




## Ticks and Tick-borne Diseases; A New Emerging global One Health Threat

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## Outline and Goals of Presentation

- Be aware of climate change impact on Tick and Tick-Borne Diseases (TBDs)
- Be able to recognize different ticks of animal and public health concern
- Be aware of TBDs epidemiology and distribution
- Recognize basic signs and symptoms of TBDs in animals
- Recognize basic signs and symptoms of TBDs in human
- Identify common diagnostic and treatment strategies
- Know when and where TBDs risk is highest
- Be aware of prevention and control methods of Tick and TBDs

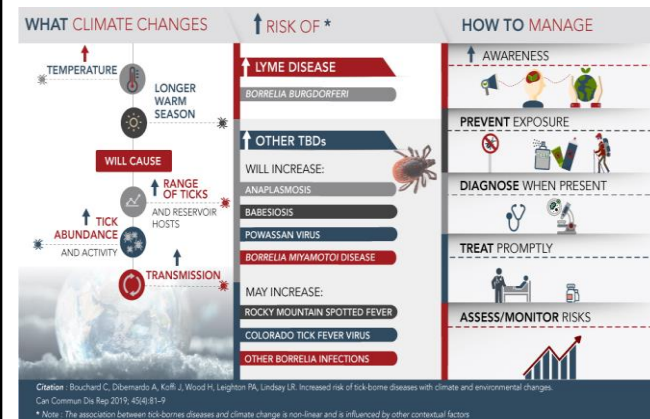
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## How can Climate Change affect Tick and TBDs?

- Climate and other environmental changes increase the prevalence, activity and range of ticks and TBDs.
  - As temperatures increase, the environment becomes more suitable for ticks and the season suitable for tick activity lengthens, so TBDs are likely to become more common.
- Increase in number, activity and range of ticks:** Rising temperature led to improved conditions for survival and reproduction of ticks and faster development leading to an acceleration of the tick lifecycle which cause:
- Increase tick abundance
  - Enable tick populations to spread to higher latitudes
  - Increase tick activity and questing behavior resulting in longer seasonal activity
- Increase in number, activity and range of hosts:** Increasing temperatures will expand the distribution range of reproduction hosts (e.g., deer) and the reservoir hosts (e.g., rodents) hosts involved in the tick lifecycle and spread of TBDs.
- Increase in human exposure to ticks:** people outdoor activity starts earlier in spring and maintain longer in the fall. With increase in length of exposure to tick habitat, combined with an extended season of tick activity, there is an increased likelihood of tick exposure.

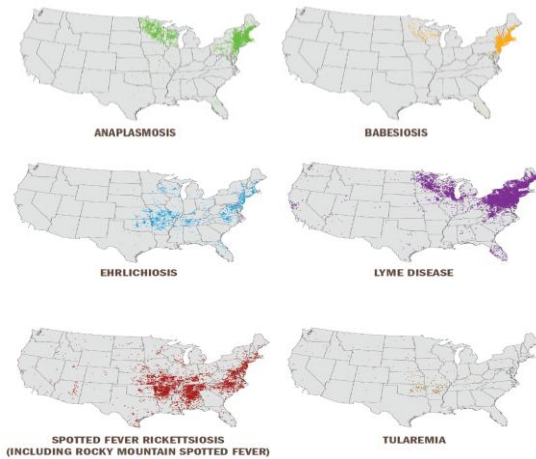
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## Impact of Climate Change on Tick-Borne Diseases



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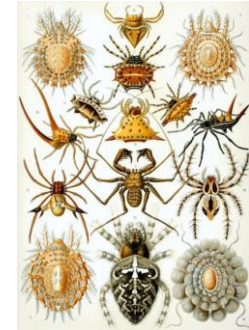
## Distribution of Tick-Borne Diseases IN USA



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## Ticks

- Class Arachnida
  - closely related to mites
- obligate blood-feeding ectoparasites
  - vectors



