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DOI: https://doi.org/10.32620/pls.2024.4.02

THE HISTORY OF DEVELOPMENT OF INTERNATIONAL COOPERATION OF UKRAINIAN FORENSIC SCIENCE INSTITUTIONS WITH FOREIGN SPECIALISTS IN COLLECTING, STUDYING AND PROCESSING HUMAN GENOMIC INFORMATION AND CONDUCTING MOLECULAR GENETIC ANALYSIS

Abstract. *The article deals with issues of organization and examination of physical evidence of biological origin (molecular genetic examination), which is becoming an increasingly relevant element in criminal proceedings.*

The authors stress that study and processing of human genomic information, as well as conduct of molecular genetic examination in forensic science institutions, which have been studied in Ukraine and abroad, can be considered in perspectives relevant issues of appointing and conducting molecular genetic examination in conditions of modern legal reality.

Keywords: *forensic examination, forensic science institutions, protection of human rights, European Court of Human Rights, national and international legislation, genome, genomic information, human biological material, DNA forensics, DNA identification, molecular genetic examination.*

1. Introduction

Forensic examination as a criminal procedural has long been firmly embedded in the practice of criminal justice. The development of modern justice is almost impossible without the use of special knowledge, skills and abilities possessed by forensic experts and specialists: holders of specialised competencies applicable in crime investigation [1, p. 168-201]. Developing and improving on the basis of the latest scientific and technical achievements, forensic examinations appear more and more often in criminal proceedings, helping to determine factual circumstances of a case [2, p. 90].

In the practice of law enforcement agencies of the Ministry of Internal Affairs of Ukraine, the main method of identifying a person is the study of papillary hand patterns. Thus, when committing a crime, persons use gloves, means clogging papillary patterns, as a result of which alternative methods of perpetrator identification are required. Dactyloscopy (fingerprint identification) is being replaced by molecular genetic examination, i.e. DNA research. As stated in Article 1 of the Law of Ukraine: On the State Registration of Human Genomic Information, human genomic information is human genetic traits and data about them; molecular genetic examination (research) for state registration of genomic information is research on biological material to obtain genetic traits of a person. All data received by authorized entities will be stored in a database of human genomic information: a collection of organized data on genomic information in electronic form [3].

Ukrainian law enforcement structures have been using certain types of genomic analysis in their practice for a long time. But now, in the context of armed aggression, this issue reaches a new level of development and use. After all, right now molecular and

genetic examination allows solving a number of urgent needs for identification of people who: committed a criminal offense; went missing; identification of unrecognizable human corpses, their remains and human body parts (this especially applies to our defenders who died on the battlefield or civilians who were in temporarily occupied territories). Thus, for example, only with the help of collecting and processing human genomic information, as well as carrying out molecular genetic examination, it was possible to identify the Ukrainians who died in Bucha (Kyiv region). Approximately two hundred people have not been identified yet. Their relatives cannot recognize them, that much their bodies have been mutilated by the Muscovites. That is why DNA testing is the only way out. It is carried out by French forensic experts along with our experts [4] (The body is completely burnt, it is impossible to recognize, 2022).

2. Literature Review

Particular issues of collecting, studying, and processing human genomic information, as well as conducting molecular genetic examination in forensic science institutions, were studied in research papers by such domestic and foreign scientists as O. M. Bandurka, Z. Bernachek, R. Kh. Bichurin, T. V. Hanzha N. M. Diachenko, A. Ivanovich, M. P. Klymchuk, O. V. Matarykina, H. V. Mudretska, V. V. Nevhad, M. V. Nechyporuk, A. Solash, H. O. Spytsyna, N. Ye. Filipenko, K. Shpindler, M. H. Shcherbakovskyi, G. Juodkaitė and others.

The problems of improving expert activity, the issue of collecting, studying and processing human genomic information as well as conducting molecular genetic examination in forensic science institutions can be studied from various viewpoints: for example, by analyzing the issue history, researching legal matters from a proper perspective, etc. Each of the indicated research areas is rather interesting and seems to be promising.

