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Contributions of Household Chemicals to Sewage and Relevance to Municipal Wastewater Systems and the Environment

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Objective:
To identify organic compounds from household products that may be present in municipal wastewater by examining volume production, consumption pattern, and physicochemical properties. To consider occurrence and fate of selected HPV target compounds through conventional and advanced wastewater treatment unit operations.

Summary:
This research found that biological treatment generally resulted in partial or complete removal (>80%), indicating that it is a good treatment option for HPV household chemicals. Researchers then evaluated the removal or transformation of particular HPV chemicals by biological treatment (activated-sludge and MBR), disinfection (UV, chloramines, chlorine), and advanced oxidation (ozone and ozone/hydrogen peroxide) processes. MBR and activated-sludge treatments generally removed all compounds similarly. For conventional disinfection processes, chlorination represents a process for partial transformation of these compounds and a second barrier, although it is likely that halogenated by-products are formed during this process. Chloramine and UV disinfection processes are not viable removal barriers. Ozonation and ozone/ hydrogen peroxide treatments performed similarly and are additional barrier options where higher effluent quality is desired. However, they don't represent a
100% barrier for all compounds (e.g. , vanillin).

The removal of an organic compound during treatment depends on its structure. Quantitative structure activity and property relationship (QSPR) models mathematically quantify the correlations between a fate parameter (e.g. , degradation rate constant), and molecular descriptors of a compound (e.g. , dipole moment and connectivity indices). QSPRs can be coupled with chemical mass balance models to quickly assess the fate and treatment of new and existing chemicals within wastewater treatment systems. Researchers evaluated the potential for various QSPRs to predict the treatability of new compounds.
Several existing QSPRs that are relevant to wastewater treatment removal routes—reactivity, phase partitioning, and physical separation—can be applied to the prediction of the removal of compounds through wastewater treatment trains. QSPRs should be evaluated further for their applicability to a range of organic compounds and realistic environmental conditions. Additional research can determine which QSPR(s) best chemically and/or physically describe an organic compounds potential to be removed by a particular mechanism. We also need to generate fate parameter data, such as biodegradation and chlorination removal rates. Uniformly measured treatment data for some removal mechanism is also needed. QSPRs should be incorporated into appropriate mass balance models and these models need to be validated by full-scale treatment data.