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## Ticks of Veterinary Importance

### Ixodidae (Hard Tick)

- sclerotized dorsal shield
  - “hard ticks”
- sexually dimorphic
  - females larger
  - male scutum covers dorsum



### Argasidae (Soft Tick)

- unsclerotized
  - “soft ticks” - *fowl tick*
- little sexual dimorphism



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## Ticks of Veterinary Importance

### Ixodidae (Hard Tick)

- primarily off host
  - “sit-and-wait”
- mate on host
- require days to complete engorgement
- live outdoors



### Argasidae (Soft Tick)

- live in close proximity to host
- mate off host
- require mins - hrs to feed and feed repeatedly
- live in dwelling/sleeping places of hosts



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**Differences in Life Cycle (1)**

	<b><u>hard ticks</u></b>	<b><u>soft ticks</u></b>
<b>L.C.</b>	O->L->N->A	O->L->N1->N2 ->N3->A
<b>Habitat</b>	Free range spp. Attack host in the day	Burrow inhabiting spp. nocturnal feeder
<b>Nymph</b>	1 instar	Several (5-7) instars
<b>Adult feeding</b>	1 blood meal	Intermittent feeders (5-12 or more)

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**Differences in Life Cycle (2)**

	<b><u>hard ticks</u></b>	<b><u>soft ticks</u></b>
<b>Hosts</b>	1-3 hosts	More than 10 hosts
<b>Egg laying</b>	Thousands / single batch	Less than thousand in several batches
<b>Life span</b>	2 months – 3 years	Long duration (as long as 16 years)

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**Family:- Argasidae*****Argus persicus***: fowl tick/blue bug.***Otobius mengnini***: spinose ear tick.***Ornithodoros moubata***: eyeless tampan of Africa.

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**Family:- Ixodidae*****Ixodes ricinus***: castor been tick***Boophilus microplus***: the topical cattle tick***Boophilus decoloratus***: blue tick***Rhipicephalus sanguineus***: brown dog tick***Rhipicephalus evertsi***: red legged tick***Haemaphysalis leachi leachi***: yellow dog tick

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## Connecting to a Host?

- Ticks feed by perching in low vegetation and waiting for a mammal to walk by
- Ticks use chemical stimuli, airborne vibrations, and body temperatures to locate mammals



Photo Credit: Local Public Health Institute of Massachusetts  
<http://www.masslocalinstitute.org>

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## Ticks as Disease Vectors

*transmit a greater variety of pathogenic micro-organisms than any other arthropod vector group*

- Bacteria/virus/protozoa in saliva of tick
  - Injected during a blood meal

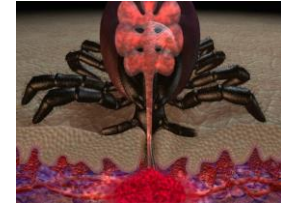


Photo Credit: Lyme Disease Action  
<http://www.lymediseaseaction.org.uk/about-ticks/tick-animation/>

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## Ticks as Disease Vectors

- Hypostoma attaches to the host's skin using hooks



Photo by Larisa Vredevoe, UC Davis



Picture from (Parola, 2001)

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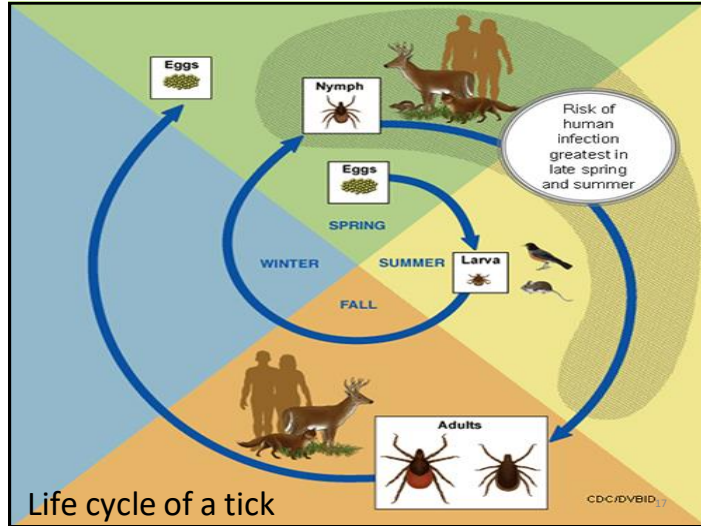
## Ticks as Disease Vectors

