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USING THE METHODS OF GENETIC FINGERPRINTING FOR PERSON IDENTIFICATION AND FORMATION OF THE STATE GENOME DATABASE (INTERNATIONAL AND NATIONAL EXPERIENCES)

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Abstract. Person identification using the methods of genomic fingerprinting contributes to the distinction of individuals by their DNA samples. In some regional agencies of the Ministry of Internal Affairs of Ukraine, laboratories have been established and operate at research forensic centers that carry out identification following the human genome. Due to the lack of the necessary legislative framework in Ukraine, there was no unified national register – the state genome database, except for the DNA register of unidentified deceased persons. With the adoption in 2022 of the Law of Ukraine "On State Registration of Human Genomic Information", the relevant issue progressed at the legislative level. At the same time, many practical problems arose after. In order to solve them, it was decided to compare the international and national experiences.

Key words: person identification during martial law, law on identification, forensic examinations.

Introduction. The Free Encyclopedia defines forensic identification as the application of forensic, or criminalistic, expertise and technology to identify and study traces of biological nature at the scene of a crime or accident. Forensic evidence is used in pre-trial investigation.

The theory of forensic science and identification is based on two fundamentals: each person is unique and unrepeatable (Cole, 2009: 233-255). The uniqueness theory was proposed in the 19th century by the French criminologist Alphonse Bertillon. Moreover, one of the founders of scientific statistics, the Belgian biologist Adolphe Quetelet, concluded that nature never repeats itself (Sudovo-medychna identyfikatsiia). The above assumption was accepted as valid and supported by other biologists, but it was never scientifically proven. Experiments were conducted to confirm that no two fingerprints are the same. However, the results were unconvincing. Many modern criminologists agree that it is impossible to individualize a person by just one facto: fingerprints, bite, or handwriting. There are cases when forensic experts rendered biased decisions and neglected the exact results of other analyzes. Another noticeable drawback is that actual studies of physical evidence often produce ambiguous results and hence cannot be considered robust enough for the court.

Forensic science has paid much attention to the problems of conducting forensic examinations and the use of expertise in the investigation of offenses. One can suppose that the issue under consideration was studied sufficiently. Many domestic scientists, such as A. F. Volobuiev, V.A. Zhuravel, V.O. Konovalova, N.I. Klimenko, O.V. Oderii, O.S. Sainchyn, V.Iu. Shepitko, M.H. Shcherbakovskyi, and others, tend to believe that expertise is applied in two forms in criminal procedural activities: a) the use of expertise during individual investigative actions; b) within identification examination.

In particular, a person can be identified by fingerprints. Criminologists have analyzed the method someway, and it seems archaic. You can identify a person by photo or video recording using facial recognition technology, gait and voice analysis, questioned document examination (characteristic phrases, bias in words, and common mistakes), or by using other biometric technologies based on

other material evidence. Such methods are widespread in forensic science. At the same time, modern science claims that it is also possible to identify a person by the deoxyribonucleic acid of the human cell nucleus (DNA) extracted from blood cells, skin epithelium, hair, saliva, or sperm (Cole, 2009), as well as by gene fingerprinting or ear imprinting. In addition, a person can be identified by bite or mold of teeth, which is the subject of forensic dentistry. Features of the application of the mentioned methods are covered in detail in this scientific article.

The main part: Based on the research of genetic engineering, biologists, and histological analysis of the cell, in the late 70s of the last century, forensic scientists and forensic experts attempted to conduct identification examinations using samples of the person's cell and biological traces removed when examining the accident scene. The findings of the forensic medical examination were first presented in court in 1980. As early as 1989, the first person was declared not guilty through DNA analysis, and since then another 336 unjustly convicted were acquitted (Cole, 2009).

Forensic DNA analysis can be a beneficial assistant in forensic identification because nearly every cell in the human body has DNA strands, except for red blood cells. Deoxyribonucleic acid is found in two cellular organelles: the nucleus (nuclear DNA is inherited by the body from two parental DNA) and the mitochondria (mitochondrial DNA is inherited only from maternal DNA). DNA testing is applied in criminal investigations, homicides, and paternity determination to identify human remains after natural disasters or terrorist attacks, as well as to identify missing persons (John Marshall, 2001). In addition, DNA analysis is conducted to confirm the suspect's connection with the victim or the crime scene.

