Forensic and Pharmaceutical, Chemical and Toxicological Analysis of Medical Drugs and Substances in Illegal Circulation in Ukraine

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Abstract. Recent years have witnessed a surge in the illegal circulation of medical drugs and substances in Ukraine, necessitating a comprehensive approach to their identification and analysis. This study delves into the forensic, pharmaceutical, chemical, and toxicological analyses of these substances, elucidating their origin, composition, and potential harm. Utilizing advanced chromatographic and spectroscopic techniques, the research provides an in-depth profile of commonly abused drugs and substances, many of which are cleverly disguised under seemingly benign nomenclatures. Forensic examinations highlighted the sophistication of counterfeit techniques that mimic legitimate pharmaceutical products, posing significant health risks to unsuspecting consumers. The toxicological assessments underscored the severe health implications associated with consumption, from acute poisoning to long-term physiological complications. This paper sheds light on the intricate nexus of illegal drug trafficking in Ukraine, emphasizing the urgency for robust pharmaceutical regulation, advanced forensic capabilities, and public awareness campaigns. Through its interdisciplinary approach, this research underscores the critical need for collaborative efforts among healthcare professionals, law enforcement agencies, and policymakers to combat the escalating menace of illicit drugs and safeguard public health. Fatal cases due to poisoning by psychoactive substances of various classification and legal groups were systematized. Features of forensic and pharmaceutical, chemical and toxicological analysis were indicated. Attention was focused on the classification of means and substances according to the current legislation of Ukraine. The experience of the Department of Pharmacy of the Luhansk State Medical University in Rivne for the development of forensic and pharmaceutical, chemical and toxicological analysis in Ukraine was presented.

Keywords: forensic pharmacy, toxicological chemistry, psychoactive drugs and substances, illegal trafficking.

Introduction. In modern conditions, the life and health of every person is priceless. Doctors ensure the right to health care, medical assistance, and health insurance. Medical care is provided free of charge in state and communal health care institutions [1]. Pharmacists guarantee every patient pharmaceutical provision of drugs of all classification and legal, nomenclature and legal, clinical and pharmacological groups [2, 3].

The pharmacy business in the "doctor-patient-pharmacist" system of legal relations provides patients with essential medicines within the current National List of Essential Medicines [4, 5].

As evidenced by forensic pharmaceutical practice, there is a drug business in parallel with the pharmacy business, which is a legal sector of Ukraine's economy. In the drug business, there is illegal circulation of narcotic and narcotic drugs, potent, poisonous, and psychotropic substances, precursors, falsified drugs, and alcoholic beverages. The disease is spread among the population in accordance with ICD-11 [6-10].

According to law enforcement agencies, the growth rate of drug addiction in Ukraine is the highest among countries in the world [11]:

- from 1 to 1.5 million of the population of Ukraine abuses narcotic drugs and psychoactive substances of other classification and legal groups;
- the dynamics of growth of the annual number of users of psychoactive substances is +8-10%;
- 120,000 people die annually as a result of drug addiction and associated diseases;
- the most drug crimes are found in Dnipropetrovsk, Donetsk Odesa and Kharkiv regions, as well as in the city of Kyiv.

In the USA (fentanyl, heroin) [12, 13], countries of the European Union (cannabis, cocaine) [14], according to forensic pharmaceutical research, there is a trend of increasing the level of drug

trafficking in prohibited narcotic drugs, psychotropic substances, and precursors. Consequences - the spread of drug addiction, associated health disorders and deaths among the population; the growth of illegal circulation of new synthesized, modified psychoactive substances, falsified drugs, alcohol surrogates and other toxicants.

Therefore, in the specified aspect, forensic chemical and pharmaceutical, chemical and toxicological studies, which are carried out by specialized institutions during the execution of forensic pharmaceutical, forensic medical, forensic narcological, clinical toxicological, forensic, anti-doping, environmental, judicial, become more relevant every year – psychiatric and other examinations.

The purpose of the study was to conduct forensic and pharmaceutical, chemical and toxicological research of drugs and substances that are in illegal circulation in Ukraine.

Materials and methods. The forensic and pharmaceutical, chemical and toxicological basis of the study was connected with legal, medical and pharmaceutical disciplines. Retrospective, comparative, documentary, graphical, legal, systemic, tabular, and forensic pharmaceutical research methods were used.

The research of the article is a fragment of research works of Luhansk State Medical University "Conceptual interdisciplinary approaches to pharmaceutical provision and availability of drugs, taking into account organizational and legal, technological, analytical, pharmacognostic, forensic and pharmaceutical, clinical and pharmacological, pharmacoeconomic, marketing, social and economic competencies" (state registration number 0123U101632, terms 2023-2027).

