Vector Borne Diseases – What Pediatric Nurse Practitioners Need to Know
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Duke Travel Medicine and Employee Health
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Speaker Introduction
Dr. Elizabeth Carver works in travel medicine in the Duke University Health System. A graduate of the University of North Carolina at Chapel Hill with degrees in psychology and nursing, she has worked at Duke for more than 20 years in patient care, research and nursing education while pursuing advanced degrees. As a nurse practitioner, she has co-authored several publications and is a national certified nurse educator (CNE). She is a member of American Nurses Association and NAPNAP. A frequent speaker on vector-borne diseases, she provides needed insights on diagnoses, treatment, parent communications and prevention messaging for stay-at-homes and travelers. She provides guidance on where vector-borne diseases are encountered in the U.S., dispelling myths and allaying parents’ concerns while encouraging prevention strategies.

Disclosures
I disclose the absence of personal or financial relationships with commercial interests relevant to this educational activity.

Learning Objectives: Vector-borne Diseases
• When patients are at risk where they live and travel
• Key messages for parents and others
• Knowing when immediate medical attention/intervention is required

Ticks
• “The Swiss Army knife of disease vectors” (National Academy of Sciences)
• Deliver bacteria, protozoans, viruses
• Around since the Jurassic era
• Major factor in illnesses worldwide
• Are opportunistic. They do not fall from trees...are in knee-high vegetation
• Survive frigid climates
• MOST BITES -- YOUR OWN YARD

Tick Statistics
• 700 hard tick species worldwide
• Of these, 241 are Ixodes
• 80 in U.S., 4 exotic
• 9 U.S. species of hard ticks and one soft tick transmit pathogens to humans
• Ticks have multi-year life span—all life stages can be infected
**U.S. Ticks**

- Lone Star Tick
- Deer or Blacklegged Tick
- Pacific Coast Tick
- Rocky Mountain Wood Tick
- American Dog Tick
- Western Blacklegged Tick
- Brown Dog Tick
- Gulf Coast Tick
- Groundhog Tick
- Soft Tick

**What These Ticks May Carry**

<table>
<thead>
<tr>
<th>Type of tick</th>
<th>May Carry These Diseases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lone Star Tick</td>
<td>Alpha-gal Meat Allergy, Bourbon Virus, Ehrlichiosis, Heartland Virus, STARI, Tularemia</td>
</tr>
<tr>
<td>Blacklegged (or Deer) Tick</td>
<td>Anaplasmosis, Babesiosis, Borrelia miyamotoi, Lyme Disease, Powassan</td>
</tr>
<tr>
<td>Pacific Coast Tick</td>
<td>Colorado Tick Fever, Pacific Coast Tick Fever, Rocky Mountain Spotted Fever, Tularemia</td>
</tr>
<tr>
<td>Rocky Mountain Wood Tick</td>
<td>Colorado Tick Fever, Rocky Mountain Spotted Fever, Tick Paralysis, Tularemia</td>
</tr>
<tr>
<td>American Dog Tick</td>
<td>Rocky Mountain Spotted Fever, Tularemia</td>
</tr>
<tr>
<td>Western Blacklegged Tick</td>
<td>Anaplasmosis, Lyme Disease</td>
</tr>
<tr>
<td>Brown Dog Tick</td>
<td>Rocky Mountain Spotted Fever (rarely bites people)</td>
</tr>
<tr>
<td>Gulf Coast Tick</td>
<td>Rickettsia parkeri (a form of spotted fever), Tick Paralysis</td>
</tr>
<tr>
<td>Groundhog Tick</td>
<td>Powassan (rarely bites people)</td>
</tr>
<tr>
<td>Soft Tick</td>
<td>Tick-borne Relapsing Fever</td>
</tr>
</tbody>
</table>

**The Most Common Tick-borne Diseases in the U.S.**

<table>
<thead>
<tr>
<th>Tick-borne Disease</th>
<th>Cases in 2019</th>
<th>Cases in 2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lyme*</td>
<td>N/A</td>
<td>33,666</td>
</tr>
<tr>
<td>Spotted fever rickettsiosis*</td>
<td>4,647</td>
<td>5,544</td>
</tr>
<tr>
<td>Anaplasmosis</td>
<td>4,697</td>
<td>4,008</td>
</tr>
<tr>
<td>Babesiosis</td>
<td>2,147</td>
<td>2,160</td>
</tr>
<tr>
<td>Ehrlichiosis</td>
<td>1,823</td>
<td>1,832</td>
</tr>
<tr>
<td>Tularemia</td>
<td>233</td>
<td>229</td>
</tr>
<tr>
<td>Powassan</td>
<td>31</td>
<td>21</td>
</tr>
<tr>
<td>Borrelia Miyamotoi, Bourbon, Heartland</td>
<td>Emerging</td>
<td>no national data</td>
</tr>
</tbody>
</table>

