"One Health"

"Greater progress in prevention and control of infectious diseases requires a more directed effort focusing on the complex interplay between human health, the health of animals, and the environment."

-CDC One Health Office

West Nile Virus in Michigan

EPIDEMIOLOGY AND
HUMAN CASE INVESTIGATION

Kim Signs, DVM
Zoonotic Disease Epidemiologist

Michigan Department of Community Health
MDCH

One Health Webinar Series
MDCH Communicable Disease Division
July 9, 2013

The West Nile Virus Cycle

- The virus is maintained by a mosquito-bird cycle
- Primary amplifying and bridge vectors are *Culex* species mosquitoes
- Typical virus amplification reaches peak levels in late summer

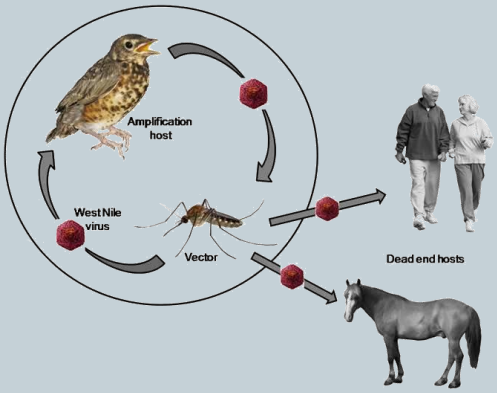


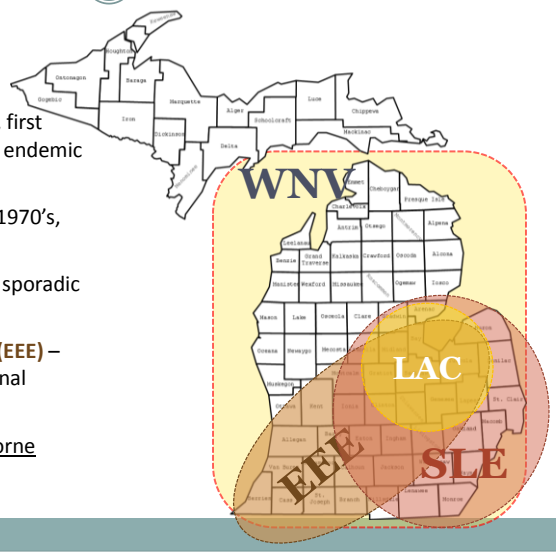
Figure © Gabe Hamer

Surveillance for Arboviruses Including WNV

Ecologic	Human
Ecologic surveillance provides the best opportunity for early detection and intervention to reduce human risk • **Reservoir species** (birds) • Sentinel species (non-avian wildlife and domestic animals) • **Mosquitoes**	• Meningitis/encephalitis patients • Blood donors

Geographic Distribution of Arboviruses

- West Nile virus (WNV) – flavivirus, first detected in the state in 2001, now endemic
- St. Louis Encephalitis virus (SLE) – flavivirus, historic outbreak in the 1970's, sporadic cases
- LaCrosse virus (LAC) – bunyavirus, sporadic cases
- Eastern Equine Encephalitis virus (EEE) – alphavirus, sporadic cases, occasional outbreaks particularly in equine
- **Powassan virus** – flavivirus, tick-borne



WEST NILE
MICHIGAN
VIRUS
Working Group

Michigan's WNV Interagency Group

Michigan Department of Community Health
- Bureau of Epidemiology
- Bureau of Laboratories

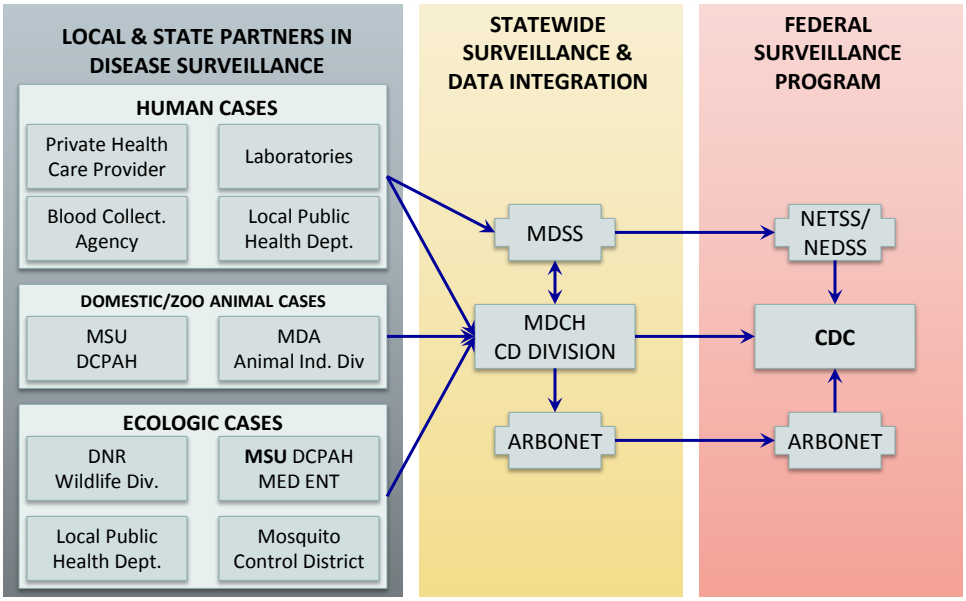
Michigan State University
- Diagnostic Center for Population and Animal Health
- Department of Entomology

Michigan Department of Agriculture and Rural Development
- Pesticide and Plant Pest Mgt. Division
- Animal Industry Division

Michigan Department of Natural Resources
- Wildlife Diseases Laboratory

Michigan Department of Environmental Quality
- Water Division
- Waste and Hazardous Materials Division

A One Health Approach to WNV in Michigan



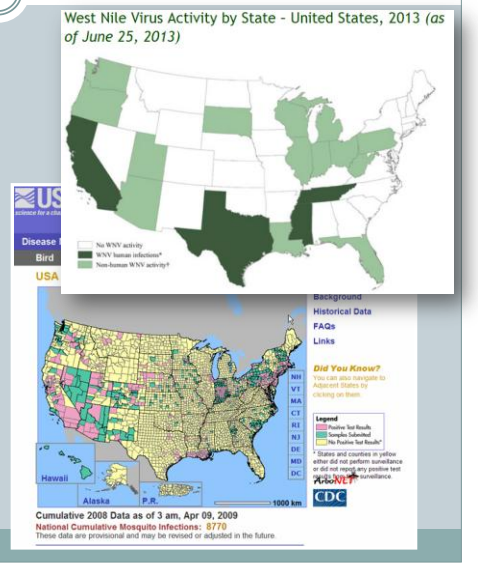
ArboNET

- ArboNET is a web-based surveillance data network comprising 54 state and local public health departments and CDC
- Surveillance for Arbovirus disease including West Nile virus, St. Louis encephalitis, Eastern Equine encephalitis, Dengue and others
- A unique strength of ArboNET is that it combines reporting of human, ecologic, and geographic data into one surveillance system.