Results and discussion. Need to note that the problems of forensic and pharmaceutical, forensic and medical, forensic and narcological, chemical and toxicological analysis of drugs and substances that are in illegal circulation in Ukraine, their abuse, the spread of drug addiction, toxic addiction and related health disorders, the creation and implementation of industrial production and medical practice of modern combined vital drugs is devoted to the publication of leading domestic scientists, namely Grizodoub O.I., Shapovalova V.O., Linsky I.V., Sosin I.K., Minko O.I., Gudzenko A.O., Nehretskii S.M., Petyunin G.P., Georgievskii V.P., Zbrozhek S.V., Gubskii Yu.I., Shapovalov V.V., Kutko I.I. and others [15-27].

Conducting forensic and pharmaceutical, forensic and medical, forensic and narcological, chemical and toxicological analysis is relevant due to the synthesis and modification in drug laboratories of new narcotic drugs, psychotropic substances and precursors prohibited for circulation in Ukraine [28].

According to the chemical and toxicological analysis of the Bureau of Forensic and Medical Examinations, in 1186 fatal cases of citizens, the presence of psychoactive substances in the biological material the following results were received (Fig. 1) [29-31]:

1. 27.15% of poisonings due to the use of combined drugs containing narcotic drugs, psychotropic substances, and precursors;
2. 22.17% of poisonings due to the use of narcotic drugs (opioids);
3. 19.72% of poisonings due to the use of several narcotics and psychoactive substances of other classification and legal groups;
4. 11.63% of poisonings due to the use of substances not identified by experts;
5. 10.7% of poisonings due to the use of stimulants;
6. 6.25% of poisonings due to the use of sedatives and hypnotics;
7. 1.27% of poisonings due to the use of hallucinogens;
8. 0.85% of poisonings due to the use of cocaine;
9. 0.26% of poisoning due to the use of cannabinoids.

Research conducted in modern conditions is aimed at the analysis and generalization of court verdicts in criminal proceedings related to illegal trafficking of psychoactive substances. Main directions:

- the issue of appointing and conducting forensic examinations, requirements for the quality, completeness, and comprehensiveness of its execution;
- the opinion of a forensic expert becomes one of the key sources of evidentiary information in a criminal case;

- the use of special knowledge when appointing and conducting forensic examinations to obtain evidentiary information during the investigation of crimes under Art. 130-140 and 305-327 of the Criminal Code of Ukraine [33];
- high-quality design of proceedings materials, thorough review and packaging of material evidence, formulation of specific requests and tasks facing the expert.

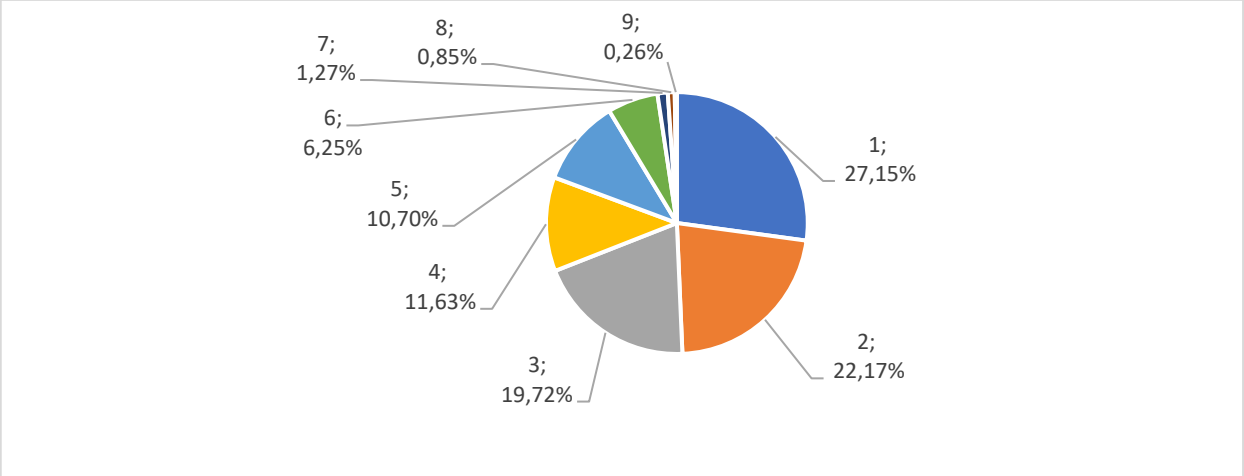

Fig. 1. Distribution of fatal cases of poisoning according to the data of chemical and toxicological analysis.

Gaps in expert activity prompted the pre-trial investigation bodies of the Ministry of Internal Affairs and Communications of Ukraine in the Kharkiv region to:

- ✓ initiation before the Ministry of Internal Affairs of Ukraine about the creation of a department for the investigation of crimes related to the illegal circulation of narcotic drugs at the investigative department;
- ✓ training of experts (pharmacists-criminologists) to improve the quality of forensic expert support for pre-trial investigation;
- ✓ interdisciplinary cooperation with medical experts and the inclusion of professors and teachers of the Department of Forensic Pharmacy (later – the Department of Pharmaceutical Law) of the National Pharmaceutical University as experts;
- ✓ initiation before the Ministry of Internal Affairs of Ukraine about the creation of a forensic pharmaceutical, expert forensic faculty at the National Pharmaceutical University.