*Confirmed & probable cases

**Lyme Disease**

- Lyme: 95% of cases from 14 states
- 2018--33,666 cases reported nationally
- 18% in children 15 and under

**Lyme Disease in Endemic States**

<table>
<thead>
<tr>
<th>State</th>
<th>2019</th>
<th>2018*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connecticut</td>
<td>1,859</td>
<td>1,226</td>
</tr>
<tr>
<td>Delaware</td>
<td>520</td>
<td></td>
</tr>
<tr>
<td>Maine</td>
<td>1,405</td>
<td>2,128</td>
</tr>
<tr>
<td>Maryland</td>
<td>1,382</td>
<td></td>
</tr>
<tr>
<td>Massachusetts</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Minnesota</td>
<td>1,541</td>
<td></td>
</tr>
<tr>
<td>New Hampshire</td>
<td>1,428</td>
<td></td>
</tr>
<tr>
<td>New Jersey</td>
<td>4,000</td>
<td></td>
</tr>
<tr>
<td>New York</td>
<td>3,638</td>
<td></td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>10,208</td>
<td></td>
</tr>
<tr>
<td>Rhode Island</td>
<td>1,111</td>
<td>959</td>
</tr>
<tr>
<td>Vermont</td>
<td>576</td>
<td></td>
</tr>
<tr>
<td>Virginia</td>
<td>1,139</td>
<td>1,021</td>
</tr>
<tr>
<td>Wisconsin</td>
<td>1,869</td>
<td></td>
</tr>
<tr>
<td>California</td>
<td>104</td>
<td></td>
</tr>
</tbody>
</table>

*Preliminary number of cases

**Lyme Disease—Most Common Symptom**

- Onset 7-14 days after tick attachment
- Bull’s eye
- Painless, doesn’t itch
- Identified in 60-80% of cases
- Usually no associated symptoms
Symptoms in Children – 1996 study

<table>
<thead>
<tr>
<th>Clinical Finding (n=201)</th>
<th>Stage of Disease</th>
<th>Early Localized</th>
<th>Early Disseminated</th>
<th>Late</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-erythema migrans lesion</td>
<td>XXX</td>
<td>2</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Fever</td>
<td>24</td>
<td>45</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Headache</td>
<td>58</td>
<td>80</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Rash</td>
<td>42</td>
<td>70</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>Ataxia</td>
<td>33</td>
<td>50</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Neck</td>
<td>26</td>
<td>34</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Nausea</td>
<td>21</td>
<td>36</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Abdominal pain</td>
<td>17</td>
<td>28</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Diarrhea</td>
<td>16</td>
<td>21</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Myalgia</td>
<td>16</td>
<td>21</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Nausea</td>
<td>16</td>
<td>21</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Vomiting</td>
<td>12</td>
<td>20</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Sweating</td>
<td>8</td>
<td>12</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Headache</td>
<td>8</td>
<td>15</td>
<td>23</td>
<td></td>
</tr>
<tr>
<td>Vomiting</td>
<td>7</td>
<td>25</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Conjunctivitis</td>
<td>5</td>
<td>25</td>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>

Atypical Erythema Migrans

- *Rheumatoid arthritis*
- *Hodgkin lymphoma*
- *Meningitis*
- *Central nervous system involvement* 9 (3)
- *Rheumatoid arthritis* 9 (3)
- *Meningitis* 9 (3)
- *Central nervous system involvement* 0 (0)
- *Total* 19 (9)

Same Ticks Are Different in the South

- In the South, deer ticks reclusive
  - Rarely emerge from leaf litter
  - Prefer other hosts
  - Less likely to feed on humans
  - Less Lyme in the environment
  - Ticks feed on lizards
  - Lizards' blood removes spirochetes in infected ticks
- In ENDEMIC areas, ticks are aggressive
  - PREFER humans

Anaplasmosis

- 2019 – 4,697 cases in the U.S.
- Children under 18 represent up to 8% of cases

Babesiosis

- 2019 - 2,147 cases in the U.S.
- 94.5% in 7 states (CT, MA, MN, NJ, NY, RI, and WI)
- 3% among children 19 and under
- Microscopic parasites infect red blood cells
  - Can also be transmitted by blood transfusions

