**Forensic DNA retention: public perspective studies in the United Kingdom and around the world**

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# Ethical Approval

This work is part of a doctoral research which has been approved by the Institute’s Ethics Committee.

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# Highlights

* Protection of Freedoms Act 2012 regime representative of surveyed British public
* Public education gap on DNA retention suggest public views are not well-informed.
* Criminal justice professionals express expansive views on forensic DNA retention
* Non-criminal justice professionals express restrictive views on forensic DNA retention
* Research into stakeholders rating of different DNA retention regimes highly recommended

**Forensic DNA retention: public perspective studies in the United Kingdom and around the world**

# Abstract

This review analysed public perspective studies on forensic DNA retention in the United Kingdom and around the world. The studies generally show strong public support for the long-term or indefinite retention of DNA from convicts and suspects. There is considerable support for the retention of DNA from all or some arrestees and potentially the entire population. This was predicated upon the belief that forensic DNA databases have crime-solving abilities, which the public rate highly. In the UK, it was found that the current Protection of Freedoms Act 2012 regime is broadly representative of the recommendations of the surveyed British public. Nevertheless, the studies highlighted a gap in forensic DNA education among the public, suggesting that public views may not be well informed. Overall, there was clear evidence of privacy concerns and the potential misuse of DNA records among the public, with a significant number opposing the retention of DNA from the innocent. It was found that most of the studies were qualitative or non-representative of the relevant population, limiting the generalisation of the results. There was also limited studies among a representative sample of primary stakeholders who are well-informed or directly exposed to the benefits, challenges and risks associated with DNA retention. A research into stakeholders rating of different forensic DNA retention regimes is therefore highly recommended. This is important because the studies suggest divergent views among criminal justice professionals and other members of the public, with the former expressing expansive views and the latter expressing restrictive views. The primary stakeholder's survey will help establish whether the relevant safeguards have been put in place to protect both public security and individual interests.

**Keywords:** Public perspective; National DNA Database; Protection of Freedoms Act 2012; privacy; public security

# Introduction

National forensic DNA databanks and databases have revolutionised the investigation of crime since they were first introduced in England and Wales in April 1995. Williams and Johnson[[1]](#footnote-1) describe the ‘common trajectory’ of forensic identity testing from initial case-by-case application in resolving violent crime to the development of DNA databases for the investigation of a wide range of offences including property crime. Currently, over 94 states in the world operate a national forensic DNA databank/database or are planning to establish one.[[2]](#footnote-2) There are 8 operational national DNA databases in continental Africa, 16 in Asia, 36 in Europe, 9 in North and South America and 2 in Oceania (Table 1).[[3]](#footnote-3) More than 67 million forensic DNA profiles are held on DNA databases globally with China (>44 million), the United States (17.1 million), and the UK (6.7 million) having the largest databases.[[4]](#footnote-4) Whilst some states restrict DNA databasing to convicted individuals, others permit short retention periods for DNA data from arrestees. The website of the Forensic Genetics Policy Initiative[[5]](#footnote-5) provides detailed analysis of the inclusion and retention criteria for different national DNA databases around the world. As the need for international collaboration in fighting cross-border crime such as human, sex and drug trafficking, terrorism and illegal immigration rises, it is expected that more states will establish a national forensic DNA database. The European Union (EU) Council Decision 2008/615/JHA, for example, requires all EU member states to create a national DNA database that can be searched automatically by other member states.[[6]](#footnote-6) Though there has been a significant progress in achieving this goal, differences in DNA retention policy have been highlighted as a potential setback in the transnational exchange of DNA data.[[7]](#footnote-7)

*Table 1 – Countries with operational national DNA database in the world*

|  |  |  |
| --- | --- | --- |
| **Continent/region** | **Country** | **Number** |
| Africa | Botswana, Egypt, Morocco, Mauritius, Namibia, South Africa, Sudan, Tunisia. | 8 |
| Asia | Bahrain, China, Indonesia, Iran, Israel, Jordan, Japan, Kuwait, Lebanon, Malaysia, Qatar, Saudi Arabia, Singapore, South Korea, United Arab Emirates, Uzbekistan. | 16 |
| Europe | Austria, Belarus, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Georgia, Germany, Greece, Hungary, Iceland, Ireland, Latvia, Lithuania, Luxembourg, Macedonia, Malta, Montenegro Netherlands, Norway, Poland, Portugal, Romania, Russia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Ukraine, United Kingdom. | 36 |
| North/South America | Argentina, Brazil, Canada, Chile, Colombia, Jamaica, Panama, Peru, United States. | 9 |
| Oceania | Australia, New Zealand. | 2 |
| Total |  | 71 |

Deoxyribonucleic acid (DNA) is the genetic material that stores genetic information of most organisms including humans.[[8]](#footnote-8) It encodes information needed for building cells, tissues and organs of an organism. The genetic material is hereditary and is passed on from parent to offspring. The DNA molecule is made up of a string of subunits called nucleotides.[[9]](#footnote-9) A g*ene* refers to specific sections of the nucleotide sequence that control phenotypic characteristics such as hair, eye, and skin colour.[[10]](#footnote-10) Some specific DNA sequences, called non-coding DNA, do not control phenotypic characteristics or their biological function is not fully understood. These non-coding areas are characterised by repetitive core sequences that vary in number within and between individuals (termed *length polymorphism*).[[11]](#footnote-11) Except for red blood cells, every cell of the human body has genomic DNA.[[12]](#footnote-12) Therefore, all biological fluids or body tissues have DNA which can be profiled for forensic identity purposes.

