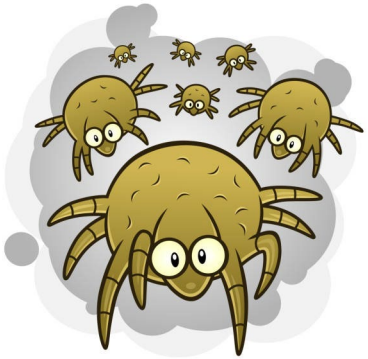


MEDICAL AND VETERINARY ENTOMOLOGY

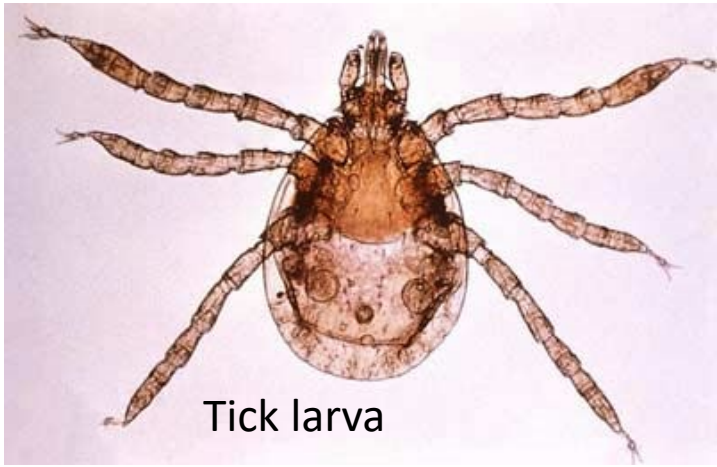
ACARI

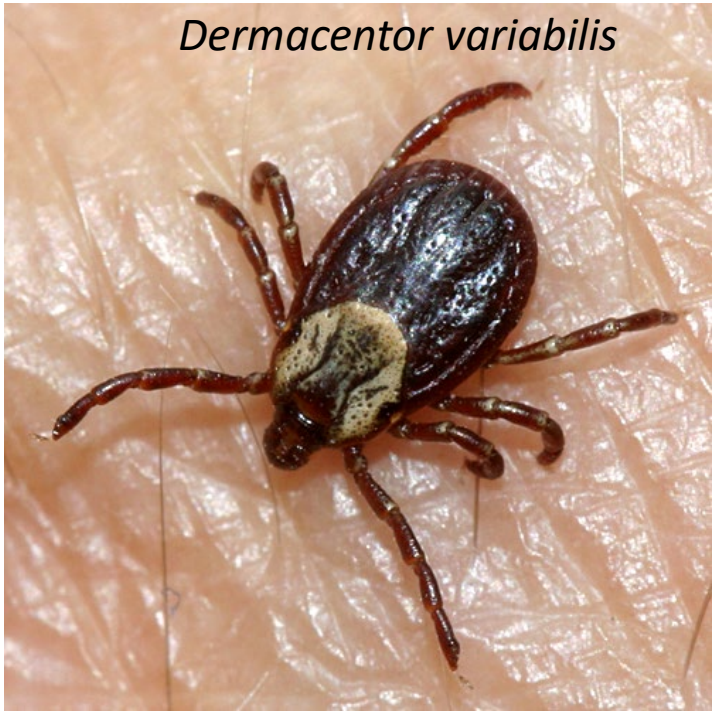
Assoc. Prof. Marija Ivković

marija.ivkovic@biol.pmf.hr

Medically significant Arthropoda - Acari

- Class Arachnida – Subclass Acari (Acarida, Acarina)
  - About 40,000 species (about 39,000 types of mites)
  - Most species are smaller than < 1 mm, first larval stage with 6 legs
  - Worldwide distribution in different ecological habitats
  - Ticks are usually larger than mites and are of higher medical importance


Tick larva


Dermacentor variabilis

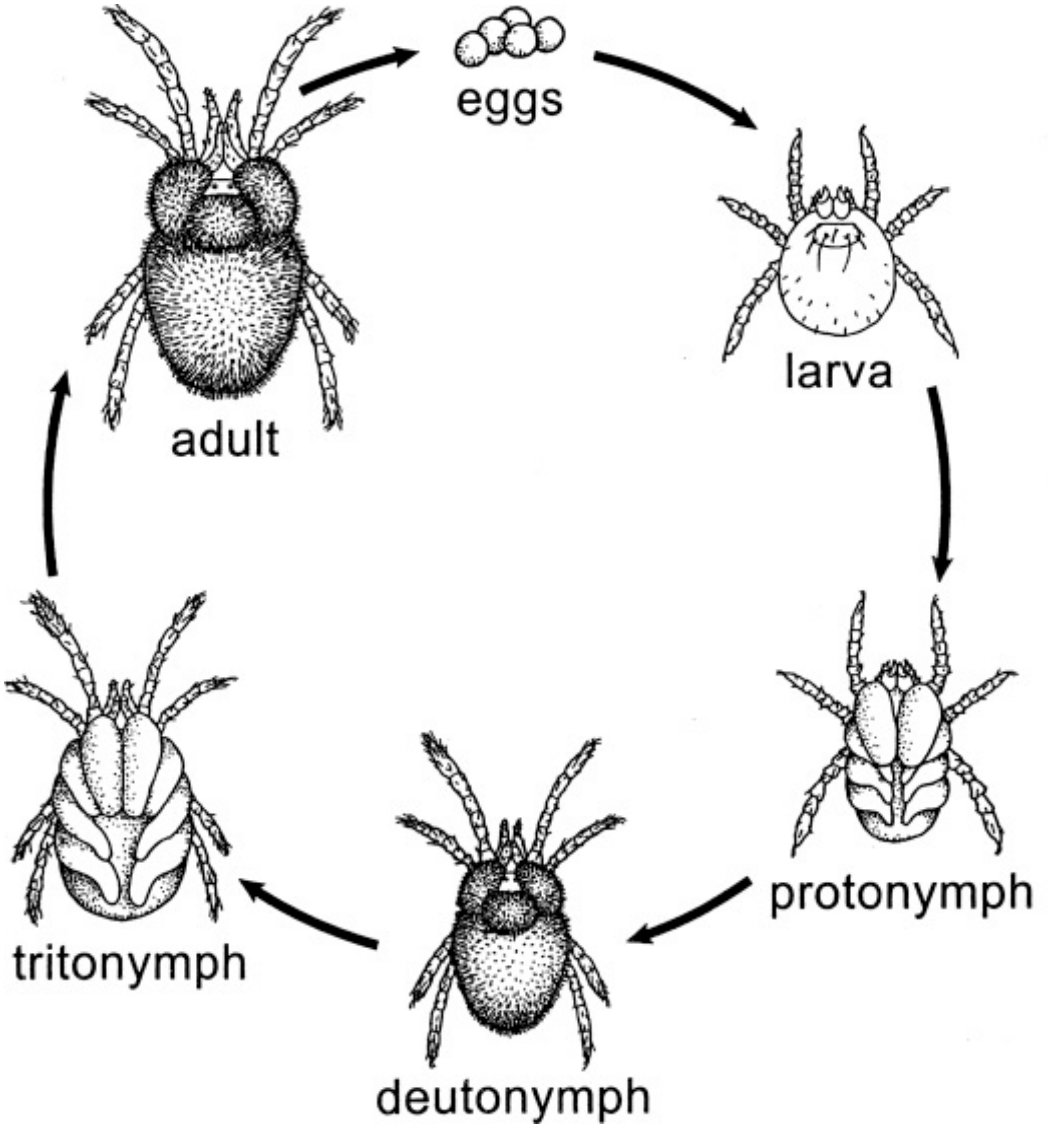

Dermatophagoides


Trombiculidae

Mullen et al. 2019

Medically significant Arthropoda - Acari

- Class Arachnida – Subclass Acari – Mites
- Life cycle includes eggs, larva, protonymph, deutonymph, tritonymph and adult
  - Problems caused by mites: Dermatitis, respiratory allergies, internal acariasis, mites as disease carriers, acarophobia and delusional parasitosis

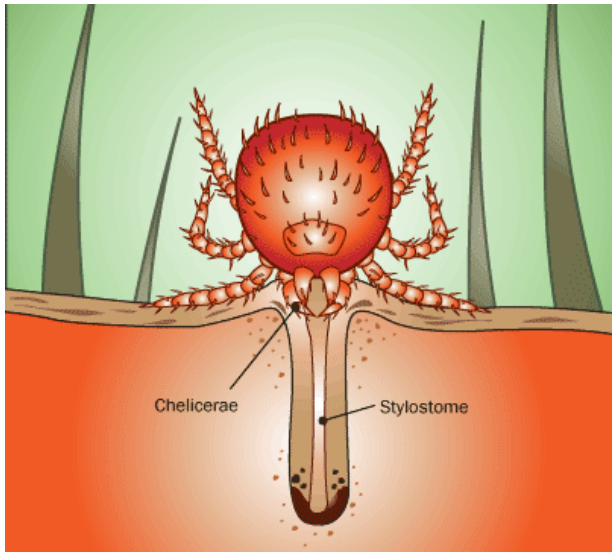


Mullen et al. 2019

Medically significant Arthropoda - Acari

- Class Arachnida – Subclass Acari – Mites
- More than 250 species cause health problems
- Most medical cases are related to respiratory allergies and dermatitis, they are not an important disease vector (except for scrub typhus in Asia).
- Different life stages feed on different things
- People are often bitten by mites that normally live on other hosts

Dermatophagoides

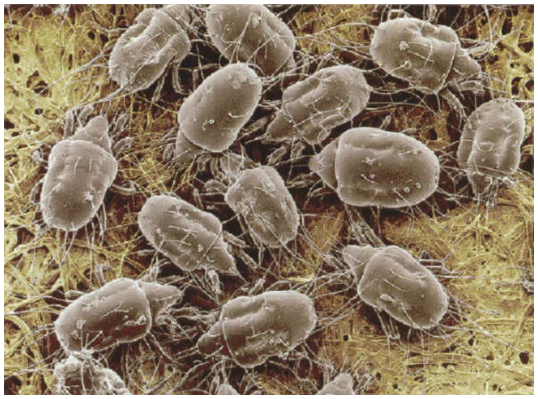


Mullen et al. 2019

Medically significant Arthropoda - Acari

- Class Arachnida – Subclass Acari – Mites – Allergies caused by mites
  - Dust mites present in our homes
  - Many species present in house dust, in Europe the most common mites from the genus *Dermatophagoides* spp., and each species has its own specific antigens
  - House mites feed on fungi, skin scraps, food scraps, etc.
  - Much more often present in damp homes and especially in carpets, mattresses, pillows, etc.
  - Up to 5000 dust mites/g of mattress dust...