The cooperation of teaching staff and practitioners contributed to the creation of a theoretical basis for forensic pharmaceutical analysis or forensic chemical-pharmaceutical examination of material evidence (substances of plant origin, mixtures, liquids, tablets, substances, etc.) in pre-trial investigation [34].

The task of forensic pharmacy during pretrial and judicial investigation is to establish the classification and legal group of a psychoactive substance (narcotic or narcotic, potent, poisonous, psychotropic, caustic, flammable, explosive or precursor. Chemical and toxicological analysis studies biological material that is in the body person (saliva, urine, tear fluid, blood, stomach products, etc.) [35, 36]. The tasks of chemical and toxicological analysis differ from the tasks of forensic and pharmaceutical analysis [37, 38]:

- ➢ sample selection, preparation for analysis;
- ➢ allocation of a toxic substance;
- ➢ determination, processing of the results of the analysis and interpretation.

Of particular interest is the classification of narcotic drugs by Panasenko O.I. [39]:

1. Volatile compounds. • Carbohydrates: pentane, hexane, heptane, octane, isooctane, petroleum ether, gasoline, cyclopropane, cyclopentane, benzene, toluene.

• Alcohols: methanol, ethanol, n-propanol, isopropanol, tert-butanol, sec-butanol, isobutanol, n-butanol, n-pentanol, isoamyl alcohol. • Ketones: acetone, methyl ethyl ketone, cyclohexanone,

methycyclohexanone. • Ethers: diethyl ether, methyl cellosolve, ethyl cellosolve, ethyl acetate, butyl acetate, isoamyl acetate. • Hydrohalogens: dichloromethane, chloroform, dichloroethane, trichloroethane, perchlorethylene, freons, fluoroethane. • Adjacent technical solvents for paints, varnishes, enamels.

2. Non-volatile compounds. a) Acidic substances: • Derivatives of barbituric acid – barbital, phenobarbital, barbamil, sodium ethaminal, cyclobarbital, hexenal. • Non-barbiturate hypnotics – tetridin, noxiron.

• Cannabinoids – cannabinol, cannabidiol, tetrahydrocannabionol.

b) Substances of a neutral nature: chloral hydrate, chlorobutanol hydrate, carbomal, bromisoval.

c) Substances of an amphoteric and weakly basic character: benzodiazepines (chlordiazepine oxide, nitrozepam, diazepam, oxazepam, phenazepam, mezapam), trioxazine, oxylidine.

d) Substances of a basic nature: morphine, codeine, ethylmorphine hydrochloride, hydrocodone, heroin, atropine, homatropine hydrobromide, scopolamine, cocaine, papaverine, promedol, aminazine, propazine, levomepromazine, stageperazine, frenolone, tryphtazine, pericyazine, diprazine, amitriptyline, imizine, chlorprothixene, azafen, haloperidol, trifluperidol, droperidol, dimedrol, suprastin, tavegil, fenkarol, no-spa, difril, LSD25, delizide, lysergid.

According to this classification, the authors teach students [39]. Necessary to emphasize that the classification [39] contradicts the current legislation of Ukraine according to the Resolution of the Cabinet of Ministers of Ukraine dated June 05, 2000 No. 770 "On approval of the list of narcotic drugs, psychotropic substances and precursors" [40]:

Table I

List No. 1 Particularly dangerous narcotics, the circulation of which is prohibited;

List No. 2 Particularly dangerous psychotropic substances, the circulation of which is prohibited;

List No. 3 Plants that contain narcotic drugs and psychotropic substances and the circulation of which is allowed for industrial purposes

Table II

List No. 1 Narcotics, the circulation of which is restricted;

List No. 2 Psychotropic substances, the circulation of which is restricted

Table III

List No. 1 Narcotics, the circulation of which is restricted and in respect of which some control measures are allowed to be excluded;

List No. 2 Psychotropic substances, the circulation of which is restricted and in respect of which some control measures are allowed to be excluded;

Table IV

List No. 1 Precursors whose circulation is restricted and in respect of which control measures are established;

List No. 2 Precursors for which control measures are established.

In accordance with the said Decree of the Cabinet of Ministers of Ukraine, experts worked out, and the Ministry of Health of Ukraine approved Order No. 188 dated August 01, 2000 "On approval of tables of small, large and especially large sizes of narcotic drugs, psychotropic substances and precursors that are in illegal circulation" (Registered in the Ministry of Justice of Ukraine on August 16, 2000 under No. 512/4733) [41].

