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*OBM Genetics*

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Review

# Leveraging DNA Databases to Reconnect Families Separated by Conflicts and Humanitarian Crises

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**Academic Editor:** Mohammadreza Mohammadabadi

*OBM Genetics*
2025, volume 9, issue 3
doi:10.21926/obm.genet.2503304

**Received:** May 14, 2025
**Accepted:** July 03, 2025
**Published:** July 15, 2025

**Abstract**

Ongoing global conflicts and humanitarian crises have led to unprecedented displacement, including millions of separated children, many of whom, especially infants, cannot be traced using traditional methods. This paper advocates for the establishment of a voluntary, privacy-protected global DNA database, managed by an extra-governmental entity, to facilitate family reunification. It presents a comprehensive socio-technical framework that synthesizes a novel operational model with the requisite legal and ethical safeguards for responsible implementation. The proposed model moves beyond traditional reactive methods by focusing on a proactive strategy of collecting DNA from at-risk populations prior to a crisis. The framework's ethical architecture is built upon stringent informed consent protocols, data confidentiality and security, individual data sovereignty, trauma-informed approaches integrated with psychosocial support, and strict adherence to international human rights law and the highest data protection standards. Addressing risks such as state misuse, improper data sharing, and genetic exceptionalism is paramount to ensure the database serves purely humanitarian ends and protects vulnerable populations. The paper concludes that the system's viability is contingent upon its independent, extra-governmental governance, which

is essential for building trust and preventing misuse, ultimately offering an invaluable tool to reunite families and uphold the fundamental right to family life.

**Keywords**
Family reunification; DNA database; humanitarian crises; separated children; displaced persons; legal safeguards; data protection

## 1. Introduction

Escalating global conflicts and humanitarian disasters have sharply increased the number of missing children and separated families. The number of individuals forcibly displaced globally has reached unprecedented levels. As of mid-2024, UNHCR estimates that 122.6 million people worldwide were forcibly displaced due to persecution, conflict, violence, human rights violations, or events seriously disturbing public order. This figure encompasses 43.7 million refugees and 72.1 million individuals displaced within their own countries [1]. Among these displaced populations is a substantial, though often underreported, number of children who have been separated from their families. By the end of 2023, a record 47.2 million children were living in forced displacement. Of these, approximately 19.1 million refugee and asylum-seeking children, and an estimated 28.1 million children displaced internally by conflict and violence [2]. Beyond these specific crises, the United Nations Children's Fund (UNICEF) estimates that 153 million children worldwide are orphans, though not all due to conflict or disaster. Furthermore, over 473 million children live in countries affected by conflict, and one in four of the world's children resides in a conflict or disaster zone [3]. These figures collectively paint a picture of a global childhood increasingly under threat of separation.

These events, which often overwhelm local and international response capacities, expose children to serious risks, including exploitation, trauma, and permanent separation from their loved ones. Traditional methods of tracing families and identifying missing persons are often too slow or ineffective in the chaotic aftermath of armed conflict or disaster. This is particularly true for infants and young children who are unable to share identifying information. Given that each day of separation can be deeply damaging to a child's development and well-being [4-6], rapid, reliable methods of reunification must be prioritized.

To meet this critical need for swift and dependable reunification, DNA testing offers a highly effective instrument. It provides high accuracy and has already proven its effectiveness in disaster victim identification [7]. It also plays a foundational role in restoring family unity, which is essential for children's psychological recovery and long-term development [8-10]. This paper proposes the establishment of a global DNA repository as a targeted application of this technology to identify and reunite separated children with their families, arguing for a significant paradigm shift towards the proactive collection of DNA from at-risk populations before crises escalate. Such a system would function as a secure, centralized database to compare genetic profiles from separated individuals against those of searching family members. Families searching for abducted children, and children who may seek to reconnect with their biological relatives years or even decades later, would benefit significantly from such a system.

