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Prevalence and Minimum Inhibitory Concentration Profiling of Ciprofloxacin-Resistant Bacteria in Coastal Waters of the Northern and Southern Provinces of Sri Lanka

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Abstract

Antibiotic resistance is a critical global health threat, with environmental contamination playing a significant but underexplored role alongside clinical misuse. Coastal waters are particularly vulnerable due to inputs of Antibiotic Residues (AR) and Antibiotic-Resistant Bacteria (ARB) from wastewater discharge, agricultural runoff, and aquaculture effluents. This study assessed the prevalence and resistance profiles of ciprofloxacin (CIP) resistant bacteria in coastal waters of Sri Lanka, where such data remain limited. Water samples were collected in triplicate from eleven coastal sites, six in the Northern Province (Karaitivu, Anaikodai, Ponnalai, Dambakola Patuna, Point Pedro, and Dutch Fort-Jaffna), and five in the Southern Province (Polhena, Weligama, Koggala, Unawatuna, and Hikkaduwa). CIP-resistant bacteria were isolated using the standard pour plate method on nutrient agar supplemented with 60 µg/mL CIP. Minimum inhibitory concentrations (MICs) were determined via agar dilution following Clinical and Laboratory Standards Institute (CLSI) guidelines. Total Viable Counts (TVCs) of bacteria were higher in Southern sites (5.07×10^4-6.75×10^4 CFU/mL) than Northern sites (1.21×10^4-1.53×10^4 CFU/mL), with the highest counts recorded at Hikkaduwa (6.75×10^4 CFU/mL, South), followed at Ponnalai (1.53×10^4 CFU/mL, North). Similarly, CIP-resistant bacteria were more prevalent in the South (2.55×10^4-6.06×10^4 CFU/mL) compared to the North (1.81×10^3-1.25×10^4 CFU/mL). Among 22 isolates, 86% of Southern isolates exhibited MIC values >360 µg/mL, whereas no Northern isolates exceeded this level. Northern isolates displayed MIC distributions of 20% at 180-240 µg/mL and 60% at 240-360 µg/mL, while Southern isolates showed no MIC values below 240 µg/mL, with only 14% falling within the 240-360 µg/mL range. These results reveal a pronounced geographic disparity in ciprofloxacin resistance, with the Southern coastal region identified as a significant hotspot for high-level resistance. While this study offers crucial initial data on CIP-resistant bacteria prevalence and MIC profiles, more extensive research is required for a comprehensive understanding. These results underscore the need for sustained environmental monitoring and targeted interventions to mitigate the spread of antimicrobial resistance in coastal ecosystems.

Keywords: *Ciprofloxacin resistance, Antibiotic-resistant, Coastal pollution, Southern province*