Test Definition: JIP

Joint Infection Panel, PCR, Synovial Fluid

Overview

Useful For

Rapid detection of synovial fluid infections caused by the following:
Anaerococcus prevotii/vaginalis
Finegoldia magna
Streptococcus species
Clostridium perfringens
Parvimonas micra
Streptococcus agalactiae
Cutibacterium avidum/granulosum
Peptoniphilus species
Streptococcus pneumoniae
Enterococcus faecalis
Peptostreptococcus anaerobius
Streptococcus pyogenes
Enterococcus faecium
Staphylococcus aureus
Staphylococcus lugdunensis
Bacteroides fragilis
Kingella kingae
Proteus species
Citrobacter species
Klebsiella aerogenes
Pseudomonas aeruginosa
Enterobacter cloacae complex
Klebsiella pneumoniae complex
Salmonella species
Escherichia coli
Morganella morganii
Serratia marcescens
Haemophilus influenzae
Neisseria gonorrhoeae
Candida species
Candida albicans

This test is **not recommended** as a test of cure.

Highlights

The BIOFIRE Joint Infection (JI) Panel is a multiplexed nucleic-acid-based, in vitro diagnostic test for the simultaneous qualitative detection and identification of 31 bacterial and yeast nucleic acids and 8 antimicrobial resistance genes from synovial fluid obtained from individuals suspected to have a JI.

This test is used to diagnose infections caused by *Anaerococcus prevotii/vaginalis, Finegoldia magna, Streptococcus* species*., Clostridium perfringens, Parvimonas micra, Streptococcus agalactiae, Cutibacterium avidum/granulosum, Peptoniphilus, Streptococcus pneumoniae, Enterococcus faecalis, Peptostreptococcus anaerobius, Streptococcus pyogenes, Enterococcus faecium, Staphylococcus aureus, Staphylococcus lugdunensis, Bacteroides fragilis, Kingella kingae, Proteus* species*., Citrobacter, Klebsiella aerogenes, Pseudomonas aeruginosa, Enterobacter cloacae complex, Klebsiella pneumoniae group, Salmonella* species*., Escherichia coli, Morganella morganii, Serratia marcescens, Haemophilus influenzae, Neisseria gonorrhoeae, Candida* species*.,* and *Candida albicans.*

The test can also detect the following antimicrobial resistance genes: CTX-M, KPC, NDM, *vanA/B*, IMP, *mecA/C* and MREJ (MRSA), OXA-48-like, and VIM.

Method Name
Multiplex Polymerase Chain Reaction (PCR)

NY State Available
Yes

Specimen

Specimen Type
Synovial Fluid

Ordering Guidance
This test is appropriate for raw, unprocessed, and untreated synovial fluid specimens only.

Shipping Instructions
Specimen must arrive at refrigerated temperature within 7 days of collection.

Specimen Required
Specimen Type: Synovial fluid
Container/Tube: Sterile vial
Specimen Volume: 1 mL
Collection Instructions:
1. Do not process or treat sample in any way.
2. Label specimen as synovial fluid.

Forms
If not ordering electronically, complete, print, and send an Microbiology Test Request (T244) with the specimen.

Specimen Minimum Volume
0.5 mL

Reject Due To

Specimen in anaerobe vial or viral transport medium (including but not limited to M4, M5, BD viral transport media, thioglycolate broth) Any specimen that has been centrifuged Anticoagulant or additive Swabs (any type or transport system)	Reject

Specimen Stability Information

Specimen Type	Temperature	Time	Special Container
Synovial Fluid	Refrigerated (preferred)	7 days	
	Ambient	4 hours	

