Forensic DNA Registries Worldwide and in Ukraine: History of Formation and Development Prospects

Oleksii Lozovyi*

* Postgraduate Student, Yaroslav Mudryi National Law University of Ministry of Education and Science of Ukraine, Kharkiv, Ukraine, ORCID: https://orcid.org/0009-0009-5355-7842, e-mail: lozovoy2805@gmail.com

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This article purpose is to analyze emergence history, formation and content peculiarities of existing forensic DNA registries in the world and in Ukraine, outline possible development prospects. For achieving this goal, general scientific and special methods of scientific cognition (comparative law, formal law, forecasting, modeling, analysis and synthesis) were used. It was found that history of emergence, formation and specifics of content of forensic DNA registries have their own characteristics in each country and depend on many factors, including power regimes (authoritarianism as, for example, in China), historical past (cultural imprint of dictatorship and distrust of police, as in Portugal), state of human rights protection, etc. Genetic trait databases can be grouped according to various principles, the main ones being: completeness (number of available profiles), inclusion criteria (restrictive or expansive), efficiency coefficient. Formation analysis of Ukrainian DNA identification system indicates gradual transition from separate forensic examinations to centralized system creation, that in its structure and principles is close to European models of average completeness.

***Keywords**: forensic DNA registries; history of formation; development prospects; number of DNA profiles; inclusion criteria; efficiency coefficient.*

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Research Problem Formulation

Forensic DNA registries play leading role in modern justice system, transforming biological traces into objective evidence with the highest degree of reliability (up to 99.99%). However, this was not always the case. Forensic DNA testing is a fairly new type of expert research, but it quickly became the gold standard of evidence. Its scientific foundation was laid only in 1984, when the British geneticist Alec Jeffreys discovered the method of DNA profiling. History of emergence, formation and specifics of the content of forensic DNA registries have their own characteristics in each country and depend on many factors, including regimes of power (authoritarianism, as, for example, in China), historical past (cultural imprint of dictatorship and distrust of police, as in Portugal), state of human rights protection, etc. These factors, as collectively as individually, influence development and content of forensic DNA registries Analysis of these factors and understanding specifics of the content of DNA registries in the world will help to form in Ukraine the most effective model of maintaining relevant records, taking into account the experience and mistakes of foreign countries during their formation.

Analysis of Essential Researches and Publications

Ukrainian scientific literature considers modern means and methods of forensic DNA analysis (R. Stepaniuk and V. Husieva [1]), legal regulation of the registration of human genomic information (O. Lehka [2]), issues of regulatory regulation of State registration of human genomic information (N. Martynenko [3]), issue of using DNA registries to identify persons killed during Russian armed aggression against Ukraine (I. Kostikov with co-authors [4] et al.) and prospects for legislative support for genetic identification of military personnel (L. Kotliarenko and A. Kofanov [5]). Foreign sources cover the functioning forensic DNA records both in individual countries and in the world as a whole: formation history of DNA databases in Eu-

1 Степанюк Р. Л., Гусєва В. О. Сучасні криміналістичні засоби та методи протидії злочинності : навч. посіб. Харків, 2024. 232 с. URL: https://files.znu.edu.ua/files/Bibliobooks/Inshi78/0058151.pdf (date accessed: 01.03.2026).

2 Легка О. Правова регламентація реєстрації геномної інформації людини: міжнародний та вітчизняний досвід. *Науковий вісник Ужгородського Національного Університету. Серія: Право*. 2022. Вип. 72. Ч. 2. С. 71—76. DOI: 10.24144/2307-3322.2022.72.44 (date accessed: 01.03.2026).

3 Мартиненко Н. Проблеми нормативного регулювання державної реєстрації геномної інформації людини. *Copernicus. Political and Legal Studies.* 2023. Vol. 2. Is. 2. Pp. 68—79. DOI: 10.15804/CPLS.2023206 (date accessed: 01.03.2026).

4 Костіков І. Ю., Марійко В. В., Щербакова Ю. В. та ін. Молекулярно-генетична ідентифікація осіб, загиблих під час російської збройної агресії проти України: успіхи та проблеми. *Криміналістичний вісник*. 2023. № 1 (39). С. 10—28. DOI: 10.37025/1992-4437/2023-39-1-10 (date accessed: 01.03.2026).

5 Котляренко Л. Т., Кофанов А. В. Перспективи законодавчого забезпечення генетичної ідентифікації військовослужбовців. *Використання досягнень сучасної науки й техніки в розкритті злочинів* : мат-ли міжвідом. наук.-практ. кругл. столу (Київ, 25.02.2021). Київ, 2021. С. 73—77. URL: https://elar.navs.edu.ua/server/api/core/bitstreams/77ecfb89-3122-474f-8571-299f0fbfbf29/content (date accessed: 01.03.2026).

rope (*P. D. Martin* with co-authors [6]), DNA technologies in criminal investigation and courts (*H. Machado* with co-authors [7]), future directions of development of forensic DNA databases (*J. Ge* with co-authors [8]), influence of different national legal systems on the formation of DNA databases (*F. Corte-Real* [9]), analysis of admissibility of such databases by the European Court of Human Rights [10] (hereinafter referred to as *ECtHR*). At the same time, scientists have not conducted detailed comparative analysis of forensic DNA registries in worldwide and in Ukraine.