Yet, the use of genetic data is not without risk. Governments have misused DNA databases for state surveillance or discriminatory purposes, and the unauthorized use of such data can cause irreparable harm to individuals and families. It is therefore critical that strong ethical safeguards, trauma-informed practices, and transparency guide the development and operation of such a database. Oversight by international humanitarian organizations and child protection experts will be vital to ensure that the data are used solely for reunification and human rights protection [11]. The protection and restoration of safe, nurturing family relationships must remain at the core of international response strategies. A global DNA database, if implemented with care and respect for privacy and human dignity, has the potential to reunite countless families and restore identities lost through war and disaster.

## 2. Limitations of Conventional Tracing Mechanisms in Crisis Contexts

Conventional approaches to family tracing and reunification face formidable challenges in the chaotic environments created by conflict and disaster. Various tools exist for identifying individuals after disasters. These range from traditional metrics like physical descriptions and clothing, to technological aids such as web-based locators and GPS, and biometric measures including fingerprints, facial recognition, and DNA [12, 13]. Biometric tools offer the advantage of being difficult to forge, and while they should not be used in isolation, they can significantly supplement other evidence [7].

These methods, however, are frequently too slow or ineffective, a reality that is particularly acute for infants and young children who are unable to provide identifying information about themselves or their families [14]. Pre-verbal children, lacking the capacity to communicate names, locations, or descriptions of relatives, represent a cohort for whom traditional, information-based tracing methods are often severely hampered, if not entirely futile.

The process of traditional tracing is inherently complex and resource-intensive. It involves meticulous searches for parents and relatives, efforts by families to locate lost children, and, in some cases, the arduous task of finding suitable long-term care solutions. In situations where millions are displaced, parents may be deceased or missing themselves, and children may be too traumatized, frightened, or simply too young to provide coherent information; the task becomes monumental. Documentation, such as birth certificates or hospital records, which forms a cornerstone of traditional investigative efforts, is often lost, destroyed, or never issued, particularly in under-resourced or conflict-affected regions.

Further complicating matters are the procedural complexities inherent in traditional family tracing efforts. Effective tracing requires not only logistical systems but also clearly defined principles, values, and roles, alongside prioritized record-keeping. Creating a comprehensive social history for each child, verifying family links, and assessing the socio-economic and safety situation of potential reunification environments are all critical but time-consuming steps. Moreover, practices such as attempting to trace with children physically present are discouraged due to potential re-traumatization and ethical concerns [15].

The integrity of data, a crucial element in any tracing system, is also highly vulnerable in crisis settings. Experiences from broader crisis intervention models highlight challenges with missing data and the potential loss of credibility if significant portions of information are unaccounted for. These issues are directly applicable to traditional tracing systems that rely on paper trails and human

memory, both of which are prone to error under duress. Even when tracing leads to potential reunification, the subsequent process of family support can be fraught with difficulties, as highlighted by challenges in family therapy during crises, such as ensuring engagement and avoiding bias.

The consistent emphasis across various analyses on the inability of infants and very young children to self-identify points to a fundamental limitation of traditional methods. Because these methods largely depend on verbal communication, names, locations, and descriptions of family members – information a pre-verbal child cannot supply – they are inherently ill-suited for this exceptionally vulnerable demographic [16].

Moreover, the description of crises frequently overwhelming local and international response capacities, combined with the inherently time-consuming nature of traditional tracing methods, suggests a critical issue of systemic saturation. In large-scale emergencies, conventional systems are quickly overburdened. This saturation leads to a lost window of opportunity for reunification. The longer a child remains separated, the more difficult tracing becomes: trails grow cold, children may be moved across borders, memories fade, and, in the most sinister cases, identities may be deliberately altered. DNA technology, particularly with advancements promising more rapid processing capabilities, offers the potential to keep this critical window open longer or to process a significantly larger number of cases within it, thereby improving the chances of successful reunification before they diminish irrevocably.

## 3. DNA Technology as a Reliable Instrument for Identity and Kinship Verification

DNA technology offers a scientifically robust and increasingly accessible tool for establishing identity and biological kinship, with significant potential to revolutionize family reunification efforts in humanitarian crises. DNA data is unique among biometric tools as it can verify both identity and kinship with high accuracy, though it comes with inherent privacy and confidentiality risks. DNA identification typically involves analyzing short tandem repeats (STRs), which are highly variable regions of the genome not generally linked to traits like appearance or health conditions [17]. A standard set of 20 STRs is commonly used for forensic and relationship testing in the United States, proving highly effective for parent-child relationships and often useful for sibling relationships [18]. For more distant relations, single-nucleotide polymorphisms (SNPs) can be employed, although some SNPs may be associated with visible traits or health predispositions [19]. Rapid DNA technology allows for quick verification of identity and close genetic relationships, a critical factor in disaster situations where families are displaced [20].

