

The Latest Quantum and Medical, Quantum and Pharmaceutical Technologies in Countering the Criminal and Legal, Forensic and Pharmaceutical Risks of Circulation of Falsified Drugs

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Received: May 28, 2024

Published: June 24, 2024

Abstract. Healthcare institutions manage the distribution of essential medications within the legal framework involving doctors, patients, and pharmacists. The criminal laws of Ukraine hold individuals accountable for distributing counterfeit medicinal products. However, members of criminal organizations often evade prosecution. There is a promising future in integrating quantum medicine, including quantum physics and quantum pharmacy, into forensic pharmaceutical, forensic medical, forensic narcological, and forensic criminalistic research. This advancement could significantly enhance our ability to combat the negative consequences associated with the circulation of falsified drugs. The incorporation of quantum medical and pharmaceutical technologies is anticipated to revolutionize forensic practices. These

technologies could provide new methods for detecting and preventing the distribution of counterfeit drugs, thereby protecting public health. Additionally, they may offer innovative solutions for addressing the legal and criminal implications of these activities. As quantum medicine progresses, it will likely play a crucial role in strengthening the integrity of healthcare systems and ensuring the safe distribution of medications. The potential of these technologies in forensic and pharmaceutical fields represents a significant step forward in the fight against drug falsification.

Keywords: quantum medicine, quantum pharmacy, microwave resonance therapy, circulation of counterfeit drugs, forensic pharmacy, pharmaceutical law, medical law.

Introduction. Public health is life expectancy, health disorders, modern pharmacotherapy, circulation of high-quality, safe, effective, affordable drugs in the system of legal relations "doctor-patient-pharmacist". It plays an important role when the doctor establishes the correct diagnosis in accordance with ICD-11, prescribing vital drugs, obtaining drugs from pharmacies for the patient's recovery [1-6]. Healthcare institutions ensure the circulation of drugs, guarantee their quality, efficiency, and safety [7-9].

Incoming quality control of drugs in hospitals is carried out by authorized persons (head or senior nurses, nurses, pharmacists). The medical use (application) of low-quality, falsified drugs is prohibited; drugs, the circulation of which is prohibited in Ukraine; drugs not registered in Ukraine; drugs without a series quality certificate; drugs without a conclusion on the quality of imported drugs (for drugs of foreign production); medical immunobiological preparations without a conclusion on compliance with the requirements of state and international standards; drugs whose expiration date has passed; without instructions for medical use.

In accordance with laws, regulations, criminal, pharmaceutical and medical law, there should be no circulation of counterfeit products in health care institutions and pharmacies. Contrary to the above, patients and citizens buy or receive during pharmacotherapy falsified drugs manufactured by members of transnational organized criminal groups, which are involved in the legalization of income (money laundering) obtained by criminal means [10-15].

Low-quality and falsified medicines affect the life and health of patients. T.A. noted this back in 2017. Gebreyesus, Director General of WHO [16, 17]. In the report "Illegal Trade: Trade in Counterfeit Pharmaceutical Products" for 2016, the value of counterfeit and falsified pharmaceutical products in circulation was estimated in the countries of the world. It amounted to 4.4 billion dollars [18]. Counterfeit antibiotics, drugs to improve lifestyle and painkillers are the most common. The largest share of falsification of medicines for cancer, diabetes, cardiovascular diseases, malaria, HIV/AIDS.

WHO experts note that:

- the availability of substandard and counterfeit antimalarial drugs alone may cause up to 116,000 deaths annually in sub-Saharan Africa;
- tens of thousands of patients die from the use of other counterfeit drugs in the countries of the world;
- in developing countries, thanks to the circulation of falsified medicines, the profit of criminals is almost 200 billion dollars a year.

According to the results of the data obtained during the monitoring of drug circulation, it was noted that in low- and middle-income countries, approximately every 10th package of drugs is falsified [19]:

- low-quality and falsified medicines and medical devices can harm patients and not cure diseases.
- counterfeit medicines lead to a loss of trust in medicines, health care providers and the health care sector;
- substandard and falsified medical products from all major therapeutic categories, including drugs, vaccines and in vitro diagnostics, have been identified;
- antimalarial drugs and antibiotics are among the most frequently reported substandard and falsified medical products;
- both generic and innovative drugs can be counterfeited, ranging from very expensive products for the treatment of cancer to very inexpensive drugs for the treatment of pain of various origins;
- counterfeit medicines are in circulation in illegal street markets, websites, pharmacies, clinics;
- low-quality and falsified medical products cause resistance to antimicrobial drugs;
- counterfeit medicines may contain no active ingredient, wrong amount of active ingredient. They usually contain corn or potato starch, chalk;
- some substandard and adulterated drugs have been toxic with fatal levels of the active ingredient or other toxic chemicals;
- low-quality and falsified drugs are often produced by unqualified personnel, in unsanitary places, contain unknown impurities and are sometimes contaminated with bacteria;
- low-quality and falsified products are difficult to detect in legal circulation, contribute to serious consequences for the patient's health, facts of disability of 6.1% of the population [20, 21]. According to a forensic medical assessment, these are light, moderate or severe injuries), including fatalities (death).

Modern challenges in the field of health care are the treatment of the most common diseases associated with the consequences of COVID-19: infectious, oncological, cardiovascular, psychoneurological, orphan endocrinological, addictive diseases, injuries due to traffic accidents, injuries received during hostilities [22-39]. However, the state guarantees the provision of patients during their outpatient and inpatient treatment with high-quality, effective, safe and economically available drugs of clinical and pharmacological, classification and legal, nomenclature and legal groups [40-52].

Illegal circulation of falsified medicines is connected with the activity of transnational criminal groups. Their criminal activity is based on the legalization of income (money laundering) obtained by criminal means. Production, transportation from one country to another of "medicines" under forged documents, distribution of "medicines" through the legal sector of the state economy (pharmacies, health care facilities) [53].

For example, the Kenyan authorities have warned citizens that the falsified drug "Truvada" for the prevention of HIV/AIDS is circulating and being sold illegally in the country. In the country, their safety, quality and effectiveness cannot be guaranteed from the use of this drug [54]. The drug "Truvada" is produced by the American company Gilead Sciences. In January 2020, counterfeit versions of drugs were in circulation and being sold in the United States. 85,247 bottles of Biktarvy and Descovy were found in 17 locations and nine states worth millions of dollars of HIV, posing a risk to patients [55]. Gilead Sciences continues to work closely with the FDA, pharmacies, hospitals, and law enforcement to remove counterfeit drugs from circulation and prevent future distribution of these drugs [56]. It is important to note the fact that thanks to the prompt work of the lawyers of the American company Gilead Sciences, law enforcement officers, evidentiary materials were collected regarding the circulation of falsified drugs, and the trial of the case revealed the following problems [55]:

- the company charged 22 defendants with violating federal trademark laws and New York consumer protection laws for their role in distributing "dangerous" counterfeits "to unsuspecting patients, putting patients' health and lives at risk";
- global sales of drugs for the treatment of HIV/AIDS (for the quarter ended 09/30/2021) amounted to 4.19 billion dollars, including 2.71 billion dollars of drugs under the Gilead brand "Biktarvy" and "Descovy";
- unauthorized pharmaceutical distributors who sold drugs to pharmacies used genuine but often empty or near-empty bottles that once contained HIV/AIDS drugs, counterfeiters then replaced with false labels and documentation and resealed the bottles to "resemble" unopened real bottles (the alleged scheme was previously reported by The Wall Street Journal);
- a common counterfeit is an antipsychotic drug that often causes drowsiness, where the pills were six times stronger than the US Food and Drug Administration recommended for some patients;
- identified a victim patient who unknowingly took a counterfeit drug after receiving a fake bottle of Biktarvy, the patient was unable to speak or walk after consuming the product.

Therefore, the relevance and purpose of the mentioned research is beyond doubt. It shows the multidisciplinary nature of the direction, the scale of activities of criminal organizations in the circulation of counterfeit products.

The purpose of the study was to research and propose the latest quantum-medical and quantum-pharmaceutical technologies in countering the criminal-legal and forensic-pharmaceutical risks of circulation of falsified drugs.

Materials and methods. Imperative material was Internet publications in Ukraine, EU countries, scientific literature, sources of scientometric databases, websites of the Verkhovna Rada of Ukraine, the Cabinet of Ministers of Ukraine, WHO, Ministry of Health of Ukraine, the State Service of Ukraine for Medicinal Products and Drug Control, Interpol, DEA, FDA, the prosecutor's office, the police, the Security Service of Ukraine, state authorities and local governments, and others.