Clinical & Interpretive

Clinical Information

Joint infections (JI) occur when pathogens access bones and joints via hematogenous spread, contiguous spread of pathogens from an adjacent infection, or direct implantation (eg, open fracture, surgery, implanted medical devices). JI broadly encompasses multiple types of infections including, but not limited to, septic arthritis (SA), and prosthetic joint infection (PJI). These infections are commonly diagnosed by a combination of laboratory results, microbiological data, histological evaluation of tissue, intraoperative inspection, and in some cases radiographic results.(1) JI are most often caused by bacterial pathogens, though yeasts are also a significant cause. Serious morbidity can arise from JI, resulting in significant pain, permanent disability, or death.(2) Additionally, JI are often complicated and result in increased hospital stay length as well as higher rates of long-term rehabilitation and rehospitalization.(3,4) Globally, the prevalence of JI is estimated to be four to ten per 100,000 people in developed countries, with the economic impact of such infections totaling hundreds of millions of dollars per year.(4,5)

Timely diagnosis of JI and administration of effective treatment can significantly reduce the rates of serious complications, duration of hospital stays, and costs. The BIOFIRE JI Panel tests a single synovial fluid sample to

simultaneously provide results for multiple aerobic and anaerobic bacteria and yeast that cause JI as well as genetic markers associated with antimicrobial resistance. Although JI is a broad category that includes multiple types of infections, the BIOFIRE JI Panel was primarily designed to detect organisms associated with SA and PJI. Rapid identification of the organism(s) in synovial fluid, along with information about antimicrobial resistance gene status for select microorganisms, may aid the physician in making timely and appropriate treatment and management decisions.

The BIOFIRE JI Panel is indicated as an aid in the diagnosis of specific agents of JI and results should be used in conjunction with other clinical and laboratory findings. Negative results may be due to infection with pathogens that are not detected by this test, pathogens present below the limit of detection of the assay, or infection that may not be detected in a synovial fluid specimen. Positive results do not rule out co-infection with other organisms. The BIOFIRE JI Panel is not intended to monitor treatment for JI.

Culture of synovial fluid is necessary to recover organisms for susceptibility testing and epidemiological typing, to identify organisms in the synovial fluid that are not detected by the BIOFIRE JI Panel, and to further identify species in the genus, complex, or group results.

Reference Values

Undetected

Interpretation

Results are intended to aid in the diagnosis of illness and are meant to be used in conjunction with other clinical and epidemiological findings.

Detected results do not distinguish between a viable or replicating organism and a nonviable organism or nucleic acid, nor do they exclude the potential for coinfection by organisms not included in the panel.

Negative results do not exclude the possibility of infection and should not be used as the sole basis for diagnosis, treatment, or other management decisions.

The antimicrobial resistance genes detected may or may not be associated with the agents responsible for disease. Undetected results for the included antimicrobial resistance genes do not guarantee susceptibility to corresponding classes of antimicrobials, as other mechanisms of antimicrobial resistance exist.

Cautions

The detection of bacterial, yeast, and antimicrobial resistance gene nucleic acid is dependent upon proper sample collection, handling, transportation, and storage. Failure to observe proper procedures in any one of these steps can lead to incorrect results. There is a risk of false positive or false negative results from improperly collected, transported, or handled samples.

Negative results do not exclude the possibility of infection and should not be used as the sole basis for diagnosis, treatment, or other management decisions. Negative results may be due to infection with organism(s) not identified by the BIOFIRE Joint Infection (JI) Panel or due to an organism concentration in the sample that is below the limit of detection for the test. Organism levels may be influenced by concurrent antibacterial/antifungal therapy, which could lead to organism levels below the limit of detection for the test.

The BIOFIRE JI Panel is intended to be used in conjunction with clinical history, signs and symptoms, and results of other

diagnostic tests, including culture and anti-microbial susceptibility testing.

The BIOFIRE JI Panel has not been validated for testing of specimens other than synovial fluid specimens.

The BIOFIRE JI Panel is not intended for use with synovial fluid in media. Media/broths may contain contaminating nucleic acids that can generate false positives.

The performance of BIOFIRE JI Panel has not been established for specimens collected from individuals without signs or symptoms of a JI.