National Surveillance Data

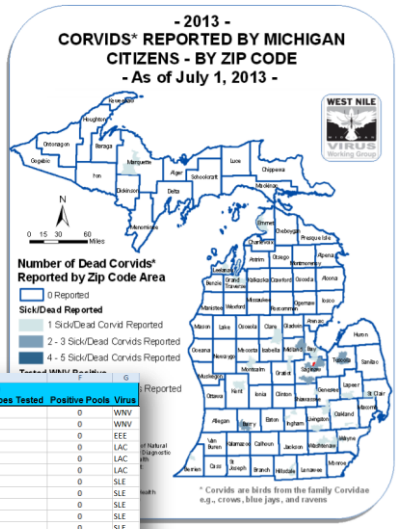
www.cdc.gov/westnile

- Epi-X: CDC Arboviral Activity Update
  - All arboviruses
  - Updated weekly
- USGS West Nile virus page
  - All arboviruses by geographic region
  - Epi-curves of human and animal cases



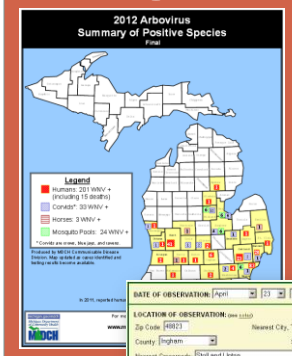
Michigan Outputs

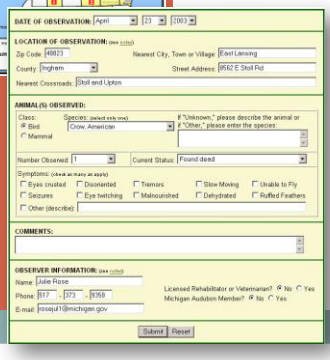
- Data is shared with the public for local consumption
- County and zip-code level data
- Prevention information is provided



Mosquito Testing Results - 2013 (As of July 1, 2013)

County	Week	Species	Pools Tested	Total Mosquitoes Tested	Positive Pools	Virus
Bay	22	Culex pipiens-restuans (Mixed)	15	447	0	WNV
Bay	23	Culex pipiens-restuans (Mixed)	3	32	0	WNV
Saginaw	24	Culex erraticus	1	1	0	EEE
Saginaw	24	Ochlerotatus j. japonicus	11	64	0	LAC
Saginaw	24	Ochlerotatus triseriatus	4	18	0	LAC
Saginaw	25	Ochlerotatus j. japonicus	1	1	0	LAC
Saginaw	20	Culex pipiens	3	3	0	SLE
Saginaw	20	Culex pipiens-restuans (Mixed)	16	141	0	SLE
Saginaw	20	Culex restuans	15	30	0	SLE
Saginaw	21	Culex pipiens	7	46	0	SLE
Saginaw	21	Culex pipiens-restuans (Mixed)	23	239	0	SLE
Saginaw	21	Culex restuans	24	177	0	SLE
Saginaw	22	Culex pipiens	26	617	0	SLE





Emerging Disease Issues
Diseases that may affect humans or animals

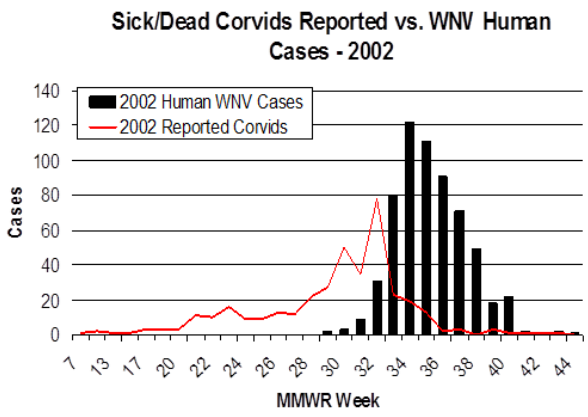
Purpose of Website

www.michigan.gov/westnilevirus

- Inter-agency site with MDCH, MDARD, MDNR, MDEQ, MDTMB, e-Michigan, and MSU.
- Disseminate up-to-date information on WNV surveillance data in birds, horses, humans, and mosquitoes.
- Solicit dead corvid reports and specimens for testing.

Benefits to Public Health

- Epidemiologists can draw relationships between ecologic data and human case data
- May allow for prediction of disease outbreak
- Control and education efforts can be mobilized to minimize human disease



Ecologic Testing Capacity in Michigan

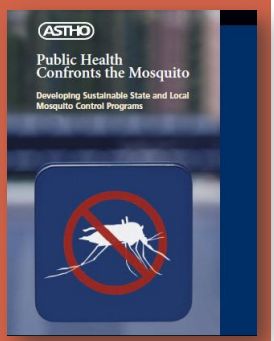
MICHIGAN STATE UNIVERSITY

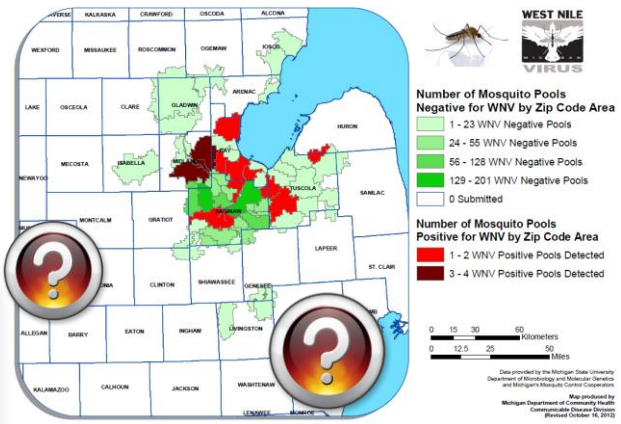
Diagnostic Center for Population and Animal Health (DCPAH)

