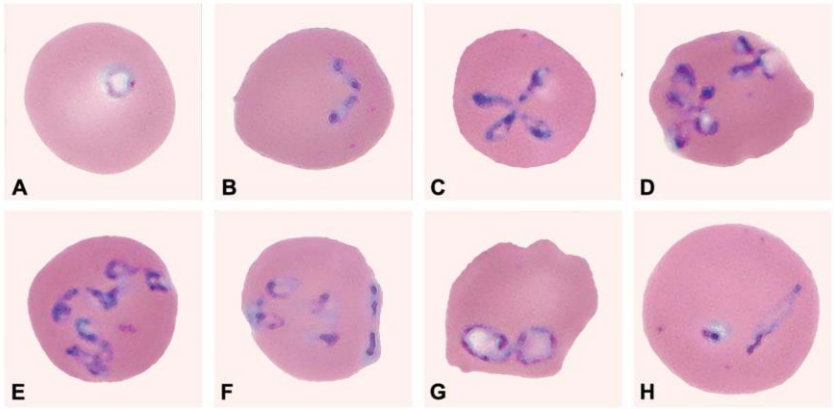

Tachyzoites









Blood & Tissue Protozoa I: Sporozoa
Babesia microfti

PPB62303 MEDICAL PARASITOLOGY 27

Definition

- Objectives
- Definition
- Morphology
- Life Cycle
- Transmission
- Epidemiology
- Pathogenesis
- Signs & Symptoms
- Diagnosis
- Treatment
- Prevention

- Babesiosis is a haemolytic disease caused by a protozoan parasite of the blood, *Babesia*.
- There are over 100 species of *Babesia* identified however only a handful of species have been documented as pathogenic in humans.
- *B. microti* and *B. divergens* are the two species to most frequently infect humans.

Life Cycle

- Objectives
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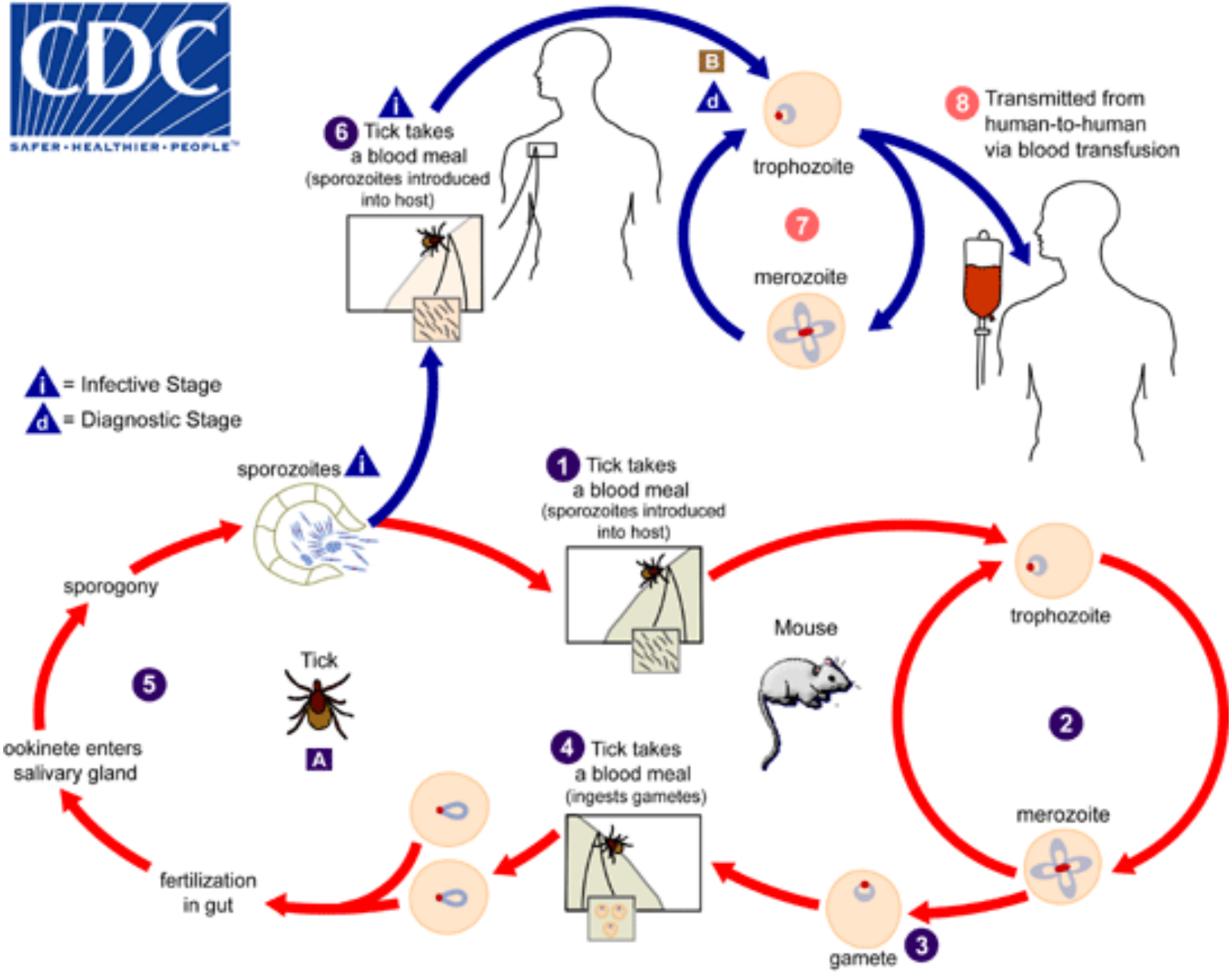

