MAYO CLINIC LABORATORIES

Test Definition: ZMMLS

Antimicrobial Susceptibility, Aerobic Bacteria, Varies

Overview

Useful For

Determining the in vitro susceptibility of aerobic bacteria involved in human infections

Reflex Tests

Test Id	Reporting Name	Available Separately	Always Performed
RMALD	Ident by MALDI-TOF mass spec	No, (Bill Only)	No
BLA	Beta Lactamase	No, (Bill Only)	No
SUS	Susceptibility	No, (Bill Only)	No
HPCR1	H pylori + Clarithro Resistance PCR	No, (Bill Only)	No
MECAB	mecA PCR Test, Bill Only	No, (Bill Only)	No

Additional Tests

Test Id	Reporting Name	Available Separately	Always Performed
MIC	Susceptibility, MIC	No, (Bill Only)	Yes

Testing Algorithm

When this test is ordered, the reflex tests may be performed at an additional charge.

All aerobically growing bacteria submitted will automatically have susceptibility testing performed and billed as appropriate. Antimicrobial agents appropriate to the organism and specimen source will be tested according to Mayo Clinic's practice and the laboratory's standard operating procedures.

If appropriate, testing for *mecA* will be performed by polymerase chain reaction (PCR) under MECAB / Methicillin Resistance Gene, *mecA* Test (Bill Only). Indications for *mecA* testing include inadequate growth by phenotypic antimicrobial susceptibility testing, lack of current organism breakpoints for oxacillin or cefoxitin, and assessment of discrepancies between cefoxitin and oxacillin phenotypic testing results.

In the event that an isolate of *Helicobacter pylori* does not grow from a client sample or does not grow for susceptibility testing, reflex testing for HPCR1 / *Helicobacter pylori* with Clarithromycin Resistance Prediction, Molecular Detection, PCR (Bill Only) may be added.

The following tables provide a listing of the antimicrobials routinely tested as well as antimicrobials that may be tested upon request. These tables are organized by isolate groups and are not all inclusive. Call 800-533-1710 and ask to speak to the Bacteriology Antimicrobial Susceptibility Testing Laboratory if the organism or antimicrobial of interest are not listed in these tables.

-Aerobic Gram-Negative Bacilli Antimicrobials
-Additional Gram-Negative Bacteria Antimicrobials
-Staphylococcus, Enterococcus, Bacillus, and Related Genera Antimicrobials
-Additional Gram-Positive Bacteria Antimicrobials
-Abiotrophia/Granulicatella (Nutritionally Variant Streptococcus) Antimicrobials

For test utilization options, see *Helicobacter pylori* Diagnostic Algorithm.

Special Instructions

- Helicobacter pylori Diagnostic Algorithm
- Infectious Specimen Shipping Guidelines
- Aerobic Gram-Negative Bacilli Antimicrobials
- Additional Gram-Negative Bacteria Antimicrobials
- Staphylococcus, Enterococcus, Bacillus, and Related Genera Antimicrobials
- Additional Gram-Positive Bacteria Antimicrobials
- Abiotrophia/Granulicatella (Nutritionally Variant Streptococcus) Antimicrobials

Method Name

Minimal Inhibitory Concentration (MIC) (Agar Dilution or Broth Microdilution or Gradient Diffusion) or Disk Diffusion(if appropriate)

NY State Available

Yes

Specimen

Specimen Type

Varies

Ordering Guidance

Mayo Clinic Laboratories will not perform susceptibility testing on select agents (eg, *Bacillus anthracis*, *Brucella* species, *Burkholderia mallei*, *Burkholderia pseudomallei*, *Francisella tularensis*, and *Yersinia pestis*). Consult with your state health department or the Centers for Disease Control and Prevention regarding antimicrobial susceptibility testing of such isolates. For more information see www.selectagents.gov/sat/list.htm.

Shipping Instructions

1. See Infectious Specimen Shipping Guidelines
2. Place specimen in a large infectious container and label as an etiologic agent/infectious substance.

