

# Antibiotic Resistant Genes and Integrons: A potential threat to the Ganga river ecosystem, India

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## Abstract:

The ecological, sociocultural and economic services offered by the mighty Ganga river of India help to support a large population and play a significant role in sustaining diverse life forms. Human interferences in the form of discharge of untreated or partially treated sewage, lack of tertiary units in the treatment plants, dumping of solid waste, unregulated discharges from industries, non-point addition of pollutants from agricultural and navigation sectors, lack of the environmental flows and typical socio-religious practices of the people have accelerated the degradation of water quality altering the microbial biochemistry of the riverine system in particular. Despite the resolve and initiatives of the Indian government, it is expected that the rejuvenation process would take substantial time. Antimicrobial resistance (AMR) is already considered as a potential threat to a river ecosystem, affecting the aquatic species, and also various stakeholders dependent for different purposes. The present study is an effort to explore the association between antibiotic resistant signatures of New Delhi metallo-β-lactamase (NDM) with integrons, which are the mobile genetic elements assisting in transmission of resistant genes in the environment. For this purpose, water samples were collected from 21 locations in an approximately 1178 km riverine stretch falling in the upper and middle Ganga regions, and analyzed for heavy metals and the resistant genes. Quantitative real-time PCR revealed that the relative abundance, when compared with total 16srRNA, varied in the range of 2.56%-42.27% (NDM) and 0.85%-61.10% (*int1*), 7.66%-27.41% (*int2*), 6.27%-100% (*int3*). NDM was prevalent in the upper Ganga region upto about 50 km length, whereas the dominance of integrons was observed in the entire monitored stretch. Further, the presence of NDM was significantly displayed in association with zinc and integrons, which are responsible for spread of resistant factors in river water. This study highlights a need of strengthening global surveillance of antimicrobial resistance in major river systems and a stronger focus on adopting stringent measures for managing microbial contaminants discharged into them.

**Keywords :** Antibiotic resistant genes, integrons, wastewater, emerging pollutants, aquatic ecosystem, water quality