Article Purpose

Analyze history of emergence, formation and peculiarities of the content of existing forensic DNA registries in the world and in Ukraine and to outline possible development prospects.

Research Methods

For achieving this goal, general scientific and special methods of scientific cognition (comparative legal, formal legal ones, forecasting, modeling, analysis and synthesis) were applied. The comparative legal method contributed to the study approaches to formation of DNA databases in different countries. This made it possible to identify common and distinctive features of the formation of DNA databases in Ukraine and other countries. Using formal legal method, legal analysis of the provisions of regulatory legal acts (laws, instructions, orders) regulating activity of DNA registries was carried out. Forecasting method was useful for reasonably predicting possibilities of implementing individual provisions of foreign legislation regulating the activity of DNA registries into the legislation and practice of Ukraine. Combination of logical methods of analysis and synthesis contributed to the analysis of approaches to the formation of databases (inclusion of certain types of profiles in databases) based on various criteria and influence of various factors on the specifics of their content (government regimes, historical past, state of human rights protection).

Main Content Presentation

Discovery of DNA structure in the 1950s ushered in a new era in biology and paved the way for the search for ways to identify a particular living organism by its genetic characteristics. The first person to study a person's individual characteristics using DNA was British geneticist Alec Jeffreys in 1984, who discovered in the structure of nuclear DNA sections that were individual for each person and varied in length and could be isolated and compared. This

6 Martin P. D., Schmitter H., Schneider P. M. A brief history of the formation of DNA databases in forensic science within Europe. *Forensic Science International*. 2001. Vol. 119. Is. 2. Pp. 225—231. DOI: 10.1016/s0379-0738(00)00436-9 (date accessed: 01.03.2026).

7 Machado H., Granja R. Forensic Genetics in the Governance of Crime. Singapore : Palgrave Pivot, 2020. Ch. 4. Pp. 45–56. DOI: 10.1007/978-981-15-2429-5_4 (date accessed: 30.03.2026).

8 Ge J., Sun H., Li H., et al. Future directions of forensic DNA databases. *Croatian medical journal*. 2014. Vol. 55. No. 2. Pp. 163–166. DOI: 10.3325/cmj.2014.55.163 (date accessed: 07.04.2026).

9 Corte-Real F. Forensic DNA databases. *Forensic Science International*. 2004. Vol. 146. Suppl: S143–4. DOI: 10.1016/j.forsciint.2004.09.043 (date accessed: 21.03.2026).

10 Tuazon O. M. Universal forensic DNA databases: acceptable or illegal under the European Court of Human Rights regime? *Journal of Law and the Biosciences*. 2021. Vol. 8. Is. 1. 24 p. DOI: 10.1093/jlb/lsab022 (date accessed: 01.03.2026).

gave rise to development of a technique for studying human DNA for the purpose of its identification that was called: *DNA fingerprinting* [11].

Creation of database with DNA profiles began in the mid-1990s. The first forensic genetic database was established in England and Wales in 1995; this example was followed by the Netherlands (1997), Austria (1997) and Germany (1998) [12].

One of the most effective DNA profiling databases for solving crimes is the UK National Criminal Intelligence DNA Database (*NDNAD*). It was the first national DNA database in the world, created through legislation passed in the UK in 1995 [13]. In 2016, it contained 5,862,642 DNA profiles of individuals and 519,678 profiles recovered from crime scenes, i.e. profiles of over 9% of country population [14]. The UK database can be used not only for crime prevention and investigation, but for the identification of the deceased. It provides successful verification results for over 32,000 crimes per year. For example, according to scientists, in 2014-2015, probability that DNA profile from a crime scene will match a profile in the database was 63.2% [15]. This database contains information about any person detained by the police, even if their guilt is not confirmed. In addition, Scotland has a procedure for voluntary submission of DNA samples by citizens for the purpose of possible identification in future civil cases. Latest data indicate that as of March 2020, the number of profiles is more than 6 million, and the database contains 600 thousand from crime scenes that is equivalent to approximately 10% of the permanent population of Great Britain [16]. Thus, this country has collected the largest collection of genetic information of the population in Europe. In April 2004, UK legalized the storage of DNA information from all those arrested on suspicion of committing any crime. However, in December 2008, ECtHR concluded that such a practice of storing DNA information was a violation of human rights and recommended changes to the system of storing personal data [17].

It should be noted that the UK NDNAD is the largest in Europe: it contains DNA from over 10% of the population that en-

11 Степанюк Р. Л., Перлін С. І., Кікінчук В. В. та ін. Криміналістичне дослідження ДНК: технології та можливості : навч. посіб. Вид. 2-ге, перероб. та допов. Харків, 2022. 120 с. URL: https://dspace.univd.edu.ua/server/api/core/bitstreams/4a11e370-44d1-45ed-9838-dc0918c7c429/content (date accessed: 24.03.2026).

12 Machado H., Granja R. Op. cit. DOI: 10.1007/978-981-15-2429-5_4 (date accessed: 05.03.2026).

13 Martin P. D., Schmitter H., Schneider P. M. Op. cit. DOI: 10.1016/s0379-0738(00)00436-9 (date accessed: 01.03.2026).

14 Степанюк Р. Л., Перлін С. І., Кікінчук В. В. та ін. Зазнач. твір. URL: https://dspace.univd.edu.ua/server/api/core/bitstreams/4a11e370-44d1-45ed-9838-dc0918c7c429/content (date accessed: 04.04.2026).

