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 Enterobacterales

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	1. Prepare a 0.5 McFarland standard suspension (using either direct colony suspension or growth method) of *Escherichia coli* 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. 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): | | 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	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™[b]—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.[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.

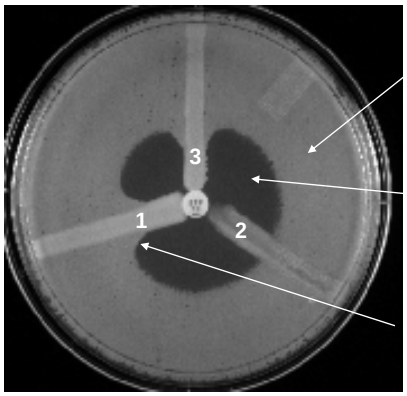

Figure 1. The MHT Performed on a Small MHA Plate.
(1) *K. pneumoniae* ATCC® BAA-1705™, positive result;
(2) *K. pneumoniae* ATCC® BAA-1706™, negative result;
and (3) a clinical isolate, positive result.

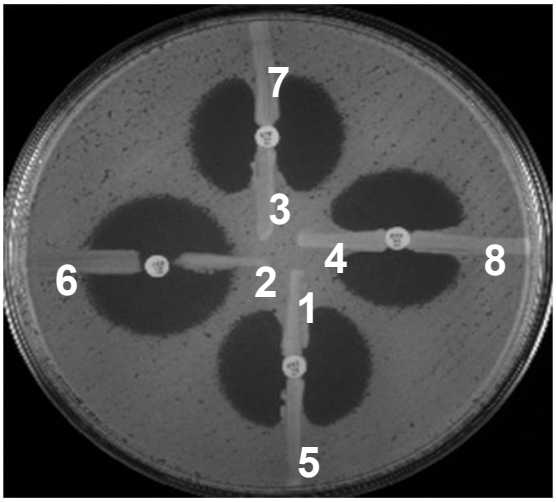

Figure 2. MHT Performed on a Large MHA Plate With Ertapenem. (1) *K. pneumoniae* ATCC® BAA-1705™, positive result; (2) *K. pneumoniae* ATCC® BAA-1706™, negative result; (3–8) clinical isolates; (6) negative result; (3, 4, 5, 7, 8) positive result.

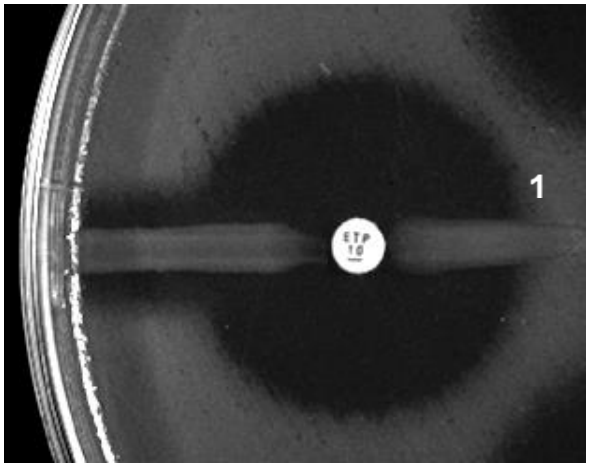

Figure 3. Example of an Indeterminate Result. (1) A clinical isolate with an indeterminate result; and (2) a clinical isolate with a negative result.