



Brain-be 2.0

Belgian Research Action through Interdisciplinary Networks

POLICY BRIEF

Policy Brief no 1

For2-BioB - Management and development of forensic biobanks at operational and policy levels in Belgium

This project has two closely related objectives. From a practical standpoint, it aims to ensure high-quality management of DNA databases used in criminal matters, while anticipating the adjustments made necessary by changes in the reference population and major advances in DNA analysis techniques. From a regulatory perspective, the project seeks to examine the limits of current legislation governing the use of DNA in the judicial context and to examine how actors in the forensic chain interact with the various rules and constraints that condition their activity. One of the outcomes of this project is the formulation of a major cross-cutting recommendation, which calls for the systematic integration of a prior impact assessment into the legislative process governing forensic DNA.

Context and question(s) of research

Since 1999, Belgium has had genetic databases designed to identify individuals and establish links between different cases in the context of criminal justice. The management of these human biobanks is entrusted by law to the National Institute of Criminalistics and Criminology (NICC), in a framework that is strictly separate from any other biobank. However, DNA analysis techniques are evolving very rapidly, forcing the NICC to adapt the way these biobanks are managed. New approaches, such as Y-chromosome analysis, mitochondrial DNA analysis and next-generation sequencing techniques, require not only technical adjustments but also anticipation of future developments in this field. At the same time, the tools used to interpret matches between DNA profiles, such as methods for calculating the probability of results, are still based on genetic reference data established more than ten years ago. However, the significant demographic changes that Belgium and Europe have undergone over the last two decades, as well as the adoption of the new DNA law in 2024 and the legalisation of emerging DNA techniques, may necessitate a reassessment or even an adaptation of the references currently used to assess the value of genetic matches.

In this context, the two research questions of the project are the following : (1) How can DNA databases be optimised, both technically and scientifically, to better serve the objectives of criminal justice? (2) How do the practices of the various actors, whether directly or indirectly involved in the use of DNA databases, influence the functioning, effectiveness and legitimacy of these databases?

Main findings

The project is divided into five distinct but interrelated areas of research, split into two distinct research pillars.

The first three axes forming **the first pillar** focus on *optimizing DNA databases as a technical and scientific tool in the service of justice*. Enhancing the operational efficiency of DNA databases is of paramount importance, particularly given their substantial contribution to forensic investigations. These databases play a crucial role in the identification of individuals, the resolution of criminal cases, and the exoneration of wrongfully accused persons. However, their effectiveness is not solely determined by their size or the number of profiles they contain, but rather by a complex interplay of methodological and statistical parameters. **The first axis** of the project examines the thresholds used to determine whether a DNA profile is eligible for entry into the database. These criteria must balance sensitivity and specificity, ensuring that profiles are both informative and reliable. The research shows that incorporating statistical parameters into inclusion criteria can improve the evidential value of so-called partial DNA profiles. Even profiles with fewer genetic markers can still be informative when they contain rare alleles, meaning elements less commonly observed in the reference population. The study also demonstrates that database size directly affects the likelihood of adventitious matches, meaning that threshold values for inclusion must be periodically reassessed as the database grows. A hybrid strategy—such as limiting the retention time of profiles with fewer genetic markers—can help prevent database saturation while maintaining efficiency. **The second axis** of the project focuses on the procedures used to compare DNA profiles within the database, as these directly impact the likelihood of detecting true matches while minimizing false positives. In this part of the project, we evaluated current comparison criteria and explored ways to further optimize them to improve both accuracy and efficiency. Transitioning to a likelihood ratio (LR)-based comparison method—a statistical tool widely used in forensic science to express the evidential value of a result—would strengthen match interpretation by assigning a statistical weight to each positive result rather than relying solely on the number of shared genetic markers, as is currently the case. If profiles with a limited number of genetic markers are included in the future, applying statistical thresholds will be essential to maintain match reliability while increasing the number of genuine matches detected. **The third axis** of the project evaluates the suitability of the reference population used to calculate statistical values that serve as decision-making elements in the first and second axes. Does the choice of population data—Belgian, European, or derived directly from profiles currently stored in DNA databases—significantly affect the statistical evaluation of matches identified in the databases? Although the comparison between the Belgian reference population and that derived directly from the DNA databases showed minimal influence on statistical outcomes, broader comparisons across global populations revealed substantial variations. These differences are particularly pronounced regarding statistical values associated with rare elements present in a specific DNA profile and must be considered, especially in the case of partial profiles, to ensure the overall efficiency, reliability, and forensic value of DNA databases. Continuous evaluation and refinement of these parameters are essential to ensure that the databases remain scientifically robust and legally defensible, especially as technological advances and population dynamics evolve.

