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Commentary

Antimicrobial Resistance Caused by Plasmids in Water

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1. Description

Antimicrobial Resistance (AMR) has been connected to a region in the environment that is conducive to its spread. Antimicrobial Resistance Genes (ARGs) spread quickly and persistently in the environment and from plasmids. Drinking water that comes from the natural environment but has been tainted by human activity may contain ARGs and bacteria that are resistant to antibiotics. This analysis assesses the global distribution of Plasmid-Mediated Antimicrobial Resistance (PMRs) in drinking water and indicates a research deficit in plasmids. AMR in drinking water is a problem that affects everyone. Some of the genes found in drinking water around the world. These genes produce hydrolyzing enzymes that can break down antibiotics, resulting in the development of antibiotic resistance. A possible methodology for the initial, comprehensive analysis of PMR in drinking water. The World Health Organization has identified antimicrobial resistance as one of the top 10 public health problems affecting the global population. Vertical gene transfer is the technique by which genetic mutations that cause AMR can be passed on to succeeding generations. As an alternative, AMR can develop through Horizontal Gene Transfer (HGT) mechanisms, transformation which involves competent cells absorbing DNA from their environment, transduction, which involves the transmission of genetic material through a viral vector and conjugation which involves the exchange of DNA through direct cell to cell contact. Whereas medical infections were the primary focus of many AMR studies, it is clear that AMR also exists in the natural environment.

It has been determined that the aquatic environment serves as a reservoir for the growth and spread of Antibiotic Resistant Bacteria (ARB) and Antimicrobial Resistance Genes (ARGs). HGT of resistance plasmids is one of the primary methods through which ARGs survive in these settings. Due to the close proximity of bacterial communities in the gelatinous matrix, biofilms that develop in drinking water distribution pipes provide a perfect environment for conjugative HGT to take place. Anthropogenic activities and inadequate water treatment, which add non-commensal pollutants to drinking water. ARBs and ARGs are added to the microbial communities as a result of this pollution. It is currently uncertain if some of these diseases are brought on by drinking water that contains ARB and ARGs. But because water is so essential to human living it is crucial to provide consumers with access to clean, safe drinking water. A quarter of the world's population did not have access to safe drinking water in 2020, according to the Joint Monitoring Program (JMP) for Water Supply, Sanitation and Hygiene. Despite advancements in the five-year period's supply of safely regulated drinking water.

Globally, drinking water has been found to contain Extended-Spectrum Beta Lactamase (ESBL) and carbapenemase genes. These genes can migrate and propagate across the environment since they are frequently present on mobile genetic components like plasmids. Bloodstream and urinary tract infections have been linked to Enterobacteriaceae that produce ESBL. Treatment for ESBL related infections frequently involves the final generation of antimicrobials the carbapenemase antibiotics. The development of Carbapenem-Resistant Enterobacteriaceae (CPE) infections has been linked to a high death rate and few to no additional treatment alternatives

hence the usage of carbapenemase may complicate available therapeutic options. This also applies to wastewater, one of the potential sources of drinking water contamination. Consistent detection techniques would make it possible to monitor and analyze the source on a worldwide scale because plasmids serve as the means of transmitting AMR from one ecological niche to another. This would therefore make it possible to implement mitigation methods, lowering the risk of AMR infections and diseases, and extending the effectiveness of the antimicrobial drugs now on the market for use in both animals and humans.

Based on research published between 1992 and 2020, the currently available literature describes the global prevalence of Plasmid-Mediated Antimicrobial Resistance (PMRs) in drinking water Emphasize the need for standardized methodologies for detecting PMRs and gaps in the literature related to the detection of resistant plasmids. Bacteria can acquire genes through the HGT processes of conjugation, transformation and transduction in the natural environment. Since conjugative AMR plasmids have been linked to AMR in pathogenic bacteria. As it can happen between bacterial species that are not genetically related, conjugation promotes genetic diversity in bacterial populations. Mobile Genetic Elements (MGEs), like plasmids are one of the mechanisms through which HGT takes place. The majority of plasmids are circular fragments of double-stranded DNA that can reproduce without the help of chromosomes. Plasmids' capacity to host particular genes such as ARGs, gives bacteria a selective advantage. The plasmid may provide a fitness cost to the bacteria in the absence of selective forces, which might result in plasmid loss. Plasmids may encode for resistance to therapeutically relevant antimicrobial medicines. This is occasionally made up for by integrating the ARGs into bacterial chromosomes.