



## IDENTIFYING MISSING PEOPLE IN THE NATIONAL DATABASE OF GENETIC PROFILES FOR APPLICATION IN JUDICIAL INVESTIGATION – CODIS – : TWO CASE REPORTS

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### SUMMARY

**A**rmed conflict in Colombia has played an important role in the missing people phenomenon, in which the Government has the duty to identify, recover and investigate the crime in the process of the victims' reparation. However, identifying missing people is a complex process because of the huge amount of time it consumes and the lack of information regarding the identity of the missing people, which is the norm in most of the cases. In such cases in which there is little information on the identity of missing people (including data of their relatives), DNA analysis and databases are of key importance in the identification process. This is why we present two cases that exemplify the role of DNA databases in the successful identification of missing people.

**Keywords:** CODIS; Genetic Profile Databases; Database Search; Identification of Missing Persons.

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## INTRODUCTION

The recovery and identification of human remains found in mass graves are a key piece in the reparation process of victims. Since many missing people entailed in forced disappearance are presumed to be death, recovering and identifying human remains allow their relatives to continue in the grieving process, according to their cultural and religious beliefs in handling the death of their beloved ones. Forced disappearance has been defined as the arrest, detention or kidnapping of a person against their will by governmental agencies, organized groups or individuals with the direct or indirect support of the State, with no information of their whereabouts (1,2). This is why many victims of forced disappearance never return home and their whereabouts often remain unknown, even many years after their deaths.

As a solution to uncover the identity of unidentified dead bodies, here we present two cases in which the CODIS database helped the authors to find two missing people. The CODIS database was created in 1990 in USA. The Department of Justice aimed to store human DNA profiles of convicted sex offenders in USA and Canada. However, the CODIS database was then used to identify victims of mass disasters outside USA by comparing the DNA of the victims with the DNA of their American relatives (3, 4). This new use of CODIS opened additional opportunities to identify missing people.

For example, in Colombia the CODIS database may be an important means to identify missing people. Since the Colombian Plan was established in 1999, a collaborative agreement between Colombia and USA to boost peace in Colombian, the National Institute of Legal Medicine and Forensic Sciences (INMLCF, for its acronym in Spanish) acquired the CODIS platform to

technologically strengthen the criminal investigations. The CODIS database changed its name to National Database of Genetic Profiles for Application in Judicial Investigation. This database stores the information provided by genetic laboratories in several cities such as Bogotá, Cali, Medellín, and Villavicencio from three govern institutions (INMLCF, Technical Team of Investigation, and the Attorney General's Office).

The database is not only used to store information of the genetic profiles of sex offenders, but it also allows searching for information with two main purposes. The first, to compare genetic profiles of the forensic evidence collected from crime scenes and victims with the information stored in the database. Such searching aims to identify the aggressor of the case or to connect related cases in serial crimes. On the other hand, the second purpose is to identify missing people. As the DNA profiles of the unidentified human remains collected from the necropsies are also stored in the database, it is possible to compare these profiles with the DNA of the relatives of missing people.

More specifically, each profile registered in the database includes Short Tandem Repeat (STR) nuclear microsatellite markers. At the beginning, the database stored 13 STR, but now it can store up to 29 STR. The DNA analyses allowed the database to store 26662 genetic profiles (2065 of human remains that were stored in the missing index and 24557 of their relatives.)

Once a match has been detected between the profiles of the suspect and those of the stored evidence (forensic module), or between an unidentified individual and their relative (identification module), the database administrator sends a report to the corresponding forensic area in the INMLCF (Pathology, Anthropology or the National Network of Missing People). These areas

analyze and exchange the information collected in the case to confirm the genetic match. Therefore, the DNA profile information stored in the database and properly indexed is useful to solve cases such as forced disappearance, identification of victims, mass disasters, sexual crimes, homicides, among others, which is very valuable for the administration of justice.

## CASE REPORTS

Two cases of missing people identified by CODIS are presented. The genetic profiles of the missing people were obtained in the Genetics Laboratory of the INMLCF in Bogotá some years ago. Additionally, the database information was cross-referenced with the genetic profiles obtained from the relatives of missing people.

### Case 1

Some unidentified human remains were analyzed in a bio-anthropological exam after exhumation. The results showed the remains belonged to a male individual aged 25 to 35 years. His genetic profiles were obtained from a bone sample and were stored in CODIS. In addition, genetic profiles of his possible biological father were obtained and stored in CODIS by the CTI Genetic Laboratory two years before the exhumation.

### Case 2

Other unidentified human remains were also analyzed in a bioanthropological exam after exhumation. The results showed the remains belonged to a male individual aged 26 to 36 years. His genetic profiles were obtained from a bone sample and stored in CODIS. In addition,

genetic profiles of his possible biological mother were obtained and stored in CODIS by the CTI Genetic Laboratory.

