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Evaluation of the Carbapenem-Resistant K.N.I.V.O. Detection K-Set for the rapid detection of carbapenemases among carbapenem-resistant gram-negative bacilli

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Background: Carbapenem resistant gram-negative bacteria pose a public health threat worldwide. Rapid detection of carbapenemases is a challenge for the clinical laboratories since it is crucial to timely apply infection control measures and to optimize antimicrobial therapy. The aim of the study was to evaluate the performance of an immunochromatographic test for the detection of carbapenamases in accordance with the standard procedures of our lab.

Method: Carbapenem resistant gram-negative bacteria (Enterobacterales and Pseudomonas aeruginosa) recovered from patients admitted to AHEPA University Hospital between January 2020 - October 2021 were included in the study. Bacterial identification and susceptibility testing were performed by the automated system VITEK2 (bioMérieux, France). All isolates were tested phenotypically for the detection of MBL, KPC or both carbapenemases with a combined disk test using meropenem disks with and without carbapenemase inhibitors (EDTA and phenylboronic acid). MBL positive isolates were further tested with the modified Hodge test and in case of a negative result we proceeded with the detection of the bla-NDM gene by PCR. The Carbapenem Resistant K.N.I.V.O. Detection K-Set (GOLDSTREAM,China) immunochromatographic lateral flow assay for the qualitative detection of KPC-, NDM-, IMP-, VIM-an OXA-48 type carbapenemases was assessed.

Results: Overall, we examined 52 non-duplicate clinical strains; 38 Klebsiella pneumoniae, 11 Pseudomonas aeruginosa, 2 Proteus mirabilis and 1 Providencia stuartii. Combination disk and PCR testing revealed 16 KPC, 19 NDM and 3 producing both KPC and NDM carbapenemases among Klebsiella pneumoniae isolates ,11 VIM-producing Pseudomonas aeruginosa, 2 NDM-producing Proteus mirabilis and 1 VIM-producing Providencia stuartii. The lateral flow assay identified all carbapanamases apart from 1 NDM produced by a Proteus mirabilis strain, exhibiting 98.1% sensitivity against the combined disk test. (Table 1.) (Image 1., Image 2.)

Conclusions: The carbapenem resistant K.N.I.V.O. Detection K-Set, was equivalent to the standard procedures used in our lab in the detection of carbapenamases yet much faster since it provides results in 15 min compared to a minimum of the 24 hour-turn-around time of the aforementioned methods. Therefore, it is a valuable tool in the early implementation of appropriate antimicrobial therapy and infection control measures.

Table 1. Carbapenemase detection by bacterial species

Bacterial species	Type of Carbapenemase	Combination disk testing/PCR	Lateral flow assay
Klebsiella pneumoniae	KPC	16	16
Klebsiella pneumoniae	NDM	19	19
Klebsiella pneumoniae	KPC-NDM	3	3
Proteus mirabilis	NDM	2	1
Pseudomonas aeruginosa	VIM	11	11
Providencia stuartii	VIM	1	1
Total		52	51

Image 1. Detection of a VIM carbapenemase

Image 2. Detection of KPC and NDM carbapenemase