

# Prevalence of Class A - Carbapenemases Producing Enterobacteriaceae in Clinical Isolates in MBS Hospital, Kota, Rajasthan

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**Abstract:** ***Aim:** The aim of this study was to determine the prevalence Class-A carbapenemases producing enterobacteriaceae in clinical isolates in MBS Hospital, Kota. **Material and Methods:** The study period was from September 2018 to March 2019. The samples which were imipenem resistant were tested for carbapenemase production by Modified Hodge Test. **Result:** Out of total 100 isolates of enterobacteriaceae, 21 were imipenem resistant of which 17 were carbapenemase producing as detected by Modified Hodge Test. Most common isolates were E.coli and Klebsiella. **Conclusion:** The frequency rate of carbapenemase producing Enterobacteriaceae is increasing many folds. Early identification of carbapenemase producers in clinical infections is important to prevent development of hospital-based outbreaks carbapenemase producers. Implementations of appropriate strategies with Over-the-counter use of antibacterial drug should be checked to limit the spread of carbapenem resistant Enterobacteriaceae.*

**Keywords:** Class-A carbapenemase, Enterobacteriaceae

## 1. Aim

The aim of this study was to determine the prevalence Class A- carbapenemases producing Enterobacteriaceae in clinical isolates in MBS hospital, Kota, Rajasthan.

## 2. Introduction

Enterobacteriaceae are inhabitants of the intestinal flora and are among the most common human pathogens, causing infections such as cystitis and pyelonephritis with fever, septicemia, pneumonia, peritonitis, meningitis, and device-associated infections. Enterobacteriaceae are the source of community and hospital acquired infections. They have the propensity to spread easily between humans (hand carriage, contaminated food and water) and to acquire genetic material through horizontal gene transfer mediated mostly by plasmids and transposons.

Carbapenem - resistant Enterobacteriaceae have been reported worldwide as a consequence of acquisition of carbapenemase genes (*I*). The first carbapenemase producer in Enterobacteriaceae (NmcA) was identified in 1993 (2). Since then a large variety of carbapenemases has been identified in Enterobacteriaceae belonging to 3 classes of  $\beta$ -lactamases: the Ambler class A, B, and D  $\beta$ -lactamases (2). In addition rare chromosome encoded cephalosporinases (Ambler class C) produced by Enterobacteriaceae. Beta-Lactamases are classified according to their functional properties and molecular structure by Ambler and Bush (3, 4). These enzymes show hydrolytic activity toward carbapenems, e.g., Klebsiella pneumonia carbapenemase (KPC, Ambler/ Bush class A), the New Delhi metallo-beta-lactamase (NDM-1), VIM and GIM-type enzymes (all Ambler/Bush class B) or OXA-48 (Ambler/Bush class D).

Spread of community-acquired enterobacterial isolates (*Escherichia coli*) that produce extended-spectrum  $\beta$ -lactamases (ESBLs) and carbapenemases has also been

reported worldwide (5). It is therefore mandatory to maintain the clinical efficacy of carbapenems (imipenem, ertapenem, meropenem, doripenem). These agents are crucial for preventing and treating life-threatening nosocomial infections, which are often associated with techniques developed in modern medicine (transplantation, hospitalization in an intensive care unit, highly technical surgery). They are detected by various methods like Class A carbapenemases by Modified Hodge Test, Class B by Combined Disk Synergy Test (CDST).

Modified Hodge Test (MHT): It is a phenotypic test used to detect Class A carbapenemases which shows clover leaf appearance. The test was performed as the phenotypic confirmatory test for carbapenemase production as per CLSI guidelines.(6, 7)

## 3. Material and Methods

This study was conducted in Department Of Microbiology, MBS Hospital, Kota. The samples were collected from September 2018 to March 2019. Various samples (swab, sputum, urine, stool, pus, blood etc.) were received for culture to the laboratory. These samples were processed and Enterobacteriaceae isolates were further tested for routine antibiotic sensitivity by Modified Kirby Bauer Disc Diffusion method. Those which were multi drug resistant were tested for carbapenem (imipenem) sensitivity. The isolates which were imipenem resistant were tested for Class- A carbapenemase production by Modified Hodge Test (MHT).

## 4. Result

34 out of 100 samples were multi drug resistant (MDR). Out of 34 MDR, 21 samples were imipenem resistant. 17 out of 21 were MHT positive. i.e. Prevalence of carbapenemase producing isolates amongst Enterobacteriaceae was found to be 17%. Klebsiella pneumonia was the most common isolate

showing carbapenemase production. Second most common was *E.coli*. And the isolates were commonly from urine and swab samples of ICU patients.

## 5. Discussion

As per our study, the prevalence of carbapenemase producing Enterobacteriaceae is 17 %. Most commonly seen bacteria are *E.coli* and *K.pneumoniae* isolated from urine and swab of critically ill and debilitated patients. Result of our study is comparable to the studies from Institute of Medizinische Microbiology, University of Zürich, Switzerland with 6.6% prevalence (8), 45% in the study of Tijet et al. (9) and 14.5% from the study in Department of Microbiology, University of Hong Kong, China.(10)

Defensive practice, ignorance of rational antibiotic prescribing principles and inadequate infection control is leading to alarming rise in multi resistance organisms.

## 6. Conclusion

In recent years, the emergence of diverse carbapenemases in members of the family Enterobacteriaceae has become a major challenge for health care systems (11). Carbapenemase-producing bacterial isolates pose a severe clinical problem, as nonsusceptibility to beta-lactams is frequently accompanied by coresistance to additional drug classes, e.g. aminoglycosides or quinolones (12, 13). As a consequence, treatment options for carbapenemase producers are alarmingly limited and often drugs displaying significant side effects need to be administered as a last resort (14). The frequency rate of carbapenemase producing Enterobacteriaceae found should not be underestimated. Early identification of carbapenemase producers in clinical infections is therefore mandatory to prevent development of hospital-based outbreaks carbapenemase producers.

The epidemic of carbapenemase producers cannot stop spontaneously. Such community-based outbreaks will be difficult to control. The factors that enhance the spread of carbapenemase producers in the community are multiple and associated with lack of hygiene, overuse and over-the-counter use of antibacterial drugs, and increased worldwide travel. In addition, many carbapenemase producers carry unrelated drug-resistance determinants. We cannot predict the speed of diffusion of carbapenemase producers in the community or their prevalence at a steady state (5%–50%). The epidemic will likely be caused mainly by nosocomial carbapenemase producers in *K. pneumoniae* of all types (KPC, IMP, VIM, NDM, and OXA-48). It is likely that in certain countries high rates of different types of carbapenemase producers may already exist, for example, in Greece (VIM and KPC) and in the Indian subcontinent (NDM, KPC, OXA-181).

Early identification of carbapenemase producers in clinical infections, at the carriage state, or both, is therefore mandatory to prevent development of those hospital-based outbreaks. The dearth of novel antibacterial drugs in the pipeline means that we must conserve the efficacy of existing antibacterial drugs as much as possible (15, 16). Carbapenemase producers in Enterobacteriaceae are

different from other multidrug-resistant bacteria in that they are susceptible to few antibacterial drugs. No vaccines are readily available for preventing infections with carbapenemase producers.

Bundled interventions including enhanced environmental cleaning, active surveillance culturing and contact precautions, as well as antimicrobial stewardship are important in controlling KPC-producing bacteria

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