MAYO CLINIC LABORATORIES

Test Definition: STICK

Tick-Borne Antibodies, Modified 2-Tier, ELISA, Serum

Overview

Useful For

Evaluation of the most common tick-borne diseases found in the United States, including Lyme disease, human monocytic and granulocytic ehrlichiosis, and babesiosis using the modified 2-tier testing algorithm approach

Evaluation of patients with a history of, or suspected, tick exposure who are presenting with fever, myalgia, headache, nausea, and other nonspecific symptoms

Sero-epidemiological surveys of the prevalence of the infection in certain populations

Diagnosis of Lyme disease

Profile Information

Test Id	Reporting Name	Available Separately	Always Performed
ANAP	Anaplasma phagocytophilum Ab, IgG,S	Yes	Yes
EHRC	Ehrlichia Chaffeensis (HME) Ab, IgG	Yes	Yes
BABG	Babesia microti IgG Ab, S	Yes	Yes
SLYME	Lyme Ab Modified 2-Tier w/Reflex, S	Yes	Yes

Reflex Tests

Test Id	Reporting Name	Available Separately	Always Performed
TLYME	Lyme IgM/IgG, WCS, EIA, S	Yes	No

Testing Algorithm

If the Lyme antibody result is positive or equivocal, then Lyme disease antibody confirmation will be performed at an additional charge.

See Acute Tick-Borne Disease Testing Algorithm

Special Instructions

- Acute Tickborne Disease Testing Algorithm

Method Name

ANAP, EHRC, BABG: Immunofluorescence Assay (IFA)
SLYME: Enzyme-Linked Immunosorbent Assay (ELISA)

NY State Available
Yes

Specimen

Specimen Type
Serum

Ordering Guidance
During the acute phase of an *Anaplasma phagocytophilum* or *Ehrlichia chaffeensis* infection, serologic tests are often nonreactive, polymerase chain reaction (PCR) testing is available to aid in the diagnosis of these cases; see EHRL / *Ehrlichia*/*Anaplasma*, Molecular Detection, PCR, Blood.

Specimen Required
Supplies: Sarstedt Aliquot Tube 5 mL (T914)
Collection Container/Tube:
Preferred: Serum gel
Acceptable: Red top
Submission Container/Tube: Plastic vial
Specimen Volume: 1.35 mL
Collection Instructions: Centrifuge and aliquot serum into a plastic vial.

Forms
If not ordering electronically, complete, print, and send Infectious Disease Serology Test Request (T916) with the specimen.

Specimen Minimum Volume
1.1 mL

Reject Due To

Gross hemolysis	Reject
Gross lipemia	Reject
Gross icterus	Reject
Heat-inactivated specimen	Reject

Specimen Stability Information

Specimen Type	Temperature	Time	Special Container

Serum	Refrigerated (preferred)	10 days	
	Frozen	14 days	

Clinical & Interpretive

Clinical Information

In North America, ticks are the primary vectors of infectious diseases.(1) Worldwide, ticks rank second only to mosquitoes in disease transmission. In the United States, tick-borne diseases include Lyme disease, Rocky Mountain spotted fever, human monocytic and granulocytic ehrlichiosis, babesiosis, tularemia, relapsing fever, and Colorado tick fever.

Symptoms of the various tick-vectored diseases range from mild to life-threatening and significantly overlap. Early symptoms, which include fever, aches, and malaise, do not aid in distinguishing the various diseases. Because early treatment can minimize or eliminate the risk of severe disease, early detection is essential, yet patients may not have developed distinctive symptoms to help in the differential diagnosis. A tick-borne panel can assist in identifying the pathogen, allowing treatment to be initiated.

For information on the specific diseases, see the individual test IDs.

Reference Values

Anaplasma phagocytophilum ANTIBODY, IgG
<1:64
Reference values apply to all ages.

Ehrlichia chaffeensis (HME) ANTIBODY, IgG
<1:64
Reference values apply to all ages.