Substances secreted into skin

- ❖ **Cementing substance**
  - Glues the hypostoma in place
- ❖ **Immunosuppressive, Anti-inflammatory chemicals**
  - Helps the tick go unnoticed by the host
- ❖ **Anticoagulant**
  - Allows blood to go where it needs to go in the body

All help the pathogen to establish a foothold in the host

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### Tick Appearance & Size Comparison

This section compares the sizes of three common ticks:
 

- Blacklegged Tick (*Ixodes scapularis*):** Shown in adult female, adult male, nymph, and larva stages. Size is approximately 1/4 to 1/2 inch.
- Lone Star Tick (*Amblyomma americanum*):** Shown in adult and nymph stages. Size is approximately 1/4 to 1/2 inch.
- Dog Tick (*Dermacentor variabilis*):** Shown in adult and nymph stages. Size is approximately 1/4 to 1/2 inch.

 A vertical scale on the left shows 1 inch and 2 inches. A dime coin is used for size comparison. A photograph on the right shows three ticks on a human hand. Source: California Department of Public Health.

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### Nymph Ticks

A close-up photograph of a human hand with a tiny nymph tick on the skin. A red text overlay reads: "It is Spring time and TICKS are hatching... this is the size of tick you have to watch out for!". At the bottom, it says: "For more important information, please go to [www.cdc.gov](http://www.cdc.gov)".

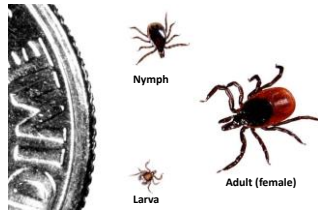
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### Ticks of Public Health Concern

		<b>Blacklegged (Deer) Tick</b> <ul style="list-style-type: none"> <li>▪ Lyme disease</li> <li>▪ Anaplasmosis</li> <li>▪ Babesiosis</li> <li>▪ Ehrlichiosis</li> <li>▪ Powassan virus</li> <li>▪ Relapsing fever</li> </ul>
		<b>American Dog (Wood) Tick</b> <ul style="list-style-type: none"> <li>▪ Spotted Fever</li> <li>▪ Group bacteria</li> <li>▪ Tularemia</li> </ul>
		<b>Lone Star Tick</b> <ul style="list-style-type: none"> <li>▪ Ehrlichiosis</li> <li>▪ Tularemia</li> </ul>

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### Blacklegged Tick Life Stages



Engorged Adult Female Blacklegged Tick



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### Blacklegged Tick Questing

- Searches for a host from the tips of low-lying vegetation.
- Sense body chemicals and other cues from potential hosts, like heat, moisture, and vibrations.
- Climbs onto a person or animal near ground level and then finds a place to attach.



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### Blacklegged Ticks Do NOT...

- Jump
- Fly Or Glide Through The Air
- See
- Fall From Treetops or High Branches



Blacklegged Tick Habitat



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### Engorged Deer Tick

- Risk of infection may be high for a partly or fully engorged tick:
  - 30% for a nymphal tick
  - 60% for an adult tick



[www.path.sunyb.edu/labs/ticpics](http://www.path.sunyb.edu/labs/ticpics)



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## Sites of Ticks on animals



Picture credits: UC Davis Veterinary School (top) and [http://www.agric.wa.gov.au/PC\\_93608.html](http://www.agric.wa.gov.au/PC_93608.html) (bottom)

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## Laying Eggs



Eggs can be infected with pathogens inside the ovaries making the new tick infectious upon birth.

