## CLSI Archived Methods

<table>
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<tr>
<th>Method</th>
<th>Date and Edition of First Publication</th>
<th>M100 Edition in Which This Procedure was Last Listed</th>
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<td>Modified Hodge Test</td>
<td>January 2009, M100-S19</td>
<td>January 2017, M100, 27th ed.</td>
<td>No longer considered a reliable phenotypic method for carbapenemase detection; other methods included in M100, such as the CarbaNP test and the mCIM, are more reliable.</td>
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Abbreviation: mCIM, modified carbapenem inactivation method.
The Modified Hodge Test for Suspected Carbapenemase Production in Enterobacterales

**Abbreviations**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tr>
<td>ATCC®</td>
<td>American Type Culture Collection</td>
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<tr>
<td>MHA</td>
<td>Mueller-Hinton agar</td>
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<tr>
<td>MHT</td>
<td>modified Hodge test</td>
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<tr>
<td>MIC</td>
<td>minimal inhibitory concentration</td>
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<tr>
<td>QC</td>
<td>quality control</td>
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**NOTE:** If using FORMER MIC breakpoints for carbapenems described in M100-S20 (January 2010), please refer to modifications in CLSI document M100.

### Test

**When to do this test:**
For epidemiological or infection control purposes. **NOTE:** No change in the interpretation of carbapenem susceptibility test results is necessary for carbapenemase-positive isolates.

**Test method:**
MHT

**Medium:**
MHA

**Antimicrobial concentration:**
10-µg ertapenem or meropenem disk

**Inoculum**
1. Prepare a 0.5 McFarland standard suspension (using either direct colony suspension or growth method) of *Escherichia coli* ATCC® 25922 (the indicator organism) in broth or saline, and dilute 1:10 in saline or broth. Inoculate an MHA plate as for the routine disk diffusion procedure. Allow the plate to dry 3-10 minutes. Place the appropriate number of ertapenem or meropenem disks on the plate as noted below and shown in Figures 1 and 2.

2. Using a 10-µL loop or swab, pick 3-5 colonies of test or QC organism grown overnight on a blood agar plate and inoculate in a straight line out from the edge of the disk. The streak should be at least 20-25 mm in length. Test the number of isolates per plate as noted below and shown in Figures 1 and 2.

**Capacity of small and large MHA plates (100-mm or 150-mm diameter, respectively):**

<table>
<thead>
<tr>
<th></th>
<th>Small</th>
<th>Large</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disks</td>
<td>1</td>
<td>1-4</td>
</tr>
<tr>
<td>Test isolates</td>
<td>1</td>
<td>1-6</td>
</tr>
<tr>
<td>QC isolates</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

**Incubation conditions**
35°C ± 2°C; ambient air

**Incubation length**
16-20 hours

**Results**
Following incubation, examine the MHA plate for enhanced growth around the test or QC organism streak at the intersection of the streak and the zone of inhibition (see Figures 1 and 2):

- Enhanced growth = positive for carbapenemase production
- No enhanced growth = negative for carbapenemase production

Some test isolates may produce substances that inhibit growth of *E. coli* ATCC® 25922. When this occurs, a clear area is seen around the streak (see Figure 3), and the MHT is uninterpretable for these isolates.

**NOTE:** Not all carbapenemase-producing isolates of Enterobacterales are MHT positive, and MHT-positive results may be encountered in isolates with carbapenem resistance mechanisms other than carbapenemase production.

**Additional testing and reporting**
Report results of the MHT to infection control or those requesting epidemiological information.

No change in the interpretation of carbapenem susceptibility test results is necessary for MHT-positive isolates.

**QC recommendations**
Test positive and negative QC organisms each day of testing.

*Klebsiella pneumoniae* ATCC® BAA-1705™—MHT positive

*K. pneumoniae* ATCC® BAA-1706™—MHT negative
NOTE 1: Test recommendations were largely derived following testing of US isolates of Enterobacterales and provide for a high level of sensitivity (> 90%) and specificity (> 90%) in detecting K. pneumoniae carbapenemase-type carbapenemases in these isolates. The sensitivity and specificity of the test for detecting other carbapenemase production can vary.

NOTE 2: No data exist on the usefulness of the MHT for the detection of carbapenemase production in nonfermenting gram-negative bacilli.

Footnotes

a. ATCC® is a registered trademark of the American Type Culture Collection.

b. Per ATCC® convention, the trademark symbol is used after “BAA” in each catalog number, in conjunction with the registered ATCC name.

Reference for the Modified Hodge Test


Figure 1. The MHT Performed on a Small MHA Plate.

(1) K. pneumoniae ATCC® BAA-1705™, positive result; (2) K. pneumoniae ATCC® BAA-1706™, negative result; and (3) a clinical isolate, positive result.

Figure 2. MHT Performed on a Large MHA Plate With Ertapenem. (1) K. pneumoniae ATCC® BAA-1705™, positive result; (2) K. pneumoniae ATCC® BAA-1706™, negative result; (3-8) clinical isolates; (6) negative result; (3, 4, 5, 7, 8) positive result.
Figure 3. Example of an Indeterminate Result. (1) A clinical isolate with an indeterminate result; and (2) a clinical isolate with a negative result.