How the identification method works. If biological material suitable for DNA purification is found at the crime scene, it is collected, processed, and forwarded to the laboratory for analysis with a mandatory convoy. Such measures are necessary because they ensure the credibility of the results obtained and guarantee their recognition by the court. Proper collection and storage of biomaterials are essential. Evidence should not be compromised or corrupted in any way. Before packaging biological evidence, it must be dried and only then put in special paper bags. Plastic packages for biological material are strictly prohibited – plastic can damage DNA or provoke the accelerated development of bacteria.

DNA can be extracted from organic material such as sperm, blood, saliva, feces, urine, teeth, bones, and hair. Depending on the type of biomaterial collected at the crime scene, various tests are run for assumption and confirmation. Assumption tests are fast and highly accurate. They are specific to determine the possible type of biological fluid under examination. Confirmation tests give an accurate answer about the type of biological material under examination. In addition to organic material, DNA material can also be formed out of physical evidence. Human DNA is most commonly found on clothing, bedding, weapons, masks, or gloves. The person under identification leaves his DNA on these objects when he touches them or holds them in his hands. Such material evidence is regarded as one that does not have visible traces but may contain DNA of the skin epithelium, which remained on the item after touching. A forensic scientist can successfully extract DNA from biological material consisting of at least six cells (Touch DNA, 2013).

The United States of America is one of the first countries that has adopted the law on DNA database for DNA profiles. In 1994, the United States passed a law on the compulsory collection of DNA samples of persons convicted of crimes committed with the use of violence, which authorized the FBI to use the CODIS (Combined DNA Index System) registration system (Cole, 2009; The Verkhovna Rada of Ukraine, 2015).

The very process of DNA-based identification seems interesting to experts. Extraction is the first step in identification using DNA analysis. Extraction is applied to separate DNA molecules from the cell. The next step is quantification, which determines how many DNA strands have been extracted from biological material. Forensic scientists then apply amplification to create copies of DNA molecules. Isolation of a DNA sample for proper identification is called separation. Only by doing all

the above steps can the specialist complete the analysis and interpretation of the DNA molecule and compare it with known genetic profiles (DNA Evidence: How Its Done).

A DNA sample found at the crime scene is compared to a known DNA sample taken from a suspect or databases. CODIS (Combined DNA Index System) is the FBI database in the United States, which contains files of genetic profiles of offenders. The electronic database has three divisions: local, regional and national – NDIS (National DNA Index System). Data from CODIS and NDIS allow forensic scientists to compare DNA found at the crime scene with DNA samples from convicted criminals and with unknown DNA samples. Based on comparison results, law enforcement agencies develop a further plan of investigative actions. If the results are positive and the DNA samples under comparison match, the identification is considered complete. An unknown genetic profile is compared with those known from the population database, and the probability of an accidental coincidence is determined. The probability of an accidental match is the theoretical probability of any person's DNA match with the DNA samples under test. The case when the markers do not match is called an exception.

During DNA typing, several markers called loci are examined. The more markers analyzed, the greater the likelihood that two unrelated individuals will have different genotypes. As a result, the belonging of DNA to a particular individual will be more reasonable. One difference between the loci of the known and unknown samples is enough to disprove the suspect's involvement in the crime committed.

The FBI has identified 13 major loci of short tandem repeats (STR) the analysis and comparison of which are the most effective for person identification. STRs are short DNA sequences in the genome with lengths of 2-6 pairs of amino acids. STR analysis is widespread in forensics because loci are easily amplified by polymerase chain reaction (PCR) and they have unique variations and thus are effective for person identification. PCR is the technique of copying DNA by making millions of copies. When all 13 major loci are tested for coincidence with a known genetic profile, the probability of an accidental coincidence is one in a trillion (John Marshall, 2001).

The British database NDNAD is one of the most classic and, at the same time, largest DNA profiles database given the population (UK National Criminal Intelligence DNA Database), which was created in 1995 (Pertsev, 2021). Under the Police and Criminal Evidence Act 1984, the DNA Profiles Database records information on any person detained or arrested by the police on suspicion of committing a crime prior to indictment. Samples remained in the collection and were not subject to seizure, even if the case against a particular person was later closed due to a lack of evidence (Touch DNA, 2013).

