When Neglected Tropical Diseases Knock on California’s Door

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Vector-Borne Disease Section
Overview of Today’s Topics

• Neglected tropical diseases: setting the stage for impact on California
• California Public Health Overview
  – Surveillance/response structure
  – Vector-Borne Disease program areas
• Two examples:
  – Arbovirus introduction (dengue, chikungunya, zika)
  – Re-emergence of Rocky Mountain spotted fever (not really NTD but similar principals)
Neglected Tropical Diseases

- Buruli Ulcer
- Chagas disease
- Dengue and Chikungunya
- Dracunculiasis (guinea worm disease)
- Echinococcosis
- Endemic treponematoses (Yaws)
- Foodborne trematodiases
- Human African trypanosomiasis (sleeping sickness)
- Leishmaniasis
- Leprosy (Hansen disease)
- Lymphatic filariasis
- Onchocerciasis (river blindness)
- Rabies
- Schistosomiasis
- Soil-transmitted helminthiases
- Taeniasis/Cysticercosis
- Trachoma
Neglected Tropical Diseases

- Buruli Ulcer
- Chagas disease
- Dengue and Chikungunya
- Dracunculiasis (guinea worm disease)
- Echinococcosis
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- Rabies
- Schistosomiasis
- Soil-transmitted helminthiases
- Taeniasis/Cysticercosis
- Trachoma

California has vector and/or disease agent
State Reportable Diseases

California Department of Public Health

- 81 human diseases or conditions (including all the national diseases), 2 animal diseases (rabies and plague)
- Vector-Borne diseases include:
  - Anaplasma/Ehrlichiosis
  - Babesiosis
  - Colorado Tick Fever (to be removed next year)
  - Dengue
  - Hantavirus cardiopulmonary syndrome
  - Lyme Disease
  - Malaria
  - Plague (human or animal)
  - Relapsing fever
  - Rocky Mountain spotted fever
  - Tularemia
  - West Nile virus
  - Yellow Fever
Adapted from Braks et al, Parasites and Vectors 2011, 4: 192
Notifiable Disease Surveillance: Route of Information

Reporting mandated by state law (Title 17 CCR)

Health care providers, laboratories, others, report to local health department (LHD)

LHD submits reports to CDPH

Reports transmitted to Centers for Disease Control and Prevention (CDC)
Notifiable Disease Surveillance: Route of Information

Reporting mandated by state law (Title 17 CCR)
Reportable TBD include: anaplasmosis, babesiosis, Lyme disease, relapsing fever (*B. hermsii*), spotted fever and non-spotted fever group rickettsia

Local health department (LHD) receives, follows-up, reviews reports

LHD submits reports to CDPH

Reports transmitted to Centers for Disease Control and Prevention (CDC)
Vector-Borne Disease Section

Primary Vector Programs
- Mosquito
- Flea
- Tick
- Rodent
Some vector-borne diseases require complex surveillance efforts to monitor, intervene, anticipate, detect, and study their epidemiology (just a few of surveillance functions)

West Nile virus transmission cycles in California

Urban cycle

Rural cycles

Aedes, Culiseta

??

Culex tarsalis

Bird/Mosquito Movement?

Culex pipiens stigmat.

?? erythro.

Dead end hosts

UCDAVIS
CALIFORNIA MOSQUITO-BORNE VIRUS SURVEILLANCE & RESPONSE PLAN

Edmund G. Brown Jr., Governor

California Department of Public Health
Mosquito & Vector Control Association of California
University of California

For further information contact:
Vector-Borne Disease Section
California Department of Public Health
(916) 352-9730
http://westnile.ca.gov

April 2015
Plague Surveillance

- CDPH has expanded and refined the statewide plague surveillance program to include:
  - investigations of human and domestic felid plague cases
  - serologic monitoring of wild carnivores
  - evaluation of epizootic activity in rodents
    - Exposure potential to humans from vector fleas assessed
    - Past history of epizootics and/or human plague cases in the region reviewed
    - Recommendations and actions taken to reduce vectors and public exposure
Tick Surveillance
Human Dengue, Chikungunya and Zika Surveillance in California