Epidemiology

- Objectives
- Definition
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- Prevention

- A widespread zoonosis, transmitted via the bite of infected hard ticks.
- Sexual reproduction takes place in ticks. Asexual reproduction takes place in a variety of mammalian hosts.
- Multiplies within red blood cells; can be confused with malaria ring forms. *Babesia* rings are more pyriform, multiplication results in pairs and tetrads resembling a “maltese cross.”
- For 25% of cases in adults and half of cases in children, the disease is asymptomatic or mild with flu-like symptoms.

Pathogenesis

- Objectives
- Definition
- Morphology
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- In cases of symptomatic infection, symptoms are characterized by irregular fevers, chills, headaches, general lethargy, pain and malaise.
- Hemolysis is common, resulting in anemia and jaundice. Severe cases progress to renal failure, hypotension, coma and death.
- The currently recommended treatment of symptomatic cases is quinine plus clindamycin

Prevention

- Objectives
- Definition
- Morphology
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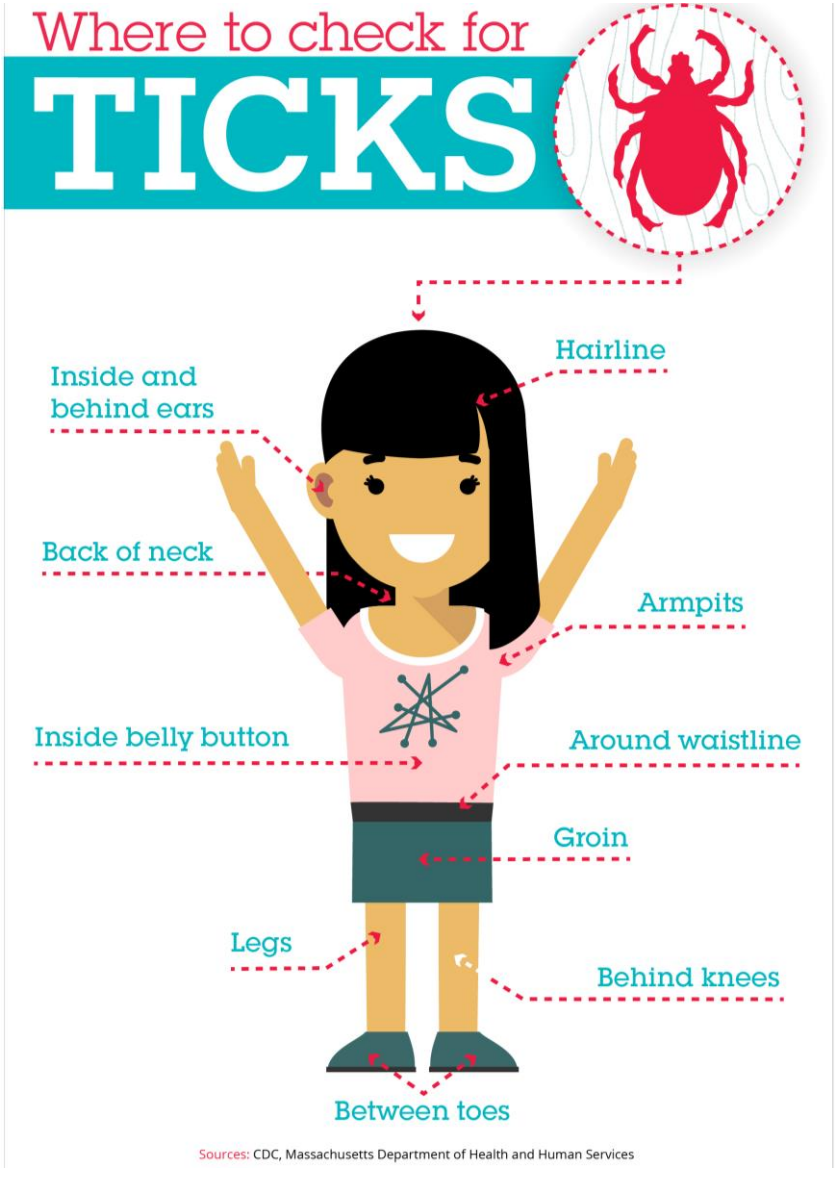
- Prevention

