Human Lyme Disease Surveillance in West Virginia

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Northeastern Region Lyme Disease Training
Introduction to Lyme Disease

Medical entomologist who identified the Lyme disease bacteria in 1982

Willy Burgdorfer (1932-2014)
What is Lyme disease?

- A bacterial infection caused by the spirochete *Borrelia burgdorferi*

- Transmitted through the bite of infected black-legged ticks
  - *Ixodes scapularis* in eastern United States
  - *Ixodes pacificus* in western United States

- Clinical manifestations vary based on stage of infection
Stages of Lyme Disease

Early localized stage
(3-30 days post-tick bite)
- Erythema migrans (EM) (also called Bull’s eye rash)
- Fever, malaise, headache, stiff neck, muscle and joint aches, and swollen lymph nodes

Early disseminated stage
(days to weeks post-tick bite)
- Additional EM lesions
- Facial or Bell’s palsy
- Headache and stiff neck due to meningitis
- Pain and swelling of joints
- Heart block and dizziness

Late disseminated stage
(months to years post-tick bite)
- Arthritis that affects large joints (particularly knees)
- Chronic neurological complications (e.g. shooting pains, numbness, and tingling in hands and feet)
Treatment for Lyme Disease

- Antibiotic treatment with appropriate antibiotics usually leads to rapid and full recovery.
  - Doxycycline
  - Amoxicillin
  - Cefuroxime axetil

- Patients with certain neurological or cardiac manifestations may require intravenous treatment.
Lyme Disease Surveillance


- The current case definition was last updated in 2011.

- The West Virginia Lyme disease surveillance system (LDSS) involves many stakeholders with different responsibilities.
# Reporting Lyme Disease

## Reportable Diseases in West Virginia

<table>
<thead>
<tr>
<th>Category I</th>
<th>Category II</th>
<th>Category III</th>
<th>Category IV</th>
<th>Category V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reporting of the following communicable diseases is required by law as follows:</td>
<td>Report within 24 hours to the Local Health Department</td>
<td>Report within 72 hours to the Local Health Department</td>
<td>Report within 1 week to the Local Health Department</td>
<td>Report within 1 week to the state health department</td>
</tr>
<tr>
<td><strong>Anthrax</strong></td>
<td><strong>Animal bites</strong></td>
<td><strong>Campylobacteriosis</strong></td>
<td><strong>Acute flaccid myelitis (AFM)</strong></td>
<td><strong>AIDS</strong></td>
</tr>
<tr>
<td><strong>Bioterrorist event</strong></td>
<td><strong>Brucellosis</strong></td>
<td><strong>Cryptosporidiosis</strong></td>
<td><strong>Anaplasmosis</strong></td>
<td><strong>Chancre</strong></td>
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<tr>
<td><strong>Botulism</strong></td>
<td><strong>Cholera</strong></td>
<td><strong>Cyclospora</strong></td>
<td><strong>Arboviral infection</strong></td>
<td><strong>Chlamydia</strong></td>
</tr>
<tr>
<td><strong>Foodborne outbreak</strong></td>
<td><strong>Dengue fever</strong></td>
<td><strong>Giardiasis</strong></td>
<td><strong>Babesiosis</strong></td>
<td><strong>Gonococcal conjunctivitis of the newborn (within 24 hours)</strong></td>
</tr>
<tr>
<td><strong>Intentional exposure to an infectious agent or biological toxin</strong></td>
<td><strong>Diphtheria</strong></td>
<td><strong>Listeriosis</strong></td>
<td><strong>Chickenpox (numerical totals only)</strong></td>
<td><strong>Gonococcal disease, drug resistant (within 24 hours)</strong></td>
</tr>
<tr>
<td><strong>Middle East respiratory syndrome coronavirus (MERS-CoV)</strong></td>
<td><strong>Hemophilus influenzae, invasive disease</strong></td>
<td><strong>Salmonellosis (except Typhoid fever)</strong></td>
<td><strong>Ehrlichiosis</strong></td>
<td><strong>Gonococcal disease, all other</strong></td>
</tr>
<tr>
<td><strong>Novel influenza infection, animal or human</strong></td>
<td><strong>Hemolytic Uremic Syndrome, postdiarrheal</strong></td>
<td><strong>Shigellosis</strong></td>
<td><strong>Hantavirus pulmonary syndrome</strong></td>
<td><strong>Hepatitis C, acute</strong></td>
</tr>
<tr>
<td><strong>Orthopox infection, including smallpox and monkeypox</strong></td>
<td><strong>Hepatitis A, acute</strong></td>
<td><strong>Trichinosis</strong></td>
<td><strong>Influenza-related death in an individual less than 18 years of age</strong></td>
<td><strong>HIV</strong></td>
</tr>
<tr>
<td><strong>Outbreak or cluster of any illness or condition</strong></td>
<td><strong>Hepatitis B, acute, chronic or perinatal</strong></td>
<td><strong>Vibriosis</strong></td>
<td><strong>Legionellosis</strong></td>
<td><strong>Pevic inflammatory disease</strong></td>
</tr>
<tr>
<td><strong>Plague</strong></td>
<td><strong>Hepatitis C</strong></td>
<td><strong>Leptospirosis</strong></td>
<td><strong>Lyme disease</strong></td>
<td><strong>Syphilis (late)</strong></td>
</tr>
<tr>
<td><strong>Rubella</strong></td>
<td><strong>Meningococcal disease, invasive</strong></td>
<td><strong>Malaria</strong></td>
<td><strong>Malaria</strong></td>
<td><strong>Syphilis, primary, secondary or early latent (less than 1 year duration) or congenital (within 24 hours)</strong></td>
</tr>
<tr>
<td><strong>Rubella, congenital syndrome</strong></td>
<td><strong>Mumps, acute infection</strong></td>
<td><strong>Psittacosis</strong></td>
<td><strong>Malaria</strong></td>
<td></td>
</tr>
<tr>
<td><strong>SARS coronavirus infection</strong></td>
<td><strong>Pertussis (whooping cough)</strong></td>
<td><strong>Respiratory syncytial virus (RSV) – related death in an individual ≤ 5 years of age</strong></td>
<td><strong>Malaria</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Smallpox</strong></td>
<td><strong>Poliomyelitis</strong></td>
<td><strong>Spotted fever rickettsiosis</strong></td>
<td><strong>Malaria</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Tularemia</strong></td>
<td><strong>Q-fever (Coxiella burnetii)</strong></td>
<td><strong>Streptococcal disease, invasive Group B</strong></td>
<td><strong>Malaria</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Viral hemorrhagic fevers</strong></td>
<td><strong>Rabies, human or animal</strong></td>
<td><strong>Streptococcal toxic shock syndrome</strong></td>
<td><strong>Malaria</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Waterborne outbreak</strong></td>
<td><strong>Shiga toxin-producing Escherichia coli (STEC)</strong></td>
<td><strong>Streptococcus pneumoniae, invasive</strong></td>
<td><strong>Malaria</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Tetanus</strong></td>
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<tr>
<td></td>
<td></td>
<td><strong>Toxic Shock Syndrome</strong></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td><strong>Tuberculosis, latent infection</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Reporting Lyme Disease (cont’d)