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## Tick Pathogenesis

- Anemia
- Dermatitis
  - inflammation, swelling, itching, ulceration from tick's saliva and mouthparts
- Paralysis
  - neurotoxin present in saliva of some species
- Tick toxicosis.
- Vector-borne diseases
  - viral, bacterial, and protozoal



*Dermacentor* sp.

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## Tick-borne Viral Diseases

- Colorado tick fever
  - rodents → *Dermacentor* → human
- tick-borne encephalitis
  - humans, cattle, horses, dogs
- African swine fever
  - wild suids → *Ornithodoros* → pig



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## Tick-borne Rickettsial Diseases

### *Rickettsia rickettsii*

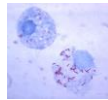
- Rocky Mountain spotted fever (RMSF)  
rabbits, rodents → *Dermacentor* → dogs, humans

### ➤ Anaplasma sp.

- Bovine anaplasmosis: cattle → *Dermacentor*
- Canine anaplasmosis: rodents, ruminants, dogs → Ixodes

### ➤ Ehrlichia sp.

- Canine ehrlichiosis: dogs, white-tail deer → *Rhipicephalus*



obligate intracellular parasites

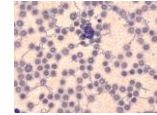
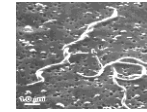
- ☐ *Coxiella burnetii*...no longer grouped with Rickettsia
- Q fever

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## Tick-borne Bacterial Diseases

### ❖ *Borrelia sp.*

- Lyme disease
- Bovine Borreliosis
- Avian Spirochetosis

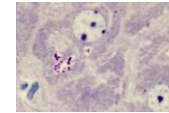


### ❖ *Mycoplasma haemocanis*

- Canine hemoplasmosis: dogs → *Rhipicephalus*

### ❖ *Francisella tularensis*

- Tularemia  
Rabbits → various ticks → humans, dogs

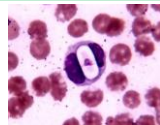


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## Tick-borne Protozoal Diseases

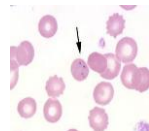
### • *Hepatozoon canis*

- Rhipicephalus* → dog



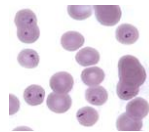
### • *Babesia sp.*

- Bovine, Canine, Feline Babesiosis, Equine Piroplasmosis
- *Rhipicephalus*



### • *Cytauxzoon felis*

- wild felids → *Dermacentor* → cats



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## Hepatozoonosis

- Etiologic agent:
  - *Hepatozoon canis*...an intracellular parasite in various tissues
  - transmitted via ingestion of infected tick (*Rhipicephalus sanguineus*)

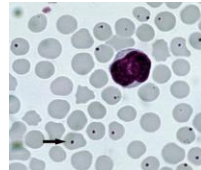
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## Anaplasmosis

Incubation Period: 1–2 weeks

Etiology:

- A. Pathogenic
  - A. Marginal: affects mammals
  - A. phagocytophilum: affects human and mammals
- B. Non-pathogenic
  - A. central: affects mammals

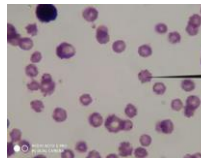


Susceptibility:

Anaplasmosis can infect multiple mammal species but is not directly transmittable between animals, including, but not limited to dogs, cats, horses, cows, sheep, goats and humans

Signs and Symptoms:

- Fever, shaking, chills
- Severe headache
- Malaise
- Myalgia
- Gastrointestinal symptoms (nausea, vomiting, diarrhea, anorexia)
- Cough



Laboratory Confirmation:

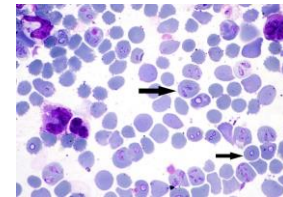
- Detection of DNA by PCR. This method is most sensitive tool.
- Indirect immunofluorescence antibody (IFA) assay in serum samples.