Forensic DNA Databases are computerised database systems that store *forensic DNA profiles* derived from *biological samples* taken from known individuals and *biological evidence* recovered from crime or incident scenes (including a person). The biological samples are usually saliva taken in the form of a mouth swab whilst the biological evidence includes saliva (e.g. extracted from cigarette butts), nasal secretions, semen and vaginal secretions (e.g. from condoms or vaginal/anal swabs), bloodstains, bones, hair, urine, faecal matter and ‘touch’ DNA – which cannot be attributed to a specific biological source.[[13]](#footnote-13) A collection of the physical biological samples/evidence including their *DNA extracts* is referred to as a *Forensic DNA databank*.[[14]](#footnote-14) The forensic DNA profile is a unique set of 10 – 16 (now up to 24[[15]](#footnote-15)) pairs of numbers and a pair of gender-specific letters (XX for female, and XY for Male) derived from the non-coding areas of the DNA. The DNA profile can be used to identify a person with a high degree of certainty but it cannot predict the health, disease risk, ancestry or the physical appearance of an individual.

The main purpose of databases is to help solve crimes that are otherwise unsolvable by traditional investigative techniques such as interrogation of suspects and witnesses. When a profile from a crime without a suspect matches a subject profile on the database, it is referred to as a *cold hit*.[[16]](#footnote-16) This can lead to the identification of the unknown offender and potentially the resolution of the crime. Another type of database hit is a *warm hit*, where a crime profile matches an already identified suspect.[[17]](#footnote-17) The warm hit can be used to corroborate other evidence or verify the identity of the suspect, though this can be achieved without the database. The retention of DNA data is only relevant for generating cold hits. The database also allows identification of serial offenders by linking different crimes. Another potential benefit of DNA databases is the possibility to analyse crime patterns, which can aid the police in identifying crime hot spots.[[18]](#footnote-18) This can help the police to develop effective proactive measures to counter crime or prevent crime.

## **The UK National DNA Database**

The United Kingdom National DNA Database (NDNAD) is the world’s largest database by the proportion of the entire population on the database (over 8.2% of the UK population). It holds DNA records from all police forces in England and Wales as well as records from the separate Northern Ireland DNA Database (NIDNAD) and Scotland DNA Database (SDNAD). Additionally, DNA profiles from the Crown Dependencies (Isle of Man, the Bailiwick of Jersey and the Bailiwick of Guernsey) are exported to the NDNAD. As of December 2017, the database held 6,151,593 subject reference profiles (of which 5,344,537 are known individuals) and 582,950 crime scene DNA profiles.[[19]](#footnote-19) A search of the database, on loading a new crime scene profile, can provide investigative ‘leads’, identify unknown offenders or eliminate suspects and link different crimes. As of 2016, the chance of a match between a newly loaded crime scene profile and a subject profile was 63.3%.[[20]](#footnote-20) Although less than 1% of crimes are detected using the NDNAD, its detection rate has been shown to be more efficient than crimes without DNA evidence.[[21]](#footnote-21) Estimates reported by Bramley[[22]](#footnote-22) in 2009 indicates that the database contributed to an increase in detection rate from 26% to 40% for all recordable offences, 16% to 41% for domestic burglary, and 8% to 63% for vehicular theft offences. About half of detections yield conviction of which a quarter result in incapacitation or imprisonment. The estimated crime prevention rate is 7.8 crimes per custodial sentence.[[23]](#footnote-23)

The crime prevention potential of the NDNAD has influenced significant government support and financial investment in its development and expansion. For example, over two hundred million pounds funding was invested in the NDNAD through the Government’s DNA database expansion programme by 2005.[[24]](#footnote-24) The programme aimed at increasing the collection of DNA samples from crime scenes and rapid sampling of suspected individuals, as well as advancing the DNA analysis technology to allow analysis of low template (i.e. smaller quantities of DNA samples, sometimes referred to as touch DNA) and degraded DNA. The expansion programme was facilitated by legislative reforms in England and Wales that widened the pool of individuals that could be sampled including those arrested, charged or convicted of a recordable offence.[[25]](#footnote-25) Several ethical and policy issues regarding data privacy and human rights have been raised about the retention of samples and profiles, particularly data of unconvicted individuals. These issues have evoked debates on public security, principles of justice such as the presumption of innocence, proportionality and necessity, and the onus of proof; and ethical values such as liberty, bodily inviolability, informed consent, privacy, equality and autonomy of individuals.[[26]](#footnote-26)

## **Forensic DNA databasing and privacy concerns**

Forensic DNA Databanking and Databasing introduces two main privacy concerns: firstly, the phenotypic characteristics (including health or disease risk, age, geographical origin, ancestry and physical appearance) of an individual and his/her biological family can be predicted from the actual DNA sample; secondly, an individual and his/her biological family can be tracked using the stored forensic DNA profile – a form of bio-surveillance.[[27]](#footnote-27) Without restrictive rules, employers, for example, may access the DNA databank to determine the genetic predisposition of prospective employees who have their DNA material or that of their relative retained. They may also be interested in finding out whether a prospective employee has their DNA records or is related to an individual on the ‘criminal’ database. This may potentially introduce a form of ‘genetic discrimination’ in employment. Unconvicted individuals on the databank/database may be denied important services because of genetic discrimination or adverse inference of criminality may be drawn against them.[[28]](#footnote-28)

Article 8 of the Human Rights Act 1998 (HRA) stipulates that:

1 Everyone has the right to respect for his private and family life, his home and his correspondence.

2 There shall be no interference by a public authority with the exercise of this right except such as is in accordance with the law and is necessary in a democratic society in the interests of national security, public safety or the economic well-being of the country, for the prevention of disorder or crime, for the protection of health or morals, or for the protection of the rights and freedoms of others.