- Confirmed and suspected cases should be reported to the local health department of the patient **within one week.**

- **What should be reported?**
  - Any Lyme disease confirmatory laboratory results
  - Erythema migrans

- **Who should report?**
  - Laboratorians
  - Healthcare providers

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**Category IV**
Report within 1 week to the Local Health Department

- Anaplasmosis
- Arboviral infection
- Babesiosis
- Chickenpox (numerical totals only)
- Ehrlichiosis
- Hantavirus pulmonary syndrome
- Influenza-like illness (numerical totals only)
- Influenza-related death in an individual less than 18 years of age
- Legionellosis
- Leptospirosis
- Lyme disease
- Malaria
- Psittacosis
- Rocky Mountain spotted fever
- Streptococcal disease, invasive Group B
- Streptococcal toxic shock syndrome
- Streptococcus pneumoniae, invasive
- Tetanus
- Toxic Shock Syndrome
- Tuberculosis, latent infection
Surveillance Data Flow Through LDSS

- **Patients**
  - Disease
  - Vector

- **Healthcare providers**
  - Relay patient information

- **Diagnostic Laboratorians**
  - Submits Form A

- **State health department**
  - Receives Form A
  - Submits Form B to Local health department

- **Local health department**
  - Submits Form B to CDC

- **CDC**
  - Receives Form B

- **General public**

- **Veterinarians**
  - Healthcare Providers
  - Private Citizens
LABORATORY RESPONSIBILITIES

- Report positive laboratory results for Lyme disease to the LHD within one week

- Follow national guidelines for Lyme disease testing
  - Two-tier approach
HEALTHCARE PROVIDER RESPONSIBILITIES

• Report suspect and confirmed cases of Lyme disease to the local health department within one week of diagnosis

• Follow national guidelines for Lyme disease testing
  • Two tier approach
Reporting Lyme Disease

STATE HEALTH RESPONSIBILITIES

- Educate the public about Lyme disease
- Educate providers and laboratories to report cases to LHDs within one week
- Educate providers about using the recommended two-tier testing approach
- Conduct tick surveillance when ticks are active
LOCAL HEALTH RESPONSIBILITIES

- Conduct appropriate case investigations
  - Contact ordering physician
  - Use “Form A” to collect clinical information from provider
  - Contact patients with EM
  - Use “Form B” to collect exposure information

- Educate the patient about Lyme disease prevention

- Report all case information in the West Virginia Electronic Disease Surveillance System (WVEDSS)
Lyme Disease Case Definition

- Defines clinical, laboratory, and epidemiologic information needed to assign a “surveillance” case status

- Case status options
  - Confirmed
  - Probable
  - Suspected
  - Not a case

IMPORTANT: A surveillance case status does not always match a diagnostic case status.