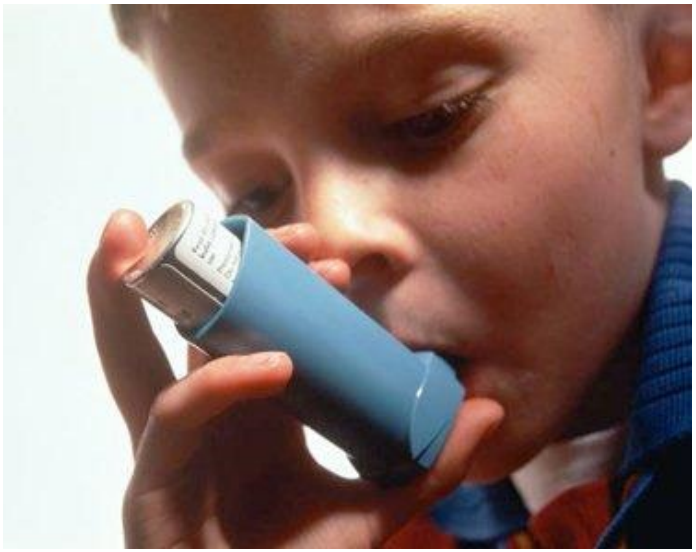
Dermatophagoides



Mullen et al. 2019

Medically significant Arthropoda - Acari

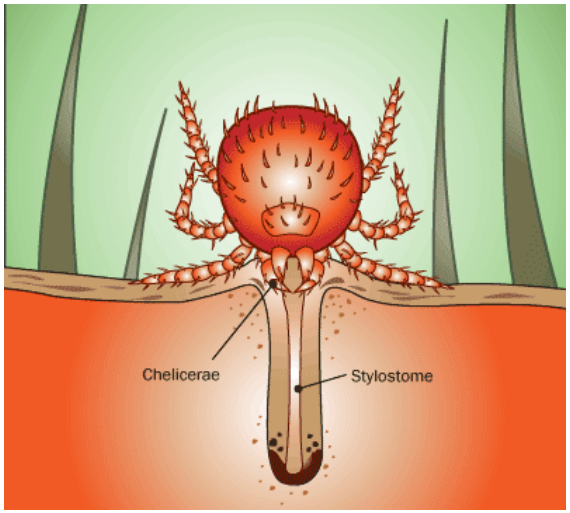
- Class Arachnida – Subclass Acari – Mites – Allergies caused by mites
  - Dust mites, their feces and discarded cuticles during shading of outer cuticle are important allergens and can cause asthma attacks, conjunctivitis, eczema,...
  - Symptoms are often seasonal in allergic people and follow fluctuations in the mite population
  - Cleaning, vacuuming, airing and reducing humidity can significantly reduce the mite population



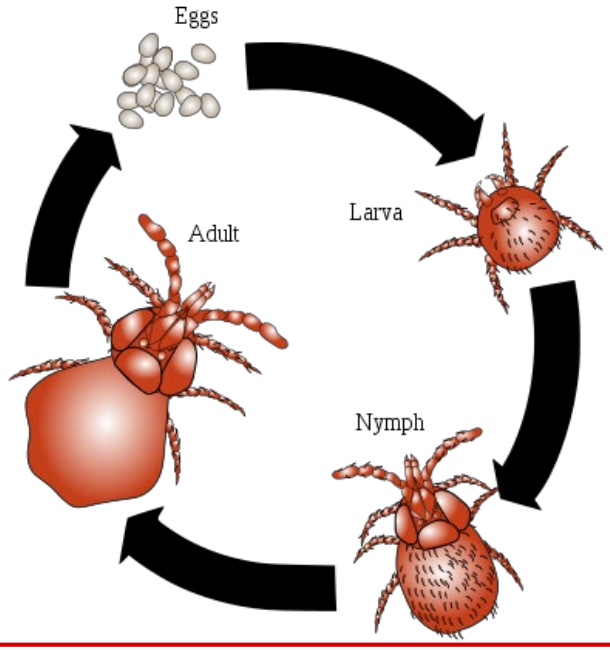
Mullen et al. 2019

Medically significant Arthropoda - Acari

- Class Arachnida – Subclass Acari – Trombiculidae – chiggers
- Larvae of about 50 species will bite humans, while nymphs and adults are predators
- Present in outdoor environments, lawns, gardens, meadows, especially in late summer and autumn
- They are attached to the skin where the clothes is in close vicinity to skin
- They inject saliva that dissolves the skin cells that the larva feeds on
- Bites usually cause rapid inflammatory responses of the body that kill the mite itself



Neotrombicular autumnalis



Mullen et al. 2019

Medically significant Arthropoda - Acari

- Class Arachnida – Subclass Acari – Trombiculidae – chiggers
- In Europe, the most common and important species *Neotrombicular autumnalis*, the larvae most often attack rodents, dogs and cats, but can also attack humans

Neotrombicular autumnalis

Trombicula alfreddugesi

Mullen et al. 2019

Medically significant Arthropoda - Acari

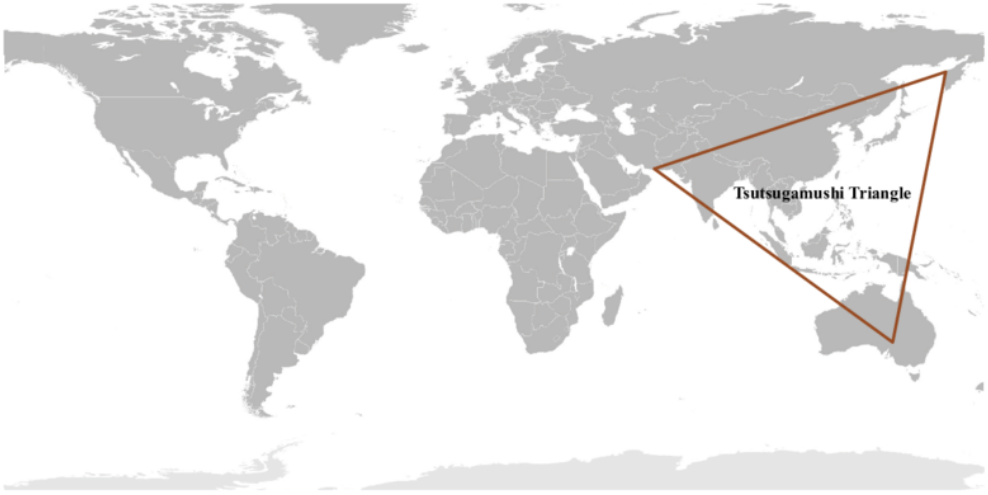
- Class Arachnida – Subclass Acari – Trombiculidae – chiggers and diseases
- Scrub typhus (Tsutsugamushi disease, tick-borne typhus, tropical typhus)
- The disease is transmitted by mites of the genus *Leptotrombidium* spp. - the causative agent of α-proteobacteria *Orientia tsutsugamushi* (*Rickettsia tsutsugamushi*)
- Symptoms of the disease are: very high fever > 40°C, primary lesion (more common in Caucasians), macular rash and lymphadenopathy
- Incubation from a mite larva bite is 6 to 21 days
- Transovarial and transstadial transmission
- Primary treatment with doxycycline (antibiotic)

***Leptotrombidium* sp.**

Santibáñez et al. 2015

Medically significant Arthropoda - Acari

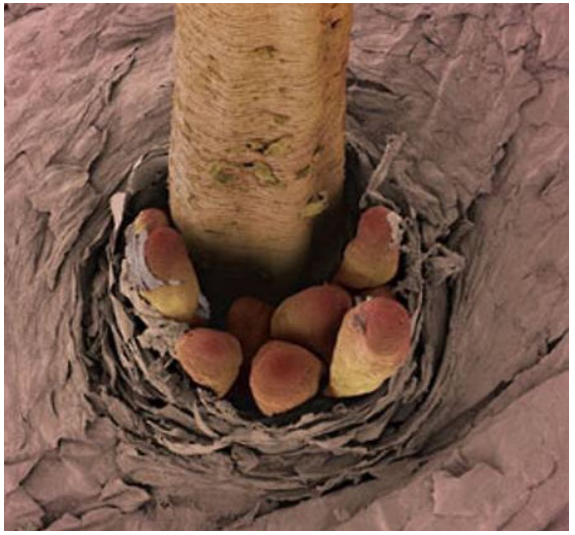
- Class Arachnida – Subclass Acari – Trombiculidae – chiggers and diseases
- Scrub typhus (Tsutsugamushi disease, tick-borne typhus, tropical typhus)
  - A widespread disease during World War II. World War (more soldiers died from these disease then from war destruction - mortality 27-35%), and today it occurs in travelers to endemic areas of the disease
  - about a billion people are at risk of infection and it is thought that about a million people become infected annually, although the numbers are probably higher - poor diagnosis and overlap of symptoms with other diseases

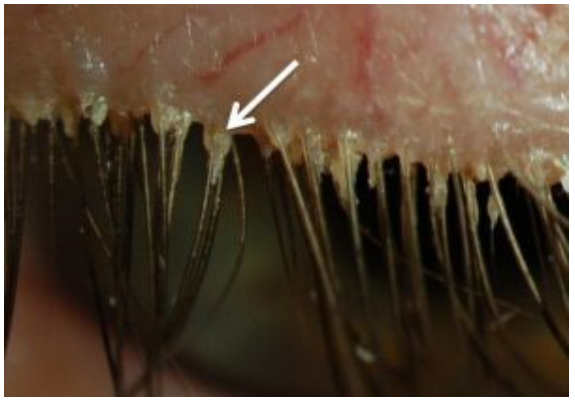


Santibáñez et al. 2015

Medically significant Arthropoda - Acari

- **Class Arachnida - Subclass Acari - Human follicular mites - Demodecidae - *Demodex folliculorum* (in 90% of all people, varies between regions), *Demodex brevis* - Demodicosis disease**

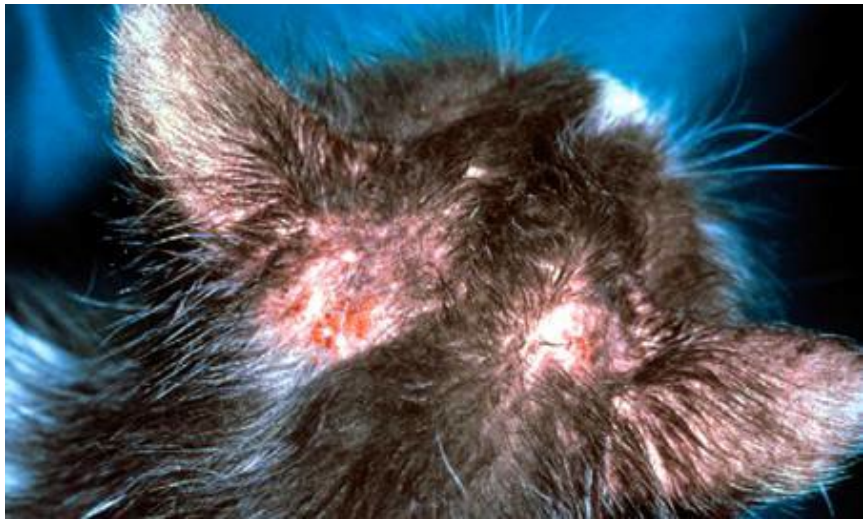




Mullen et al. 2019

Veterinary significant Arthropoda - Acari

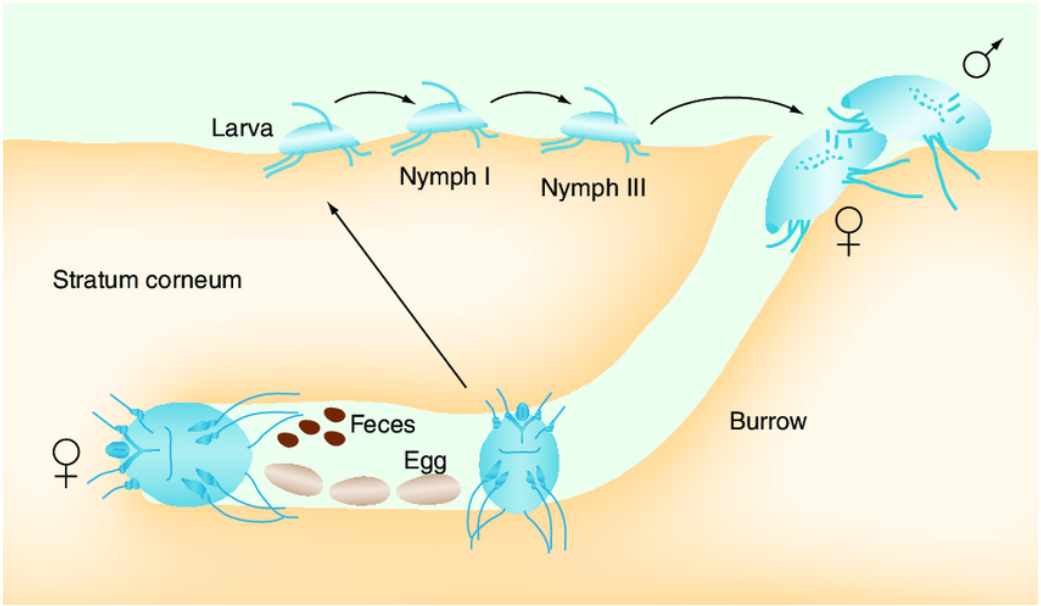
- **Class Arachnida - Subclass Acari - Demodecidae - Demodicosis (Mange) disease in animals (dogs, cats, cattle, goats,...) - agents from the genus *Demodex* spp.**