It follows that any interference with the privacy of an individual must be justified or proportionate and necessary. For convicted individuals, there is a consensus for their DNA to be stored due to their potential risk to society or high propensity to re-offend.[[29]](#footnote-29) The estimated recidivism rate among violent offenders is over 60% within three years.[[30]](#footnote-30) The retention of convicted individual’s profiles may help in achieving key public security objectives such as crime prevention or reduction, investigation, detection, prosecution and resolution of crime. The retention of DNA samples and profiles of unconvicted individuals has been controversial because there is limited data to justify retention.[[31]](#footnote-31)

## **Retention regimes**

Forensic DNA databanking/databasing is generally governed by legislation to ensure that it operates lawfully, ethically and effectively in the prevention and early resolution of crime. The retention regime is the legal system that governs whose DNA samples/profiles can be stored and the length of retention. The general factors considered in the development of appropriate retention regime include *definition and size of the active or previously active criminal population* (i.e. individuals who have committed crime, are committing crime, or are likely to commit crime), *recidivism rate* *or re-arrest rate,* and *heterogeneity of offences committed by individual offenders.*[[32]](#footnote-32) The different retention models used or proposed for national databases include: comprehensive/universal database,[[33]](#footnote-33) convicted individuals database, suspected individuals database, arrestee database, volunteer database or a combination of these with or without databanking (i.e. storage of the actual DNA sample). The models for length of DNA sample/profile retention include: indefinite, until the death of subject or hundred years, temporal retention based on the seriousness of the offence, age, the maximum length of sentence or a mixture of these.

Generally, an effective retention regime should ensure that the data of the ‘active or previously active criminal population’ are retained on the database for a justifiable period whereby it will assist in the maintenance of public security.[[34]](#footnote-34) As established in existing literature and European court cases,[[35]](#footnote-35) the public interest in the creation of databases should be balanced with the civil liberties of individuals, particularly the right to privacy. Hence, an effective retention regime should be compatible with human rights law. The literature shows that most states apply a specific combination of inclusion and retention criteria influenced by legal history and politics.[[36]](#footnote-36) Comparing the trajectory of DNA database practices in liberal democracies and communitarian systems, Toom[[37]](#footnote-37) suggests a level of conformity to due process in the former and crime control in the latter.

### Public security

The legal justification for the privacy intrusiveness of forensic DNA databases/databanks has mainly relied on public security grounds.[[38]](#footnote-38) The definition of public security, based on paragraph 2 of article 8 of the European Convention on Human Rights (ECHR) or the HRA, encompass the protection of national security, public safety, the economic well-being of the state, and protection from threats directed at the public.[[39]](#footnote-39) Article 8 also includes the protection of the rights and freedoms of individuals.[[40]](#footnote-40) In this regard, public security can be described as the protection of the state and its structures as an institution, the public as an entity, and individuals (especially where the person represents the public, such as crime victims) from any form of threat to their economic, social, environmental, and cultural well-being and health. The threats include crime or disorder, terrorism, disaster, disease outbreaks, military attack, political instability, disruption of economic relations, and non-enforcement of human rights, international law and the law of the state. In the context of crime fighting and forensic DNA databasing/databanking, public security, based on section 63T of the Police and Criminal Evidence Act 1984, can be defined as the utilisation of DNA databasing/databanking technology:

1. in the interests of national security,
2. for the purposes of a terrorist investigation,
3. for purposes related to the prevention or detection of crime, the investigation of an offence or the conduct of a prosecution, or
4. for purposes related to the identification of a deceased person or of the person to whom the material relates.[[41]](#footnote-41)

### Privacy

Privacy is a complex concept to define and it may be subjective to social context and technological advancement. Shils[[42]](#footnote-42) defines privacy as a state of ‘zero-relationship’ among members of a community (either two individuals or two groups or an individual and a group). Gavison[[43]](#footnote-43) also defined privacy as ‘a limitation of others' access to an individual’. Perfect privacy is achieved when a person’s information is not available to others, not observed, and is physically inaccessible to others. Privacy also means the independence of an individual, group or organisation to decide when, how, where, why and what information about them to release to others.[[44]](#footnote-44) Practically, the state of zero-relationship, control over private information and inaccessibility may be difficult to achieve in a real society, especially in a society dependent on technology that facilitates networking or interconnectivity, monitoring of movement and social interactions with limited regulations. For example, there is a massive amount of open source information about individuals and organisations available online which can easily be accessed. The individual has limited or no control over the use of such information.

Another definition of privacy is that it is an ‘area of a man's life which, in any given circumstances, a reasonable man with an understanding of the legitimate needs of the community would think it wrong to invade’.[[45]](#footnote-45) This definition broadens the scope of privacy and may cover other areas such as family life, the home, correspondence or professional association. Both international and national laws provide for the protection of the right to privacy of individuals including their family life, home and correspondence.[[46]](#footnote-46)

In summary, privacy can be described as a state whereby:

1. a person’s body, actions, thoughts, feelings and desires, health status or physical condition, their relationships, possessions and interactions with their environment; and
2. any material and/or information retrieved, generated or inferred from them such as their DNA material, DNA profile, fingerprints, photographic image, physical appearance and origin, religious beliefs or way of life, political opinions, sexual life, habits, behaviour and communication records are concealed from others in the same social environment. This is also applicable to a group of people or an organisation or institution.

As explained in section 1.2, the databanking and databasing of DNA records from individuals constitute an interference with their privacy.[[47]](#footnote-47) Though an individual may provide consent to the storage and use of their DNA records, sensitive information about biological relatives can also be revealed. Retained DNA samples could be analysed for sensitive information (such as health status or disease risk) about the person and their biological family. The retained DNA profile could be used for familial searching and can reveal unknown family relationships. For these reasons, there is need to justify this interference as stipulated under Article 8 (2) of the HRA.

### Retention regimes for the UK (England and Wales) NDNAD

The retention regimes for DNA data from England and Wales, Northern Ireland and Scotland are independent of each other though they share several similarities currently. Table 2 summarises the current retention regimes applied in each jurisdiction. The law in England and Wales, and Northern Ireland is the same.

