

Overview
Useful For

An initial screening or confirmatory testing method for suspected babesiosis during the acute febrile stage of infection in patients from endemic areas, especially when Giemsa-stained peripheral blood smears do not reveal any organisms or the organism morphology is inconclusive.

Method Name

Real-Time Polymerase Chain Reaction (PCR)/DNA Probe Hybridization

NY State Available

Yes

Specimen
Specimen Type

Whole Blood EDTA

Advisory Information

This is a qualitative assay and the results are reported either as negative or positive for targeted *Babesia* species DNA.

Specimen Required

Container/Tube: Lavender top (EDTA)

Specimen Volume: 1 mL

Forms

If not ordering electronically, complete, print, and send a [Microbiology Test Request](#) (T244) with the specimen.

Specimen Minimum Volume

0.5 mL

Reject Due To

Hemolysis	Mild OK; Gross OK
Lipemia	Mild OK; Gross reject
Icterus	NA
Other	Green-top (heparin) tube

Specimen Stability Information

Specimen Type	Temperature	Time	Special Container
Whole Blood EDTA	Refrigerated	7 days	

Clinical and Interpretive

Clinical Information

Babesiosis is a tick-transmitted zoonosis caused by intraerythrocytic protozoa in the genus *Babesia*. *Babesia microti* responsible for the vast majority of human cases in the United States, with most cases occurring along the Northeast Coast and the upper Midwestern states. A small number of cases of *B duncani* human infection have also been reported along Pacific Coast states from Washington to northern California, and *B divergens*/*B divergens*-like strains have been detected in humans in Missouri (MO-1 strain), Kentucky, and Washington. In Europe, *B divergens* and *B venatorum* are the primary causes of human babesiosis.

Humans most commonly acquire infection through the bite of an infected tick. The most common tick vectors in the United States are *Ixodes scapularis* and *Ixodes pacificus*, while *Ixodes ricinus* and other ticks transmit the parasite in Europe and Asia. Less commonly, babesiosis may be acquired through blood transfusion and across the placenta from the mother to the fetus.

Most patients with babesiosis are asymptomatic or have only a self-limited mild flu-like illness, but some develop a severe illness that may result in death. Patient symptoms may include fever, chills, extreme fatigue, and severe anemia. The most severe cases occur in asplenic individuals and those over 50 years of age. Rare cases of chronic parasitemia, usually in immunocompromised patients, have been described.

Babesiosis is conventionally diagnosed through microscopic examination of Giemsa-stained thick and thin peripheral blood films looking for characteristic intraerythrocytic *Babesia* parasites. This method is relatively rapid, widely available, and capable of detecting (but not differentiating) human-infective *Babesia* species. It is also necessary for calculating the percentage of parasitemia which is used to predict prognosis, guide patient management, and monitor response to treatment. However, microscopic examination requires skilled microscopists and may be challenging in the setting of low parasitemia or prior drug therapy. Also, *Babesia* species may closely resemble those of *Plasmodium falciparum*.

The Mayo Clinic real-time PCR assay provides a rapid and more sensitive alternative to blood film examination for detection and differentiation of *B microti*, *B duncani*, and *B divergens*/*B divergens*-like parasites. It does not cross-react with malaria parasites.

Reference Values

Negative

Interpretation

A positive result indicates the presence of *Babesia* species DNA and is consistent with active or recent infection. While positive results are highly specific indicators of disease, they should be correlated with blood smear microscopy, serological results and clinical findings.

A negative result indicates absence of detectable DNA from *Babesia* species in the specimen, but does not always rule out ongoing babesiosis in a seropositive person, since the parasitemia may be present at a very low level or may be sporadic.

Other tests to consider in the evaluation of a patient presenting with an acute febrile illness following tick exposure include serologic tests for Lyme disease (*Borrelia burgdorferi*), and molecular detection (PCR) for ehrlichiosis/anaplasmosis. For patients who are past the acute stage of infection, serologic tests for these organisms should be ordered prior to PCR testing.

Cautions

While this assay is designed to detect symptomatic infection with *Babesia microti*, *B duncani*, and *B divergens*/MO-1, it may detect low-grade asymptomatic parasitemia in individuals in babesiosis-endemic areas. Thus, it should only be used for testing patients with a clinical history and symptoms consistent with babesiosis.

Inhibitory substances may cause false-negative results.

Inadequate specimen collection or improper storage may invalidate test results.

Supportive Data

The following validation data supports the use of this assay for clinical testing.

Accuracy/Diagnostic Sensitivity and Specificity:

Ninety-six whole blood specimens were tested by this real-time PCR assay and another real-time PCR assay. Concordance was 99%.

