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Start-up of the criminal genetic database in Mendoza, Argentina

Laura Locarno, Dante Corradi, Miguel Marino*

Registro Provincial de Huellas Genéticas Digitalizadas, Ministerio Público Fiscal de Mendoza, Argentina

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ABSTRACT

The usefulness of DNA databases is widely known and demonstrated. After the successful experiences of the UK and the USA the creation of databases increased rapidly around the world. In Latin America the implementation was slower and more problematic, with Chile and Uruguay being the first to implement them. In Argentina the problems were greater and more persistent.

Although the lack of legislation or applicable laws is a generalized problem, the most difficult one to overcome was the lack of decision, interest and resources by those responsible at an institutional level.

In 2016, Mendoza province modified its database law by creating the *"Registro Provincial de Huellas Genéticas Digitalizadas"* which allowed the process of construction and consolidation to begin. From January 2017 all prisoners, convicted and imputed of all types of crimes began to be sampled. This made the database to grow rapidly, reaching 13.821 samples in that year.

During 2018, in addition to the daily imputed individuals, we began with the sampling from all the Mendoza Police Department, including the Scientific Police that deals with the crime scene. At present the database has a total of 40.652 individuals.

In August 2018, the FBI's CODIS system was installed, and later the data loading process began. In 12 months we have reached 87 match or hits of which 46 correspond to sexual assault, 17 to robbery, 16 to homicides and the rest to other cases. Given that within the sexual abuse cases we were able to identify several serial sexual offenders, the 87 hits allowed clarifying 174 criminal cases.

These results reaffirm the potential of the databases and gives a light of hope for victims of crime.

In this work we present the advances and challenges that we faced in a chronological order.

1. Introduction

The usefulness of DNA databases is widely known and demonstrated. After the successful experiences of the UK and the USA, the creation of databases increased rapidly around the world [1,2]. In Latin America the implementation was slower and more problematic, with Chile and Uruguay being the first to implement them. In Argentina the problems were greater and more persistent.

Although the lack of legislation or applicable laws is a generalized problem, the most difficult one to overcome was the lack of decision, interest and resources by those responsible at an institutional level.

Mendoza is a province of Argentina whose population is around 1.9 million people. It is one of the Argentine provinces that have a DNA database applicable law, and is the first to show strong evidence of its implementation. Only in two and a half years our database is growing very quickly and producing excellent results.

In 2016, Mendoza modified its database law by creating the *"Registro Provincial de Huellas Genéticas Digitalizadas"* which allowed the process of construction and consolidation to begin. Previous law was never implemented, because it had a lot of difficulties. With the modification of this law, those problems were solved, and finally the database started to work with inclusion of more autosomal markers (at least 20) and more individuals, including criminals (imputed, convicted, prisoners), volunteers and police forces. First, to begin with the sample collection, we created software for data register of all persons to be sampled. From January 2017 all prisoners, convicted and imputed of all types of crimes began to be sampled. This made the database to grow rapidly, reaching 13,821 samples in the first year. In a couple of months we trained people who were in charge of taking samples throughout the province.

In August 2018, the FBI's CODIS (Combined DNA Index System) system was installed, and later the data loading process began. In 12 months we have reached 87 match or hits of which 46 correspond to sexual assault, 17 to robbery, 16 to homicides and the rest to other cases. Given that within the sexual abuse cases we were able to identify several serial sexual offenders, the 87 hits allowed clarifying 174

* Corresponding author at: Belgrano 245, Mendoza CP: 5500, Argentina.
E-mail address: mmarino@jus.mendoza.gov.ar (M. Marino).

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criminal cases.

During 2018, in addition to the daily imputed individuals, we began with the sampling from all the Mendoza Police Department, including the Scientific Police that deals with the crime scene. At present the database has a total of 40,652 individuals.

On the other hand, evidence samples were selected and analyzed to be incorporated to the database. We began to process these samples during 2017 and, at the moment, have been included 289 in CODIS.

In this work we present the advances and challenges that we faced in a chronological order.

2. Material studied, methods, techniques

2.1. Reference samples

Since January 2017 we collected samples of prisoners, imputed, convicted, volunteers, police, private security, and members of "*Registro Provincial de Huellas Genéticas Digitalizadas*". At present, samples of 40,652 individuals were collected using "BODE buccal DNA collectors"; every sample was codified with a barcode. The general data (metadata) of each person was included in software "Sistema Genética" specifically designed for that. Metadata included in "Sistema Genética" consists in personal information (name, surname, age, etc), information of the crime which the individual was imputed, and biometrics like picture and fingerprints. All mentioned data is printed and signed by the sampled person and the responsible of the collection.

