Public Health Laboratory Surveillance of Tick-borne Diseases Causing Pathogens

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PHASE Internship at the
Maryland Department of Health and Mental Hygiene
Laboratories Administration Division of Virology and Immunology
Preceptor: Division Chief Maria Paz Carlos, PhD, MBA
Lyme Disease

- *Borrelia burgdorferi*
- *Ixodes scapularis* and *Ixodes pacificus*
- *Erythema migrans*
- Late manifestations

http://www.ticktexas.org/ticks/afis_black_legged_tick.htm  
http://borreliaburgdorferi.org/
Rocky Mountain Spotted Fever

- _Rickettsia rickettsii_
- _Dermacentor variabilis and D. andersoni_
- Rash
- Up to 80% fatality rate (untreated)

http://www.cdc.gov/rmsf/symptoms/index.html#symptoms

http://www.cdc.gov/tularemia/transmission/
Ehrlichiosis

- *Ehrlichia chaffensis* and *Anaplasma phagocytophilum* (HME and HGA)
- *Amblyomma americanum*
- *Ixodes scapularis*
- *Dermacentor variabilis*

Babesiosis
• *Babesia microti*
• *Ixodes scapularis*
• Hemolytic anemia

Tularemia
• *Francisella tularensis*
• Deer tick and fly bite
• Aerosole transmission
• Handling of infected animals
<table>
<thead>
<tr>
<th>File</th>
<th>Abstract</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.06.01.03.htm</td>
<td>10.06.01.03. 03 Reportable Diseases, Conditions, Outbreaks, and Unusual Manifestations; Submitting Clinical Materials.A. A person, as set forth in Regulation .04 of this chapter, shall report the diseases or conditions listed in §C of this regulation, or any other condition as requested by the Secretary.B. Within 1 working day of a positive laboratory finding for a disease or condition listed in §C of this regulation, or upon request of the Secretary, the director of a medical laboratory shall:</td>
</tr>
</tbody>
</table>
03 Reportable Diseases, Conditions, Outbreaks, and Unusual Manifestations; Submitting Clinical Materials.

A. A person, as set forth in Regulation 04 of this chapter, shall report the diseases or conditions listed in §C of this regulation, or any other condition as requested by the Secretary.

B. Within 1 working day of a positive laboratory finding for a disease or condition listed in §C of this regulation, or upon request of the Secretary, the director of a medical laboratory shall:

