Nanomaterials and photonic solutions: Novel ‘at source’ approaches to stop hospital-derived priority substances reaching the sewer network

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Introduction

Hospitals discharge pharmaceuticals and their metabolites continuously into the aquatic environment. Toxicity studies have shown detrimental effects even at very low drug concentrations on aquatic organisms, such as impacts on reproduction and behaviour.

Efficient wastewater treatment is urgently needed, to eliminate persistent pharmaceuticals, and prevent potential drug accumulation in food chains and to stop the development of multidrug resistant bacteria.

Photocatalysis is a promising approach to remove persistent pharmaceuticals from wastewater via light promoted synthesis of highly reactive oxygen species (ROS), which can oxidise and eliminate drug compounds. However, metal oxide semiconductor nanomaterials need further optimisation to enhance ROS-yields and make photocatalysts more efficient.

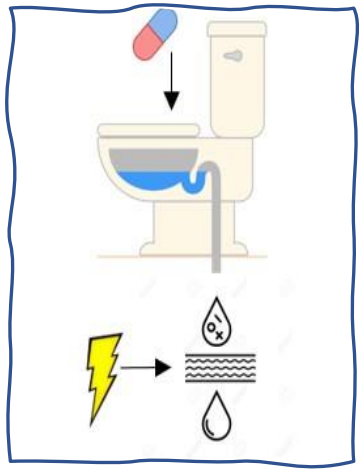
Research Objectives

- Select persistent target drugs in light of hospital prescription volume, abundance in hospital wastewater and environmental toxicity (see right).
- Compare HPLC-MS and Raman spectroscopy approaches to determine drugs at relevant concentrations for hospital wastewater (≥ 1 ng/L).
- Design photocatalytic porous structures coated with metallic nanomaterials. Increase ROS-yields via ‘surface-tuning’ and by combining various metallic nanomaterials.

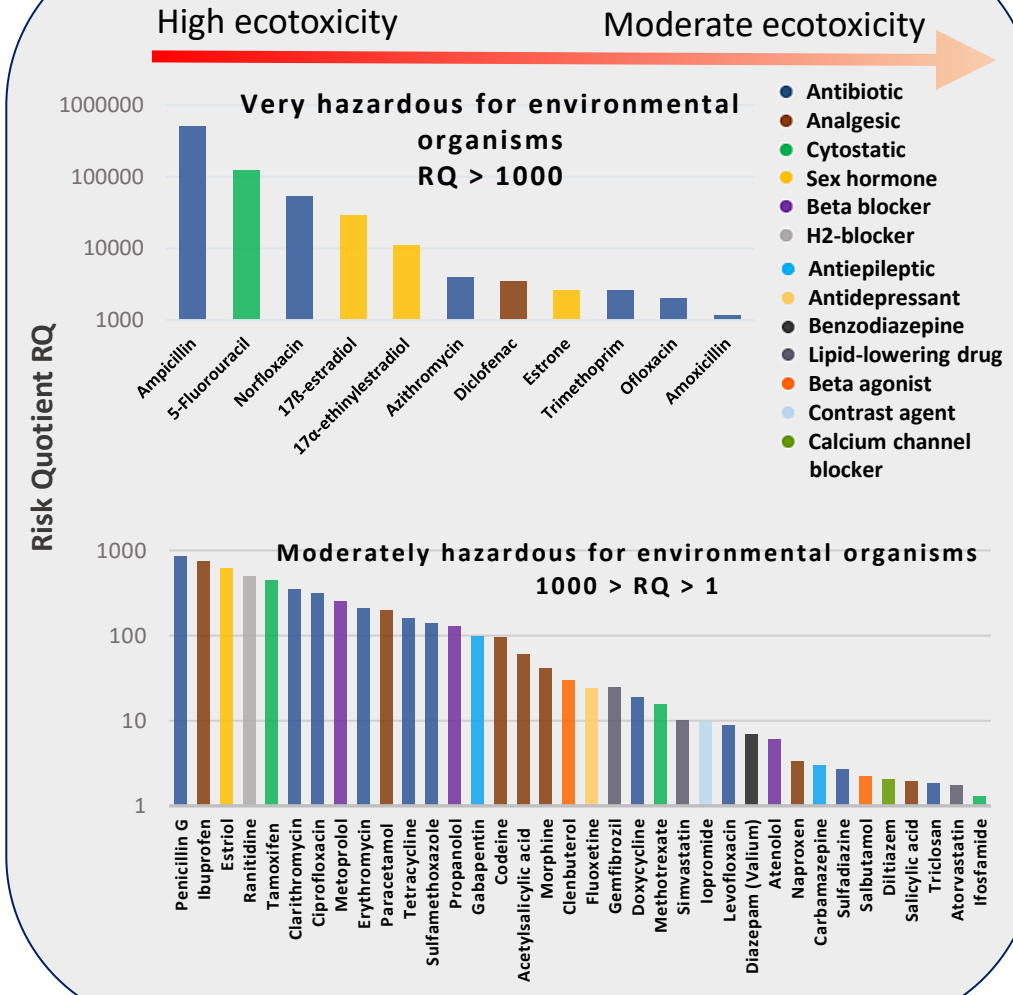
$$RQ = \frac{MEC_{max}}{PNEC}$$

MECmax = Maximal drug concentration measured in hospital effluents

PNEC = Predicted no-effect concentration (concentration below which no toxic effects in daphnia, fish, algae are observed)



Compound prioritisation



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