Multidisciplinary research was aimed at:

- forensic pharmaceutical monitoring of the level and scale of illegal circulation of falsified drugs;
- assessment of the criminal and legal, medical and pharmaceutical, socio-economic consequences of circulation of falsified drugs, harmful effects on the patient's body;
- providing scientific and practical information to doctors and pharmacists about the consequences of illegal circulation of falsified drugs for the life and health of the patient, the state economy, pharmaceutical companies and health care institutions;
- optimizing the work of the central executive body by improving legislation and regulatory acts in the field of countering the illegal circulation of falsified drugs;
- studying and offering the latest quantum medical and quantum pharmaceutical technologies based on nuclear medicine.

The authors used normative and legal, historical, documentary, retrospective, forensic and pharmaceutical, tabular, mathematical and graphic methods of analysis.

The topic of the article is a fragment of the following research works:

- ❖ Private scientific institution "Scientific and Research University of Medical and Pharmaceutical Law" on the topic "Multidisciplinary study of post-traumatic stress disorders during the war among patients (primarily combatants)" (state registration number 0124U002540, implementation period 2024-2029);
- ❖ Kharkiv Medical Academy of Postgraduate Education on the topics "Improvement of the organizational and legal procedure for providing drugs to patients from the standpoint of forensic pharmacy, pharmacy organization and management" (state registration number 0116U003137, implementation period 2016–2020) and "Pharmaceutical and medical law: integrated approaches to the drug circulation system from the standpoint of forensic pharmacy and the organization of the pharmaceutical case" (state registration number 0121U000031, implementation period 2021-2026);
- ❖ Lviv Medical University (Lviv Medical Institute) on the topic "Improving the drug circulation system during pharmacotherapy on the basis of evidentiary and forensic pharmacy, organization, technology, biopharmacy and pharmaceutical law" (state registration number 0120U105348, deadline 2021-2026).

Results and discussion. The work of investigative, investigative and expert forensic bodies and judicial bodies of Ukraine is aimed at countering crime. During the investigation of criminal cases related to murders, traffic accidents, bodily injuries of various degrees of severity, illegal circulation of narcotic drugs, psychotropic substances, precursors, drugs of various clinical and pharmacological, classification and legal, nomenclature and legal groups, a decision was proposed on establishment of a specialized department of forensic pharmacy. Scientific investigators, operatives, lawyers, judges, forensic experts, forensic doctors, narcologists, psychiatrists created such a department in 1990. Among the first founders of the Department of Forensic Pharmacy are Doctor of Pharmaceutical Sciences, Professor V.V. Shapovalov, candidates of pharmaceutical sciences Khalin M.M., Petrenko S.L., Abrosymov O.S., Danilyuk O.V., Bondarenko V.V., Nikonova M.M., Sosin I.K., heads of the Ministry of Internal Affairs Kinshakov V.G. and many others. Later, the Department of Forensic Pharmacy was renamed the Department of Medical and Pharmaceutical Law, General and Clinical Pharmacy headed by Prof. Shapovalova V.O. For the implementation of a new science – medical law and pharmaceutical law (component – forensic pharmacy), by the Higher Attestation Commission of Ukraine introduced scientific specialty 15.00.01 – organization of pharmaceutical business, drug technology and forensic pharmacy.

Ignorance of doctors, pharmacists, scientists and the public in the criminal law of Ukraine demanded the proof of the results of the investigation of criminal cases, their analysis for the organization of the system of professional development, the implementation of legislative, normative and legal, educational and methodical, organizational and legal work at all levels of government in the state Annual scientific and practical conferences have been launched to increase the level of protection of rights and freedoms, life and health of specialists in medicine, pharmacy, masters, postgraduates, doctoral students, and patients [9, 57-62].

In Ukraine, the circulation of falsified products exists according to the open sources [63].

In Lviv, law enforcement officers seized a large batch of falsified medicines. These were the most popular over-the-counter drugs among the population. Falsified drugs were removed from 30 legal pharmacies. In Vasytkiv, Kyiv region, the underground counterfeited medicines. In total, they were seized in the amount of approximately UAH 7 million.

Officials of a private enterprise created an extensive network for the supply of counterfeit drugs in the territories of Lviv, Khmelnytskyi, Zakarpattia, Ivano-Frankivsk, Ternopil, Volyn and Rivne regions. The State Medical Service of Ukraine instructed territorial bodies to carry out unscheduled inspections of economic entities regarding the presence, routes of receipt and distribution of suspected falsification of medicinal products.

The editorial office of "Your Health" received a letter from the employees of pharmacies in Sumy. They addressed the same letters to the Administration of the President of Ukraine, the Cabinet of Ministers of Ukraine, the Security Service of Ukraine, the Ministry of Health of Ukraine and the

Prosecutor General's Office. Specialists wrote about the existence of shadow schemes of pharmacy chain activity in their city, and gave specific addresses. Most often, this is a chain of pharmacies, which consists of 10 units plus pharmacy kiosks. The turnover of one such network is 2.5-3 million hryvnias per month. The business was opened by fictitious persons, the premises were also purchased with the participation of fictitious persons. The official part of the goods is delivered by accompanying invoices, most often one unit at a time. This is necessary in order for the pharmacy to have medicines of all series available. This ensures serial coverage of unofficial receipts of medicines in the pharmacy. Medicines were purchased from the supplier in cash without documents, using the so-called "form 2". The suppliers of official and unofficial medicines are the same. The goods are delivered according to "form 1" and "form 2" at the same time. The calculation is carried out on the spot with the forwarder drivers. The money for the received goods is returned to the wholesale company. With legal documents, they make their way into one of "their" pharmacies. This process is called "transferring legal medicines to illegal ones." Pharmacy entrepreneurs sell medicines without cash registers, which makes it impossible to record and control the goods sold. Sales volume is also not controlled. In such pharmacies, double bookkeeping is conducted.

Counterfeiting of medicines, as noted by specialists of the non-profit organization for combating counterfeit products Authentication Solutions Providers' Association (ASPA), is growing all over the world [64]. Among the fakes, there are:

- ✓ antibiotics;
- ✓ antiviral (antimalarial chloroquine);
- ✓ vitamins (vitamin C);
- ✓ analgesics;
- ✓ drugs for the treatment of diabetes Novo Nordisk (Bagsvaerd, Denmark), Wegovy, Ozempic, Eli Lilly (Indianapolis, Indiana, USA);
- ✓ hormones, steroids, anorectics;
- ✓ drugs for erectile dysfunction;
- ✓ narcotic and psychotropic drugs;
- ✓ drugs for weight loss.

The growth dynamics of falsified drugs seized in the world during 2018-2022 is shown in Fig. 1. In 2022, 6,615 offenses related to pharmaceutical activity were registered, which is 10% more than in 2021 [64].

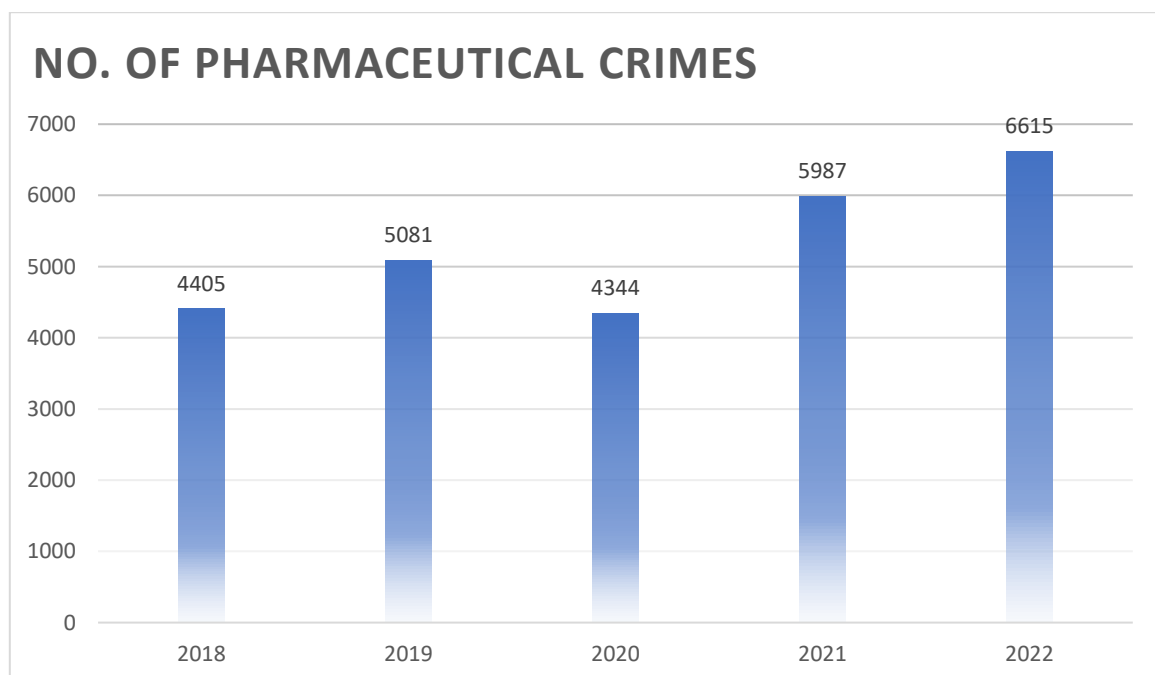


Fig. 1. Dynamics of growth of falsified drugs seized in the world during 2018-2022 [64].