1. Submit clinical material to the Department's public health laboratory; and

2. Include information about the clinical material on a form provided by the Secretary.

C. List of Reportable Diseases and Conditions.

<table>
<thead>
<tr>
<th>Diseases and Conditions</th>
<th>Laboratory Evidence of</th>
<th>Submit Clinical Materials to the Department</th>
<th>Immediate</th>
<th>Within 1 Working Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) An outbreak of a disease of known or unknown etiology that may be a danger to the public health</td>
<td>Similar etiological agents from a grouping or clustering of patients</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2) A single case of a disease or condition not otherwise included in this table of known or unknown etiology, that may be a danger to the public health</td>
<td>An etiologic agent suspected to cause that disease or condition</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(3) An unusual manifestation of a communicable disease in an individual</td>
<td>An etiologic agent suspected to cause that disease</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(4) Acquired immunodeficiency syndrome (AIDS)</td>
<td>Refer to COMAR 10.18</td>
<td>Refer to COMAR 10.18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(5) Amoebiasis</td>
<td>Entamoeba histolytica</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(6) Anaplasmosis</td>
<td>Anaplasma phagocytophilum</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(7) Animal bites</td>
<td>Not Applicable</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(8) Anthrax</td>
<td>Bacillus anthracis</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(9) Arboviral infections including, but not limited to: (a) Dengue fever; (b) Eastern equine encephalitis; (c) LaCrosse virus infection; (d) St. Louis encephalitis; (e) Western equine encephalitis; (f) West Nile virus infection;</td>
<td>Any associated arbovirus including, but not limited to: (a) Dengue virus; (b) Eastern equine encephalitis virus; (c) LaCrosse virus; (d) St. Louis encephalitis virus; (e) Western equine encephalitis virus; (f) West Nile virus;</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>(10) Babesiosis</td>
<td>Babesia species</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Disease/Infection</td>
<td>Description</td>
<td>Notes</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>------------------</td>
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<td></td>
</tr>
<tr>
<td>(22) Ehrlichiosis</td>
<td>Ehrlichia species</td>
<td>Isolation from or demonstration in brain tissue, central nervous system tissue, or cerebrospinal fluid, of any pathogenic organism</td>
<td>X (Infectious agents as indicated elsewhere in §C of this regulation and viral agents except for HSV)</td>
<td></td>
</tr>
<tr>
<td>(23) Encephalitis, infectious</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>(24) Epsilon toxin of Clostridium perfringens</td>
<td>Clostridium perfringens, epsilon toxin</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>(26) Giardiasis</td>
<td>Giardia species</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>(27) Glanders</td>
<td>Burkholderia mallei</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>(28) Gonococcal infection</td>
<td>Neisseria gonorrhoeae</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>(29) Haemophilus influenzae invasive disease</td>
<td>Haemophilus influenzae, isolated from a normally sterile site</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>(30) Hantavirus infection</td>
<td>Hantavirus</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>(31) Harmful algal bloom related illness</td>
<td>Not Applicable</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>(32) Hemolytic uremic syndrome, post-diarrheal</td>
<td>Not Applicable</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>(33) Hepatitis A acute infection</td>
<td>Hepatitis A virus IgM</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>(34) Hepatitis, viral (B, C, D, E, G, all other types, and undetermined)</td>
<td>Hepatitis B, C, D, E, and G virus, other types</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>(35) Human immuno deficiency virus (HIV)</td>
<td>Refer to COMAR 10.18</td>
<td></td>
<td>Refer to COMAR 10.18</td>
<td></td>
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<tr>
<td>(36) Influenza associated pediatric mortality</td>
<td>Influenza virus-associated pediatric mortality in persons younger than 18 years old (if known)</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>(37) Influenza: novel influenza A virus infection</td>
<td>Isolation of influenza virus from humans of a novel or pandemic strain</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>(38) Isosporiasis</td>
<td>Cryptosporidium (synonym Isospora belli)</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>(39) Kawasaki syndrome</td>
<td>Not Applicable</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>(40) Legionellosis</td>
<td>Legionella species</td>
<td>X (if isolate from human)</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>(41) Leprosy</td>
<td>Mycobacterium leprae</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>(42) Leptospirosis</td>
<td>Leptospira interrogans</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>(43) Listeria</td>
<td>Listeria species</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>(44) Lyme disease</td>
<td>Borrelia burgdorferi</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>(45) Malaria</td>
<td>Plasmodium species</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Disease Description</td>
<td>Pathogen/Agent</td>
<td></td>
<td></td>
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<tr>
<td>---</td>
<td>----------------------------------------------------------</td>
<td>-----------------------------------------</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>63</td>
<td>Rocky Mountain spotted fever</td>
<td>Rickettsia rickettsii</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>64</td>
<td>Rubella (German measles) and congenital rubella syndrome</td>
<td>Rubella virus</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>65</td>
<td>Salmonellosis (nontyphoidal)</td>
<td>Salmonella species, including serogroup, if known</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>66</td>
<td>Severe acute respiratory syndrome (SARS)</td>
<td>SARS-associated coronavirus (SARS-CoV)</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>67</td>
<td>Shiga-like toxin producing enteric bacterial infections</td>
<td>Shiga toxin, shiga-like toxin, or the toxin-producing bacterium</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>68</td>
<td>Shigellosis</td>
<td>Shigella species, including species or serogroup, if known</td>
<td>X</td>
<td></td>
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<tr>
<td>69</td>
<td>Smallpox and other orthopoxvirus infections</td>
<td>Variola virus, vaccinia virus, and other orthopox viruses</td>
<td>X</td>
<td></td>
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<tr>
<td>70</td>
<td>Staphylococcal enterotoxin B poisoning</td>
<td>Staphylococcus enterotoxin B</td>
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</tr>
<tr>
<td>71</td>
<td>Streptococcal invasive disease, Group A</td>
<td>Streptococcus pyogenes, Group A, isolated from a normally sterile site</td>
<td>X</td>
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</tr>
<tr>
<td>72</td>
<td>Streptococcal invasive disease, Group B</td>
<td>Streptococcus agalactiae, Group B, isolated from a normally sterile site</td>
<td>X</td>
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</tr>
<tr>
<td>73</td>
<td>Streptococcus pneumoniae invasive disease</td>
<td>Streptococcus pneumoniae, isolated from a normally sterile site</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>74</td>
<td>Syphilis</td>
<td>Treponema pallidum</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>75</td>
<td>Tetanus</td>
<td>Clostridium tetani</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>76</td>
<td>Trichinosis</td>
<td>Trichinella spiralis</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>77</td>
<td>Tuberculosis and suspected tuberculosis$^6$</td>
<td>Mycobacterium tuberculosis complex</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>78</td>
<td>Tularemia</td>
<td>Francisella tularensis</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>79</td>
<td>Typhoid fever (case, carrier, or both, of)</td>
<td>Salmonella Typhi</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>
AIM