15 Brown T., Geddes L., Gill P., et al. Making sense of forensic genetics. What can DNA tell you about a ? London : Sense About Science, 2017. 21 p. URL: https://senseaboutscience.org/wp-content/uploads/2017/01/making-sense-of-forensic-genetics.pdf (date accessed: 09.03.2026).

16 Amelung N., Granja R., Machado H. Modes of Bio-Bordering. The Hidden (Dis)integration of Europe. Singapore : Palgrave Pivot, 2021. Ch. 4 : Germany. Pp. 55–71. DOI: 10.1007/978-981-15-8183-0_4 (date accessed: 09.03.2026).

17 Case of S. and Marper v. The United Kingdom (Applications nos. 30562/04 and 30566/04). 4 Dec. 2008 / HUDOC. European Court of Human Rights : web. URL: https://hudoc.echr.coe.int/fre#{%22itemid%22:[%22001-90051%22]} (date accessed: 17.03.2026).

sures high efficiency in solving crimes with a probability of coincidence of 63.2% (2014-2015). However, despite positive results in the field of justice, the practice of indefinitely storing DNA profiles of detainees whose guilt has not been proven has been recognized by the ECtHR as a violation of human rights. In our opinion, the British model confirms that the maximum filling of the DNA database dramatically increases the number of solved crimes, but requires constant legal adjustment so as not to turn into an instrument of unlimited State interference in private lives of citizens.

The French National Database of Genetic Profiles (*Fichier National Automatisé des Empreintes Génétiques, FNAEG*) was created in 1998. It initially contained information only on persons convicted of crimes of sexual nature. In November 2001, the law on the collection of genetic data was extended to other crimes, including acts of terrorism and barbarity. This law provides for a penalty of 2 years in prison and a fine of 20,000 Euros for refusing to take the testes [18]. The *FNAEG* can contain DNA profiles of minors aged 13 and over. In this database, profiles of suspects but not convicted persons account for almost 75%. At the same time, sanctions have been legalized in France for refusal to provide a DNA sample by convicted persons (2001) and suspects (2003). This explains why, by spring 2018, the database contained 3.8 million individual DNA profiles and 0.5 million unidentified profiles from traces left at crime scenes or from unidentified corpses. It is worth noting that the first of these figures does not take into account any duplicates, since individual profiles could have been registered under different names. After removing duplicates (2018), the FNAEG contained approximately 2.9 million individual genetic profiles and 480,000 unidentified traces. The *FNAEG* stores DNA profiles of suspects for 25 years and of convicted persons for 40 years. This period applies to all individuals, regardless of age (juvenile or adult) and the severity of committed crime [19].

It should be noted that *FNAEG* has transformed from a highly specialized registry into a large-scale control system, where 75% of profiles belong to suspects rather than convicts and it contains many duplicates. As noted above, the system is characterized by strict enforcement of samples and long retention periods (25-40 years) for both adults and minors.

In United States, experimental DNA databases were introduced in 6 states and forensic laboratories in 1990, and in 1994, a law was passed to forcibly collect DNA samples from people convicted of violent crimes. In this way, the FBI received formal permission to use the Combined DNA Index System (*CODIS*). Currently, all 50 states provide for mandatory DNA collection from persons who have committed a crime of sexual violence or murder, and 47 states collect DNA from all convicted criminals. In 1990, a registry of DNA data of all US military personnel was created. This data is stored for the entire period of service, and after the end of the contract it

18 Петряєв С. Ю., Трофименко М. В. Щодо питання формування національної бази ДНК-даних в Україні. *Вісник Національного технічного університету України «Київський політехнічний інститут». Політологія. Соціологія. Право*. 2010. № 3 (7). С. 164—166. URI: https://ela.kpi.ua/handle/123456789/5569 (date accessed: 17.03.2026).

19 Vailly J., Bouagga Ya. Opposition to the Forensic Use of DNA in France: The Jurisdiction and Veridiction Effects. *BioSocieties*. 2019. Vol. 15. No. 3. Pp. 394—419. DOI: 10.1057/s41292-019-00150-y (date accessed: 17.03.2026).

is removed and destroyed. As of 2015, US database contains almost 14 million DNA profiles [20]. According to FBI, 21.7 million DNA profiles were collected in 2023, equivalent to approximately 7% of the U.S. population [21].

In our opinion, US-built biometric surveillance system is one of the most powerful in the world. It provides high efficiency in solving crimes, but at the same time creates serious privacy challenges, as an individual's genetic profile ceases to be their personal secret.

In 2008, Greek government passed a law establishing National DNA Database of Greece which would only register DNA profiles of convicted criminals convicted of serious violent crimes. A year later, amendments to the law allowed the DNA of arrested or accused persons to be registered in the database, even if they were later acquitted. The list of crimes for which DNA profiling is carried out in Greece now includes not only serious crimes, but minor offenses, which commission is punishable by imprisonment for a term of 3 months or more [22].