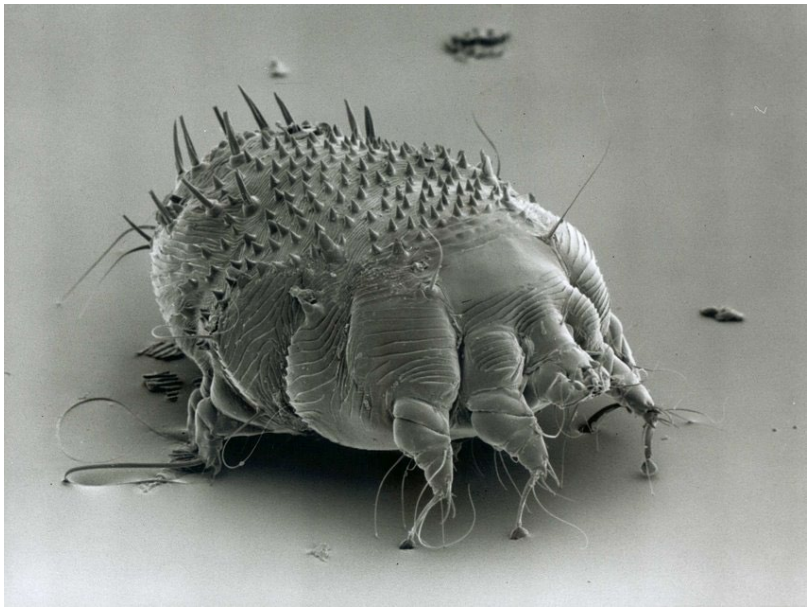


Mullen et al. 2019

Medically significant Arthropoda - Acari

- **Class Arachnida - Subclass Acari - Sarcoptidae - Itching or Scabies (lat. Scabies) - caused by the mite *Sarcoptes scabiei***
- **An obligate parasite with worldwide distribution**
- **Fertilized females dig tunnels (0.5 mm/day) in the epidermis where they lay eggs, the larvae crawl on the skin, change into nymphs and continue digging tunnels in the epidermis, after a while the adults come out, mate and the whole cycle starts over**

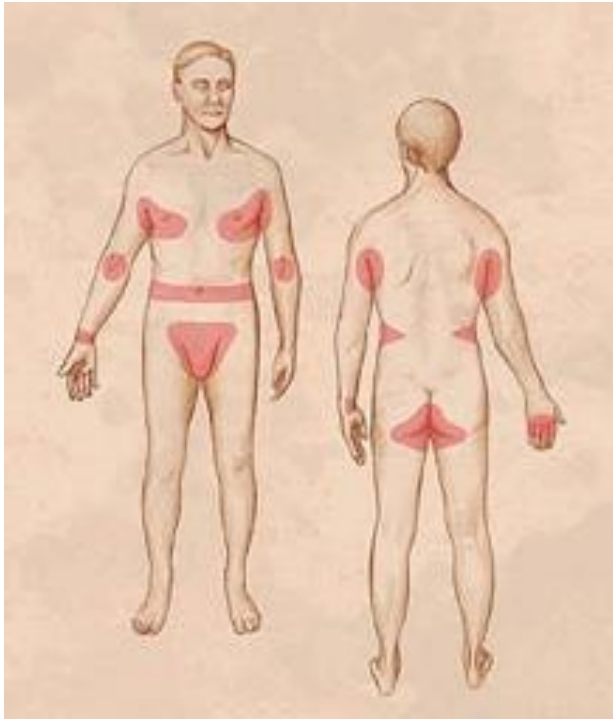




Mullen et al. 2019

Medically significant Arthropoda - Acari

- **Class Arachnida - Subclass Acari - Sarcoptidae - Itching or Scabies (lat. Scabies) - caused by the mite *Sarcoptes scabiei***
  - **Antigens of mites and their feces stimulate a strong immune response, itching is very intense, especially at night**
  - **The rash can take different forms and vary depending on the location on the body, but the lesions are most often papular (classic papular itch)**



Mullen et al. 2019

Medically significant Arthropoda - Acari

- Class Arachnida - Subclass Acari - Sarcoptidae - Itching or Scabies (lat. Scabies) - caused by the mite *Sarcoptes scabiei*
  - The development of hyperkeratotic (Norwegian) itch mainly occurs in weak, chronically ill, less resistant, elderly and immunodeficient persons - the most contagious form

Mullen et al. 2019

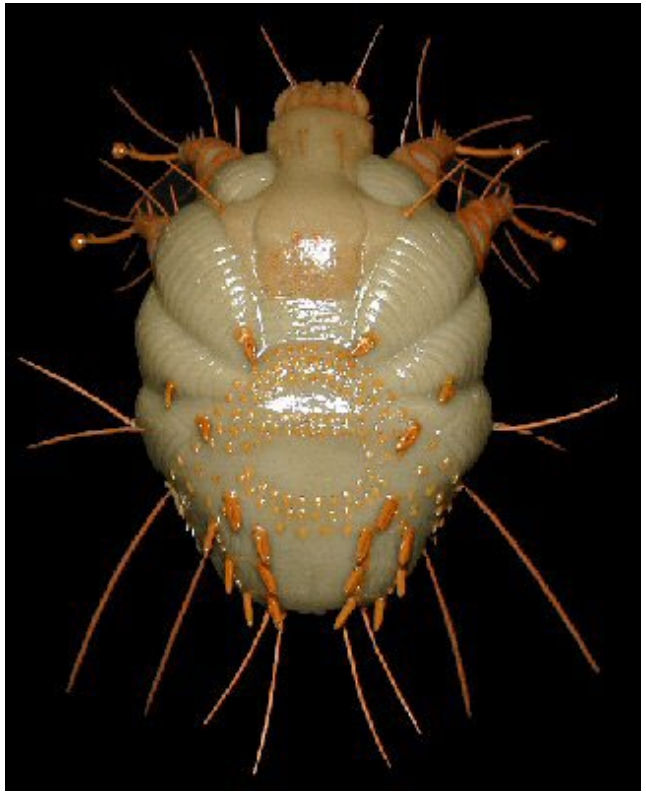
Medically significant Arthropoda - Acari

- **Class Arachnida - Subclass Acari - Sarcoptidae - Itching or Scabies (lat. Scabies) - caused by the mite *Sarcoptes scabiei***
  - **It is transmitted by direct skin-to-skin contact, through bedding, clothing**
  - **Adults and eggs can survive up to 3 days without a host**
  - **Diagnosis involves scraping and biopsy of the skin to identify the *Sarcoptes scabiei* mite**
  - **Treatments with different acaricides – e.g. permethrin cream**
  - **Clothes, couches, carpets, bedding should be washed in acaricidal agents or in very hot water to control the infection**

Mullen et al. 2019

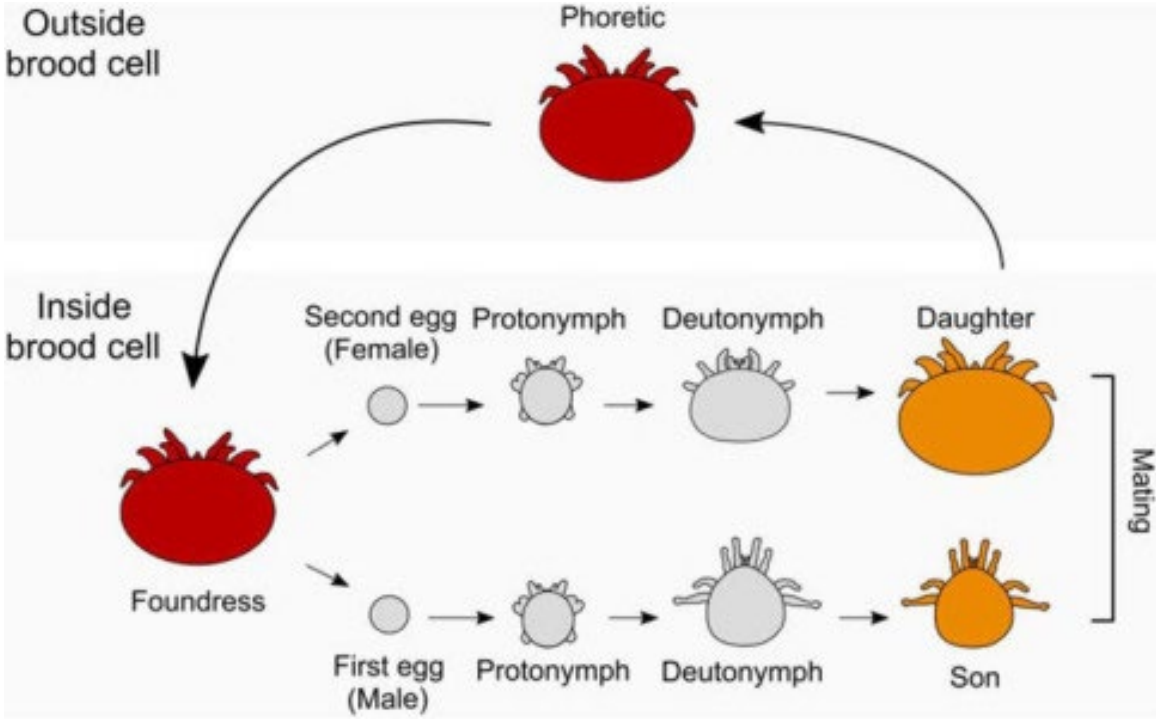
Medically significant Arthropoda - Acari

- **Class Arachnida - Subclass Acari - Sarcoptidae - Itching or Scabies (lat. Scabies) - caused by the mite *Sarcoptes scabiei***
  - **It is estimated that from 1-10% of the human population will be infected with this mite at least once in their life (data varies depending on the source)**
  - **Symptoms from the initial infection appear after a few weeks and the infection lasts a very long time if it is not treated**
  - **The symptoms of subsequent infections appear much earlier and the mite infestation itself disappears by itself, even without treatment due to a faster (and more efficient) immune response - the possibility of developing a vaccine**



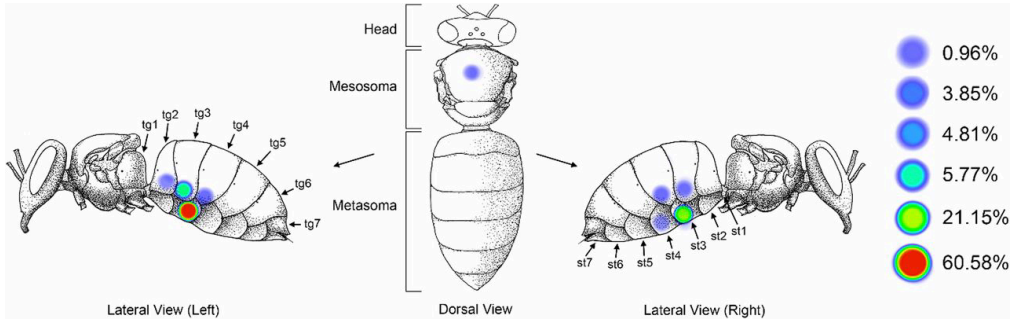
Mullen et al. 2019

- **Razred Arachnida – Podrazred Acari – red Mesostigmata – *Varroa destructor* – Varoa**
- **The mite (tick) is a pest on bees, on the species *Apis cerana* (Asian bee) and *Apis mellifera* (Honey bee)**
- **Original only on the Asian bee, transmitted all over the world**
- **They feed on the fat tissue of larvae and adults**



Veterinary značajni Arthropoda - Acari

- **Razred Arachnida – Podrazred Acari – red Mesostigmata – *Varroa destructor* – Varoa**

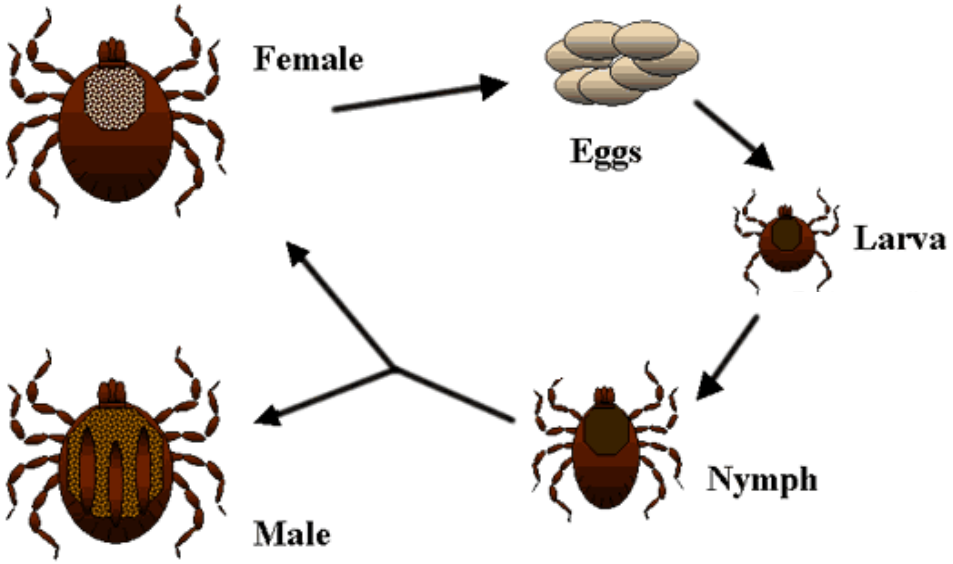


Veterinary significant Arthropoda - Acari

- **Razred Arachnida – Podrazred Acari – red Mesostigmata – *Varroa destructor* – Varoa**
  - **Bees with pronounced hygienic behavior when removing varroa-infected brood are called VSH (Varroa sensitive hygiene) bees**
  - **At least 5 bee viruses are vectors (perhaps as many as 18), and varroa feeding sites are more susceptible to various other viral, bacterial and fungal infections**
  - **One of the viruses they transmit is the deformed wing virus (DWV)**