CLINICAL CRITERIA

- Erythema migrans (EM) ≥5 cm in diameter

- Late manifestations
  - **Musculoskeletal system**: recurrent, brief attacks of joint swelling followed by chronic arthritis.
  - **Nervous system**: lymphocytic meningitis, cranial neuritis, facial palsy, radiculoneuropathy, or encephalomyelitis
  - **Cardiovascular system**: acute onset of high-grade 2\(^\text{nd}\) degree or 3\(^\text{rd}\) degree atrioventricular conduction detects (myocarditis)

LABORATORY CRITERIA

- Positive culture for *Borrelia burgdorferi*
- Two-tier testing: serology screen with reflex to Western blot
  - Enzyme immunoassay (EIA) or immunofluorescent assay (IFA)
  - IgM Western blot (when ≤30 days from symptom onset)
  - IgG Western blot (at any point during illness)
- CSF antibody positive for *B. burgdorferi* by when the titer is higher than it was in serum
- Single-tier IgG Western blot

Case Definition: Laboratory Criteria

LABORATORY CRITERIA

Two-Tiered Testing for Lyme Disease

First Test

- Enzyme Immunoassay (EIA)
- Immunofluorescence Assay (IFA)
  OR

Second Test

- Signs or symptoms ≤ 30 days
  - IgM and IgG Western Blot
- Signs or symptoms > 30 days
  - IgG Western Blot ONLY

Consider alternative diagnosis

OR

If patient with signs/symptoms consistent with Lyme disease for ≤ 30 days, consider obtaining a convalescent serum

National Center for Emerging and Zoonotic Infectious Diseases
Division of Vector Borne Diseases | Bacterial Diseases Branch
What Do Laboratory Tests Detect?

- Laboratory tests are important to provide evidence that a person is/was infected with *Borrelia burgdorferi*
  - Presence of *B. burgdorferi* bacteria in the body
  - Presence of an immune response by the body to *B. burgdorferi*

- Presence of *B. burgdorferi*
  - Positive culture for *B. burgdorferi*: bacteria was able to be grown from patient specimen

- Presence of an immune response by the body
  - Positive EIA, Positive IgG/IgM Western blot: detection of antibodies associated with Lyme disease infection
Presence of an Immune Response

- Serum specimens are routinely collected for Lyme disease testing
  - Cerebral spinal fluid (CSF) less common

Acute or past infection with Lyme disease

= antibody

Antibody response to *Borrelia burgdorferi* infection detected in patient’s specimen
What are IgM and IgG?

- Ig is the abbreviated form of “immunoglobulin.”
  - IgM = immunoglobulin M
  - IgG = immunoglobulin G

- Immunoglobulin is another word for “antibody.”

- Antibodies are types of proteins.
IgM and IgG Antibodies

- IgM antibodies are the first antibodies produced by the immune system
  - IgM antibodies indicate a recent infection.

- IgG antibodies are the most commonly produced antibody by the body.
  - Account for 75% of total antibodies produced.
  - IgG antibodies indicate an infection occurred at some point.
How does an EIA/IFA work?

DEFINITIONS

• Antigen: substance that causes the immune system to produce antibodies against it

• Antibody: protein produced by the body and used by the immune system to identify and neutralize foreign substances or pathogens (e.g. bacteria, viruses)

• Enzyme-linked substrate: substance that when added to a test will cause a reaction (either a color change or fluorescence)
How does an EIA/IFA work? (cont’d)

Negative Test

Add serum from patient

Patient specimen does not have antibodies to Lyme disease

No binding to antigen = No reaction

= Lyme disease antigen

= Antibody produced by patient to antigen

= enzyme-linked substrate
How does an EIA test work? (cont’d)

Positive Test

Patient specimen has antibodies to Lyme disease

Add serum from patient

Binding = Color change or fluorescence

Amount of antibody detected can be measured by the amount of color change or fluorescence

= Lyme disease antigen

= Antibody produced by patient to antigen

= enzyme-linked substrate
More on EIA/IFA

- Results are usually numerical having negative, equivocal, and positive reference ranges.

