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Colorimetric tests for the detection of carbapenemases in Gram-negative bacilli: which test to choose?

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Background: Detection of carbapenemases (CP) in Gram-negative bacilli (GNB) is challenging. Phenotypic methods like the modified Hodge (MH) test are inaccurate, time-consuming and difficult to interpret, while molecular and MALDI-TOF MS based methods require trained personnel and expensive infrastructure. Last years, straightforward and reliable chromogenic screening tests based on the hydrolysis of carbapenems became commercially available.
The analytical performance, hands-on-time (HOT) and turn-around-time (TAT) of 3 commercially available colorimetric screening tests for the detection of CP in GNB, i.e. RAPIDEC CARBA NP (BioMérieux, NP); Neo-Rapid CARB (Rosco Diagnostica; NEO) and β-CARBA test (Bio-Rad, β) were evaluated.

Material/methods: For this study 12 strains from External Quality Control (EQC) programs (8 *Enterobacteriaceae,* 3 *Acinetobacter baumanii* and 1 *Pseudomonas aeruginosa*) and 57 clinical isolates (39 *Enterobacteriaceae,* 3 *A. baumanii* and 15 *P. aeruginosa*) were selected. All EQC strains were CP positive: 4 VIM, 3 OXA-48, 2 GES-12 ,1 IMP, 1 OXA-23 and 1 KPC. Of the clinical strains, 38 were CP positive and 19 CP negative. CP production was confirmed by the national reference laboratory (14 VIM, 11 OXA-48, 6 KPC, 4 NDM, 2 OXA-23, 1 OXA-51+GES).

Results: The NP-test was positive for 45, negative for 17 and inconclusive for 7 strains [4 *A. baumanii* (1 OXA-51+GES, 2 OXA-23 and 1 GES-12), 1 GES *P. aeruginosa* and 2 CPE negative *E. aerogenes*]. When inconclusive results were considered as positive, sensitivity was 98% (1 false negative OXA-23 *A. baumanii*) and specificity was 84% (3 false positive CPE negative *Enterobacter* species). Interpreting inconclusive tests as negative resulted in a sensitivity of 88% (false negative results for 1 OXA-51+GES, 3 OXA-23 and 1 GES-12 *A. baumanii* and 1 GES *P. aeruginosa*) and a specificity of 95%. With the NEO-test 49 strains were CP-positive and 20 CP-negative, leading to a sensitivity of 98% (1 false negative GES *P. aeruginosa*) and a specificity of 100%. The β-test, applicable only for Enterobacteriaceae, was positive for 33 strains and negative for 14 strains, resulting in a sensitivity of 94% (1 false negative OXA-48 *E. kobei/asburiae* and VIM *E. cloacae*) and a specificity of 100%. HOT was comparable for the 3 tests (5-8 minutes) but TAT showed more variation (90-170 minutes for the NP-test, 35 minutes for the β-test and 82-129 minutes for the NEO-test depending on the incubation time). The TAT of the MH-test, currently used, is on average 20 hours.

Conclusions: All 3 evaluated screening tests are easy to use and suitable for a fast and reliable detection of CP in GNB. The analytical performance of the NEO-test was superior to the others with a slightly higher TAT. Compared to older phenotypic methods as the MH-test however, the result is known one day earlier.