Designer Drugs: An Escalating Challenges for Forensic Investigators

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Abstract

The proliferation from traditional drugs to designer drugs presents significant challenges for forensic scientists. The rapid emergence as well as diverse chemical structures of designer drugs poses significant challenges for regulatory authorities and forensic scientists. Although, several common and sophisticated methodologies exist which provide high sensitivity and specificity for the accurate detection of various drugs in different matrices, identification and detection of designer drugs is herculean task for investigators. Despite advancements in forensic methodologies, several challenges even persist in the seizure and identification of designer drugs in fields for Investigating Agencies. A productive collaboration between forensic scientists, regulatory agencies, and institutions would be able to successfully combat the dynamic nature of new psychotropic substances.

Keywords: Designer Drugs; Forensic Scientists; Chemical Structures; Traditional Drugs

Abbreviations

NPS: New Psychoactive Substances; LC-MS/MS: Liquid Chromatography-Mass Spectrometry; NMR: Nuclear Magnetic Resonance; HRMS: High-Resolution Mass Spectrometry; FTIR: Fourier Transform Infrared.

Introduction

Drugs have been part of human society for centuries. The proliferation of traditional drugs to designer drugs, which are drugs, not controlled by the 1961 Single Convention on Narcotic Drugs or the 1971 Convention on Psychotropic Substances, presents significant challenges in forensic science. Annually, designer drugs or new psychoactive substances (NPS) are introduced to the global drug market and are consumed across approximately 141 countries and territories worldwide. As of November 2023, the UNODC has received reports on 1,230 substances [1]. A significant influx of NPS in the consumer market is driven by the limitless potential to modify the chemical structures of existing NPS and thereby complicating monitoring efforts [2]. Given the market's volatility and diverse array of substances, there is an urgent imperative to disseminate current information on designer drugs. Many countries are increasingly prioritizing proactive systems to gather data on the identification, sale, and consumption of NPS [3]. This mini review delves into the forensic aspects of designer drugs, highlighting detection, legal implications, and the ongoing battle between regulation and innovation.

Improving chemical analysis is vital because of the significant complexities posed by NPS which has prominent impact on clinicians, forensic toxicologists, researchers, investigating authorities and professionals in diverse fields. Keeping pace with the camouflaged spread of these substances remains a continuous toxicological challenge for researchers. Moreover, detecting NPS is challenging due to their diverse chemical

compositions, market volatility, and their tendency to rapidly emerge and potentially disappear [4].

Traditional drugs, such as cocaine, heroin, cannabis etc have been widely abused for decades. In general, the mechanism of action and adverse effects of designer drugs closely parallel those of traditional drugs of abuse [5]. Their long history of abuse has resulted in the development of robust, forensic methodologies for their detection, analysis, and legal regulation. These methodologies are designed to provide high sensitivity and specificity, which are critical for the accurate identification and quantification of drugs in different matrices. Gas Chromatography-Mass Spectrometry, high-Performance Liquid Chromatography, Immunoassays, thin Layer Chromatography are a widely used analytical techniques in forensic drug examination, Effective sample preparation is crucial for accurate drug detection and analysis. Techniques such as solid-phase extraction and liquid-liquid extraction are employed to remove interfering substances and thus isolate drugs from complex matrices.

On the other hand, designer drugs or NPS are substances that are chemically modified to mimic the effects of existing drugs at the same time circumventing legal restrictions. Their rapid emergence, diverse chemical structures and often unknown pharmacological effects poses significant challenges for regulatory authorities and forensic scientists. Standard detection methods may not be effective due to their constantly changing chemical structures. Therefore, the constantly evolving nature of designer drugs necessitates the use of advanced analytical techniques to accurately identify and quantify these substances. Traditional methods may not always be effective due to the novelty and structural diversity of NPS. Therefore, forensic laboratories employ a range of sophisticated techniques like Liquid Chromatography-Mass Spectrometry (LC-MS/MS), Nuclear Magnetic Resonance (NMR) Spectroscopy, High-Resolution Mass Spectrometry (HRMS), Fourier Transform Infrared (FTIR) Spectroscopy, along with the established traditional methods, for determination and elucidation of, structure of these versatile moieties [6-10].

The initial lack of understanding about the metabolism of many NPS also causes delay in their accurate identification. For newly reported substances and their metabolites, precise identification and quantification rely on the availability of certified reference materials. However, their reference materials are not easily and consistently manageable [2]. Furthermore, commercial production of reference material is a time-consuming process and by the time the reference material becomes ready, a modified version of the same drug appears in market which is again undetectable. Additionally, the research and development of reference materials necessitate a substantial capital investment and

may not always be considered economically feasible. Even if reference materials are accessible, routine laboratories often lack the capability to utilize primary analytical techniques such as nuclear magnetic resonance and high resolution mass spectrometry for identifying novel materials [11].