Looking Beyond the Unfortunate Travel Souvenir
Viruses and Transmission

• Chikungunya is an alpha virus similar to WEE and Ross River virus
• Dengue and Zika viruses are both flaviviruses similar to yellow fever and Japanese encephalitis virus
• All are arboviruses and transmitted primarily human to human by *Aedes aegypti* and *Ae. albopictus*
Dengue, Chikungunya, Zika mosquito transmission cycles
Geographic spread

Dengue virus area of risk

Spread of Chikungunya virus

The spread of the Zika virus
Arboviruses
Ease of Introduction
Aedes modes of introduction into U.S.

Imported used tires
(Southeastern U.S.)

Lucky Bamboo (California)
Aedes albopictus and Aedes aegypti have arrived and become established in CA

Aedes albopictus  
Asian tiger mosquito  
2008: First introduced then eradicated  
2011: Los Angeles County

Aedes aegypti  
Yellow fever mosquito  
2013: Madera, Fresno, San Mateo Counties
Impact of invasive *Aedes* introduction to California

- **Vector:** Dengue, chikungunya, and several encephalitis viruses
- Increased risk of introduction of exotic mosquito-borne viruses
- Aggressive day-biting mosquitoes
- Prefer to bite people (rather than birds or other animals)
- Difficult to control: Breed in containers
Invasive *Aedes* Mosquitoes Detection Sites in California, 2011-2015


- **Green** (*Aedes albopictus*): Hayward, Menlo Park, Atherton, El Monte, Arcadia, Irwindale, Duarte, Monrovia, Monterey Park, City of Industry, Bradbury, South El Monte, Avocado Heights, Whittier, San Gabriel, La Puente.
Climate Change and Invasive *Aedes* Mosquitoes in CA

- **Tropical species**
  - Warm weather enhances survival, reproduction, and spread

- **Drought: unintended consequence**
  - Residents store water in backyard buckets, containers, and rain barrels
  - Do not maintain swimming pools

- *Aedes* establishment and spatial distribution may serve as indictors of climate change
Aedes aegypti and Aedes albopictus Mosquitoes

Two invasive (non-native) mosquito species have recently been found in several California cities (see map below) and there is a potential for them to spread into other areas of California. They are named Aedes aegypti (the yellow fever mosquito) and Aedes albopictus (the Asian tiger mosquito). Unlike most native mosquito species, Aedes aegypti and Aedes albopictus bite during the day. Both species are small black mosquitos with white stripes on their back and on their legs. They can lay eggs in any small artificial or natural container that holds water.

Aedes aegypti and Aedes albopictus have the potential to transmit several viruses, including dengue, chikungunya, Zika, and yellow fever. None of these viruses are currently known to be transmitted within California, but thousands of people are infected with these viruses in other parts of the world, including in Mexico, Central and South America, the Caribbean, and Asia. The presence of Aedes aegypti and Aedes albopictus mosquitoes in California poses a threat that dengue and chikungunya viruses can be transmitted in infested areas from returned infected travelers. Travelers can protect themselves by preventing mosquito bites. When traveling to countries with dengue, chikungunya, or Zika use insect repellent, wear long sleeves and pants, and stay in places with air conditioning or with window and door screens.
Local mosquito response

San Gabriel Valley Mosquito & Vector Control District
Protecting the Public from Vector-Borne Disease since 1989

Sterile Male Tiger Mosquito Release Program

An environmentally-safe and pesticide-free approach for the control of Asian tiger mosquito infestations in Southern California.

