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"BALANCING PRIVACY AND JUSTICE: ETHICAL CONSIDERATIONS IN FORENSIC GENETIC GENEALOGY"

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ABSTRACT

Forensic Genetic Genealogy (FGG) has revolutionized criminal investigations by combining DNA analysis with genealogical research to identify suspects and victims. While it has proven instrumental in solving cold cases and delivering justice, its use raises significant ethical concerns—particularly regarding individual privacy, informed consent, and the potential misuse of genetic data. This paper explores the delicate balance between advancing public safety and protecting personal privacy. It critically examines the ethical frameworks guiding FGG, the implications of using consumer DNA databases, and the need for transparent policies and oversight. By analysing real-world cases and current regulatory approaches, the study emphasizes the importance of ethical guidelines to ensure responsible and equitable use of this powerful investigative tool.

Keywords: Forensic Genetic Genealogy, Privacy, Ethics, DNA Databases, Criminal Justice

INTRODUCTION: A NEW ERA IN CRIME SOLVING

Forensic Genetic Genealogy[1] has emerged as a groundbreaking tool in modern criminal investigations, combining DNA profiling with genealogical research to identify perpetrators and victims often in cases that have remained unsolved for years. While this approach has seen prominent applications in Western countries like the United States, interest in its potential use is growing in India as forensic science continues to evolve and integrate with digital and genomic technologies.[2] India, with its complex social and genetic diversity, presents both unique opportunities and challenges in the implementation of FGG as part of its criminal justice system.

[1] FGG
[2] M.S. Reddy et al., *Role of Forensic DNA in Criminal Justice Delivery System in India: A Review*, 7 J. Forensic Sci. & Crim. Invest. 555 (2018)

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In FGG, investigators utilize DNA evidence typically collected from crime scenes and compare it against profiles in genealogical databases, which may include publicly accessible or voluntarily submitted data from individuals interested in ancestry and lineage.[3] Although India currently lacks large-scale public genetic genealogy databases like GEDmatch, initiatives like the Centre for DNA Fingerprinting and Diagnostics (CDFD) and state forensic laboratories are laying the groundwork for advanced genetic profiling. Moreover, India's recent legislative developments, such as the DNA Technology (Use and Application) Regulation Bill, propose a framework for the use of DNA in criminal and civil investigations.

The potential of FGG in India is significant particularly in identifying unknown victims, solving cold cases, and tracking repeat offenders but it also raises critical ethical and legal concerns. Issues such as informed consent, data security, and the risk of caste-based or communal profiling must be carefully addressed. As India steps into this new era of crime-solving technology, the establishment of robust privacy protections and ethical guidelines will be essential to ensure that justice does not come at the cost of civil liberties.

HOW FORENSIC GENETIC GENEALOGY WORKS

Forensic Genetic Genealogy (FGG) integrates traditional genealogical techniques with advanced DNA analysis to trace familial relationships and identify unknown individuals involved in criminal cases. The process begins with the extraction of DNA from biological evidence collected at a crime scene such as blood, saliva, or hair which is then subjected to autosomal DNA testing, targeting approximately 700,000 single nucleotide polymorphisms (SNPs) across the genome. This type of DNA testing, distinct from the short tandem repeat (STR) analysis commonly used in India's forensic laboratories, allows for more distant familial matching, often reaching third or fourth cousins.[4] The resulting DNA profile is uploaded where permitted into public or third-party genealogy databases such as GEDmatch or FamilyTreeDNA, where it is compared against voluntarily submitted profiles from individuals who have used consumer genetic testing services for ancestry or health-related purposes.[5]
If a genetic match is found, forensic genealogists analyse the shared DNA segments and build

[3] Anshu Raina & R.K. Mahajan, *Recent Advances in Forensic DNA Profiling: Current and Future Perspectives*, 41 Ind. J. Med. Res. & Pharm. Sci. 39, 41 (2022).
[4] M.K. Borkar et al., Advances in Forensic DNA Analysis and Its Application in Criminal Investigation, 12 Int'l J. Sci. & Res. 212, 213 (2021).
[5] A. Bansal & R. Badiye, STR Markers and Their Forensic Applications: A Review, 60 Egyptian J. Forensic Sci. 27, 28–29 (2020).

