

Science for Environment Policy

Active pharmaceutical ingredients in wastewater: who are the major contributors?

Active pharmaceutical ingredients (APIs) – responsible for the biological activity of drugs – have been widely found in the environment, yet the precise sources and relative importance of emissions via wastewater are not quite clear. This study assessed emissions from three health institutions in Germany – a hospital, a psychiatric hospital, and a nursing home – and found their contribution was low compared to that from households. However, more research is needed to understand the environmental effects of neurological drugs, emissions of which were in some cases relatively high.

Pharmaceuticals are often not fully metabolised by the human body. After excretion, they can enter the environment via wastewater. As a result, active pharmaceutical ingredients (APIs, the elements of drugs that are responsible for their medicinal effects) have been found in receiving environments across the globe, where they may have toxic effects on aquatic life.

Hospitals are considered a major source of APIs, but data on emissions from other forms of health institution are lacking. This study investigated the role of psychiatric hospitals and nursing homes, whose significance as emission sources could increase as the population ages, and if the burden of psychiatric illness increases (as some estimates suggest).

The researchers assessed the relative impact of the different health institutions using pharmaceutical consumption data from 2010–2012 for the psychiatric hospital (146 beds), nursing home (286 inhabitants) and general hospital (741 beds). All were located within one German district with approximately 400 000 citizens.

The consumption data for 50 APIs were processed to determine the total amount consumed each year at each institution. The APIs were selected mainly on the basis of their consumption (rather than existing effects data), an approach likely to help in the identification of new APIs of potential concern. Consumption at the general hospital was highest at approximately 1262 kg per year. The nursing home had an average consumption of 83 kg/year, followed by the psychiatric hospital, at 32 kg/year.

Usage patterns of APIs in the psychiatric hospital and nursing home differed significantly from those in the general hospital. In particular, there was greater use of neurological drugs, such as anticonvulsants, psycholeptics (calming medications) and psychoanaleptics (stimulants, which include antidepressants and anti-dementia drugs). These drugs comprised 74% of API consumption in the psychiatric hospital, and 65% of that in the nursing home.

The authors say that, due to their chemical properties, these APIs are unlikely to harm the natural environment. However, there is no conclusive evidence that they are innocuous, and further investigation of the risk they pose is needed.

The researchers compared consumption in health facilities to that in households using an 'emission potential' (EP), calculated by dividing the average consumption of a given API in a health institution by the average consumption in German households. An EP above one means more APIs per person are released by health institutions than households.

Continued on next page.



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Concentrations of APIs in the waste water effluent from the institutions were measured to assess the correlation between consumption and emission and to determine the reliability of emissions predictions, and thereby to compare emissions from the different institutions and from households.

Overall, health institutions were calculated to make a very low contribution to total wastewater discharge when compared to households. However, some APIs stood out (EP>1) as being more used in one or other of the health institutions, e.g. some sedatives and anti-infectives, released by the general hospital, and some anticonvulsants, antipsychotics and antidepressants, used in the nursing home.

The authors say their findings, including their novel method to assess usage patterns and contributions to wastewater, will provide practical support for decision makers tasked with managing pharmaceutical emissions from health institutions, providing a sound basis for informed decision making on emission reduction strategies. They suggest their simpler method could partially replace extensive monitoring campaigns for pollution.

The removal of pharmaceutical substances is not specifically regulated by the Urban Waste Water Treatment Directive (**UWWTD (91/271/EEC)**), which addresses the removal of organic pollution more generally from waste water at treatment plant level (secondary or biological treatment). However, in the areas identified as "sensitive" under this Directive, Member States should consider (and, in some cases, require) additional treatment steps if necessary to meet certain other legislative requirements, such as those of the Water Framework Directive (**WFD (2000/60/EC)**).