The number of offenses increased in all countries. In the Asia-Pacific region – 1,738 offenses, 934 – in Latin America and 185 in Africa.

So, for example, as of April 1, 2022, it turned out that:

- ☑ criminal groups in India are key global producers of counterfeit drugs;
- ☑ circulation of non-standard, falsified medicines in India increased by almost 47%;
- ☑ despite the efforts of the regulatory authorities to combat the production of fake drugs through the implementation of QR codes, the problem remains endemic.

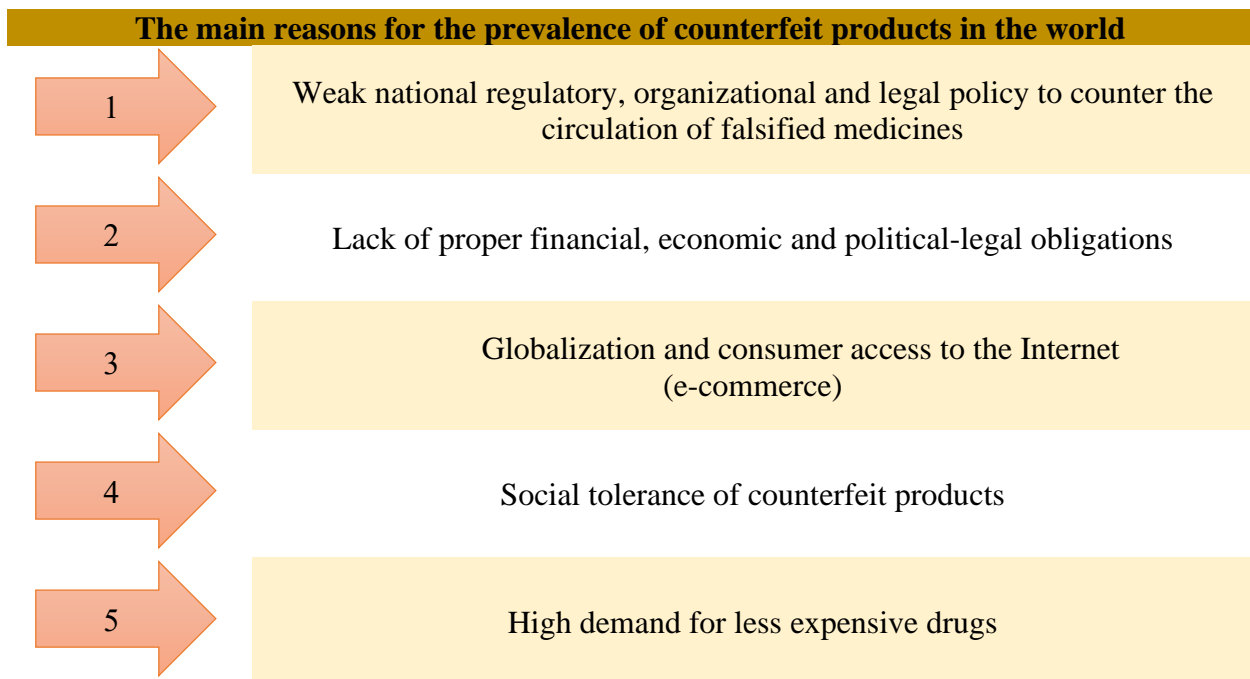
In the publication Ziavrou K.S., Noguera S., Boumba V.A. analysis of the report of the Organization for Economic Cooperation and Development (OECD) for 2020 is provided. China, Hong Kong, Singapore and India are considered the main countries from which counterfeit pharmaceuticals originate [65].

China and India are the main producers of falsified medicines. The United Arab Emirates, Singapore, Hong Kong, Yemen and Iran act as transit countries. Counterfeit exports go to the United States, Europe, Japan, some South American countries and Africa. The global market is between US\$65 billion and US\$200 billion every year, making it a very profitable criminal enterprise. The range of falsified medicines is expanding. Most counterfeits are distributed through e-commerce and social media platforms, fraudulent pharmacies, messaging apps and the dark web. Express courier and postal parcels are the most popular methods of delivery of counterfeit goods.

Employees of the Department of Health of India stated that against the background of the COVID-19 pandemic, an increase in the circulation of falsified drugs has been established [66]:

- 9 cases when wholesalers and retailers manufactured and sold fake medicines to patients (with fake labels of the original company);
- one case, when the circulation of falsified anti-cancer drugs was exposed, the police arrested 7 citizens, including hospital employees;
- counterfeit medicines were distributed in Delhi markets, border areas, third and fourth tier cities in North India, i.e. sold to patients in areas where there is no proper control over drug billing;
- among the falsified drugs are drugs for the treatment of cancer, blood pressure control, type 2 diabetes and cholesterol.

The main reasons for the prevalence of counterfeit products in the world are shown in Fig. 2.



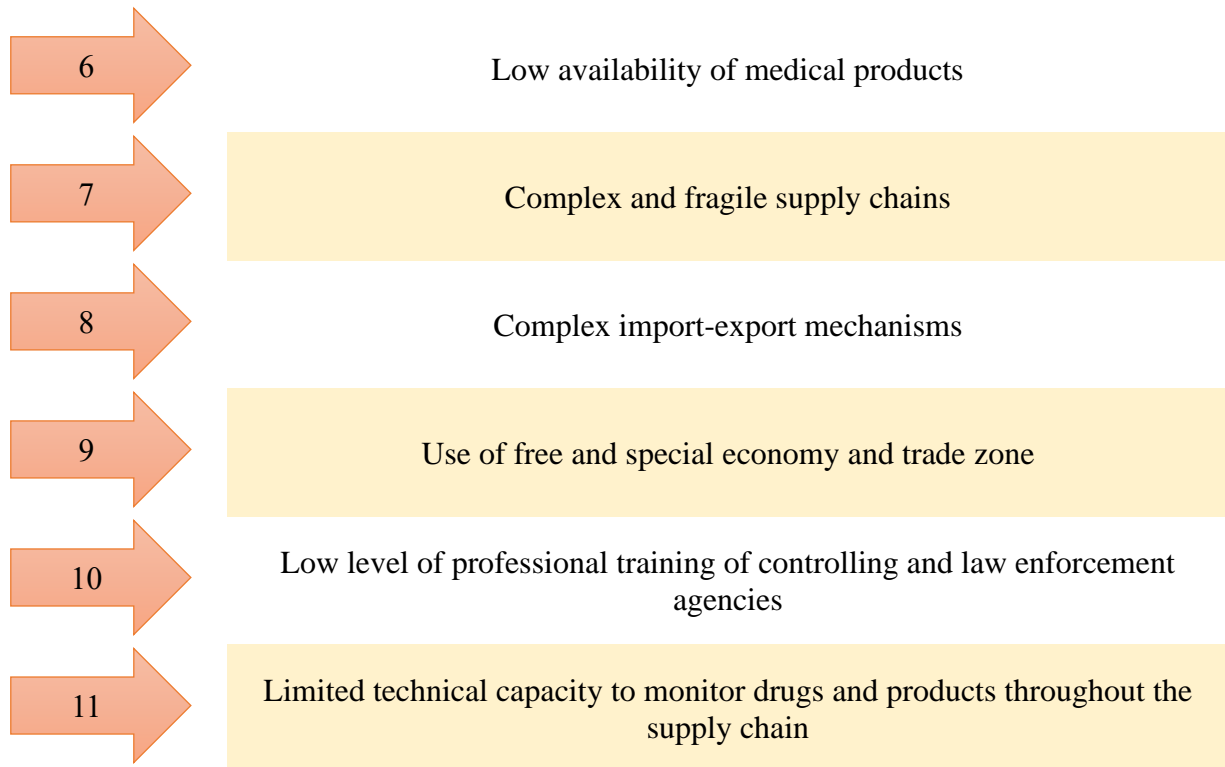


Fig. 2. The main reasons for the prevalence of counterfeit products in the world.

