



# 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 ceftiofex, and assessment of discrepancies between ceftiofex 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.

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- [-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](http://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
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**Specimen Stability Information**

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

**Clinical & Interpretive**

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**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, either the Clinical and Laboratory Standards Institute (CLSI) or the European Committee on Antimicrobial Susceptibility Testing (EUCAST), as applicable.

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.

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**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 [CLSI]: 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; 056110-01, 08/2020;15203E-EN, 07/2016)

Cefiderocol is tested by disk diffusion.(Clinical and Laboratory Standards Institute [CLSI]: Performance Standards for Antimicrobial Disk Susceptibility Tests. 13th ed. CLSI standard M02. CLSI; 2018)

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 [CLSI]. 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

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**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