DNA is already an internationally accepted method for Disaster Victim Identification (DVI), used in events like the MH17 crash, the 2004 Indian Ocean Tsunami, and the 9/11 attacks [21-23]. Genetic information is typically gathered from victims (post-mortem DNA) and family members (ante-mortem DNA) [24, 25]. Rapid DNA technologies have further expedited this process, offering time and cost efficiencies despite higher initial equipment costs, by reducing the expenses associated with prolonged identification efforts [26]. Compared to other biometrics like fingerprints (which can be damaged) or facial recognition (whose efficacy is unclear for decedents, injured individuals, or developing children), DNA offers a more robust and often indispensable identification method [27]. Beyond DVI, DNA data can be pivotal in reuniting living family members, particularly in chaotic humanitarian crises. Its ability to verify kinship, not just identity, is a significant advantage. DNA can

help expose fraudulent relationship claims and potentially deter trafficking efforts [28]. It can also be used concurrently for DVI and living family reunification, for instance, by identifying a child and testing kinship with a deceased parent and a living one. The high discriminatory power of DNA reduces errors, and advances in rapid DNA technology shorten separation times, which is crucial for child well-being [29]. Successfully applying DNA for identification can resolve ambiguous loss and facilitate healing by enabling reunion [30].

Technological advancements continue to enhance the capabilities of DNA analysis. Next-Generation Sequencing (NGS) allows for the study of complex DNA mixtures (e.g., from multiple individuals), the profiling of highly degraded or low-quantity samples, and even the prediction of ancestral origins and certain phenotypic traits. NGS also improves the resolution of mitochondrial DNA (mtDNA) and Y-chromosome analysis, which are valuable when nuclear DNA is scarce or compromised. Innovations in sample collection and management aim to streamline processes, reduce errors, and potentially lower the costs associated with DVI operations, principles of which could be adapted for collecting samples from living individuals. Furthermore, techniques like mini-STR analysis have been developed to increase success rates with degraded DNA, a common challenge in forensic and humanitarian contexts [31].

The core challenge lies in adapting the proven technical power of DNA to a profoundly different human context [32]. DVI primarily focuses on deceased individuals, providing closure for families and supporting legal processes. Reuniting living children, however, involves ongoing rights, immediate protection needs, and long-term implications for the child's future well-being. Ethical considerations such as informed consent from vulnerable living individuals, the stringent privacy requirements for data that pertains to ongoing lives, and the potential for re-traumatization during the process take on different dimensions and greater weight. Thus, a direct transposition of DVI protocols is insufficient. A new operational framework explicitly designed for the unique needs and vulnerabilities of separated children is essential. Implementing these advanced technologies must be carefully paired with concurrent developments in effective data governance frameworks and comprehensive capacity-building initiatives, thereby ensuring their responsible use while effectively managing potential risks [33].

## 4. Building a Global DNA Database: Proposed Models and Frameworks

The vision of a global DNA database dedicated to reuniting separated children is ambitious, requiring a carefully planned operational framework and robust technical infrastructure. Such a system must be designed not only for efficacy but also with paramount attention to security, ethics, and the unique vulnerabilities of the children and families it aims to serve. This section outlines a proposed model for such an undertaking, drawing insights from existing expertise while addressing the unique humanitarian context.

