FORENSIC INTELLIGENCE AND HEROIN SIMILARITY NETWORKS: STREET MARKET AND DARK WEB

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INTRODUCTION

Heroin remains a challenge for public health and criminal investigation in Europe.

The 2022 ban on opium poppy cultivation in Afghanistan may have influenced heroin composition and adulteration patterns.

At the same time, the dark web trade in heroin introduces new dynamics into traditional distribution networks.

In Portugal, it remains to be explored whether samples from these two contexts exhibit related chemical profiles.

AIM

To assess the potential of chemical similarity networks within forensic intelligence to identify and interpret connection patterns between street-market and dark web heroin samples in Portugal, by integrating analytical profiles with contextual metadata.

FORENSIC INTELLIGENCE AND SIMILARITY NETWORKS



Forensic Intelligence:

It transforms forensic analytical data into actionable strategic knowledge.

Going beyond case-by-case courtroom evidence, it cross-references chemical profiles to identify links between seizures, map market dynamics, and support criminal investigation, public health, and harm reduction.



Chemical Similarity Networks:

Computational models based on graph theory, in which each sample is a node and edges connect samples whose chemical similarity exceeds a statistical threshold calibrated using receiver operating characteristic (ROC) curves.

They enable the identification of chemical clusters through community detection algorithms, and the stability of these clusters can be assessed across different thresholds.

METHODOLOGY AND DATASETS

Street-market samples:
Chemical profiles of syringe residues collected within the ESCAPE project.

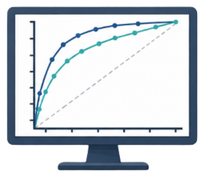
Dark web samples:
Chemical profiles of heroin powders purchased online from anonymous marketplaces.



GC-MS/MS analysis of the samples.



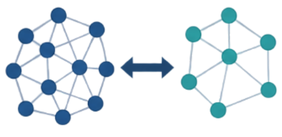
Assessment of data comparability and harmonization.



Statistical calibration of sample linkages using ROC curves.



Context-specific network construction and analysis.



Cross-context comparison.



Linking chemical clusters to metadata to assess their forensic intelligence value.

EXPECTED OUTCOMES

This study is expected to:

- Assess the analytical comparability between syringe residues and solid powders.
- Characterize the stability of chemical clusters within each market.
- Identify potential chemical links between street and dark web samples.

Where present, high-risk adulterants, such as nitazenes and other novel synthetic opioids, will also be examined, given their relevance to the early detection of emerging public health threats.



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