1. Avoidance

2. Protective Clothing

2. Insect Repellent

4. Examine body after suspected exposure



Prevention: Example

Stuffed insecticide (permethrin) treated cotton in tick control tubes. Mice will steal the treated cotton and use it as nesting material, preventing an infestation.

Treating your shoes with permethrin repellent is TickSmart and should be done every month throughout the spring and summer.

PERMETHRIN FACT SHEET

DID YOU KNOW??

WHAT IS PERMETHRIN?

- It is a stable (synthetic) form of an insecticidal compound produced by the chrysanthemum flower.
- It is commonly used to treat lice (Nix 1% shampoo) and scabies infections (5% cream).
- It biodegrades quickly in contact with soil and water.
- It is odorless and will not stain clothing.

HOW WELL DOES IT WORK?

- It has been used as a clothing treatment to prevent bites from ticks, flies, and mosquitoes since the 1970s, and used by the military since the 1990s.
- It provides a quick tick knock-down effect – both repels and kills.
- A URI study found that people wearing permethrin-treated sneakers and socks were 73.6 times less likely to have a tick bite than those wearing untreated footwear.
- Each at-home treatment lasts for roughly 3-4 weeks (with washing!).
- Commercially-treated clothes can last up to 70 washes.

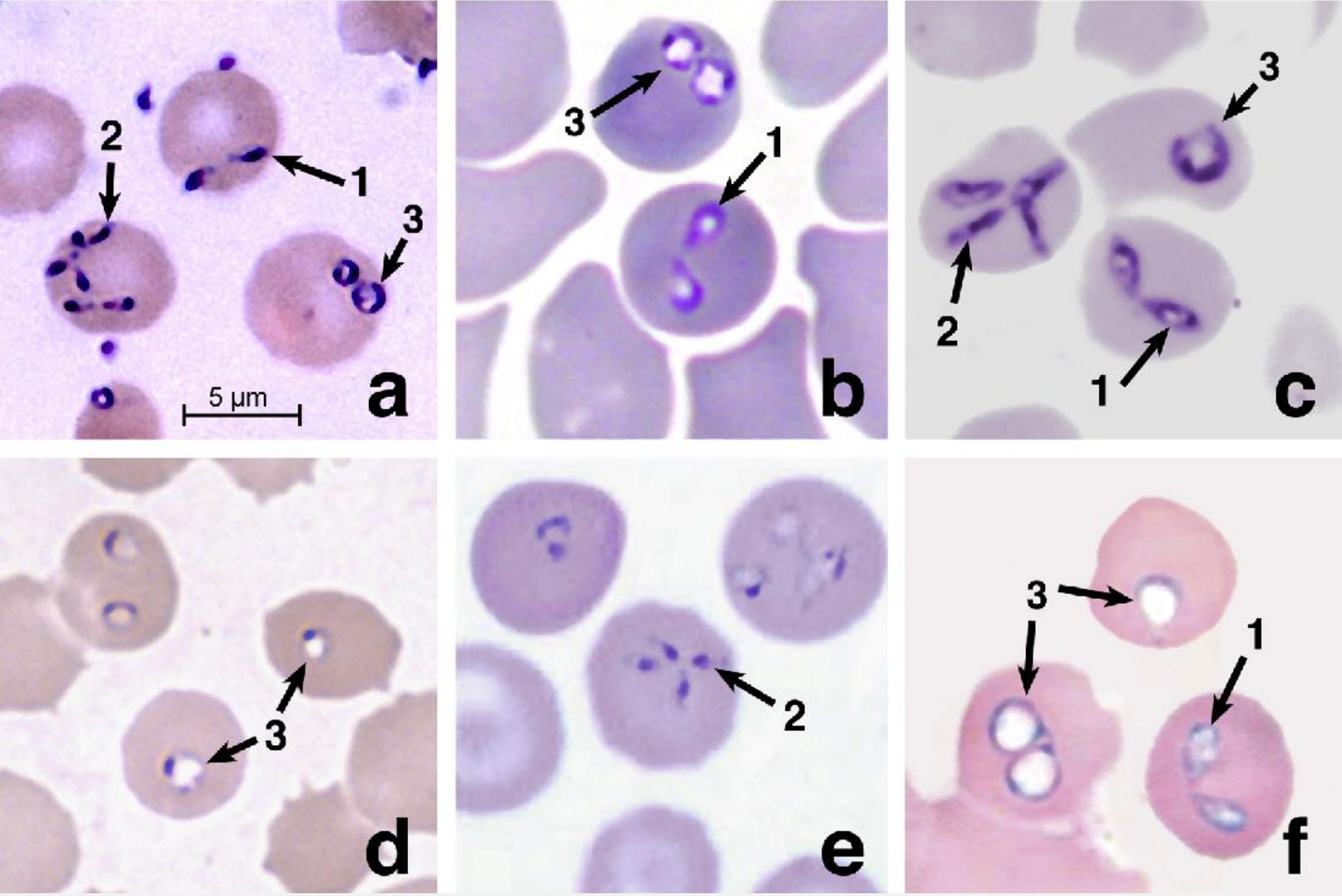
SHOULD I BE CONCERNED ABOUT USING THIS CHEMICAL?

- Permethrin is over 2,250 times more toxic to ticks than humans.
- Put directly on the skin, typically less than 1% of active ingredient is absorbed into the body; DEET can be absorbed at over 20 times that rate.