The analysis of the Greek model demonstrates one of the fastest transformations in Europe from a strictly limited to a maximally expanded biometric data collection system. In just one year (2008–2009), Greece moved from a conservative model (only those convicted of serious violent crimes) to an expansive model that allows for DNA collection even from minor offenders. We consider Greece an example of a country that has chosen the path of rapid biometrics and has sacrificed strict privacy criteria (as in Portugal or Germany) in order to create a large-scale tool for police surveillance.

Rapid development of DNA databases in China is interesting. According to governing body of the National DNA Database, the China Institute of Forensic Medicine of the Ministry of Public Security, their *NDNAD* contained 68 million profiles as of 2018, although it was only created in 2005 and less than a year before that (2017) it contained 55 million. Such rapid growth means that in terms of the number of profiles, the Chinese *NDNAD* is the largest in the world. United States of America is in second place in terms of the number of DNA data in the national database (17,530,781; as of 2018) and United Kingdom is in third place (6,024,032 as of 2017). In China, there are three different DNA databases in operation: the aforementioned *NDNAD*, the National Missing Children's DNA Database (hereinafter referred to as the *NMCDD*) and the Y-STR database, which is a component of the *NDNAD*. In terms of the number of profiles, both the Chinese *NDNAD* and Y-STR are the largest databases of their kind in the world. They are all managed by the Ministry of Public Security of the People's Republic of China. As of September 2017, there were 598 forensic DNA laboratories with 1,050 DNA analysis devices and 3,344 technical staff. The Chinese databases contain 3.1% of the population's profiles, while different prov-

20 Butler J. M. The future of forensic DNA analysis. *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences*. 2015. Art. 370(1674):20140252. DOI: 10.1098/rstb.2014.0252 (date accessed: 10.03.2026).

21 Klippenstein K. FBI hoovering up DNA at a pace that rivals China, holds 21 million samples and counting / The Intercept_ : web. Aug 29 2023. URL: https://theintercept.com/2023/08/29/fbi-dna-collection-surveillance/ (date accessed: 16.03.2026).

22 Voultsos P., Njau S., Tairis N., et al. Launching the Greek forensic DNA database. The legal framework and arising ethical issues. *Forensic Science International. Genetics*. 2011. Vol. 5. Is. 5. Pp. 407–410. DOI: 10.1016/j.fsigen.2010.08.013 (date accessed: 17.03.2026).

inces have different levels of coverage, as each region is managed separately. It is worth noting again that the Chinese *NDNAD* contains very few profiles of actual offenders (although increasing percentage of the population covered by the DNA database is a priority). Most of the 95% of profiles are reference samples collected from target populations. The definition of target populations varies from province to province [23].

Analysis of the Chinese model of DNA database formation indicates the creation of a biometric control system unprecedented in scale, which in terms of quantitative indicators is significantly ahead of its Western counterparts (USA and Great Britain). As noted above, China *NDNAD* has demonstrated an abnormal fill rate of 13 million profiles in less than a year (2017-2018) indicating a strong administrative resource and technological base (nearly 600 laboratories). In our opinion, an important difference from the US and the UK, where the databases are populated mainly by criminals, in China, 95% of the profiles belong to people who have not committed a crime. The system focuses on "target populations," which transforms the database from a forensics tool to a mass state surveillance tool.

Unlike China, German DNA databases are average in size. Because of this public perception of genetics in Germany is influenced by memories of its Nazi past and how science was used for racial genetics. This contributes to a strong sense of privacy regarding genetics among Germans and a general suspicion of state and law enforcement agencies that have access to the confidential genetic information of their citizens. The German DNA database was launched in 1998 by the Ministry of the Interior at the Federal Criminal Police Office. Today, it is average in size compared to other databases in Europe [24]: it contains 871,506 DNA profiles (according to a report by *The European Network of Forensic Science Institutes*, hereinafter referred to as *ENFSI*) [25]. In addition to Federal Criminal Police Office, prosecutors can access data from the German DNA database for criminal justice purposes. Later legislation further defined conditions for the collection and storage of DNA profiles. The first specifications provided that DNA profiles could be created and stored for serious crimes. The second specification appeared in 1999: it listed crimes that were considered serious, justifying creation of DNA profile of convicted persons. In addition to serious crimes, repeated commission of other criminal offenses, including burglary, defamation and heavy drinking could lead to collection of DNA profile. In 2005, third specification expanded the list of crimes that give rise to the right to collect and store DNA profiles of suspects, adding minor offenses if they are considered repeated acts. Another significant change was that the permission of a judge is no longer mandatory, and people can voluntarily agree to provide samples for DNA profiling. This amendment contributed to

23 Bernotaite A. Building of the World's Largest DNA Database: The China Case / In: Shrivastava P., Dash H. R., Lorente J. A., Imam J. (eds) Forensic DNA Typing: Principles, Applications and Advancements. Singapore : Springer, 2020. Pp. 639–658. DOI: 10.1007/978-981-15-6655-4_33 (date accessed: 24.03.2026).

24 Amelung N., Granja R., Machado H. Op. cit. DOI: 10.1007/978-981-15-8183-0_4 (date accessed: 15.02.2026).

25 ENFSI Survey on DNA Databases in Europe 2020 / ENFSI : web. 2021. URL: https://enfsi.eu/wp-content/uploads/2021/09/ENFSI-survey-DNA-database-Europe-2020.pdf (date accessed: 26.02.2026).

a significant increase in the number of collected DNA profiles [26].