The performance of the BIOFIRE JI Panel has not been specifically evaluated for synovial fluid specimens collected from patients being treated with antibiotics.

Bacterial and yeast nucleic acids may persist in vivo independent of organism viability. Detection of organism nucleic acid does not imply that the corresponding organisms are infectious or are the causative agents for clinical symptoms.

The results for the antimicrobial resistance gene assays do not specifically link the resistance gene to the applicable bacteria detected. In polymicrobial specimens, the resistance gene may be associated with any of the applicable bacteria detected or an organism that was not detected by the panel.

Antimicrobial resistance can occur via multiple mechanisms. A "Not Detected" result for the antimicrobial resistance gene assays does not indicate antimicrobial susceptibility. Subculturing and standard susceptibility testing of isolates are required to determine antimicrobial susceptibility.

Supportive Data

This test is US Food and Drug Administration approved on synovial fluid specimens; the manufacturer has evaluated the clinical performance data of this sample type. The Clinical Bacteriology Laboratory at Mayo Clinic conducted a verification of the FilmArray Joint Infection Panel using 5 pools of known target analytes from a commercially available verification panel. The assay demonstrated overall agreement of 100% with expected results. The Clinical Bacteriology Laboratory also compared culture growth of 75 clinical samples (42 positive and 33 negative) and JIP results. The percent positive agreement was above 80% for all targets tested. The pools did not include the downgraded organism identifications for the *Streptococcus* species and *Candida* species but were included in the clinical specimens tested.

Clinical Reference

1. Tande AJ, Patel R. Prosthetic Join Infection. Clin Micrbiol Rev. 2014;27(2):302-345. doi:10.1128/CMR.00111-13
2. Berendt T, Byren I. Bone and joint infection. Clin Med (Lond). 2004;4(6):510-518. doi:10.7861/clinmedicine.4-6-510
3. Lipsky BA, Weigelt JA, Gupta V, Killian A, Peng MM. Skin, Soft Tissue, Bone, and Joint Infections in Hospitalized Patients: Epidemiology and Microbiological, Clinical, and Economic Outcomes. Infect Control Hosp Epidemiol. 2007;28(11):1290-1298. doi:10.1086/520743
4. Grammatico-Guillon L, Baron S, Gettner S, et al. Bone and joint infections in hospitalized patients in France, 2008: clinical and economic outcomes. J Hosp Infect. 2012;82(1):40-48. doi:10.1016/j.jhin.2012.04.025
5. Faust SN, Clark J, Pallett A, Clarke NMP. Managing bone and joint infection in children. Arch Dis Child. 2012;97(6):545-553. doi:10.1136/archdischild-2011-301089
6. Esteban J, Salar-Vidal L, Schmitt BH. Multicenter evaluation of the BIOFIRE Joint Infection Panel for the detection of bacteria, yeast, and AMR genes in synovial fluid samples. J Clin Microbiol. 2023;61(11):e0035723. doi:10.1128/jcm.00357-23

Performance

Method Description

The BIOFIRE Joint Infection Panel is a closed system that performs all the chemistry required to isolate, amplify, and detect nucleic acid from multiple bacterial, yeast, and select antimicrobial resistance genes from synovial fluid obtained from individuals suspected to have a joint infection. A panel contains reagents in freeze-dried form and is divided into discrete segments where the required chemical processes are carried out. Patient sample and hydration fluid are drawn by vacuum into the panel and then placed into the Biofire FilmArray instrument. The detection process operations are automated (nucleic acid purification, first stage polymerase chain reaction (PCR), second stage PCR, and melt curve analysis of replicates for each assay) and complete in about an hour in this closed system.

Nucleic Acid Purification:
The sample is lysed by a combination of chemical and mechanical mechanisms, and the liberated nucleic acid is captured, washed, and eluted using magnetic bead technology.