- Exposure risk of permethrin-treated clothing to toddlers is 27 times below the EPA's Level of Concern (LOC).
- A 140-pound person would have no adverse health effects if exposed to 32 grams of permethrin/day. There is less than 1 gram of permethrin in an entire bottle of clothing treatment.
- Permethrin is pregnancy category B (showing no evidence of harm to fertility or fetus).

Treating your shoes with permethrin repellent is TickSmart and should be done every month throughout the spring and summer.

Caution: Permethrin won't hurt humans or dogs but it is harmful to bees, fish, and aquatic insects – do not spray clothing near flowers or water sources. Do not allow cats near permethrin-treated clothing until it has fully dried.

Sources:
United States Environmental Protection Agency. 2006. Permethrin Facts. http://www.epa.gov/oppsrrd1/REDs/factsheets/permethrin_fs.htm
Toynton K, Luukinen B, Buhl K, Stone D. 2009. Permethrin General Fact Sheet; National Pesticide Information Center, Oregon State University Extension Services. http://npic.orst.edu/factsheets/PermGen.html
Miller NJ, Rainone EE, Dyer MC, Gonzalez ML, Mather TN. 2011. Tick bite protection with permethrin-treated summer-weight clothing. J. Med. Entomol. 48(2):327-333. http://www.tickencounter.org/pub/tick_repellent_clothing.pdf



Babesia parasites in human erythrocytes. (a) *B. divergens*, (b) *B. venatorum*, (c) *Babesia* sp. MO1 from Kentucky, (d) *B. microti*, (e) *B. duncani*, (f) *Babesia* sp. KO1 from