- EIA/IFA can test for IgG or IgM antibodies or both IgG and IgM antibodies.
  - “Total antibody” test

- False positives are common
  - Reason for two-tiered approach
Higher resulted values $\rightarrow$ darker wells $\rightarrow$ high concentration of antibodies in specimen
Western blots help identify specific proteins from samples of many different proteins by:

- Separating proteins based on size and electrical charge
- Transferring proteins onto a solid membrane medium
- Marking specific proteins for visualization
- Allowing photo development of detected proteins on film
How does a Western blot work? (cont’d)

1. Prepare samples
2. Load samples into a gel
3. Run sample to separate proteins by size and charge
4. Transfer proteins onto a membrane
5. Incubate membrane with labeled-antibody
6. Develop film
Western Blot Test

**IgM Western Blot**

An IgM immunoblot should be considered positive if **two of the following three bands** are present:
- 24 kDa (OspC) band
- 39 kDa (BmpA) band
- 41 kDa (Fla) band

**IgG Western Blot**

An IgG immunoblot should be considered positive if **five of the following ten bands** are present:
- 18 kDa band
- 21 kDa (OspC) band
- 28 kDa band
- 30 kDa band
- 39 kDa (BmpA) band
- 41 kDa (Fla) band
- 45 kDa band
- 58 kDa band
- 66 kDa band
- 93 kDa band

Presence of bands of appropriate size → detection of proteins (antibodies)
EIA/IFA and Western Blots

- EIA/IFA and Western blots are used to detect both IgM and IgG antibodies

- Results for these tests are not standardized
  - Different terminology, reference ranges

- More on lab interpretation during the “Laboratory Interpretation and Mock Case Scenario” section of training
These tests will not meet the laboratory criteria:

- Capture assays for antigens in urine
- Lymphocyte transformation tests
- Quantitative CD57 lymphocyte assays
- Polymerase chain reaction (PCR)
- Tests that measure antibodies in joint fluid (synovial fluid)
- IgM test without a previous EIA/IFA
- EIA/IFA only
Case Definition

EPIDEMIOLOGIC CRITERIA

- Exposure: having been in a potential tick habitat ≤ 30 days before onset of erythema migrans (EM) in a county in which LD is endemic

- Endemicity: A county in which two confirmed cases* have been acquired within the county OR in which established populations of a known tick vector are infected with *Borrelia burgdorferi*

*The cases must have appropriate laboratory criteria based on the recommended two-tier testing system and EM.*
Lyme Disease Endemic Counties

Prior to 2012

As of 2016

County must have reported at least two confirmed cases who met laboratory (positive EIA and IgM Western blot from serum specimen collected within 30 days of illness onset), clinical (physician-diagnosed erythema migrans ≥5 cm), and exposure (reported exposure within home county) criteria.

Established population of *Ixodes scapularis* infected with *Borrelia burgdorferi*. 
CONFIRMED CASE

- A case with erythema migrans (EM) and known exposure in an endemic county
  - OR

- A case with EM and laboratory evidence of infection without known exposure in an endemic county
  - OR

- A case with laboratory evidence of infection and at least one late manifestation of disease

Note: An endemic county does not have to be in West Virginia.
Case Classifications (cont’d)

PROBABLE
- A case with laboratory evidence of infection and physician-diagnosed Lyme disease, but lacks clinical evidence of infection

SUSPECTED
- A case with EM, no known exposure, and no laboratory evidence of infection
- OR
- A case with laboratory evidence of infection but no clinical information available
LOCAL HEALTH RESPONSIBILITIES

- Conduct appropriate case investigations
  - Contact ordering physician
    – Use “Form A” to collect clinical information from provider
  - Contact patients with EM
    – Use “Form B” to collect exposure information

- Educate the patient about Lyme disease prevention

- Report all case information in the West Virginia Electronic Disease Surveillance System (WVEDSS)
Data entered in WVEDSS by local health is used to generate surveillance reports.

- Vectorborne disease reports (Spring-Fall)
- Annual tickborne disease surveillance report
- Oral and poster presentations
- HANs
- Media requests

Thank you for all of your work on case investigations!
WVEDSS: Improving Data Quality

- Certain fields are routinely left blank or are incorrectly marked.
  - Race
  - Ethnicity
  - Illness onset date
  - Laboratory results

- Labs that are used to start case investigations are sometimes entered incorrectly.
RACE AND ETHNICITY

- Don’t be afraid to ask the patient for race and ethnicity information if contact is made
  - “Would you mind sharing your race and ethnicity so that we can collect accurate Lyme disease surveillance data for WV?”
  - Explain why this data is important
  - No response/refusal → check unknown (do not leave blank)

- Ask the healthcare provider
  - Healthcare providers definitely have this information

- Understand why the data is important
  - Better understand characteristics of cases
  - Identify at-risk populations
### Ethnicity Information As Of: 01/15/2015

**Ethnicity:** Not Hispanic or Latino

<table>
<thead>
<tr>
<th>Race Information As Of: 01/15/2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Race: Unknown</td>
</tr>
<tr>
<td>☒ American Indian or Alaska Native</td>
</tr>
<tr>
<td>☐ Asian</td>
</tr>
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<td>☐ Black or African American</td>
</tr>
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<tr>
<td>☒ White</td>
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### Ethnicity Information As Of: 02/18/2015

**Ethnicity:**

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<tbody>
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</table>
ILLNESS ONSET DATE

- Illness onset date ≠ diagnosis date
  - Diagnosis date should not be used for determining if laboratory specimens were collected within 30 days

- Many “confirmed” and “probable” case are likely ascertained as “not a case” due to missing illness onset date.
  - Positive two-tier testing will not be confirmatory

- Ask the healthcare provider
  - Possibly in physician’s notes in medical records
WVEDSS: Improving Data Quality (cont’d)

MANUAL ENTRY OF PATIENT LABS

What’s wrong with this lab entry?

