

For2-BioB

Management and development of forensic biobanks at operational and policy levels in Belgium

Contract - B2/233/P2/For2-BioB

SUMMARY

Context: Since 1999, Belgium has had genetic databases to identify individuals and link files in the criminal justice system. The management of these human biobanks is entrusted by law to the NICC, in a totally sealed construction from any other biobank. However, DNA analysis techniques are evolving rapidly, and the NICC must adapt its biobank management to these new realities (Y chromosome, mitochondrial DNA, next generation sequencing, etc.) and anticipate the announced transformations in this field. Similarly, tools used for interpretation of matches between DNA profiles (Likelihood Ratio for example), used by the NICC as well as by accredited DNA analysis laboratories, are based on allelic frequencies dating back more than 20 years. However, the demographic changes at the Belgian and European levels over the last twenty years, as well as new 2024 DNA Law and the legalization of emergent DNA technics may lead to a re-evaluation and even adaptation of the 'referents' currently used to evaluate matches.

Objectives: This project has two interrelated objectives. On an operational level, the aim is to ensure optimal management quality of these criminal biobanks and to anticipate possible adaptations dictated both by changes in the reference population and by major developments in DNA analysis practices. From a regulatory point of view, it is a matter of questioning the limits of the current legislation on the use of DNA analysis in criminal matters. This legislation is limited to regulating the relationships between the traditional criminal justice actors, in a logic that completely ignores a series of other actors who nevertheless occupy a central place in the field of biobanking. The For2bioB project is thus designed to evaluate various aspects of the operational conditions of the NICC's DNA databases, structured around two key pillars. The first pillar focuses on optimizing the DNA database as a technical and scientific tool in the service of justice (WP1,2 & 3). The second pillar addresses the practices of all actors involved, both directly and indirectly, in the use of DNA databases (WP 4 & 5).

Conclusions: **WP1:** This work package shows that incorporating statistical parameters such as RMP into the inclusion criteria can improve the evidential value of partial DNA profiles. Even profiles with fewer markers can still be informative when they contain rare alleles. The study also demonstrates that database size directly affects the likelihood of adventitious matches, meaning that threshold values must be periodically reassessed as the database grows. Hybrid strategies, such as limiting the retention of low-marker profiles, can help prevent database saturation while maintaining efficiency. **WP2:** Transitioning to an LR-based comparison method would strengthen match interpretation by assigning a statistical weight to each hit rather than relying solely on the number of shared loci. This approach would also reduce the workload for DNA laboratories. If lower-marker profiles are included in the future, applying both LR and RMP thresholds will be essential to maintain match reliability while still increasing the number of genuine matches detected. **WP3:** The conducted analyses confirm that allele frequency differences between populations can have a measurable impact on RMP calculations. Although the comparison between the Belgian reference population and the BE-CODIS database showed minimal influence on statistical outcomes, broader comparisons across global populations revealed substantial variation. These differences were systematically identified using the NICC | INCC Frequency Calculator, which

enabled systematic evaluation of DNA profiles across diverse population datasets. Such findings highlight the importance of considering population-specific data in forensic genetics. **WP4:** This work package highlights that optimising the regulation of the use of DNA technology in criminal matters cannot be reduced to isolated or purely technical adjustments. It requires, upstream, a broadening of the legislator's field of reflection (*sensu lato*), systematically integrating the legal, procedural, institutional and social implications of the choices made. The scenario-building tool, notably through its vector axes, is specifically designed to anticipate these effects, beyond considerations of immediate operational efficiency alone. WP4 also emphasises the importance of embedding regulation within a procedural dynamic, by supporting the legislator both in the construction of the norm and in the evaluation of its implementation. In this respect, optimisation also entails the establishment of ex post evaluation mechanisms, making it possible to assess concretely the effects of the norm, to identify discrepancies between law and practice, and to adjust the regulatory framework accordingly. Furthermore, the analysis highlights the need to mobilise comparative criminal law in a strategic manner, particularly with regard to technical aspects, especially in areas where the Belgian framework lags behind or presents zones of uncertainty. It also stresses the risks associated with legal vacuums or regulatory blind spots, notably where certain practices or actors, such as laboratories, are not subject to any specific regulatory framework, despite playing a central role in the criminal process. Finally, WP4 recalls that fundamental rights do not merely constitute external limits to penal action, but also serve as structuring benchmarks for the effectiveness and legitimacy of the production of judicial truth. Optimising regulation therefore requires particular attention to the coherence of the arrangements put in place, by avoiding the multiplication of ad hoc bodies or mechanisms that are poorly articulated with the general functioning of the criminal justice system, and by favouring solutions that are compatible with existing procedural frameworks. **WP5:** Certain areas of tension have been identified throughout the forensic process, thanks to the cross-referenced accounts of the participants in the empirical investigation. The contingency of the process to material constraints, whether human (number of people available, training of those involved, etc.), financial (number of samples that can be analysed, type of analysis performed, etc.), temporal (management of audience flows, pre-filling of requisitions, etc.), or operational (lack of automated decryption software, lack of a telephone hotline accessible to those working at crime scenes, etc.) is particularly marked. These areas of tension hinder the smooth flow of information between those involved in the forensic process and prevent legal safeguards from being respected. They therefore have a direct impact on the quality of the forensic process. Moreover, these tensions push actors to deploy strategies aimed at exercising control over the flow of information and influencing the decisions of others involved in the forensic process. In response to this, the two regulatory scenarios developed in the framework of WP5 are based on a dynamic of balance. The first provides the stability, reliability and efficiency gains necessary for the functioning of a system subject to severe constraints. The second mobilises the judgement and cooperation essential for dealing with complex situations and ensuring the conformity of the process. Their combination aims to sustainably strengthen the organisational effectiveness, scientific relevance and legal robustness of DNA evidence.

Transversal conclusions: to achieve the objectives, the project's results are structured around three complementary axes. The first aims to limit quantity in favor of quality, ensuring compliance, representativeness, and control of tools and data. The second focuses on supporting stakeholders and preserving the human, ethical, and normative dimensions of the judicial process, considering workload, uncertainties, and normative choices generated by innovation. Finally, the third bridges science and practice, leveraging interdisciplinary, inductive, and pedagogical research to translate scientific knowledge into operational and normative recommendations, thereby promoting an evidence-informed, ethical and sustainable optimisation of the forensic DNA process. Nevertheless, in a context where resources are already limited, it is problematic for legislators to continue introducing new technical tools without assessing their concrete effects on work organisation, available budgets and the operational capacities of the system. This lack of prior assessment undermines the overall sustainability of the process and complicates the consistent implementation of the proposed solutions. Thus, the project finally offers a cross-cutting recommendation, which advocates for **the institutionalisation of ex ante impact assessment within the legislative process governing forensic DNA.**

Such an assessment would serve multiple purposes: (1), it would objectively measure the financial, human, and organisational costs associated with any proposed technical innovation ; (2) it would evaluate expected benefits in concrete terms, taking into account available resources, operational constraints, and the actual practices of stakeholders, as well as the tangible effects on the objectives of the criminal justice process; (3) it would establish an evaluation methodology tailored to the specificities of DNA evidence, drawing on scientific, criminological, technical, and legal knowledge; and (4), it would be conducted by an established body in conjunction with the DNA Evaluation Commission, ensuring representation of researchers from all relevant disciplines, including criminology, law, and forensic sciences.

Keywords: Forensic DNA, DNA Databases, Genetic Comparison, DNA regulations, Actorial strategies, Public policies.