Babesia microti IgG ANTIBODIES
<1:64
Reference values apply to all ages.

LYME ANTIBODY
Negative
Reference values apply to all ages.

Interpretation

Anaplasma phagocytophilum:
A positive immunofluorescence assay (titer > or =1:64) suggests current or previous infection. In general, the higher the titer, the more likely the patient has an active infection. Four-fold rises in titer also indicate active infection.

Previous episodes of ehrlichiosis may produce a positive serology although antibody levels decline significantly during the year following infection.

Ehrlichia chaffeensis:
A positive immunofluorescence assay (titer > or =1:64) suggests current or previous infection. In general, the higher the titer, the more likely the patient has an active infection. Four-fold rises in titer also indicate active infection.

Previous episodes of ehrlichiosis may produce a positive serology although antibody levels decline significantly during the year following infection.

Babesia microti:
A positive result of an indirect fluorescent antibody test (titer > or =1:64) suggests current or previous infection with *Babesia microti*. In general, the higher the titer, the more likely it is that the patient has an active infection. Patients with documented infections have usually had titers ranging from 1:320 to 1:2560.

Lyme disease:
Negative:
Negative for antibodies to *Borrelia (Borreliella)* species causing Lyme disease. Negative results may occur in patients recently infected (< or =14 days) with *Borrelia burgdorferi*. If recent infection is suspected, repeat testing on a new sample collected in 7 to 14 days is recommended.

Equivocal or Positive:
Not diagnostic. Supplemental testing in accordance with the modified two-tiered testing algorithm for Lyme disease has been ordered by reflex.

Cautions

Anaplasma phagocytophilum:
Serology for IgG may be negative during the acute phase of infection (<7 days post-symptom onset), during which time detection using targeted nucleic acid amplification testing (eg, polymerase chain reaction: PCR) is recommended.

Detectable IgG-class antibodies typically appear within 7 to 10 days post-symptom onset.

IgG-class antibodies may remain detectable to months to years following prior infection. Therefore, a single time point-positive titer needs to be interpreted alongside other findings to differentiate recent versus past infection.

Other members of the *Ehrlichia* genus (eg, *Ehrlichia ewingii*) may not be detected by this assay.

Ehrlichia chaffeensis:
Serology for IgG may be negative during the acute phase of infection (<7 days post symptom onset), during which time detection using targeted nucleic acid amplification testing (eg, PCR) is recommended.

Detectable IgG-class antibodies typically appear within 7 to 10 days post symptom onset.

IgG-class antibodies may remain detectable for months to years following prior infection. Therefore, a single time point-positive titer needs to be interpreted alongside other findings to differentiate recent versus past infection.

Other members of the *Ehrlichia* genus (eg, *E ewingii*) may not be detected by this assay.

Babesia microti:
Previous episodes of babesiosis may produce a positive serologic result.

In selected cases, documentation of infection may be attempted by animal inoculation or PCR methods (LBAB / *Babesia* species, Molecular Detection, PCR, Blood)

Performance characteristics have not been established for the following specimen characteristics:
-Lipemic
-Hemolyzed

Lyme disease:
A negative result does not exclude the possibility of infection with Lyme disease causing *Borrelia* species. Patients in the early stages of Lyme disease and those who have been treated with antibiotics may not exhibit detectable antibody titers. Patients with clinical history, signs, or symptoms suggestive of Lyme disease should be retested in 2 to 4 weeks in the event that the initial test result is negative.

A positive result is not definitive evidence of infection with *Borrelia burgdorferi*. It is possible that other disease conditions may produce artifactual reactivity in the assay (eg, infectious mononucleosis, syphilis). All equivocal or positive results should be supplemented immunoblot testing for IgM- and IgG-class antibodies in accordance with Centers for Disease Control and Prevention and the Association of State and Territorial Public Health Laboratory. Directors (CDC/ASTPHLD) recommendations.

