FORENSIC DNA DATABASING: RETENTION REGIMES AND EFFICACY

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FORENSIC DNA DATABASING: RETENTION REGIMES AND EFFICACY

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Abstract

Three legislative regimes have governed the England and Wales National DNA Database (NDNAD). These are broadly described as *restrictive* (1995 – 2001), *expansive* (2001 – 2013) and *semi-restrictive/Protection of Freedoms Act 2012 (PoFA) regimes* (2013 – present). The actual effectiveness of the three regimes remains abstruse. This research aimed to assess the efficacy of the different regimes to advance any reforms that may maximise the utility of the database and enhance the protection of public security and the individual's right to privacy. The research focused on the societal and individual interest outcomes of DNA databasing. The methodology involved a document analysis of reports of oversight bodies, *contributing to the establishment of the benefits, challenges and risks of the current regime.* Secondly, a literature review of research into DNA databasing was conducted. *This identified key effectiveness indicators for the assessment of NDNAD regimes.* A self-administered semi-structured questionnaire was used to assess the perception of the public about the statutory functions and ethical implications of the NDNAD. The questionnaire also asked about views on the most appropriate inclusion and retention criteria for the database. Lastly, a stakeholder survey was conducted to determine the views of experts on the efficacy of the NDNAD regimes against the effectiveness indicators.

Overall, a majority of the 201 participants who answered the public survey perceived the NDNAD to be effective in detecting, investigating and prosecuting crime. The participants were sceptical about the ability of the NDNAD to prevent crime. *This suggests a reform of the statutory purpose of DNA retention to represent actual outcomes.* Most participants favoured the inclusion and retention of DNA data from arrested, charged or convicted individuals. A selective regime based on offence seriousness was preferred by participants for the retention of DNA data from convicted adults. *This indicates a reform of the current blanket rule which allows indefinite retention.* The surveyed expert group (*n = 31*, mainly law enforcement officers) perceived the expansive regime to be the most effective for public security, implementation cost and efficiency reasons. The findings imply discrepancies with the current law governing the NDNAD. Whilst participants of the public survey support further restrictions to the PoFA regime, the expert group favoured the expansive regime. The survey evidence suggests a need for *a statutory requirement to generate systematic data about the actual effectiveness of the NDNAD. Further, a consultation scheme should be established to account for the acceptability of the NDNAD regime among a representative sample of the public.* These reforms will help improve the legitimacy of the law and ensure a balanced approach in 'shaping' the proportionality of the NDNAD regime.

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List of abbreviations

ACC	Australian Crime Commission
ACIC	Australian Criminal Intelligence Commission
ACPO	Association of Chief Police Officers
APCC	Association of Police and Crime Commissioners
ASBCPA	Anti-Social Behaviour, Crime and Policing Act 2014
BFEG	Biometrics and Forensics Ethics Group
BHSS	Business, Humanities and Social Sciences
BPI	Biometrics Perception Index
BRU	Biometrics Retention Unit
BTP	British Transport Police
CBQ	Checkbox questions
CE	capillary electrophoresis
CED	Contamination Elimination Database
CIA	confidentiality, integrity and availability
CIBSA	Criminal Investigations (Bodily Samples) Act 1995
CJA	Criminal Justice Act 2003
CJPA	Criminal Justice and Police Act 2001
CJPOA	Criminal Justice and Public Order Act 1994
CLFPA	Criminal Law (Forensic Procedures) Amendment Act 37
CNDD	Canadian National DNA Databank
CODIS	Combined DNA Index System
CPA	Crime and Policing Analysis Unit
CPS	Crown Prosecution Service
CRUD	Collection, Retention, Use and Destruction of forensic DNA records
CSA	Crime and Security Act 2010
CSDD	Cambridge Study in Delinquent Development
CSEW	Crime Survey for England and Wales
CSFS	Chartered Society of Forensic Sciences
CSS	crime sample submission
CSW	crime scene worker
DDD	Denmark DNA Database
DEP	DNA Database Expansion Programme
DNA	Deoxyribonucleic acid

DPA	Data Protection Act 2018
DPD	DNA Profile Databank
dsDNA	double-stranded DNA
DWG	DNA Working Group
ECHR	European Court of Human Rights
EIS	Europol Information System
ENFSI	European Network of Forensic Science Institutes
ESR	Environmental Science and Research Institute
ESS	European Standard Set
FDP	Forensic DNA Phenotyping
FIND	Forensic Information Database
FINDS	Forensic Information Database Service
FSP	Forensic Science Provider
FSS	Forensic Science Service
GDPR	General Data Protection Regulation 2016
HGC	Human Genetics Commission
HPD	Houston Police Department
HR	Hit rate
HRA	Human Rights Act 1998
HV	hypervariable
ICO	Information Commissioners Office
IDD	Interpol DNA Database
IV	instrument variable
LCN	low copy number
LCS	Law, Criminology and Security
LDIS	Local DNA Index System
MBS	Mail-based survey
MCQ	multiple-choice question
MLP	Multi-locus probe
MPACLP	Metropolitan Police Authority Civil Liberties Panel
MPS	Massively parallel DNA sequencing
MR	match rate
mtDNA	mitochondrial DNA
NCA	National Crime Agency