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## CANINE BABESIOSIS

- *Babesia canis* and *Babesia gibsoni* are known to cause disease conditions in dogs.

• A tick carrying *B. canis* sporozoites attaches to a dog, and feeds on its blood, releasing many sporozoites into the dog's bloodstream. Each sporozoite attaches to a red blood cell, and moves inside the cell. This transmission requires 2-3 days.



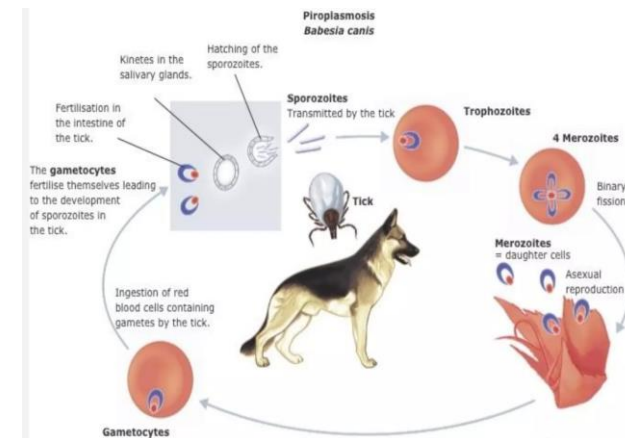
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## TRANSMISSION

- Arthropod vectors (ticks): *Rhipicephalus sanguineus*, *Haemophysalis bispinosa*, *Haemophysalis longicornis*.
- Transplacental: *Babesia gibsoni* has been detected in three day old puppies (Douglass, K.M., 2003)
- Direct blood contamination
- Formites: Needle- sharing and re-use of surgical instruments for tail-docking and ear cropping.
- Dog fighting, e.g. Pitbull breed

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## Life Cycle



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## CLINICAL SIGNS

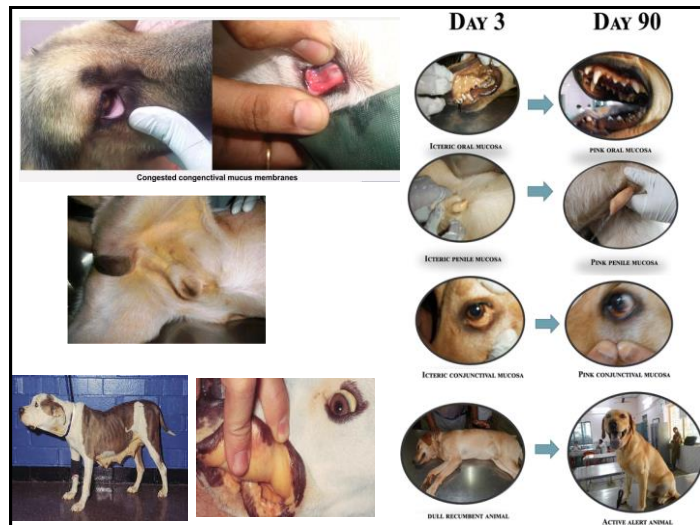
- Incubation period: 10-24 days subclinically
- The disease has been classified into various ways.
- Disease due to *B.canis rossi* infection manifests in uncomplicated and complicated forms.
- Uncomplicated form: Anorexia lethargy, fever, pale mucous membranes, water-hammer pulse and splenomegaly.