Patients infected with other members of the *B burgdorferi* sensu lato complex, including *B garinii*, *B afzelii*, and *B mayonii* will be detected by this assay; however, they cannot be differentiated.

This test should not be performed as a screening procedure for the general population. The predictive value of a positive or negative result depends on the prevalence of analyte (antibodies present to VlsE1 and pepC10 antigens) in a given population. Testing should only be performed when clinical evidence suggests the diagnosis of *Borrelia* infection or related etiological conditions observed by the physician.

Lyme serology should not be used for treatment monitoring as IgG can remain for years post-resolution of infection. Instead, monitoring resolution of symptoms in response to treatment is recommended.

Clinical Reference

1. Centers for Disease Control and Prevention (CDC). Tick-borne diseases of the United States: A Reference Manual for Health Care Providers. 5th ed. CDC; 2018. Available at www.cdc.gov/ticks/tickbornediseases/index.html
2. Mathieu ME, Wilson BB: Ticks (including tick paralysis). In: Mandell GL, Bennett JE, Dolin R, eds: Mandell, Douglas, and Bennett's Principles and Practice of Infectious Diseases. Vol 1. 5th ed. Churchill Livingston; 2000:2980-2983
3. Theel ES: The past, present and (possible) future of serologic testing for Lyme disease. J Clin Microbiol. 2016;54(5):1191-1196. doi: 10.1128/JCM.03394-15.
4. Dattwyler RJ: Lyme borreliosis: an overview of clinical manifestations. Lab Med. 1990;21:290-292. doi: 10.3390/healthcare6030104.

5. Schwan TG, Burgdorfer W, Rosa PA: *Borrelia*. In: Murray PR, ed: Manual of Clinical Microbiology. 7th ed. ASM Press; 1999:746-758
6. Centers for Disease Control and Prevention (CDC): Recommendation for test performance and interpretation from second national conference on serological diagnosis of lyme disease. MMWR Morb Mortal Wkly Rep. 1996;45:481-484

Performance

Method Description

Anaplasma phagocytophilum:
The patient's serum is diluted and is placed in microscopic slide wells that have been coated with *Anaplasma phagocytophilum*-infected cells. After incubation, the slides are washed and a fluorescein-isothiocyanate conjugate is added to each well. The slides are then read using a fluorescence microscope and significant fluorescent staining of intracellular organisms constitutes a positive reaction.(Dumler JS, Asanovich KM, Bakken JS, Richter P, Kimsey R, Madigan JEl: Serologic cross-reactions among *Ehrlichia equi*, *Ehrlichia phagcoytophilia*, and human granulocytic ehrlichia. J Clin Microbiol. 1995;33:1098-1103; Pancholi P, Kolbert CP, Mitchell PD, et al: *Ixodes dammini* as a potential vector of human granulocytic ehrlichiosis. J Infect Dis. 1995 Oct;172(4):1007-1012; Dawson JE, Fishbein DB, Eng TR, Redus MA, Green NR: Diagnosis of human ehrlichiosis with the indirect fluorescent antibody test: kinetics and specificity. J Infect Dis. 1990 Jul;162(1):91-95; package insert: Anaplasma phagocytophila IFA IgG. DiaSorin Molecular; 8/12/2016)

Ehrlichia chaffeensis:
The patient's serum is diluted and is placed in microscopic slide wells that have been coated with *Ehrlichia chaffeenis*-infected cells. After incubation, the slides are washed and a fluorescein-isothiocyanate conjugate is added to each well. The slides are then read using a fluorescence microscope and significant fluorescent staining of intracellular organisms constitutes a positive reaction.(Dumler JS, Asanovich KM, Bakken JS, Richter P, Kimsey R, Madigan JE: Serologic cross-reactions among *Ehrlichia equi*, *Ehrlichia phagcoytophilia*, and human granulocytic ehrlichia. J Clin Microbiol. 1995;33:1098-1103; Pancholi P, Kolbert CP, Mitchell PD, et al: *Ixodes dammini* as a potential vector of human granulocytic ehrlichiosis. J Infect Dis. 1995 Oct;172(4):1007-1012; Dawson JE, Fishbein DB, Eng TR, Redus MA, Green NR: Diagnosis of human ehrlichiosis with the indirect fluorescent antibody test: kinetics and specificity. J Infect Dis. 1990 Jul;162(1):91-95; package insert: Ehrlichia chaffeensis IFA IgG. DiaSorin Molecular; 8/12/2016)