3. Main Content Presentation

The shift in EU policy towards a common forensic science area has become not only a decisive step in the development of forensic science, but has also highlighted the previously unidentified need for forensic harmonization and its role in ensuring human security. It is now recognized that only the harmonization of forensic science and law in general can guarantee the existence of the fundamental values of a democratic society: freedom and security [5, p. 354]. And this is a highly important postulate, especially when it comes to protection of an individual while collecting, studying and processing human genomic information as well as conducting molecular genetic analysis.

The shift in EU policy towards a common forensic science area has become not only a decisive step in the development of forensic science, but has also highlighted the previously unidentified need for forensic harmonization and its role in ensuring human security. For all the diversity of terminology used, we deem these concepts to be semantically related and will use them as synonyms.

As stated in Article 1 of the Draft Law of Ukraine On State Registration of Human Genomic Information [2], human genomic information is human genetic traits and information about them; molecular genetic analysis (research) for state registration of genomic information is study of biological material to obtain genetic traits of a man. All data received by authorized entities will be stored in human genomic information database: a set of sequenced genomic information data in electronic form.

Molecular analysis gives an answer to the question: what are molecules a test substance consists of? It is performed using gas chromatography and chromatography of high pressure fluids, chromatography spectrometry and molecular mass spectrometry, molecular spectral analysis [6, p. 34-36]. DNA analysis is a perspective modern method widely applied by Interpol and forensic laboratories around the world. There are two directions in DNA profiling: the first is correspondence of biological samples found at a crime scene and received from the suspect who committed this crime; the second is the establishment of family ties by DNA nature (continually used in civil cases to establish paternity) [7].

In case of performing a retrospective analysis of the origin and development of molecular genetic analysis (or, as it is called, DNA fingerprinting) and creation of specific databases, it can be stated that in fact the first forensic DNA database was created between 1986-1987 in England when searching for a serial rapist and murderer (when two teenage girls, three years apart from each other, were raped and killed in Leicestershire). Then, in a short term, in two neighboring towns the police collected blood samples of the whole male population of the corresponding age group (about 5 thousand people) who agreed to hand it over voluntarily. This was the first case of DNA fingerprinting in practice to apprehend a criminal. Unfortunately, the undertaken activities did not produce a positive result as the suspect fraudulently replaced his own blood with another person's biological material. This manipulation was exposed a few years later. This entire case, which is considered to be the first application of DNA analysis in criminal investigations, is described in the book "Blooding", by Joseph Wambough [8].

Given the significance of possession of such information by law enforcement, DNA databases based primarily on the so-called single-locus VNTR polymorphism that can be conditionally viewed as the first generation of commonly used markers for DNA profiling. Step by step, information on DNA polymorphism of criminals was accumulated at the scene, and a number of laboratories stored DNA profiles based on VNTR loci for a total of more than 5,700 individuals in the United Kingdom until 1995. In April of the same year, the National DNA Database (NDNAD) of England and Wales was launched becoming the world's first nationwide DNA database based on the second generation of STR locus markers. The launch of such a database was preceded by adoption in 1994 by the British Parliament of the Criminal Justice and Public Order Act, which became a legal basis for the NDNAD. This law let the police to take DNA samples without the consent of any person accused of committing an offense classified as "registered" as well as search for information in a database of relevant DNA profiles. By December of the same year, 1995, NDNAD already stored 19,000 DNA profiles and exposed more than 100 criminals while searching the database, due to

matching polymorphism data of their DNA with stored ones in this database. The experience of applying the British national forensic DNA database shows an average increase of 60% in detection and a 3–4 times [9] increase in detection of petty offenses.

Considering the cutting-edge experience of England in detection of criminal offenses and felonies, similar forensic DNA databases were launched in the European Union and other countries. To date, forensic DNA databases are already used in 69 countries of the world, and in 34 countries databases are at different stages of development [10]. For example, one of the first such databases was launched in 1996 in Northern Ireland, Scotland and New Zealand. In 1997, they were launched in the Netherlands and Austria; in 1998: Germany. In 1998, a DNA database was launched in Slovenia; in 1999: Finland and Norway; in 2000: Denmark, Switzerland, Sweden, Croatia, Bulgaria; in 2001: France and the Czech Republic; in 2002: Belgium, Estonia, Lithuania, Slovakia; in 2003: Hungary and Latvia [11].