*Table 2 – Summary of current forensic DNA data retention regimes in the UK*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Retention category** | | **England/Wales system[[48]](#footnote-48) (2013 – present)** | **Northern Ireland system[[49]](#footnote-49) (2013 – present)** | **Scottish system**  **(2007 – present)[[50]](#footnote-50)** |
| CONVICTION | | | | |
| Adults | All recordable crimes | Indefinite | Indefinite | Indefinite |
| Under 18 years | Serious offence | Indefinite | Indefinite | Indefinite |
| Minor Offence | *First*: 5 years plus length of sentence  *Second conviction or custodial sentence >5years*: indefinite | *First*: 5 years plus length of sentence  *Second conviction or custodial sentence >5years*: indefinite | Indefinite |
| NON-CONVICTION | | | | |
| Minor offence | | Automatic deletion after the conclusion of investigation or any proceedings | Automatic deletion after the conclusion of investigation or any proceedings | Automatic deletion after the conclusion of investigation or any proceedings |
| Charged with a serious Offence | | 3 years (+ 2-year renewal with consent of Court) | 3 years (+ 2-year renewal with consent of Court) | 3 years (+ 2-year renewal(s) with consent of Court) |
| Arrested for a serious offence | | 3 years with consent of Commissioner (+2-year renewal with consent of Court) | 3 years with consent of Commissioner (+2-year renewal with consent of Court) | Automatic deletion after the conclusion of investigation or any proceedings |
| Issued with a Penalty Notice for Disorder (PND) | | 2 years | 2 years | 2 years |
| Terrorist suspects | | Retention under relevant legislation a (+2-year renewal(s) with NSD by Chief Constable) | Retention under relevant legislation a (+2-year renewal(s) with NSD by Chief Constable) | Retention under relevant legislation a (+2-year renewal(s) with NSD by Chief Constable) |

*aIncluding The Police and Criminal Evidence Act 1984 (s. 63M), Terrorism Act 2000 (para. 20E of sch. 8), Counter-terrorism Act 2008 (s. 18B), Terrorism Prevention and Investigation Measures Act 2011 (para. 11 of sch. 6), Criminal Procedure (Scotland) Act 1995 (s. 18G).*

The retention regimes that have been applied to forensic DNA data from England and Wales can be broadly divided into three: ‘*restrictive regime*’ (1995 – 2001), ‘*expansive regime*’ (2001 – 2013) and ‘*semi-restrictive regime’* (2013 – present). The first regime, brought into force following amendment of the Police and Criminal Evidence Act 1984 (PACE) by the Criminal Justice and Public Order Act 1994 (CJPOA), is characterized by indefinite retention of all DNA samples and profiles of convicted individuals, and destruction of DNA records after an individual is acquitted or the case is discontinued.[[51]](#footnote-51) All loaded profiles are subjected to speculative searching against other profiles. Challenges associated with this system include delays in the destruction of non-convicted individuals’ DNA records which renders some relevant database hits unlawful and inadmissible in court.[[52]](#footnote-52) Another challenge is repeated sampling of non-convicted suspects.

The expansive regime was introduced following amendments to PACE by the Criminal Justice and Police Act 2001 (CJA) and Criminal Justice Act 2003 (CJA). This system removed the obligation for the police to destroy DNA records of non-convicted individuals and permitted the indefinite retention of DNA samples and profiles of any individual who becomes a suspect during a criminal investigation. It is reported that, in December 2005, the records of 200,300 individuals who had been arrested but not charged were retained on the NDNAD. About 5% (8,493) of individuals in this retention category were identified as suspects in 13,964 other offences including murders, sexual assaults, aggravated burglaries and the supply of controlled drugs.[[53]](#footnote-53) This statistical evidence suggests that retention of non-convicted individuals’ DNA records could potentially aid future investigations, improve early detection of crime and serve as a crime deterrent. The major challenge with the expansive model is the infringement of the right to privacy of innocent individuals. Studies and reviews that evaluated the English/Welsh, Scottish, Dutch and Canadian retention models noted the disproportionality of the expansive model against the right to privacy of non-convicted individuals.[[54]](#footnote-54) Prior to 2008, the UK Court of Appeal and the House of Lords supported the expansive regime against the infringement of individuals’ private interest.[[55]](#footnote-55)

In 2008, the European Court of Human Rights (ECtHR) ruled that the expansive retention model for the NDNAD does not maintain a fair balance between individuals right to privacy and public security. This ruling in the case of *S and Marper v the United Kingdom* led to the development of the current Protection of Freedoms Act (2012) (PoFA) retention model which requires the destruction of all DNA samples after profiling or within six months[[56]](#footnote-56), recognising the sensitivity of the actual DNA material. The PoFA model permits indefinite retention of DNA profiles of most convicted individuals and temporal retention for some first-time convicted minors and unconvicted individuals (Table 2 above).

Since the implementation of the PoFA regime in October 2013, over 1.7 million profiles of unconvicted individuals have been removed from the database and over 7.7 million DNA samples have been destroyed after DNA profiling.[[57]](#footnote-57) These deletions were carried out to ensure compliance with the PoFA regime that seeks to balance public and individual interests. Following the implementation of PoFA, reports of the NDNAD Strategy Board (NSB),[[58]](#footnote-58) the Ethics Group (now Biometrics and Forensics Ethics Group (BFEG))[[59]](#footnote-59) and the Commissioner for the Retention and use of Biometric Material (Biometrics Commissioner)[[60]](#footnote-60) indicate an improvement in the genetic privacy of individuals, particularly the retention of DNA records of non-convicted individuals. The new regime has also improved the match rate of the database compared to previous retention regimes (Figure 1). According to Amankwaa and McCartney,[[61]](#footnote-61) this suggests that the PoFA regime may be potentially more effective in protecting public security than earlier regimes. It is however highlighted that some profiles that require retention have been deleted from the database, risking public security. Also, the Biometrics Commissioner notes that the State may risk the failure to detect and prevent crime due to non-retention of all arrestee data. A further risk is that some profiles have been retained unlawfully due to challenges with the retention process and the IT system for the database. The current policy on this issue requires the police to check the legality of each match before acting. However, unlawful hits are being used for intelligence purposes and this may constitute a breach of privacy.[[62]](#footnote-62)