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## CLINICAL SIGNS (cont'd)

- Complicated form: May be due to concurrent infection with *Ehrlichia canis*
- Or due to systemic inflammatory response syndromes (SIRS) that frequently develops into severe illness
- SIRS may occur alone but frequently associated with single or multiple organ damage or dysfunction.
- Complication by organ dysfunction:
  - Acute renal failure, hepatopahty , haemo-concentration , immune mediated hemolytic anaemia, pulmonary oedema/acute respiratory syndrome, or cerebral involvement

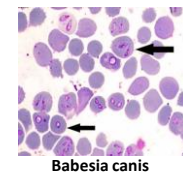
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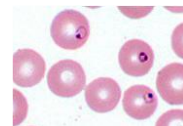
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## DIAGNOSIS

- **Microscopic examination:** Thin blood smear stain with Giemsa for parasites identification
- **Blood analysis and CBC:** Thrombocytopenia, Macrocyticanemia and Autoagglutination
- **Serum biochemistry profile:** hyperglobulinemia, hyperbilirubinemia, increased liver enzyme, and hypoalbuminemia.
- **Urinalysis:** bilirubinuria, hemoglobinuria, and proteinuria
- **PCR:** Most current and accurate tool for identification of parasites DNA



Babesia canis



Babesia gibsoni

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## DIFFERENTIAL DIAGNOSIS

- Trypanosomosis
- Ehrlichiosis
- Leptospirosis
- Haemobartonellosis
- Autoimmune haemolytic anaemia

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## TREATMENT

- Diaminazine acetate 7% soln 3.5mg/kg
- Midocarp 6.6 mg/kg
- Oxytetracycline 5% 10mg/kg
- Haematinics eg. Vitamin B-complex
- Blood and fluid transfusion in severe cases

## PREVENTION AND CONTROL

- Vaccination
- Active tick control
- Good hygienic practice

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## Tick control

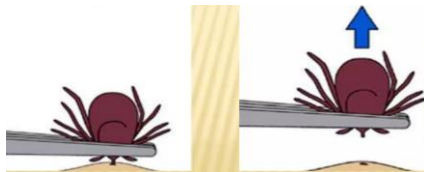
### Tick removal:-



Pull straight upward, slowly and steadily, do not tug or twist.



Avoid rupturing the tick body Wash and disinfect bite area



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## Treatment

### Carbaryl :-

- powder 5% as dust
- Liquid 10% is used as spray.

### Ivermectin :-

- 1% is given S/C.
- Bolus/tablet 0.2mg/kg bw
- 0.5% used as pour-on



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### Doramectin :-

- 1% is given SC
- 0.2mg/kg b.w



Shampoo like ketochlore  
Or frontline plus can be  
used for bathing of dog.

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- Use of tick repellent on the coat of animal.



Daily grooming of animal can  
reduce the infestation.



Anti tick bath can be used

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### Tick control in environment

- Maintenance of cleanliness where animals are kept.
- Removing of cracks and crevices at the farm or place where animal are kept.
- Insecticides: Negative impact on environment



- Amitraz 12.5% (spray)
- Deltamethrin 1.2% (spray)



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### Tick borne Diseases in Human (Lyme Disease)

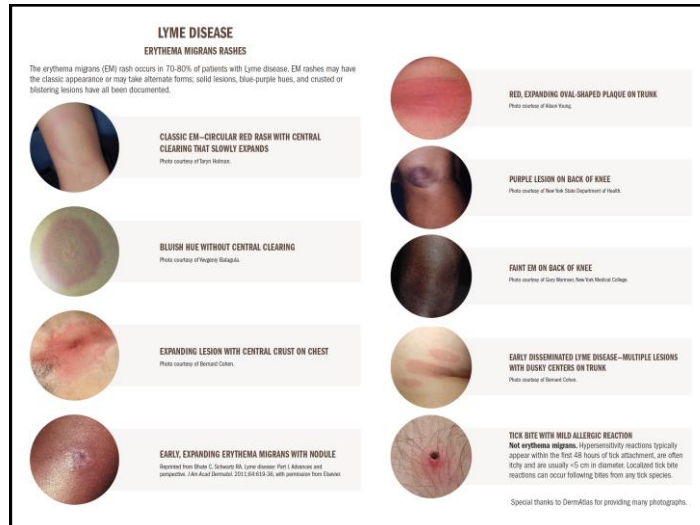


#### STAGE 1 (early localized Lyme disease)

- Occurs 1 – 30 days post tick bite
- Erythema migrans: occurs in 2/3 of patients with LD; develops on average 7 days after bite at or near site of bite; may be bull's eye rash or uniform color in appearance; untreated may persist for 2-3 weeks.
- Flu-like symptoms: occurs within days to one week; low grade fever, fatigue, myalgia, arthralgia, headache, neck stiffness; may resolve spontaneously.



