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UNRAVELING GENETIC VARIABILITY IN ANTIMICROBIAL RESISTANCE AMONG INTRACELLULAR AND EXTRACELLULAR BACTERIA

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Antimicrobial resistance (AMR) represents a critical global health threat, driven by the remarkable evolutionary adaptability of microorganisms such as bacteria, fungi, and viruses. These organisms continuously evolve to overcome the effects of antimicrobials, resulting in infections that are increasingly challenging to treat. The emergence of resistance is a dynamic process influenced by a range of factors, including diverse resistance mechanisms present in both intracellular and extracellular bacteria. This review highlights the importance of studying both types, as they employ distinct survival strategies that impact treatment outcomes. Intracellular bacteria can evade immune responses and are often protected from antibiotics, complicating infection eradication. In contrast, extracellular bacteria typically develop resistance through horizontal gene transfer and biofilm formation, presenting additional management challenges. Understanding the genetic basis and dynamics of these mechanisms is crucial for developing rapid diagnostic tools and effective treatment strategies. This review delves into the complexities of AMR, emphasizing the various strategies bacteria use to neutralize antibiotics and the implications for managing both intracellular and extracellular infections. It also addresses the role of environmental reservoirs and host-pathogen interactions in the development and spread of resistance. Key conclusions emphasize the urgent need for innovative strategies to enhance antibiotic efficacy, considering the unique challenges posed by both intracellular and extracellular bacteria. By tackling these issues, the review aims to improve approaches for managing bacterial infections in clinical and public health contexts.