Analysis of the German model, in our opinion, indicates unique balance between historical memory and the needs of modern criminalistics, where ethics and confidentiality are of paramount importance. Unlike China or Britain, filling of the database in Germany is hampered by the "trauma of the past" (Nazi racial genetics). It has created a high level of public distrust of the collection of biometrics by the state, which explains the rather small size of the database (approximately 871 thousand profiles).

Dutch DNA database was legally established in 1994 and became operational in 1997. It is one of the medium-sized databases in the European Union (*EU*). According to ENFSI, in June 2016 it contained 237,254 profiles of individuals, which represented 1.4% of the country's population. In April 2020, the Dutch DNA database contained 328,542 profiles of individuals, which represented 1.9% of the population (out of 17,134,178 individuals). Netherlands has a strong track record of innovation in the regulation and practical application of genetic technologies for forensic purposes. In 1994, they became the first country to introduce specific legislation for the use of forensic DNA to compare DNA profiles from a suspect and from a crime scene. In 2003, Netherlands pioneered regulation of the use of genetically determined physical characteristics in criminal investigations and DNA data (e.g. forensic DNA phenotyping, family searching and mass screening) have since become important in criminal investigations in that country [27].

Analysis of the Dutch model indicates that this State is a global technological pioneer that relies not on the quantity of profiles, but on the depth and innovativeness of analysis methods. Despite having a database with a relatively small number of profiles (only 1.9% of the population), Netherlands demonstrates high efficiency through the implementation of advanced techniques, such as DNA phenotyping and familial searching. In our view, the use of "controversial" technologies (mass screenings, searching for relatives) is somewhat debatable, demonstrating the country readiness to expand the boundaries of privacy intrusion for the sake of solving particularly serious or high-profile crimes.

Poland established a DNA database in 2007. According to *ENFSI*, in June 2016, the Polish DNA database contained 45,679 profiles of individuals. This is 0.12% of the country resident population (38,200,000 individuals). Compared to other EU countries, the Polish DNA database is not as large as the Portuguese one that contains profiles of 0.09% of the resident population. From the very beginning, exchange of forensic DNA data was considered fundamental to Polish project of technological modernization, European integration and the fight against international crime. Polish National DNA Database stores and processes DNA profiles according to the following criteria: accused, defendant, suspect and other persons for whom there are no grounds for removing from the case file and destroying the evidence collected from them; unknown persons or persons trying to hide their identity; unknown corpses; unknown traces collected at a crime scene, which origin

26 Amelung N., Granja R., Machado H. Op. cit. DOI: 10.1007/978-981-15-8183-0_4 (date accessed: 15.02.2026).

27 Ibid. Ch. 5 : The Netherlands. Pp. 73–87. DOI: 10.1007/978-981-15-8183-0_5 (date accessed: 15.02.2026).

cannot be linked to a specific person. The technical infrastructure of the national DNA database is managed by the Biology Department of Central Forensic Laboratory of the Police (*CFLP*) that is the custodian of the DNA database, as well as other biometric databases. As one of the main providers of forensic services in Poland, the *CFLP* is responsible for case management, providing technical and forensic resources and participating in forensic examinations. Poland uses the *CODIS* IT system. The support provided by the FBI for *CODIS* includes, among other things, provision of reference services and is one of the reasons why 22 EU Member States use it to collect and search DNA profiles. Therefore, software has contributed to some standardization of national systems [28].

Analysis of the Polish model indicates construction of a system focused not on mass, but on international integration and technological standardization within the EU and NATO. Having one of the lowest coverage rates in the EU (only 0.12% of population), Poland compensates for this by using American *CODIS* system that makes its database fully compatible with databases of 22 EU countries and the USA that is critically important for combating cross-border crime. The categories of persons whose data are added to the database (accused, suspected, unidentified corpses) indicate strictly forensic nature of the system. Poland avoids the practice of mass data collection "for the future", typical for Britain or China.

Portuguese DNA database was created in 2008 and is one of the smallest in the EU, as the country has limited criteria for adding and deleting DNA profiles. According to *ENFSI*, in June 2016, this database contained 5,339 profiles of individuals (0.05% of country resident population) and as of 31 December 2019, it contained 10,270 profiles of individuals convicted of a crime (0.1% of 10,257,342 individuals). Portuguese integration into the Prüm system in 2015 helped the country quickly establish links for the exchange of DNA data with 19 countries. However, Portugal has strictly limited the number of data categories available for exchange: it only exchanges data on convicted persons and samples from crime scenes, making it one of the countries that exchanges the fewest data categories of all (compared to Greece). Portuguese history is largely marked by the long period of dictatorship in the 20th century (1926–1974), characterized by political and police repression and censorship, which left an indelible mark on society and, in particular, on the legal and criminal justice culture of the country. For example, in collective imagination, police were until a certain point perceived as closely linked to the authoritarianism of the dictatorship. The cultural imprint of dictatorship and distrust of police have significantly influenced development of the national DNA database in Portugal: for example, the DNA database is managed by the National Institute of Legal Medicine and Forensic Sciences, not the police. Despite initial desire to create an extensive DNA database, the legislative framework in Portugal has ultimately proven to be one of the most restrictive in Europe: it can be considered a derivative of the special regime of protection of personal data and genetic confidentiality. The Portuguese DNA database uses the *CODIS* system [29].