NCIDD	National Criminal Investigation DNA Database
NCP	National Contact Point
NDIS	National DNA Index System
NDNAD	National DNA Database
NDU	NDNAD Delivery Unit
NFA	No Further Action
NFAS	Natural, Formal and Applied Sciences
NFDD	National Forensic DNA Database
NFOEB	National Forensic Oversight and Ethics Board
NGM	Next Generation Multiplexing
NGS	next-generation DNA sequencing
NIDNAD	Northern Ireland DNA Database
NPCC	National Police Chiefs' Council
NPIA	National Policing Improvement Agency
NSD	National Security Determination
NUB	NDNAD User Board
PACE	Police and Criminal Evidence Act 1984
PCA	Policing and Crime Act 2017
PCR	Polymerase Chain Reaction
PED	Police Elimination Database
PNC	Police National Computer
PND	penalty notice for disorder
PoFA	Protection of Freedoms Act 2012
qPCR	quantitative real-time PCR
RCL	residual career length
RDP	Rapid DNA Profiling
RFLP	Restriction Fragment Length Polymorphism
RI	Return Index
RMP	Random Match Probability
RNO	residual number of offences
ROI	return on investment
RSS	Reference Sample Submission
RVOD	Recidivistic Violent Offenders' DNA Database
SAK	sexual assault kit

SAPS	South African Police Service
SDIS	State DNA Index System
SDNAD	Scotland DNA Database
SDS	sodium dodecyl sulphate
SGM	second-generation multiplex
SLP	Single-locus probe
SNP	Single Nucleotide Polymorphism
SSGC	Solid-phase Silica Gel Column
STR	Short Tandem Repeat
STRidER	STRs for Identity ENFSI Reference Database
SWGDAM	Scientific Working Group on DNA Analysis Methods
UDNAD	Universal DNA Database
UKAS	United Kingdom Accreditation Service
VA	voluntary attendance
VNTR	Variable Number Tandem Repeat
WBS	Web-based survey

Dedication

...to God, for His love and faithfulness.

...to my late brother, Constable P. Appiah.

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Declaration

I hereby declare that the dissertation, submitted in partial fulfilment of the requirement for the degree of Doctor of Philosophy in Law, represents my own work and has not been submitted for any other award. All content and ideas drawn directly or indirectly from external sources have been duly acknowledged in the text. Journal publications, written evidence to parliamentary inquiries and presentations of the author that were fully or partly derived from the thesis are presented in Appendix XII.

Any ethical clearance for the research presented in this thesis has been approved. Approval has been sought and granted by the Faculty Ethics Committee on 27 January 2017 (Appendix XIV). Approval for match rate data access was also sought and granted by the National DNA Database Strategy Board and Ethics Group on 22 June 2017 (Appendix XV). Additional ethical clearance was sought and granted by the Faculty Ethics Committee for the public survey on 12 June 2018 (Appendix XVI).

I declare that the Word Count of this Thesis is 84,355 words (the word length excludes bibliography (academic references), footnotes and appendices).

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Chapter 1: General introduction

This chapter defines the focus of this research and introduces the key concepts used throughout the dissertation. Section 1.1 outlines the basic definitions in DNA databasing. Section 1.2 covers a brief overview of the research framework and aims. Section 1.3 defines the term DNA databasing, its scope and relationship with the concepts of privacy and public security. The section concludes with an overview of the England and Wales National DNA Database (NDNAD). In section 1.4, the term 'retention regime' is reviewed in the United Kingdom (UK) context. The terms efficacy, effectiveness and efficiency and their relationship with DNA databasing are introduced in section 1.5. The problem statement and justification for the research is outlined in section 1.6. The seventh section highlights the significance and original contribution of the research, namely, *establishment of the benefits, challenges and risks of the current NDNAD regime; identification of key indicators or NDNAD outcomes to assess effectiveness; empirical data about the current public and expert views on the inclusion and retention criteria for the NDNAD and the effectiveness of NDNAD regimes; and identification of key areas to reform/improve the current regime.* The last section outlines the structure of the thesis with an overview of each chapter.