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extended family trees using public records like birth certificates, marriage registers, obituaries, and social media data. This genealogical reconstruction helps investigators identify potential suspects or unidentified victims by triangulating between multiple distant relatives and narrowing down the list of candidates based on location, age, sex, and other case-specific details. In the Indian context, while genealogy databases are not yet widely established, the potential for such methods is increasingly being recognized. Institutions like the Centre for DNA Fingerprinting and Diagnostics and the proposed DNA data banks under the DNA Technology Bill may play future roles in developing similar capacities. Despite its effectiveness, the use of FGG also demands careful legal oversight to prevent misuse of genetic data and ensure compliance with privacy norms.

UNLOCKING COLD CASES: THE PROMISE OF FGG

Forensic Genetic Genealogy has emerged as a powerful tool in criminal justice, especially for solving cold cases that had previously gone unsolved for decades. The most well-known example is the capture of Joseph James DeAngelo, also known as the Golden State Killer, who was identified in 2018 through FGG after eluding authorities for over 40 years. Investigators used a crime scene DNA sample to create a SNP profile and uploaded it to GEDmatch, a public genealogy database. By identifying distant relatives and constructing an extensive family tree, they were able to trace the DNA back to DeAngelo, a former police officer, ultimately leading to his arrest and conviction for multiple murders and sexual assaults.[6] This landmark case showcased the groundbreaking potential of FGG to breathe new life into cold case investigations and provide long-awaited closure to victims' families.

Since then, FGG has been instrumental in solving hundreds of cold cases worldwide, including the identification of unknown murder victims, missing persons, and long-time fugitives. In the United States, agencies such as the FBI and various state police departments have successfully partnered with private genetic genealogy firms to resolve cases that had exhausted all traditional forensic leads. The methodology has proven especially effective in cases involving unidentified human remains, where traditional biometric tools fall short. In the Indian context, while FGG has not yet been officially adopted, India's vast repository of unsolved criminal cases particularly those involving missing persons or unidentified bodies stands to benefit immensely from this innovation. The integration of FGG within Indian forensic science,

[6] Justin Jouvenel, *To Find Alleged Golden State Killer, Investigators First Found His Great-Great-Great-Grandparents*, Wash. Post (Apr. 30, 2018), https://www.washingtonpost.com

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supported by frameworks like the DNA Technology (Use and Application) Regulation Bill, could open new pathways for justice. As India modernizes its forensic infrastructure, FGG offers a promising avenue for unlocking cold cases and reinforcing the rule of law

PRIVACY AT RISK: WHOSE DNA IS IT ANYWAY?

While Forensic Genetic Genealogy has proven valuable in solving cold cases, it also raises serious concerns about genetic privacy, consent, and data ownership. Unlike traditional forensic methods, FGG often involves uploading an individual's DNA profile to public or third-party genetic databases, where the data may be used not only by ancestry companies but also by law enforcement. A major ethical concern is that one person's voluntary submission of DNA can inadvertently expose hundreds of genetically related individuals, many of whom have not consented to such use. For example, in the Golden State Killer case, the suspect was identified through distant relatives who had uploaded their genetic data to GEDmatch, raising the question: Should a third cousin's consent be enough to implicate you in a criminal investigation In many jurisdictions, including India, there are no clear legal frameworks governing the secondary use of genetic data, especially when it comes to law enforcement access. The proposed DNA Technology (Use and Application) Regulation Bill, 2019 attempts to regulate DNA usage for identification purposes but is vague on matters like individual consent, data sharing across agencies, and rights of relatives. Moreover, data ownership remains a grey area; while commercial companies may claim rights over stored DNA data, individuals and their families often lack clarity on how their genetic information can be used, reused, or shared. In a country as genetically and socially diverse as India, the implications are even more profound misuse or unauthorized access to DNA data could exacerbate caste, religious, or regional discrimination.[7] Therefore, while FGG offers powerful investigative potential, it must be accompanied by strict regulatory safeguards to prevent unintended violations of privacy and bodily autonomy.

GENETIC INFORMANTS: THE ETHICS OF THIRD-PARTY IMPLICATION

One of the most contentious ethical issues in Forensic Genetic Genealogy (FGG) is the phenomenon of third-party implication—where individuals who have never submitted their

[7] S. Krishnan, *Digital DNA: Ethics and Governance of Forensic Genetic Databases in India*, 58 Econ. & Pol. Weekly 35, 37 (2023).

