# Microbiological Analysis of *Pseudomonas aeruginosa* Multi-Resistant Strains

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## Introduction

*Pseudomonas aeruginosa* (PSAE) belongs among major nosocomial pathogens, often associated with multidrug resistance (MDR) [1]. Treatment of diseases caused by these pathogens is complicated and reserve antibiotics such as carbapenems are needed. One of the important mechanisms of resistance is the production of beta-lactamases such as carbapenemases [2].

## Objectives

The aim of this study was to phenotypically determine the mechanism of resistance of the MDR PSAE to carbapenems, to determine the susceptibility to other selected antibiotics and to analyse the prevalence of these bacteria in the University Hospital Olomouc (UHO) and the Military Hospital Olomouc (MHO).

## Methodology

Meropenem-resistant MDR PSAE strains were isolated from clinical materials of UHO and MHO patients between 1 January 2020 and 31 December 2022. The isolates were identified by standard microbiological procedures using the MALDI-TOF MS system and their antibiotic susceptibility was determined by the dilution micromethod according to EUCAST criteria [3]. Carbapenemase production was detected by immunochromatographic assay CARBA-5 and verified by genetic analysis.

**References**

1. Reynolds D, Kollef M. The Epidemiology and Pathogenesis and Treatment of Pseudomonas aeruginosa Infections: An Update. Drugs. 2021 Dec;81(18):2117-2131.
2. Tenover FC, Nicolau DP, Gill CM. Carbapenemase-producing Pseudomonas aeruginosa -an emerging challenge. Emerg Microbes Infect. 2022 Dec;11(1):811-814.
3. European Committee on Antimicrobial Susceptibility Testing. Breakpoint tables for interpretation of MICs and zone diameters. Available from http://www.eucast.org.

Figure 1. Sample distribution according to hospital and department

| University Hospital Olomouc (UHO) | No of isolates |
|---|---|
| Dep. of Anesthesiology, Resuscitation, and Intensive Care | 30 |
| Dep. of Pulmonary Diseases and Tuberculosis | 14 |
| Dep. of Internal Medicine (I, II, III) | 11 |
| Dep. of Specialized Surgery (Urology, Orthopedics, Neurosurgery) | 9 |
| Dep. of Intensive Care for Surgical Specializations | 8 |
| Dep. of Surgery (I, II) | 6 |
| Dep. of Long-Term ICU | 5 |
| Other departments (Traumatology, Haemato-Oncology, Pediatrics and Neurology) | 5 |

| Military Hospital Olomouc (MHO) | No of isolates |
|---|---|
| Dep. of Long-Term ICU | 26 |
| Dep. of Anesthesiology and Resuscitation | 5 |
| Dep. of Long-term Care | 5 |
| Dep. of Internal Medicine | 1 |

Picture 1. CARBA-5 Tests


Picture 2. E-Test

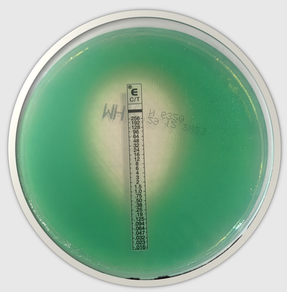
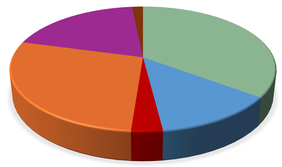


Figure 3. Type of Resistance to Carbapenems


## Figure 4. Type of samples tested

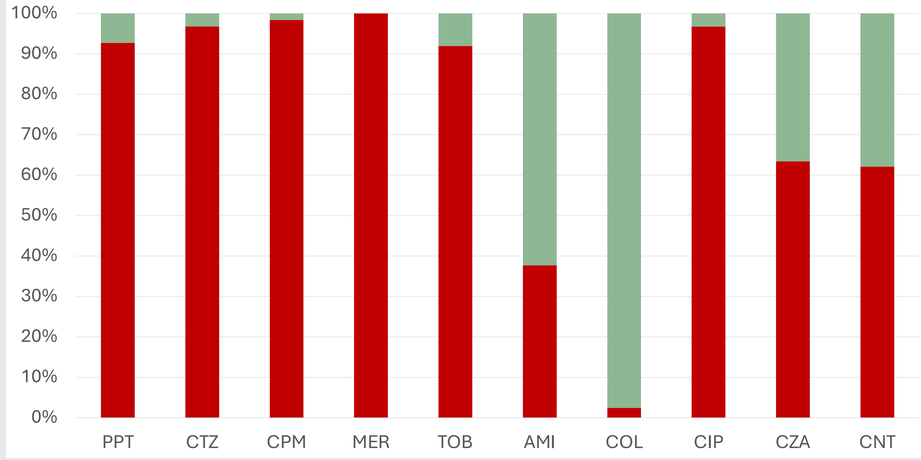
35% Lower respiratory tract (sputum, endotracheal secretion, BAL)
13% Upper respiratory tract (throat, nasopharynx, oral cavity swab)
3% Blood stream infection (hemoculture)
28% Urine
19% Drain, punctate, tissue, wound swab
2% Other (stool etc.)



## Results

Of the 125 isolates, most of them were obtained from the Department of Anesthesiology, Resuscitation, and Intensive Care, UHO (24%) and the Department of Long-Term Intensive Care, MHO (21%). MDR PSAE were most frequently cultured from the lower respiratory tract (35%), urine (28%), and wounds (19%). Approximately half of the meropenem-resistant isolates produced carbapenemases (49%), specifically metalo-beta lactamases VIM (26%) and IMP (23%) types. However, these strains were still largely susceptible to colistin (98%) and amikacin (62%).

Figure 2. PSAE resistance to different antibiotics




Legend: PPT - piperacillin/tazobactam, CTZ - ceftazidime, CPM - cefepime, MER - meropenem, TOB - tobramycin, AMI - amikacin, COL - colistin, CIP - ciprofloxacin, CZA - ceftazidime/avibactam, CNT - ceftolozane/tazobactam

## Conclusion

MDR PSAE strains pose a significant risk in the treatment of nosocomial infections. They still retain relatively good susceptibility to colistin and amikacin. Approximately half of our isolates produced carbapenemases which is a serious finding from a clinical and epidemiological point of view. Along with treatment, adhering to recommended hygiene protocols is very important preventative measure.

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