In the Sterile Male Tiger Mosquito Pilot Program, Vector Control will release sterile male Asian tiger mosquitoes (Aedes albopictus) in a localized area of South El Monte. Male mosquitoes do not bite and will mate with female tiger mosquitoes in the infestation zone. Eggs laid by these mated female mosquitoes will be sterile and will not hatch. The released males will die soon after mating. This program will show how well the control strategy can contribute to our overall Asian tiger mosquito control program.

This technique will only target the Asian tiger mosquitoes.

Asian tiger mosquitoes have taken broad hold in an increasing number of neighborhoods since they were detected in 2011. For four years, they have posed a potential public health risk to millions of people living in Los Angeles County. As they expand their presence, they increase the risk for local disease outbreaks of dengue and chikungunya.

While most cases are outside of the United States, residents traveling to areas with local transmission can come back infected. Infected travelers entering an area where Asian tiger mosquitoes are present can start a local outbreak of these debilitating illnesses.

LA County Invasive Aedes Infestation Area

District Alert!

Due to the recent drought many pools and ponds have dried up. Any standing water at the bottom make perfect habitats for mosquitoes.

Click here for maintenance tips for you water features

Click here for information on our functional pool policy

GLOSSARY OF TERMS
Surveillance for Chikungunya, Dengue and Zika in California

- CDPH is working closely with local health departments and vector control agencies
  - Identifying viremic cases
  - Mapping co-location of viremic cases and invasive *Aedes*
  - Prompting mosquito surveillance near case residents

- Communication between local Vector Control Agencies and Health Departments is critical to ensure rapid response to reduce risk of local transmission
In 2015:

- 561,501 confirmed and 2,326,829 probable cases
- Including 10,276 deaths
- Highest incidence rate (820/100,000) was in Brazil with over 1.5 million cases
- Cases were reported from 49 countries or territories in the Americas
Confirmed Dengue Cases in Mexico by State
January 1, 2015 – December 31, 2015

Data for map available from http://www.epidemiologia.salud.gob.mx/dgae/panodengue/intd_dengue.html
Dengue Outbreak in Hawaii
260 Cases to Date


As of February 10, 2016

Total number of confirmed cases

Risk levels for potential dengue infection:
- High Risk
- Moderate Risk
- Some Risk

*Risk levels of areas where confirmed cases may have contracted dengue fever are determined by the number of confirmed cases with recent onset dates who reported visiting those areas. Individuals should always protect themselves against mosquitoes and mosquito bites island-wide; extra precaution should be taken in areas of risk. For more information on dengue fever and ways to protect yourself from mosquitoes, visit: http://health.hawaii.gov/docd/dengue-outbreak-2015/*
Countries or territories with reported autochthonous transmission. Total cases as of EW 5, 2016.

- Total cases in 2016
  - > 1,778 to 3,178
  - > 243 to 1,778
  - > 19 to 243
  - > 0 to 243
  - > 0 to 19
  - 0 to 0
Confirmed Chikungunya Cases in Mexico by State
January 1, 2015 – December 31, 2015

Sonora
Chihuahua
Coahuila
Durango
Nuevo León
Tamaulipas
Yucatán
Oaxaca
Guerrero
Chiapas
Colima
Jalisco
Nayarit
Tabasco
Puebla
Morelos

Countries, Territories and Areas with Autochthonous Zika Virus Circulation (2007-2016)
Confirmed Zika Cases in Mexico by State
January 1, 2016 – February 19, 2016

Sonora
Chihuahua
Coahuila
Durango
Nuevo León
Tamaulipas
Yucatán
Oaxaca
Guerrero
Chiapas
Colima
Jalisco
Nayarit
Tabasco
Morelos

0 confirmed cases
1 – 25 confirmed cases
26 – 50 confirmed cases
51 – 100 confirmed cases
More than 100 confirmed cases

Ag. = Aguascalientes
Quer. = Querétaro
DF = Distrito Federal
Tl. = Tlaxcala

Data provided by the Mexican Ministry of Health
Imported Dengue in the United States, 2015