Necessary Information

Organism identification and specimen source (anatomical body site) are required.

Specimen Required

Preferred:
Specimen Type: Bacterial isolate swab
Supplies:
E-Swab (T853)
Infectious Container, Large (T146)
Container/Tube:
Preferred: E-Swab collection and transport system
Acceptable: Flocked swab and 1-mL liquid Amies transport medium in 12 x 80 mm tube
Collection Instruction:
1. Perform isolation of bacterial isolate.
2. Utilize the flocked swab to obtain an adequate sample of pure cultured isolate. **Do not submit mixed cultures.**
3. Place swab into the transport system containing 1-mL liquid Amies transport medium.
4. If needed, break off end of swab and close the transport tube.
5. Place the transport system into the secondary infectious container for shipment.
6. Each isolate must be submitted under a separate order.
Note: For the following organisms, submit an agar slant or other appropriate media to ensure viability upon arrival to the laboratory; *Neisseria gonorrhoeae*, *Campylobacter* species, *Helicobacter pylori*, and any other fastidious organism.

Acceptable:
Specimen Type: Pure culture of organism from source cultured
Supplies: Infectious Container, Large (T146)
Container/Tube: Agar slant or other appropriate media
Collection Instructions:
1. Perform isolation of bacterial isolate.
2. Bacterial organism must be submitted in pure culture, actively growing. **Do not submit mixed cultures.**
3. Place the agar slant or other appropriate media into the secondary infectious container for shipment.
4. Each isolate must be submitted under a separate order.

Forms

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

Reject Due To

Agar plate	Reject

Specimen Stability Information

Specimen Type	Temperature	Time	Special Container
Varies	Ambient (preferred)		
	Refrigerated		
	Frozen		

Clinical & Interpretive

Clinical Information

Antimicrobial susceptibility testing (AST) determines the minimal inhibitory concentration (MIC) of antimicrobial agents. The MIC is a measurement of the activity of an antimicrobial agent against an organism. It is defined as the lowest concentration of an antimicrobial agent that inhibits growth of the microorganism. Clinical breakpoints are derived from a number of data including:
-The pharmacokinetics/pharmacodynamics of an antimicrobial agent
-The MIC distribution of a large number of isolates
-Clinical outcome data for a patient population treated with the antimicrobial of interest

Antimicrobial susceptibility testing should be performed on pure culture isolates of pathogenic bacteria (or those potentially pathogenic in special situations) grown from specimens that have been appropriately collected so as not to confuse clinically significant isolates with normal or contaminating microbiota. Susceptibility testing is indicated for any organism that contributes to an infectious process warranting antimicrobial chemotherapy if its susceptibility cannot be reliably predicted from the organism's identity.

The MIC obtained during AST is helpful in indicating the concentration of antimicrobial agent required at the site of infection necessary to inhibit the infecting organism. For each organism-antimicrobial agent combination, the Clinical and Laboratory Standards Institute and/or the European Committee on Antimicrobial Susceptibility Testing provides interpretive criteria for determining whether the MIC should be interpreted as susceptible, susceptible dose dependent, intermediate, nonsusceptible, resistant, or epidemiological cutoff value if applicable.

Reference Values

Susceptibility results are reported as minimal inhibitory concentration (MIC) in mcg/mL. Breakpoints (also known as clinical breakpoints) are used to categorize an organism as susceptible, susceptible-dose dependent, intermediate, resistant, or nonsusceptible according to breakpoint setting organizations such as the Clinical and Laboratory Standards Institute (CLSI), the European Committee on Antimicrobial Susceptibility Testing (EUCAST), or the US Food and Drug Administration (FDA). Breakpoints are updated annually to reflect those published in the most current edition.

Breakpoints published by CLSI are used for routine susceptibility results. For those antimicrobials which do not have CLSI breakpoints, FDA breakpoints are used.

The CLSI breakpoint for clarithromycin and EUCAST breakpoints for antimicrobials other than clarithromycin are utilized for *Helicobacter pylori*.