- No ordered test information
- Resulted test is unclear
  - EIA/IFA or Western blot?
  - IgM or IgG detected?
Search “(Lyme Disease) Antibody”
Search for “(Lyme Disease) antibody”

<table>
<thead>
<tr>
<th>Test Name</th>
<th>Select</th>
</tr>
</thead>
<tbody>
<tr>
<td>Borrelia burgdorferi (Lyme Disease) Antibody, Blood</td>
<td>EIA/IFA or Western blot</td>
</tr>
<tr>
<td>Borrelia burgdorferi (Lyme Disease) Antibody, Cerbrospinal fluid (CSF)</td>
<td>EIA/IFA or Western blot</td>
</tr>
<tr>
<td>Borrelia burgdorferi (Lyme Disease) Antibody, IgG banding pattern, Blood</td>
<td>Western blot</td>
</tr>
<tr>
<td>Borrelia burgdorferi (Lyme Disease) Antibody, IgG, Blood</td>
<td>EIA/IFA or Western blot</td>
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</tbody>
</table>

Though “Ordered Test” is not a required field, please select one of these options when entering EIAs/IFAs or Western blots
Search for “(Lyme Disease) Antibody”
<table>
<thead>
<tr>
<th>Test Name</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select Borrelia burgdorferi (Lyme disease) antibody</td>
<td>EIA/IFA or Western blot</td>
</tr>
<tr>
<td>Select Borrelia burgdorferi (Lyme Disease) Antibody, Blood (serology)</td>
<td>EIA/IFA or Western blot</td>
</tr>
<tr>
<td>Select Borrelia burgdorferi (Lyme Disease) Antibody, Blood, ELISA</td>
<td>EIA</td>
</tr>
<tr>
<td>Select Borrelia burgdorferi (Lyme Disease) Antibody, Blood, IFA</td>
<td>IFA</td>
</tr>
<tr>
<td>Select Borrelia burgdorferi (Lyme disease) antibody, IgG</td>
<td>IgG EIA/IFA or Western blot</td>
</tr>
<tr>
<td>Select Borrelia burgdorferi (Lyme Disease) Antibody, IgG banding pattern, Blood, Western blot (WB)</td>
<td>IgG WB</td>
</tr>
<tr>
<td>Select Borrelia burgdorferi (Lyme Disease) Antibody, IgG, Blood, Western blot (WB)</td>
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<tr>
<td>Select Borrelia burgdorferi (Lyme disease) antibody, IgM</td>
<td>IgM EIA/IFA or Western blot</td>
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<td>Select Borrelia burgdorferi (Lyme Disease) Antibody, IgM, Blood, Western blot (WB)</td>
<td>IgM WB</td>
</tr>
</tbody>
</table>
IgM EIA Example

<table>
<thead>
<tr>
<th>Ordered Test:</th>
<th>Borrelia burgdorferi (Lyme Disease) Antibody, IgM, Blood</th>
</tr>
</thead>
</table>

**Resulted Tests and Results**

- Resulted Test: Borrelia burgdorferi (Lyme Disease) Antibody, Blood, ELISA
  - Result(s): positive
  - Reference Range: > 5.00000

- Status:

- Result Comments:

---

IgM Western Blot Example

<table>
<thead>
<tr>
<th>Ordered Test:</th>
<th>Borrelia burgdorferi (Lyme Disease) Antibody, IgM banding pattern, Blood</th>
</tr>
</thead>
</table>

**Resulted Tests and Results**

- Resulted Test: Borrelia burgdorferi (Lyme Disease) Antibody, IgM, Blood, Western blot (WB)
  - Result(s): positive
  - Bands 23 and 41 are present

- Reference Range:

- Status:

- Result Comments:
Electronic laboratory reporting (ELR) will improve data quality in the long run
- Will still need to get race and ethnicity data

Many laboratories currently send reports electronically
- Quest, Mayo Clinic, Lab Corp

Ordered test, resulted test, results, and other fields will be populated by the laboratory electronically
- Electronic lab reports are designated with an “E”
## ELR in WVEDSS

<table>
<thead>
<tr>
<th>Test Results</th>
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<tbody>
<tr>
<td><strong>Ordered Test:</strong></td>
</tr>
<tr>
<td><strong>Codes:</strong></td>
</tr>
<tr>
<td><strong>Status:</strong></td>
</tr>
</tbody>
</table>

