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Wastewater-based epidemiology for local tobacco and nicotine use with small-area estimations

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Background: Tobacco and nicotine use is a significant global public health threat, increasing the risk of many cancers and cardiovascular disease. Local governments need small-area smoking and vaping estimates for targeted interventions, but representative real-world

data is often unavailable/costly. Wastewater-based epidemiology (WBE) is rapidly emerging as a valuable tool for population-level health monitoring, offering detailed, community-wide signals of substance use. Here, we present a novel integration of WBE with local synthetic populations to enhance the spatial estimation of tobacco use.

Methods: This preliminary work involved building a synthetic population for England via iterative proportional fitting using three years of Health Survey for England data and 2021 UK Census demographics, yielding local estimates of health-risk behavioural factors. Complementary non-targeted UHPLC-MS/MS analysis of wastewater from a municipal sewage works in York, England, successfully detected eight tobacco and nicotine metabolites.

Results: By integrating these approaches, we found that the estimated smoking prevalence for the City of York Council from our synthetic population was supported by the detection of multiple tobacco and nicotine metabolites in the local wastewater including cotinine and anabasine.

Discussion/Conclusions: Building on this foundation, a critical next step is the establishment of a surveillance network with multiple wastewater treatment sites across England. This proposed integrated surveillance system could provide nuanced insights into prevalence, trends, and potential hotspots at a neighbourhood level. The ability to generate validated local estimates through this combined approach offers significant potential to directly impact public health decision-making. Real-time surveillance data can inform the allocation of resources for targeted interventions, monitor the effectiveness of public health campaigns, and provide early warnings of emerging trends.

Key messages:

- Wastewater analysis for tobacco metabolites shows potential as a complementary tool for population-level monitoring.
- Synthetic populations offer local estimates of tobacco use and other health factors, addressing real-world data limitations.