In our opinion, the analysis of Portuguese model demonstrates an example of a highly cautious approach to biometric

28 Amelung N., Granja R., Machado H. Op. cit. Ch. 6 : Poland. Pp. 89–103. DOI: 10.1007/978-981-15-8183-0_6 (date accessed: 24.02.2026).

29 Ibid. Ch. 7 : Portugal. Pp. 105–117. DOI: 10.1007/978-981-15-8183-0_7 (date accessed: 24.02.2026).

control, where the historical experience of dictatorship has shaped the architecture of modern justice system. This has led to unique institutional solution: the database is subordinated not to the Ministry of Internal Affairs, but to the National Institute of Legal Medicine and Forensic Sciences, which distances DNA collection from police apparatus. Strictness of the criteria for data entry and deletion makes Portugal's DNA database a model of *minimal necessity*, where privacy prevails over the expansion of police tools. Although Portugal has joined the Prüm system and established connections with 19 countries, it has deliberately limited the categories of data for exchange strictly to convicted individuals. This contrasts with other countries that exchange suspects' data.

It is worth noting that history of establishing DNA databases in Europe varies across different countries; therefore, based on the time of their creation, we propose dividing them into 'old' and 'new.' The 'old' databases include those of the United Kingdom (1995), the Netherlands (operational since 1997, although legally established in 1994), Austria (1997), Germany (1998), and France (1998). (Incidentally, United States DNA database also belongs to the 'old' category: experimental versions were introduced in 1990, and in 1994, law was passed on the compulsory collection of DNA samples from individuals convicted of violent crimes.) We propose classifying DNA databases established after 2000 as 'new,' such as those in Poland (2007), Portugal (2008), Greece (2008), and Romania (2008).

It is clear that all aforementioned countries utilize these databases for criminal investigation purposes. While examining the criteria for the inclusion and deletion of DNA profiles from forensic databases as set forth in the legislation of EU countries, as well as the US, Canada, China and several others, two main groups can be distinguished: countries with expansive legislation (Austria, Denmark, Estonia, Finland, Latvia, Lithuania, Scotland, Slovakia, the United Kingdom (England and Wales), the US, and China) and countries with restrictive legislation (Belgium, France, Germany, Hungary, Ireland, Italy, Luxembourg, the Netherlands, Poland, Portugal, Romania, Spain, and Sweden).

In the group of countries whose legislation has restrictive effects, a common condition for including profiles in databases is that a person is either suspected of a crime or convicted of an offense (particularly a serious one) that carries a potential or actual prison sentence. In the group of countries with expansive effects in their legislation, the thresholds for inclusion are lower, and the retention periods for profiles are longer. Within the expansive group, inclusion criteria in most countries apply to suspects (with Denmark and Finland being exceptions, where inclusion is tied to the maximum prison term). The legislative configurations of countries expanding their databases reflect a focus on increasing the number of DNA profiles to maximize matches between individuals and crime scene stains. The argument in favor of this is that individuals who have committed minor offenses or are merely suspects may be involved in more serious crimes in the future. Furthermore, creating legal conditions for expanding the DNA database will not only increase the efficiency of criminal investigations but is also likely to act as a crime deterrent [30].

30 Santos F., Machado H., Silva S. Forensic DNA databases in European countries: is size linked to performance? *Life Sciences, Society and Policy*. 2013. Vol. 9. Art. 12. 13 p. URL: https://link.springer.com/article/10.1186/2195-7819-9-12 (date accessed: 09.03.2026).

While analyzing DNA databases of various countries, they can be conditionally grouped into large, medium and small based on their size and capacity. Examples of large ones include the DNA databases of the United Kingdom, France and the United States. The medium category includes the databases of the Netherlands, Germany and others, while the small category comprises those of Portugal, Poland and others.

It should be noted that number of matches between samples is not linked to the number of profiles contained in the database. Countries with a larger number of profiles in their DNA database (as a population percentage) do not necessarily achieve an efficiency rate significantly higher than countries with a comparatively smaller share. In other words, a high efficiency rate of trace-to-person matches indicates that the 'right' people are being included in the database, meaning that the profiles of these individuals have a high probability of matching DNA traces from the crime scene [31].

In Ukraine, first forensic examination using DNA analysis with a radioactive label in a homicide case was performed in 1992 and in "1993, the leadership of the Ministry of Internal Affairs of Ukraine made a decision and initiated work to establish a molecular genetic laboratory with the aim of introducing DNA analysis methods for the detection and investigation of crimes.

Conducting forensic examinations and research using the molecular genetic method of DNA analysis (DNA profiling) in the department of medico-biological examination began in 1994" [32].

In Ukraine, activities related to maintaining forensic records of human genetic characteristics were regulated only in 2009 with the adoption of the Instruction on Organizing the Functioning of Forensic Records of the Ministry of Internal Affairs Expert Service, which regulates, among other things, general issues of creating and maintaining such records [33].