To better contextualize new proposals, it is helpful to consider the landscape of existing international DNA databases, which are primarily oriented towards law enforcement. These are either “global” or regional. A key global example is the Interpol DNA Gateway platform, established in 2002 [34]. As of early 2025, 87 member countries contribute to the Interpol DNA Database (IDD), which currently holds more than 280,000 DNA profiles [35]. The IDD holds DNA profiles from convicted individuals, suspects, missing persons, unidentified human remains, and crime scenes. The IDD excludes personal information of data subjects, and the profiles are governed by the

national laws of the submitting law enforcement agency [34]. For example, profiles originating from the UK will be subject to the rules set out in the Protection of Freedoms Act 2012 (PoFA) [36], meaning domestic laws largely dictate access and use of data and the protection of the rights of IDD data subjects [37]. Regionally, one well-established criminal intelligence and information database is the Europol Information System (EIS), which includes a DNA database containing profiles from European Union Member States [38]. The EIS was established in 2005 and stores information on serious international crime, including convicted and suspected individuals, as well as other related crime data. Like the Interpol database, profiles stored on the EIS are subject to national laws of the submitting agency, and access to data stored on the EIS can be restricted by the submitting agency [38, 39]. While valuable for criminal investigations, these existing frameworks, with their law enforcement focus and governance by national state agencies, differ significantly in structure and purpose from the humanitarian-focused system envisioned for family reunification.

This paper proposes a new humanitarian-focused model involving the establishment of an extra-governmental DNA database specifically designed for the rapid reunification of living, separated children. While organizations like the International Commission on Missing Persons (ICMP) provide a powerful precedent for large-scale, independent DNA identification, their primary mandate is broad and often focused on identifying victims of past conflicts. The system proposed here builds upon the ICMP's proven principles of neutrality and data security, adapting them for this distinct and urgent child-centric purpose. A cornerstone of this proposed model is its independence from direct state control, managed by a neutral and independent entity or organization. This structural independence is essential, designed to foster trust and ensure the database serves purely humanitarian ends. It directly addresses foundational concerns about data security and the ever-present potential for state misuse – issues that are particularly acute for vulnerable populations fleeing persecution and which can act as significant barriers to participation. The legitimacy and ultimate success of the proposed global DNA database critically depend on this perceived and actual neutrality, as well as robust protection from state interference.

The database is intended to serve multiple functions: to expedite the reunification of rescued or found children with their families by matching their DNA against the reference samples, and also to act as a long-term resource, allowing children who may have been separated for years or even decades to potentially trace their biological origins and connect with relatives later in life. The operational model for such a database should emphasize working outside direct government control, collaborating instead with civil society organizations and treaty-level intergovernmental agencies. This collaborative approach aims to ensure that the data is used exclusively for family reunification and, where appropriate, for documenting human rights violations, strictly preventing mission creep. The development and oversight of such a system would necessitate comprehensive expertise from various fields, including bioethics, genetics, pediatrics, child psychology, human development, forensics, social policy, and law, highlighting the extensive knowledge required.

A central and distinctive recommendation of this paper is the implementation of proactive DNA collection from living family members, representing a critical shift from traditional, reactive tracing methods, which typically commence after a child is reported missing. This proactive stance involves identifying populations or regions at high risk of mass displacement or family separation and, with appropriate consent and safeguards in place, building a reference database in anticipation of future crises. Such an approach could dramatically accelerate the identification process if a child from an enrolled family is later found separated, as their family's DNA profile would already be on file.

However, this proactive model also introduces a new layer of ethical complexity. Decisions regarding which populations are deemed "at risk" for pre-emptive data collection, the mechanisms for obtaining truly informed consent for potential future (and unspecified) separation events, and the protocols for the secure long-term storage of such data, mainly if no separation ultimately occurs, require cautious consideration and robust ethical oversight. While potentially more effective in rapid identification, this model demands an even higher standard of governance and community consultation compared to collecting DNA solely from families of children already known to be missing.

## 5. Legal Safeguards in Humanitarian DNA Database Frameworks

Building upon the framework for a global humanitarian DNA database, this section discusses the critical legal and ethical architecture required for its responsible and rights-respecting implementation. The inherent sensitivities of genetic data, particularly from vulnerable populations and children, necessitate robust safeguards against the significant risks of misuse, which demand proactive and comprehensive legal address. This architecture must be designed to proactively address concerns about surveillance, discrimination, and privacy violations, protect individual rights, and build unwavering trust among all stakeholders.