Powassan – Another Concerning Virus Delivered by the Deer Tick

- Same 14 states as Lyme (vectored by deer ticks)
- Transmission occurs within 15 minutes of attachment
- Rare, but 10% fatality rate
- 50% of survivors have lasting neuro symptoms
Spotted Fever Rickettsioses

Rocky Mountain Spotted Fever is the one of greatest concern
• Children 10-19 at moderate risk
• Those 5–9 at highest risk for fatal outcome
• Tick attachment >6 hours required for injection of bacteria
• Symptom onset 7 days -14 days after tick bite
• FIVE states account for 60%+ of all cases
  • NC, OK, AR, TN, MO

Ehrlichioses

• 2019–1,921 cases
• 12% in individuals 18 or younger
• MO, AK, NY, VA – more than 50% of all reported cases (2017)

Southern Tick Associated Rash Illness (STARI)

• Not bacterial
• Pathogen unknown
• Reported in children
• Lyme-like symptoms
• In the Southeast, more prevalent than Lyme
• Also called Masters’ Disease
• Lone Star ticks

Heartland Virus

• More than 40 cases reported since 2009
• Pre 2019, all cases were in older men with frequent outside exposures
• Not notifiable
• Fatalities have occurred

Incidence in 2018

Case Fatality Rate, RMSF 2008-2013

• Children <10 years = 6% of RMSF diagnoses, but 22% of RMSF deaths
• “If you don’t treat by Day 5, they may be DEAD by Day 8”—CDC MD
• Before antibiotics, fatality rate was 80%
Galactose-alpha 1,3-galactose (alpha gal) present in tick saliva and red meat is found in children

Delayed anaphylaxis, hives

Reaction to meat consumption (beef, pork, lamb, wild game, cow’s milk)

May be fat-content related, so risk in milk is lower

In VA, 15% of patients were children (n=51)

Allergy may wane if tick bites are avoided

Tick-Associated Red Meat Allergy

Lone Star Ticks are the Culprits

Tularemia

In 2019, 233 cases reported

26.5% of the tularemia cases are kids 19 or under

Transmitted by tick and deer fly bites, handling or eating infected meat

Dermal, ocular, oral, inhalation exposures

Can be fatal

Colorado Tick Fever

91 confirmed cases (1995-2003)

Men at higher risk

Highest infection rate in those over 51

Biphasic fever in 48% of patients

Rash 12% (faint, transient, and inconsistent in distribution)

Fever, myalgia, headache common

GI symptoms in 20% of patients

3 patients had central nervous system disease, 8 other cases in the literature

Isolated from patients with flulike syndromes, meningitis, encephalitis, other severe complications

Can be fatal

Colorado Tick Fever

Tick Paralysis

Rare

Occurs most often in children younger than 16 years old and adult men

Within 24 hours of tick removal, paralysis subsides

Tick-borne Relapsing Fever

483 cases reported 1990 – 2011

Found in rodent-infested mountain cabins

Soft ticks’ bite is brief, usually less than 1/2 hour

Emerge at night and feed while the person is sleeping

Recurring fever, nonspecific symptoms (e.g., headache, myalgia, arthralgia, shaking chills, GI complaints

Occurs in children and adults

Asian Longhorned Tick—An Invasive Tick

First found in N.J., now in 12 states

Tick’s behavior is very different from U.S. species

Sunlight/short grass in the Bronx

Reproduces without males

 Attacks by the thousands on an animal and kills it

No reported human disease transfers yet in the U.S.

Experts worry about ability to vector diseases (Lyme, RMSF, others)

Carries Japanese encephalitis in Asia

Asian Longhorned Tick—An Invasive Tick
Tick-Bite Prevention Messages

• Use EPA-registered repellent when in tick territory
• Let clothing be a barrier
• Use permethrin treatment on clothing (kills on contact)
• Do a tick check before going inside
• Nymphs emerge in early Spring...they’re one of the most dangerous life-forms—hard to spot, may be infected vertically (from mother)

• When coming inside, put clothing in the dryer on high heat for 20 minutes
• Do a tick-check when you’re in the shower
• Check all nooks and crannies
• Look for moving freckles
• Estimated disease transmission time 24-36 hours
  • Except Powassan 15 minutes
  • Rocky Mountain Fever 6 hours

What TO DO

• REMOVE the tick ASAP
  • Clean wound area with soap and water, antiseptic
  • Put the tick in alcohol to kill it

What NOT to do...