During the period of 2007–2013, institutions of the Ministry of Internal Affairs Expert Service of Ukraine conducted over 8,000 forensic DNA tests and obtained more than 14,000 DNA profiles. For storing and processing these profiles (specifically, to search for matches), the Central Record of Human Genetic Characteristics (hereinafter referred to as the *CRHGC*) was introduced. According to *CRHGC* records, during the specified period, over 130 unidentified bodies were identified based on DNA profiles. [34].

In Ukraine, automated forensic records of human genetic characteristics have been functioning since 2009 at both central and regional levels. These records include operational and investigative

31 Asplen Ch. ENFSI Survey on the DNA Profile Inclusion, Removal and Retention of Member States' Forensic DNA Database / ENFSI : web. 2009. 11 p. URL: http://enfsi.eu/wp-content/uploads/2016/09/enfsi_report_on_dna_legislation_in_europe_0.pdf (date accessed: 03.03.2026).

32 Дяченко Н. М. Основні етапи розвитку молекулярно-генетичної експертизи в Державному науково-дослідному експертно-криміналістичному центрі МВС України. *Криміналістичний вісник*. 2011. № 1 (15). С. 167. URL: https://visnyk.dndekc.mvs.gov.ua/arxiv/tom-15-1-2011-kriminalisticnii-visnik (date accessed: 05.02.2026).

33 Інструкція з організації функціонування криміналістичних обліків експертної служби МВС : затв. наказ. МВС України від 10.09.2009 р. № 390. URL: https://zakon.rada.gov.ua/laws/show/z0963-09#Text (date accessed: 05.02.2026).

34 Костіков І. Ю., Марійко В. В., Щербакова Ю. В. та ін. Зазнач. твір. DOI: 10.37025/1992-4437/2023-39-1-10 (date accessed: 01.03.2026).

collections maintained by the State Scientific Research Forensic Center (hereinafter referred to as the SSRFC) and regional scientific research forensic centers (hereinafter referred to as the SRFCs). These collections are compiled from the DNA profiles of individuals suspected or accused of committing a crime, placed in custody or convicted (subject to their voluntary consent); biological traces seized during crime scene examinations, particularly in cases of missing persons, as well as during other investigative actions and operational-search activities; and unidentified bodies. DNA profiles are obtained during forensic DNA analyses conducted at the SSRFC, the SRFCs, the State Institution Main Bureau of Forensic Medical Examination of the Ministry of Health, Crimean Republican Institution 'Bureau of Forensic Medical Examination' and the bureaus of forensic medical examination (hereinafter referred to as the BFMEs) of the Kyiv, Sevastopol city and regional state administrations.

Regional operational and investigative collections are compiled at SRFCs on the same grounds as at the SSRFC and DNA profiles are obtained during forensic DNA analyses conducted at SRFCs and BFMEs. DNA profiles obtained using genetic analyzers and determined by a set of standard marker systems (STR loci) which are uniform for forensic laboratories in accordance with *ENFSI* recommendations are subject to registration. [35].

In July 2022, the Verkhovna Rada of Ukraine adopted the Law *On State Registration of Human Genomic Information* [36], providing a legal framework for processing human genomic information for the purpose of its state registration in Ukraine, which is extremely important for the law enforcement system and the field of forensic activities. This Law distinguishes two forms of state registration of genomic information: compulsory and voluntary. It regulates the rules for collecting biological material for the state registration of genomic information regarding specific categories of individuals, conducting forensic DNA analyses, the rules for storing and destroying biological material as well as many other issues.

In 2023, the Electronic Register of Human Genomic Information (hereinafter referred to as the *ERHGI*) became operational in Ukraine, serving as a functional subsystem of the unified information system of the Ministry of Internal Affairs of Ukraine. The structure, operating procedure, main tasks, purpose and functions of the *ERHGI* are defined in the Regulation on the Electronic Register of Human Genomic Information [37]. The *ERHGI* is effective for identifying individuals who have committed criminal offenses, searching for missing persons, identifying unidentified bodies, human remains and body parts, as well as identifying individuals unable to provide information about themselves due to health status, age or

35 Інструкція з організації функціонування ... . URL: https://zakon.rada.gov.ua/laws/show/z0963-09#Text (date accessed: 05.02.2026).

36 Про державну реєстрацію геномної інформації людини : Закон України від 09.07.2022 р. № 2391-IX. URL: https://zakon.rada.gov.ua/laws/show/2391-20#Text (date accessed: 05.02.2026).

37 Положення про Електронний реєстр геномної інформації людини : затв. наказ. МВС України від 04.08.2023 р. № 639. URL: https://zakon.rada.gov.ua/laws/show/z1657-23#Text (date accessed: 05.02.2026).

other circumstances [38]. This is particularly important in the context of the war with Russia. Along with the *ERHGI*, the *CRHGC* and the local record of human genetic characteristics (hereinafter referred to as the *LRHGC*) function concurrently.

Conclusions

In general, 69 countries worldwide currently have national databases of genetic characteristics, and another 34 countries are in the process of establishing them. Recently, such databases have been actively expanded in Asia, particularly in China, India and South Korea.

In our opinion, databases of genetic characteristics can be classified into groups based on the following main criteria: size and capacity (number of profiles contained in the database), the principle of profile inclusion (restrictive or expansive effects) and the efficiency rate. The Ukrainian DNA database is fairly new (2009) compared to that of the United Kingdom (1995) and certain EU countries (the Netherlands (1997) and France (1998)), yet it is sufficiently developed compared to Poland (2007) and Portugal (2008).