New Delhi police seized fake cancer drugs from pharmacies in Old Delhi [67]. Counterfeit products were sold in three stores, which were searched and counterfeit drugs were seized. The investigation also revealed that most of the drugs had fake import labels from different countries.

Examples from forensic pharmaceutical practice (No. 1-4) show that in Ukraine (examples No. 1-3) and the countries of the European Union (example No. 4) criminal legal and forensic pharmaceutical risks depend on professionalism, awareness, competences persons responsible for incoming quality control of drugs.

Example from forensic and pharmaceutical practice No. 1. Criminal proceedings were instituted by the investigator of the Solomyansk police department of the State Police Department in Kyiv under the procedural guidance of the Solomyansk District Prosecutor's Office of the city of Kyiv regarding the illegal activities of a group of individuals. Conducted illegal circulation (forwarded, accounted for, stored, transported, distributed, sold) on the territory of Ukraine falsified drugs under part 2 of Art. 321-1 of the Criminal Code of Ukraine [68].

During the investigation, it was established that on May 16, 2023, a group of citizens was exposed in the city of Kyiv, who were involved in the illegal circulation of falsified drugs of the oncology group, which came to Ukraine from abroad. Criminals developed and organized schemes for the illegal circulation of falsified medicines of the oncology group on the territory of Kyiv and other cities of Ukraine. Criminals accepted orders from citizens through the online pharmacy form. The cost of falsified medicines was UAH 46.5 thousand per 1 package.

On the basis of the court order, in order to search for falsified drugs, to record information about the circumstances of the commission of a criminal offense, criminals were searched at places of illegal storage of falsified drugs. The following products were seized:

- large number of drugs with visual signs of falsification;
- quality certificates of unknown origin;
- draft records, cash, computer equipment, mobile phones and other evidentiary items.

Referred to forensic pharmaceutical examination. The expert's opinion confirmed that the medication packaging does not correspond to the sample of the original drug. Citizens involved in the commission of a crime have been notified of suspicion under Part 2 of Art. 321-1 of the Criminal Code of Ukraine and a preventive measure was chosen – detention. Investigations are ongoing.

Example from forensic and pharmaceutical practice No. 2. The leadership of the State Service of Medicines and Narcotics Control of Ukraine reported the circulation (sale) of the falsified drug AVASTIN 400, concentrate for solution for infusions (Fig. 3).

The drug was purchased in Ukraine by specialists of Roche Ukraine LLC through the Internet [69]. The drug is prohibited for circulation in Ukraine (supply, transportation, storage, sale, use).



Fig. 3. Specialists of "ROSH Ukraine" LLC discovered through the Internet the falsified drug AVASTIN in illegal circulation and bought it, which was reported to the control authorities [69].

At the same time, specialists of the State Service of Ukraine for Medicinal Products and Drug Control reported that they received a letter from Roche Ukraine LLC regarding:

- ✓ detection of a counterfeit series of AVASTIN 400 mg/16 ml in circulation in Ukraine. Manufactured in Switzerland by F. Hoffmann-La Roche Ltd, Basel manufacturing site Kaiseraugst;
- ✓ the manufacturer confirmed that the drug is falsified with labeling in English for the countries of the Far East;
- ✓ the owner of the Avastin registration certificate in Ukraine, Roche Ukraine LLC, purchased a counterfeit drug as a test purchase via the Internet;
- ✓ the original series of Avastin was imported to Georgia and Kosovo in February-March 2020;
- ✓ on the packaging of the falsified drug, significant differences were found regarding the quality of printing, font, location of information, shape of the box; missing information about the supplier and signs to protect against counterfeiting;
- ✓ officially, the drug Avastin of the specified series was not supplied to the territory of Ukraine and was not in circulation.

Example from forensic and pharmaceutical practice No. 3. The leadership of the State Service of Ukraine for Medicinal Products and Drug Control reported the detection of a falsified drug Omnitrop, a solution for injections (Fig. 4). According to the representative of the owner of the registration certificate in Ukraine, Sandoz Ukraine LLC, the drug is falsified [70].

In a message from the security department of Novartis companies, noted that:

- the original drug Omnitrop, a solution for injections, was produced for the Ukrainian market in the amount of 4,819 packages. It was fully delivered to Ukraine as part of state procurement in February 2020;
- the drug arrived from Spain without secondary packaging and instructions for medical use, as well as without observing the conditions of the cold chain marked on the Omnitrope bottle;
- the original drug was produced in October 2019. It had secondary packaging and was accompanied by instructions for medical use;
- the manufacturer of the drug confirmed the falsification. The drug does not contain the active ingredient somatropin. The manufacturer classifies this case as a confirmed fake.

The level of interaction, coordination of efforts, efficiency and scale of operative and investigative, forensic and pharmaceutical, expert and criminological work of Europol employees, law enforcement agencies and prosecutors in combating the circulation of falsified drugs

in the countries of the European Union is of interest, as evidenced by the example from the forensic and pharmaceutical practice No. 4.



Fig. 4. During the monitoring of the Internet, the security department of "Novartis" discovered the falsified drug Omnitrope 5 mg/1.5 ml in circulation, which was sold through the Internet site and made a test purchase in Spain.

Example from forensic and pharmaceutical practice No. 4. The SHIELD IV operation was coordinated by Europol criminal analysts [71]. Between April and October 2023, law enforcement agencies from Italy, France, Greece and Spain, judicial, customs, medical and anti-doping authorities from 30 countries on 3 continents focused their efforts on combating the trade in falsified medicines and banned doping substances.

Trade in falsified drugs is becoming an increasingly urgent problem in the European Union. The SHIELD IV investigation revealed the following:

- ❖ the model of large-scale human trafficking, which is very profitable for organized crime, encourages more criminal groups to enter the trade;
- ❖ trade – a sphere of crime that causes significant costs to the health care sector, the pharmaceutical sector, and causes negative consequences for the health of the population;
- ❖ illegal suppliers of drugs continue to advertise doping substances on the Internet, targeting non-professional athletes and members of limited or private sports groups;
- ❖ along with performance-enhancing products, erectile dysfunction drugs are offered through dubious channels on the Internet and remain one of the most counterfeits seized by law enforcement agencies;
- ❖ uncontrolled use of drugs and doping, especially counterfeit products, can cause serious and irreversible bodily harm.

According to the results of the "SHIELD IV" operation, law enforcement agencies performed the following:

- ✓ 1,284 persons have been charged (296 arrested and 988 are being prosecuted);
- ✓ criminal activities of 52 organized criminal groups were investigated;
- ✓ total amount of confiscated products exceeds 64 million euros, including:
- ✓ 636,263 illegal packages of drugs;
- ✓ 69,255 kilograms of powders and raw materials;
- ✓ 11,551 liters of active substance;
- ✓ 121,503 vials and ampoules;
- ✓ more than 12 million tablets and pills;
- ✓ 4 underground laboratories were dismantled;
- ✓ 92 websites on the Internet were closed;
- ✓ 3,935 inspections were carried out;
- ✓ 4,321 anti-doping "competitive" controls were conducted;
- ✓ 3,659 out-of-competition anti-doping tests were conducted.

The analysis of the given examples from forensic pharmaceutical practice (No. 1-4) shows the following:

- the activity of specialists of the State Service of Ukraine for medicines and drug control needs improvement;
- needs to increase the level of interaction of the State Service of Ukraine for medicinal products and drug control with the national police of Ukraine, Security Service of Ukraine (SSU), NDEKTS, tax service, forensic medical service and public organizations;
- criminal and legal mechanisms for combating the circulation of falsified drugs in Ukraine are not yet sufficiently effective;
- consideration of the issue of increasing the criminal liability of members of criminal groups under Part 3 of Art. 209 of the Criminal Code of Ukraine – legalization (laundering) of property obtained through crime. The authors of the article proposed the following revision.

Actions provided for in part one or two of this article, committed by an organized group or on a particularly large scale, **or if they caused the death of a person or other serious consequences,**
shall be punished by imprisonment for ten to fifteen years or life imprisonment with confiscation of property.