A primary challenge is mitigating the potential for DNA data, collected for reunification, to be misused for other purposes, such as unauthorized comparisons with criminal databases or to justify actions like deportation [40]. This fear can deter individuals from providing samples, a phenomenon observed during the U.S. "Zero Tolerance" policy [41, 42] and in the aftermath of 9/11, which led families to seek extra-governmental identification processes [43]. Furthermore, governments have, in some instances, misused DNA databases for state surveillance or discriminatory purposes, and the unauthorized use or leakage of genetic data can inflict irreparable harm. Concerns about the expansion of gene surveillance are particularly acute with specific DNA analysis techniques, such as searching for potential relatives through partial matches. Such methods can raise significant issues of equality, accuracy, privacy, and possible racial discrimination, and may disproportionately affect minority groups, often overrepresented in state databases [44, 45]. Similarly, proposals for compulsory or universal genetic databases have faced strong opposition due to their potential for "indignity, error and abuse," as exemplified by Kuwait's attempt to implement such a database, which was invalidated on constitutional grounds [46]. Such experiences underscore that expanding databases without addressing systemic discrimination or fostering governmental trust offers little resolution to these concerns.

A significant related risk is "function creep" or "purpose creep," where data initially collected for a specific, legitimate purpose is later used for unrelated, often unanticipated, and potentially rights-infringing purposes [47]. For a humanitarian DNA database, immense pressure could arise from law enforcement or national security agencies seeking access for their investigations.

The legal architecture must therefore incorporate several key mitigation strategies. A foundational element is establishing a clear, distinct, and legally binding mission for the DNA database, focused solely on humanitarian reunification and explicitly separate from law enforcement mandates. This necessitates a standardized, developmentally appropriate, and trauma-informed consent protocol. Such a protocol must justify the use of DNA, specify the information to be gathered and shared (with robust non-disclosure agreements), detail sample

collection and destruction procedures, outline the consenting process, offer alternatives, and be sensitive to children's developmental stages and potential trauma.

The documented history and legitimate fear of state misuse of DNA data represent a significant ethical and practical impediment. For refugees, asylum seekers, or members of persecuted minorities, providing their DNA to any entity perceived as linked to state authorities could evoke profound reluctance. Therefore, the legal architecture for the extra-governmental database proposed in Section 4 must unequivocally ensure its structural and operational independence from direct state control. This is not merely a desirable feature but a foundational necessity, requiring specific legal provisions within its charter—such as governance by an independent international board, secure and autonomous funding mechanisms, strictly enforceable purpose limitation clauses internationally, and transparent oversight—to build the legitimacy and acceptance vital for voluntary participation. Any ambiguity regarding potential state access for non-humanitarian purposes, not explicitly mitigated by its founding legal framework, could fatally undermine the initiative. Partnerships with trusted non-governmental organizations can also help alleviate concerns about governmental misuse [11].

Moreover, the legal framework must address the sensitive nature of DNA, which contains data about genetic relationships, ancestry, and health predispositions [48]. This raises concerns about privacy and rights to incidental findings, such as misattributed parentage, which could disrupt families or lead to stigmatization [49]. A privacy-preserving technical and legal approach, possibly using database-to-database comparisons for kinship matching rather than one-to-one individual tests where feasible, can limit inferences about specific families and protect non-genetic family structures.

While the focus is on the immense benefits of DNA technology for identification, the legal and ethical framework must guard against "genetic exceptionalism." This refers to the tendency to treat genetic information as uniquely powerful, definitive, and infallible, which can potentially overshadow other forms of evidence or lead to premature or incomplete conclusions. Crucially, this risk extends to how the concept of “family” itself is defined. A core tension exists between the biological definitions of kinship revealed by DNA technology and the broader social or legal constructions of family. A significant critique of global DNA-based approaches is that they may inadvertently serve as a gatekeeping tool, prioritizing biological relationships over established non-genetic families (e.g., adoptive, blended, or other customary kin structures). This is not a hypothetical concern; recent U.S. policies, such as the Office of Refugee Resettlement's requirement for DNA verification for certain sponsors, illustrate how state-run systems can privilege genetic links [50].