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**STAGE 2 (early disseminated LD)**

- develops 2-10 weeks after inoculation
  - Approximately 25% of patients infected with *B. burgdorferi* have signs and symptoms of disseminated disease at presentation.
- ❑ **Musculoskeletal:**
- intermittent inflammatory arthritis involving knee, ankle, wrist;
  - occurs within 6 months of erythema migrans lesion;
  - untreated episodes last approximately 1 week;
  - recurrences involving > one joint may occur every few months;
  - recurrent episodes usually lessen in severity and usually resolve over 10-year period.
- ❑ **Neurologic:** reported in 5-20% of cases;
- clinical facial neuropathy (Bell palsy) in 3% of cases;
  - meningitis (headache – waxes and wanes; mild to severe; neck pain or stiffness);
  - photophobia
- ❑ **Cardiac:** palpitations, chest pain, or shortness of breath.
- ❑ **Cutaneous:** multiple erythema migrans lesions – small papules (1-5 cm) and oval-shaped.

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**STAGE 3 (late or chronic Lyme disease)**

- Occurs months to years after initial infection; may occur after a period of latency.
- Most patients do not have a history of erythema migrans lesion; important to check history of Bell palsy, aseptic meningitis, arthritis, peripheral neuropathy, cognitive dysfunction.
- **Rheumatologic:** Hallmark of Stage 3 involves large joints (knee involved 90% of time); arthritis must be differentiated from early presenting arthralgia.
- **Neurologic:** Both central and peripheral nervous systems: subacute encephalopathy, chronic, progressive encephalopathies, late axonal neuropathies, fibromyalgia symptoms, radicular pain from acute disc disease.
- **Cardiac:** Conduction abnormalities; myocarditis, pericarditis
- **Neuropsychiatric:** Decreased concentration and short-term memory loss; anxiety; depression; sleep disorders; irritability.

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## Prevention of Tick-borne Diseases in Human

- Avoid tick-infested areas
- Wear light colored clothing
- Tuck pant legs into socks and boots
- Wear long-sleeved shirts that are buttoned at the wrists
- Use DEET
  - ≤50% for Adults
  - ≤30% for Children under 12
- Use permethrin-based mosquito and tick repellent (on clothing only)



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## Prevention of Tick-borne Diseases

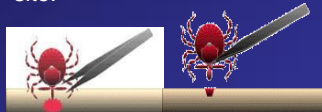
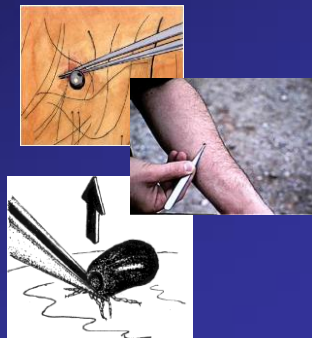
- When hiking or walking, minimize contact with vegetation
- Walk within the center of mowed trails
- Perform a tick-check on yourself, your children and pets
- Use full-length mirror to check yourself
- Remove, wash and dry clothing
- Sooner you remove the ticks, the better




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## Prevention of Tick-borne Diseases: Tick Removal

- Use sharp-tipped tweezers or forceps
- Remove tick by grasping it as close to the skin as possible. Pull it straight out, slowly and steadily.
- After tick is removed, wash your hands with soap and water. Apply antiseptic to bite site.



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# Questions?

## Thank You

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