Stasenکو T. and Zarichkova M. have a separate opinion [72]. It is believed that the pharmacy is the last link in the circulation chain. Today, the pharmacy is responsible for cases where patients receive falsified medicines. A pharmacist must be aware of counterfeit circulation issues.

In Ukraine, there is also a problem with the circulation of falsified drugs. Counterfeit drugs of foreign and domestic production reach pharmacies [73]:

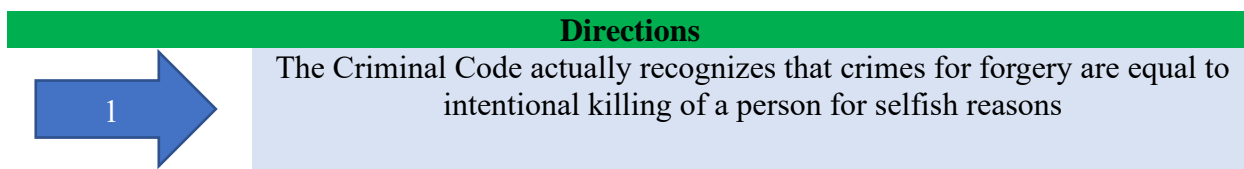
- medicines for which there is a demand;
- seasonal nature of the appearance of fakes on the market: in the cold season – antiviral, antibiotic and vitamin preparations, in the warm season – antihistamine, antidiarrheal and anthelmintic.

When buying drugs at a pharmacy, the consumer should pay attention to:

- ❖ packaging and markings must include the name of the manufacturer, series and expiration date;
- ❖ the packaging must contain instructions in the national language regarding use;
- ❖ the name must be written in Braille on the secondary packaging;
- ❖ manufacturers put protective holograms on medicine packages;
- ❖ tablets, ampoules should be of a certain shape, uniform in color, and not contain extraneous inclusions;
- ❖ upon request, the pharmacy must provide a quality certificate for a particular drug as proof that it is genuine and not falsified;
- ❖ it is necessary to request a fiscal receipt, which will indicate all the details of the pharmacy, the names of the drugs and their price;
- ❖ in case of suspicion that the purchased drug is fake, with the receipt and the drug, the citizen can request to check the quality of the product.

In Ukraine, as Ternova S. writes, falsified medicines are available on the Internet, end up in pharmacies and are even exported [74]. The scale of the falsification is hidden. Prices will be high on legal pharmacy sites. For example, 90-100 thousand UAH, and for others – 13-20 thousand UAH for the same drug. Unregistered medicines are the most falsified.

Directions for combating falsification of drugs are shown in Fig. 5.



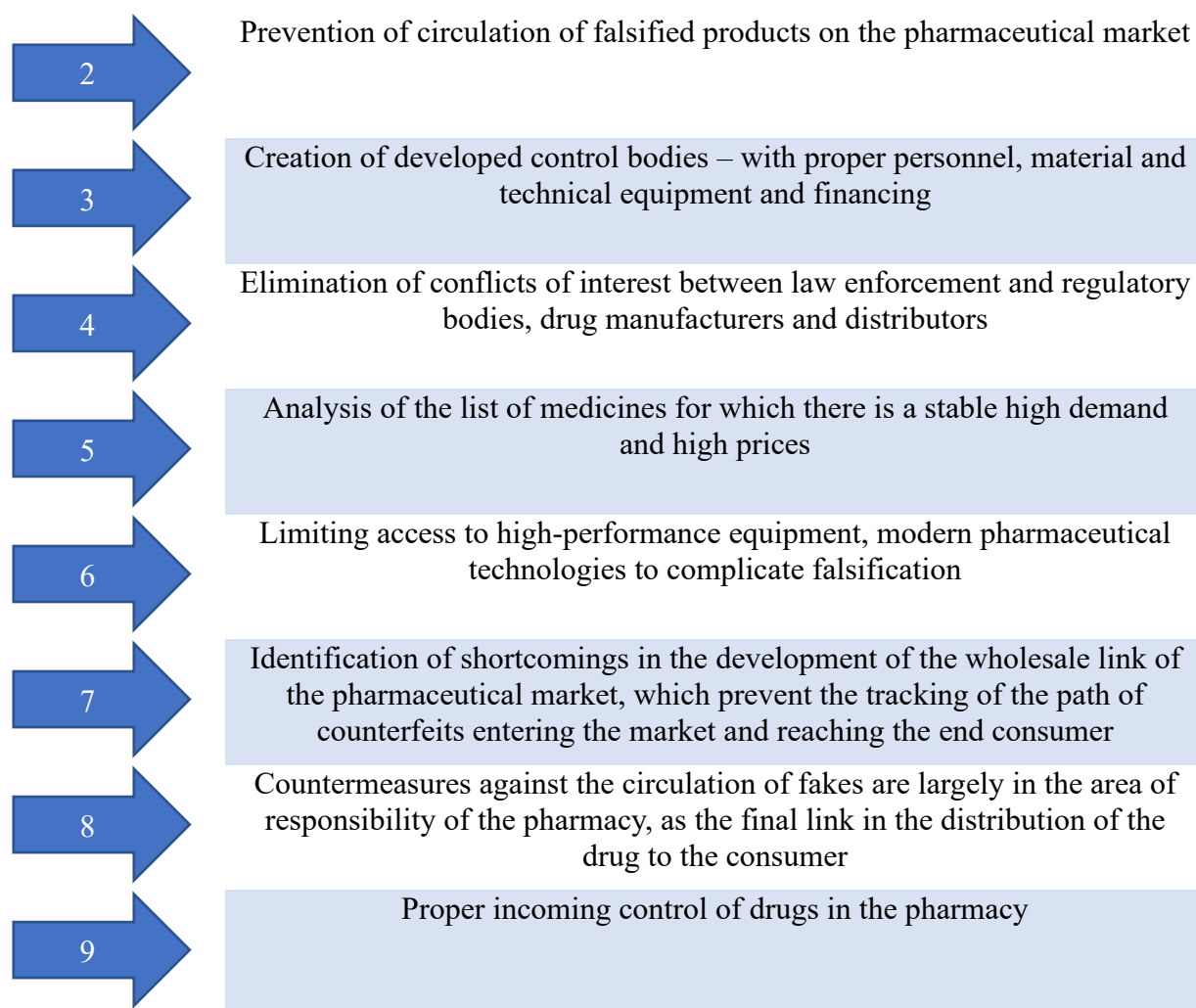


Fig. 5. Directions of combating falsification of drugs.

According to Lavrov R.O., the main factor affecting the distribution of counterfeit drugs in Ukraine is the presence of interest from international smugglers [75]. Here are the factors on which the fight against the circulation of falsified drugs depends (Fig. 6).

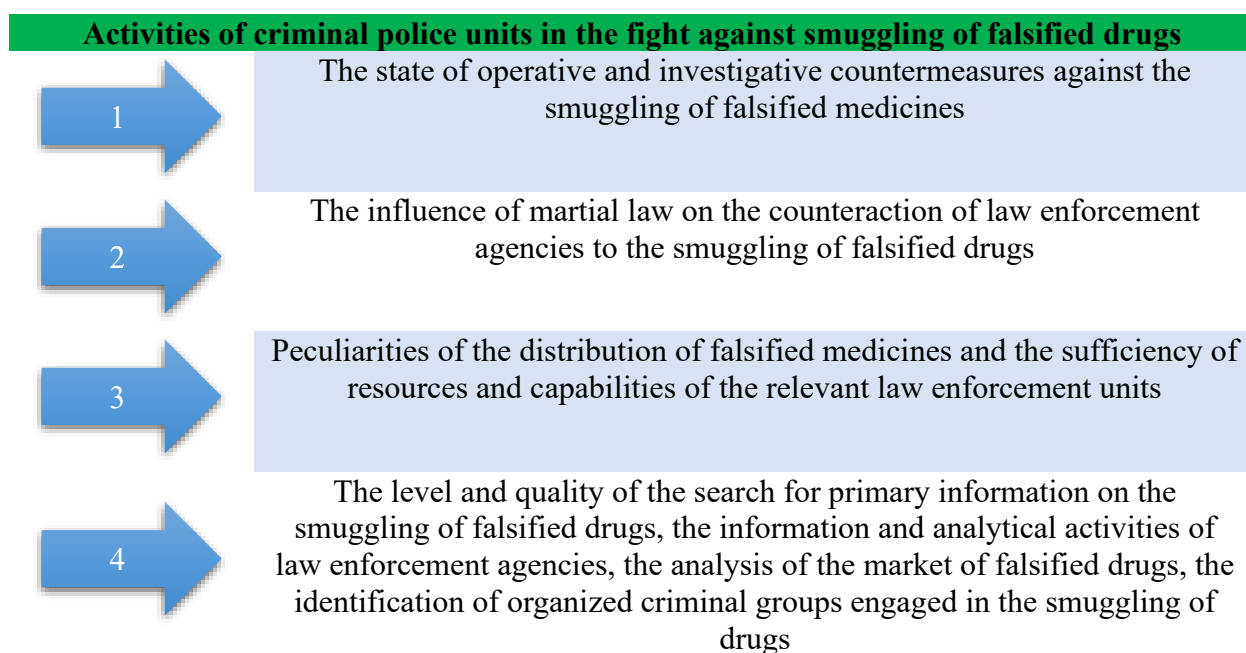


Fig. 6. Factors against the circulation of falsified drugs.