Interpol has its own automated genetic database, the DNA Gateway, which contains DNA profiles provided by member countries. DNA Gateway was launched in 2002 and stores more than 242,000 DNA profiles from 85 member countries [12]. Unlike other databases, the DNA Gateway is applicable only to compare and share information and does not allow to identify a particular person because it does not contain personally identifiable information. It functions as a stand-alone database and is not linked to other Interpol databases.

In the late 1980s, in the USA, a number of states decided to launch similar DNA databases and when some other states followed their example, the FBI developed the Combined DNA Index System (CODIS), which enabled to exchange data and use it by other states and first was applied in court in 1991 in Minnesota. In 1992, the US Armed Forces Institute of Pathology launched a DNA bank designed to identify the military personnel killed in Iraq during operation Desert Storm of 1991. The peculiarity of this repository is that it stores blood samples of servicemen but not their DNA data that are obtained as unidentified remains found during military operations become available.

The analysis of the CODIS system that has been operating in a pilot mode since 1990 showed that as of October 1993, a total of 141,870 DNA samples of criminals analyzed on the basis of VNTR polymorphism had been collected in several states involved in this tested system. At the same leader's time, true turned out to be California and Virginia with 37 and 70 thousand DNA profiles accordingly. By December 31, 1993, legislative decisions on the operation of DNA databases had been adopted in 19 US states. A prominent role in further development of such DNA databases and their dissemination throughout the United States was played by the DNA Identification Act dated 1994. By the end of 1997, the CODIS database had increased by another 85,000 samples presented as VNTR loci. And at the time of the transition of the CODIS system to another type of polymorphism in the form of STR-loci in different US states, in aggregate there were more than 230 thousand records of VNTR polymorphism as of July 1998.

As a result, DNA databases based on STR polymorphism began to appear in the USA. The basis for operation of the new national DNA database in the USA is the Law on DNA Identification (42 USC §14132) dated 1994, which enshrined the creation of the National DNA Index System (NDIS) consisting of convicted offender, arrestees, legal, detainees, forensic [casework], unidentified human remains, missing persons, and relatives of missing persons. Similar databases have been launched at the local level (Local DNA Index System: LDIS) and the state level (State DNA Index System: SDIS) in compliance with state laws. All of them make up a single system called the Combined DNA Index System: CODIS (CODIS and NDIS Fact Sheet - FBI). Since July 2004, CODIS has been operating in the United States in all 50 states and the District of Columbia, although in October 1998, when the system was first launched based on 13 STR loci, it was applied for forensic purposes in only 9 states but already stored about 119 thousand DNA profiles some of which were received from previously available DNA samples, prior analyzed on the basis of DQA1/PM- and VNTR-loci.

CODIS was designed to compare a target DNA record against the DNA records contained in the database. Once a match is identified by the CODIS software, the laboratories involved in the match exchange information to verify the match and establish coordination between their two agencies. The match of the forensic DNA record against the DNA record in the database may be used to establish probable cause to obtain an evidentiary DNA sample from the suspect. The law enforcement agency can use this documentation to obtain a court order authorizing the collection of a known biological reference sample from the offender. The casework laboratory can then perform a DNA analysis on the known biological sample so that this analysis can be presented as evidence in court [2, p. 89-213].

Following the USA, the CODIS system based on 13 STR-loci was adopted in Canada in December 1998 and the relevant DNA database Canadian National DNA Databank (NDDB) was launched, but its first practical application took place in mid-2000. At the same time, The NDDB is very much similar to the three-tier CODIS system in the USA.