- Arbovirus Dx—animals (equine, domestic pets, wildlife):
  - PCR (tissue, swabs, blood feathers, CSF)
  - IHC (tissue)
  - IgM Capture ELISA (serum)
- Entomology/MMG
  - Mosquito PCR (SLE, WNV, EEE, LaCrosse)

The CDC and ASTHO have published important guidance documents for communities interested in developing mosquito surveillance and control programs. They are available at:

www.michigan.gov/westnile

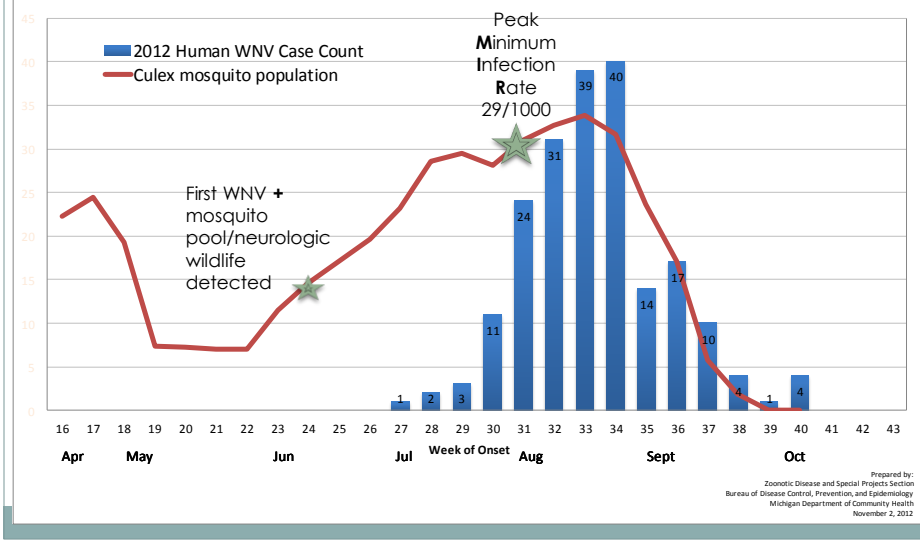




Mosquito testing/surveillance

In Michigan, limited mosquito surveillance and testing is conducted through the Bay Area Mosquito Control Districts. While this provides a good indicator of mosquito activity and infection, it does not provide specific information as to the risk in Michigan's most highly affected regions.

2012 West Nile Virus Activity* in Michigan



Prepared by:
Zoonotic Disease and Special Projects Section
Bureau of Disease Control, Prevention, and Epidemiology
Michigan Department of Community Health
November 2, 2012

Arbovirus Case Definition

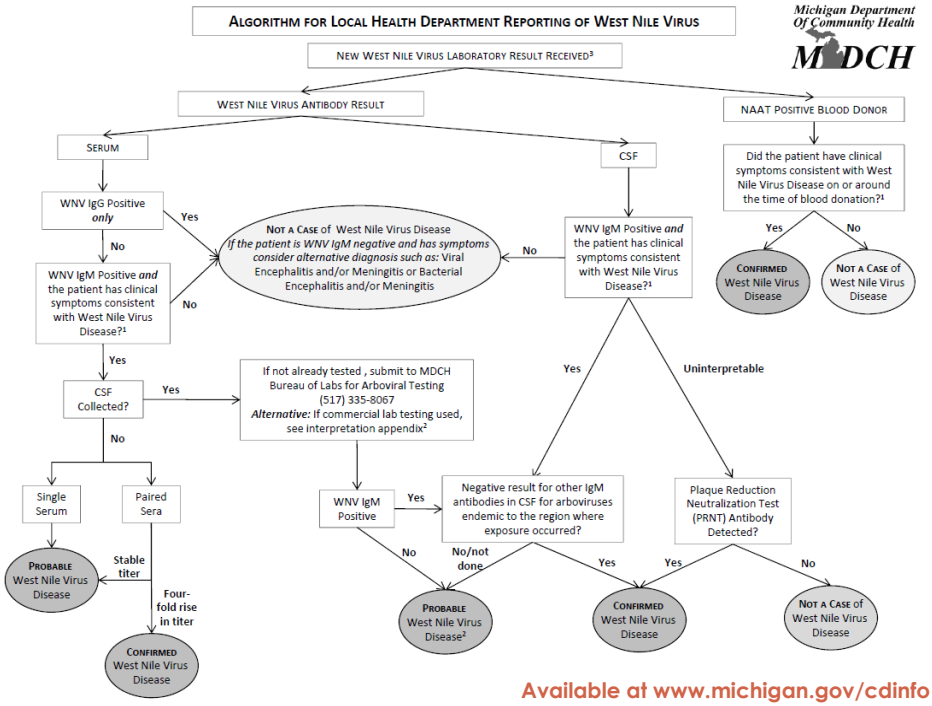
A clinically compatible case of arboviral disease is defined as follows:

Neuroinvasive disease

- Fever (≥100.4 F or 38 C) as reported by the patient or a health-care provider, AND
- Meningitis, encephalitis, acute flaccid paralysis, or other acute signs of central or peripheral neurologic dysfunction, as documented by a physician, AND
- Absence of a more likely clinical explanation.

Non-neuroinvasive disease

- Fever (≥100.4 F or 38 C) as reported by the patient or a health-care provider, AND
- Absence of neuroinvasive disease, AND
- Absence of a more likely clinical explanation.

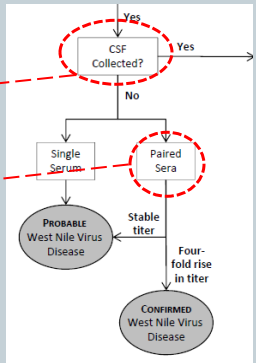


Available at www.michigan.gov/cdinfo

Human Diagnostic Testing for Arboviruses

Patients presenting with meningitis/encephalitis from May-Nov should be tested for all arboviruses potentially circulating in Michigan; WNV, SLE, EEE, LAC

- CSF is the preferred specimen
  - MDCH turn-around is approximately 1 week
- Paired sera is an alternative to CSF
  - At MDCH, reserved for hospitalized patients for whom CSF is not available, more prolonged turn-around time
- Flavivirus (SLE, WNV) cross-reaction poses a diagnostic dilemma, particularly for commercial labs that lack an equivalent EIA for SLE.