N=540
Imported Human Dengue Cases in California 2010-2015*

n = 581

Number of reported dengue cases

<table>
<thead>
<tr>
<th>Year</th>
<th>Confirmed</th>
<th>Probable</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>1</td>
<td>42</td>
</tr>
<tr>
<td>2012</td>
<td>10</td>
<td>76</td>
</tr>
<tr>
<td>2013</td>
<td>8</td>
<td>119</td>
</tr>
<tr>
<td>2014</td>
<td>23</td>
<td>109</td>
</tr>
<tr>
<td>2015</td>
<td>25</td>
<td>89</td>
</tr>
</tbody>
</table>

* As of February 17, 2016
Imported Dengue in California, 2015

• 114 cases reported in 2015*
  – From 22 counties, 10 with invasive *Aedes*
  – 62 cases returned to counties with invasive *Aedes*
    • Of those 76% were likely viremic while in California
• 54% of cases were female
• 32% of cases required hospitalization
• 45% of cases had travel to Latin America
  – Mexico 17%, El Salvador 12%

*Estimated February 2016
Chikungunya in the United States

2014:
- 2,811 imported cases reported in US
- 12 locally acquired cases in Florida

2015:
- 679 imported cases reported in US
- No locally acquired cases
Imported Chikungunya Cases in California, 2015

- 233 cases reported in 2015* (140 cases in 2014)
  - From 30 counties, 10 with invasive *Aedes*
  - 152 cases returned to counties with invasive *Aedes*
    - Of those 53% were likely viremic while in California
- 67% of cases were female
- Only 8% of cases required hospitalization
- 91% of cases had travel to Latin America
  - Mexico 40%, El Salvador 16%, Guatemala 13%

*Estimated as of February 2016
Dengue and Chikungunya Cases in California and Location of Invasive Aedes

- **Aedes aegypti**
- **Aedes albopictus**

2015 Human dengue and/or chikungunya cases:
- No reported cases
- 1-10 reported cases
- 11-20 reported cases
- >21 reported cases

California, USA

- San Diego
- Los Angeles
- Kern
- Tulare
- Fresno
- Madera
- San Bernardino
- Riverside
- Imperial
- San Diego
- Alameda
- San Mateo
Imported Zika in the United States, 2015-2016

N = 107
### Imported Zika in California 2013-2016

<table>
<thead>
<tr>
<th>Year</th>
<th>CDC Final Confirmed Cases*</th>
<th>CDC Preliminary Positive Cases*</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>1</td>
<td>NA</td>
</tr>
<tr>
<td>2014</td>
<td>3</td>
<td>NA</td>
</tr>
<tr>
<td>2015</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>2016</td>
<td>6</td>
<td>0</td>
</tr>
</tbody>
</table>

- All 14 Zika cases reported to date have traveled to a region with a known Zika outbreak at time of travel
- Travel countries include: French Polynesia, Cook Islands, Easter Island, Kiribati, El Salvador, Haiti, Colombia, Mexico and Honduras
- Of the 10 cases in 2015-2016, 5 were residents of counties with invasive *Aedes*
  - 8 were potentially viremic while in California

*CDPH has received the final written lab report from CDC
**CDPH has received preliminary notification of a positive case from CDC
Factors Mitigating Dengue, Chikungunya and Zika Transmission in California

- Relatively short viremia (average 5-7 days)
- Housing conditions and lifestyles minimize vector - human contact
- Vector distribution and longevity is variable and uneven
- Vector density needed for transmission may not be high enough
- Comprehensive mosquito control programs in California
Conclusion

- Risk of local dengue, chikungunya or Zika transmission is low
- No locally acquired infections have been documented in California
- The detection of *Aedes aegypti* and *Aedes albopictus* and viremic travelers in the same area is a public health concern
  - Climate change/Drought may impact distribution/abundance of vector based on human response
- Enhanced surveillance of both mosquitoes and case patients is necessary to reduce risk of autochthonous transmission
More Information