In Israel, the national DNA database was created in 2007 by order No.14.5.05 of the Main Directorate of the Israel Police. Its use is governed by the Protection of Privacy Law 1981. Under Order No. 14.5.05, the recording and use of DNA profiles is carried out by the chemical and biological laboratory of the Main Investigation Department of the Israel Police. The laboratory is accredited and operates according to the international standard ISO/IEC 17025; it also uses the American CODIS system, which ensures the compatibility of data on record both in the Israeli police and abroad, allowing for verification of genomic information in Interpol and the US FBI (Pertsev, 2021).

On July 9, 2022, the Verkhovna Rada of Ukraine adopted the Law "On State Registration of Human Genomic Information" No. 4265, which is essential for the law enforcement system and forensic activities. According to the Government portal, the law regulates the creation and operation of human genomic information recording, improves the performance of law enforcement agencies in investigating crimes and identifying criminals, and improves the search for missing persons and the identification of unknown persons (The Verkhovna Rada of Ukraine, 2020).

Why is the Law important right now? Amidst martial law, the legal regulation of the mechanism for collecting, processing, and using human genomic information has become an urgent need for the rapid identification of criminals, search for missing persons, and identification of unidentified bodies. The Law enshrines that mandatory and voluntary state registration of genomic information will be carried out in Ukraine (Sergii Ionushas, 2022).

Mandatory state registration will relate to genomic information of:

– persons who committed (or were convicted of) intentional grave or especially grave crimes against the foundations of national security of Ukraine; human life, health, sexual freedom, and sexual inviolability; in the field of distribution of narcotic drugs; against the peace and security of mankind and international law and order;

– unidentified persons, their remains, and parts of the human body;

– persons who are unable to report information about themselves due to health, age, or other circumstances.

The right to voluntary state registration of genomic information will have all citizens of Ukraine, foreigners, and stateless persons at their own request.

State registration of human genomic information in Ukraine will occur in several stages:

– selection and storage of human biological material;

– conducting molecular genetic examination (research) of biological material;

– entering information into the Electronic Register of Human Genomic Information.

It is worth noting that the Electronic Register is state property, and its holder will be the Ministry of Internal Affairs of Ukraine, which should ensure the processing, preservation, protection, and provision of available human genomic information.

The positive aspects are as follows:

– the electronic register will improve the work of law enforcement agencies of Ukraine in the prevention, detection, disclosure, and investigation of crimes since the samples available in the register can be compared with samples of biological material found at the crime scene;

– it contributes to the search for missing persons, in particular, by comparing samples of next of kin with samples of biological material of discovered corpses or with such samples found at the accident scene;

– it simplifies the identification of unidentified corpses by comparing samples of biological material of the corpse and its closest relatives;

– voluntary state registration of human genomic information will allow everyone to search for close relatives, establish family ties, or even paternity (Sergii Ionushas, 2022).

In addition, the Law provides for a specific procedure for the mandatory collection of biological material during martial law from the military, police officers, members of the junior and commanding staff of the civil defense service, as well as members of volunteer formations of territorial communities (in peacetime, the collection will be carried out at the request of the person, that is, only with his consent). In martial law, the approach will allow, if necessary, conducting a molecular genetic examination of the deceased persons, and hence their families getting the body of the deceased defender for burial.

The law provides for the creation of an electronic register of human genomic information. Registration of information can be both state-mandatory and voluntary. Data from the register are not subject to disclosure. Mandatory state registration will be implemented at the expense of the state budget, and voluntary registration will be fee-based. The Ministry of Internal Affairs is designated as the holder of the database.

Issues regarding the specifics of the selection, storage and transportation of samples (biological material) for a molecular genetic test are settled following the procedure approved by the Cabinet of Ministers.

After the molecular genetic test, the genomic information, involving the registration card, is sent within 10 working days to the Administrator of the Electronic Register for its registration.

At the same time, the official of the law enforcement agency, who provides the Administrator with genomic information, fills out the registration card before sending it, in which personally identifiable information is depersonalized by assigning a unique alphanumeric code.

