

# Emerging micropollutants in Kenya: a case study on the occurrence patterns of pharmaceutical residues in wastewater and river water in Nairobi and Kisumu city

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In the last two decades, pharmaceuticals have received a lot of attention in developed countries as emerging environmental micropollutants. However, in Africa, despite challenges regarding water quantity and quality being often more severe than in more developed regions, little is known concerning the occurrence of these contaminants. Apart from general water quality parameters, this study presents unique data on concentrations and loads of 24 pharmaceuticals including antibiotic, anti(retro)viral, analgesic, anti-inflammatory and psychiatric drugs in three wastewater treatment plants and three rivers in Nairobi and Kisumu, Kenya. Generally, antiretrovirals (e.g. nevirapine and zidovudine) and antibiotics (e.g. metronidazole, sulfamethoxazole and trimethoprim), being commonly used drugs in the treatment of important African diseases such as HIV and malaria, were in all matrices more prevalent as compared to the Western world. For one of the first times, removal efficiencies of pharmaceuticals in wastewater stabilization ponds have been determined, ranging between 11 and 99%. For a number of compounds, a different removal is observed as compared to more conventional activated sludge systems. At some locations, total concentrations in river water (up to 320  $\mu\text{g L}^{-1}$ ) were similar or exceeded concentrations in untreated wastewater. Considering both concentrations and loads (up to 180  $\text{kg d}^{-1}$ ), our results indicate the major impact of waste dumpsites and, particularly, domestic discharges from informal settlements without proper sanitation facilities, being common in the studied area. In conclusion, there is a distinct pharmaceutical contamination pattern as compared to the Western world, which might be a trigger for further research in developing regions.

## Acknowledgements

We acknowledge the financial support from the Flemish Government for the MAT 95XP-Trap mass spectrometer in the framework of the investment support for heavy research equipment. We also thank the Flemish Inter-University Council/University Development Cooperation (VLIR-UOS) for their Short Research Stay (SRS) and ICP-PhD grant, which enabled the success of this project.