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DNA can nonetheless become the subject of police investigations because a relative has uploaded their genetic profile to a public or third-party database. In these cases, DNA acts as a genetic informant, revealing familial links that can lead to criminal suspects or even innocent individuals being placed under surveillance without their knowledge or consent. While such leads have solved numerous cases, including high-profile homicides, critics argue that this effectively outsources surveillance to citizens and creates a backdoor route for law enforcement to bypass traditional privacy protections. This raises profound ethical questions: Does your cousin's curiosity about ancestry give the state a license to investigate you? In countries like India, where joint families and extended kinship networks are common, one DNA upload could potentially implicate dozens of individuals, some of whom may not even be aware of their genetic proximity to a suspect.[8] Unlike fingerprinting or CCTV footage, genetic data reveals sensitive, immutable, and deeply personal information, including health risks and ancestral origins. Moreover, India currently lacks specific guidelines on how third-party implications should be handled within the legal system. The proposed DNA Technology (Use and Application) Regulation Bill, 2019 does not explicitly address the rights of non-consenting genetic relatives, creating legal ambiguity and potential for misuse.[9] As FGG continues to evolve, the ethical principle of informed consent must be extended beyond individual users to recognize the interconnected nature of genetic identity, thereby ensuring that the innocent are not collateral damage in the pursuit of justice.

CONSENT AND TRANSPARENCY: THE MISSING PIECES

At the heart of ethical concerns surrounding Forensic Genetic Genealogy (FGG) lies the issue of informed consent and transparency particularly in how genetic data is accessed and used by law enforcement. Many popular genetic genealogy platforms, such as GEDmatch and FamilyTreeDNA, have implemented opt-in/opt-out policies in response to public criticism, allowing users to choose whether their data may be accessed for law enforcement purposes. However, these consent mechanisms are often buried in complex terms of service and rely on users' understanding of forensic applications, which may not be adequately conveyed at the time of data submission. For example, GEDmatch initially allowed law enforcement access by default, only changing to an opt-in model in 2019 after controversy over the use of its database in high-profile criminal cases. FamilyTreeDNA similarly faced backlash for granting FBI

[8] vrinda Bhandari & Smriti Parsheera, *Regulating DNA Technology in India: A Legal and Ethical Perspective*, 15 NUJS L. Rev. 1, 13–15 (2022).
[9] The DNA Technology (Use and Application) Regulation Bill, 2019, Bill No. 47 of 2019

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access to its data without first notifying users, prompting a shift toward more transparent policies.

Despite these changes, serious ethical concerns remain. Many users are unaware that their data could potentially be used to implicate relatives in criminal investigations, and opt-in models still do not resolve the issue of third-party exposure as relatives who did not consent are indirectly affected by another's choice. Furthermore, in jurisdictions like India, where such commercial genealogy databases are not yet widespread, the absence of legal standards for consent, disclosure, and data-sharing agreements means that future implementation of similar tools could mirror early Western missteps. The DNA Technology (Use and Application) Regulation Bill, 2019 lacks specific provisions mandating transparency about secondary uses of DNA data, including access by investigative agencies. For FGG to operate ethically, explicit, informed, and ongoing consent mechanisms must be built into the system, and users must be clearly informed of the full scope of data usage, including potential law enforcement access. Without these safeguards, the promise of justice risks being undermined by a lack of respect for individual autonomy and genetic privacy.

MISSION CREEP: EXPANDING THE SCOPE BEYOND SERIOUS CRIMES

Forensic Genetic Genealogy was initially hailed as a breakthrough tool for solving the most heinous and intractable crimes cold case homicides, serial sexual assaults, and the identification of unknown remains. However, an emerging concern in legal and bioethics communities is the phenomenon of "mission creep" the gradual expansion of FGG use beyond its original purpose to include non-violent, minor, or even property crimes.[10] In the United States, there have already been cases where FGG was used in investigations of burglary and vandalism, sparking backlash from privacy advocates who argue that the intrusion into personal and familial genetic data was disproportionate to the gravity of the offense. This expansion erodes the ethical justification for using such an invasive tool, especially when it involves sensitive genetic information and the potential identification of individuals who are not suspects but genetically related to one.

[10] Natalie Ram, *DNA by the Entirety: The Fourth Amendment and the Genetic Panopticon*, 115 Colum. L. Rev. 873, 891–92 (2015).

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The lack of clear legal boundaries and oversight mechanisms exacerbates this concern. In India, the proposed DNA Technology (Use and Application) Regulation Bill, 2019 does not strictly limit the types of crimes for which DNA-based investigations let alone FGG can be used, raising fears that genetic tools could be misused for political surveillance, caste-based profiling, or overreach in petty crimes. As genetic databases expand and law enforcement capabilities increase, the risk of normalizing the use of FGG for low-stakes cases becomes more tangible, thereby diluting public trust and amplifying concerns about state surveillance. Ethically, this shift undermines the principle of proportionality that the invasiveness of a tool must be matched by the seriousness of the crime and threatens to turn exceptional technology into a routine surveillance practice. To prevent mission creep, clear statutory limits must be placed on FGG usage, ensuring that it remains a tool of last resort, reserved for crimes where justice truly demands extraordinary measures.