A United Europe also does not stand aside from collection, study, classification and use of personal genomic information. ENFSI members are 73 organizations (forensic science institutions, forensic laboratories) from 39 European countries [13]. It is the world's largest international organization of forensic science institutions that gained international recognition. Among the countries which institutions are a part of the European network are Armenia, Austria, Azerbaijan, Belgium, Bulgaria, Great Britain, Hungary, Greece, Georgia, Denmark, Spain, Ireland, Italy, Lithuania, Latvia, Montenegro, the Netherlands, Norway, Poland, Romania, Russia (The Council of the European Network of Forensic Institutions (ENFSI) made a decision to suspend the membership of the Russian Federal Forensic Center (Moscow) and the North-West Regional Forensic Center (St. Petersburg). The decision was taken at the initiative of the leadership of the Kyiv Research Institute of Forensic Expertise of the Ministry of Justice of Ukraine (KNDISE). In addition to the exclusion of forensic expert institutions of the Ministry of Justice of the Russian Federation, the ENFSI Council also made a decision to exclude all Russian scientists from the European Academy of Forensic Science (EAFS), as

reported by Penelope Mineati, Head of ENFSI, in a letter sent to KNDISE. "ENFSI views with Ukraine and especially with four Ukrainian member institutions of ENFSI. We hope that this senseless war will end without further casualties on either side," Penelope Mineati said in the letter. Victories on the scientific front: forensic expert institutions of the Russian Federation are excluded from international specialized organizations. Publication date: 20.03.2022. URL: https://lexinform.com.ua/v-ukraini/noviny-kompaniy/peremogy-na-naukovomu-fronti-sudovo-ekspertni-ustanovy-rosijskoyi-federatsiyi-vyklyucheni-z-mizhnarodnyh-profilnyh-organizatsij/), Serbia, Slovakia, Slovenia, Turkey, Ukraine, Sweden, Switzerland, etc. [14, p. 236-241].

The ENFSI Purpose declared in its Constitution is to be on the cutting edge of the world to ensure the quality of development and conduct of forensic examination across Europe. A core ENFSI activity is the organization's strive to earn credibility in the field of forensic science in Europe and the world by enhancing the quality of forensic services at all stages of court proceedings: from the scene to the court. It is supported by the following principles:

- ENFSI membership combines production, scientific and methodological capacities of forensic science institutions;
- expansion of ENFSI membership strengthens the credibility of this organization by law enforcement agencies and judges;
- business relations with other organizations associated with criminalistics and forensic science are established and maintained orderly;
- activities of all ENFSI member institutions are strongly encouraged (that actively implement modern research methods and international standards in forensic expert practice and ensure high level of expertise in forensic experts in particular types of forensic examinations) [13]).

The 31st ENFSI Annual Meeting organized by the Italian Forensic Science Police Service was held on May 29-31, 2018, in Rome (Italy); it was attended by representatives of 55 forensic science institutions from 31 European countries. Attention was drawn to exchange of experience and latest R&D projects in the following areas: DNA analysis, drug analysis, document verification, tools identification, ballistics and forensic visualization (face recognition, photogrammetry, police portraiture). When we mention the ENFSI network, it is important to state that ENFSI is a monopolistic institution of the European Union, which is responsible for the development of forensics in the member states of the European Union and the states that intend to become one. In 2009, the European Commission decided to grant ENFSI the monopoly status concerning forensic science in Europe (European Forensic Initiatives Centre – EFIC Foundation). The Commission tends to turns to ENFSI in situations when information or advice on forensic science is needed. Also, as a result of this decision the Commission has allocated some money for ENFSI to spend on various projects executed through specific action grants. As a monopolistic institution in the European Union in the field of forensic sciences, ENFSI started the EFSA 2030 project (European Forensic Science Area) at the beginning of 2022 (Vision of the European Forensic Science Area 2030). Through the aforementioned project entitled "Improving the Reliability and Validity of Forensic Science and Fostering the Implementation of Emerging Technologies", ENFSI has a vision to ensure the quality, development and presentation of forensic sciences with the imperative of foresight with the aim of recognizing scientific and technical-technological trends that will serve for the progress of forensic sciences in the years to come. The vision of EFSA 2030 aims to include the upcoming trends in forensic science in the application of new methods for solving (so far) unsolvable forensic issues, as well as the challenges brought by the application of new methods, techniques and technologies. The purpose of the vision is to harmonize and balance the development of forensic sciences, which will contribute to a more effective administration of justice in Europe. For the topic covered by this article, part of vision 2.2 is important, which regulates the handling of forensic databases, and therefore the DNA profile database.