• Burn it (gasoline, kerosene)
• Smother it (petroleum jelly)
• Poison it (fingernail polish)
• Annihilate it (hot match tip)
• Crush it
• Use Dawn soap

Tick Take-aways

• Put ticks in alcohol to kill them (hand sanitizer works)
• Don’t crush ticks—pathogens can be transmitted to your hands
• If you removed a tick and the head remains, don’t panic
• The body is the part that really matters
• Use an antibiotic ointment/spray on the bite area
• For some tick-borne diseases, there are no cures—protection is the ONLY option
• If bitten by a tick and you have NO symptoms, there is no need to see a healthcare professional and no need for antibiotics
• Many fearful of Lyme disease do so anyway

Treatment for Tick-borne Diseases

• If the child is symptomatic, DO NOT wait for test results
• Doxycycline is AAP’s and CDC’s recommendation
• National survey 2012
  • 35% of providers would not give to patients younger than 8 years old due to concern for dental coloration

KEY MESSAGE: FOLLOW AAP/CDC GUIDELINES AND GIVE DOXYCYCLINE REGARDLESS OF THE PATIENT’S AGE
Tick Summary

• Lyme is the most commonly reported tick-borne disease
• 95% of cases occur in 14 states (Northeast, Mid-Atlantic and upper Midwest)
  • Co-infections occur
  • It’s under-reported
• Ehrlichioses, RMSF can be fatal without prompt treatment
  • Treat on presumptive diagnosis of a tick-borne infection
  • Don’t wait for lab confirmation
• Doxycycline for ALL ages
• You don’t have to go to the woods to get a tick bite

Mosquitoes in the U.S.

• 3,500 species worldwide
• 175 species in the U.S.
• Mosquitoes transmit 10 different diseases to humans in the U.S.
• Travel-related mosquito-borne diseases reported in many states

Mosquito-borne Disease Cases—U.S.

<table>
<thead>
<tr>
<th>Mosquito-borne Disease</th>
<th>Cases in 2019 (% Travel-related)</th>
<th>Cases in 2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>West Nile Virus</td>
<td>915 (30%)</td>
<td>2,646</td>
</tr>
<tr>
<td>La Crosse Encephalitis</td>
<td>50 (2%)</td>
<td>86</td>
</tr>
<tr>
<td>Eastern Equine Encephalitis</td>
<td>38 (1%)</td>
<td>6</td>
</tr>
<tr>
<td>Jamestown Canyon Virus</td>
<td>26 (1%)</td>
<td>41</td>
</tr>
<tr>
<td>St Louis Encephalitis</td>
<td>15 (1%)</td>
<td>8</td>
</tr>
<tr>
<td>Western Equine Encephalitis</td>
<td>0 (0%)</td>
<td>0</td>
</tr>
<tr>
<td>Malaria*</td>
<td>1,650 (99.6%)</td>
<td>1,748</td>
</tr>
<tr>
<td>Dengue*</td>
<td>1,183 (98.3%)</td>
<td>464</td>
</tr>
<tr>
<td>Chikungunya*</td>
<td>133 (100%)</td>
<td>117</td>
</tr>
<tr>
<td>Zika*</td>
<td>20 (95%)</td>
<td>76</td>
</tr>
</tbody>
</table>

* Primarily Travel-related

Source: Centers for Disease Control and Prevention

West Nile Virus—Endemic in the Lower 48

• About 19% of patients develop fever with other symptoms (headache, body aches, joint pains, vomiting, diarrhea, or rash)
• 1% develop serious, sometimes fatal, illness
• In 2018 - 2,646 cases reported in the U.S.
  • Nebraska – 251 cases, California - 217
• In 2019 - Final numbers are not in
  • California - 214 cases, Arizona – 172 cases
• 80% are asymptomatic

West Nile in Children

• 0.1% of the cases are in children 19 and under
• 34% of cases reported to CDC in kids are neuroinvasive (N=2397 1999-2016)
• Same incidence as in all other age groups
• Adults present with encephalitis, kids with meningitis in the more severe cases
• Fatality rate in older adults is 14...1% in children
• Nationally, more cases in kids than for all ages for SLE, LAC, EEE, and WEE combined!
La Crosse Encephalitis
- 88% of the cases are those 19 years old and younger, many in boys 5–9