Babesia microti:
This immunofluorescence assay (IFA) detects antibodies against Babesia microti. The patient's serum is diluted and is placed in microscopic slide wells that have been coated with *B microti*-infected red blood cells from Syrian hamsters. After incubation, the slides are washed and a fluorescein-isothiocyanate conjugate is added to each well. The slides are then read using a fluorescence microscope and significant fluorescent staining of intraerythrocytic organisms constitutes a positive reaction.(Krause PJ, Telford SR III, Ryan R, et al: Diagnosis of babesiosis: evaluation of a serologic test for the detection of *Babesia microti* antibody. J Infect Dis. 1994 Apr;169(4):923-926; package insert: Babesia IFA IgG. DiaSorin Molecular; 8/12/2016)

Lyme disease:
The first-tier Lyme disease screening enzyme-linked immunosorbent assay (ELISA) used is the Zeus ELISA *Borrelia* VlsE1/pepC10 IgG/IgM test system. The Zeus ELISA *Borrelia* VlsE1/pepC10 IgG/IgM test system is designed to detect IgG-

and IgM-class antibodies (not differentiated by the assay in the final result) in human sera to VlsE1 and pepC10 antigens. Diluted test sera are incubated in antigen coated microwells. Any antigen-specific antibody in the sample will bind to the immobilized antigen. The plate is washed to remove unbound antibody and other serum components. Peroxidase conjugated goat antihuman IgG and IgM are added to the wells and the plate is incubated. The conjugate will react with IgG and IgM antibodies immobilized on the plate. The wells are washed to remove unreacted conjugate. The microwells containing immobilized peroxidase conjugate are incubated with peroxidase substrate solution. Hydrolysis of the substrate by peroxidase produces a color change. After a period of time the reaction is stopped, and the color intensity of the solution is measured photometrically. The color intensity of the solution depends upon the antibody concentration in the original test sample.(Package insert: *Borrelia* VlsE1/pepC10 IgG/IgM Test System. Zeus Scientific, Inc; Rev. Date 05/25/2021)

PDF Report
No

Day(s) Performed
Monday through Friday

Report Available
2 to 4 days

Specimen Retention Time
14 Days

Performing Laboratory Location
Mayo Clinic Laboratories - Rochester Superior Drive

Fees & Codes

Fees
- Authorized users can sign in to Test Prices for detailed fee information.
- Clients without access to Test Prices can contact Customer Service 24 hours a day, seven days a week.
- Prospective clients should contact their account representative. For assistance, contact Customer Service.

Test Classification
See Individual Test IDs

CPT Code Information
86618
86666 x 2
86753
86617 x 2 (if appropriate)

LOINC® Information

Test Definition: STICK

Tick-Borne Antibodies, Modified 2-Tier, ELISA, Serum

Test ID	Test Order Name	Order LOINC® Value
STICK	Tick-Borne Abs w/ Lyme MTTTA, S	103603-7

Result ID	Test Result Name	Result LOINC® Value
81157	Anaplasma phagocytophilum Ab, IgG,S	23877-4
81128	Babesia microti IgG Ab, S	16117-4
81478	Ehrlichia Chaffeensis (HME) Ab, IgG	47405-6
SLYME	Lyme Ab Modified 2-Tier w/Reflex, S	83081-0