## METHODOLOGY

### Looking for missing people using CODIS

CODIS is administrated by a national casework manager who conducts a routine search in the database (version 5.7.4, Match Manager module). The searching aims to matching DNA profiles of unidentified human remains to DNA profiles of missing people's relatives. More specifically, matching is positive when 10 genetic markers in at least one allele are shared by both sources. However, the matching process takes into account the possibility that the DNA profile can include a higher number of genetic markers (5).

Positive matches are then sent to the National Group of Forensic Pathology (INMLCF) where additional exams are performed to confirm the identity of the human remains. Results of these additional exams were analyzed in conjunction with the genetic data in the presented cases.

### Additional genetic studies

As the identification protocols require matching more than 16 genetic markers to confirm the identity of the human remains, new analyses were conducted. The analyses included the DNA extracts of missing people's bone samples that were stored after the initial genetic analysis for including the data in CODIS. In addition, blood samples of the missing people's relatives that were initially analyzed and stored in the CTI laboratory to include the data in CODIS were requested to perform a new ge-

netic analysis. Results from both analyses were then matched in the two cases

### Extraction, amplification and DNA typing

DNA of the possible father (case 1) and the possible mother (case 2) were extracted from blood samples of the FTA cards using the Chelex 100™ Resin (6). On the other hand, the remaining DNA of the human remains was retaken and amplified again. To obtain the STR from these DNA samples, PCR was performed using multiple protocols including Powerplex® 16 HS and PowerPlex® ESX 17 kits from Promega and the Thermal Cycle GeneAmp PCR Systems 2720 or 9700 (Applied Biosystems) to increase the DNA profile of the samples in both cases (7,8).

Moreover, the PCR fragments were analyzed through capillary electrophoresis using the ABI 3130 and 3100 genetic analyzers of Applied Biosystems. By the same token, the allele assignment was done with sequenced allelic ladders associated with their respective kit, and typing the alleles was done using the program Gene Mapper, version 3.2 (9).

### Calculating probatality

The paternity index (PI) was determined in case 1 and the maternity index (MI) was determined in case 2, taking into account the gene frequencies of Colombian population (10,11,12,13,14).

## RESULTS

In the first case, DNA profiles from both the unidentified corpse and the father of a missing person shared 50% of the infor-

mation for 15 markers. By the same token, DNA profiles in case 2 from both the unidentified corpse and the mother of a missing person also shared 50% of the information for 15 markers. Therefore, analyzed additional non-genetic information for both cases was collected to confirm the identity of the missing persons. Additional information was available in the National Network Information System for Missing People (SIRDEC, for its acronym in Spanish) and included places of disappearance and sex of the unidentified individuals, among other criteria.

After analyzing the information gathered, a new genetic analysis was conducted to confirm the identities. The analysis included 23 markers that indicated the non-exclusion of parenthood in both cases.

The results of additional genetic analyses were evaluated by members of the pathology group along with the ante-mortem findings described in the autopsy, the forensic anthropological study, and the information of the disappearance for each individual, which finally ended in the definitive identification of the victims, hence the bodies were delivered to their relatives.

Since there was no available information about the family members in case 1, the National Network Information System for Missing Persons at the INMLCF contacted the family by using the different available network channels of communication. In case 2, this was done through the authority in charge of the casework, and finally the bodies were delivered to their respective families.

As exemplified above, CODIS and the National Database of Genetic Profiles for Application in Judicial Investigation are an invaluable aid in the process of identifying missing people. In case 1, the sample from the unidentified corpse was entered into the database one year before the DNA profile of the biological father.



It is important to highlight the need of inclusion of more DNA profiles from both relatives of missing people and unidentified corpses in CODIS to enable matches that can lead to a positive identification, as it was the case with these two individuals, even many years after the disappearance event. This allows more families to continue with the grieving process once the identification has been made.

Considering their experience with handling the system, the DNA laboratory at the National Institute of Legal Medicine and Forensic Sciences has recommended that the number of genetic markers of a DNA profile to be included in the database contains at least 23 genetic markers, for both unidentified corpses and relatives, in order to allow matches with higher probability values that avoid further DNA analysis. This recommendation has been informed to other participating laboratories that are connected to the CODIS network.

Additionally, it is important to note that the laboratories that include DNA profiles into databases follow quality driven processes under the ISO/IEC 17025 regulations for the management and quality control of the DNA profiles. They must have different level of access and restrictions for the management of the genetic data taking into account the UNESCO declaration for the human genetic data as sensitive information that have to be properly stored in terms of confidentiality, privacy and integrity for both missing persons and relatives.

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