2.2. Forensic data sharing across agencies and jurisdictions is ongoing and is predicted to increase in the future. Where relevant, the forensic community should study the differences in data collection methods and file formats which hinder the exchange of information, vital to maximizing the use of forensic analysis and comparison. ENFSI supports the harmonization of formats in datasets and offers tools to share reference data [2, p. 89-213].

Further study of professional literature helped to find out that apart from ENFSI there are other international organizations in the world today. They address the issue of the development and enhancement of forensic science activities, international cooperation in this field:

1. The International Association for Identification (IAI) is one of the largest and most authoritative professional forensic associations. Currently, IAI, which has become one of the most prestigious professional associations in the world, has more than 5,000 members from 69 countries. It is chaired by a 15-member Board of Directors headed by the President. The IAI has 29 standing committees, including on science and practice, scene research, fingerprinting, trace evidence analysis, forensic habitology, polygraph, forensic identification standards, international relations, etc. In addition, credible commissions for certification of forensic experts in seven specializations have been established. The association has 45 branches in various US states and other countries [14, p. 836].

2. The International Society for Forensic Genetics was created in 1989 in Germany to advance achievements of genetics in forensic science and justice. The Society has assumed the role of a leading organization in the field of forensic genetics and coordinates research on genetic markers for justice purposes. It was supposed that the opening of European borders within the EU could lead to increase in international crime rate, and forensic geneticists would need standard techniques of research and results documentation. At present, the society consists of the main laboratories of forensic genetics of leading forensic and forensic science institutions in European countries, such as Austria (Institute of Forensic Medicine), Belgium (National Institute of Criminalistics and Criminology), Denmark (Section of Forensic Genetics at the Institute of Forensic Medicine), Great Britain (Forensic Science Service, Institute of Cell and Molecular Science), Finland (National Bureau of

Investigation Forensic Laboratory), France (Forensic Sciences Institute, The Scientific Police Laboratory of Lyon), Germany (Institut für Rechtsmedizin, German Federal Criminal Police Office), Greece (Hellenic Police Forensic Science Division), Ireland (Forensic Science Laboratory of Police Officers), Italy (Institute of Legal Medicine of the Catholic University), Netherlands (The Netherlands Forensic Institute), Norway (Institute of Forensic Science), Portugal (National Legal Medicine Institute), Scotland (School of Chemistry of the University), Spain (Institute su medicine), Sweden (National Laboratory of Expertise)and Switzerland (Institute of Forensic Medicine). This group implements a significant project: creation of a DNA database of different populations [15, p. 65].

3. The International Crime Scene Investigators Association was established to assist individuals and organizations specialized in crime scene investigation. Scene investigation is complex and requires knowledge and skills in almost all forensic disciplines.

4. The Association for Crime Scene Reconstruction started to operate as an association of a group of experts in the states of Oklahoma and Texas (USA). These experts realized the necessity for a multidisciplinary investigation of a crime scene as a single whole object, which allows to recreate many elements of a criminal event, to detect and preserve physical evidence. Association members are representatives of law enforcement agencies responsible for crimes investigation, forensic experts and teachers. Currently, the association has more than 550 members [2, p. 89-213]. Among other things, the objectives of the Association's activity are as follows: encouraging exchange of information and procedures (techniques) vital for reconstruction of crime scenes; encouraging research of the existing and development of new improved methods of crime scenes investigation for reconstruction; promotion of educational programs designed to raise qualifications of forensic experts-practitioners in the field of crime scene reconstruction; provide association members with the opportunity of consultation with colleagues in particular cases; publication of a newsletter; enhancing cooperation and relations between agencies and representatives of different forensic science institutions; to ensure that association members can interact with forensic experts of various expert specializations within the association and to disseminate information about themselves [16, p. 218].

5. In 2015, Forensic Science Ireland adopted a strategic program for 2015-2018. Apart from plans on the improvement of forensic support of criminal justice bodies, creation of a DNA database and initiation of a number of organizational measures, further strengthening of international cooperation in the field of forensic science (FSI Strategic Plan 2015–2018) was planned.

