

CLSI Archived Methods

Method	Date and Edition of First Publication	M100 Edition in Which This Procedure was Last Listed	Comments	Procedure Available on Page(s):
Modified Hodge Test	January 2009, M100-S19	January 2017, M100, 27th ed.	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.	2-4

Abbreviation: mCIM, modified carbapenem inactivation method.

The Modified Hodge Test for Suspected Carbapenemase Production in *Enterobacteriaceae*

Abbreviations

ATCC®	American Type Culture Collection
MHA	Mueller-Hinton agar
MHT	modified Hodge test
MIC	minimal inhibitory concentration
QC	quality control

NOTE: If using FORMER MIC breakpoints for carbapenems described in M100-S20 (January 2010), please refer to modifications in CLSI document M100.

Test	MHT												
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	<p>1. Prepare a 0.5 McFarland standard suspension (using either direct colony suspension or growth method) of <i>Escherichia coli</i> ATCC®^a 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.</p> <p>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.</p> <p>Capacity of small and large MHA plates (100-mm or 150-mm diameter, respectively):</p> <table border="1"> <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>		Small	Large	Disks	1	1-4	Test isolates	1	1-6	QC isolates	2	2
	Small	Large											
Disks	1	1-4											
Test isolates	1	1-6											
QC isolates	2	2											
Incubation conditions	35°C ± 2°C; ambient air												
Incubation length	16-20 hours												
Results	<p>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):</p> <ul style="list-style-type: none"> Enhanced growth = positive for carbapenemase production No enhanced growth = negative for carbapenemase production <p>Some test isolates may produce substances that inhibit growth of <i>E. coli</i> ATCC® 25922. When this occurs, a clear area is seen around the streak (see Figure 3), and the MHT is uninterpretable for these isolates.</p> <p>NOTE: Not all carbapenemase-producing isolates of <i>Enterobacteriaceae</i> are MHT positive, and MHT-positive results may be encountered in isolates with carbapenem resistance mechanisms other than carbapenemase production.</p>												
Additional testing and reporting	<p>Report results of the MHT to infection control or those requesting epidemiological information.</p> <p>No change in the interpretation of carbapenem susceptibility test results is necessary for MHT-positive isolates.</p>												
QC recommendations	<p>Test positive and negative QC organisms each day of testing.</p> <p><i>Klebsiella pneumoniae</i> ATCC® BAA-1705^{™b}—MHT positive</p> <p><i>K. pneumoniae</i> ATCC® BAA-1706[™]—MHT negative</p>												

NOTE 1: Test recommendations were largely derived following testing of US isolates of *Enterobacteriaceae* and provide for a high level of sensitivity (> 90%) and specificity (> 90%) in detecting *K. pneumoniae* carbapenemase-type carbapenemases in these isolates.¹ 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

¹ Anderson KF, Lonsway DR, Rasheed JK, et al. Evaluation of methods to identify the *Klebsiella pneumoniae* carbapenemase in *Enterobacteriaceae*. *J Clin Microbiol.* 2007;45(8):2723-2725.

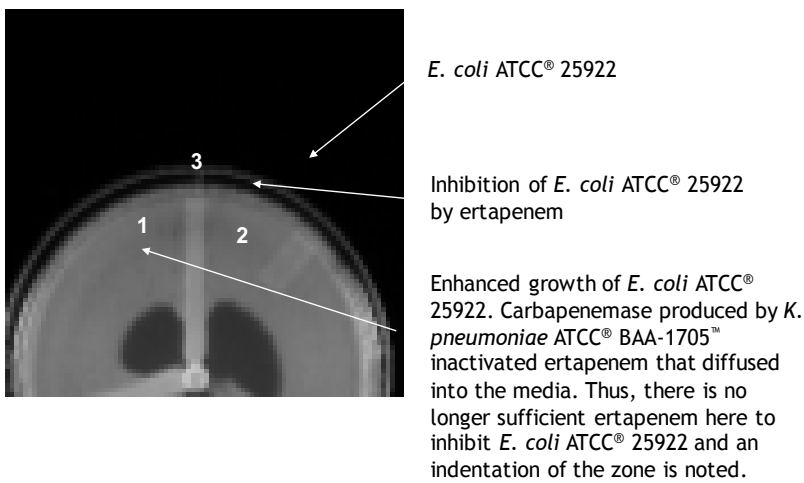


Figure 1. The MHT Performed on a Small MHA Plate.

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

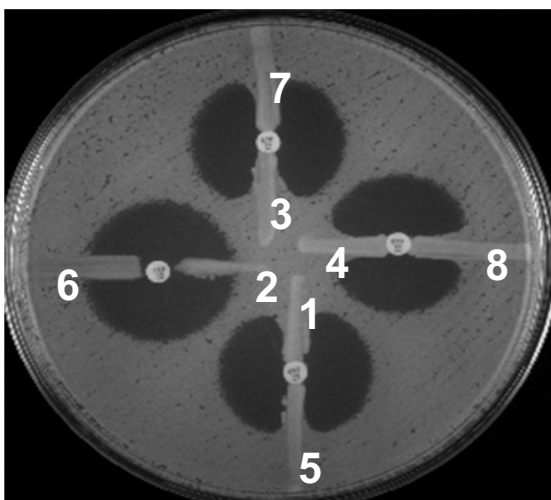
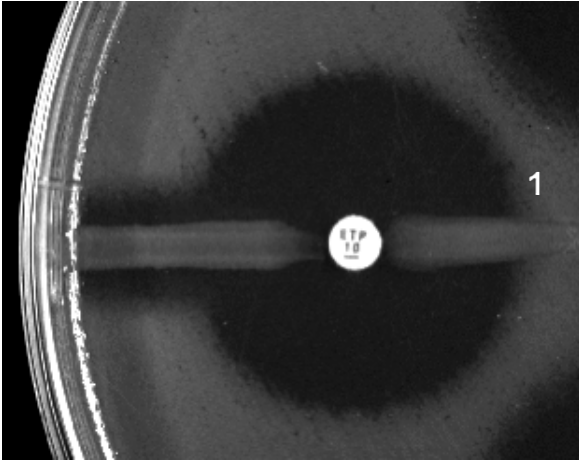


Figure 2. The MHT Performed on a Large MHA Plate With Ertapenem. (1) *K. pneumoniae* ATCC® BAA-1705™, positive result; (2) *K. pneumoniae* ATCC® BAA-1706™, negative result; (3-8) clinical isolates; (6) negative result; (3, 4, 5, 7, 8) positive result.



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Figure 3. An Example of an Indeterminate Result. (1) A clinical isolate with an indeterminate result; and (2) a clinical isolate with a negative result.