As UN experts note, falsified medicines and medical products are produced in many countries [19]. Low- and middle-income countries have the highest share of low-quality and falsified medicines. And also, on countries located in zones of conflicts or civil unrest.

It is possible to detect a falsified drug independently by visual signs:

- checking the packaging and instructions for use of the drug for the presence of spelling, grammatical and other errors;
- reconciliation of manufacturing date – expiration date;
- ensuring compliance of any details on the outer packaging with the dates indicated on the inner packaging and instructions for use;
- absence of color change and unusual smell, presence of sediment in ampoules;
- discussion with a pharmacist, doctor, lawyer that the drug does not work, has significant side effects;
- report suspicious drugs to the national body for regulating the quality of drug circulation.

Combating the circulation of falsified drugs requires the implementation of modern quality control methods. The national drug verification system has stages [76]:

- 2023 – a memorandum on cooperation between the Ministry of Health of Ukraine and relevant stakeholders was signed. The Ministry of Health of Ukraine undertook to create the necessary regulatory framework, and the associations of domestic and foreign manufacturers – the national organization for the verification of drugs after the adoption of the relevant regulatory framework;
- 2024 – the draft resolution of the Cabinet of Ministers of Ukraine (CMU) "Some issues of safety and verification of medicinal products" was finalized [77].

It was proposed to approve:

- regulations on the national system for drug verification. The basic foundations for the creation and functioning of the Ukrainian national organization for drug verification have been laid;
- the procedure for applying safety measures to the packaging of the drug. Defines technical and other requirements.

2024-2025 – implementation of the verification system from January 1, 2024 to January 1, 2026. Nothing changes for manufacturers. They carry out their activities in accordance with the current regulation of the circulation of medicines.

A national drug verification system is being created.

2026 (from January 1, 2026) – on a voluntary basis, it will be possible to use safety measures on drug packages. In most EU countries, which have introduced a verification system, it is forbidden to open the secondary packaging of medicines.

2028 (from January 1, 2028) – a mandatory requirement to apply safety measures on drug packages will come into force. Prescription drugs will not be able to be circulated.

Organized crime does not stand still. Criminal phenomena are constantly developing. The activities of organized crime and organized criminal groups are changing. In the digital society, very different organized criminal groups with different organizational models coexist: from online cybercrime to traditional organized criminal groups and hybrid criminal groups [78, 79].

Today, in the countries of the world, an organized criminal market is associated with the trade in falsified medicines. According to Bottoni P., Caroli S., drug business and prostitution are surpassed by the most profitable business in the field of health care related to the legalization of proceeds (money laundering) obtained through criminal means [80].

Obstacles in the fight against falsified drugs, as noted by Nayyar G.M.L., Attaran A., Clark J.P., Culzoni M.J., include the following areas [81]:

- lack of consensus on definitions;
- lack of reliable and scalable technologies (analysis methods) to detect falsification before falsified medicines reach patients;
- poor international and national leadership and organization of the accountability system for combating and countering the circulation of counterfeit goods,

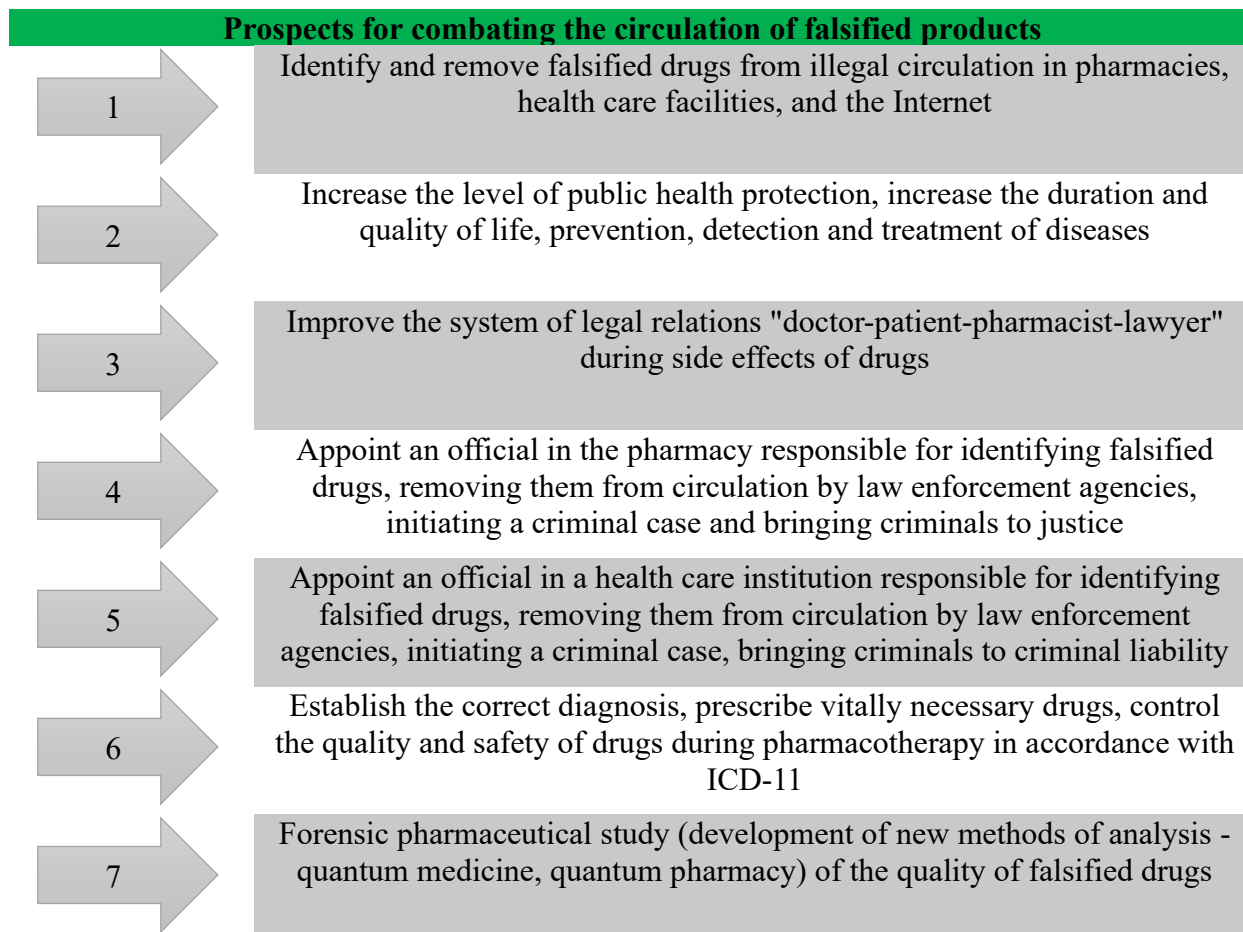
- insufficient regulatory and normative legal measures to combat counterfeit production (for example, China, India).

The main urgent needs that need to be solved and directed to ensuring the quality and safety of drugs in all countries can be divided into three areas (Table 1).

Table 1. The main urgent needs that need to be solved and directed to ensuring the quality and safety of drugs in all countries.