Balcean suggests real-time information on the market of NPS by combining chemical analysis of samples from individuals with direct engagement with drugs (like from rehab centre etc.), giving the possibility to increase preparedness and responsiveness towards NPS [4]. Moreover, if data is collected from rehabilitation centre, the actual picture becomes clear as the drug abusers are often unaware of the true identity of drug sold which more than often are adulterated with potentially dangerous or lethal substances, e.g., Xanax pills adulterated with etizolam [12]. Presently, some countries have established systems to gather information on the sale and consumption of internationally controlled psychoactive substances, both domestically and globally [1] (e.g., New Zealand, Canada, and the UNODC Global Smart Update 2022). This has provided countries with insights into the scale and trends of the internationally controlled substances market within their jurisdictions. However, comprehensive data regarding the prevalence and usage of NPS among the general population still remains scarce.

In India, most information on NPS is sourced from newspapers, with a notable absence of comprehensive data on a large scale. Currently, the extent of NPS prevalence is unclear. Nevertheless, reports from newspapers and anecdotal evidence suggest a rising trend among young users. These substances have been reported to be used in rave parties, particularly in urban areas [13,14]. Indirect indicators of use such as seizure data have also raised concern over the growing use of NPS in India. As per data from the Narcotics Control Bureau, 62kg of mephedrone, 1kg of ketamine, 62kg methaqualone and psychotropic injections 3932 quantities were seized in year 2022 [15].

Legal Implications

The legal landscape for designer drugs is complex and constantly evolving. Traditional drug scheduling approaches would be insufficient for addressing the dynamic nature of NPS. Legislators struggle to keep up with the rapid creation of new substances, often resulting in a cat-and-mouse game between lawmakers and clandestine chemists. As NPS is not controlled by International Drug Control Conventions, their legal status varies from country to country. Until 2022, 67 countries and territories globally have implemented legal responses to control NPS as per United Nations Office on Drugs and Crime [1]. NDPS Act 2023 has been recently implemented in India which emphasises on improved convictions in NDPS cases. It places judicial discretion as the

highest form of authority in determining the extent of crimes of repeated offenders of drug trafficking.

Large Legal changes with regard to placing NPS under controls have not been carried out due to lack of sufficient data. India needs to address the emergence of NPS given its substantial young adult population, widespread internet access, and insufficient medical and legal readiness to manage these substances. At the international level, up to March 2023, the Commission on Narcotic Drugs decided to place 78 NPS under international control [1].

Role of Forensic Scientists and Challenges Thereof

Forensic scientists play a critical role in legal proceedings involving controlled drugs. Their expertise ensures that drug-related evidence is accurately analysed, interpreted, and presented in court. Forensic reports and expert testimony can significantly impact the outcomes of criminal cases, influencing decisions on charges, sentencing, and convictions. Despite advancements in forensic methodologies, several challenges persist in the analysis of designer drugs like:

1. Rapid Emergence of New Substances: The continuous introduction of new designer drugs makes it difficult for forensic laboratories to maintain up-to-date detection capabilities. Developing and validating analytical methods for each new substance is time-consuming and resource-intensive.
2. Lack of Reference Standards: Many designer drugs are newly synthesized and may not have commercially available reference standards. The absence of reference standards complicates the accurate identification and quantification of these substances.
3. Unpredictable Toxicological Effects: The pharmacological and toxicological effects of many designer drugs are not well-documented. This unpredictability makes it challenging to link detected substances to observed symptoms or behaviours, complicating the interpretation of forensic results.
4. Poly-drug Use/ Cocktail of Drugs: Individuals often use multiple drugs simultaneously, including both traditional and designer drugs. This poly-drug use can complicate the analysis and interpretation of forensic results, requiring comprehensive and advanced analytical approaches.
5. Currently toxicology screening of standardized drug testing for NPS are not yet available in most laboratories. The increasing number of NPS also poses a challenge to traditional methods used to diagnose these substances. The heterogeneity in designer drug product contents, concentration, and chemical constituents have further increased challenges in detection.
6. Navigating the challenges encountered by forensic investigating agencies during crime scene investigations

presents a formidable endeavour. Law enforcement officers must remain abreast of the rapidly evolving landscape of designer drugs. While equipped with drug identification kits designed for detecting regulated substances in the field, these tools may not consistently yield positive results for designer drugs which may provide an escape route for the accused.

Conclusion

To keep pace with the rapid emergence of new NPS, forensic laboratories need to continuously update their reference libraries and develop novel detection strategies. Collaborative efforts with other institutions and regulatory agencies are essential to stay informed about the latest trends in designer drug abuse. The dynamic nature of NPS, coupled with legislative challenges, necessitates ongoing collaboration between forensic scientists and regulatory agencies. By staying at the forefront of technological and methodological developments, forensic experts can effectively address the complexities of designer drug analysis and support the legal system in combating the proliferation of these drugs. The current drug landscape demands a multifaceted and adaptive approach in forensic science. By staying at the forefront of technological advancements and fostering strong collaborations, forensic experts can effectively contribute to the fight against drug abuse and its associated legal challenges.

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