California Department of Public Health (CDPH)
https://www.cdph.ca.gov/HealthInfo/discond/Pages/Zika.aspx

Centers for Disease Control and Prevention (CDC)

Pan American Health Organization (PAHO)

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916-552-9758
Rocky Mountain Spotted Fever: a Re-Emerging Disease
California has several endemic tick-borne pathogens in Rickettsiales order

Rickettsial diseases called, “spotted fever group” because rashes are typically seen with infections with these bacteria
RMSF in Humans

• Clinical:
  – Nonspecific (can be difficult to diagnose)
  – Fever, headache, nausea, muscle aches 2-14 days after tick bite
  – Rash develops 3-5 days after fever
  – Decreased clotting cells leading to severe complications: Acute respiratory distress syndrome (ARDS), abdominal pain (leading to surgery), neurologic or bleeding disorders, loss of circulation (gangrene)
  – Case fatality reports ranging from 5-90%
RMSF in Humans

• **Diagnosis:**
  – Serology: Rising antibody titers (4X change in acute and convalescent samples). IFA or ELISA tests.
  – PCR, immunohistochemical staining of tissue, culture: (tissues difficult to obtain)

• **Treatment: Doxycycline**
  – adults and children
  – Can not wait for diagnosis – must treat on suspicion
Life cycle of *Rickettsia rickettsii*

- Mammal reservoir but...
- Tick may be both reservoir and vector
- Rarely find agent in the tick

- American Dog Tick
  *Dermacentor variabilis*

- Rocky Mountain wood tick
  *Dermacentor andersoni*
Rocky Mountain Spotted Fever Nationally

Source: CDC http://www.cdc.gov/rmsf/stats/
Rocky Mountain Spotted Fever, Arizona

- 2002-2004: 11 confirmed cases of RMSF identified in close geographic area in Arizona
- No *Dermacentor* spp ticks found in area
- Homes and areas around homes infested with brown dog ticks; many free-roaming dogs in area
- *R. rickettsia* detected molecularly and cultured from area ticks
- First time brown dog tick implicated as vector for RMSF in N. America
RMSF Response: 2004-2005

SHORT TERM
• Education for residents & clinicians
• Tick control on dogs
• Pest control around homes
• Community clean-up

LONG TERM
• Animal control program
• Sustained vector control
• Structural changes to homes – skirting
• Clean-up campaign: Tribal Members and others

Team: CDC, HIS, Tribes, ADHS, ORKIN®, WATSONIANS, USDA, Army – Ft. Huachuca
Tick Control for Dogs: Animal Services Agency Coordination

- USDA, Army, CDC, IHS & ADHS
- Zodiak® tick collars – (propoxur – 3 month residual) were placed on 1,000’s of dogs (est. 70%+ coverage)
- Also, spot-on treatments & sprays
Not all dogs were approachable
Rocky Mountain Spotted Fever, Mexico

- Urban outbreak of RMSF in Mexicali, Mexico, 2009
- Brown dog tick-associated
- > 1200 suspect cases, 217 confirmed
- 6 deaths (2.3%) among confirmed cases
Brown dog tick habitat, Mexico

Are dogs in California Affected?

- Dogs are a common tick host for *R. rickettsii* tick-vectors. They can get ill-even die- from infections with *R. rickettsii*.
- Reports in the literature of concomitant infection of owners and their dogs, suggesting a common exposure
- Anecdotal reports of RMSF in CA dogs
The Infestation of *Rhipicephalus sanguineus* in a Residential Area, Riverside, 2005
Dog Mansion
Findings

• On July 26, 2005, more than 200 *Rh. sanguineus* ticks were collected at the site in Riverside