*Figure 1 – Trend of NDNAD match rate from 2003/04 to 2015/16.[[63]](#footnote-63) The match rate measures the chance that a crime scene profile loaded on the database matches a subject profile. The graph shows a gradual increase in the match rate, with highest rates observed within the PoFA period 2013/14 to 2015/16.*

## **Significance of public perspectives on forensic DNA retention**

Whilst forensic DNA databases continue to grow in the UK and around the world, several studies have highlighted poor engagement of the public in the development of forensic DNA retention law or policy.[[64]](#footnote-64) The dissemination of information regarding the actual effectiveness of forensic DNA databases is also inadequate and public views are suspected to be influenced by the media and fictional investigative television programs (CSI effect).[[65]](#footnote-65) To partly fill the public knowledge gap, Sense about Science and EUROFORGEN[[66]](#footnote-66) recently published a brief guide that seeks to demystify the use of DNA. Public perspectives about DNA retention is important because they can help policy-makers to develop acceptable and proportionate legislative regimes for national DNA databases. The views of the public can also inform the development, use and governance of the database.[[67]](#footnote-67) This review sought to survey empirical studies carried out in the UK and different national contexts on forensic DNA retention. The goal of the study was to establish the existing knowledge on public perspectives on DNA retention, identify research gaps and provide recommendations for further research.

# Method

This review forms part of a larger literature-based project on the efficacy of forensic DNA retention regimes, focusing on the UK National DNA Database. The included empirical studies were identified after a search of 8 legal and multidisciplinary/science academic databases using a combination of keywords related to the topic. The databases searched were Hein Online, LexisNexis, Lawtel, Westlaw, Web of Science, ScienceDirect, Scopus, and PubMed. Some included publications were also identified from a random search on Google, screening of references of the included literature, and through research network referrals. The systematic search was conducted from 20th January to 5th May 2017. The search was limited to publications in English.

# Results and discussion

A total of 23 primary studies related to forensic DNA retention or databases were identified and analysed in this review. Table 3 summarises the specific research focus of the studies and citations. Nine studies were conducted in the United Kingdom whilst fourteen were carried out in other states around the world.

*Table 3 – Summary of empirical studies related to public perspectives on forensic DNA retention*

|  |  |  |  |
| --- | --- | --- | --- |
| **Research focus** | **Number of publications** | **Specific research area** | **Citations** |
| Public perspectives on forensic DNA databasing | 23 | Inclusion and retention criteria for DNA databases; Ethical positions about DNA databasing; Effectiveness of DNA databases; Opinions of prisoners about DNA databasing; Voluntary participation in DNA databasing; Views of criminal justice professionals versus other members of the public | Human Genetics Commission (2001); Williams R and Johnson P (2004) 23 New Genetics and Society 205; McCartney C (2006) 46 British Journal of Criminology 175; McCartney C (Willan Publishing 2006); Nuffield Council on Bioethics (2007); Human Genetics Commission (2008); Home Office (2009); Anderson C and others (2011) 20 Public Understanding of Science 146; MPA Civil Liberties Panel (2011) Metropolitan Police Authority;  Dundes L (2001) 21 Bulletin of Science, Technology and Society 369; Gamero JJ and others (2003) 1239 International Congress Series 773; Gamero JJ and others*.* (2006) 1288 International Congress Series 777; Gamero JJ and others (2007) 33 Journal of Medical Ethics 598; Gamero JJ and others (2008) 2 Forensic Science International: Genetics 138; Curtis C (2009) 29 Bulletin of Science, Technology & Society 313; Curtis C (2014) 34 Bulletin of Science, Technology & Society 21; Prainsack B and Kitzberger M (2009) 39 Social Studies of Science 51; Machado H and others (2011) 210 Forensic Science International 139; Machado H and Silva S (2012) Journal of Biomedicine and Biotechnology 592364; Machado H and Silva S (2014) 8 Forensic Sci. Int. Genet 132; Machado H and Silva S (2015) 35 Bull Sci Technol Soc 16; Machado H and Silva S (2016) 41 Sci. Technol. Human Values 322; Teodorović S and others (2017) 28 ‎Forensic Sci. Int. Genet 44. |

## **Public perspective studies in the United Kingdom (2000 – 2011)**

### Inclusion and retention criteria for DNA databases

In 2000, MORI Social Research[[68]](#footnote-68) investigated the attitudes of a random sample of the British public (*n* = 1,038) towards human genetic information. The quantitative survey was sponsored by the Human Genetics Commission (HGC). With regards to forensic DNA information, most interviewees supported sampling of individuals charged with murder (98%), sexual crimes (98%), and burglary (68%). Whilst 48% of the study participants supported the destruction/deletion of DNA records of those acquitted, 46% thought that the records should be retained. The remaining 6% answered ‘don’t know’.

Between November 2006 and January 2007, the Nuffield Council on Bioethics[[69]](#footnote-69) conducted a consultation about the use of forensic bioinformation in the UK. The consultation received 135 responses from individuals (76%) and organisations (24%) within the law enforcement, prosecutorial and human rights community and the ‘general’ public. Citing the assumption of ‘innocent until proven guilty’, there was considerable support for ‘no conviction, no retention’ of DNA records. Many respondents, however, thought that absent conviction, retention of arrestee or volunteer DNA should be based on informed consent. Some respondents justified the retention of all or some arrestees’ data or that of the entire population by citing public security or safety reasons. Another reason in support of a universal DNA database (UDNAD) was equity. For convicted individuals, the range of opinions included indefinite retention for all, retention based on re-offending history, and type/seriousness of crime. Among those who favoured retention for convicted children, some thought that the retention period should be proportionate to the crime. Those who opposed retention for young children convicted of minor crimes cited the adverse impact it may have on their development.