To assess the importance of continued public health laboratory surveillance of tick-borne diseases in the State of Maryland.
Laboratory Surveillance of Tick-borne Disease Causing Agents Tested from 2008 to 2011 at the State of Maryland DHMH Laboratories Administration Division of Virology and Immunology

OBJECTIVE

To analyze the immunological test results for Lyme disease (LD), Rocky Mountain Spotted Fever (RMSF), Ehrlichiosis (HGA and HME), Babesiosis and Tularemia.
METHODS

Lyme Disease

2 steps method

1\textsuperscript{st} Step - Enzyme linked Immunoassay (ELFA) – VIDAS

2\textsuperscript{nd} Step - Western Blot
RMSF and Ehrlichiosis (HME and HGA)

Titers = or >1:64 probable positive cases

Further testing is needed in order to obtain a definite diagnosis.

http://lymediseaseguide.org/test-accuracy-ifa
Tularemia and Babesia

Submitted to Centers for Disease Control and Prevention (CDC)
Total No. of Specimens Tested at the Laboratories Administrations for Lyme Disease, Ehrlichiosis, Rocky Mountain Spotted Fever and Babesiosis from 2008 to 2011

### Lyme Disease

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Specimens</th>
<th>LD submitted</th>
<th>LD positive</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>15.7%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>11.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>12.9%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>10.4%</td>
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</tbody>
</table>

### Rocky Mountain Spotted Fever

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Specimens</th>
<th>RMSF submitted</th>
<th>RMSF positive</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>1.6%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>7.5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>8.2%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>7.1%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Ehrlichiosis

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Specimens</th>
<th>Ehrlichiosis submitted</th>
<th>Ehrlichiosis positive</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>2.2%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>4.6%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>3.2%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>3.8%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Babesiosis

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Cases</th>
<th>Babesiosis submitted</th>
<th>Babesiosis positive</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>4.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>2.2%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>0%</td>
<td></td>
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</tbody>
</table>
Number of Positive Specimens Stratified by Age Tested at the Laboratories Administrations for Lyme Disease, Ehrlichiosis, Rocky Mountain Spotted Fever and Babesiosis from 2008 to 2011
Number of Positive Specimens Stratified by Sex Tested at the Laboratories Administrations for Lyme Disease, Ehrlichiosis, Rocky Mountain Spotted Fever and Babesiosis from 2008 to 2011
CONCLUSIONS

• **Lyme Disease** is the most (n=323) prevalent.
  • RMSF (n= 30) Ehrlichiosis (n=21)
• Most of the cases were found in **males** except for Ehrlichiosis
• Most LD cases were found in the **20 to 29 years** old group
• Most RMSF cases were found in the **50 to 59 years** old group
• Most Ehrlichiosis cases were found in the **40 to 49 years** old group
Public Health Laboratory
Surveillance of Lyme Disease in the State of Maryland: A Ten Year Trend Analysis