While the policy states that DNA results are not the sole factor for denial and includes provisions for data protection, its mechanics reveal the inherent risks associated with this approach. For instance, refusal to test is not an outright disqualifier. Still, it results in the sponsor being re-categorized to a status that "will require enhanced vetting procedures"—a powerful incentive to comply. More critically, from an ethical standpoint, the policy "presumes consent for children under the age of 14 for purposes of DNA sample submissions." This approach, which prioritizes bureaucratic confirmation over the complex realities of kinship and the principles of informed consent, demonstrates how even state-level policies can function as a gatekeeping mechanism, create procedural delays, and fall short of the robust, trauma-informed, and child-centric safeguards advocated for in this paper. It is essential to point out that DNA matches, particularly those

indicating kinship, are often probabilistic rather than absolute certainties [51]. The system must therefore be designed to integrate DNA findings into a broader, multidisciplinary framework for child protection assessments. This ensures that genetic data informs, but does not solely dictate, reunification decisions, which must always prioritize a child's best interests, safety, and well-being, including their account and wishes where appropriate.

## 6. Data Protection Standards for Global DNA Reunification

To counter potential risks of misuse and to build a system founded on respect for human dignity, the proposed global DNA database must be built upon several firmly established, clear pillars and operational safeguards. These pillars are essential for ensuring the database's legitimacy, trustworthiness, and adherence to international human rights. This section will detail these critical components, including the paramount importance of rigorous and culturally sensitive informed consent processes; stringent measures for data confidentiality, security, and fostering a degree of individual data sovereignty; the necessity of trauma-informed practices integrated with appropriate psychosocial support; and finally, the overarching requirement for the database to operate in strict accordance with international human rights law and the highest prevailing data protection standards. Each of these elements forms an indispensable part of the protective architecture for this humanitarian initiative.

### *6.1 Informed Consent*

Consent for collecting biometric data from living individuals is paramount. Protocols can be adapted from DVI scenarios, but they must also consider nuances such as cross-border data sharing, cooperation with authorities, and the lifelong nature of DNA data [52, 53]. This may involve rolling consent, assent protocols for children, and re-consent at specific milestones [54]. Consent processes must be informed by child development theories and principles of assent [55]. For a global DNA database, informed consent processes must be exceptionally rigorous, culturally sensitive, and tailored to the comprehension levels of participants, including parents or legal guardians of separated children. Consent must be freely given, without coercion, and individuals must be informed about several key aspects of the procedure. These include: the specific purpose of the DNA collection (i.e., family reunification); how their data will be stored, secured, and for how long; who will have access to the data and under what conditions; and the potential for incidental findings (e.g., non-paternity, health-related information, though the database should be designed to avoid seeking such information). Furthermore, they must be informed of their right to refuse participation without penalty and, where feasible, their right to withdraw consent and have their data removed, along with an understanding of the privacy standards and confidentiality measures in place. A best-practice approach, such as utilizing ethnographic fieldwork to develop trauma-sensitive consent processes, is a crucial step in this direction. For older children and adolescents, mechanisms for obtaining their assent, in addition to parental or guardian consent, should be explored.

### *6.2 Confidentiality and Data Security*

Stringent measures must be implemented to protect the confidentiality and security of highly sensitive genetic data. This involves several critical components, including the robust encryption of

DNA profiles and any associated personal identifying information, as well as the implementation of strict access controls to ensure that only authorized personnel with a legitimate need can access the data. Additionally, a secure physical and digital storage infrastructure is essential to prevent unauthorized access, breaches, loss, or alteration, complemented by regular security audits and updates designed to counter evolving cyber threats.

### *6.3 Data Sovereignty and Control*

While complex in a global, extra-governmental context, individuals should retain a degree of control over their genetic information. This aligns with the principles of informed consent and the right to withdraw. The extra-governmental model proposed in Section 4 inherently aims to shift data control away from states and towards individuals and the trusted international non-governmental or intergovernmental organization custodian. Clear policies on data ownership, retention periods, and procedures for data deletion upon request or after a defined period are essential.