Eastern Equine Encephalitis
- 38 cases nationwide 2019
  - A new U.S. record
  - Mostly New England and Michigan
  - Risk higher for those over 50, under 15
  - 2019 four children (5-11) infected, 2 died (2019)
  - 30% fatality rate historically
  - 50% of survivors have physical or mental sequelae
    - Mild brain dysfunction to severe intellectual impairment, personality disorders, seizures, paralysis, cranial nerve dysfunction

St Louis Encephalitis
- Often asymptomatic
- 74% of symptomatic cases neuroinvasive
- 7% fatality rate

Keystone Virus
- Transmitted by mosquito - Aedes atlanticus
- First reported in 1964 in Keystone, Florida
- Symptoms include fever and rash
- May lead to encephalitis

Jamestown Canyon Virus
- 26 in 2019
- 16% of the cases in 19 and under (2015)
- Acute febrile illness, meningitis, meningoencephalitis
Travel-related Diseases
- Zika, CHIKV, dengue, and malaria in the US are primarily travel-related.
- People visiting endemic areas may contract one or more of them... many are asymptomatic.
- When returning to the U.S., they can be bitten by local mosquitoes, giving them the disease, initiating an outbreak.
- For Zika, transmitted sexually, there are more cautions.

KEY MESSAGE: Use repellents during and AFTER travel. Use condoms or abstain.

The Aedes Mosquitoes Are Different
- Important to know mosquito behavior
- Day time biters
- Knees to ankles
- Live in urban settings
- Difficult to repel
- AGGRESSIVE
- Prefer people
- Aedes aegypti
- Zika, Dengue, ChikV
- Yellow Fever

ESTIMATED Potential Range of Aedes Aegypti and Aedes Albopictus 2017

2020 Aedes aegypti and Aedes albopictus, CA Detection Sites by County/City

Zika Virus Infections in the U.S. (2019)
20 cases in the U.S. - 19 travel-related, one lab transmission

Chikungunya in the U.S., 2019
134 Cases -- Travel-related
2019 States reporting cases
Dengue

- In 2019 – 1,158 cases reported to CDC
- 20 locally transmitted (FL, DC, NC, TX)

Source: Centers for Disease Control and Prevention

Malaria in the U.S.

- 1,650 cases in 2019
- Consistent increase in cases since 1973
- 99.6% travel-related
  - Most patients U.S. residents
  - 17% children (<18 years)
  - Severe infection with end organ damage more common in children 5 years old or younger
  - 10 deaths, all adults


Key Mosquito Messages

- WNV: most common mosquito borne disease in the U.S., <10% in children
- Asymptomatic infection (80%), WNF (19%), neuroinvasive disease (1%)
- Imported infections are widely endemic in other countries
- Malaria, Chikungunya, dengue, Zika virus
- Know where your students are going for breaks, school/family-related trips
- Elsewhere in the U.S., other mosquito-borne diseases are possible. Know before you go

Why Care about Repellents?

- For many VBDs, prevention strategies are the only option
- VBDs are becoming more prevalent
- TYPES of VBDs are increasing
- Personal protection for those at home/traveling

What to Use?

- Always use a repellent with an EPA-registered active ingredient
  - Tested for safety and efficacy
  - Tested for specific vectors

EPA-Registered Repellents

- DEET –500 products
- Picaridin—40 products
- IR 3535—45 products
- Oil of Lemon Eucalyptus—10 products
- Catnip Oil—4 products
- BIOUD—1 product
- Oil of Citronella-3
Concentration is the Key

- The higher the concentration the LONGER the repellent helps protect
- More isn’t BETTER, it’s LONGER
- Duration of efficacy is comparable at comparable concentrations for the EPA-registered actives
- 5% picaridin lasts an hour—same for DEET-based products
- Pick the concentration that matches your time of exposure
- Duration of efficacy shorter for ticks than for mosquitoes

Guidance for Use on Kids

- EPA has NO age limitations on registered actives except Oil of Lemon Eucalyptus
- Children must be 3 YEARS of age
- CDC/Am. Academy of Pediatrics
- Use DEET, picaridin, IR3535 on kids as young as 2 MONTHS of age in concentrations up to 30%
- Adults apply to their own hands, smoothing repellent evenly on the child’s exposed skin
- Avoid fingers in very young children
- Keeps repellent out of eyes and mouths