Medically significant Arthropoda - Ixodidae

- Class Arachnida - Subclass Acari - Order Ixodida – Ticks
- > 800 spp., all species parasitize vertebrates in at least one life stage
- Almost all species of medical importance are from the family Ixodidae (Ticks) - all stages feed on blood
- Ixodidae have one nymph stage and males of some species do not feed
- Most often they need one blood meal per life stage, the females feed for 1 to 2 weeks, then they are released and the eggs hatch and die



Nicholson et al. 2019

Medically significant Arthropoda - Ixodidae

- Class Arachnida - Subclass Acari - Order Ixodida – Ticks
  - Most species are host specific, but those that are most medically important are opportunists
  - Ticks are good vectors of many bacteria, viruses, phagotrophic protists, fungi harmful to humans and animals
  - All tick-borne diseases are zoonoses, not specific to humans
  - The most important diseases they transmit are: Lyme disease (Lyme borreliosis), Human granulocytic anaplasmosis, Tularemia, Rocky Mountain spotted fever, Mediterranean spotted fever, Human babesiosis, Powassan virus disease, Encephalitis, Crimean-Congo hemorrhagic fever, Tick paralysis (not caused by a pathogen), etc...

Nicholson et al. 2019

Medically significant Arthropoda - Ixodidae

- **Class Arachnida - Subclass Acari - Order Ixodida – Ticks**
  - **The most important vector in Europe is the common tick (*Ixodes ricinus*) - in humans and animals**

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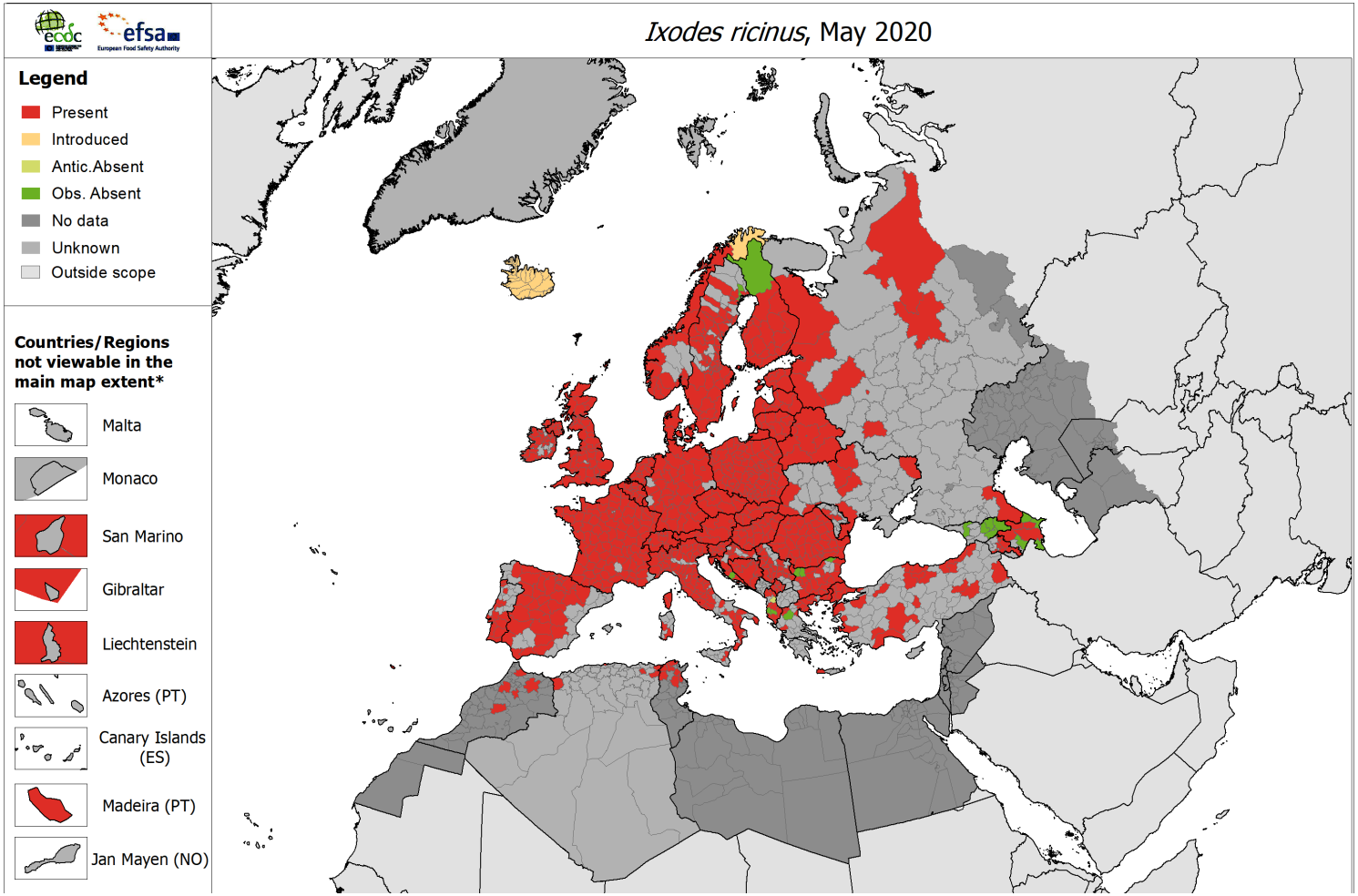
Medically significant Arthropoda - Ixodidae

- **Class Arachnida - Subclass Acari - Order Ixodida – Ticks**
  - **The most important vector in Europe is the common tick (*Ixodes ricinus*) - in humans and animals**



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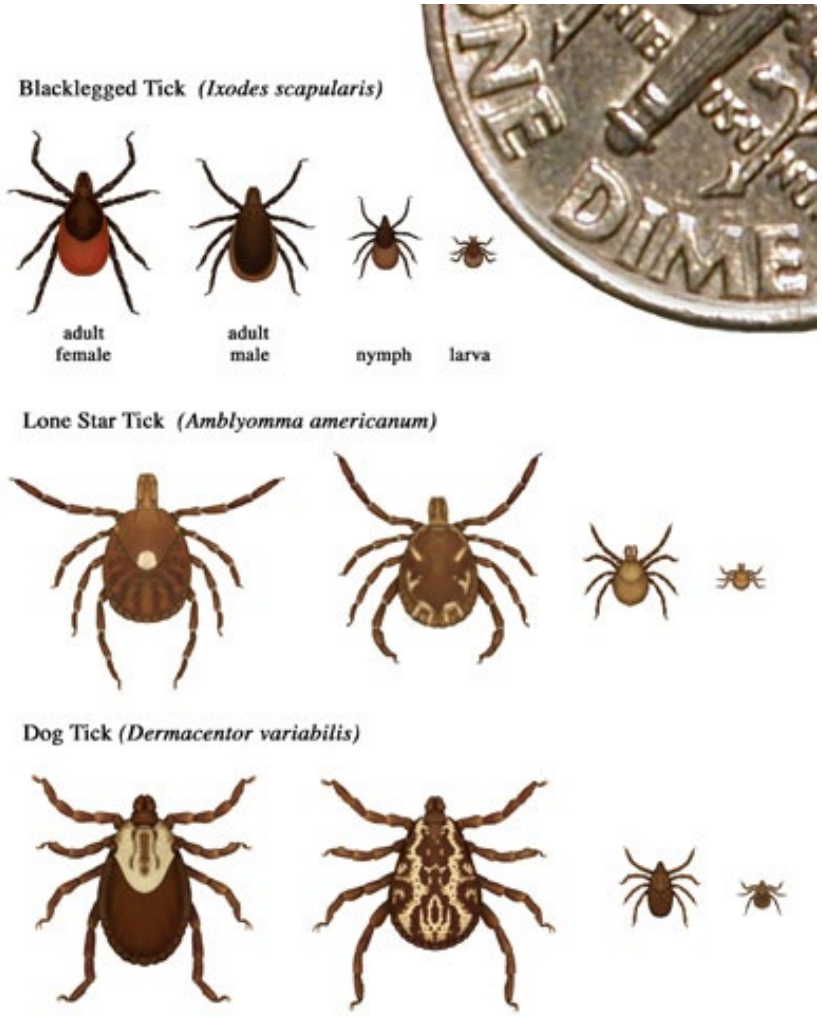
Medically significant Arthropoda - Ixodidae

- Class Arachnida - Subclass Acari - Order Ixodida – Ticks
  - The most important vectors in North America are: ***Ixodes scapularis, Amblyomma americanum*** i ***Dermacentor variabilis***


Ixodes scapularis



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Medically significant Arthropoda - Ixodidae

- **Class Arachnida - Subclass Acari - Order Ixodida – Ticks**

TABLE 27.2 Representative Tick-Borne Diseases of Public Health Importance and Associated Characteristics (All Tick-Borne Diseases Have Not Been Included)

Disease	Causative Agent	Primary Tick Vector Species	Animal Host(s) Beyond Humans
Human babesiosis	*B. microti,*	*Ixodes scapularis*	Rodents, cattle
	B. divergens	*Ixodes ricinus*	
	B. duncani (WA1, CA5)	Unknown	
	"B. ventorum" (EU-1)	*Ixodes ricinus*	
Tick-borne encephalitis	*Flavivirus*[a]	*I. ricinus, I. persulcatus*	Rodents, insectivores, carnivores, etc.
Kyasanur Forest disease	*Flavivirus*[a]	*Haemaphysalis spinigera*	Monkeys, small mammals, carnivores, birds, cattle
Powassan encephalitis	*Flavivirus*[a]	*Ixodes, Dermacentor,* and *Haemaphysalis* spp.	Rodents, hares, carnivores
Colorado tick fever	*Coltivirus*[b]	*Dermacentor andersoni*	Rodents, carnivores, domestic animals
Heartland virus	*Phlebovirus*[c]	*Amblyomma americanum*	Possibly raccoons and deer
Severe fever with thrombocytopenia syndrome virus	*Phlebovirus*[c]	*Haemaphysalis longicornis*	Goats, wild animals
Bourbon virus	*Thogotovirus*[d]	*Amblyomma americanum*	Deer, raccoons
Crimean- Congo hemorrhagic fever	*Nairovirus*[c]	*Hyalomma m. marginatum, H. m. rufipes,* others	Hares, hedgehogs, small mammals
Rocky Mountain spotted fever	*Rickettsia rickettsii*	*Dermacentor variabilis, D. andersoni, A. cajennense, Rhipicephalus sanguineus,* others	Small mammals, carnivores, dogs, rabbits, others
Boutonneuse fever[e]	*Rickettsia conorii*	*R. sanguineus, D. marginatus, D. reticulatus,* others	Small mammals, hedgehogs, dogs
African tick-bite fever	*Rickettsia africae*	*Amblyomma* spp.	Mammals, including humans
Rickettsia parkeri rickettsiosis	*Rickettsia parkeri*	*Amblyomma maculatum* group ticks	Cotton rats and others, cotton mice, dogs
Pacific Coast fever	*"Rickettsia philipii"* (364D)	*Dermacentor occidentalis*	Unknown, likely rodents
Human ehrlichiosis	*Ehrlichia chaffeensis*	*Amblyomma americanum,*	Deer, dogs
Human ehrlichiosis	*Ehrlichia ewingii*	*Amblyomma americanum*	Dogs, deer
Ehrlichiosis	*Ehrlichia muris eauclairensis*	*Ixodes scapularis*	*Peromyscus leucopus,* dogs
Human anaplasmosis	*Anaplasma phagocytophilum*	*Ixodes scapularis, I. pacificus I. ricinus, I. persulcatus*	Rodents, deer, dogs
Human anaplasmosis	*Anaplasma platys*	*Rhipicephalus sanguineus*	Dogs
Human anaplasmosis	*"Anaplasma capra"*	*Ixodes persulcatus*	Goats, sheep
Human anaplasmosis	*Anaplasma ovis*	*Rhipicephalus* spp., *Dermacentor* spp.	Sheep
Neoehrlichiosis	*Neoehrlichia mikurensis*	*Ixodes ricinus, I. persucatus*	Rodents, canines, badger, fox
Q fever	*Coxiella burnetii*	Many tick species	Large domestic livestock
Lyme disease	*Borrelia burgdorferi B. afzelii, B. garinii B. bissettii*	*Ixodes scapularis, I. ricinus, I. pacificus, I. persulcatus,* others	Mammals, birds
Tick-borne relapsing fever	*Borrelia* spp.	*Ornithodoros* spp.	Various mammals
Tularemia	*Francisella tularensis*	*Haemaphysalis leporispalustris,* others	Lagomorphs, rodents, carnivores
Tick paralysis	Tick proteins	*I. holocyclus, I. rubicundus, D. variabilis, D. andersoni,*	Cattle, sheep, dogs, other mammals, birds, others
Tick-bite allergies	Tick proteins	*Argas reflexus, Ornithodoros coriaceus, Ixodes pacificus,* etc.	Humans