Today, students study toxicological chemistry by topic. General characteristics, classification of substances that cause poisoning (pharmaceuticals, chemical plant protection agents, industrial poisons, household chemicals, plant poisons, etc.). Objects of chemical and toxicological analysis (internal organs, tissues, blood, urine, lymph). Decay of biological material and basic reactions of secondary metabolism. Methods of preservation of biological objects. Methods of chemical and toxicological analysis, their classification, and general characteristics. Methods of isolating poisonous and potent substances from biological material. Cleaning methods, their selection and evaluation. Principles and methods of detection and quantitative determination of organic and inorganic

compounds. Basic requirements for methods of chemical and toxicological analysis. General and targeted chemical and toxicological analysis. Rules for the selection, referral, and acceptance of objects for forensic chemical examination. Peculiarities of forensic chemical analysis of biological objects. General principles of interpretation of forensic chemical research results. Peculiarities of forensic chemical examination of a corpse in case of death after resuscitation measures and intensive therapy. Gas chromatography as a modern highly efficient method of separation, identification, and quantitative determination of "volatile" poisons. Methods of group and individual identification of poisonous substances using multi-column gas chromatographic analysis [42].

The guidelines of the United Nations Organization on Drugs and Crime [43, 44] are the basic basis of forensic research of material evidence recovered by law enforcement agencies from crime scenes (narcotic and narcotic drugs, psychotropic, potent, and poisonous substances, precursors). As determined by experts:

- verification of analytical methods and calibration of equipment are important aspects of quality assurance in the laboratory;
- guidelines refer to the testing of banned narcotics, psychotropic substances and precursors in seized materials and biological samples;
- management provides practical recommendations for law enforcement agencies, expert institutions for validation and verification of examination methods;
- the procedures described are a synthesis of the experience of scientists from several reputable laboratories around the world;
- various details in the existing protocols of verification of methods according to their context, act on general principles of scientific achievements;
- guidelines focused on quality assurance issues and good laboratory practice in drug, psychotropic substance and precursor testing laboratories can serve as a basic basis for training documents.

The modern European market of new psychoactive substances, which are removed from illegal circulation every year, is characterized by a large number of means and substances [45]. The term "new psychoactive substances" used in expert practice covers a wide range of classification-legal and clinical-pharmacological groups of drugs and substances that are not controlled by international drug control agreements. Some of them may be the subject of national regulatory measures in the criminal-legal and medical-pharmaceutical spheres. Thus, in 2021, a record 8.5 tons of new psychoactive substances were removed from illegal circulation by the member states of the European Union. Established legislative and regulatory control in the countries of the European Union contributed to the reduction of the number of new derivatives of some narcotic drugs (fentanyl). In 2022, 24 new cannabinoids were removed from illegal circulation. Psychoactive drugs and substances seized between 2005 and 2020 include the following groups: cathinones, cannabinoids, opioids, benzodiazepines, arylalkelamines, arylcyclohexylamines, phenethylamines, piperazines, piperidines, pyrrolidines, plants, and extracts.

Using the scientific potential of expert associations, educational institutes, and research institutions in Europe, which are engaged in applied research, can increase competitiveness in the investigation of certain categories of crimes. It will contribute to the integration of forensic expert activity and will lead to the harmonization and improvement of national legislation, theoretical foundations of forensic expert activity, international recognition of its individual components, and will generally increase the professional skill of experts [46-49]. More promising domestic methods of forensic medical identification at the moment may be those that do not require large material costs, will use available reagents and equipment, and will be easy and quick to perform [50].

I note that a control and analytical laboratory is being created at the Department of Pharmacy of Luhansk State Medical University in Rivne. Planned to conduct a wide range of forensic pharmaceutical, chemical and toxicological research. At the 1st stage of scientific and practical activity of Luhansk State Medical University, scientific and practical memoranda of cooperation have already been concluded:

- with Ukrainian Scientific Pharmacopoeial Center for Quality of Medicines for the internship of students, master's, and doctoral students;
- the implementation of compatible scientific activities will contribute to the training of highly qualified pharmaceutical personnel in specialty 226 "Pharmacy, industrial pharmacy". URL: http://sphu.org/dp-farmakopejnij-centr-otrimav-podyaku-vid-derzhavnogo-zakladu-luganskij-derzhavnij-medichnij-universitet-news.html;
- with pharmaceutical enterprises to search for and create on their basis vital medicines;
- with the State Medical Service for Medicines and Drug Control in the Rivne Region;
- with the institution of higher education in Malaysia - Lincoln University College (Lincoln University College).
- with the public institution of higher education of the Warmian-Masurian University (city of Olsztyn, Poland);
- with the private higher education institution John Paul II Catholic University (city of Lublin, Poland);
- with the foundation named after the benefactor princes of Ostrozki (Ostrozki Foundation);
- from SE "State Expert Center of the Ministry of Health of Ukraine";
- with the Rivne Scientific Research Expert Forensic Center of the Ministry of Internal Affairs of Ukraine;
- With the Communal Institution "Regional Bureau of Forensic Medical Examination" of the Rivne Regional Council.