Diagnosing Arboviruses Other Than WNV

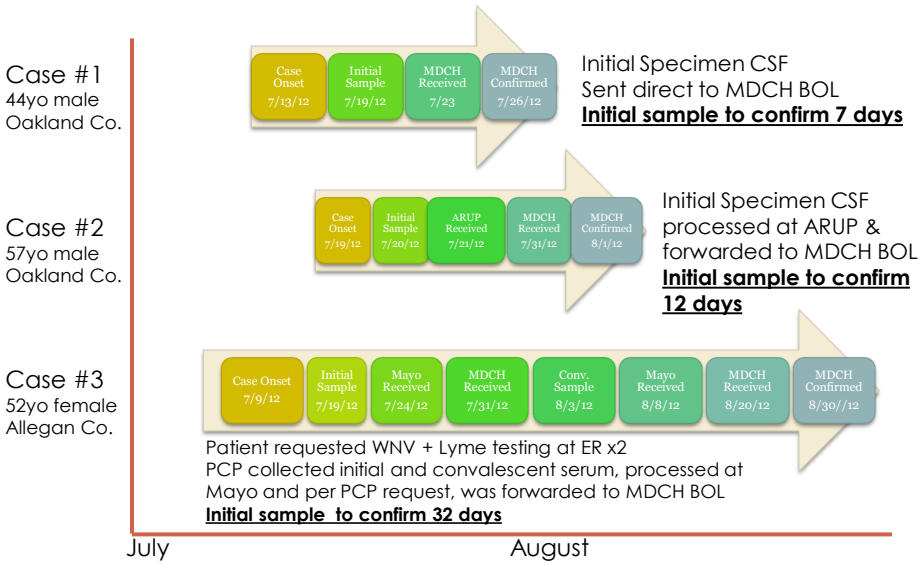
- CDC and MDCH offer MIA and EIA tests for EEE, SLE and CGV not available through commercial labs
- IFA is methodology utilized by commercial laboratories offering EEE, SLE and CGV serology (lower cost, no BSL concerns)
- IFA is less sensitive than EIA at detecting IgM
- MDCH asks hospitals to submit **CSF** on patients with suspect viral meningitis/encephalitis for the arbovirus panel testing
- **In 2010, several meningitis/encephalitis patients that tested "negative" for IgM and/or IgG utilizing an IFA against arboviruses at commercial labs were found to be positive using IgM EIA, MIA and PRNT methodology at BOL**

Take Home Message

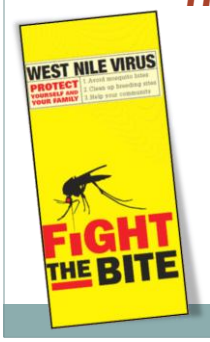
- MDCH utilizes "state of the art" methodologies for detecting arbovirus infections
- MDCH provides these tests free of charge to Michigan physicians and their patients
- Proper specimen and test selection is crucial in making the diagnosis of arboviral disease
  - CSF: IgM* MIA for WNV, SLE, EEE, IgM EIA for LAC
  - Serum: IgM* EIA, PRNT on acute and convalescent specimens

* IgG alone cannot be utilized to diagnose an acute arboviral illness

Human WNV Case Identification



Prevention and intervention activities need to be implemented as soon as possible in the transmission cycle to be effective - to reduce the number of human cases

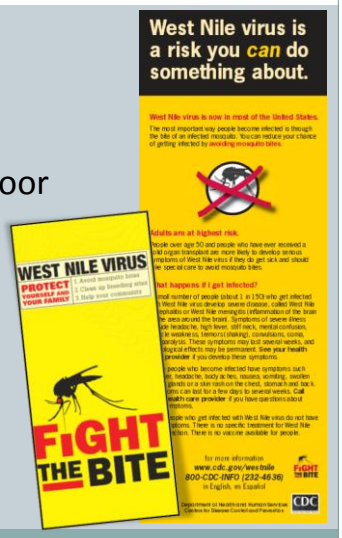


Prevention

- Early detection
- Personal Protection
- Mosquito Control

Education

- Surveillance Data Updated weekly
  - Emerging Diseases website
  - ArboNET → USGS maps
- Risk Groups (age, health status, outdoor exposure, etc)
- Personal Protection
  - Source reduction
  - Behavior modification
  - Repellent Use
  - Vaccination



Community Mosquito Control

Cultural Controls

- Educational campaigns
- Filling areas prone to flooding
- Drain management
- Scrap-tire campaigns
- Draining/filling abandoned pools

Pesticides

- Larviciding
  - Killing mosquito larvae before they emerge
  - The best, most cost-effective preventive measure
- Adulticiding
  - Killing mosquitoes "on the wing"
  - Ultra-low volume applications

Communities in Michigan with active mosquito control historically report fewer human cases of West Nile virus disease, despite detecting the disease in mosquitoes and wildlife yearly.

Lyme Disease in Michigan

EPIDEMIOLOGY AND
HUMAN CASE INVESTIGATION

Erik Foster, MS
Medical Entomologist
One Health Webinar Series
MDCH Communicable Disease Division
July 9, 2013

The Lyme Disease Cycle

Environment

Ticks and wildlife hosts flourish in habitats with overlapping resources and environmental suitability

Animal Disease

Small mammals such as mice and chipmunks are reservoirs. Our companion animals, especially dogs, may become infected and show signs of illness

Human Disease

People may become infected by an *Ixodes scapularis* tick when working or recreating in tick habitats

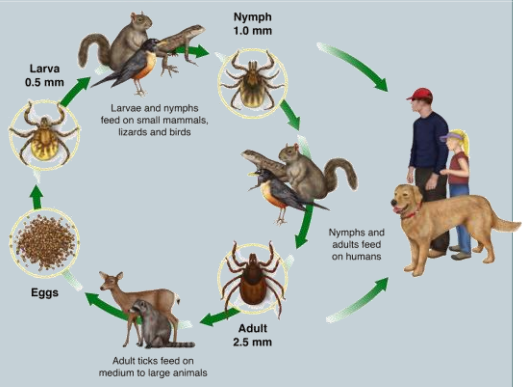
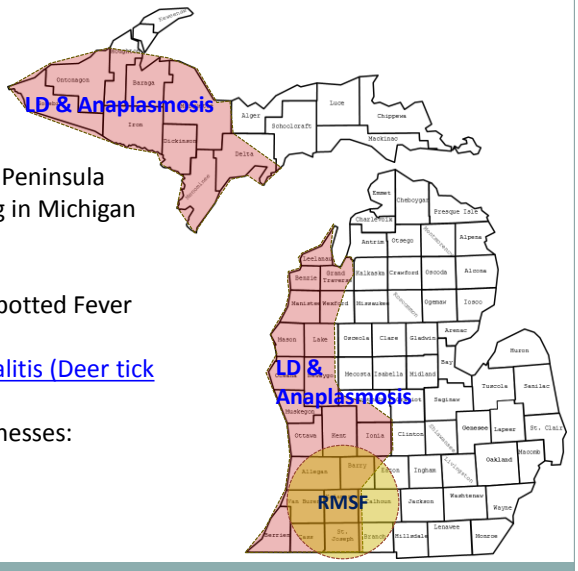