1.1 Basic terminologies in forensic DNA databasing

Deoxyribonucleic acid (DNA) is the genetic material that stores genetic information of humans and most organisms.[1] It encodes the 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 a double helix structure made up of a string of subunits called *nucleotides*.[2]

A *gene* refers to specific sections of the DNA nucleotide sequence that codes for a protein or a functional biomolecule or predict phenotypic characteristics, such as, hair, eye, and skin colour.[3] Some specific DNA sequences, called *noncoding DNA*, neither code for a functional biomolecule or control phenotypic characteristics or their biological function is not fully understood.[4] These noncoding areas are characterised by repetitive core sequences that vary

[1] Jeremy M Berg, John L Tymoczko and Lubert Stryer, *Biochemistry* (7th edn, WH Freeman and Company 2012); R Garrett and Charles M Grisham, *Biochemistry* (5th edn, Brooks/Cole, Cengage Learning 2012).
[2] Berg, Tymoczko and Stryer (n 1); Garrett and Grisham (n 1).
[3] Garrett and Grisham (n 1); Berg, Tymoczko and Stryer (n 1); Manfred Kayser, 'Forensic DNA Phenotyping: Predicting Human Appearance from Crime Scene Material for Investigative Purposes' (2015) 18 Forensic Science International: Genetics 33.
[4] Manfred N Hochmeister, 'DNA Technology in Forensic Applications' (1995) 16 Molecular Aspects of Medicine 315.

in number within and between individuals (termed *length polymorphism*).[5] Except for red blood cells which lack nuclei, every cell of the human body has genomic DNA.[6] Therefore, all biological fluids or body tissues contain DNA, which can be profiled for human identity purposes. The technical terms, history and evolution of forensic DNA identity testing and databasing are detailed in Chapter 2. In the rest of this subsection, the general terms and concepts in DNA databasing are briefly defined.

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.[7] The principal focus of this study is the retention of DNA records from known individuals (i.e. subject or reference samples/profiles).

A collection of the physical-biological samples/evidence including their *DNA extracts* is referred to as a *Forensic DNA databank*.[8] The forensic DNA profile refers to a unique set of 10 – 24 pairs of numbers and a pair of gender-specific letters (XX for female, and XY for Male).[9] The numbers are derived from the noncoding 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. Other forensic

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[5] John Butler, *Forensic DNA Typing* (2nd edn, Elsevier 2005).

[6] Ted Gordon-Smith, 'Structure and Function of Red and White Blood Cells' (2013) 41 Medicine 193; Berg, Tymoczko and Stryer (n 1); Richard Li, *Forensic Biology* (2nd edn, CRC Press, Taylor & Francis Group 2015); Zhong-Wei Zhang and others, 'Red Blood Cell Extrudes Nucleus and Mitochondria against Oxidative Stress' (2011) 63 IUBMB Life 560.

[7] Mark A Jobling and Peter Gill, 'Encoded Evidence: DNA in Forensic Analysis' (2004) 5 Nature Reviews. Genetics 739; Kelly Virkler and Igor K Lednev, 'Analysis of Body Fluids for Forensic Purposes: From Laboratory Testing to Non-Destructive Rapid Confirmatory Identification at a Crime Scene' (2009) 188 Forensic Science International 1; Butler (n 5); Roland AH van Oorschot and Maxwell K Jones, 'DNA Fingerprints from Fingerprints' (1997) 387 Nature 767; Timothy J Verdon, R John Mitchell and Roland AH van Oorschot, 'Evaluation of Tapelifting as a Collection Method for Touch DNA' (2014) 8 Forensic Science International: Genetics 179.

[8] John Butler, *Advanced Topics in Forensic DNA Typing: Methodology* (Elsevier 2012).

[9] Dennis Y Wang and others, 'Developmental Validation of the GlobalFiler® Express PCR Amplification Kit: A 6-Dye Multiplex Assay for the Direct Amplification of Reference Samples' (2015) 19 Forensic Science International: Genetics 148; Scottish Police Authority, 'Scots Forensic Service to Lead Europe in DNA Technology' (*Scottish Police Authority*, 11 August 2015) <http://www.spa.police.uk/news/322981/296781/> accessed 23 December 2016.

genetics technologies, such as, Forensic DNA Phenotyping (FDP)[10] and ancestry testing[11] are required to predict these phenotypic characteristics by analysing the physical DNA sample. It must be noted that monozygotic (identical) twins have similar DNA and hence DNA profiles from such individuals are indistinguishable.

The main purpose of forensic DNA databases is to help solve legal issues (mainly crime) that are otherwise unsolvable by traditional investigative techniques, such as, interrogation of suspects and witnesses or involved parties. When a profile from a crime without a suspect matches a subject (known person's) profile on the database, it is referred to as a *cold hit*.[12] This can lead to the identification of the unknown suspect 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.[13] 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 relevant for generating cold hits. The database also allows the 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 hotspots.[14] This can help the police to develop effective proactive measures to counter crime or prevent crime. One of the main predictors of how well a DNA database fulfils the functions above is the quality of DNA databasing law.[15] Hence, using the NDNAD as a case study, this research sought to assess the efficacy of the legislative regime that governs the retention of DNA records.