### *6.4 Trauma-Sensitive Approaches in DNA Family Matching*

The entire process, from initial contact with families to sample collection and the eventual communication of DNA results (whether a match is found or not), must be conducted using trauma-informed approaches. This means recognizing that individuals and families affected by conflict and disaster are likely to have experienced significant trauma. Interactions should be empathetic, respectful, and designed to avoid re-traumatization. This includes providing clear, simple information, ensuring privacy during sample collection, and offering psychosocial support services before, during, and after the process.

Given the long-term nature of the proposed database, which may hold data for decades and potentially be used to reunite children with their parents or guardians when they are adults, the concept of initial consent requires careful consideration. Ethical best practice may necessitate a "dynamic consent" model [56]. This would involve mechanisms for individuals, upon reaching the age of majority or demonstrating sufficient maturity, to be re-contacted (where feasible and desired) to re-consent to the continued storage and use of their data, modify the terms of their consent, or request the removal of their profile. Such an approach would better respect individual autonomy over time, particularly as societal understanding and norms regarding genetic privacy continue to evolve.

The revelation of kinship through DNA analysis can sometimes uncover unexpected, sensitive, or even traumatic information. This could include discovering non-paternity, unknown half-siblings, or receiving confirmation of a parent's death (if the database is also linked to DVI efforts). Therefore, a trauma-informed approach must be deeply interwoven with principles of genetic counseling. This requires specialized personnel who are cross-trained to not only accurately interpret and explain DNA results but also to prepare individuals and families for potential outcomes, manage emotional distress, and deliver information in a compassionate, supportive, and culturally sensitive manner. The process of communicating DNA results in this humanitarian context is far more than simple information delivery; it is a sensitive psycho-social intervention that demands a unique blend of skills.

### *6.5 Adherence to International Human Rights Law and Data Protection Standards*

The operation of a global DNA database for family reunification must be firmly anchored in international human rights law and adhere to the highest prevailing data protection standards. The integrity of the family unit and the right to family life are protected under international human rights and humanitarian law, and efforts to reunify separated families are crucial for upholding these fundamental rights.

Key international organizations, including the International Commission on Missing Persons (ICMP), the International Committee of the Red Cross (ICRC), and the United Nations Children's Fund (UNICEF), have established comprehensive data protection frameworks. The ICMP, whose sole mandate is to account for the missing, operates under a robust data protection framework that ensures genetic data provided by families is used exclusively for identification, is not shared with any party for other purposes without consent, and is protected by stringent technical and legal safeguards. The ICRC Rules on Personal Data Protection, revised in 2020, emphasize the preservation of the integrity, confidentiality, and availability of personal data while respecting the rights, freedoms, and dignity of individuals whose data is processed. Likewise, UNICEF's Policy on Personal Data Protection stipulates a compliance framework ensuring that personal data is processed justifiably, for defined purposes, limited in scope, kept accurate, secured, retained only as long as necessary, and handled transparently concerning data subjects, with particular care mandated for children's data. These existing frameworks from leading humanitarian actors provide essential guidance.

Core data protection principles that must govern the database include: lawfulness, fairness, and transparency in all data processing activities; strict purpose limitation, ensuring data is used solely for humanitarian family reunification; proportionality and data minimization, collecting only the data that is strictly necessary; maintaining data accuracy; ensuring data integrity and confidentiality through robust security measures; and adhering to storage limitation principles, meaning data is not kept indefinitely without justification. Regulations such as the European Union's General Data Protection Regulation (GDPR), known for its stringent requirements, are increasingly viewed as a benchmark, and its principles should inform the standards applied by global databases, even when operating in regions with less developed local laws. The sensitivity of genetic data, akin to "neurodata," which is noted for its informational richness and predictive potential, further underscores the need for rigorous scrutiny and protection.

Given that the proposed global DNA database will inevitably collect data from, store data in, and potentially share data across numerous jurisdictions with varying, inconsistent, or even absent national data protection laws, a critical operational principle must be adherence to the highest feasible international standards for all data, irrespective of its point of origin or the location of the data subject. Applying a patchwork of local standards, some of which may be weak or poorly enforced, would result in inequitable protection and undermine trust. Adopting a universally high standard, such as that reflected in GDPR principles (e.g., lawful basis for processing, robust consent, data minimization, security by design, rights of data subjects), for all data processed within the global system is essential for ensuring consistent, robust, and ethically sound protection for the most vulnerable individuals.