The technical standardization committee No. 192 "Forensic examination" of the National Standardization Body of Ukraine was created. Tasks: standardization of the processes of forensic expert activity, requirements for the creation of expert methods, conducting forensic examinations and expert research, working with material evidence by harmonizing international and regional standards, developing, and adopting national standards. It is another step on the way to improving the judicial expert provision of justice [51].

The abuse of prescription and non-prescription drugs is a growing concern [52]. Increased number of users switch from the abuse of street drugs and psychotropic substances to prescription and over-the-counter drugs. Actions of the pharmacist:

- increased responsibility in the circulation of drugs in pharmacies;
- conducting pharmaceutical care of patients about the potential for addiction (side effects, contraindications for use);
- constant improvement of the level of self-education in the system of continuous professional development;
- cooperation with doctors providing outpatient care to prevent substance abuse after discharge from the hospital;
- engaging in open communication to reassure patients and develop trusting relationships;
- participation in ensuring safe and effective drug use systems, including the development of pharmacotherapeutic elements of drug detoxification protocols and organizational responsibilities for the supply, distribution, and control of drugs.

Conclusion. Forensic and pharmaceutical, chemical and toxicological analysis of drugs and substances in illegal circulation in Ukraine was developed. The rate of growth of the drug trade was analyzed. Fatal cases due to poisoning by psychoactive substances of various classification and legal groups are systematized. The main directions of forensic and pharmaceutical, chemical and toxicological expert research were given. The tasks of forensic and pharmaceutical, chemical and toxicological analysis were compared. Attention is focused on the classification of means and substances according to the current legislation of Ukraine. The United Nations guidelines on drugs and crime was analyzed. Attention is focused on the market of "new psychoactive substances". The experience of the Department of Pharmacy of the Luhansk State Medical University in Rivne for the development of forensic and pharmaceutical, chemical and toxicological analysis in Ukraine was presented.

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References.

1. Constitution of Ukraine. *Verkhovna Rada of Ukraine.* 1996. URL: https://zakon.rada.gov.ua/laws/show/254%D0%BA/96-%D0%B2%D1%80#Text
2. Shapovalov V., Osyntseva A., Shapovalov V. Organization of pharmaceutical business, drug technology, forensic and clinical pharmacy: multidisciplinary innovative nanotechnologies in the development and implementation of new medical products to medical and pharmaceutical practice. *SSP Modern Pharmacy and Medicine*. 2022. Vol.2. No.3. P.1-18. URL: https://doi.org/10.53933/sspmpm.v2i3.61
3. Zbrozgek S. Reform of the healthcare system as a basis for streamlining the organization of circulation and availability of medicines for patients in the context of the COVID-19 pandemic. *SSP Modern Pharmacy and Medicine*. 2021. Vol. 1. No. 2. P. 1-32. URL: https://doi.org/10.53933/sspmpm.v1i2.31.
4. 4 million patients received essential medicines free of charge or with a partial co-payment within the framework of the "Affordable Medicines" program – Viktor Lyashko. *Government portal.* 14.09.2023. URL: https://www.kmu.gov.ua/news/4-mln-patsiientiv-otrymaly-zhyttievo-neobkhidni-liky-bezoplatno-abo-z-chastkovoiu-doplatoiu-v-mezhakh-prohramy-dostupni-liky-viktor-liashko
5. Resolution of the Cabinet of Ministers of Ukraine dated January 06, 2023 No. 18 "On Amendments to the National List of Essential Medicines". *Government portal.* 06.01.2023. URL: https://zakon.rada.gov.ua/laws/show/18-2023-%D0%BF#Text
6. Ivanishyn-Hayduchok L., Shapovalova V., Shapovalov V. ICD-11: Organizational and legal, medical and pharmaceutical, social and economic issues of implementation of the program of state guarantees of medical care in 2022 in Ukraine, based on the fundamental principles of the European Union. *SSP Modern Pharmacy and Medicine.* 2022. Vol.2. No.2. P.1-14. URL: https://doi.org/10.53933/sspmpm.v2i2.53.
7. Shapovalova V. The ICD-11 for the twenty-first century: the first view from the organizational, legal, clinical and pharmacological aspects. *SSP Modern Pharmacy and Medicine*. 2022. Vol.2. N.1. P.1-13. URL: https://doi.org/10.53933/sspmpm.v2i1.37.
8. Shapovalov (Jr.) V., Zbrozhek S., Gudzenko A. et al. Organizational and legal analysis of the pharmaceutical provision for the most common diseases of society. *International Journal of Pharmaceutical Sciences Review and Research.* 2018. Vol.51. N.1. P.118-124. URL: http://globalresearchonline.net/journalcontents/v51-1/18.pdf.
9. Shapovalov V.V. (Jr.), Zbrozhek S.I., Shapovalova V.O. et al. Organizational and legal evaluation of availability of medicines' circulation for cancer patients. *Pharmacia*. 2018. Vol. 65. N.2. P.17-22. URL: http://bsphs.org/?magasine=organizational-and-legal-evaluation-of-availability-of-medicines-circulation-for-cancer-patients.
10. Shapovalova V. Forensic and pharmaceutical risks in the organization of pharmacotherapy of covid, post-covid and long-covid disorders. COVID-19 and vaccination practice standards. *SSP Modern Pharmacy and Medicine*. 2022. Vol. 2. No. 4. P. 1–24. URL: https://doi.org/10.53933/sspmpm.v2i4.69
11. Prishchepa Ya. Up to 1.5 million Ukrainians consume drugs. *Suspilne.* 26.10.2021. URL: https://suspilne.media/175098-do-15-miljona-ukrainciv-spozivaut-narkotiki-venediktova/
12. Irvine M. A., Oller D., Boggis J. et al. Estimating naloxone need in the USA across fentanyl, heroin, and prescription opioid epidemics: a modelling study. *The Lancet*. Vol.7. No.3. e210-e218. DOI: https://doi.org/10.1016/S2468-2667(21)00304-2
13. Yousif N. How the fentanyl crisis' fourth wave has hit every corner of the US. *BBC*. 17.09.2023. URL: https://www.bbc.com/news/world-us-canada-66826895

