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Review of Approaches for Monitoring Psychoactive Substances in Wastewater

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Research Purpose

Scotland faces a significant public health challenge, with one of the highest levels of deaths related to drug use in Europe. In 2019/20, an estimated 1.32% of those aged 15-64 years in Scotland were opioid dependent. In 2023, 1,172 drug misuse deaths were registered in Scotland, an increase of 12% (121 deaths) compared with 2022. Evolving drug markets, multiple drug use and social/ health inequalities are part of the complex equation leading to this public health crisis.

Rapid responses from policy makers regarding emerging or changing drug use patterns have the potential to reduce harm. Information about supply and demand delivered to the National Mission (National Drugs Mission Plan 2022-2026) requires high quality data. In Scotland, there is limited population-level prevalence data relating to harmful drug use. Existing approaches to assess harmful drug use at a national level include several monitoring and surveillance initiatives, such as RADAR (Rapid Action Drug Alerts and Response), as well as a study to provide an estimate of prevalence. However, these data do have specific limitations and cannot provide a comprehensive picture of all drug consumption in Scotland. The Scottish Government have commissioned Public Health Scotland, University of Bristol, and Glasgow Caledonian University to carry out work to better understand prevalence of problem substance use in Scotland. This estimate is based on modelling of existing mortality, hospital and prescription-based datasets and, as such, can only provide an estimate of the number of people with opioid dependence, as opposed to all drugs, and currently only provides a prevalence estimate up to 2019/20.

The application of Wastewater-Based Epidemiology approaches (WWBE) to better understand the use of these substances could enhance the information provided to monitoring platforms such as RADAR , as well as the potential for comparison with international estimates on drug use. Global analysis of drug residues and metabolites in wastewater has been shown to provide timely and robust community health information that complements other monitoring methods. However, it is reliant on the availability of suitable monitoring platforms, analytical techniques, and statistical analysis of data.

Research Aim and Objectives

This project aimed to establish the feasibility and benefits of using wastewater influent monitoring infrastructure to monitor the presence of psychoactive substance and their metabolites in Scotland and, particularly, whether and how it would benefit existing early warning reporting systems and other drug use intelligence.

The project had several overarching objectives, listed here with the overall findings:

i. Which target substances should be monitored to address the highest public health threats, and for which are there recognised analytical strategies internationally?

A systematic review of the literature identified that New Psychoactive Substances (NPS) are commonly developed to circumvent legislation. Contamination

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To access the outputs for this project, please visit: crew.ac.uk/publication/psychoactive-substances-wastewater-monitoring-approaches

of illicit drugs with new and toxic substances is both common and widespread across drug types and so people who use drugs are often unaware of the exact type and range of substances they may be taking at one time, exacerbating associated harms for individuals. In Scotland, frequently reported combinations are benzodiazepines (primarily diazepam and bromazolam), cocaine and opioids, new synthetics such as nitazenes and xylazine have exhibited an increasing role in drug related harms and deaths. In Scotland, the most detected drug in hospital admissions (March-May 2024) was cocaine, followed by temazepam and desmethyl-diazepam. The most detected drug classes in post-mortem toxicology reports (January-March 2024) were opioids benzo-diazepines. The most common individual substances detected were cocaine (36%), heroin/ morphine (31%), diazepam (30%) and methadone (28%).

ii. What are the characteristics of existing infrastructure and different analytical approaches available internationally and in Scotland to support monitoring? Wastewater has already proven useful in monitoring COVID levels at a national level. While literature findings did not emphasise a routine analysis timeline, either continuous and/or periodic monitoring scenarios have yielded useful information.

An evaluation of analytical methodologies highlighted several techniques capable of identifying psychoactive substances in wastewater. Laboratory instrumentation such as LC-MS/MS and LC-HRMS are most commonly employed for wastewater analysis.

iii. What are the characteristics of early warning reporting systems on drug use that monitoring activities feed into?

Psychoactive substance early warning systems are typically supported by a framework which includes the monitoring and reporting of public health threats, the release of information, and a resulting regulatory response. Data sources usually include analytically-supported confirmatory analysis, although self-reporting or community surveys have also proven to be successful. Early warning systems in place worldwide receive periodic updates from various sources including waste-water monitoring data. Rapid Action Drug Alerts and Response (RADAR) is Scotland's drugs early warning system. RADAR identifies new and emerging harms, recommends rapid and targeted interventions, and publishes information on services, harms and emerging drug trends, including a quarterly reports.

iv. What options for monitoring are feasible or infeasible to do in Scotland based on existing infrastructure, capacities, laboratory expertise and capability, funding, and reporting systems?

The findings of this project have highlighted that waste-water monitoring for known and emerging drugs is likely feasible and beneficial to implement in Scotland. An ethical approach to sampling and monitoring is possible given the infrastructure already in place. The technical expertise and instrumentation are available at several laboratory sites, which will allow timely processing of samples and data. It is likely that funding and increased capacity would be required to accommodate additional sampling efforts.

Despite significant progress in NPS characterisation, specific correction factors, reference standards, and metabolic by-products are not always available. This may present as a challenge when deriving quantitative consumption estimates for these substances.

v. What potential benefits are afforded by such a monitoring approach?

While monitoring is analytically complex, there are multiple benefits of wastewater analysis for investigating psychoactive substances, including a better understanding of geographical trends and use trends over time, as well as detection of a wide array of psychoactive substances and complex NPS.

vi. What is the recommended approach to implement trials post-project?

Based upon the collective information outlined in this study, the research team recommends trialling cocaine, diamorphine, methadone, diazepam, and amphetamines through low-resolution LC-MS analysis and synthetic cannabinoids, synthetic opioids, and novel benzo-diazepines through high-resolution LC-MS. These pilot studies will establish the foundation for wastewater analysis in Scotland and encourage expansion as method development and resources allow.

The harm caused by drugs is a significant public health issue for Scotland and it is important to continue to develop the existing data landscape for the purpose of public health surveillance, to ensure we have a robust and timely understanding of substance use. This, in turn, may help identify actions to reduce and prevent drug harms and deaths.