While data protection regulations are often perceived primarily as a set of compliance obligations or constraints, their practical implementation in the humanitarian sphere can be a catalyst for more

effective action. Robust data protection practices, as outlined by organizations such as the ICRC and UNICEF, are essential to building and maintaining trust with affected populations. When individuals believe that their data, especially highly sensitive genetic information, will be handled securely, used responsibly, and protected from misuse, they are more likely to willingly participate in humanitarian programs, including DNA collection for reunification purposes. This enhanced cooperation can improve the reach and efficacy of aid delivery. Therefore, strong data protection is not merely a legal or ethical hurdle; it is an integral component of operational effectiveness, accountability to affected populations, and the overall success of the humanitarian mission.

## 7. Conclusions

Violent conflicts and humanitarian crises have led to a critical rise in separated children, with an estimated 43.3 million children living in forced displacement by the end of 2022. Traditional tracing methods are frequently overwhelmed and ill-suited for the unique vulnerabilities of this group, especially infants. DNA technology presents a scientifically robust means for identity and kinship verification, offering significant potential to enhance family reunification efforts, as demonstrated by its utility in Disaster Victim Identification.

A key contribution of this paper is the proposal for a global, extra-governmental DNA database that moves beyond reactive measures. We advocate for a system founded on the proactive collection of DNA samples from at-risk populations, creating a long-term repository for matching separated individuals before they are lost in the chaos of a crisis.

However, the successful and ethical implementation of such a system is contingent upon several critical factors:

1. **Proactive and Independent Governance:** An extra-governmental model, managed by a neutral and independent entity, is crucial to manage the proactive collection of sensitive data ethically and to build trust, mitigate fears of state surveillance or misuse (e.g., for deportation or discrimination), and prevent function creep, ensuring the database serves purely humanitarian objectives.
2. **Robust Legal and Ethical Frameworks:** Comprehensive safeguards are non-negotiable. This includes:
    - **Informed Consent:** Rigorous, culturally sensitive, trauma-informed, developmentally appropriate, and potentially dynamic consent processes (including assent for children and re-consent at majority) are foundational.
    - **Data Protection:** Stringent measures for data confidentiality, security (encryption, access controls), and integrity must be implemented, adhering to the highest international standards like GDPR principles for all data, regardless of origin.
    - **Purpose Limitation:** A legally binding mission focused solely on humanitarian reunification, explicitly separate from law enforcement.
    - **Trauma-Informed Practices:** The entire process must be empathetic, avoid re-traumatization, and include psychosocial and genetic counseling support, especially when dealing with incidental findings or difficult news.
3. **Integration and Oversight:** DNA findings must be integrated into a broader, multidisciplinary child protection assessment, avoiding "genetic exceptionalism" and prioritizing the child's best interests at all times. This explicitly includes recognizing and respecting established social

and legal family structures, ensuring that DNA serves as a tool for reunification, not a barrier that excludes non-biological kin. Oversight by international humanitarian organizations and child protection experts is vital. Leveraging decades of experience, secure infrastructure, and established trust, organizations like the ICMP could be instrumental in establishing or overseeing such a system.

If these principles are meticulously upheld, a global DNA database, operating with transparency and respect for human dignity, can become an invaluable asset in reuniting countless families, restoring lost identities, and upholding the fundamental right to family life for children affected by war, disaster, and displacement. Strong data protection, in this context, is not a barrier but an enabler of trust and operational effectiveness.

## Author Contributions

A.S. conceptualized and designed the overall framework and wrote the initial draft of the manuscript. K.C. contributed to the legal analysis, conducted the literature review on existing DNA database frameworks, compiled and verified data references, and provided substantial revisions to the manuscript. Both authors reviewed, edited, and approved the final version of the paper.

## Competing Interests

The authors have declared that no competing interests exist.

## AI-Assisted Technologies Statement

Artificial intelligence (AI) tools were used solely to improve the readability of this work. The authors remain fully responsible for the content and have thoroughly reviewed the final manuscript to ensure its accuracy and integrity.

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