Antibiotic resistance genes accumulating in Lake Geneva

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Large quantities of antibiotic-resistant bacteria enter the environment via municipal – and especially hospital – wastewater streams. Although wastewater treatment plants reduce the total number of bacteria, the most hazardous – multiresistant – strains appear to withstand or even to be promoted by treatment processes. This was demonstrated by Eawag researchers in a study carried out in Lake Geneva, near Lausanne.

Treated wastewater from the city of Lausanne – around 90,000 m3 per day – is released into Vidy Bay (Lake Geneva); the discharge point is located 700 m offshore, at a depth of 30 m. The Lausanne region does not have a pharmaceutical industry or intensive animal production. However, the Lausanne treatment plant receives wastewater not only from the region's 214,000 inhabitants and a number of smaller healthcare centres, but also from a major healthcare facility – the University Hospital of Canton Vaud (CHUV). As studies from the hospital and veterinary medicine sectors have indicated an increasing prevalence of antibiotic resistance, a group of researchers have now investigated whether resistance genes also enter the environment – specifically, Lake Geneva – via wastewater treatment plants[i]. Resistance testing was performed using both traditional culture methods and elaborate genetic analysis.

In the first sampling programme ever conducted on this scale in Switzerland, data were obtained for municipal wastewater, lake water and lake sediments. Some of the findings were in line with expectations, e.g. particularly high levels of highly multiresistant bacteria in wastewater at the CHUV. But the study also produced surprising results: while, overall, more than 75% of bacteria are eliminated at the treatment plant, the proportion of especially resistant strains is increased in treated wastewater. According to microbiologist Helmut Bürgmann, the treatment plant is likely to serve as a hot spot for the exchange of antibiotic resistance genes. Here, bacteria which otherwise inhabit the human body encounter others already adapted to the environment, and mobile genetic elements can be readily transferred as a result of the high bacterial cell densities. Bürgmann comments: "The uptake of resistance genes by bacteria is not unusual and doesn't in itself pose a hazard; what wasn't previously known was that levels of multiresistance genes are elevated in the lake, and particularly also in the sediment, close to the wastewater discharge outlet." This, he believes, increases the risk that, at some point, resistance genes will also be transferred to pathogens. That could occur in the lake itself, or in the human body, if mobile genetic elements for antibiotic resistance find their way into drinking water.

Nadine Czekalski, who carried out most of the investigations as part of her dissertation, sees "no grounds for panic". A drinking water pump is situated 3 km from the point where wastewater is discharged into the lake. The researchers detected multiresistance genes in sediment samples collected close to the pump, but not in lake water at this site. In addition, water taken from the lake is treated before being fed into Lausanne's water supply system. But Czekalski and Bürgmann agree that there is a need for caution. After all, approx. 15% of Switzerland's wastewater is discharged, after treatment, directly into lakes. Vidy Bay can be regarded as a typical model of this situation. Accordingly, in the researchers' view, the federal government's plans to introduce an additional process for the removal of micropollutants at selected treatment plants is a step in the right direction: the advanced treatment process largely inactivates not only micropollutants, but also resistant microorganisms. However, as hospital wastewater contains the highest load of multiresistant bacteria, the researchers also recommend that it should undergo separate treatment.

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https://www.eawag.ch/en/info/portal/news/news-archive/archive-detail/antibiotic-resistance-genes-accumulating-in-lake-geneva