Each sample is archived in a paper envelope, identified by barcode. Samples are processed in two batches of 88 at the same time, which are punched on two 96 well plates by using a "BSD 600 Plus" (Microelectronic system). Each plate includes two negative controls, two positive controls, two ladders and two reaction blanks. The amplification of autosomal STRs gets done using the "PowerPlex Fusion 6C" (Promega Corporation) or "Globalfiler" (Thermo Fisher Scientific) commercial kits. The Pre-PCR preparation is performed with "QIAgility" (Qiagen). Both plates are introduced in a ProFlex PCR system thermocycler (Applied Biosystems) to perform the PCR.

Once the PCR reaction is over, the amplified samples are prepared for ABI3500 injection following manufacturer`s recommendations.

Data collected of the capillary electrophoresis are analyzed using GeneMapper ID-X. Analysis is performed by two trained analysts. Once the data is checked by both of them, this gets incorporated into "CODIS" software.

2.2. Evidence samples

After the modification of the previous law, evidences whose authors are unknown are incorporated into the database. To date we have 289 evidences in the CODIS software.

Evidences are analyzed and processed following international recommendations and absolutely separated of the reference samples processing.

DNA extraction from evidence samples is performed using "Maxwell 16" (Promega) prior digestion overnight, according to manufacturer's recommendations. Quantification was performed an ABI7500 Real-Time PCR System (Applied Biosystems®) using Quantifiler® Trío DNA Quantification kit. The autosomal STRs amplification is performed using "PowerPlex Fusion 6C" (Promega Corporation) or "Globalfiler" (Thermo Fisher Scientific) commercial kits. The samples are amplified in a Veriti thermal cycler (Applied Biosystems). After preparation, the amplification products are injected in an ABI3500 genetic analyzer (Applied Biosystems). Data collected is analyzed with GeneMapper IDX Software. Once the results are checked by two analysts, this are exported and incorporated in "CODIS".

3. Results

In two and a half years, we have 40,652 reference samples. Of those, 30,507 belongs to criminal categories (imputed, convicted and prisoners), and the rest are elimination categories (laboratory staff, police) and volunteers.

At present we have incorporated 31,475 genetics profiles to CODIS, 31,186 are reference samples (28,599 "Suspect known"/"Convicted Offender", 875 "Convicted Sexual Offender", 1 "multiallelic offender", 9 "staff", and 1,702 "elimination known") and 289 evidences. With this numbers we have found 87 matches, 46 in sexual assault cases (53%), 17 in robbery (19.5%), 16 in murders (18.4%) and 8 in others crimes (9%). These 87 matches hit on 174 cases.

It is important to point out that in matches of sexual assault cases, the 66% of individuals were incorporated to a database for minor crimes, like robbery, petty thefts, injuries or threats. In 23% of cases exists a prior crime related with sexual assaults. In two cases, serial sexual offenders were identified by use of CODIS, both are in prison now. In one of those cases, sexual abuser had been included on CODIS for a minor burglary and with the database we were able to link him to four sexual assaults. In the second case, sexual abuser had been imputed by injuries; he was involved in seven robberies with posterior sexual assault.

However, in murder cases hits, the 36% of the individuals involved had committed murders before.

Recently we identified two killers, from two different cases, in less than three days. By analysis of critical evidences, and its incorporations to CODIS software, they are in prison now.

4. Discussion

Criminal genetic databases have become an essential tool for crime investigation, resolving cold cases and reducing and preventing crime. Another advantage of this tool is the possibility of association between related cases [1–3]. The effectiveness of the criminal genetic databases is based on a larger number of cases that are committed by recidivistic offenders; this situation is particularly frequent in our province.

Clearly best results are observed with larger and most qualified databases, thus around 2000's some countries expanded their legislation resulting in most inclusive databases like England, Northern Ireland and Wales [5,6]. And just like them, our province included more crimes in a new law, allowing solve more number of cases. With the latest law actualization we can submit to the database offenders involved in many types of crimes, severe or not. Just like previously shown, many sex crimes were solved by the incorporation of criminals with minor prior offences. That`s the reason why in the rest of the world, different legislation have been modified to include more offenses for DNA collection [1,4].

5. Conclusion

These results reaffirm the potential of the databases and gives a light of hope for victims of crime. We believe that it is possible to reach important results in a little time, with efforts and dedication. The social impact of our results shows the relevance of this tool in crime investigation.

We are very sure of the success of our database implementation and, at this time, we are expecting that the national law begins to work in our country, to solve more cases and save more lives.

Declaration of Competing Interest

None.

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Further Reading

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