1.2 Research aims

The main aim of this research was to identify any reforms that may maximize the utility of the NDNAD and enhance the protection of public security and the individual's right to

[10] Kayser (n 3).
[11] Chris Phillips, 'Forensic Genetic Analysis of Bio-Geographical Ancestry' (2015) 18 Forensic Science International: Genetics 49; C Santos and others, 'Forensic Ancestry Analysis with Two Capillary Electrophoresis Ancestry Informative Marker (AIM) Panels: Results of a Collaborative EDNAP Exercise' (2015) 19 Forensic Science International: Genetics 56.
[12] Butler, *Advanced Topics in Forensic DNA Typing: Methodology* (n 8) 231; Matthew Gabriel, Cherisse Boland and Cydne Holt, 'Beyond the Cold Hit: Measuring the Impact of the National DNA Data Bank on Public Safety at the City and County Level' (2010) 38 The Journal of Law, Medicine & Ethics 396; Simon J Walsh, James M Curran and John S Buckleton, 'Modeling Forensic DNA Database Performance' (2010) 55 Journal of Forensic Sciences 1174.
[13] Gabriel, Boland and Holt (n 12); Walsh, Curran and Buckleton (n 12).
[14] Carole McCartney, 'The DNA Expansion Programme and Criminal Investigation' (2006) 46 British Journal of Criminology 175.
[15] Damir Marjanović and others, 'Forensic DNA Databases in Western Balkan Region: Retrospectives, Perspectives, and Initiatives' (2011) 52 Croatian Medical Journal 235.

privacy. To achieve the research aim, the study was conceptualised within a framework of the effectiveness/efficacy of the different retention regimes governing the NDNAD. Effectiveness can be perceived (*perceived effectiveness*), which concerns the attitudes or beliefs of people about whether a system is achieving its purpose or not. Secondly, effectiveness may be apparent (*potential effectiveness*) in the sense of an assessment of the potential of a system to meet its expected goals/purpose. Thirdly, effectiveness can be actual (*actual effectiveness*), in terms of the real outcomes of a system, and how it meets its real expectations or predefined standard outcomes. Lastly, effectiveness can be considered as a combination of all the above. In the context of forensic DNA databases, actual effectiveness may be difficult to measure. This is due to the inter-relationship between the use of the NDNAD and other policing tools/strategies in addressing public security outcomes such as the prevention, detection, investigation and prosecution of crime. This challenge is confirmed by the Strategy Board[16] and Ethics Group[17] for the NDNAD as an explanation for the lack of data on conviction rates, for example, of the NDNAD.

Based on recommendations of the Ethics Group,[18] initial specific research aims (Figure 1.1), and corresponding methodology (Appendix I) were drafted to assess the 'potential effectiveness' of the different retention regimes enacted to govern the NDNAD. This focused on the match rate output of the database. Approval for this project was granted by the Strategy Board (Appendix XV), however, the required data could not be extracted due to the configuration of the NDNAD. The database does not store arrest or conviction records of subjects – known individuals. This data is stored separately on the Police National Computer (PNC). The only data that could be obtained were the total number of subject profiles, crime scene profiles, crime scene-to-subject matches, subject-to-crime scene matches, annual crime scene load match rates and annual subject load match rates from April 2003 to March 2017. The raw data is shown in Appendix XI. Due to the limitations of the available data, the match rate analysis based on regime characteristics was not pursued. The gaps identified emphasise the necessity of including systems to evaluate the potential and actual effectiveness of DNA database retention regimes from the onset of its creation.

[16] FIND Strategy Board, *National DNA Database: Annual Report, 2017 to 2018* (Forensic Information Database Strategy Board 2019) 21.
[17] National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2014* (National DNA Database Ethics Group 2015) 18.
[18] National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2014* (n 17).

To evaluate the overall performance of the NDNAD under the different NDNAD retention regimes using two types of database match rates proposed by the DNA Working Group (DWG) of the European Network of Forensic Science Institutes (ENFSI): *H/C* and *H/N*;

• where *H* is the number of hits or matches between subject and crime scene profiles, *C* is the number of crime scene profiles loaded on the database, and *N* is the number of subject or reference profiles on the database. The performance metric *H/C* demonstrates the potential value of the database towards crime solving whilst *H/N* indicates whether the database is representative of the active or previously active criminal population or individuals linked to a crime scene.

To estimate and compare the annual *H/C* and *H/N* for different retention categories as defined by law within and between the applicable retention regimes.

To estimate and compare the annual *H/C* and *H/N* for different subject profile retention periods (years).

Figure 1.1 - Research aims to assess potential effectiveness of NDNAD retention regimes using match rates

The final specific research aims explored in this study focused on the 'perceived effectiveness' of DNA databases and retention regimes among the public and primary stakeholders (experts). Whilst the weight of this evidence alone is limited, it contributes to the 'cumulative effectiveness' of DNA databases in terms of its legitimacy or acceptability in society. To achieve the overarching aim of the research, the study assessed relevant government and organisation reports, reviewed available literature, and carried out public and stakeholder surveys.