Image © Bay Area Lyme Fund

Tick-borne diseases of Michigan



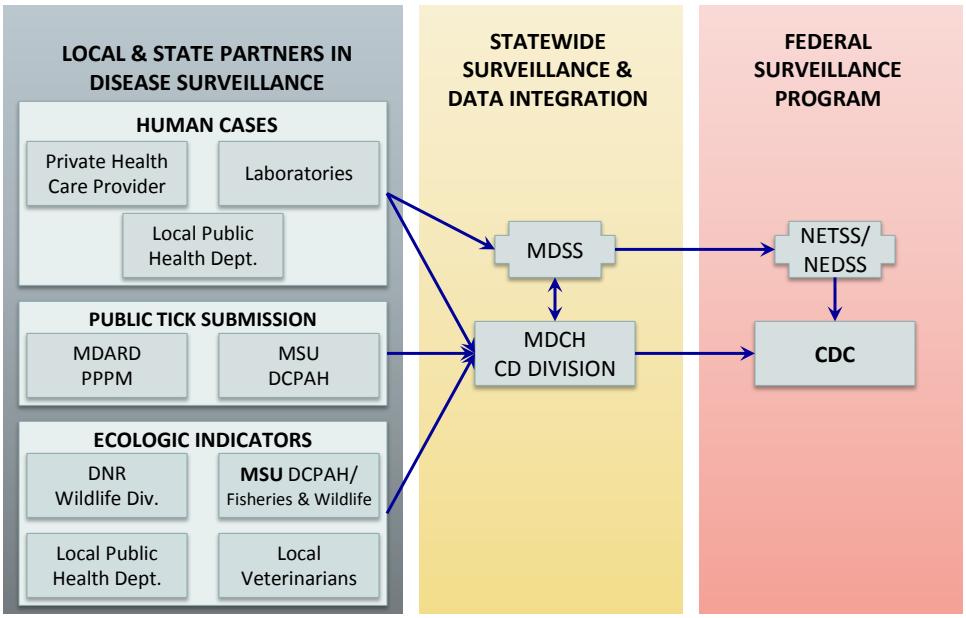
- Historically rare in the Lower Peninsula
- Tick-borne illnesses occurring in Michigan include:

MORE COMMON ↑ LESS COMMON

  - » Lyme disease
  - » Rocky Mountain Spotted Fever
  - » Anaplasmosis
  - » Powassan Encephalitis (Deer tick virus)
- Other potential tick-borne illnesses:
  - » Babesiosis
  - » Ehrlichiosis
  - » Tularemia

**Diseases underlined in blue are potentially transmitted by the Blacklegged tick

A One Health Approach to Lyme in Michigan



Surveillance for *Ixodes scapularis* and Lyme Disease

Ecologic/Animal

- Citizen submitted ticks
  - Identified and forwarded to MDCH-BOL for Lyme testing if *I. scapularis* & alive
- Lyme disease is not an animal reportable condition, however, building relationships with local veterinarians may allow for information to passed on if there is a rise in local animal cases
- Field studies
  - Small mammal trapping
  - Tick drags
  - PCR detection of *B. burgdorferi*

Human

Lyme disease human surveillance focuses on identification of clinically acute cases:

- Physician reported Lyme disease
- Laboratory reports

Lyme disease risk and human case incidence in Michigan: 2012

EPI SNAPSHOT 2012

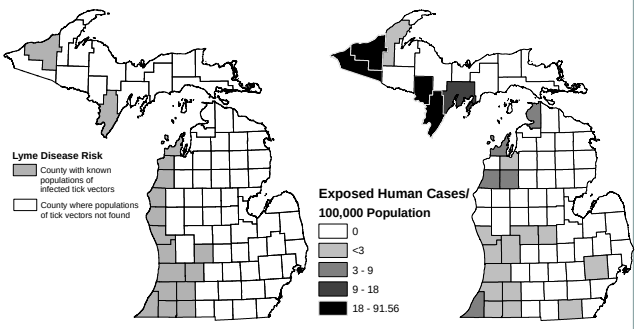
Incidence of locally acquired Lyme disease

Full State:
0.69 cases/100,000 pop.

Upper Peninsula:
14.52 cases/100,000 pop.
*[*91.55 cases/100,000 pop. In Menominee Co.]*

Western Lower Peninsula:
1.14 cases/100,000 pop.

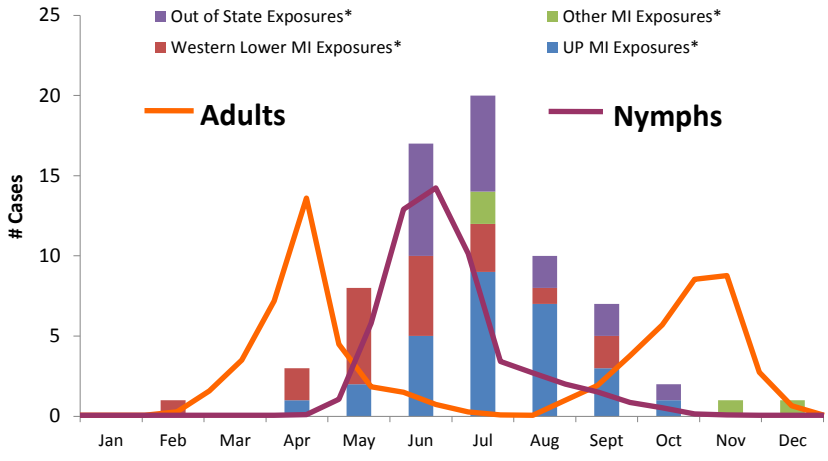
Counties outside of western UP/LP regions:
0.05 cases/100,000 pop.



(Left) Lyme disease risk based on known populations of infected tick vectors. (Right) Incidence of locally acquired human Lyme disease cases, 2012.

E. Foster, MDCH. 2013

Case Onsets: 2012



*based on analysis of 70 cases w/reported onset date, 2012.