OBJECTIVES
To analyze a decade (2002 to 2011) of Lyme Disease immunological test results.
To assess the importance of continuous Lyme disease surveillance at MD DHMH Laboratories Administration Division of Virology and Immunology.
Total No. of Specimens Tested at the Laboratories Administrations for Lyme Disease from 2002 to 2012
Number of Positive Specimens Stratified by Age Tested at the Laboratories Administrations for Lyme Disease, 2002 - 2012
Number of Positive Specimens Stratified by **Sex** Tested at the Laboratories Administrations for Lyme Disease, 2002 - 2012
Distribution of Lyme Disease Positive Cases by Month from 2002 to 2011 Tested at the Laboratories Administrations

Percentage of Positive Cases vs. Month for Lyme Disease Cases

- January: 4%
- February: 3%
- March: 5%
- April: 8%
- May: 9%
- June: 12%
- July: 18%
- August: 14%
- September: 7%
- October: 6%
- November: 5%
- December: 4%
CONCLUSIONS

• Number of tested specimens drastically decreased after 2009
• Most positive cases were found in:
  – 20 to 29 years
  – 50 to 59 years
  – unknown
• Most cases were found in Male
• Prevalence in June, July and August
LIMITATIONS AND CHALLENGES

- Surveillance
- Clinical diagnosis
- Testing
- Data interpretation
- Dynamics in pathogens
- Advances in technology
LESSONS LEARNED

• Reporting
• Importance of tick-borne diseases
• Collaboration between physicians and laboratories
• Collaboration between laboratories
• Innovations are crucial
• Education and awareness
POLICY AND PRACTICE IMPLICATIONS

• COMAR
• Case definition
• Continued support for laboratory surveillance
• Collaborations between multiple agencies
• Relationship between Departments of Health and Academia
• Susceptible Populations
• Biowarfare
REFERENCES

ACKNOWLEDGEMENTS

I would like to thank Ms. Beth Resnick, Director of the Public Health Practice and Training Program at the Johns Hopkins University Bloomberg School of Public Health, as well as Ms. Dipti Shah and Ms. Patti Truant for supporting my professional training opportunities.

A special thank you to:
Dr. Leena Trivedi
Thomas Lawson
William Murtaugh

I am sincerely appreciative of Dr. Maria Paz Carlos, the Chief of the Division of Virology and Immunology at the State of Maryland Department of Health and Mental Hygiene Laboratories Administration and for her patience, understanding, and unending support of my personal and professional development.
ACTIVITIES (October 2011-June 2012)

Masters Thesis in partial requirement for the Masters of Health Sciences in Molecular Microbiology and Immunology, Johns Hopkins School of Public Health
Significance of Tick-borne Pathogens and Laboratory Surveillance

Manuscript Submitted
- Public Health Laboratory Surveillance of Lyme Disease in the State of Maryland: A Ten Year Trend Analysis. M. Dembele, 1 L. Trivedi, 2* T. Lawson, 2* and M.P. Carlos 2, 3

Manuscripts In-Preparation
- Laboratory Surveillance of Tick-borne Diseases Causing Agents in the State of Maryland Public Health Laboratory (2008 to 2011). M. Dembele, 1 L. Trivedi, 2* T. Lawson, 2* and M.P. Carlos 2, 3
- Review of tick-borne Diseases Causing Pathogens

Poster Presentations
- Laboratory Surveillance of Tick-borne Diseases Agents and other Relevant Pathogens in the State of Maryland, M. Dembele; L. Trivedi; T. Lawson; S. Montgomery, M. P. Carlos. ASM Biodefense and Emerging Infectious Diseases Research Meeting, Washington, 2012
- Importance of Lyme Disease Laboratory Testing Surveillance in the State of Maryland Public Health Laboratory, M. Dembele; L. Trivedi; T. Lawson; S. Montgomery, M. P. Carlos. APHL annual meeting, Seattle, 2012 (Accepted)
- Public Health Laboratory Surveillance of Lyme Disease, Ehrlichiosis and Rocky Mountain Spotted Fever in the State of Maryland from 2000 to 2011, M. Dembele; L. Trivedi; T. Lawson; S. Montgomery, M. P. Carlos. ASM Annual Meeting, San Francisco, 2012 (Accepted)
Laboratory Surveillance of Tick-borne Causing Agents and Other Relevant Pathogens in the State of Maryland
M. Dembele, L. Trivedi, T. Lawson, S. Montgomery and M. Carlos PhD, MBA.
Maryland Department of Health and Mental Hygiene, Laboratories Administration, Division of Virology and Immunology
*Corresponding Author: mdembele@hsph.edu

