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Fate of antibioresistance, pharmaceuticals and endocrine disruptors from a former municipal landfill

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Antibioresistance may develop in different contexts (e.g. hospitals, wastewater treatment plants, animal farming) through various processes. Because municipal landfills may have received medication waste coming from citizens but also from hospitals, they may represent a source of antibioresistance disseminating in the natural environment. Together with the fate of pharmaceuticals and endocrine disruptors, we studied the fate of antibioresistance from a former municipal landfill located in Nantes, France. Both municipal and hospital waste were deposited in this landfill between 1969 and 1987. The total volume of waste is around 2 million cubic meters.

We sampled leachates from the landfill, as well as groundwater upstream and downstream the landfill. Extraction (SPE or liquid/liquid) on frozen or fresh samples allowed quantifying 30 pharmaceutical molecules and 8 other emerging by LC/MSMS, UPLC/MSMS or GC/MSMS. The abundance of total cultivable communities was determined by counting on non-selective medium. Culture media used in clinical microbiology (drigalski / ceftazidime, Msuper CARBA and ESBL) were used to determine the proportion of the bacterial community that is resistant to antibiotics. Eventually, the diversity of the total communities was studied by PCR-TTGE and by 16S metabarcoding (MiSeq Illumina).

Over of the whole substances sought, 11 pharmaceutical molecules (not antibiotics), have been quantified in the leachates and 2 endocrine disruptors (bisphenol A and triclosan). Most substances were also recovered in groundwater immediately downstream the site (including carbamazepine) at concentrations ranging between 0.1 µg/L and 10 µg/L. The number of detected substances was lower a few hundred meters far from the landfill. More especially bisphenol A and diclofenac show lower concentrations ranging from 0.1 to 1 µg/L and about 0.1 µg/L respectively). Similar observations were shown for antibioresistance. The bacteria from leachates show a more important antibioresistance than in the other groundwater samples. The transfer of

antibioresistant bacteria seems limited downstream the landfill, with nevertheless higher content at the immediate downstream. The natural attenuation may be explained by several processes, some being the same as for metals and PAH.