E. Foster, MDCH. 2013

Case Investigation

INFORMATION YOU NEED TO GET STARTED:

DATE OF ILLNESS ONSET

COMPLETE CLINICAL PRESENTATION

DETAILED LAB RESULTS

TRAVEL HISTORY IN-STATE AND OUT-OF-STATE

EXPOSURE TO POTENTIAL TICK HABITATS (WOODED, BRUSH, OR GRASSY AREAS IN A LYME DISEASE ENDEMIC COUNTY OR STATE)

Definitions

Exposure

- Having been (≤ 30 days before onset of EM) in wooded, brush, or grassy areas (i.e., potential tick habitats) in a county in which Lyme disease is endemic.
- A history of tick bite is not required.

Endemicity

- A county in which Lyme disease is endemic is one in which at least two confirmed cases have been acquired in the county or in which established populations of a known tick vector are infected with *B. burgdorferi*.

Laboratory Evidence of Infection

- Positive culture for *B. burgdorferi*, OR
- Two-tier testing interpreted using established criteria, where:
  - Positive IgM immuoblot is sufficient only when ≤30 days from symptom onset
  - Positive IgG immunoblot is sufficient at any point during illness
- Single-tier IgG immunoblot seropositivity using established criteria.
- CSF antibody positive for *B. burgdorferi* by Enzyme Immunoassay (EIA) or Immunofluorescence Assay (IFA), when the titer is higher than it was in serum

Surveillance Case Definition

Confirmed:

a) a case of physician Dx **EM** with a known exposure OR,

b) a case of physician Dx **EM** with **laboratory evidence** of infection and without a known exposure OR,

c) a case with at least one **late manifestation** that has **laboratory evidence** of infection.

Probable:

a) any other case of physician-diagnosed Lyme disease that has **laboratory evidence** of infection

NOTE: Cases of Lyme disease can not be closed-out as suspect

Erythema Migrans (EM) Rash

EM is defined as a skin lesion that typically begins as a red macule or papule and expands over a period of days to weeks to form a large round lesion, often with partial central clearing. The rash is not painful or pruritic, but it may be warm to the touch:

- A single primary lesion must reach greater than or equal to 5 cm in size across its largest diameter.
- Secondary lesions also may occur.
- Annular erythematous lesions occurring within several hours of a tick bite represent hypersensitivity reactions and do not qualify as EM.

Classic EM—Circular red rash with central clearing that slowly expands →

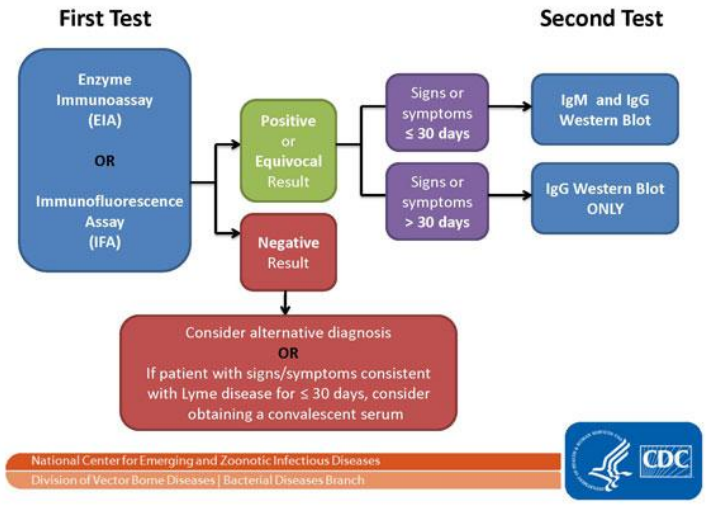
← Early disseminated Lyme disease—multiple red lesions with dusky centers

Tick bite with mild allergic reaction. Not an erythema migrans. Allergic reactions typically appear within the first 48 hours of tick attachment and are usually <5 cm in diameter. →

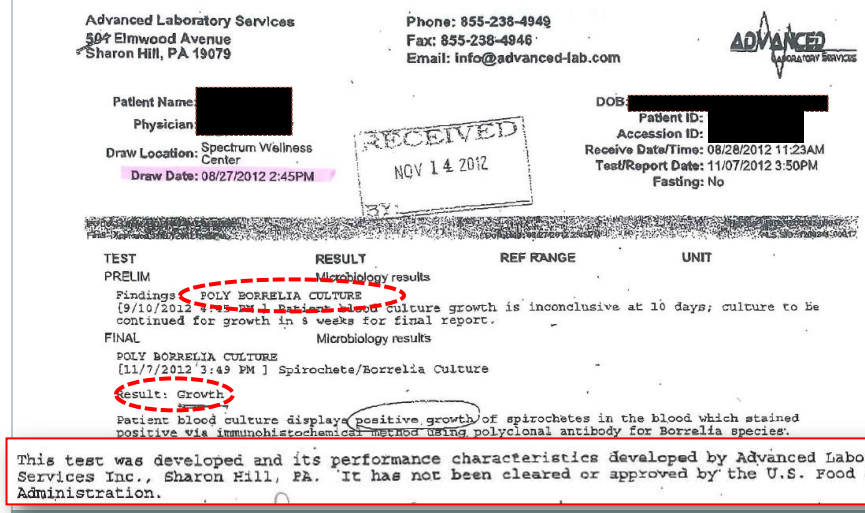
Late Manifestations (Disseminated Lyme disease)

- Confirmatory:
  - Arthritis (objective episodes of joint swelling)
  - Bells palsy or other cranial neuritis
  - Encephalomyelitis (CSF titer must be higher than serum titer), lymphocytic meningitis, or radiculoneuropathy
  - 2nd or 3rd degree atrioventricular block
- Non-confirmatory
  - Arthralgia
  - Bundle branch block
  - Cognitive impairment or encephalopathy
  - Fatigue, fever/sweats/chills, headache, myalgias, myocarditis, neck pain
  - Other rash
  - Palpitations, paresthesias, or visual/auditory impairments

Two-Tiered Testing for Lyme Disease



Caution When Reviewing Labs



Advanced Laboratory Services
504 Elmwood Avenue
Sharon Hill, PA 19079

Phone: 855-238-4949
Fax: 855-238-4946
Email: info@advanced-lab.com

ADVANCED LABORATORY SERVICES

Patient Name: [redacted]
Physician: [redacted]
Draw Location: Spectrum Wellness Center
Draw Date: 08/27/2012 2:45PM