The specific aims of the study were:

1. To identify the benefits, challenges, risks and emerging issues associated with the implementation of the provisions of Part 1 of the Protection of Freedoms Act 2012 (PoFA) governing the retention of forensic DNA records (i.e. DNA samples and profiles). This aim was achieved by conducting a document analysis of reports of NDNAD oversight bodies.

2. To determine the perception of the public about the public security functions of the NDNAD as specified by section 63T(1)(c) of the Police and Criminal Evidence Act 1984 (PACE)[19] including:
    a. prevention of crime
    b. detection of crime

[19] Police and Criminal Evidence Act 1984.

c. investigation of an offence
d. conduct of a prosecution

3. To ascertain the views of the public about the most appropriate inclusion criteria and retention period for DNA records from different categories of individuals who may be subject to DNA sampling for policing purposes. Specific aims 2 and 3 were achieved by carrying out an online public survey targeting citizens and residents of England and Wales.

4. To assess the views of primary stakeholders (experts) about the effectiveness of the different NDNAD retention regimes. The objectives for this aim were to review the literature to identify effectiveness criteria that are relevant for assessing the efficacy of retention regimes; develop, test and refine the wording of questions based on the identified effectiveness criteria; and assess the reliability and validity of the questionnaire; and administer the questionnaire to the study participants.

5. To identify areas of possible reform to the legislative regime governing the retention of forensic DNA records in England and Wales. This aim was achieved by analysing the findings from the document analysis, literature review and surveys.

1.3 Forensic DNA databasing

The term forensic DNA databasing has been used by Goulka *et al*.[20] to refer to 'the shape and use of a DNA database, including how profiles are added to it and how searches are run.' In broad terms, forensic DNA databasing can be described as a dynamic process that involves the enactment of DNA laws and policies; establishment of DNA regulatory bodies; the institution of DNA quality management systems; the collection, retention, use and destruction of forensic DNA records (CRUD); and the development of infrastructure to support CRUD. This research is mainly concerned about the retention aspects of forensic DNA databasing. Hence, this term mainly refers to the retention of DNA records throughout the thesis. The next sub-section describes the scope of forensic DNA databasing globally.

[20] Jeremiah Goulka and others, 'Toward a Comparison of DNA Profiling and Databases in the United States and England' (RAND Corporation 2010).

1.3.1 Scope of forensic DNA databases

Forensic DNA databanks or databases have revolutionised the investigation of crime since they were first introduced in England and Wales in April 1995.[21] Williams and Johnson[22] describe the 'common trajectory' of forensic identity testing, starting 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.[23] There are 8 operational national DNA databases in continental Africa, 17 in Asia, 40 in Europe, 15 in North and South America and 2 in Australasia (Table 1.1).[24] More than 67 million forensic DNA profiles are held in DNA databases globally, with China (> 44 million), the United States (> 18 million), and the United Kingdom (> 7 million) having the largest databases.[25] Whilst DNA databasing continue to grow with increasing match rates, there is limited information on how effective they are in resolving crime.[26] Available information is only limited to individual cases where DNA played a critical role in identifying unknown suspects.

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[21] Peter D Martin, Hermann Schmitter and Peter M Schneider, 'A Brief History of the Formation of DNA Databases in Forensic Science within Europe' (2001) 119 Forensic Science International 225; Butler (n 8).
[22] Robin Williams and Paul Johnson, *Genetic Policing: The Use of DNA in Criminal Investigations* (Willan Publishing 2008).
[23] Forensic Genetics Policy Initiative, 'Welcome to the Genetics Policy Initiative!' (*Forensic Genetics Policy Initiative*, 5 July 2016) <http://dnapolicyinitiative.org/> accessed 3 September 2019.
[24] Forensic Genetics Policy Initiative, 'Global Summary' (*Forensic Genetics Policy Initiative*, 10 February 2016) <http://dnapolicyinitiative.org/wiki/index.php?title=Global_summary> accessed 11 April 2017; ENFSI, 'ENFSI Survey on DNA Databases in Europe-June 2016' (*ENFSI*, 2017) <http://enfsi.eu/wp-content/uploads/2017/01/ENFSI-Survey-on-DNA-Databases-in-Europe-June-2016.pdf> accessed 11 April 2017; INTERPOL, 'Global DNA Profiling Survey Results 2016' (INTERPOL 2016).
[25] Forensic Genetics Policy Initiative, 'Global Summary' (n 24); Ge Baichuan, Peng Jianxiong and Liu Bing, 'The Tactics System and Capacity-Building of National DNA Database' (2016) 41 Forensic Science and Technology 259; FBI, 'CODIS - NDIS Statistics as of July 2019' (*Federal Bureau of Investigation*, 2019) <https://www.fbi.gov/services/laboratory/biometric-analysis/codis/ndis-statistics> accessed 3 September 2019; Home Office, 'National DNA Database Statistics: Q1 2019 to 2020' (Home Office 2019) <https://www.gov.uk/government/statistics/national-dna-database-statistics> accessed 21 August 2019; Human Rights Watch, 'China: Police DNA Database Threatens Privacy' (*Human Rights Watch*, 15 May 2017) <https://www.hrw.org/news/2017/05/15/china-police-dna-database-threatens-privacy> accessed 30 May 2017.
[26] Paul Wiles, *Annual Report 2016: Commissioner for the Retention and Use of Biometric Material* (Office of the Biometrics Commissioner, UK 2017) 13-14.