Genomic information is stored in the Electronic Register for 5 to 50 years. The relevant information is available for inquiry officers, investigators, prosecutors, heads of prosecutor's offices and pre-trial investigation bodies, persons authorized to carry out operative-search, counter-intelligence, intelligence activities, the investigating judge, the court, authorized persons of the National Central Bureau of Interpol, and bodies of foreign states in exceptional cases.

Conclusions. Summarizing the above, it should be concluded that there is still a lot of work ahead: subordinate regulations need to be adopted, and ministries and relevant departments need to bring their acts into compliance with the Law to make it efficient to the maximum. The first step in Ukraine on the long road to state registration of human genomic information has already been made (Sergii Ionushas, 2022). It is the results of the state registration of genomic information that will contribute to the identification of criminals; the search for missing persons; the identification of unidentified corpses, their remains, and body parts; the identification of persons who, due to their health, age, or other circumstances, are not able to report information about themselves. The above will make it possible to solve and investigate the most complex qualified murders and other serious, as well as especially serious, related crimes.

References:

1. Cole, S. A. (2009). Forensics without uniqueness, conclusions without individualization: the new epistemology of forensic identification. Law, Probability and Risk, no. 8 (3), pp. 233–255. ISSN 1470-8396.
2. Sudovo-medychna identyfikatsiia [Forensic identification]. Retrieved from: https://uk.wikipedia.org/wiki/%D0%A1%D1%83%D0%B4%D0%BE%D0%B2%D0%BE-%D0%BC%D0%B5%D0%B4%D0%B8%D1%87%D0%B-D%D0%B0_%D1%96%D0%B4%D0%B5%D0%BD%D1%82%D0%B8%D1%84%D1%96%D0%BA%D0%B0%D1%86%D1%96%D1%8F#cite_note-:3-2 (accessed 08.10.2022)
3. Butler, John M. (John Marshall) (2001). Forensic DNA typing: biology & technology behind STR markers. San Diego: Academic Press. ISBN 978-0-12-147951-0
4. "Touch DNA: From the Crime Scene to the Crime Laboratory". Forensic Magazine, April 12, 2013.
5. DNA Evidence: How Its Done. Retrieved from: www.forensicsciencesimplified.org (accessed 08.10.2022).
6. The Verkhovna Rada of Ukraine (2020) Proekt Zakonu pro derzhavnu reiestratsiiu henomnoi informatsii liudyny № 4265 vid 26.10.2020 [Draft Law on State Registration of Human Genomic Information № 4265 dated 26.10.2020]. Retrieved from: https://itd.rada.gov.ua/billInfo/Bills/Card/4382. (accessed 08.10.2022) (in Ukrainain).
7. Government Portal (2022) Parlament pryiniav Zakon «Pro derzhavnu reiestratsiiu henomnoi informatsii liudyny» [The Parliament adopted the Law "On State Registration of Human Genomic Information"]. Retrieved from: https://www.kmu.gov.ua/news/parlament-pryiniav-zakon-pro-derzhavnu-reiestratsiiu-henomnoi-informatsii-liudyny (accessed08.08.2022)
8. Sergii Ionushas (2022) Movchaznyi svidok [Silent Witness]. Retrieved from: https://www.facebook.com/sergii.ion/posts/pfbid02XZ8TMdoFh8KJ7npbNed9FouwjFjiXT8SDQtixddTRSusCFBQvjLPzpBu4J4ZiiDkl (accessed 08.10.2022)
9. The Verkhovna Rada of Ukraine (2015) Pro zatverdzhennia Polozhennia pro Ekspertnu sluzhbu Ministerstva vnutrishnikh sprav Ukrainy: nakaz MVS Ukrainy vid 3 lystopada 2015 r. № 1343 [Regulations on the expert service of the Ministry of Internal Affairs of Ukraine: order of the Ministry of Internal Affairs of Ukraine dated November 3, 2015 No. 1343]. Retrieved from: https://zakon.rada.gov.ua/laws/show/z1390-15#Text (accessed 09.10.2022)
10. Pertsev R. V. (2021) Formirovanie bazy dannyh geneticheskih profilej cheloveka i pravovoe regulirovanie ee ispolzovanie v Izraile [Formation of the database of human genetic profiles and legal regulation of its in Israel]. Forensic examination of Belarus. 1 (12).