[a] *Family Flaviviridae.*
[b] *Family Reoviridae.*
[c] *Family Bunyaviridae.*
[d] *Family Orthomyxoviridae.*
[e] *Also known as Mediterranean spotted fever.*

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Medically significant Arthropoda - Ixodidae

- Class Arachnida - Subclass Acari - Order Ixodida – Ticks
  - – Encephalitis (tick-borne encefalitis – TBE)
    - 12 related, but different, flavivirus serotypes that make up the TBE complex
    - TBE is endemic in over 30 European and North Asian countries with about 14,000 cases per year, of which 11,000 cases are in Russia
    - The vector is *Ixodes ricinus* (European subtype) and *Ixodes persulcatus* (Siberian and Far Eastern subtype)
    - The disease begins with fever and headache, and only after that, inflammation of the brain (encephalitis) and meninges (meningitis) occurs - mortality depends on the serotype, mortality for the European serotype is 1-2%
    - Even with recovery, it can have long-term and chronic consequences (especially the Siberian subtype)
    - Very good (99% efficacy) vaccine available

Ixodes persulcatus

Nicholson et al. 2019

Medically significant Arthropoda - Ixodidae

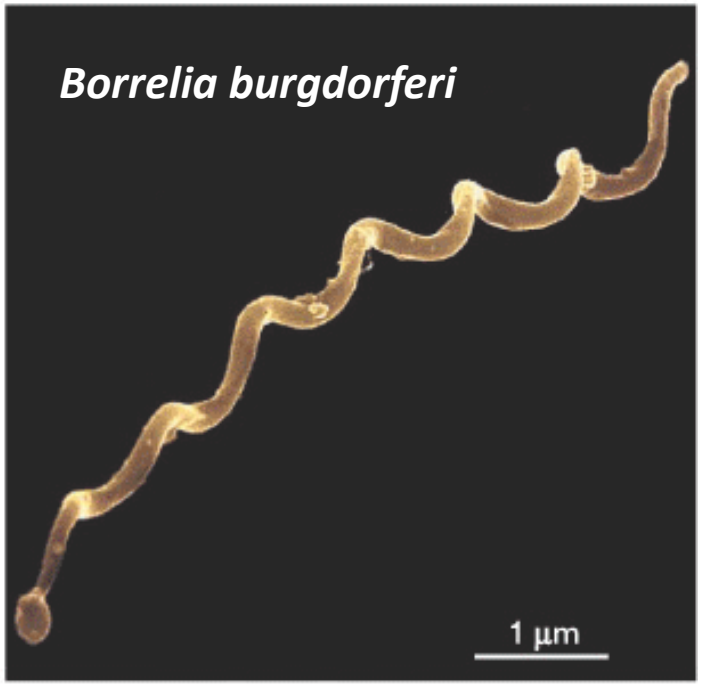
- **Class Arachnida - Subclass Acari - Order Ixodida – Ticks – Tick paralysis**
  - **A disease in humans and animals caused by the feeding of pregnant females of different genera (the most common species of the genera *Ixodes* and *Dermacentor*) – the body's reaction to tick saliva**
  - **Gradual paralysis of the body that can lead to death within 48 hours of the onset of symptoms**
  - **By removing the tick, the symptoms disappear in a few hours (if removed in time)**
  - **Girls under the age of 10 are most often affected**

Dermacentor andersoni

Nicholson et al. 2019

Medically significant Arthropoda - Ixodidae

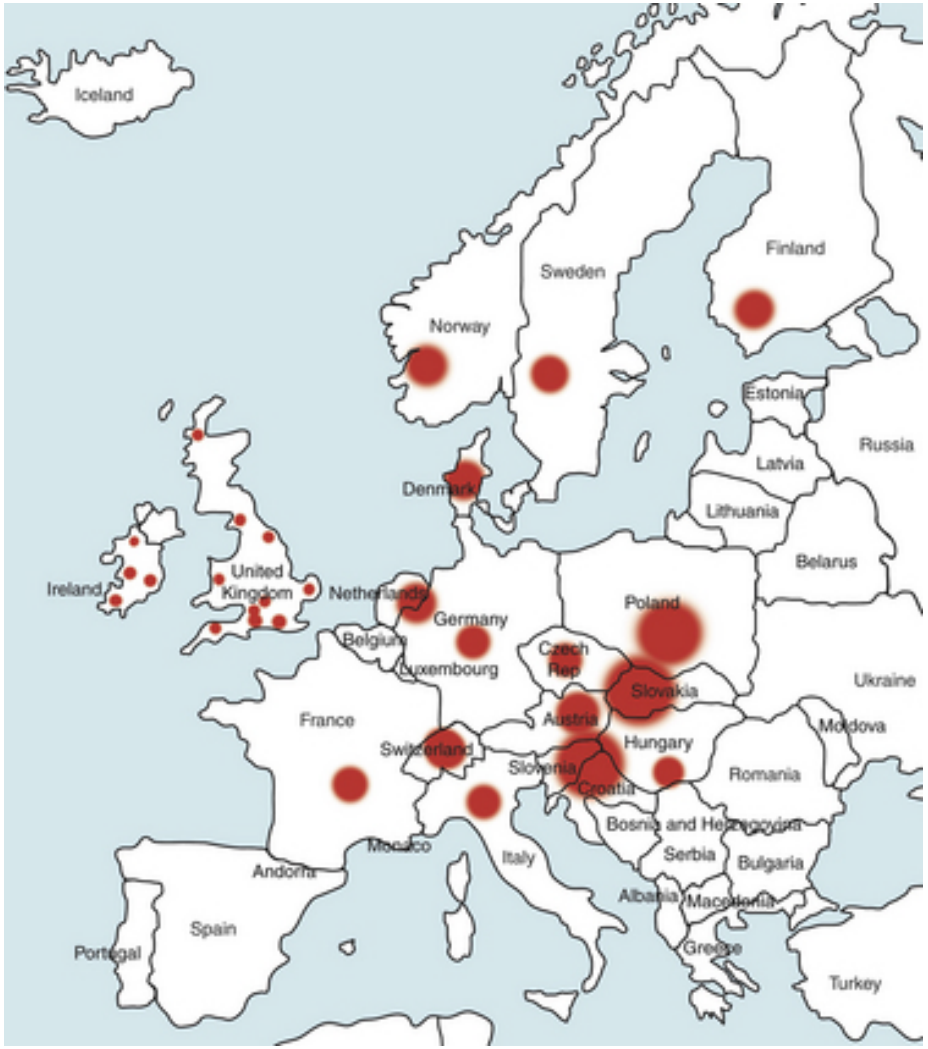
- **Class Arachnida - Subclass Acari - Order Ixodida – Ticks – Lyme disease (Lyme borreliosis)**
  - **Disease caused by spirochete bacteria *Borrelia burgdorferi* complex (*B. burgdorferi* sensu lato)**
  - **They are most often found in the extracellular matrix, blood cells, joints, heart and nervous system**
  - **It can be transmitted by different species, but *Ixodes ricinus* is the most common vector in Europe and *I. scapularis* in North America**

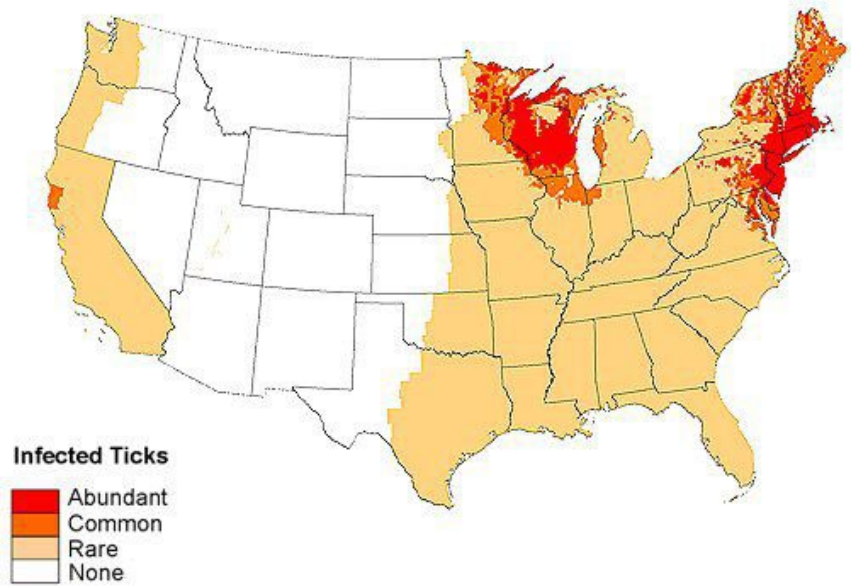


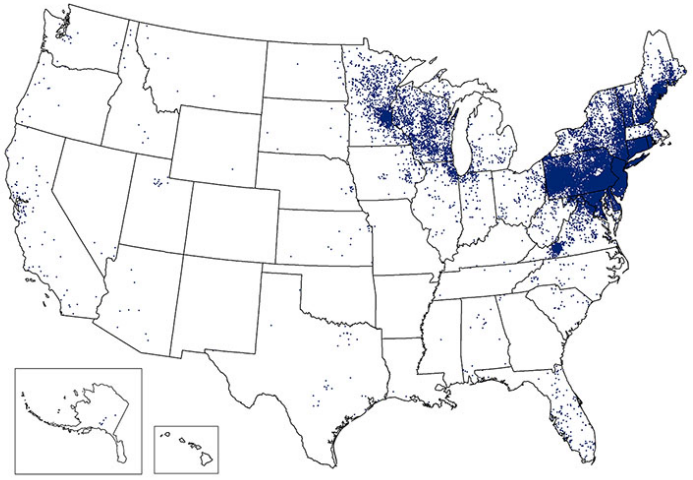
Nicholson et al. 2019

Medically significant Arthropoda - Ixodidae

- **Class Arachnida - Subclass Acari - Order Ixodida – Ticks – Lyme disease (Lyme borreliosis)**