These problems could be tackled and the full potential of point-of-care and mobile forensic analyses could be realized if measurement devices could be operated in an integral forensic network. Through the network, the necessary calibration and quality control measures could be taken that would enable reliable forensic instrumentation for assuaring further usage of findings as admisable and reliable evidence. The network would allow forensic experts to assess data generated outside the forensic laboratory and to provide direct assistance to the investigators on location (crime scene). From these activities, it also becomes apparent for which samples a more detailed follow-up examination is required at the forensic laboratory. The forensic expert capacity is thus used more effectively and findings can be fed into the platform creating a continuous cycle of platform and data development. This approach would combine central data gathering allowing forensic intelligence and knowledge management with rapid and efficient decentralized forensic analysis. This novel concept, although technologically challenging, could lead to a step change in the efficiency and efficacy of the forensic information gathering process. It could also cause a paradigm shift in the role of forensic institutes and forensic experts in the criminal justice system: a shift towards a new role for forensic institutes and laboratories as custodians of the forensic platforms and point-of-care and portable equipment and methods. It would also allow forensic institutes to develop powerful forensic intelligence tools to reveal potential case and evidence connections, to better understand criminal activities, to monitor and optimize policing, to improve the efficiency of forensic investigations and to assist in crime prevention and disruption [17].

For the effective usage of forensic databases not only proper legal bases are necessary but also bilateral agreements among states are vital. In order to combat terrorism in the most efficient way, seven countries of the European Union (Austria, Belgium, France, Germany, Luxembourg, the Netherlands and Spain) signed an agreement on May 27, 2005, in the city of Prüm in the Federal Republic of Germany, which ensures, in particular, the exchange of DNA profiles and fingerprints. The Council of the European Union accepted this initiative by adopting the Decision of the European Union Council 2008/617/JHA dated 23 June 2008 (Agreement 208/615) on the stepping up of cross-border cooperation, particularly in combating terrorism and cross-border crime. The agreement ensures interstate exchange of forensic data between EU member states in the field of DNA profiles, fingerprints and vehicle registration data.

Given the significance of this document, we would like to cite specific provisions of the Agreement, in particular those related to forensic databases. For example, Chapter 2 DNA profiles, fingerprint material and other data, Article 2 Establishment of national DNA analysis files stresses: Member States shall open and keep national DNA analysis files for the investigation of criminal offences. Processing of data kept in those files, under this Decision, shall be carried out in accordance with this Decision, in compliance with the national law applicable to the processing. For the purpose of implementing this Decision, the Member States shall ensure the availability of reference data from their national DNA analysis files. Reference data shall only include DNA profiles established from the non-coding part of DNA and a reference number. Reference data shall not contain any data from which the data subject can be directly identified. Reference data which is not attributed to any individual (unidentified DNA profiles) shall be recognizable as such.

Article 3 Automated searching of DNA profiles:

1. For the investigation of criminal offences, Member

States shall allow other Member States' national contact points access to the reference data in their DNA analysis files, with the power to conduct automated searches by comparing DNA profiles. Searches may be conducted only in individual cases and in compliance with the requesting Member State's national law.

2. Should an automated search show that a DNA profile supplied matches DNA profiles entered in the receiving Member State's searched file, the national contact point of the searching Member State shall receive in an automated way the reference data with which a match has been found. If no match can be found, automated notification of this shall be given.

Article 4 Automated comparison of DNA profiles:

1. For the investigation of criminal offences, the Member States shall, by mutual consent, via their national contact points, compare the DNA profiles of their unidentified DNA profiles with all DNA profiles from other national DNA analysis files' reference data. Profiles shall be supplied and compared in automated form. Unidentified DNA profiles shall be supplied for comparison only where provided for under the requesting Member State's national law.

2. Should a Member State find that any DNA profiles supplied match any of those in its DNA analysis files, it shall, without delay, supply the other Member State's national contact point with the reference data with which a match has been found.