Table 1.1- Countries with an operational national forensic DNA database[27]

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, Syria, United Arab Emirates, Uzbekistan.	17
Europe	Albania, Austria, Azerbaijan, Belarus, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Georgia, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Macedonia, Malta, Montenegro, Netherlands, Norway, Poland, Portugal, Romania, Russia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Ukraine, United Kingdom.	40
North/South America	Argentina, Brazil, Canada, Chile, Colombia, Costa Rica, Ecuador, El Salvador, Honduras, Jamaica, Panama, Peru, St Lucia, United States of America, Uruguay.	15
Australasia	Australia, New Zealand.	2
Total		**82**

In some states, DNA databasing is mainly restricted to convicted individuals, for example, the New Zealand DNA Profile Databank (DPD), whereas others, such as, the England/Wales NDNAD, permit short retention periods[28] for DNA data from arrestees and volunteers.[29] The website of the Forensic Genetics Policy Initiative[30] provides a 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 migration rises, it is expected that more states will consider establishing 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.[31] Though there has been significant progress in achieving this goal, differences in DNA retention policy or legislation have been highlighted as a potential setback in the transnational exchange of

[27] INTERPOL, 'Global DNA Profiling Survey Results 2016' (n 24); Forensic Genetics Policy Initiative, 'DNA Policy Info by Country' (*Forensic Genetics Policy Initiative*, 2017) <http://dnapolicyinitiative.org/wiki/index.php?title=Main_Page> accessed 10 November 2017.
[28] Example: 3 years when arrested for a qualifying (serious) recordable offence
[29] Filipe Santos, Helena Machado and Susana Silva, 'Forensic DNA Databases in European Countries: Is Size Linked to Performance?' (2013) 9 Life Sciences, Society and Policy 1; Criminal Investigations (Bodily Samples) Act 1995.
[30] Forensic Genetics Policy Initiative, 'DNA Policy Info by Country' (n 27).
[31] ENFSI DNA Working Group, *DNA Database Management Review and Recommendations* (ENFSI 2016).

DNA data.[32] This gap highlights the need to identify the most effective retention regime for databases.

1.3.2 Forensic DNA databasing and privacy

A concept that has consistently featured in the debates about DNA legislation is privacy. Privacy is a complex concept to define and it may be subject to social context and technological advancement. Shils[33] 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[34] 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.[35] 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. Further, the literature suggests a privacy paradox where individuals tend to exhibit differences between their attitudes and behaviour towards privacy-related technologies (such as, online applications) based on different circumstances.[36]

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'.[37] This definition broadens the scope of privacy and may cover other areas, such as, family life, the home, correspondence or professional

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[32] Filipe Santos, 'The Transnational Exchange of DNA Data: Global Standards and Local Practices' in K Jakobs and Knut Blind (eds), *Proceedings of the 22nd EURAS annual standardisation conference: Digitalisation: Challenge and opportunity for standardisation.* (Verlag Mainz 2017); Helena Machado and Rafaela Granja, 'Ethics in Transnational Forensic DNA Data Exchange in the EU: Constructing Boundaries and Managing Controversies' (2018) 27 Science as Culture 242.
[33] Edward Shils, 'Privacy: Its Constitution and Vicissitudes' (1966) 31 Law and Contemporary Problems 281.
[34] Ruth Gavison, 'Privacy and the Limits of Law' (1980) 89 Yale Law Journal 421, 428.
[35] Alan Westin, *Privacy and Freedom* (Bodley Head 1970).
[36] Nina Gerber, Paul Gerber and Melanie Volkamer, 'Explaining the Privacy Paradox: A Systematic Review of Literature Investigating Privacy Attitude and Behavior' (2018) 77 Computers & Security 226.
[37] Justice (the British Section of the International Commission of Jurists) as cited in Gavison (n 34), 426.

association. Both international and national laws provide for the protection of the right to privacy of individuals including their family life, home and correspondence.[38]

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

a) a person's body, actions, thoughts, feelings and desires, health status or physical condition, their relationships, possessions and interactions with their environment; and,
b) 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, an organisation or institution.