### Resulted Tests and Results

- **Resulted Test:** Borrelia burgdorferi Ab.IgG+IgM (Lyme IgG/IgM Ab)
- **Result(s):** 2.04000 ISR
- **Reference Range:** 0.00-0.90
- **Interpretation:** Above high normal
- **Result Method:**
  - **Status:** Final
  - **Test Code(s):** 34148-7 (LN LOINC) /015272 (L LOCAL)
  - **Result Comments:** Negative <0.91
    - Equivocal 0.91 - 1.09
    - Positive >1.09

- **Date/Time:** 2015-04-21 15:32:51.0
- **Performing Facility:** LabCorp Dublin
  - **Facility ID:** 36D0327333 (FI)
### ELR in WVEDSS

<table>
<thead>
<tr>
<th>Date Received</th>
<th>Provider/Reporting Facility</th>
<th>Date Collected</th>
<th>Test Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>05/13/2011</td>
<td>Quest Diagnostics-Chantilly</td>
<td>01/04/2011</td>
<td>-</td>
</tr>
<tr>
<td>06/27/2015</td>
<td>LABCORP</td>
<td>06/23/2015</td>
<td>-</td>
</tr>
<tr>
<td>06/27/2015</td>
<td>LABCORP</td>
<td>06/23/2015</td>
<td>-</td>
</tr>
<tr>
<td>06/27/2015</td>
<td>LABCORP</td>
<td>06/23/2015</td>
<td>-</td>
</tr>
<tr>
<td>02/20/2016</td>
<td>Winchester Medical Center</td>
<td>02/19/2016</td>
<td>-</td>
</tr>
</tbody>
</table>

Manually entered

- Borrelia burgdorferi (Lyme Disease) Antibody, Blood (serology): +1.37000
- Borrelia burgdorferi (Lyme Disease) Antibody, IgG, Blood, Western blot (WB): positive
- Borrelia burgdorferi (Lyme Disease) Antibody, IgM, Blood, Western blot (WB): negative

ELR
The WVEDSS Lyme disease page is in the process of being updated to have the same layout as other zoonotic disease pages.

ETA: April 2016
Rejection Messages

If cases are not correctly ascertained in WVEDSS, you will receive the following rejection message:

*Reason for Rejection: Incorrect ascertainment based on information provided.*
Lyme Disease Surveillance Data
Confirmed and Probable Lyme Disease Cases Reported By County (N=1,573) — West Virginia, 2000-2015

- County with no reported cases of Lyme disease
- County with 1-10 reported cases of Lyme disease
- County with 11-100 reported cases of Lyme disease
- County with >100 reported cases of Lyme disease
The Eastern Region accounted for 88.2% of confirmed and probable LD cases reported in WV from 2000-2014.
Reported Lyme Disease Cases

<table>
<thead>
<tr>
<th>County</th>
<th># of cases from 2000-2014</th>
<th># of cases in 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barbour</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Doddridge</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Harrison</td>
<td>11</td>
<td>4</td>
</tr>
<tr>
<td>Marion</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>Monongalia</td>
<td>12</td>
<td>9</td>
</tr>
<tr>
<td>Preston</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Taylor</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>43</strong></td>
<td><strong>23</strong></td>
</tr>
</tbody>
</table>
Reported Lyme Disease Cases

NORTHWESTERN REGION

Endemic counties highlighted in red

<table>
<thead>
<tr>
<th>County</th>
<th># of cases from 2000-2014</th>
<th># of cases in 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brooke</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Calhoun</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Clay</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Gilmer</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Hancock</td>
<td>5</td>
<td>13</td>
</tr>
<tr>
<td>Marshall</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Ohio</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>Pleasants</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Ritchie</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Roane</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Tyler</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Wetzel</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Wirt</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Wood</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>TOTAL</td>
<td>34</td>
<td>32</td>
</tr>
</tbody>
</table>
Reported Lyme Disease Cases

WESTERN REGION

<table>
<thead>
<tr>
<th>County</th>
<th># of cases from 2000-2014</th>
<th># of cases in 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boone</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Cabell</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Jackson</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Lincoln</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Logan</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Mason</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Mingo</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Wayne</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>TOTAL</td>
<td>6</td>
<td>4</td>
</tr>
</tbody>
</table>
Reported Lyme Disease Cases

<table>
<thead>
<tr>
<th>County</th>
<th># of cases from 2000-2014</th>
<th># of cases in 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fayette</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Greenbrier</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>McDowell</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Mercer</td>
<td>12</td>
<td>5</td>
</tr>
<tr>
<td>Monroe</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>Nicholas</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Raleigh</td>
<td>9</td>
<td>0</td>
</tr>
<tr>
<td>Summers</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Wyoming</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>TOTAL</td>
<td>50</td>
<td>24</td>
</tr>
</tbody>
</table>
Reported Lyme Disease Cases