First-Stage PCR:
A reverse transcription step is performed to convert viral RNA into complementary DNA prior to amplification. The purified nucleic acid solution is combined with a preheated master mix to initiate the reverse transcription step and subsequent thermocycling for multiplex PCR.

Second-Stage PCR:
Products of first stage PCR are diluted and mixed with fresh PCR reagents, which is distributed over the second stage PCR array. The individual wells of the array contain primers for different assays (in triplicate) that target specific nucleic acid sequences from each of the pathogens detected, as well as control template material.

DNA Melting Analysis:
Temperature is slowly increased, and fluorescence in each well of the array is monitored and analyzed to generate a melt curve.

Analysis of Melt Curves:
The software evaluates the DNA melt curve for each well to determine if a PCR product was present in that well. If the melt profile indicates the presence of a PCR product, then the analysis software calculates the melting temperature of the curve, which is then compared against the expected range for the assay. When the software determines that the melt curve falls inside the assay-specific melt temp range, it is called positive. When it determines that the melt curve is not in the appropriate range, it is called negative.

Analysis of Replicates:
Melt curves of each of the 3 replicates for each assay are evaluated to determine the assay result. For an assay to be called positive, at least 2 of the 3 associated melt curves must be called positive, and the melting temperature for at least 2 of the 3 positive melt curves must be similar (within 1 degree C). Assays that do not meet these criteria are called negative.(Instruction manual: BioFire Joint Infection (JI) Panel IVD. BioFire Diagnostics, LLC; RFIT-PRT-0690-01, 06/2022)

PDF Report
No

Day(s) Performed
Monday through Sunday

Report Available
1 to 2 days

Specimen Retention Time
14 days

Performing Laboratory Location
Mayo Clinic Laboratories - Rochester Main Campus

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
This test has been cleared, approved, or is exempt by the US Food and Drug Administration and is used per manufacturer's instructions. Performance characteristics were verified by Mayo Clinic in a manner consistent with CLIA requirements.

CPT Code Information
87627

LOINC® Information

Test ID	Test Order Name	Order LOINC® Value
JIP	Joint Infect Panel PCR, Synovial Fl	97608-4

Result ID	Test Result Name	Result LOINC® Value
621730	CTX-M	88250-6
621731	IMP	85498-4
621732	KPC	49617-4
621733	mecA/C and MREJ (MRSA)	96309-0
621734	NDM	73982-1
621735	OXA-48-like	85827-4
621736	vanA/B	62261-3
621737	VIM	85501-5

621700	Anaerococcus prevotii/vaginalis	97609-2
621714	Bacteroides fragilis	97610-0
621729	Candida albicans	97611-8
621728	Candida spp.	97612-6
621715	Citrobacter spp.	97613-4
621701	Clostridium perfringens	97614-2
621702	Cutibacterium avidum/granulosum	97615-9
621716	Enterobacter cloacae complex	97616-7
621703	Enterococcus faecalis	97617-5
621704	Enterococcus faecium	97618-3
621717	Escherichia coli	97619-1
621705	Finegoldia magna	97620-9
621718	Haemophilus influenzae	97621-7
621719	Kingella kingae	97622-5
621720	Klebsiella aerogenes	97623-3
621721	Klebsiella pneumoniae complex	97624-1
621722	Morganella morganii	97625-8
621723	Neisseria gonorrhoeae	97626-6
621706	Parvimonas micra	97627-4
621707	Peptoniphilus spp.	97628-2
621708	Peptostreptococcus anaerobius	97629-0
621724	Proteus spp.	97630-8
621725	Pseudomonas aeruginosa	97631-6
621726	Salmonella spp.	97632-4
621727	Serratia marcescens	97633-2
621709	Staphylococcus aureus	97634-0
621710	Staphylococcus lugdunensis	97635-7
621711	Streptococcus agalactiae	97636-5
621712	Streptococcus pneumoniae	97637-3
621713	Streptococcus pyogenes	97638-1
621827	Streptococcus spp.	97639-9
621738	Interpretation	59464-8