14. Cocaine – the current situation in Europe (European Drug Report 2023). *EMCDDA.* 2023. URL: https://www.emcdda.europa.eu/publications/european-drug-report/2023/cocaine_en
15. Gryzodub O., Shapovalov V. Quality Systems in Pharmacy: Multidisciplinary Context of the State Pharmacopoeia of Ukraine. *SSP Modern Law and Practice*. 2023. Vol. 3. No 1. P. 1-23. DOI: https://doi.org/10.53933/sspmlp.v3i1.81. URL: https://ssp.ee/index.php/mlp/article/view/81
16. Shapovalova V. A., Shapovalov, V. V., Agapov, D. A. (2019). Forensic pharmacy: review of the measures to counter the spreading of the psychoactive substances over the Internet. *Farmatsevtychnyi Zhurnal.* 2019. No.3. P.18-21. URL: https://pharmj.org.ua/index.php/journal/article/view/511/479
17. Linsky I.V., Minko O.I., Shapovalov V.V. Monitoring of trends in the spread of dependence on particularly dangerous narcotic drugs and other groups of psychoactive substances as a component of the national security system in Ukraine. *Medicines of Ukraine.* 2007. No. 112. P. 12-25
18. V.V. Shapovalov, A. O. A.O. Gudzenko, V.O. Shapovalova V.O. Pharmaceutical law regarding the assessment of crime related to the circulation of psychoactive substances and measures to combat drug-related morbidity. *Pharmaceutical journal.* 2006. No. 5. P.39-43. URL: https://pharmj.org.ua/archives/2006/2006-5.pdf
19. Shapovalov V.V. (mol.) Forensic and pharmaceutical monitoring of patients with drug addiction with psychical and behavioral problems after using of the psychoactive substances. *Farmatsevtychnyi Zhurnal*. 2011. No.1. P. 25-28. URL: https://pharmj.org.ua/index.php/journal/article/view/705
20. Chernykh V.P., Piminov O.F., Shapovalova V.O. et al. From police chemistry – to forensic chemical-pharmaceutical examination, from forensic pharmacy – to pharmaceutical law (Historical information on the department of pharmaceutical law of the IPKSF of the National Academy of Sciences). *Ukrainian Herald of Psychoneurology.* 2009. Vol. 17. No. 2. Appendix. P. 59-66. URL: http://194.44.242.25/cgi-bin/Webirbis3/cgiirbis_64.exe?LNG=&Z21ID=&I21DBN=DB2_PRINT&P21DBN=DB2&S21STN=1&S21REF=&S21FMT=FULLW_print&C21COM=S&S21CNR=500&S21P01=0&S21P02=1&S21P03=A=&S21STR=%D0%9F%D0%BE%D1%81%D0%B8%D0%BB%D0%BA%D1%96%D0%BD%D0%B0,%20%D0%9E.%20%D0%92
21. Sosin I.K., Chuiev Yu.F., Shapovalova V.O. et al. Narcology: National Textbook. *Kharkiv: Kolehium.* 2014. 1500 p.
22. Gudzenko A. A., Shapovalov V. (Jr.) V., Shapovalova V.A. et al. Organizational and legal, forensic and pharmaceutical researches of pharmaceutical provision for mental disorders of victims in the emergencies at regional level. *Likars'ka Sprava.* 2018. Vol. 7-8. P. 149-157. URL: https://doi.org/10.31640/JVD.7-8.2018(24).
23. Shapovalov V.V. (Jr.), Linskiy I.V. Evidence-based pharmacy: definition of the control regime for the medicines in the pharmaceutical correction schemes of the opioid dependence. *Pharmaceutical Journal.* 2013. No. 3. P. 35-40. URL: https://pharmj.org.ua/index.php/journal/article/view/399.
24. Shapovalova V.A., Voloshyn P.V., Stefanov A.V. et al. Medicines for neurologists, psychiatrists and narcologists. *Kh.: Fakt.* 2003. 784 p.
25. Shapovalova V. The ICD-11 for the twenty-first century: the first view from the organizational, legal, clinical and pharmacological aspects. *SSP Modern Pharmacy and Medicine*. 2022. Vol.2. N.1. P.1-13. URL: https://DOI.org/10.53933/sspmpm.v2i1.37
26. Shapovalova V.A., Shapovalov V.V. The clinical efficacy of the combined drug agent Valcophen in children. *Likars'ka sprava*. 1999. No.1. P.124–126. URL: https://pubmed.ncbi.nlm.nih.gov/10424023/.
27. Petyunin G.P., Polyakh A.M., Shepitko V.Yu. Narcotic drugs, psychotropic substances, and precursors. *A reference dictionary for law enforcement officers. Kharkiv: "Law".* 2006. 96 p. https://www.academia.edu/26493156/%D0%A1%D0%B5%D1%80%D1%96%D1%8F_%D0%A1
28. Shapovalov V. Illegal drug laboratories: forensic and pharmaceutical, forensic and expert, forensic and toxicological, forensic and chemical, criminal and legal examination to combat drug