LEGAL AND REGULATORY GAPS

Despite its growing use in criminal investigations, Forensic Genetic Genealogy (FGG) operates in a legal grey area across much of the world, including India. There is currently no uniform international legal framework governing how genealogical DNA data can be accessed, stored, and used by law enforcement. In countries like the United States, the legal status of FGG is largely shaped by agency policy and case-by-case discretion, rather than clear legislative mandates, leaving vast room for variation in how different jurisdictions handle privacy, consent, and oversight.This fragmentation creates loopholes that can be exploited, such as cross-border data access without proper user consent or judicial review. Moreover, judicial oversight is minimal or absent in many FGG-related investigations, with law enforcement often gaining access to genetic data without a warrant, raising serious constitutional and human rights concerns.

In the Indian context, the legal infrastructure is even less prepared to handle the complexities of FGG. Although the DNA Technology (Use and Application) Regulation Bill, 2019 aims to regulate DNA use in criminal and civil matters, it falls short in addressing genealogical tracing, familial implication, and third-party consent. There is also no requirement for independent or judicial oversight before DNA samples are uploaded to or compared with any database, a glaring omission considering the invasive nature of genetic analysis. Additionally, India lacks a comprehensive data protection law; the recently passed Digital Personal Data Protection Act, 2023 does not directly address the sensitive category of genetic data in the context of criminal

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investigations. The absence of standardized global protocols and strong domestic safeguards leaves individuals vulnerable to misuse, unauthorized surveillance, and privacy breaches. Without robust legislative reform and international cooperation, the powerful capabilities of FGG risk operating beyond the reach of both courts and constitutions.

TOWARD A BALANCED APPROACH: ETHICAL PRINCIPLES IN PRACTICE

To harness the benefits of Forensic Genetic Genealogy while safeguarding fundamental rights, a balanced ethical framework must guide its application. Central to this framework are the principles of proportionality, necessity, transparency, and oversight. Proportionality requires that FGG be deployed only in serious criminal investigations where less intrusive methods have failed, ensuring that the invasive nature of genetic analysis is justified by the gravity of the offense. Necessity dictates that law enforcement should exhaust traditional forensic tools before resorting to genealogical databases, thus preserving genetic privacy as a last-resort resource.

Transparency mandates clear communication to DNA contributors about how their data may be used, including potential law enforcement access and the risks of third-party implications. This includes simplified, accessible consent protocols and public reporting of FGG use to foster trust. Crucially, robust judicial oversight must be instituted to authorize access to genetic data, ensuring checks and balances against potential abuses and warrantless surveillance. In India, these ethical imperatives should be embedded within the evolving legal framework, including amendments to the DNA Technology (Use and Application) Regulation Bill, 2019, to explicitly recognize consent mechanisms, restrict data usage to serious crimes, and mandate judicial review.[11] Furthermore, independent data protection authorities should oversee compliance, and cross-border data sharing must adhere to stringent privacy standards.By institutionalizing these principles, FGG can realize its promise of delivering justice without compromising individual autonomy and privacy rights.

CONCLUSION: NAVIGATING THE FUTURE OF GENETIC JUSTICE

The advent of Forensic Genetic Genealogy marks a transformative moment in criminal justice,

[11] Vrinda Bhandari & Smriti Parsheera, *Regulating DNA Technology in India: A Legal and Ethical Perspective*, 15 NUJS L. Rev. 1, 25–28 (2022).

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promising unprecedented breakthroughs in solving cold cases and delivering long-overdue closure to victims and their families. Yet, this innovation brings with it profound challenges chief among them the tension between the collective pursuit of justice and the preservation of individual genetic privacy and autonomy. As FGG technology advances and becomes more accessible, it risks outpacing the legal and ethical frameworks designed to regulate its use, potentially leading to privacy infringements, consent violations, and unwarranted surveillance of innocent individuals. The current global landscape, and India's nascent regulatory efforts, underscore the urgency of developing clear, enforceable standards that uphold transparency, proportionality, and rigorous oversight. Only through such balanced approaches can society ensure that the power of genetic information is harnessed responsibly protecting individual rights while advancing the cause of justice. Moving forward, continuous dialogue among lawmakers, ethicists, scientists, and the public will be vital to navigate this complex terrain, shaping a future where innovation and ethics coexist harmoniously in the realm of genetic justice.