BACKGROUND
The purpose of study is to analyze the immunological test results from suspected Lyme disease (LD), Ehrlichiosis (HME and HGE), Tularemia, Rocky Mountain Spotted Fever (RMSF), Babesia, Q fever, and plague specimens submitted to the Maryland Department of Health and Mental Hygiene (DHMH) Laboratories Administration Division of Virology and Immunology. The respective causative agents for the five tick borne disease are Borrelia Burgdorferi, Ehrlichia chaffeensis (HME), Anaplasma phagocytophilum (HGA), Francisella tularensis, Rickettsia. The occurrence of Coxiella burnetii and Yersinia pestis. This analysis will provide a better understanding of the occurrence of emerging and re-emerging tick and rodent born diseases in Maryland.

METHODS
From January 2008 to November 2011, de-identified data (N=3556) were obtained from DHMH Laboratories Administration State of Maryland Laboratories Information Management System. Indirect Immunofluorescence Assay (IFA) method was used for Ehrlichiosis and RMSF. Agglutination test was used for Tularemia serodiagnosis. A two step method consisting of an Enzyme Immunoassay (EIA) and Western Blot (WB) was used for LD, Babesia, Coxiella burnetii and Yersinia Pestis specimens were forwarded to CDC for testing.

RESULTS
- Most cases of LD, RMSF and Babesia were detected in the 25-45 years old age group. There were 146, 19 and 2 positive cases respectively. In the instance of Ehrlichia, there were 8 positive cases in both the 25-45 and >60 years old age groups. The majority of Coxiella cases were of unknown age.
- Most cases of LD, RMSF and Babesia were detected in Males. They amounted to 230, 17 and 5 positive cases respectively. The majority of Coxiella cases were of unknown sex.
- The volume of positive LD cases decreased over time while Ehrlichia and RMSF experienced a peak in 2009 followed by a continuous reduction in number of positive cases. The occurrence of Coxiella cases decreased with 3 cases in 2008, 3 in 2009, none in 2010 and 1 in 2011.
- From 2008 to 2011, the positivity rate for LD was reduced by more than 50%. Ehrlichia’s positivity rate was constant throughout the years, while RMSF experienced its lowest positivity rate in 2008 (1.6%) and its highest in 2010 (8.6%).
- There were 3 cases of Babesia and no case of Yersinia or Tularemia. All positive specimens except for LD represent probable cases. There were no submitted specimens for yersiniae.

<table>
<thead>
<tr>
<th>Year</th>
<th>Positivity Rate of Pathogens in %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lyme</td>
</tr>
<tr>
<td>2008</td>
<td>15.6%</td>
</tr>
<tr>
<td>2009</td>
<td>11.1%</td>
</tr>
<tr>
<td>2010</td>
<td>13.7%</td>
</tr>
<tr>
<td>2011</td>
<td>7.2%</td>
</tr>
</tbody>
</table>

DISCUSSION
Lyme disease was the most prevalent tick-borne disease with male cases accounting for 71.4% and the 25-59 years old age group for 45%. RMSF was the second most predominant disease, with male cases and the 25-59 years old age group accounting for the majority of the detected cases with 56.6% and 63%, respectively. There were 3 positive cases of C. burnetii and Babesia. 47.5% of Ehrlichios positive cases were female while 76.2% were in the 25 to 59 and >60 years age groups. No positive cases of Tularemia and Yersinia were detected. No submission for Yersinia testing occurred from 2008 to 2011.

CONCLUSIONS
Laboratory diagnosis can alleviate the burden of an outbreak by the immediate identification of early exposure cases, and confirmation allows appropriate treatment.

Moreover, a comprehensive laboratory surveillance of emerging and re-emerging pathogens in the most susceptible populations is a valuable tool in public health prevention and control.
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QUESTIONS?