The Human Genetics Commission[[70]](#footnote-70) again assessed the views of the British public on DNA retention policy through a Citizen’s Inquiry in 2008. The panel was composed of a diverse group of 25-30 UK citizens from Birmingham and Glasgow. Drawing from the outcomes of several inquiry sessions with experts, and visits to policy-makers and communities, the panel made 29 recommendations about the operation of the NDNAD. Concerning themes related to DNA retention policy, most participants were against a universal database. Most participants also favoured the exclusion of DNA profiles of the innocent and supported the destruction of all DNA samples after profiling. Most panellists recommended that retention length for convicted individuals should be based on the seriousness of the offence. Also, retention (short or long-term based on offence seriousness) should apply irrespective of age. One critical theme that emerged from the inquiry is the lack of adequate information about the NDNAD and differences in opinion between criminal justice professionals and other members of the public.

In 2009, the UK government published a consultation document[[71]](#footnote-71) in response to the *Marper* decision. The document detailed a new DNA retention policy, which was incorporated in the Crime and Security Act 2010 (s. 14, repealed). The consultation received 503 responses from the public including 402 individuals.[[72]](#footnote-72) There was strong support for the destruction of all DNA samples after profiling. This policy was perceived to balance public interest and civil liberties. Criminal justice professionals, however, expressed concerns that this policy may adversely affect the ability of the police to solve cold cases. Most respondents favoured the non-retention of DNA profiles of all unconvicted arrestees. Some respondents, however, supported the proposal to temporarily store data of individuals arrested for a serious offence (ranging from 3 – 14 years). For convicted individuals, most respondents favoured indefinite retention of DNA profiles irrespective of the seriousness of the offence. However, some expressed concern that this policy is disproportionate, and that the seriousness of offence and length of sentence should be considered. Respondents supported the deletion of DNA profiles of all children under 10 years. For children between the ages of 10 and 18, respondents supported a maximum of 10 years’ retention if not convicted and indefinite if convicted. There were criticisms of the insufficiency of data available on the efficacy or effectiveness of the NDNAD among the respondents. This suggests that the views of the public on DNA retention policy may be limited by the lack of adequate empirical evidence.

In June 2011, the Metropolitan Police Authority Civil Liberties Panel (MPA CLP) produced a report on public perspectives about the National DNA Database.[[73]](#footnote-73) The report was informed by a legal and policy review, public and stakeholder consultations, and an online survey of a cross-section of Londoners (*n* = 615). Most respondents to the online survey (84%) were against the retention of DNA of arrestees absent a conviction. Participants also expressed concern about the lack of justification for retaining DNA records of non-convicted individuals. Among the reasons cited was the disproportionality between the high number of ‘innocent’ DNA records retained relative to the low number ‘NDNAD match’ convictions.

The consultation with stakeholders and selected citizens highlighted the following reasons in support of retention of arrestee DNA records: future detection of serious crime (such as sexual assault); the concept of ‘nothing to hide, nothing to fear’; and the speeding up of the investigative process due to rapid elimination of the innocent. Reasons for non-retention of arrestee DNA records were the criminalisation of the innocent, disproportionate representation of ethnic groups and distrust of the data retention procedure and use of DNA records. Like the HGC Citizen’s Inquiry and the Government’s consultation, the report emphasised significant differences in opinion between criminal justice professionals, and individuals subjected to sampling/retention and human rights advocates. The former group supported indefinite or long-term retention of all arrestee data whilst the latter favoured temporal or non-retention of arrestee DNA records. The conflict between the different groups is attributed to the limited statistical evidence to justify the retention/non-retention and periods of retention of DNA records of different categories of individuals.

### Ethical positions about DNA databasing

Williams and Johnson[[74]](#footnote-74) assessed the views of 60 primary stakeholders of the NDNAD including human rights advocates using a semi-structured interview approach. Some respondents expressed concern about the potential phenotypic and behavioural predictions of DNA, and its excessive surveillance power. They thought that DNA databasing/databanking should be limited because of the ‘genetic exceptionalism’ of DNA information. Other interviewees thought that the forensic DNA profile derived from the sample has limited predictive power. Hence, there should be little concern about privacy and civil liberties. This latter group of interviewees were those who supported the expansion of the database to include either convicted individuals and suspects or the entire population. There were views in support of the destruction of DNA samples after profiling.

Anderson *et al*.[[75]](#footnote-75) also assessed the views of young offenders in South Wales about the National DNA Database in 2008. The study used a qualitative citizens jury model among the participants (*n* = 84, aged 12-19 years). The focus group discussion that informed the Mock Trial found a strong level of support for the establishment of a UDNAD. In the mock trial, the young offenders (12) that served as the jury returned a verdict that disfavoured the establishment of a UDNAD due to cost, a threat to civil liberties, inability to achieve universality, and diminishing of the presumption of innocence principle. The initial outcome of the focus group discussion (i.e. support for UDNAD) was attributed to potential stigmatisation or discrimination of young people who have their data retained on a more restricted database.

### Effectiveness of DNA databases

Through qualitative interviews, McCartney[[76]](#footnote-76) investigated the perspectives of 14 criminal justice professionals and policymakers about the effectiveness of the UK DNA expansion programme and retention regimes. Some interviewees thought that the NDNAD is an effective tool to solve cold cases and assess crime trends, justifying the need for retention of DNA profiles. Forensic DNA databanking was thought to be necessary because DNA samples can be used to upgrade the NDNAD when new technology (for example massively parallel sequencing[[77]](#footnote-77)) becomes available. Those who opposed these views thought that the NDNAD is not always useful because not all cases involve DNA. Some expressed views supporting ‘no conviction, no retention’. There were concerns about overreliance on DNA and the NDNAD and its associated risk of abbreviating police detective work. One interviewee thought that the deterrence effect of the NDNAD is debatable because offenders change their ‘modus operandi’. Supported by a review of the literature and DNA detection rates, McCartney[[78]](#footnote-78) concluded that a large database may not be effective in detecting crime. Given that retention of DNA of innocent individuals may constitute an infringement of privacy, the study emphasised the need for further investigation into the impact of DNA retention policy (and the NDNAD) on crime detection.