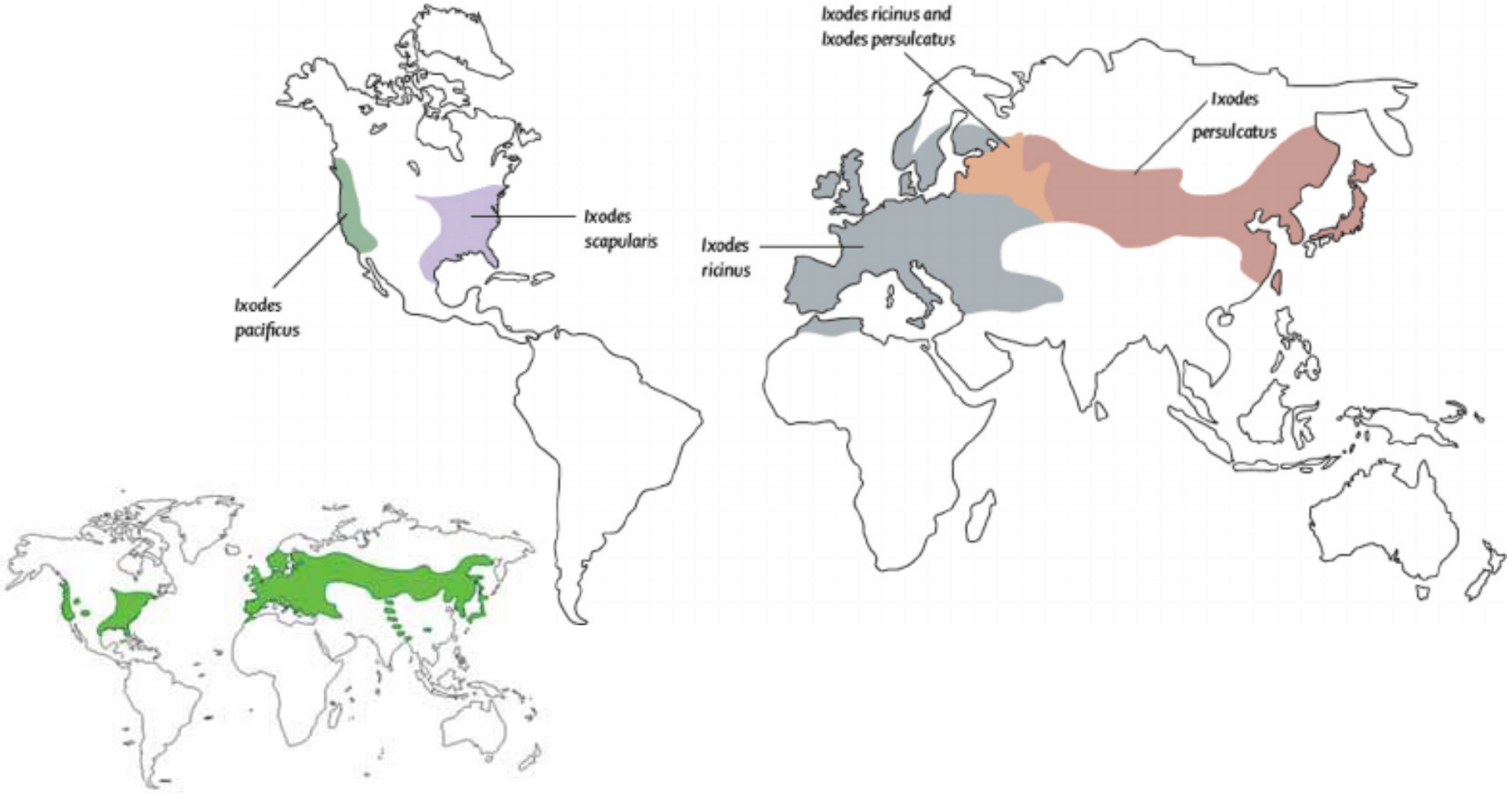




Nicholson et al. 2019

Medically significant Arthropoda - Ixodidae

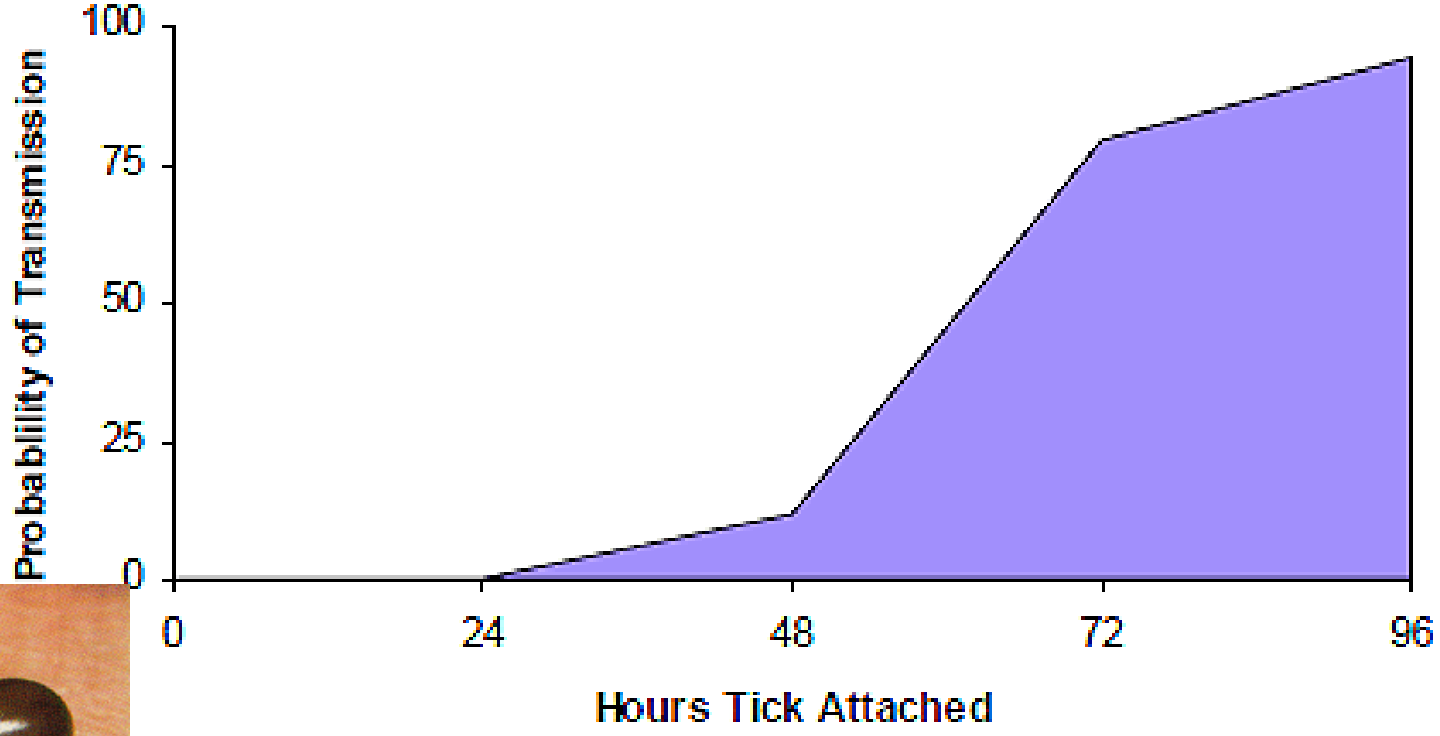
- **Class Arachnida - Subclass Acari - Order Ixodida – Ticks – Lyme disease (Lyme borreliosis)**



Nicholson et al. 2019

Medically significant Arthropoda - Ixodidae

- Class Arachnida - Subclass Acari - Order Ixodida – Ticks – Lyme disease (Lyme borreliosis)
  - The longer they feed, the greater the chance of transmitting the disease, nymphs transmit more often because they are smaller and harder to notice



Nicholson et al. 2019

Medically significant Arthropoda - Ixodidae

- **Class Arachnida - Subclass Acari - Order Ixodida – Ticks – Lyme disease (Lyme borreliosis)**
  - **The longer they feed, the greater the chance of transmitting the disease, nymphs transmit more often because they are smaller and harder to notice**
  - **The most common reservoirs of the bacteria are small rodents, unlike the large herbivores that ticks regularly feed on**
  - **Transstadial transmission of bacteria, but not transovarial, each generation must be reinfected by feeding**

Nicholson et al. 2019

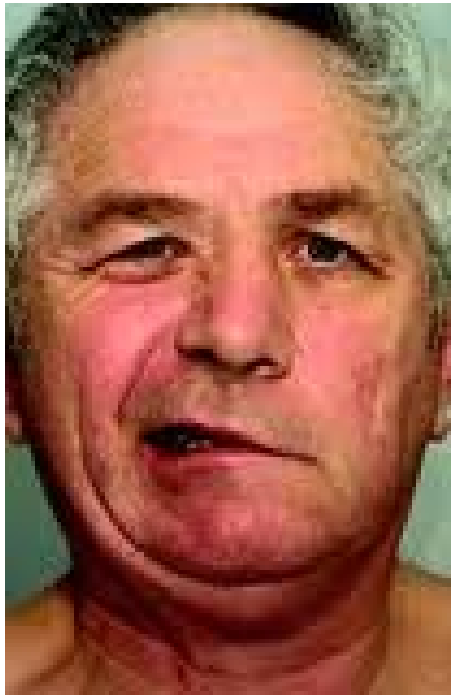
Medically significant Arthropoda - Ixodidae

- **Class Arachnida - Subclass Acari - Order Ixodida – Ticks – Lyme disease (Lyme borreliosis)**
  - **I. phase of the disease (early manifestation) - most often develops 1 to 2 weeks after infection with flu-like symptoms and erythema migrans (bull's eye rash) in 60% to 80% of cases**

Nicholson et al. 2019

Medicinski značajni Arthropoda - Ixodidae

- **Class Arachnida - Subclass Acari - Order Ixodida – Ticks – Lyme disease (Lyme borreliosis)**
  - **II. stage of the disease - early spread - in some patients the disease can rapidly develop (weeks to months after infection with the bacteria) on the central nervous system (Neuroborreliosis - symptoms can resemble multiple sclerosis) and cause loss of nerve function and meningitis and / or problems with the heart and muscles bone discomfort**



Nicholson et al. 2019

Medically significant Arthropoda - Ixodidae

- **Class Arachnida - Subclass Acari - Order Ixodida – Ticks – Lyme disease (Lyme borreliosis)**
  - **III. stage of the disease (late stage) - the continuation of the disease is difficult to predict - in some untreated people the disease no longer shows any symptoms, while in > 50% of people it develops months or years after the initial infection, the most common are Lyme arthritis, Lyme myocarditis and numerous neurological disorders (most adults) – very difficult to determine the cause**
  - **II. phase many also never develop**

Nicholson et al. 2019

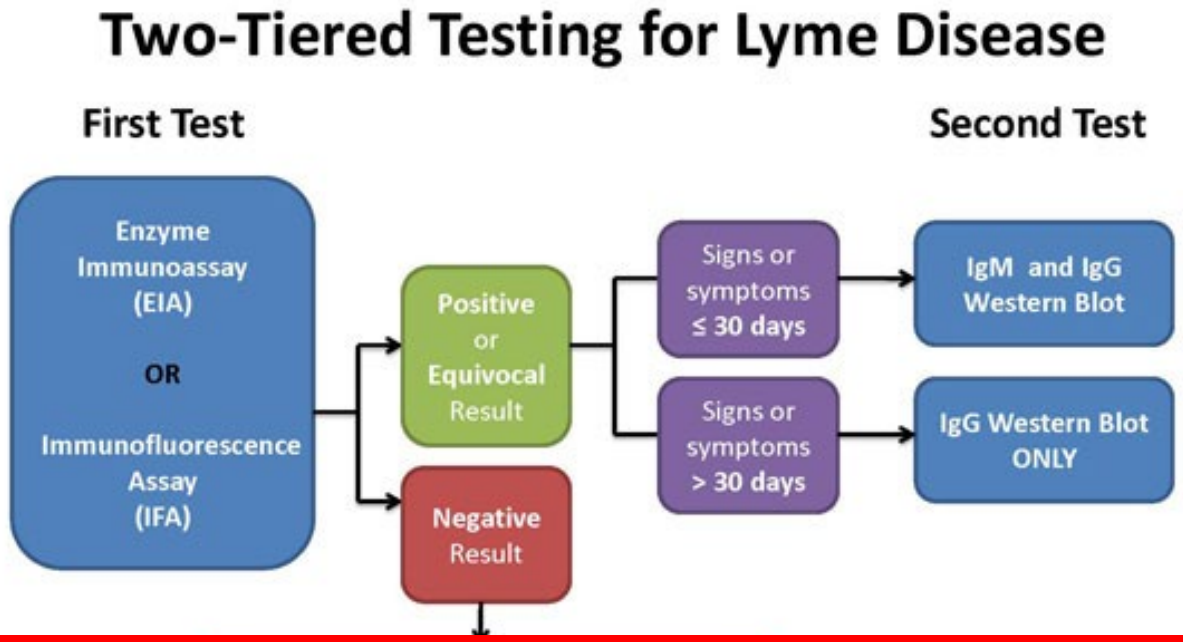
Medically significant Arthropoda - Ixodidae

