

Heavy metal pollution can increase antibiotic resistance in rivers

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Scientists have shown that elevated heavy metal levels in rivers can lead to higher levels of antibiotic resistance.

Research by Newcastle University and the Indian Institute of Technology, Delhi quantified antibiotic and metal resistance in sediments from the Ganges and Yamuna Rivers in India and streams in the River Tyne catchment. The results show heavy metals, which are high in the River Tyne catchment due to historic mining and [industrial activity](#), relate to antibiotic resistance levels in the river. The same was seen in the Indian rivers, especially in areas of industrial activity.

Publishing their findings in the journal *Environmental Pollution*, the team investigated the relationships between heavy metals concentrations, metal resistance gene (MRG) and [antibiotic resistance gene](#) (ARG) abundances. The study shows that MRG and ARG abundances increase where metal levels are higher, suggesting reaches with [metal pollution](#) have increased antibiotic resistance, even when elevated antibiotics are not evident.

The results show that metal pollution also affects resident bacteria, with Firmicutes and Bacteroidota being the most abundant phyla at sites with high metal pollution. These bacteria are common in metal contaminated environments and are known to carry MRGs and ARGs in groups in "gene cassettes," which explains why metal exposures can cause antibiotic resistance.

The study shows that specific metal combinations that promote the strongest bacterial responses are Cobalt plus Nickel, and the combination of Cobalt, Zinc and Cadmium.

Study co-author, Professor David Graham, of Newcastle University's School of Engineering, says that "the work does not necessarily imply a health risk, but it shows that a river or stream without antibiotics pollution can still have elevated antibiotic resistance due to other pollutants, such as metals. However, in a river like the Yamuna, which has high metals in combination with many other pollutants, greater

concerns about the spread of antibiotic resistance exist."

Study lead author, Dr. Sonia Gupta of the Indian Institute of Technology, Delhi, says that "high metal exposure has the potential to co-select for antibiotic resistance in bacteria, making them potentially resistant to multiple antibiotics."

Dr. Gupta also noted that "the impacts of [heavy metals](#)-induced antibiotic resistance get exacerbated when high metal levels are combined with other pollutants such as antibiotics, detergents, and other chemicals, highlighting the importance of reducing heavy metal pollution as part of One Health solutions for reducing ARG transmission and spread."

Antibiotic resistance, also called AMR, is major global public health issue that has implications on the effective treatment of a growing number of infections caused by bacteria, parasites, viruses and fungi. Antibiotic use selects for resistance strains in human and animal wastes, which can be released to the environment via wastewater, spreading ARGs and AMR bacteria across nature.

Professor Graham will introduce discussions on environmental dimensions of [antibiotic resistance](#) at the Annual Meeting of the MEP Interest Group on AMR on 17 May.

More information: Sonia Gupta et al, Effects of heavy metals pollution on the co-selection of metal and antibiotic resistance in urban rivers in UK and India, *Environmental Pollution* (2022). [DOI: 10.1016/j.envpol.2022.119326](https://doi.org/10.1016/j.envpol.2022.119326)

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