HOW You Apply is Important

- ALL concentrations repel mosquitoes
- Use a 25% or higher product for Aedes species
- Apply sparingly to exposed skin, smooth on like sunscreen or body lotion
- Apply sparingly to clothing or under clothing if mosquitoes can bite through fabric (Aedes can)
- Repellent washes off with perspiration/swimming/rain, so reapply as needed

Repellent Use for Mosquitoes

- 100% = @12 hours
- 34.5% sustained release = @12 hours
- 30% = up to 8 hours
- 25% = up to 6+ hours
- 15% = up to 4+ hours
- 10% = up to 2+ hours
- 5% DEET-based product = @ 90 min
  Protection levels off at @ 50%

Repellent Use for Ticks

Start with 20%
- Apply to exposed skin AND clothing, shoes, socks, pants
- Use permethrin-treated clothing—KILLS on contact
- CDC and other experts: Use a 20% or higher concentration for ticks
- LOWER concentrations don’t work well or very long
- A 25% concentration DEET product may last 5-6 hours for mosquitoes BUT 3-4 for ticks, so REAPPLY
- Dress appropriately—long pants tucked into socks
**Sunscreen and Repellent**

- Apply sunscreen first, then repellent
- Reapply sunscreen often
- Reapply repellent when bugs return

**DEET Safety**

- Eye stinging most common AE
  - Alcohol in formulations
  - A mild irritant
  - Resolves immediately by flushing eyes with water
- VERY RARELY skin irritation
  - Individuals may find non-fragranced formulation works for them

**Repellent for Pregnant Women and Nursing Mothers**

- DEET-based products recommended by
  - CDC
  - World Health Organization
  - American Academy of Pediatrics
  - American College of Obstetrics and Gynecology
- Study in Thailand showed no issues with moms or children
- Extensive animal tests also show no issues

**DEET Urban Legends**

- Causes seizures
  - Extensive independent meta-analysis and other reviews show this is not true
- Higher concentrations are more dangerous
  - No relationship between adverse events and concentration when used according to directions
- Children are at greater risk
  - Serious adverse events are exceedingly rare, associated with misuse and NOT related to age
- Causes death
  - Ingestion of substantial amounts
- Label directions are "scary" (wash, etc.)
- SAME directions on all EPA-registered repellents

**Environmental Working Group**

- "...DEET...is widely used but much maligned"
- ...Safety profile is better than many people assume
- ...Effectiveness at preventing bites is approached by only a few other repellent ingredients
- DEET isn't a perfect choice nor the only choice. But weighed against the consequences of Lyme disease and West Nile virus, we believe it is a reasonable one

**NONE of These Work**

- Essential oil concoctions (20 min for mosquitoes, 0 min for ticks)
- Wrist bands
- Citronella plants
- Torches (it's the smoke)
- Waist band products (if it's not windy and you don't move)
- Dryer sheets
- B-1
- Phone apps, gismos of all sorts
Key Messages
• Use EPA-registered repellent
• Use 25% for *Aedes* mosquitoes
• Use a concentration to match your time of exposure (5%=60 minutes, 30%=8 hours) for other mosquitoes
• Apply sparingly, smooth onto exposed skin
• Apply to clothing
  • Use permethrin only on clothing
  • Let clothing be a barrier

More Key Messages
• Use 20%+ concentration for ticks
• Repellents don’t protect as long for ticks as they do for mosquitoes
• Estimated disease transmission time 24-36 hours
  • Powassan 15 minutes
  • Rocky Mountain Fever 6 hours
• Some tick-borne diseases can be deadly

THERE ARE NO CURES FOR VIRAL VBDs – PROTECTION IS CRUCIAL

Resources
• CDC.gov
• 800-789-3300 info@RepellentInfo.org
• American Mosquito Control Association www.Mosquito.org
• Tick Encounter (University of Rhode Island) - in depth information about ticks TickEncounter.org
• Rutgers New Jersey Agricultural Experimental Station http://vectorbio.rutgers.edu/
• University of Massachusetts Amherst https://www.umass.edu/

Questions

Emerging Diseases
• Bourbon Virus - Midwest and South
  • First isolated in 2014
• *Borrelia Miyamotoi* - a relapsing fever-related spirochete
  • Rare disease
  • Found in upper Midwest, Northeast, and mid-Atlantic states
• The other diseases in the Spotted Fever Group – less severe than RMSF
  • *Rickettsia parkeri* rickettsiosis
  • Pacific Coast tick fever
  • *Rickettsia sibirica*

Alpha-Gal Allergy

Map showing incidence of alpha-gal in the US as reported by patients (See Maps, March 2017)