Axes 4 and 5 then form **the second pillar of the project**, which focuses on *the rules governing the practices of the various actors involved in the forensic process*. **Axis 4 of the project** highlights that regulating the use of DNA in criminal matters cannot be limited to technical decisions taken in isolation. Every legislative choice (authorising a technique, restricting its use or modifying its conditions) has concrete effects on the conduct of investigations, the protection of fundamental rights, the workload of those working in the field and citizens' confidence in the justice system. Using comparative scenarios, the project demonstrates the value of broadening the legislator's thinking upstream, in order to anticipate these effects rather than correcting them after the fact. This approach makes it possible to weigh up, in a structured manner, sometimes contradictory issues: the effectiveness of the investigation, legal certainty, protection of privacy,

equal treatment and social acceptability. Area 4 also emphasises that optimising regulation does not end with the adoption of the law. It requires the establishment of mechanisms to assess the implementation of the rules in practice and identify discrepancies between the law and actual practices. Without such assessment mechanisms, there is a high risk of unregulated practices emerging or inequalities in treatment that are difficult to correct. The analysis also highlights several grey areas in the current framework, particularly with regard to certain key players in the criminal justice process, such as laboratories, whose central role is not always accompanied by clear and specific rules. These legal loopholes undermine the consistency of the system and can compromise the quality of the evidence produced. Finally, Area 4 points out that fundamental rights should not be seen solely as limits on criminal proceedings. They also constitute essential benchmarks for ensuring the legitimacy, reliability and effectiveness of the production of judicial truth. Consistent and balanced legislation thus contributes to strengthening, rather than hindering, the proper functioning of criminal justice.

Axis 5 of the project, which is based on a survey of stakeholders in the field, identified several sources of tension throughout the judicial analysis process, by cross-referencing the testimonies of those involved. These tensions can largely be explained by the system's dependence on very concrete material constraints. These primarily concern human resources, with sometimes insufficient numbers of staff and uneven levels of training. They also relate to financial constraints, which limit the number of samples that can be analysed and the type of analyses that can be carried out. Added to this are time constraints, linked for example to the management of people flows, the advance preparation of requisitions or the pressure of deadlines. Finally, there are operational difficulties, such as the lack of automated software for decrypting data or the lack of telephone hotlines always accessible to teams working directly at crime scenes. All of these constraints hinder the smooth flow of information between the various actors in the judicial process and sometimes prevent the effective enforcement of legal safeguards. They therefore have a direct impact on the quality of the work carried out. 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. To address this situation, two regulatory scenarios have been developed as part of the aforementioned work. They are based on a logic of balance. The first seeks to provide the stability, reliability and efficiency gains necessary for the functioning of a system subject to severe constraints. The second scenario focuses more on professional skills, human judgement and cooperation between actors, which are essential for dealing with complex situations and ensuring the legitimacy of the process. The combination of these two scenarios aims to strengthen the organisational efficiency, scientific relevance and legal soundness of DNA evidence in a sustainable and complementary manner.

Conclusion and recommendations

To achieve the objectives outlined above, the project's results are organised around three complementary dimensions. The first is to *prioritise quality over quantity*, ensuring compliance with rules, data representativeness and rigorous control of the tools and information used. The second focus is on *supporting those involved in producing and implementing the standard*, whether legislators or those involved in the forensic process, and on preserving the human, ethical and normative dimensions of the process, taking into account the workload, uncertainties and value choices that technological innovations can entail. The third area seeks to *bring scientific research closer to practical application*, drawing on interdisciplinary, inductive and educational work to transform scientific knowledge into concrete recommendations that are both operational and normative. The aim is thus to promote an improvement in the use of forensic DNA that is fact-based, ethical, realistic and sustainable.

Nevertheless, in a context where resources are already limited, it is problematic for legislators to continue introducing or authorising 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 makes a major cross-cutting recommendation, **calling for the systematic integration of a prior impact assessment into the legislative process**

governing forensic DNA. Such an assessment would first make it possible to objectively measure the financial, human and organisational costs associated with any new technical innovation. It would then serve to assess the expected benefits in concrete terms, taking into account the resources actually available, operational constraints, the effective practices of the actors involved and the tangible effects on the objectives of criminal justice. It would also have the role of defining an evaluation method adapted to the specificities of DNA evidence, drawing on scientific, criminological, technical and legal knowledge. Finally, this assessment should be carried out by a recognised body, in collaboration with the DNA Assessment Commission, in order to ensure a balanced representation of researchers from all relevant disciplines, including criminology, law and forensic science.

Read more

Coquet M., Dorné T., Rousseau F., Hugues S., Morandini M., Steuve S., Hausman J.-M., Renard B., ***Management and development of forensic biobanks at operational and policy levels in Belgium***. Final Report. Brussels: Belgian Science Policy Office 2026 – 422 p. (BRAIN-be 2.0 - (Belgian Research Action through Interdisciplinary Networks)).

Information

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