• *R. rickettsii* DNA was detected in 1 of 62 (1.6%) adult *Rh. sanguineus* ticks by CDC (different from those isolated from Montana and Arizona.)
Does Spot get Spots?
Survey for Canine Cases of Rocky Mountain Spotted Fever in California.
Results

- 338 completed responses
- Predominately small animal practices though a few mixed and exotic-mixed practices also responded.
- Practice size ranged from 5-50,000 dog visits per year (median 2500 dog visits).
<table>
<thead>
<tr>
<th>County</th>
<th># Reported RMSF Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orange</td>
<td>6</td>
</tr>
<tr>
<td>San Diego</td>
<td>5</td>
</tr>
<tr>
<td>Contra Costa</td>
<td>3</td>
</tr>
<tr>
<td>San Mateo</td>
<td>3</td>
</tr>
<tr>
<td>Alameda</td>
<td>2</td>
</tr>
<tr>
<td>Calaveras</td>
<td>1</td>
</tr>
<tr>
<td>Kern</td>
<td>1</td>
</tr>
<tr>
<td>Los Angeles</td>
<td>1</td>
</tr>
<tr>
<td>Riverside</td>
<td>1</td>
</tr>
<tr>
<td>Sacramento</td>
<td>1</td>
</tr>
<tr>
<td>Santa Barbara</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>25</td>
</tr>
</tbody>
</table>
### Clinical Presentation

<table>
<thead>
<tr>
<th>Clinical Sign</th>
<th>Number (percentage) n=25</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fever</td>
<td>17 (68%)</td>
</tr>
<tr>
<td>Other*</td>
<td>11 (44%)</td>
</tr>
<tr>
<td>Multiple painful joints</td>
<td>11 (44%)</td>
</tr>
<tr>
<td>Tiny hemorrhages on gums, mucous membranes</td>
<td>4 (16%)</td>
</tr>
<tr>
<td>Abdominal Pain</td>
<td>3 (12%)</td>
</tr>
<tr>
<td>Edema (swelling)</td>
<td>2 (8%)</td>
</tr>
</tbody>
</table>
Small number of clinical cases precludes statistical comparison, however, note that a large percentage of clinics with RMSF dogs reported high exposure in their general practice to the brown dog tick, followed by the American dog tick and the western black-legged tick when compared to all practices.

### Comparison of reported tick species between veterinary practices with and without RMSF K9 cases

<table>
<thead>
<tr>
<th>Tick Species</th>
<th>Practices with NO RMSF (n=321)</th>
<th>Practices with RMSF (n=17)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown dog tick</td>
<td>80%</td>
<td>90%</td>
</tr>
<tr>
<td>Unknown spp.</td>
<td>50%</td>
<td>0%</td>
</tr>
<tr>
<td>American dog tick</td>
<td>60%</td>
<td>100%</td>
</tr>
<tr>
<td>None to rare tick</td>
<td>30%</td>
<td>100%</td>
</tr>
<tr>
<td>Western black-legged tick</td>
<td>20%</td>
<td>100%</td>
</tr>
<tr>
<td>Pacific Coast tick</td>
<td>0%</td>
<td>10%</td>
</tr>
<tr>
<td>Rocky Mtn Wood tick</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Lone Star tick</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Winter tick</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>
“Does Spot get Spots?”

Conclusions

• RMSF is rare in dogs in California
• Large number of cases reported from urban areas and with no travel history supports idea that RMSF ecology has changed over the past 50 years.
• Spot *does* get spots, though rarity of disease both in humans and dogs and complexity of surveillance precludes using canines as regular “sentinel” for human disease.
Could dogs in Southern California be infected with *R. rickettsii* and/or infested with infected brown dog ticks? (CDC, CDPH and Imperial Co. DOH study)

Established Two Sites for Dog Surveillance

- City Animal Shelter in Calexico
- County Animal Shelter in El Centro
Training Animal Shelter Staff
Results