Overall, the analysis of public perspective studies carried out in the UK indicates that the current semi-restrictive retention policy (i.e. the PoFA regime and/or the ‘Scottish model’) is broadly representative of the recommendations of the surveyed public. However, considering the NDNAD public education gap, it is difficult to ascertain whether public views are well informed. Secondly, most studies are not based on the views of a representative sample of the British population and therefore it is difficult to generalise the findings. Thirdly, the conflict of views that seem to emerge between criminal justice professionals and other members of the public indicate that there is a need to investigate the actual efficacy or effectiveness of DNA retention policies. This will help establish the relevant categories of individuals and standard retention lengths to improve the performance and management of the database.

## **Other public perspective studies around the world (1999 – 2017)**

### Inclusion and retention criteria for DNA databases

An international study by Wertz[[79]](#footnote-79) surveyed the views of 4,868 geneticists, general practitioners and patients about forensic DNA typing and databasing. Most participants favoured a sampling regime capturing convicted sex offenders (95%), convicts of serious offences (89%), those charged with sexual (79%) or serious offences (71%). Indefinite DNA retention was supported by 90% and 55% of participants for those convicted and charged, respectively. Most participants opposed DNA typing of the innocent.

In the United States, Dundes[[80]](#footnote-80) surveyed 416 residents of Maryland using a convenience sampling approach in 1999. The study found strong support for a DNA database of convicted violent offenders’ (89%), convicted felons’ (77%), all convicted offenders’ (65%) and suspects of violent offences (65%). Most respondents opposed DNA retention for suspects of any crime (56%) and all newborns (55%). It was found that most participants who supported capital punishment (75%) or unrestricted means to solve crime (80%) favoured retention for convicted violent offenders. Dundes[[81]](#footnote-81) concluded that an expanded DNA database may be valuable to crime-fighting. However, there should be appropriate safeguards to prevent misuse of the database. The study did not consider how long DNA records should be stored. Also, the results cannot be generalised because the study sample was not representative of the Maryland population.

Gamero *et al.*[[82]](#footnote-82) investigated public awareness of DNA databases in a representative sample (*n* = 1,654) of the Spanish population in 2003. The study used a random sampling approach to recruit interviewees. Most participants (86.9%) were aware of the usefulness of DNA typing in a criminal investigation. This varied by level of education: 81.7%, 87.2%, 90.3%, 66.7% for those with primary, secondary, higher and no formal education, respectively. Non-consensual DNA sampling was supported by most participants for accused individuals (54.99%) or in cold cases (79.87%). About 8 out of 10 participants (79.9%) supported a recidivistic violent offenders’ DNA database. There was strong support for convicted offender’s DNA database (72.0%), and volunteers’ DNA database (65%). When stratified by profession, participants in the law enforcement field were more supportive of a recidivistic offenders’ DNA database, regardless of the type of offence (between 55% – 60%). About six out of ten participants (57.4%) opposed databasing of all citizens’ DNA records without consent. Regarding the length of retention, most participants (52.1%) favoured DNA retention until the death of the subject.

In New Zealand, Curtis[[83]](#footnote-83) researched the views and expectations of the public about the forensic use of DNA in 2009. A random sample of 100 participants was interviewed via telephone. Most respondents thought that the following individuals should have their DNA records retained: convicted sexual offenders (100%), convicted violent offenders (93%), all convicted offenders (65%), suspects of sexual offences (75%), suspects of violent offences (61%), arrestees of sexual offences (62%), and arrestees of violent offence (52%). More than half of respondents opposed retention for arrestees or suspects of any crime and a UDNAD. Regarding the length of retention, 74% thought DNA records should be stored indefinitely. About eight out of ten respondents were confident of the efficient contribution of DNA towards the resolution of crime. Eighty-one percent of respondents were willing to volunteer their DNA records when requested by the police. Most respondents (63%) expressed concerns about privacy. It is worth mentioning that the main source of DNA information within this population was the media and the author found limited knowledge about DNA analysis and databasing processes. Even though the study was representative, the small sample size limits the generalisation of the results.

### Opinions of prisoners about DNA databasing

A qualitative study carried out in Austria by Prainsack and Kitzberger[[84]](#footnote-84) in 2006 and 2007 interviewed 26 prisoners to ascertain their knowledge and views about forensic DNA technology. Most interviewees strongly believed in the effectiveness of DNA in solving a crime or eliminating the ‘usual’ suspects in a criminal inquiry. The main source of DNA information in this population was also the media or television programs. Many participants expressed concern about the potential abuse of DNA databases, breach of privacy and the possibility of ‘planting’ evidence. Most interviewees opposed the establishment of a UDNAD or retention of DNA records of the innocent. Although participants noted the potential stigma associated with DNA retention, the study did not explicitly address how long data should be stored on databases for different categories of individuals.

In Portugal, Machado *et al*.[[85]](#footnote-85) also assessed the views of 31 prisoners about forensic DNA databases using a qualitative semi-structured interview approach. The study was conducted in 2009. Most interviewees supported the indefinite retention of DNA records of convicted individuals. This view was influenced by the possibility of exonerating wrongly convicted individuals or eliminating the usual suspects using DNA records held on the database. Some participants supported the establishment of a UDNAD for similar reasons and the possibility to neutralise discrimination or stigmatisation of ex-convicts. The expansion of DNA databases to include records of all convicted individuals was supported by other interviewees. Like the Austrian study, there were concerns about the potential misuse of retained DNA records.