In some instances, an interpretive category cannot be provided based on available data; therefore, the following comment will be included on the report: There are no established interpretive guidelines for agents reported without interpretations.

For information regarding CLSI and EUCAST susceptibility interpretations, see Susceptibility Interpretative Category Definitions.

Interpretation

A "susceptible" category result and a low minimum inhibitory concentration value indicate in vitro susceptibility of the organism to the antimicrobial tested.

Refer to Reference Values for interpretation of various antimicrobial susceptibility interpretive categories (ie, susceptible, susceptible-dose dependent, intermediate, nonsusceptible, resistant, or epidemiological cutoff value).

Cautions

In vitro susceptibility does not guarantee clinical response. Therefore, the decision to treat with a particular agent should not be based solely on the antimicrobial susceptibility testing result.

Clinical Reference

1. Jorgensen JH, Ferraro MJ. Antimicrobial susceptibility testing: a review of general principles and contemporary practices. Clin Infect Dis. 2009;49(11):1749-1755
2. Jenkins SG, Schuetz AN. Current concepts in laboratory testing to guide antimicrobial therapy. Mayo Clin Proc. 2012;87(3):290-308
3. Procop GW, Church DL, Hall GS, et al. Antimicrobial susceptibility testing. In: Koneman's Color Atlas and Textbook of Diagnostic Microbiology. 7th ed. Wolters Kluwer Health; 2017:1074-1171

Performance

Method Description

An agar dilution method is used for routine testing. The agar dilution method employs the use of antimicrobial agents incorporated in agar plates. The antimicrobial agent is added to agar in various concentrations depending upon levels attainable in serum, urine, or both. A standardized suspension of the organism is applied to the agar plates, which are incubated for a minimum of 16 to 18 hours at 35 degrees C. Complete inhibition of all but one colony or a very fine residual haze represents the end point.(Clinical and Laboratory Standards Institute. Methods for Dilution Antimicrobial Susceptibility Tests for Bacteria That Grow Aerobically. 12th ed. CLSI standard M07.CLSI; 2024)

Daptomycin and tigecycline are tested by agar gradient diffusion.(Package inserts: Etest Biomerieux; 15204E-EN, 2017/04; 056110-01 08/2020; 056953-01 09/2021)

Cefiderocol is tested by disk diffusion.(Clinical and Laboratory Standards Institute. Performance Standards for Antimicrobial Disk Susceptibility Tests. 14th ed. CLSI standard M02.CLSI; 2024)

Broth microdilution method is used for routine testing of *Granulicatella* species and *Abiotrophia* species. Various concentrations of select antimicrobials are added to the wells of a microtiter plate. A standardized suspension of organism is inoculated into the wells and incubated 20 to 24 hours. The minimal inhibitory concentration is read at the well with the lowest antimicrobial concentration exhibition no visible growth.(Clinical and Laboratory Standards Institute. Methods for Dilution Antimicrobial Susceptibility Tests for Bacteria That Grow Aerobically. 12th ed. CLSI standard M07. CLSI; 2024)

PDF Report

No

Day(s) Performed

Monday through Friday

Report Available
4 to 7 days

Specimen Retention Time
Bacterial isolates: 30 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
87077-Ident by MALDI-TOF mass spec (if appropriate)
87185-Beta lactamase (if appropriate)
87186-Antimicrobial Susceptibility, Aerobic Bacteria, MIC-per organism for routine battery (if appropriate)
87181-Susceptibility per drug and per organism for drugs not in routine battery (if appropriate)
87150-H pylori + Clarithro Resistance PCR (if appropriate)
87150-mecA PCR (if appropriate)

LOINC® Information

Test ID	Test Order Name	Order LOINC® Value
ZMMLS	Susceptibility, Aerobic, MIC	50545-3

Result ID	Test Result Name	Result LOINC® Value
ZMMLS	Susceptibility, Aerobic, MIC	21070-8