Article 7 Collection of cellular material and supply of DNA profiles

Where, in ongoing investigations or criminal proceedings, there is no DNA profile available for a particular individual present within a requested Member State's territory, the requested Member State shall provide legal assistance by collecting and examining cellular material from that individual and by supplying the DNA profile obtained, if: 1) the requesting Member State specifies the purpose for which this is required; 2) the requesting Member State produces an investigation warrant or statement issued by the competent authority, as required under that Member State's law, showing that the requirements for collecting and examining cellular material would be fulfilled if the individual concerned were present within the requesting Member State's territory. 3) under the requested Member State's law, the requirements for collecting and examining cellular material and for supplying the DNA profile obtained are fulfilled [18].

Meanwhile, it should be stressed that this Convention is open for accession by any member state of the European Union. After accession, acceding states will also be obliged to implement it into national legislation. As is apparent from the Agreement text, only member states have access to forensic databases (in the field of DNA profiles and fingerprints). However, candidate countries for accession to the European Union must thoroughly prepare to join the forensic database through the Prussian Agreement. That is particularly true for accreditation of forensic laboratories in the field of DNA profiles and fingerprint analysis in compliance with the ISO 17025 international standard.

If we consider domestic experience of processing human genomic material and conducting molecular genetic analyses, the widest network of forensic genetics laboratories is owned by forensic science institutions of the Ministry of Internal Affairs of Ukraine. In particular, molecular genetic analysis is performed at the State Scientific Research Forensic Center of the Ministry of Internal Affairs of Ukraine, scientific forensic science centers of the Ministry of Internal Affairs of Ukraine in the Kyiv, Kharkiv, Vinnytsia, Zaporizhzhia, Lviv, Mykolaiv, and Ivano-Frankivsk regions. The functions of keeping automated forensic records of human genetic traits are also fulfilled by the divisions of Expert Service of the Ministry of Internal Affairs of Ukraine [19, p. 175].

4. **Conclusions**

After analyzing the opinions of scientists and summarizing [2, p. 89-213] the above, we stress that for the development and effectiveness of measures of international cooperation of Ukrainian forensic science institutions with foreign experts in collecting, studying and processing human genomic information and conducting molecular genetic examination, the following should be undertaken:

Firstly, it is required to introduce an independent interstate system of forensic bodies that will help to identify and use internal resources of this system, of all interested parties, and significantly improve its efficiency. A unified scientific and technical policy will ensure more efficient use of scientific, personnel and financial resources, eliminate facts of unqualified or illegal use of forensic examination, minimize duplication in research planning, which, in turn, will allow directing financial and human resources to the development of new forensic technologies. Also, the efficiency of using existing opportunities relying on specialization of individual departmental, regional, state and international forensic expert groups will be enhanced.

In the general management structure of forensic science, modern high-tech, analytical hardware-software complexes that need significant material costs (e.g., DNA-running equipment, automated spectro analytical and computer complexes, etc.) may be most efficiently applied. And, finally, there will be a chance to create uniform on-site sample collections for the whole system, expert data banks, identification statistics based on expert evidence for individual identification and development of modern expert technologies.

Secondly, analysis of prospects for improving legal support for molecular genetic analysis expressed in legislative initiative will regulate the rule on the condition that participants of pre-trial investigation oppose the collection of biological material. The development of legal rules reflecting the interaction of state and private forensic science institutions is a vital direction for advancing forensic expert activity in today's reality.

The methodological relevance of the analyzed issues is realized both from the point of view of the theoretical and the practical component. In this regard, in conditions of modern legal reality, it is required to prioritize timely detection and objective assessment of a number of factors negatively affecting the key indicators of both law enforcement agencies and forensic expert work in forensic science institutions of Ukraine, and also the state of HR training system and the development of research in this field.

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Sample for citation:
Nechyporuk M., Spitsyna H., Ivanovic A. The history of development of international cooperation of Ukrainian forensic science institutions with foreign specialists in collecting, studying and processing human genomic information and conducting molecular genetic analysis. Propylae law and security: science. magazine. National Aerospace University named after M.E. Zhukovsky "Kharkiv Aviation Institute", 2024. No. 4. P. 24-30. DOI: 10.32620/pls.2024.4.02.