Forensic DNA databasing and/or databanking introduces several privacy concerns. Firstly, the phenotypic characteristics (including health or disease risk, age, geographical origin, ancestry and physical appearance) of an individual and their biological family can be predicted from the DNA sample. Secondly, an individual and their biological family can be tracked using the stored forensic DNA profile – a form of biosurveillance.[39] Without appropriate safeguards, employers, for example, may be interested in accessing databanks 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 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.[40]

Article 8 of the European Convention on Human Rights 1950 (the Convention) stipulates that:

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[38] Universal Declaration of Human Rights 1948; European Convention on Human Rights 1950; Human Rights Act 1998.
[39] Robin Williams and Paul Johnson, 'Circuits of Surveillance' (2004) 2 Surveillance & Society 1.
[40] MPA Civil Liberties Panel, *Protecting the Innocent: The London Experience of DNA and the National DNA Database* (Metropolitan Police Authority 2011) <http://policeauthority.org/metropolitan/downloads/scrutinites/dna.pdf> accessed 29 March 2017.

> 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.

Based on the above, any interference with the privacy of an individual must be proportionate. This means the interference should be necessary (or relevant) to achieve a defined legitimate objective, and the process should be adequate, non-excessive and balanced with any competing interests.[41] For convicted individuals, there appears to be a consensus for their DNA records to be stored due to their potential risk to society and/or high propensity to re-offend.[42] The estimated recidivism rate among violent offenders is over 60% within three years.[43] The retention of convicted individual's profiles may help in achieving key public security objectives, such as, crime prevention, 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.[44]

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[41] Els J Kindt, *Privacy and Data Protection Issues of Biometric Applications: A Comparative Legal Analysis* (Springer Verlag 2013).

[42] Butler (n 8); Carole McCartney, *Forensic Identification and Criminal Justice: Forensic Science, Justice and Risk* (Willan Publishing 2006); Bob Bramley, 'DNA Databases' in Jim Fraser and Robin Williams (eds), *Handbook of forensic science* (Willan Publishing 2009).

[43] Butler (n 8); Jean McEwen and Philip Reilly, 'A Review of State Legislation on DNA Forensic Data Banking.' (1994) 54 American Journal of Human Genetics 941; Patrick A Langan and David J Levin, 'Recidivism of Prisoners Released in 1994' (2002) 15 Federal Sentencing Reporter 58; Patrick A Langan, Erica L Schmitt and Matthew R Durose, *Recidivism of Sex Offenders Released from Prison in 1994* (Bureau of Justice Statistics, US Department of Justice 2003).

[44] McCartney, *Forensic Identification and Criminal Justice: Forensic Science, Justice and Risk* (n 42); *S and Marper v The United Kingdom* [2008] ECHR 1581; Kate Beattie, 'S and Marper v UK: Privacy, DNA and Crime Prevention' [2009] European Human Rights Law Review 229; Human Genetics Commission, *Nothing to Hide, Nothing to Fear? Balancing Individual Rights and the Public Interest in the Governance and Use of the National DNA Database* (Human Genetics Commission 2009) <http://www.statewatch.org/news/2009/nov/uk-dna-human-genetics-commission.pdf> accessed 29 March 2017; Carole McCartney, Tim J Wilson and Robin Williams, *The Future of Forensic Bioinformation* (Nuffield Foundation 2010) <http://www.nuffieldfoundation.org/future-forensic-bioinformation> accessed 29 March 2017; Carole McCartney, 'Of Weighty Reasons and Indiscriminate Blankets: The Retention of DNA for Forensic Purposes' (2012) 51 The Howard Journal of Criminal Justice 245.

1.3.3 Forensic DNA databasing and public security

The legal justification for the privacy intrusiveness of forensic DNA databases/databanks has mainly relied on public security grounds.[45] The definition of public security, based on paragraph 2 of article 8 of the Convention, encompass the protection of national security, public safety, the economic well-being of the state, and protection from threats directed at the public.[46] Article 8 also includes the protection of the rights and freedoms of individuals.[47] 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 and national laws. In the context of crime-fighting and forensic DNA databasing/databanking, public security, based on section 63T(1) of PACE, can be defined as the utilisation of DNA databasing/databanking technology:

a) in the interests of national security,
b) for the purposes of a terrorist investigation,
c) for purposes related to the prevention or detection of crime, the investigation of an offence or the conduct of a prosecution, or
d) for purposes related to the identification of a deceased person or of the person to whom the material relates.[48]

In this research, section 63T(1)(c) is considered broadly as a summary of the four public security functions of the database. Hence, the term public security refers to the prevention, detection, investigation and prosecution of crime throughout the thesis. The next section briefly describes the England and Wales NDNAD, which is the focus of this research.