Analytical Sensitivity/Limit of Detection (LoD). The LoD established using whole organism spiked into specimen matrix (whole blood) is as follows:

-*Babesia microti*, ATCC PRA 99 - 2,670 target copies/mL

-*B duncani* ATCC PRA 302 - 1,540 target copies/mL

-*B* MO-1 positive patient DNA - 10,700 target copies/mL

-*B divergens* positive patient DNA - 5,270 target copies/mL

Serial 10-fold dilutions of microscopy-positive specimens were also tested in a blinded fashion using conventional thick and thin blood films and the Mayo *Babesia* species PCR. The PCR was able to consistently detect 2 10-fold dilutions lower than using microscopy.

Analytical Specificity:

No cross-reactivity was noted using a panel of 34 bacteria, viruses, parasites and fungi were detected by the *Babesia* species PCR.

Precision:

Interassay and intra-assay precision was 100% precision.

Reference Range:

The reference range is negative. This was confirmed by testing 93 blood specimens from asymptomatic individuals for the presence of *Babesia* species by the *Babesia* species PCR assay. All 93 specimens were negative.

Reportable Range:

This test is a qualitative assay, and results are reported as positive or negative for *Babesia* species (*B microti*, *B duncani*, *B divergens*, and *Babesia* MO-1).

Clinical Reference

1. Anderson JF, Mintz ED, Gadaw JJ, et al: *Babesia microti*, human babesiosis and *Borrelia burgdorferi* in

Connecticut. J Clin Microbiol 1991;29(12):2779-2783

2. Herwaldt BL, de Bruyn G, Pieniazek NJ, et al: *Babesia divergens*-like infection, Washington State. Emerg Infect Dis 2004;10(4):622-629

3. Herwaldt B, Persing DH, Precigout EA, et al: A fatal case of babesiosis in Missouri: identification of another piroplasm that infects humans. Ann Intern Med 1996;124(7):643-650

4. Persing DH, Herwaldt BL, Glaser C, et al: Infection with a *Babesia*-like organism in northern California. N Engl J Med 1995;332(5):298-303

5. Quick RE, Herwaldt BL, Thomford JW, et al: Babesiosis in Washington State: a new species of *Babesia*? Ann Intern Med 1993;119(4):284-290

6. Vannier E, Krause PJ: Human Babesiosis. N Engl J Med 2012 Jun 21;366(25):2397-2407

7. Burgess MJ, Rosenbaum ER, Pritt BS, et al. Possible Transfusion-Transmitted *Babesia divergens*-like/MO-1 in an Arkansas Patient. Clin Infect Dis 2017

Performance

Method Description

Nucleic acid is extracted from EDTA whole blood using the automated MagNA Pure bead-based system (Roche Molecular Systems). The extract is then transferred to individual self-contained capillary cuvettes for amplification. The LightCycler is an automated instrument that amplifies and monitors the development of target nucleic acid (amplicon) after each cycle of PCR.

The DNA target for PCR assay is a gene encoding the nuclear small subunit ribosomal RNA (SS-rDNA). This assay consists of 2 forward primers, 1 reverse primer, and 2 probes, which are specific for the *Babesia* species target DNA. The specific base pair DNA target sequence is first amplified by PCR using the target-specific primers. Amplicon is then detected during melting curve analysis using fluorescence resonance energy transfer (FRET) probes, which utilizes one hybridization probe with a donor fluorophore, fluorescein, at the 3' end and a second hybridization probe with an acceptor fluorophore, LC-Red 640, at the 5' end. Fluorescence is produced when the 2 probes anneal to the target sequence in close proximity to one another. The LC-Red 640 then emits a measurable and quantifiable light signal at a specific wavelength. (Burgess MJ, Rosenbaum ER, Pritt BS, et al. Possible Transfusion-Transmitted *Babesia divergens*-like/MO-1 in an Arkansas Patient. Clin Infect Dis 2017; Supplemental Data)

PDF Report

No

Day(s) and Time(s) Test Performed

Monday through Saturday; Varies

Analytic Time

Same day/1 day

Maximum Laboratory Time

4 days

Specimen Retention Time

1 week

Performing Laboratory Location

Rochester

Fees and 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 Regional Manager. For assistance, contact [Customer Service](#).

Test Classification

This test was developed and its performance characteristics determined by Mayo Clinic in a manner consistent with CLIA requirements. This test has not been cleared or approved by the U.S. Food and Drug Administration.

CPT Code Information

87798 x 3

LOINC® Information

Test ID	Test Order Name	Order LOINC Value
LBAB	Babesia species, PCR, B	88461-9

Result ID	Test Result Name	Result LOINC Value
36114	Babesia microti	88452-8
36115	Babesia duncani	88451-0
36116	Babesia divergens/MO-1	88450-2