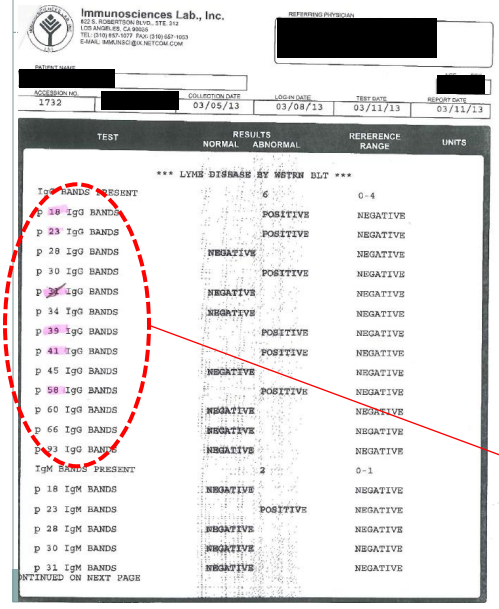
RECEIVED
NOV 14 2012
BY:

DOB: [redacted]
Patient ID:
Accession ID: [redacted]
Receive Date/Time: 08/28/2012 11:23AM
Test/Report Date: 11/07/2012 3:50PM
Fasting: No

TEST	RESULT	REF RANGE	UNIT
PRELIM	Microbiology results		
Findings	POLY BORRELIA CULTURE		
	[9/10/2012 3:35 PM] Patient blood culture growth is inconclusive at 10 days; culture to be continued for growth in 8 weeks for final report.		
FINAL	Microbiology results		
	POLY BORRELIA CULTURE		
	[11/7/2012 3:49 PM] Spirochete/Borrelia Culture		
	Result: Growth		
	Patient blood culture displays positive growth of spirochetes in the blood which stained positive via immunohistochemical method using polyclonal antibody for Borrelia species.		

This test was developed and its performance characteristics developed by Advanced Laboratory Services Inc., Sharon Hill, PA. It has not been cleared or approved by the U.S. Food and Drug Administration.

Caution When Reviewing Labs



Immunosciences Lab., Inc.
[redacted]

REFERRING PHYSICIAN: [redacted]
PATIENT NAME: [redacted]

ACCESSION NO.	COLLECTION DATE	LOG-IN DATE	TEST DATE	REPORT DATE
1732	03/05/13	03/08/13	03/11/13	03/11/13

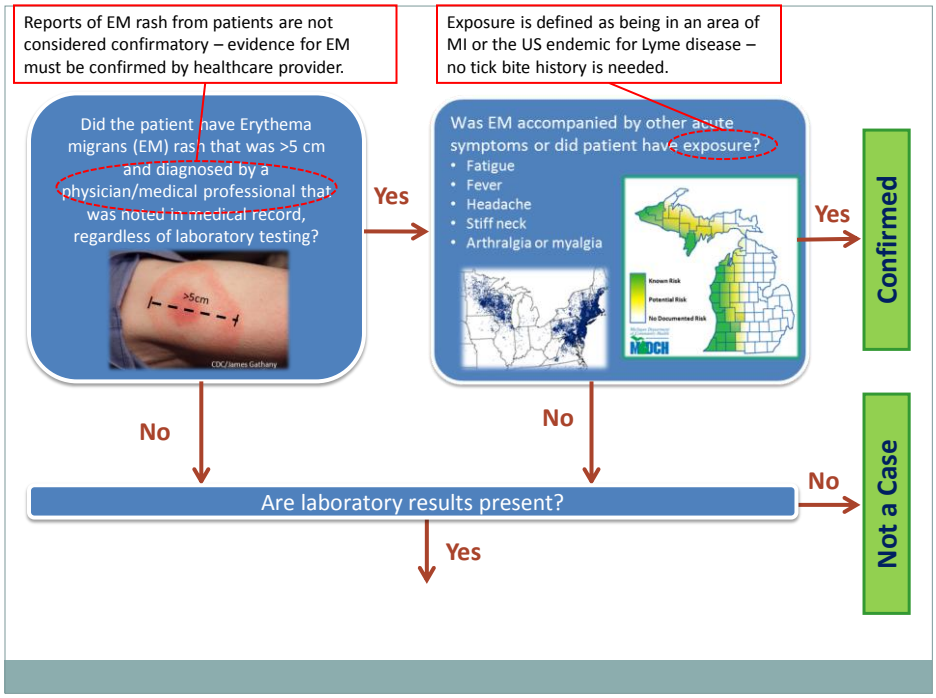
TEST	RESULTS NORMAL	RESULTS ABNORMAL	RERERENCE RANGE	UNITS
*** LYME DISEASE BY WSTRN BLT ***				
IgG BANDS PRESENT		6	0-4	
p 18 IgG BANDS		POSITIVE	NEGATIVE	
p 23 IgG BANDS		POSITIVE	NEGATIVE	
p 28 IgG BANDS	NEGATIVE		NEGATIVE	
p 30 IgG BANDS		POSITIVE	NEGATIVE	
p 31 IgG BANDS	NEGATIVE		NEGATIVE	
p 34 IgG BANDS	NEGATIVE		NEGATIVE	
p 39 IgG BANDS		POSITIVE	NEGATIVE	
p 41 IgG BANDS		POSITIVE	NEGATIVE	
p 45 IgG BANDS	NEGATIVE		NEGATIVE	
p 58 IgG BANDS		POSITIVE	NEGATIVE	
p 60 IgG BANDS	NEGATIVE		NEGATIVE	
p 66 IgG BANDS	NEGATIVE		NEGATIVE	
p 93 IgG BANDS	NEGATIVE		NEGATIVE	
IgM BANDS PRESENT		2	0-1	
p 18 IgM BANDS	NEGATIVE		NEGATIVE	
p 23 IgM BANDS		POSITIVE	NEGATIVE	
p 28 IgM BANDS	NEGATIVE		NEGATIVE	
p 30 IgM BANDS	NEGATIVE		NEGATIVE	
p 31 IgM BANDS	NEGATIVE		NEGATIVE	