CENTRAL REGION

Endemic counties highlighted in red

<table>
<thead>
<tr>
<th>County</th>
<th># of cases from 2000-2014</th>
<th># of cases in 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Braxton</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Kanawha</td>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td>Lewis</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Putnam</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Upshur</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Webster</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>19</strong></td>
<td><strong>16</strong></td>
</tr>
</tbody>
</table>
2000-2015 SURVEILLANCE DATA

- 1,573 confirmed and probable Lyme disease cases were reported
  - 18.4% of cases reported in 2015

- Counties bordering Maryland, Virginia, and Pennsylvania reported the most cases

- Numbers include cases that acquired Lyme disease outside of West Virginia
## Reported Exposure Location

<table>
<thead>
<tr>
<th>Year</th>
<th>Exposure Location</th>
<th># (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Within home jurisdiction</strong></td>
<td>81 (83.5)</td>
</tr>
<tr>
<td></td>
<td><strong>Outside of jurisdiction</strong></td>
<td>7 (7.2)</td>
</tr>
<tr>
<td></td>
<td><strong>Unknown</strong></td>
<td>9 (9.3)</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td>97 (100.0)</td>
</tr>
<tr>
<td>2012</td>
<td><strong>Within home county</strong></td>
<td>121 (84.6)</td>
</tr>
<tr>
<td></td>
<td><strong>Outside of jurisdiction</strong></td>
<td>6 (4.2)</td>
</tr>
<tr>
<td></td>
<td><strong>Unknown</strong></td>
<td>16 (11.2)</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td>143 (100.0)</td>
</tr>
<tr>
<td>2013</td>
<td><strong>Within home county</strong></td>
<td>110 (80.9)</td>
</tr>
<tr>
<td></td>
<td><strong>Outside of jurisdiction</strong></td>
<td>9 (6.6)</td>
</tr>
<tr>
<td></td>
<td><strong>Unknown</strong></td>
<td>17 (12.5)</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td>136 (100.0)</td>
</tr>
<tr>
<td>2014</td>
<td><strong>Within home county</strong></td>
<td>230 (79.6)</td>
</tr>
<tr>
<td></td>
<td><strong>Outside of jurisdiction</strong></td>
<td>15 (5.2)</td>
</tr>
<tr>
<td></td>
<td><strong>Unknown</strong></td>
<td>44 (15.2)</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td>289 (100.0)</td>
</tr>
</tbody>
</table>
## 2012-2015 Lyme Disease Surveillance Data

<table>
<thead>
<tr>
<th>SURVEILLANCE VARIABLE</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td># of case investigations</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Confirmed</strong></td>
<td>313 (100)</td>
<td>369 (100)</td>
<td>397 (100)</td>
<td>617 (100)</td>
</tr>
<tr>
<td><strong>Probable</strong></td>
<td>82 (26.2)</td>
<td>116 (31.4)</td>
<td>112 (28.2)</td>
<td>243 (39.4)</td>
</tr>
<tr>
<td><strong>Suspected</strong></td>
<td>15 (4.8)</td>
<td>27 (7.3)</td>
<td>24 (6.0)</td>
<td>46 (7.5)</td>
</tr>
<tr>
<td><strong>Not a case</strong></td>
<td>211 (67.4)</td>
<td>211 (57.2)</td>
<td>230 (57.9)</td>
<td>281 (45.5)</td>
</tr>
<tr>
<td>Physician-diagnosed</td>
<td>-</td>
<td>232 (62.9)</td>
<td>208 (52.4)</td>
<td>TBD</td>
</tr>
<tr>
<td><strong>Physician diagnosed + not a case</strong></td>
<td>-</td>
<td>93 (25.2)</td>
<td>71 (17.9)</td>
<td>TBD</td>
</tr>
<tr>
<td>Lost to follow-up</td>
<td>-</td>
<td>45 (12.2)</td>
<td>86 (21.7)</td>
<td>TBD</td>
</tr>
<tr>
<td>(suspected and not a case)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Is West Virginia Underreporting LD?

MISSING LABORATORY CRITERIA

- Loss to follow up investigations
- Physician-diagnosed + “not a case”
- Inappropriate/Insufficient labs
- Lyme disease symptoms + “not a case”

Public Health Healthcare Providers

- Public Health Healthcare Providers
- Public Health Healthcare Providers
- Public Health Healthcare Providers
  - Laboratorians
  - Laboratorians
  - Laboratorians

Engagement of stakeholders

SURVEILLANCE CASES ≈ DIAGNOSTIC CASES ≈ “TRUE” CASES
Potential Factors Influencing Reporting

**Increased Awareness**

- Seasonal tickborne disease health alerts?
  - 2015 health alert on increased LD activity

- Local health department training on LD surveillance?
  - 2013 LD webinar
  - 2014 training in LD endemic region (eastern counties)
  - 2016 LD training in regions with endemic counties (March and April)

- Outreach to healthcare providers?
  - 2015 LD webinar collaboration with West Virginia University
  - 2013 and 2016 survey