trafficking, illegal circulation of prohibited psychoactive substances, morbidity. *SSP Modern Law and Practice*. 2023. Vol. 3. No. 2. P. 1-19. URL: https://doi.org/10.53933/sspmlp.v3i2.100
29. Report on the drug and alcohol situation in Ukraine for 2022 (based on 2021 data). Kyiv, 2022. 77 p.
30. Georgievsky V.P. Chromatographic methods in the creation and control of medicinal products in Ukraine. Surface. 2014. Issue 6 (21). P. 326-421. URL: https://surfacezbir.com.ua/index.php/surface/article/view/559/559
31. Shapovalov V. Interdisciplinary Legal, Forensic and Pharmaceutical, Forensic and Chemical, Forensic and Narcological, Forensic and Toxicological, Criminal and Legal Study of the Illegal Trafficking of Amphetamine. *SSP Modern Law and Practice*. 2023. Vol. 3. No 3. P.1-14. DOI: https://doi.org/10.53933/sspmlp.v3i3.108
32. Krasnianska T., Ponomarenko M. Organization of the pharmaceutical business, drug technology and forensic pharmacy: modern trends in the development of the science of pharmaceutical law during the COVID-19 pandemic. *SSP Modern Pharmacy and Medicine*. 2022. Vol. 2. No. 3. P.1 -15. DOI: https://doi.org/10.53933/sspmpm.v2i3.59
33. Criminal Procedure Code of Ukraine. *Verkhovna Rada of Ukraine.* URL: https://zakon.rada.gov.ua/laws/show/4651-17#n2444
34. Shapovalov V.V. Development of the scientific and practical foundations of the organization and conduct of forensic chemical-pharmaceutical examination of medicinal products: Author's abstract. thesis for PhD. Kharkiv 1997. 24 p.
35. Bugaichuk K.L., Savchenko O.O., Pribytkova N.O. Peculiarities of the pre-trial investigation of illegal production, manufacture, acquisition, storage, transportation, forwarding or sale of narcotic drugs, psychotropic substances or their analogues: scientific and methodological recommendations. Kharkiv. 2015. 99 c. URL: https://core.ac.uk/reader/187222290
36. Tychyna D.M., Antoshchuk A.O. etc. Investigation of illegal circulation of poisonous or potent drugs: method. river Kyiv: *National. Acad. internal affairs.* 2022. 54 p. URL: http://elar.naiau.kiev.ua/bitstream/123456789/22094/1/B2.pdf
37. Bayurka S.Y., Bondar V.S., Merzlikin S.I. etc. Analytical toxicology. Kharkiv: NFaU, 2017. 384 p.
38. Zavolovich A. Methods of forensic analysis of acute intoxications with ethyl alcohol (review of literary sources). Forensic medical examination. 2021. No. 2. P. 24-30. URL: http://forensic.bsmu.edu.ua/article/view/249793
39. Panasenko O.I., Buryak V.P., Parchenko V.V. and others Aspects of determination of some narcotic substances Educational and methodological manual of the department of toxicological and inorganic chemistry of Zaporizhzhya State Medical University. *Zaporizhzhia State Medical University.* 2014. 129 p. URL: http://dspace.zsmu.edu.ua/bitstream/123456789/933/1/14Aspekty_vyznachennya_deyakykh.pdf
40. Resolution of the Cabinet of Ministers of Ukraine dated May 06, 2000 No. 770 "On approval of the list of narcotic drugs, psychotropic substances and precursors". *Verkhovna Rada of Ukraine.* URL: https://zakon.rada.gov.ua/laws/show/770-2000-%D0%BF#Text
41. Order of the Ministry of Health of Ukraine dated August 1, 2000 No. 188 "On approval of tables of small, large and especially large sizes of narcotic drugs, psychotropic substances and precursors that are in illegal circulation". *Verkhovna Rada of Ukraine.* URL: https://zakon.rada.gov.ua/laws/show/z0512-00#Text
42. Panasenko O.I. Toxicological chemistry: educational method. manual for students. *Zaporizhzhia: ZDMU.* 2015. 235 p. URL: http://dspace.zsmu.edu.ua/bitstream/123456789/3225/1/15Toksykolohichna%20khimiia.pdf
43. Guidance for the Validation of Analytical Methodology and Calibration of Equipment used for Testing of Illicit Drugs in Seized Materials and Biological Specimens. *United Nations*. 2009. 48 c. URL: https://www.unodc.org/unodc/en/scientists/guidance-for-the-validation-of-analytical-methodology-and-calibration-of-equipment.html