- **Class Arachnida - Subclass Acari - Order Ixodida – Ticks – Lyme disease (Lyme borreliosis) – Diagnosis**
  - **In areas where the disease is not common, it is often misdiagnosed**
  - **Phase I – Erythema migrans + tick bite sufficient for clinical diagnosis and treatment**
  - **Confirmation of the diagnosis through serological tests is very problematic in the early stages (false negative).**
  - **II. stage – Diagnosis often requires serological tests because neurological symptoms can be caused by different diseases and conditions**
  - **III. phase – Same as in II. stages, very often undiagnosed or misdiagnosed until serological tests were performed**

Nicholson et al. 2019

Medically significant Arthropoda - Ixodidae

- **Class Arachnida - Subclass Acari - Order Ixodida – Ticks – Lyme disease (Lyme borreliosis) – Diagnosis**

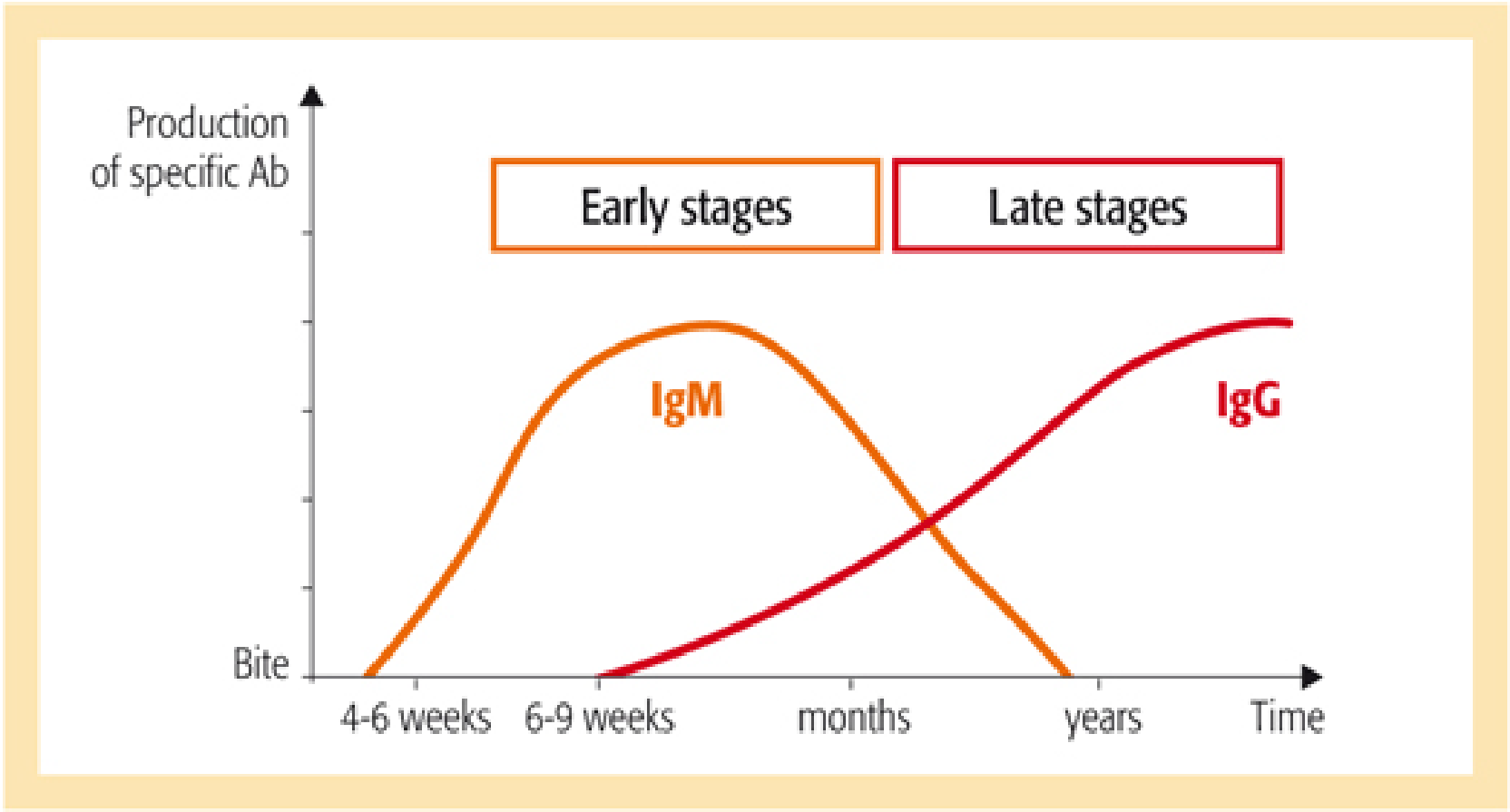


Borrelia is a slow-growing bacterium (duplication time 12-18 h) with the possibility of different antigens on its wall, therefore the immune system needs time to develop specific antibodies that can be used to prove the infection, also the interpretation of the results for IgM and IgG is very difficult

Nicholson et al. 2019

Medically significant Arthropoda - Ixodidae

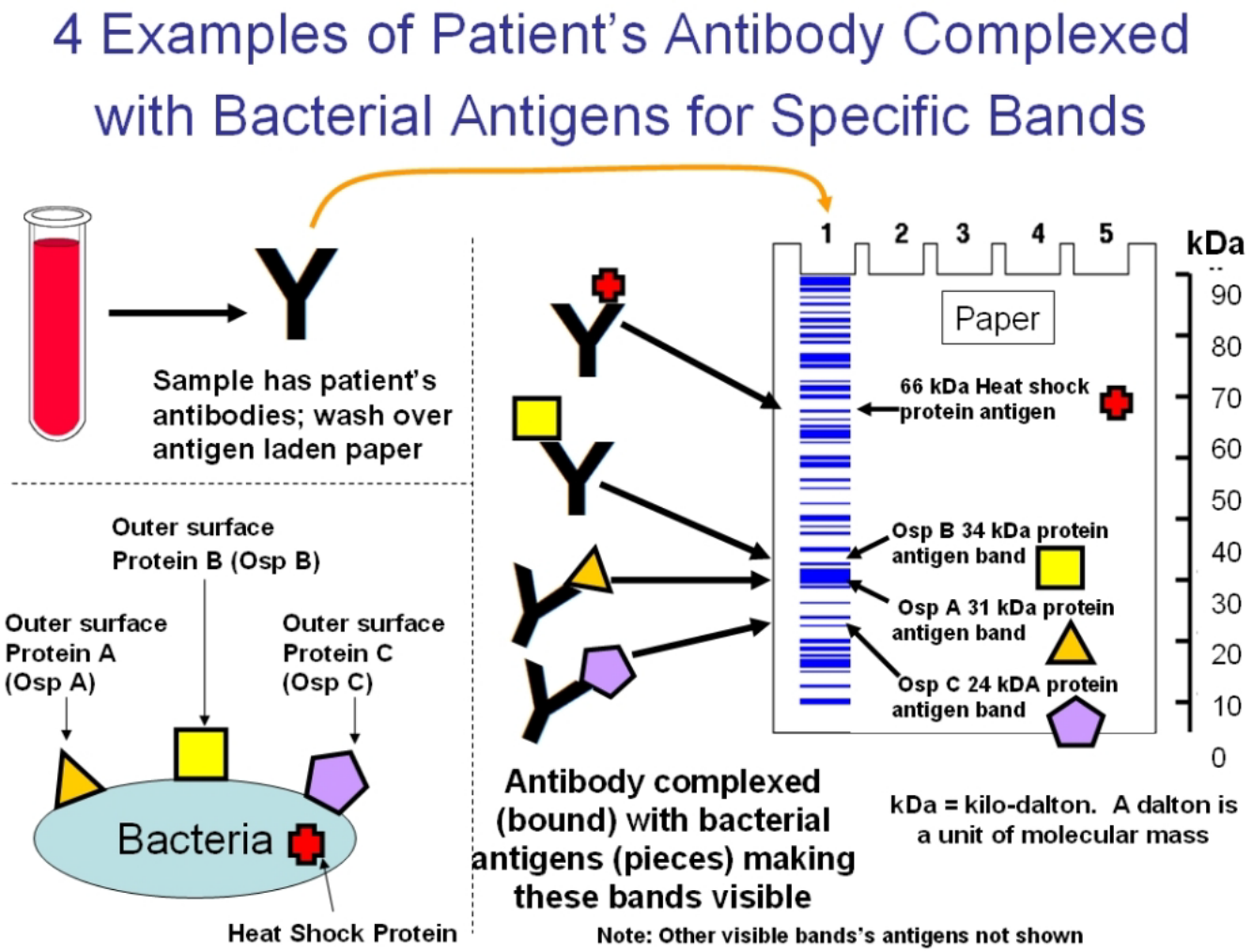
- **Class Arachnida - Subclass Acari - Order Ixodida – Ticks – Lyme disease (Lyme borreliosis) – Diagnosis**



Nicholson et al. 2019

Medically significant Arthropoda - Ixodidae

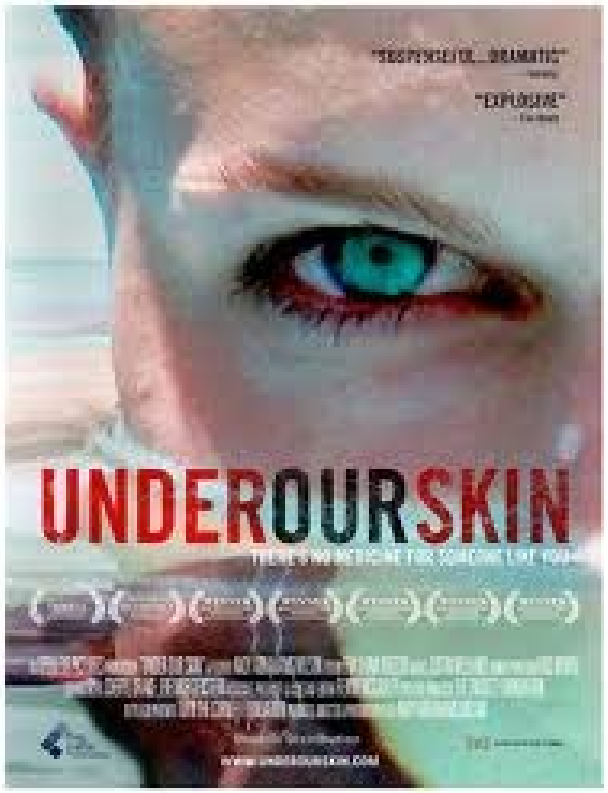
- **Class Arachnida - Subclass Acari - Order Ixodida – Ticks – Lyme disease (Lyme borreliosis) – Diagnosis**



Nicholson et al. 2019

Medically significant Arthropoda - Ixodidae

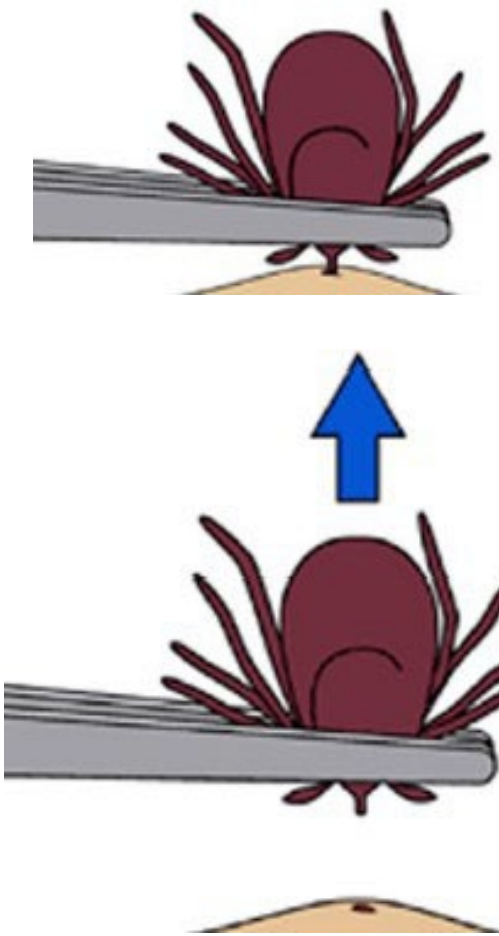
- **Class Arachnida - Subclass Acari - Order Ixodida – Ticks – Lyme disease (Lyme borreliosis) – Treatment**
  - **It is best to treat stage I of the disease with doxycycline (not children under 8) and amoxicillin (can children under 8)**
  - **In 10 - 20% of patients, it is also possible to develop a special syndrome, PTLDS (post-treatment Lyme disease syndrome) with typical symptoms of fatigue, reduced intellectual abilities, insomnia that last for a long time after treatment with antibiotics**