No.	Urgent needs
1.	Modern innovative research with the aim of developing and comparing the most accurate and accessible methods of analysis and tools for determining the quality and safety of medicines supplied to pharmacies and health care institutions
2.	Implementation of national legislation to the requirements of the international convention on promoting the production and use of high-quality and safe drugs and protecting all countries from criminals and non-professional citizens (offenders) who circulate falsified products (manufacture, transport, store, distribute, sell, sell, etc.) dangerous for human life and health
3.	Identification of an international organization WHO, UN, FDA, INTERPOL, which has adequate international support, for: <ul style="list-style-type: none"> - establishment of standards and educational programs; - ensuring effective supervision during circulation of the quality of medicines; - providing authoritative guidance to countries in collaboration with national health regulatory authorities, pharmaceutical companies and international agencies, all of whom have a pressing interest and investment in ensuring that patients around the world have access to quality and safe medicines

Prospects for counteracting the circulation of falsified products are shown in Fig. 7.



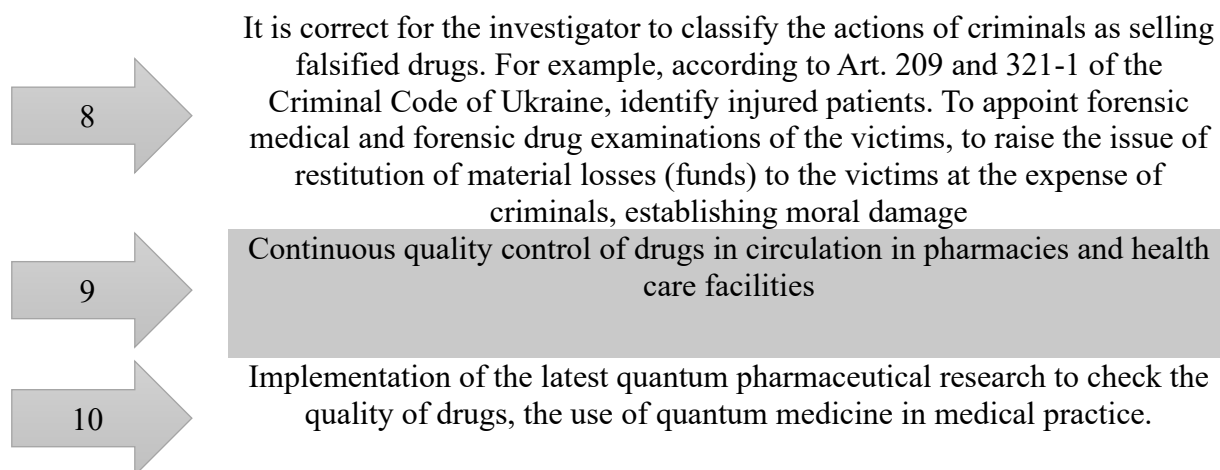


Fig. 7. Prospects for counteracting the circulation of counterfeit products.

Today we have the introduction into medical practice of a new promising direction of practical medicine – quantum medicine. As V.F. Moskalenko, S.P. Sitko, E.N. Horban, B.P. Hrubnyk, and Yanenko A.F. note. Quantum medicine is based on fundamental principles of living physics. It is carried out on the basis of the scientific research center of quantum medicine "Vidguk" of the Ministry of Health of Ukraine (Main – 73.10.0 Research and development in the field of natural and technical sciences (main) [82]. The basic of the known technologies of quantum medicine is microwave resonance therapy. It uses the influence of low of intense electromagnetic radiation in the millimeter range on active points and zones of the human body, which leads to the correction of disturbances in the body's electromagnetic field (the so-called electromagnetic frame). It helps to eliminate the metabolic changes caused by these disturbances.

In modern conditions, as Bisiani J., Anugu A., Pentyala S. emphasize, the interdisciplinary implementation of quantum physics in medicine is taking place. The growth and expansion of new scientific developments has great prospects for improving the quality of medical care, clinical research, diagnosis and treatment of diseases [83].

- ✓ The inclusion of quantum physics in medicine can allow effective diagnosis of diseases.
- ✓ Applying the theory of mathematical structures that describe the transmission of neurons through the brain and mind on a quantum scale can help doctors better understand psycho-neurological diseases in patients.
- ✓ Quantum theory can even provide plausible explanations for minor changes in DNA, shortening of telomeres in patients who develop cancer, HIV/AIDS, etc. disorders
- ✓ Implementation of quantum theory in medicine can help diagnose and treat social diseases (infections, Alzheimer's disease, cancer, allergies, immune.
- ✓ Quantum physics may have a significant impact on the expansion of medical and pharmaceutical care in the near future.

EU researchers found that weak electromagnetic fields allow to "communicate" with human tissues and organs [84]. On the basis of this phenomenon, devices have been developed that allow treating a patient taking into account his age, individual characteristics, illness, etc.

A model was developed according to which the human body is surrounded by a kind of electromagnetic "framework" containing information about its condition and development [85].

The biofield refers to the radiation of a special type of energy inherent in all living things. Human electromagnetic radiation fits perfectly into the schemes of traditional biophysics. Living cells emit weak electromagnetic waves. Their components have an electric charge. Each molecule has its own, very weak magnetic field [86]. The movement of blood and lymph through the vessels is the movement of charged particles that interact with each other and with the vessel walls, attract and repel each other. All these complex and interconnected processes contribute to the "building material" of the body's electromagnetic framework.

Studies show that the most important information for our health is carried by waves of the millimeter range [87, 88]. In order to influence the human body (patient) at this level, it is necessary to "communicate" with it also with the help of these electromagnetic waves, which can convey the necessary information to the patient's body (individual organ). The hypothesis was soon confirmed: it turned out that patients react differently to electromagnetic radiation with a wavelength of 4-6 mm. Each patient's body responds to one special, individual frequency. Electroencephalogram, electrocardiogram changes. A feeling of warmth appears. This phenomenon was difficult to explain with the help of already existing theories of absorption of electromagnetic waves by living cells. It was suggested that resonance phenomena occur in the patient's body when an individual electromagnetic frequency is applied to the patient's organ.

And the essence of resonance emerges from the course of school physics: if the frequency of oscillations introduced from the outside coincides with the natural frequency of oscillations of the system, then their amplitude increases [89]. Scientists have observed the same phenomena when a person is affected by electromagnetic waves of a certain frequency. The effect of exposure increased from session to session.

During research, scientists from various fields of knowledge realized that they had discovered some unknown phenomenon in the field of interaction between living matter, the human body, pharmaceuticals, and electromagnetic waves [90-92]. It was established that the areas of the body that were directed to the electromagnetic radiation did not react, but the "high risk" zones – for example, the hand was irradiated, but the heart reacted. And some areas have always had increased sensitivity to the individual frequency of electromagnetic waves. Gradually, the study of these areas led to the belief that they correspond to acupuncture points.

Eastern medicine divides the surface of the human body into so-called sensitive meridians. Acupuncture points are located along the meridians. Acupuncture is an integral part of traditional Chinese medicine, which is about 3000 years old [93, 94]. The effect on these points and meridians gave the maximum effect. Modern research and the intuition of ancient sages have coincided.

Meanwhile, Eastern medicine provided the key to a completely new type of treatment and pharmacotherapy, called bioresonance or quantum therapy [95].

In the field of innovative developments, technologies and methods related to the field of quantum technologies, the field of so-called quantum medicine is occupied. The origin of this concept goes back to the concept of quantum biology. A branch of biology whose goal is to consider living systems from the standpoint of quantum theory. In the concept of quantum biology, the terms of quantum mechanics are used to describe biological processes and dynamic molecular structures: absorption of electromagnetic radiation of a certain frequency; transformation of chemical energy into movement; magnetoreception in animals and Brownian motors in many cellular processes. Quantum physics and quantum chemistry gave rise to quantum biophysics and quantum biochemistry. And among them – quantum physiology, quantum biology, quantum medicine. The term "quantum medicine" was introduced in 1994 as a realization of the fundamental concepts presented by the quantum physics of the living [96].

Currently, there are a number of medical technologies based on the concept of quantum medicine:

- electrotherapy;
- electron therapy;
- laser Therapy;
- proton therapy;
- plasma therapy;
- quantum therapy;
- frequency therapy;
- frequency wave therapy;
- electric field therapy;
- magnetic field therapy;
- bioresonance therapy;

- ☑ PEMF, Pulsed electromagnetic field therapy;
- ☑ ECCT, Electro-capacitive cancer therapy;
- ☑ oncologic electromagnetic therapy;
- ☑ TTF, Tumor treating fields;
- ☑ radio frequency therapy;
- ☑ ultrahigh frequency therapy.

All of the above types of therapy are based on the concept of quantum mechanics, quantum coherence, as the basis of the developing field of quantum medicine.

All aspects of the application of quantum theories and equipment, which are based on the principles of quantum physics, are applied directly to living, biological objects, consider the impact directly on biological objects.