• 116 dogs examined (45 in Calexico and 71 in El Centro) March - April 2009
• Ticks found on 35 (30%) dogs (16 in Calexico and 19 in El Centro)
• Overall, 200 ticks were collected (111 females, 87 males, and 2 nymphs) and all were identified as *Rh. sanguineus*
• PCR testing results showed that one female tick was presumptively positive for rickettsial DNA but species (or strain) was not confirmed
Conclusions

• *Rh. sanguineus* infestation on dogs in Imperial Co. is more heavier than initially thought and the ticks can be potentially relocated into neighboring areas

• Lack of *R. rickettsii* detection in ticks suggested that the risk of RMSF in the area is minimal at the time

• Active tick surveillance and control of free-roaming dogs are important aspects for keeping the risk of RMSF below epidemic thresholds
2013

- Resident, Fresno county
- Presented late December 2012 to local ED with fever, headache, muscle aches, rash on wrist, leg, and torso.
- Patient succumbed to illness
- Organ tissues tested positive by immunohistochemistry and PCR at CDC
- Patient had history of visiting local rural California areas one week preceding disease onset
- 36 *Dermacentor* spp. ticks recovered from one area patient visited; all tested negative
2014

- Resident, Imperial County
- Presented May to local ED with fever, nausea, vomiting
- During course of illness, RMSF serologic tests showed rising titer (confirmed case)
- Patient could not recover and died late June
- Patient’s mother traveled with dogs across Mexican border
- Brown dog ticks present in and around home; 1/95 positive for *R. rickettsii*
- News release issued by Imperial County after patient’s death to increase awareness of disease, importance of treating tick infestations
Life cycle of *Rickettsia rickettsii*

**Tick Vectors in California**

- Mammal reservoir but...
- Tick may be *both* reservoir and vector
- Rarely find agent in the tick

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**Brown Dog Tick**
*Rhipicephalus sanguineus*
Urban areas and natural areas throughout California

**Pacific Coast tick, CA**
*Dermacentor occidentalis*
Humid, natural areas throughout California

**American Dog Tick**
*Dermacentor variabilis*
Natural areas throughout California

**Rocky Mountain wood tick**
*Dermacentor andersoni*
Natural areas northeastern California
Since 2002 there have been 13 confirmed cases of RMSF reported in California.

- Travel history out of county
- Fatality

County of residence of confirmed RMSF human cases
Number Confirmed and Probable RMSF Cases, 1997 - 2014
RMSF Seasonality

Nationwide, 1993 - 2010

California, 1997 - 2014
Demographics, RMSF Confirmed and Probable Reported Cases, 1997 – 2014

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>95% CI Lower</th>
<th>95% CI Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>24</td>
<td>43.6 %</td>
<td>30.3 %</td>
<td>57.7 %</td>
</tr>
<tr>
<td>Male</td>
<td>31</td>
<td>56.3 %</td>
<td>42.3 %</td>
<td>69.7 %</td>
</tr>
<tr>
<td>TOTAL</td>
<td>55</td>
<td></td>
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</tr>
</tbody>
</table>

Age distribution of RMSF reported cases:

`Age`:
- 0 - 9: 4
- 10 - 19: 4
- 20 - 29: 2
- 30 - 39: 6
- 40 - 49: 6
- 50 - 59: 10
- 60 - 69: 11
- 70 - 79: 4
- 80 - 89: 1

Count by Age:

- 0 - 9: 4
- 10 - 19: 4
- 20 - 29: 2
- 30 - 39: 6
- 40 - 49: 6
- 50 - 59: 10
- 60 - 69: 11
- 70 - 79: 4
- 80 - 89: 1
North/South Distribution County of Residence, RMSF Case Patients

Proportion of case-patients (confirmed and probable) whose county of residence is in North/South CA, by year of symptom onset, $p < 0.05$. 
Frequency of Hispanic/Latino ethnicity self reported, by year

- Trend (not significant) toward greater frequency of Hispanic/Latino ethnicity, (N=39)
Chi Squared (MxN) p > 0.05
Typical *Dermacentor* spp Life Cycle

Note: The life cycle of a 3-host tick may take 1-2 years depending on whether or not the tick can find a suitable host between life stages.