Nicholson et al. 2019

Medically significant Arthropoda - Ixodidae

- Class Arachnida - Subclass Acari - Order Ixodida – Ticks – Lyme disease (Lyme borreliosis) – Prevention and prophylaxis
- Prevention – repellents, tick checks, showering, appropriate clothing, avoiding infested areas
- In Canada (but not here), they also give prophylaxis (1 dose of doxycycline 200 mg) if they meet these 4 criteria:
- Tick attached > 36 h
- Treatment with the drug can start 72 hours after the tick has been removed
- Area with a very high percentage of infected ticks (> 20%)
- That a person may receive the antibiotic doxycycline



Nicholson et al. 2019

Medically significant Arthropoda - Ixodidae

- **Class Arachnida - Subclass Acari - Order Ixodida – Ticks – Lyme disease (Lyme borreliosis) – in the USA**

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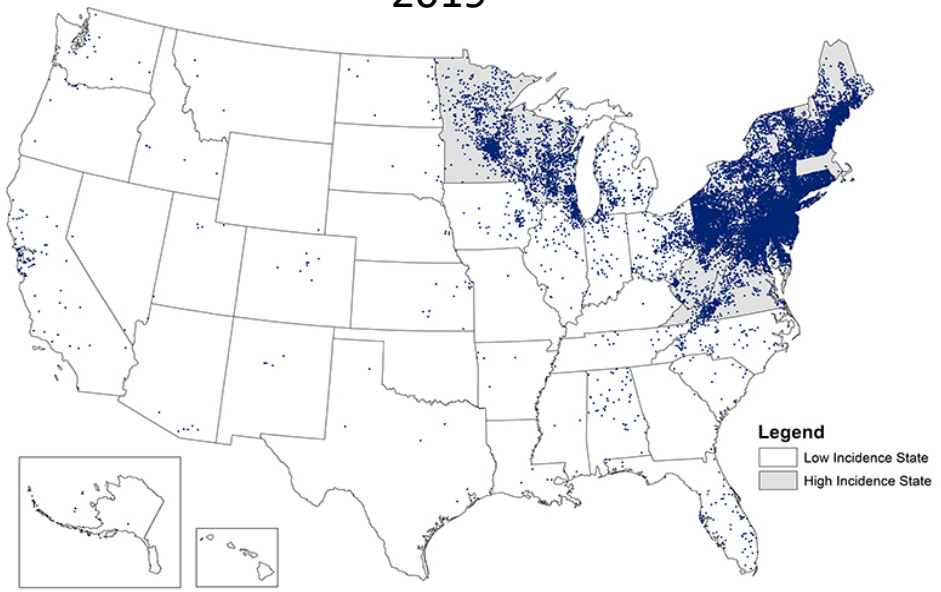
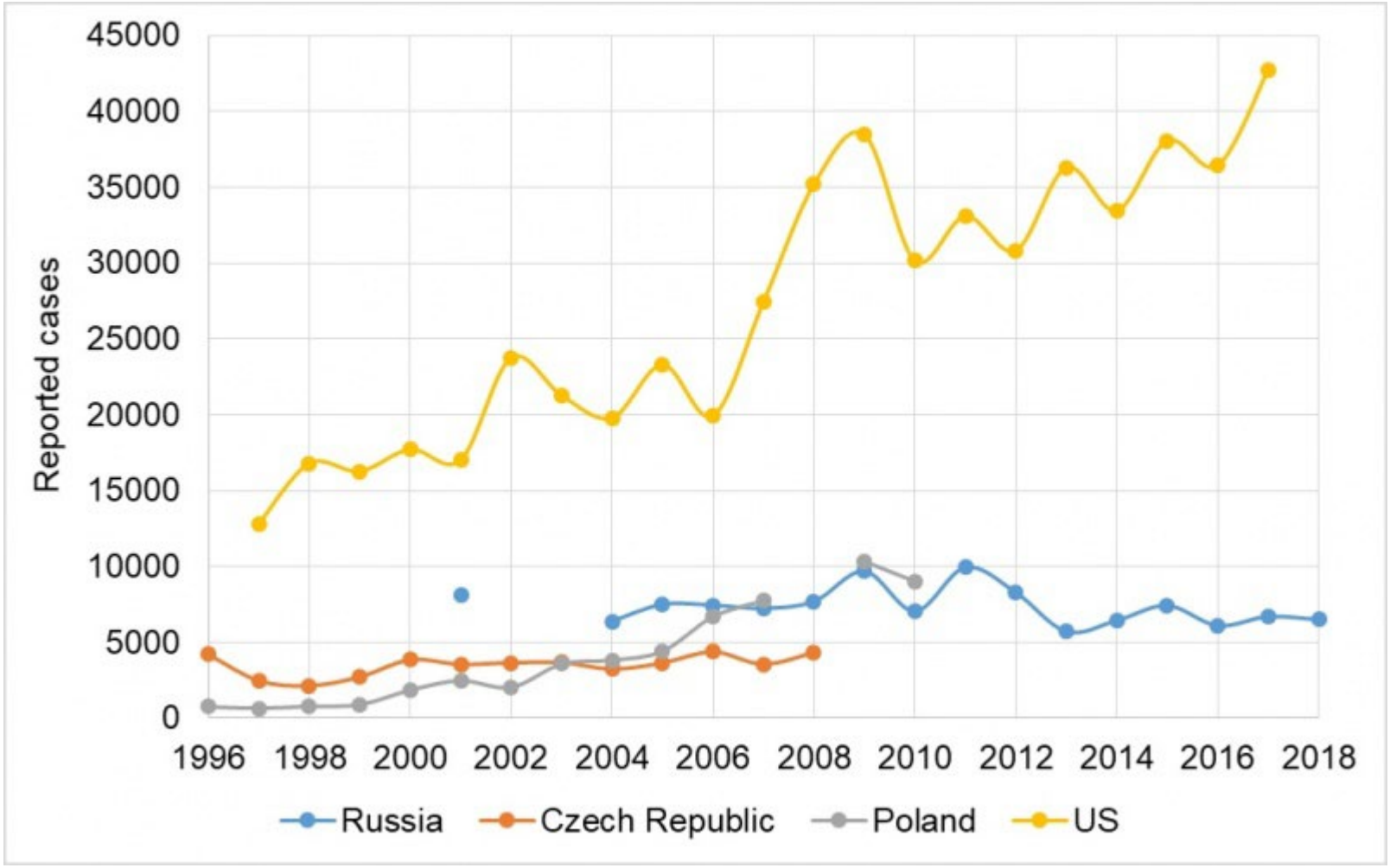


Nicholson et al. 2019

Medically significant Arthropoda - Ixodidae

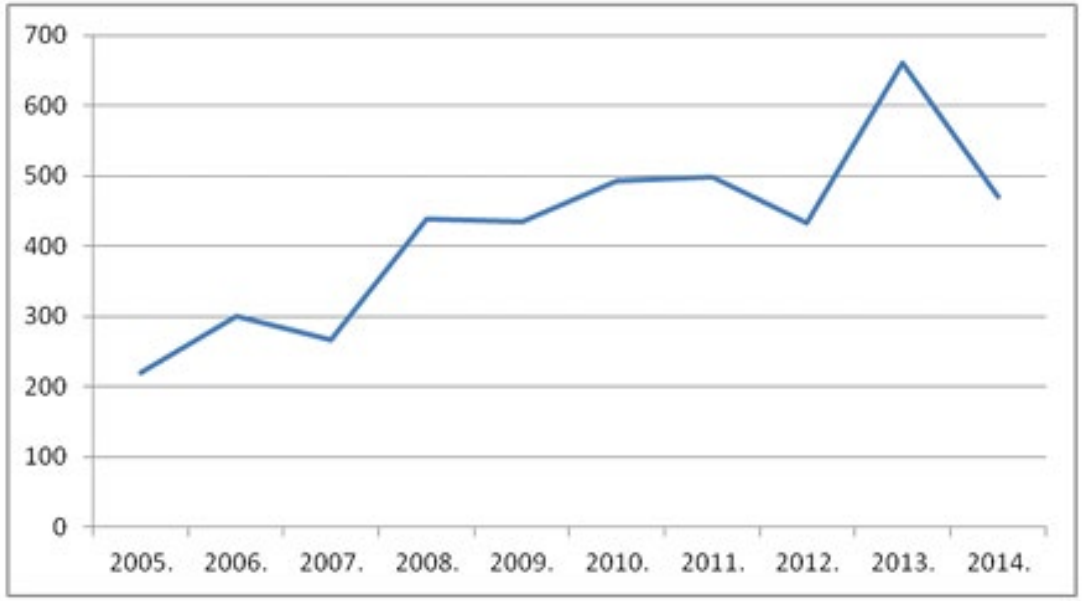
- **Class Arachnida - Subclass Acari - Order Ixodida – Ticks – Lyme disease (Lyme borreliosis) – in Europe**

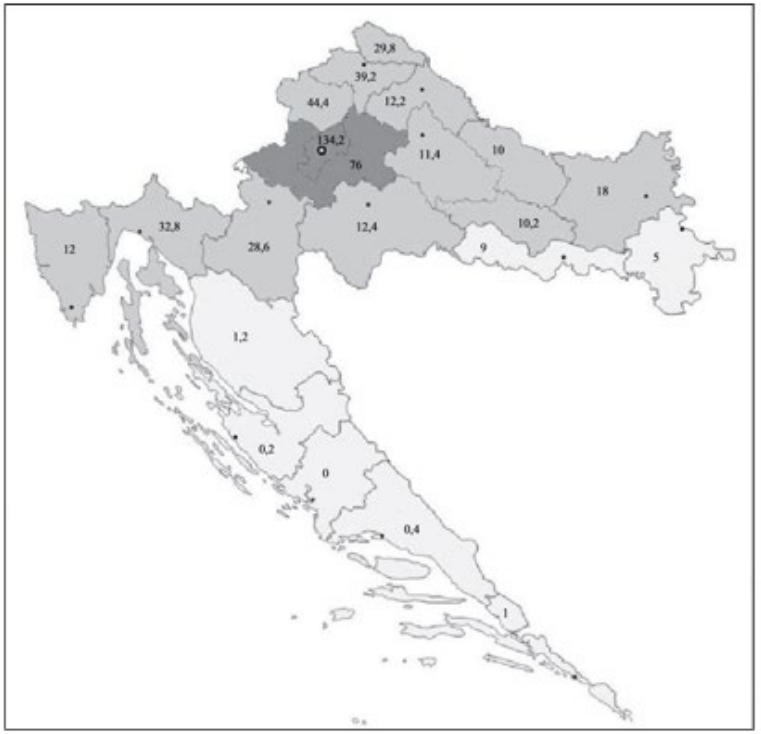


Nicholson et al. 2019

Medically significant Arthropoda - Ixodidae

- **Class Arachnida - Subclass Acari - Order Ixodida – Ticks – Lyme disease (Lyme borreliosis) – in Croatia**

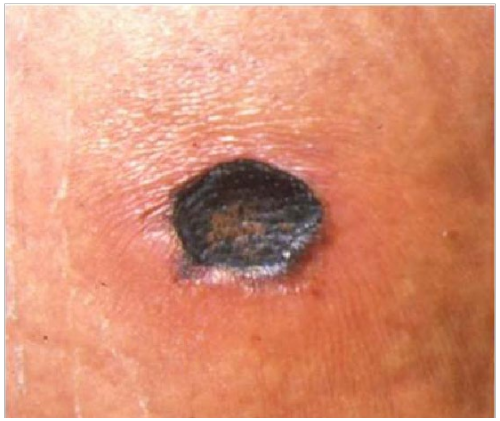




Nicholson et al. 2019; Ropac et al. 2019

Medically significant Arthropoda - Ixodidae

- Class Arachnida – Red Acari – family Ixodidae – Ticks – Mediterranean spotted fever
- The vector is the brown dog tick (*Rhipicephalus sanguineus*), and the cause of the disease is the bacterium *Rickettsia conorii*.
- Incubation of the disease is 5 to 7 days from the tick bite
- The initial signs of the disease are fever, severe headache, malaise, nausea, joint and muscle pain, and a rash in the form of spots and lumps.
- In some patients, a red change (ulcer, tache noire) is visible at the site of the tick bite with a black center, surrounded by a red ring, about 1 cm in diameter, and accompanying enlarged lymph nodes.
- It is treated with antibiotics doxycycline



Nicholson et al. 2019