44. Guide to the application of the quality control system in drug testing laboratories. *UN.* 2009. 53 c. https://www.unodc.org/documents/scientific/QMS_R_web.pdf
45. New psychoactive substances – the current situation in Europe (European Drug Report 2023). *EMCDDa.* 2023. URL: https://www.emcdda.europa.eu/publications/european-drug-report/2023/new-psychoactive-substances_en#edr-2023-nps-source-data-table1
46. Pampukha H.G. Regarding the prospects for the development of international forensic expert activity. Scientific and practical publication "Actual issues of standardization of judicial expert provision of justice in Ukraine. *Development prospects" Materials of the international scientific and practical conference (Kyiv, July 4-5, 2018).* P. 156-159.URL: https://m3rkxutm8pk3eqapl5ynjvb3gjps8uao.cdn-freehost.com.ua/wp-content/uploads/2021/06/123456789.pdf
47. Emen E., Aslan R., Aydoğdu M. et al. Development of a chemometric method in urine sample for newly designed hallucinating psychoactive substances: 5-MeO-MiPT. *Ege Journal of Medicine*. 2023.Vol. 62. No.3. P. 355-363. URL: http://egetipdergisi.com.tr/en/pub/issue/79039/1360340
48. Cui S.-F., Yang H.-L., Lin S.-Y. et al. Identification and Quantification of the Main Psychoactive Ingredients of Cannabis in Urine Using Excitation–Eemission Matrix Fluorescence Coupled with Parallel Factor Analysis. *ACS Omega*. 2023. P.1-9. URL: https://pubs.acs.org/doi/full/10.1021/acsomega.3c04913
49. Barbarić L., Bezbradica S.C. A forensic application of genetic markers for distinction between drug-type and fiber-type. *Cannabis sativa. Forensic Science International.* 04.10.2023. URL: https://www.sciencedirect.com/science/article/abs/pii/S0379073823003031
50. Fedorova A.O. The current state and prospects for the development of forensic medical identification of the time of death. Actual issues of standardization of judicial expert provision of justice in Ukraine. *Development prospects. Materials of the international scientific and practical conference (Kyiv, July 4-5, 2018).* P. 203-206. URL: https://m3rkxutm8pk3eqapl5ynjvb3gjps8uao.cdn-freehost.com.ua/wp-content/uploads/2021/06/123456789.pdf
51. Ruvin O.G., Poltavskyi A.O. The creation of the technical committee 192 "forensic examination" of the national standardization body of Ukraine is another step on the way to improving the forensic and expert provision of justice in the state. Actual issues of standardization of judicial expert provision of justice in Ukraine. Development prospects. *Materials of the international scientific and practical conference (Kyiv, July 4-5, 2018).* P. 176-179.URL: https://m3rkxutm8pk3eqapl5ynjvb3gjps8uao.cdn-freehost.com.ua/wp-content/uploads/2021/06/123456789.pdf
52. Chiappini S., Guirguis A., Martin Corkery J. & Schifano F. Misuse of prescription and over-the-counter drugs to obtain illicit highs: how pharmacists can prevent abuse. *The Pharmaceutical journal.* 2020. URL: https://pharmaceutical-journal.com/article/research/misuse-of-prescription-and-over-the-counter-drugs-to-obtain-illicit-highs-how-pharmacists-can-prevent-abuse