Based on the analysis of the experience of the United Kingdom, the United States, China, Germany, the Netherlands, Poland, Portugal and Greece, a comprehensive conclusion can be drawn regarding contemporary global strategies for creating and using DNA databases.

Firstly, a correlation exists between national history and the DNA database regime. For instance, democratic countries with a history of dictatorship (Germany, Portugal) maintain databases with the smallest number of profiles (0.05–1%). In these nations, high distrust of the police prevails; therefore, control over DNA is frequently transferred to civilian medical institutions, and data collection is strictly limited to convicted individuals. It is worth noting that countries with an authoritarian lean or a priority on state security (China, for example) create mammoth databases (68 million+), where 95% of profiles belong to law-abiding citizens (target groups).

Secondly, a certain conflict exists between the efficiency and privacy of DNA databases. The United Kingdom demonstrates through its example that covering 10% of the population yields a colossal number of solved crimes (63%) but leads to legal sanctions from the ECtHR due to violations of the rights of innocent individuals. Greece is following the same path. The Netherlands chose a different direction: technological advancement instead of quantity. Even with a small coverage (1.9% of the population), they successfully solve crimes using methods such as DNA phenotyping and familial searching.

Thirdly, a technological standardization effect exists. Most countries (USA, Poland and another 22 EU members) utilize the American CODIS system. This creates a unified digital space for combating international terrorism and cross-border crime. Even small-scale databases (such as that of Poland) become effective due to compatibility with international registries.

Compared to the analyzed countries, the establishment of the Ukrainian DNA identification system indicates a gradual transition from isolated tests to the

38 Дубонос К. В. Актуальні питання впровадження електронного реєстру геномної інформації людини. *Судова експертиза в контексті відновлення України* : мат-ли III всеукр. наук.-практ. конф. (Львів, 09.06.2023). Київ, 2023. С. 67—74. URL: https://intelect.org.ua/wp-content/uploads/2023/08/sudova-ekspertyza-2023-druk.pdf (date accessed: 05.02.2026).

creation of the centralized CRHGC system, which in its structure and principles is close to European medium-capacity models. Despite the fact that the first such test was performed in 1992, regulatory framework implementation and the creation of a unified CRHGC database occurred only in 2009. This indicates slow institutionalization compared to pioneer countries (United Kingdom, USA). The adoption of the specialized Law 'On State Registration of Human Genomic Information' transferred DNA operations from the level of departmental instructions of the Ministry of Internal Affairs to the nationwide level. This created a legitimate foundation for mass registration, similar to the system of the United States and the United Kingdom. The introduction of the ERHGI in Ukraine in 2023 ensures the digitalization of processes, while compliance with *ENFSI* standards guarantees the compatibility of Ukrainian data with European databases, which is important for identifying citizens abroad.

Parallel functioning of the state-of-the-art ERHGI and the time-tested CRHGC and LRHGC indicates a transitional period in Ukrainian DNA profiling. This makes it possible to preserve data arrays from past years, gradually integrating them into a modern digital platform. The division into compulsory registration (for criminals and under special categories in war conditions) and voluntary registration helps Ukraine maintain a balance between state security and human rights, avoiding accusations of mass surveillance (such as in the case of China).

Ukraine is a state with democratic values, which is reflected in its DNA databases. Legislation of Ukraine guarantees the right of citizens to personal inviolability and the presumption of innocence, making it impossible to introduce mass and indiscriminate storage of DNA samples and profiles of unconvinced individuals in our state for the purpose of expanding such databases as a justification for strengthening public safety.

Криміналістичні ДНК-обліки у світі та в Україні: історія становлення та перспективи розвитку

Олексій Лозовий

Мета статті — аналіз історії виникнення, становлення та особливостей наповнення наявних криміналістичних ДНК-обліків у світі й в Україні, окреслення можливих перспектив розвитку. Для досягнення поставленої мети застосовано загальнонаукові та спеціальні методи наукового пізнання (порівняльно-правовий, формально-юридичний, прогнозування, моделювання, аналіз і синтез). З'ясовано, що історія виникнення, формування та специфіка наповнення криміналістичних ДНК-обліків мають свої особливості в кожній країні й залежать від багатьох чинників, поміж яких владні режими (авторитаризм — як, наприклад, у Китаї), історичне минуле (культурний слід диктатури та недовіра до поліції, як у Португалії), стан захисту прав людини та ін. Бази даних генетичних ознак можна групувати за різними принципами, основними з яких є такі: наповненість (кількість наявних профілів), критерії включення (обмежувальної або експансивної дії), коефіцієнт ефективності. Аналіз становлення української системи ДНК-ідентифікації свідчить про поступовий перехід від поодиноких експертиз до створення централізованої системи, яка за своєю структурою та принципами наближена до європейських моделей середнього наповнення.

Ключові слова: *криміналістичні ДНК-обліки; історія становлення; пер-*

спективи розвитку; кількість ДНК-профілів; критерії включення; коефіцієнт ефективності.

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Declaration of Competing Interest

Author declares no conflict of interest.

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