



# The Contamination Crisis and a Filtration Fix

**TakeAIM 2nd place 2019:**

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Everyday, almost 2bn people drink contaminated water. In low-income countries, inadequate drinking-water causes close to 0.5m diarrhoeal deaths each year. The majority of deaths occur among children under five. Climate change, population growth, and urbanization threaten water supply systems that are clearly already struggling. Global access to safe water is surely one of humanity's greatest challenges.

Humanitarian organizations, such as WHO and UNICEF, suggest that the key to unlocking the health, social, and economic benefits of clean water lies in home-useable filters. These filters consist of complex networks of pores, which capture harmful particles as contaminated water is driven through them, making it safe to drink. No additional chemicals are required, rendering these filters easy-to-use and relatively cheap to purchase. However, as the pores capture contaminants, they block, clogging the filter and preventing further decontamination. The running costs due to clogging are too high for some filters to be commercially viable.

At University of Oxford, we are collaborating with WL Gore & Associates to derive a probabilistic mathematical model that predicts contaminant removal and clogging in their specialized filtration material. By experimenting with the pressure and flow-rate of the incoming water, and the pore structure and geometry of the material, we are developing an optimal filtration regime that maximizes the volume of contaminated water that can be filtered before clogging. Furthermore, we are building computational simulations of our model to maximize filtration efficiency and thus minimize energy wastage. Our optimization will decrease the cost of contaminant removal, which will hopefully ultimately lead to increased accessibility of clean water to those who need it most.

The Smith Institute, enabled by the generous sponsorship of our leading corporate partners, ran the TakeAIM competition in 2019 to make visible the crucial role that mathematics will increasingly play in all aspects of our lives. The competition was open to undergraduate and postgraduate students working in the mathematical sciences. First prize was £1,000 of Apple or Amazon vouchers, with second prize winners receiving £200 and 8 runners-up receiving £25 in their choice vouchers.

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