### Voluntary participation in DNA databasing

Machado and Silva[[86]](#footnote-86) in 2012 focused on the willingness of a non-representative sample (*n* = 628) of Portuguese citizens to accept the inclusion of their DNA profile on the DNA database. Most respondents (53.5%) answered ‘perhaps’ (30.3%) or would not accept (23.2%). Voluntary participation in DNA databases (46.5% respondents) decreased significantly with age (p < 0.001) and education (p = 0.011). The perception of the DNA database as a criminal database was the main influence of non-acceptance (59.6%) to volunteer DNA records. Acceptance was influenced by the belief in the idea of ‘nothing to hide, nothing to fear’ (18.2%), the crime-solving capacity of databases (20.9%) and UDNAD (23.3%).

Machado and Silva[[87]](#footnote-87) categorised the data by profession (Law enforcement (*n* = 63), health and life sciences (*n* = 32), research and development (*n* = 160), and other professionals (*n* = 203)) to assess the perceived benefits and risks of database practices. Most participants agreed on the crime-solving efficiency (88.5%), judicial efficiency (78.2%) and crime prevention and deterrence effect (47.9%) of databases. The risks agreed by the professional group were data insecurity (72.8%), misuse of DNA data (67%), stigmatisation (34.9%) and genetic discrimination (25.3%) in descending order.

Machado and Silva[[88]](#footnote-88) also analysed the open-ended questions in the survey to determine the motivations for voluntary participation in databases. The study found that solidarity, altruism and civic responsibility to contribute to public protection motivate voluntary participation; resistance to participation is influenced by privacy intrusiveness, misuse of DNA data and fear of potential genetic discrimination; non-participation is motivated by the idea that only criminals should have their data retained, stigmatization of database subjects, and lack of direct benefits of databases. A limitation of this study was that a non-representative sample was surveyed and hence the results cannot be generalised. Secondly, the findings may be attributed to potential media or academic influence on the subject rather than actual experience or exposure to the Portuguese DNA retention system.

Curtis[[89]](#footnote-89) also investigated the understanding of a representative random sample (*n* = 394) of New Zealand citizens about the forensic use of DNA and databasing practices in 2014. Although participants had limited knowledge about forensic DNA databasing practices, the majority believed in the crime-solving capacity of forensic DNA (93.9%) and would be willing to volunteer their DNA data (75.8%). This finding is consistent with the earlier New Zealand study[[90]](#footnote-90) but contrasts with findings from the Portuguese study[[91]](#footnote-91) where willingness to participate is less than 50%. The study also found that most participants consider the use of DNA to be relevant in serious crimes such as major assault (72.2%) and sexual offences (85.5%). Ethical concerns agreed by most respondents were privacy issues (51.4%), errors (66.9%) and ‘planting’ of DNA (57.8%).

### Views of criminal justice professionals versus other members of the public

According to Teodorović *et al.,*[[92]](#footnote-92) users of the DNA database appear to favour permissive rules whilst data subjects prefer restrictive rules. This observation is consistent with the findings from public perspective studies in the UK.[[93]](#footnote-93) Teodorović *et al.,*[[94]](#footnote-94)assessed the views of a non-representative sample (*n* = 558) of the Serbian public about forensic DNA database practices in 2016. A questionnaire was used to survey the ‘general’ public (*n* = 162), prosecutors (*n* = 169), prisoners (*n =* 156), student police officers (*n* = 51), and prison guards (*n* = 20). Most respondents (57.9%) supported retention criteria including DNA records of either convicted individuals (16.1%); convicted and suspected individuals (24.2%); or convicts, suspects and volunteers (17.6%). A UDNAD was supported by 34.9% of the population. For convicted individuals, 96.3% of respondents favoured retention for those either convicted of serious crimes (29.1%), all crimes (41.9%) or all crimes and offences (25.3%). About half of respondents (51.6%) preferred indefinite DNA retention (general public (38.9%), prosecutors (61.5%), prisoners (56.4%), prison guards (60%), and student police officers (41.2%)). The second favoured option was retention until the death of the subject (37.1%). For suspects, 36.9% were in favour of inclusion for any crime and 33.3% for only serious offences. More than half of each subpopulation preferred indefinite retention whilst 33.9% favoured retention until acquittal. Close to half of respondents (47%) indicated concern about the privacy intrusiveness of DNA databases. However, a large proportion of participants in the prosecutors’ category (51.5%) indicated no concern about the violation of privacy.

# Conclusion

In summary, the studies emphasise the value placed upon the ability of forensic DNA databases to solve crime. The outcome of studies conducted in the UK and around the world show considerable public support for the retention of DNA from convicts, suspects and potentially all arrestees and the entire population. This observation is predicated upon the belief that DNA databases have crime-solving abilities, which they rate highly. There is clear evidence of privacy concerns and the potential misuse of DNA records among the public, with a significant number opposing the retention of DNA from the innocent. This calls for well-informed public engagement by authorities to assure the public of the safeguards established for DNA databases. This is important because it appears public opinion is mainly influenced by the media and television programs rather than facts of the system being implemented.

While studies of public perspectives are relevant in developing appropriate retention policies, these studies do not address the actual value of DNA retention to public security. Furthermore, there is a scarcity of such studies among a representative sample of primary stakeholders who are well-informed about the subject area and are directly exposed to the benefits, challenges and risks associated with DNA databasing. There is a need for research into the effectiveness rating of the different NDNAD or forensic DNA database retention policies among a representative sample of managers and users of the system. This will help establish whether the relevant safeguards have been put in place to protect both public security and private interests. In England and Wales, the recommended stakeholders include all Police Forces, Police Authorities, Forensic Science Providers, managers of the database, prosecution services, human rights committees and advocates and others with a direct interest in the use and operation of the database.

# Conflict of interest

None.

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