The author of the article Yuriy Titarenko expands the scientific terminology and proposes to introduce the terms: Bioquantum therapy and Bioquantum medicine into the scientific circulation.

The medical work of doctors and other specialists in medicine and pharmacy begins in health care institutions with the use of bioresonance therapy devices. After consultation with a specialist, you can use it yourself.

- ❖ The individual frequency of electromagnetic waves affects different parts of the patient's system and organs.
- ❖ Control the patient's reactions to different wavelengths. In some cases, the patient's own sensations are also guided: does he feel warmth and tingling.
- ❖ After establishing the individual frequency of electromagnetic influence, the patient undergoes a course of procedures.
- ❖ The complex of quantum technologies and pharmaceuticals affects the disease at once in two directions – from the outside and from the inside. The patient's recovery time is shortened.
- ❖ Today, the authors proposed the use of equipment in medicine: proton-plasma device "ProtonPlasmaTherapy", frequency-wave device "BICOM Optima".
- ❖ The authors of the article used a combination of quantum therapy and pharmaceuticals with radiocontrast and plasmacontrast effects. Pharmaceutical preparations must meet the requirements of good GxP practices.

According to literature sources of 2014, Pogotova G.A. and Chekman I.S. emphasize the fact that thanks to achievements in the field of quantum physics, quantum mechanics, chemistry, electrodynamics, computer technologies, molecular biology, physiology, biochemistry, pharmacology, clinical pharmacy, theoretical foundations have been laid that contributed to the development of a new direction – quantum pharmacology, i.e. quantum pharmacy [100].

Thus, the authors of the article note that quantum pharmacy (quantum pharmacology) is a science that applies:

- principles of theoretical and practical pharmaceutical chemistry, drug technology, physicochemical properties, analysis, quantum medicine, quantum physics and quantum mechanics;
- mathematical and computer modeling methods for studying the molecular structure of medicinal products;
- mechanisms of action of drugs during interaction with receptors, molecules, organs and systems of the human body (animals) to establish pharmacological action, adverse reactions;
- purposeful synthesis of biologically active compounds as a basis for the creation of new original drugs;
- development of new combined drugs (or with new indications for use);
- study of molecular mechanisms of action of pharmaceuticals during pharmacotherapy;
- study of the mechanisms of a complex of pharmaceutical preparations and microwave resonance therapy;

- prediction of pharmacological activity, detection of the most pronounced pharmacodynamic efficiency and therapeutic activity of new biologically active compounds, active pharmaceutical ingredients;
- detection of falsified drugs in legal circulation and their seizure in pharmacies and health care facilities.

The introduction of quantum medicine (quantum physics, quantum pharmacy, etc.) into forensic pharmaceutical, forensic medicine, forensic drug and forensic research as an element of the development of quantum medicine enables the development of quantum pharmacy as an element of preventing the circulation of falsified drugs. Record evidence of criminal activity. Detection of disorders due to the use of falsified drugs. Establishing cause-and-effect relationships according to the forensic evaluation criteria – mild, moderate, serious injuries or fatality. Preservation of the health of an individual patient suffering from oncological, psycho-neurological, narcological, HIV/AIDS and other health disorders in accordance with ICD-11.

On December 2, 2021, representatives of the State Service of Ukraine for Medicinal Products and Drug Control joined the celebration of the 10th anniversary of the MEDICRIME Council of Europe Convention on falsifications that threaten the life and health of the population [101].

- ✓ Agreement, ratification and harmonization of international legislation based on the MEDICRIME convention. It has been ratified in 18 countries, 4 of which are not members of the Council of Europe, and Congo and Tunisia have been invited to ratify the convention.
- ✓ Success at work during the COVID-19 pandemic.
- ✓ Growing demand for pharmaceutical preparations and medical products.
- ✓ MEDICRIME is the 1st international tool of criminal legislation, which provides recommendations for strengthening the responsibility for crimes involving the falsification of medicines and money laundering.

The State Service of Ukraine for Medicinal Products and Drug Control prohibits or allows recirculation of drugs in its documents [102, 103].

Business entities that carry out sales, storage and use of drugs should immediately check the presence of the specified series of drugs after receiving this order. In the case of detection of the specified drugs in circulation, take measures to remove them from circulation by placing them in quarantine. Notify the territorial body of the State Medical Service by location. Control over the implementation of this order is carried out by the territorial bodies of the State Medical Service according to the location. Failure to comply with this order entails responsibility in accordance with the current legislation of Ukraine.

With the mentioned standing orders and letters of the officials of the State Service of Ukraine for Medicinal Products and Narcotics Control about banning the circulation of a specific drug and permission to renew the circulation of all series of the drug, it is necessary to make changes to the regulatory framework. The State Service of Ukraine for Medicinal Products and Drug Control needs to increase the level of cooperation with the police, SSU, customs service, Interpol, DEA and PNU "Research University of Medical and Pharmaceutical Law" on the development of new methods of drug research, the annual publication "Counterfeit drugs", participation in annual conferences, implementation of the latest multidisciplinary digital medical technologies.

The authors of the article proposed the following normative measures:

- establish the administrative and criminal responsibility of officials of the State Service of Ukraine for medicinal products and drug control for actions or inactions related to the illegal ban on circulation of drugs or illegal permission for circulation;
- initiate before the deputies of the Verkhovna Rada of Ukraine to review and supplement the Law of Ukraine "On Medicinal Products" with Article 16.1. "On establishing the responsibility of officials of the central executive body implementing state policy in the field of quality control and safety of medicinal products", i.e. – ***Officials of the central executive body implementing state policy in the field of quality control and safety of medicinal products and other specialists – for the action or inaction related to the illegal ban on the distribution of drugs or illegal permission for distribution, they bear administrative or***

criminal responsibility.

The authors of the article suggested that the management private scientific institution in the field to contact with a proposal:

- State Service of Ukraine for Medicinal Products and Drug Control on the creation of a faculty on the basis of the University to develop and implement a program for improving the qualifications of officials of pharmacies and health care institutions of Ukraine responsible for the incoming quality control of medicinal products (1 time in 5 years);
- National Health Service of Ukraine, which, when concluding contracts with business entities under the medical guarantee program, requires the inclusion of the following clauses in the contract: appointment by order of an authorized person responsible for the incoming control of the quality, safety and effectiveness of drugs; ensuring incoming quality control of drugs at all stages of circulation and taking responsibility; improving the qualifications of officials responsible for the incoming quality control of drugs; Ministry of Health of Ukraine regarding initiation for health care institutions and pharmacies of all forms of ownership of the upgrading of the qualifications of officials authorized for the incoming quality control of drugs in order to combat the circulation of falsified products.

Conclusions. Quantum and medical, quantum and pharmaceutical technologies for counteracting forensic and pharmaceutical, forensic and medical, criminal and law consequences from the circulation of falsified drugs were considered. Health care institutions carry out the circulation of vital drugs in the system of legal relations "doctor-patient-pharmacist". They guarantee the consumer the quality, effectiveness, safety, availability of drugs of all clinical and pharmacological, classification and legal, nomenclature and legal groups. The criminal legislation of Ukraine establishes responsibility for the circulation of falsified "medicinal products". However, members of criminal groups avoid responsibility under Art. 209 of the Criminal Code of Ukraine. Therefore, the criminal and legal mechanisms for combating the circulation of falsified drugs in Ukraine are not yet sufficiently effective. Today, it is necessary to consider the issue of increasing the criminal liability of members of criminal groups under Part 3 of Art. 209 of the Criminal Code of Ukraine – legalization (laundering) of property obtained through crime. Needs to improve the quality of the investigation and qualification of crimes committed under Art. 321-1 of the Criminal Code of Ukraine. It is necessary to additionally qualify under Art. 209 of the Criminal Code of Ukraine and the article on forensic medical criteria for assessing harm to a patient's health (mild, moderate, severe or fatal consequences). It requires the identification of injured persons and the calculation of funds for damage to life and health. At the same time, the search for modern methods of analysis requires the introduction of quantum medicine (quantum physics, quantum pharmacy) into forensic and pharmaceutical, forensic and medicine, forensic and narcology, forensic and criminalistic researches, as an element of the development of quantum medicine. Enables the development of quantum pharmacy as an element of preventing the circulation of falsified drugs.

Conflict of interest. The authors have approved the article for publication and declare that the research was conducted in the absence of any conflict or potential conflict of interest.

Funding. The authors state, that this research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

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