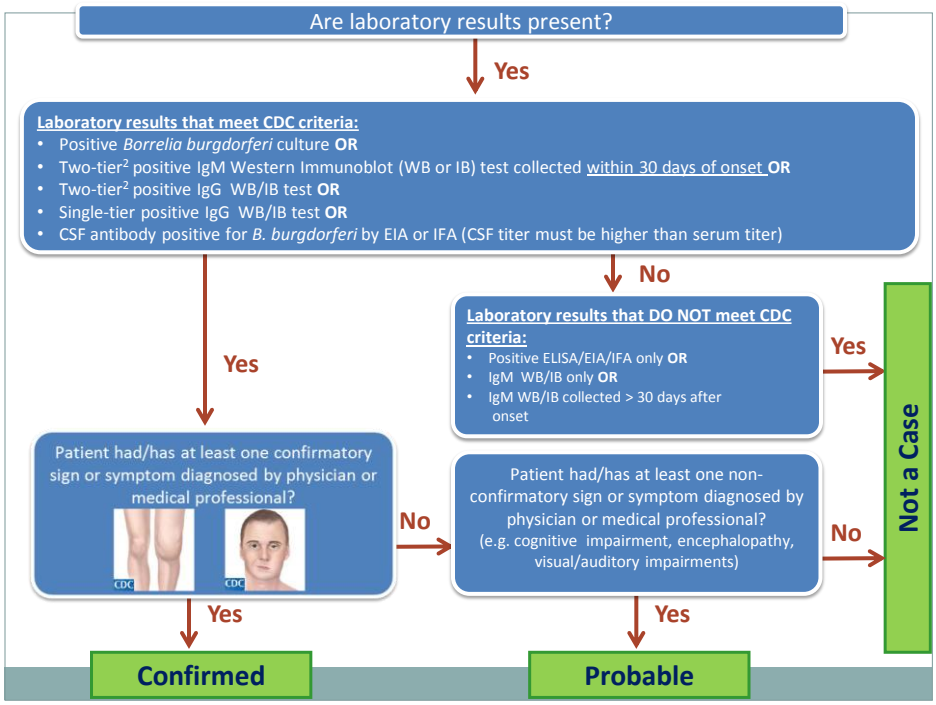
NTINUED ON NEXT PAGE

CDC Guidelines for positive IgG Western Blot Interpretation include any 5 of the following 10 bands:

P18	P39	P66
P21-23	P41	P93
P28	P45	
P30	P58	

This example shows a laboratory that tests for alternate bands. Note the addition of P31, P34, P60, to make a total of 13 bands tested.


Reports of EM rash from patients are not considered confirmatory – evidence for EM must be confirmed by healthcare provider.
Exposure is defined as being in an area of MI or the US endemic for Lyme disease – no tick bite history is needed.
Did the patient have Erythema migrans (EM) rash that was >5 cm and diagnosed by a physician/medical professional that was noted in medical record, regardless of laboratory testing?
>5cm
CDC/James Gathany
Yes
Was EM accompanied by other acute symptoms or did patient have exposure?
• Fatigue
• Fever
• Headache
• Stiff neck
• Arthralgia or myalgia
Known Risk
Potential Risk
No Documented Risk
MDCH
Yes
Confirmed
No
No
Are laboratory results present?
No
Not a Case
Yes


Are laboratory results present?
Yes
Laboratory results that meet CDC criteria:
• Positive Borrelia burgdorferi culture OR
• Two-tier[2] positive IgM Western Immunoblot (WB or IB) test collected within 30 days of onset OR
• Two-tier[2] positive IgG WB/IB test OR
• Single-tier positive IgG WB/IB test OR
• CSF antibody positive for B. burgdorferi by EIA or IFA (CSF titer must be higher than serum titer)
No
Yes
Laboratory results that DO NOT meet CDC criteria:
• Positive ELISA/EIA/IFA only OR
• IgM WB/IB only OR
• IgM WB/IB collected > 30 days after onset
Yes
Not a Case
Patient had/has at least one confirmatory sign or symptom diagnosed by physician or medical professional?
CDC
CDC
No
Patient had/has at least one non-confirmatory sign or symptom diagnosed by physician or medical professional? (e.g. cognitive impairment, encephalopathy, visual/auditory impairments)
No
Yes
Yes
Confirmed
Probable

Tick Reporting in MDSS

- Lab results from MDCH BOL are automatically entered in MDSS
  - If tick is non-*Ixodes*, results can be found under '**Unusual Outbreak or Occurrence**'
  - No IFA results will be listed in the report
- If tick is an *Ixodes scapularis*, it may be tested by IFA and Results can be found under '**Lyme Disease**'
  - Does not mean that a human case of Lyme disease actually occurred - Report can be completed as 'not a case'.
- Tick identification and testing may be performed in support of clinical evaluation by physician – In an instance of a positive tick result, patient follow-up should be conducted

Tick Identification and Testing

Kit includes:

- plastic vial
- self-addressed, padded return envelope
- submission form
- instructions for submission
- "Ticks and Your Health" brochure
- Available at: www.michigan.gov/lymedisease

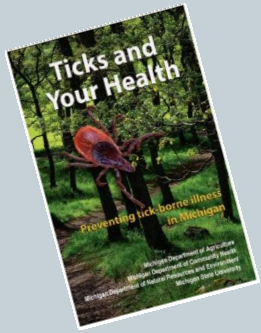
Lyme Disease Prevention

What can we do to prevent tick-borne disease?

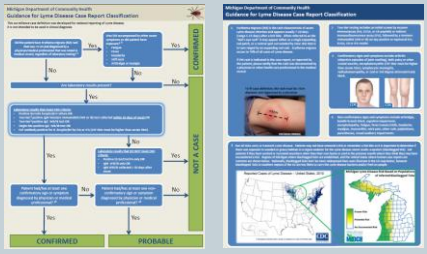
Everyone can personally prevent tick-borne disease by:

- Becoming educated about ticks
- Preventing tick bites:
  - Using personal and clothing repellents
  - Stay on the trail when hiking in the woods
  - Wear light colored clothing so ticks may be more easily seen
- Removing ticks promptly:
  - Conduct tick-checks daily/shower checks
  - Remove any attached ticks with fine tipped forceps
- Consulting healthcare provider promptly if signs of illness develop after tick bite, or being in an area endemic for Lyme disease

Guidance and Resources



- Information about ticks, tick-borne illnesses, treatment, preventions, ticks and pets, and maps.
- Order printed copies, or view on-line at: www.michigan.gov/cdinfo



- Flowchart to help classify cases of Lyme Disease
- Highlights symptoms and high risk areas
- Available at www.michigan.gov/cdinfo

Websites

- Emerging diseases in Michigan:
  - www.michigan.gov/emergingdiseases
- Information from CDC:
  - www.cdc.gov/lyme
- Posters, pamphlets, and guides available at:
  - www.michigan.gov/lymedisease