

# Susceptibility patterns, resistance genes, risk factors and outcomes of multidrug-resistant *Pseudomonas aeruginosa* (MDR-PA) in north-eastern Peninsular Malaysia: A multicenter study

Md Salim SN<sup>1</sup>, Mohamad NI<sup>2</sup>, Rashid R<sup>3</sup>, Sayed Hitam SA<sup>4</sup>, Deris, ZZ<sup>1</sup>

<sup>1</sup>Department of Medical Microbiology and Parasitology, Universiti Sains Malaysia, Kubang Kerian, Malaysia, <sup>2</sup>Pathology Department, Microbiology Unit, Hospital Raja Perempuan Zainab II, Kota Bharu, Malaysia, <sup>3</sup>Pathology Department, Microbiology Unit, Hospital Tanah Merah, Tanah Merah, Malaysia, <sup>4</sup>Pathology Department, Microbiology Unit, Hospital Sultan Ismail Petra, Kuala Krai, Malaysia

## ABSTRACT

**Introduction:** MDR-PA is one of the emerging nosocomial Gram-negative organisms responsible for high morbidity and mortality. Gradual increase in antibiotic resistance left clinicians with limited therapeutic options. Minimal data exist regarding MDR-PA in Malaysia. Therefore, this study aimed to investigate the resistance genes, antibiotic profiles including activity of ceftolozane-tazobactam (C-T), risk factors and outcomes of MDR-PA infection. **Materials and Methods:** In this case-control study, two hundred subjects were recruited from four major hospitals in Kelantan State of Malaysia between March 2021 and February 2022. One hundred MDR-PA isolates were subjected to C-T disc diffusion testing and conventional multiplex PCR for resistance genes detection. Whereas risk factors and outcomes were analysed by comparing 1:1 case (MDR-PA) and control (susceptible-PA). **Results:** The novel antibiotic, ceftolozane-tazobactam showed the best performance among  $\beta$ -lactams with anti-pseudomonal properties (53.0% resistant rate). The most prevalent gene was OprD (91.0%) followed by bla-NDM-1 (46.0%). None of the isolates carry bla-OXA-48 gene. The factors independently associated with MDR-PA acquisitions were age (OR:1.02;  $p = 0.028$ ), genitourinary disorder (OR: 6.89;  $p = 0.001$ ) and central venous catheter (OR: 3.18;  $p = 0.001$ ). This study also showed MDR-PA acquisitions were associated with microbiological failure (41.1% vs 25.0%;  $p = 0.001$ ) and mortality (40% versus 6%;  $p < 0.001$ ). **Conclusion:** The emergence of *Pseudomonas aeruginosa* harbouring bla-NDM-1 gene in Kelantan state population should alarm clinicians since it can spread from person to person, causing an outbreak. Early anticipation in patient at risk of acquiring MDR-PA is crucial to facilitate case detection and infection control measures.