- Dissemination of tick prevention and surveillance information?
  - At local health departments, provider offices, veterinary practices, public health events, updated website
REGIONAL EPIDEMIOLOGISTS

Northwestern Region
Frances Nicholson
Mid-Ohio Valley HD

Western Region
Debra Ellison
Cabell-Huntington HD

Southern Region
Michelle Trickett
Beckley-Raleigh Co. HD

Eastern Region
Kimberly Kline
Pendleton Co. HD

Northeastern Region
Bob White
Monongalia Co. HD

Central Region
Lindsey Mason
Kanawha-Charleston HD
DIVISION OF INFECTIOUS DISEASE EPIDEMIOLOGY
ZOONOTIC DISEASE PROGRAM (ZDP)

- Dr. Danae Bixler, MD, MPH
  • Director of the Division of Infectious Disease Epidemiology

- Miguella Mark-Carew, PhD
  • Zoonotic Disease Epidemiologist

- Eric Dotseth, MS
  • State Public Health Entomologist

- David Stiltner
  • Zoonotic Disease Data Analyst
Tickborne diseases are spread through the bite of an infected tick. Many of these diseases can also infect pets. Lyme disease is the most common tickborne disease reported in West Virginia. From 2000-2014, there were over 1,100 cases reported across the state, mostly in the Eastern Panhandle. The number of counties reporting Lyme disease cases has increased in recent years.

Anaplasmosis, ehrlichiosis, and Rocky Mountain spotted fever have also been reported in West Virginia, with about 1-10 cases of each per year.

Tickborne infection can cause a variety of symptoms including fever, headache, chills, myalgia, and rash. Most infections occur from late spring through early fall when ticks (and people and pets) are most active.

The best way to prevent tickborne diseases is to prevent getting bitten by a tick. Using tick repellent, checking one’s body and pets for ticks, and properly removing ticks are good prevention methods. Antibiotics are effective in treating tickborne diseases and can prevent severe complications when given early in the course of infection.
Lyme disease

Lyme disease is a bacterial infection caused by bites from *Ixodes scapularis* (also known as "deer" ticks or "black-legged" ticks). It is the most common tickborne disease in the United States and West Virginia. Symptoms generally begin 3 to 30 days after the tick bite and include fever, headache, chills, and rash (erythema migrans). If an infected person is not treated early with antibiotics, Lyme disease can progress over weeks to years to cause recurrent arthritis, pain and swelling at joints, facial palsy, and neurological complications.

Most cases of Lyme disease are concentrated in the northeastern and midwestern regions of the United States. In 2013, 95% of cases were reported in 14 states (which include neighboring Maryland, Pennsylvania, and Virginia). As of 2015, there are seven counties in West Virginia that are considered "endemic" for Lyme disease: Berkeley, Hampshire, Hancock, Jefferson, Mineral, Morgan, and Wood Counties.

Need more information on Lyme disease? Click on one of the icons below.
Internet Resources: DIDE Webpages

Lyme Disease Reporting Resources for Local Health

- **Lyme Disease Surveillance Protocol**: A comprehensive guide for Lyme disease surveillance.
- **Lyme Disease Case Definition**: The current NNDSS case definition (2011).
- **Lyme Disease Case Report Form**: Used to collect epidemiologic, clinical, and laboratory information for Lyme disease case investigations.
- **LHD Lyme Disease Investigation Toolkit**: This toolkit includes case ascertainment tools, Western Blot lab interpretation help, provider quicksheet, and more.

LYME DISEASE: What you need to know

- How it’s spread
- Where it’s found
- How it’s prevented
- How it’s diagnosed
- How it’s treated

PREVENT TICKBORNE DISEASES

- Wear repellent
- Check for ticks daily
- Shower soon after being outdoors
- Call your doctor if you get a fever or rash following a tick bite

For more information: www.cdc.gov

PREVENT LYME DISEASE!

- WEAR REPELLENT
- CHECK FOR TICS DAILY
- SHOWER SOON AFTER BEING OUTDOORS
- CALL YOUR DOCTOR IF YOU GET A FEVER OR RASH

Tick Safety: Your guide to Lyme disease and other tick-borne diseases
Summary

- A variety of stakeholders play roles in the West Virginia Lyme disease surveillance system.

- Lyme disease reporting is increasing in West Virginia.
  - Case counts and geographic distribution

- More LD “endemic” counties are likely to be classified in the coming years.
  - Five classified in 2015 alone

- Electronic lab reporting will improve data quality, but in the meantime, try to get complete case data.
  - We definitely use it!
Miguella Mark-Carew, PhD
Zoonotic Disease Epidemiologist
Division of Infectious Disease Epidemiology
WV Department of Health & Human Resources
Bureau for Public Health
350 Capitol St. Rm. 125
Charleston, WV 25301
Office phone: 304-356-4021
miguella.p.mark-carew@wv.gov