1. Female tick lays eggs on ground.

2. Six-legged larva feeds on a small mammal, then drops off to the ground and molts.

3. Eight-legged nymph feeds on a small mammal, then drops off to the ground and molts.

4. Eight-legged adults feed and mate on a larger mammal, including livestock and pets, then drop off to the ground. Males die soon thereafter and females begin to develop eggs.
Brown Dog Tick (*Rhipicephalus sanguineus*)

typical life cycle
Impact on Messaging
For both tick vectors:

• Awareness of Disease
• Avoid tick bites
  – Remove ticks promptly and correctly
  – Inspect pets and remove ticks
• See physician if develop fever, headache or rash after tick bite
• Take pet to veterinarian if it develops fever, lethargy after tick-bite
Impact on Messaging: *Dermacentor* spp

- **Awareness of RMSF Disease**
  - More general approach
  - Target audience (California): outdoor enthusiasts, rural residents

- **Avoid tick bites**
  - Stay in middle of trails
  - When in tick habitat: wear repellents containing DEET or clothing treated with permethrin
  - Remove ticks promptly and correctly

- **See physician if develop fever, headache or rash after tick bite**

- **Take pet to veterinarian if it develops fever, lethargy after tick-bite**
Impact on Messaging
Brown Dog Tick (Rhipicephalus sanguineus)

- Awareness of Disease
  - May need community approach
    - Local resident/physician awareness

- Avoid tick bites
  - Host and environmental issue
    - Keep dogs on tick prevention (collars, vet-approved product)
    - Environmental treatment may be required by licensed pest-control operator (multiple treatments sometimes necessary)
    - Clean up yard to remove debris where ticks can hide
      - Remove ticks promptly and safely
      - Inspect pets and remove ticks

- See physician if develop fever, headache or rash after tick bite
- Take pet to veterinarian if it develops fever, lethargy after tick-bite

Source: Az. Dept. of Health Services
Treating Brown Dog Tick Infestations
Protect Your Family From Rocky Mountain Spotted Fever!

Get Rid of Ticks on People
When you are outside or touching dogs you might get a tick. After you come inside check your body and your child’s body for ticks and take them off.

Get Rid of Ticks in Your Yard
Ticks live in the things you leave outside such as old mattresses. Don’t give ticks a home. Take trash and old mattresses from your yard to the landfill. Some yards may also need treatment with a chemical that kills ticks.

Contact a Doctor or Nurse
Rocky Mountain spotted fever is a disease that is spread by ticks. A person who has Rocky Mountain spotted fever would have a fever and sometimes a rash.

Call your doctor or public health nurse if you or your child:
- Get a fever or rash
- Have been outside or touching dogs

For more information on Rocky Mountain spotted fever:
San Carlos Health Department: (928) 475-2798
Indian Health Services- Office of Environmental Health: (928) 475-7213
Conclusions: re-emerging *Rickettsia*

- Newly identified tick vector for California demonstrated
- Potential south to north introduction
- Impacts health education messaging
- One health approach (canine/human) useful for surveillance and control
  - Sustained surveillance/control effort needed for brown dog tick-transmitted RMSF
Final Thoughts on Diseases at California’s Door

• More pandemics likely to be seen “knocking” at the door
  • Air travel/massive rapid movement of people
  • Increased income disparity will contribute to emergence
  • Climate change may influence vectors as well as social structure that will encourage more migration
• Public health infrastructure allows for early detection and planning for introduced disease
  • Ongoing, systematic surveillance
• Build on previous experience (e.g. West Nile virus) and multi-agency (One-Health) collaboration
Questions?