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[45] Helena Soleto Muñoz and Anna Fiodorova, 'DNA and Law Enforcement in the European Union: Tools and Human Rights Protection' (2014) 10 Utrecht Law Review 149; Nuffield Council on Bioethics, *The Forensic Use of Bioinformation: Ethical Issues* (2007) <http://nuffieldbioethics.org/wp-content/uploads/The-forensic-use-of-bioinformation-ethical-issues.pdf> accessed 11 October 2016.
[46] Kevin Aquilina, 'Public Security versus Privacy in Technology Law: A Balancing Act?' (2010) 26 Computer Law & Security Review 130.
[47] Home Office, *Keeping the Right People on the DNA Database: Science and Public Protection* (Home Office 2009).
[48] Protection of Freedoms Act 2012, s 16.

1.3.4 Overview of the England and Wales National DNA Database

The England and Wales National DNA Database is the world's largest database by the proportion of the entire population in the database (over 8.3% of the UK population). It holds DNA profiles from all police forces in England and Wales as well as profiles from the separate Northern Ireland DNA Database (NIDNAD) and Scotland DNA Database (SDNAD). Additionally, DNA profiles from the Channel Islands (Isle of Man, the Bailiwick of Jersey and the Bailiwick of Guernsey) are exported to the NDNAD. As of June 2019, the database holds more than 6.4 million subject profiles (of which ~5.5 million are known individuals) and over 0.63 million crime scene profiles.[49] A search of the database, on loading a new crime scene profile, can provide unknown investigative 'leads', identify unknown offenders or eliminate suspects and link different crimes. As of 2017/18 fiscal year, the chance of a match between a newly loaded crime scene profile and a subject profile in the database is 65.5%.[50]

Although less than 1% of crimes are detected using the NDNAD, its detection rate has been reported to be higher than crimes without DNA evidence.[51] Estimates reported by Bramley[52] in 2009 suggest that the detection rate for recordable crimes where DNA is loaded on the NDNAD is higher (40%) than the rate for recordable crimes without DNA (26%). When filtered by crime type, the detection rate for DNA crimes[53] was higher than non-DNA crimes (domestic burglary: 41% vs 16%; vehicular theft: 63% v 8%). About half of DNA detections are estimated to yield conviction of which a quarter result in a custodial sentence.[54] The estimated crime prevention rate was 7.8 crimes per custodial sentence.[55] These estimates suggest that the NDNAD could be of value to crime detection and prevention. However, this may apply to crimes where DNA can be recovered from the crime scene and loaded on the NDNAD. As noted by the Commissioner for the Retention and Use of Biometric Material (Biometrics Commissioner), the resolution of most crimes do not involve DNA.[56] This means that the comparison of the above detection rates should be interpreted cautiously.

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[49] Home Office, 'National DNA Database Statistics: Q1 2019 to 2020' (n 25).
[50] FIND Strategy Board, *Annual Report 2017 to 2018* (n 16).
[51] Bramley (n 42); McCartney, 'The DNA Expansion Programme and Criminal Investigation' (n 14); Wiles, *Annual Report 2016* (n 26).
[52] Bramley (n 42).
[53] i.e. cases where DNA is loaded on the National DNA Database
[54] Bramley (n 42).
[55] Bramley (n 42).
[56] This may be the case when identity is not in question or there was no obvious crime scene or DNA was not deposited during the crime. See Wiles, *Annual Report 2016* (n 26) 10.

The practical value of the NDNAD can be illustrated using the 1999 case of Keith Samuels,[57] a serial rapist from Northampton who committed seven rapes from 1984 to 1990. Advances in DNA technology allowed police detectives to establish that biological evidence (semen) recovered from the crime scenes originated from the same individual. In 1998, Keith Samuels was arrested for a cheque book fraud, leading to his DNA sample being taken, profiled and loaded on the NDNAD. The reference profile matched the crime scene profiles from the rapes. This led to his subsequent conviction and nine life sentences in 1999. The reports of the Strategy Board for the NDNAD contains several examples of individual cases where the database contributed to investigations or case resolution.[58]

The crime detection potential of the NDNAD has influenced significant government support and financial investment in its development and expansion. For example, about £300 million was invested in the NDNAD through the Government's DNA Database Expansion Programme (DEP) by 2005.[59] 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 the analysis of low template[60] and degraded DNA. The DEP was facilitated by legislative reforms in England and Wales that widened the pool of individuals that could be sampled and added to the database, including those arrested, charged or convicted of a recordable offence.[61] This inclusion criterion (i.e. entry in the NDNAD) is still applied to the database. Several ethical and policy issues regarding data privacy and human rights have been raised about the retention of DNA records, particularly records of unconvicted individuals. These issues have evoked several debates focused mainly on public security and privacy, and other related areas such as the presumption of innocence, proportionality and necessity, the onus of proof, liberty, bodily inviolability, informed consent, equality and autonomy of individuals.[62] The next section outlines how the

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[57] Williams and Johnson, 'Circuits of Surveillance' (n 39); Lisa Smith and John Bond, *Criminal Justice and Forensic Science: A Multidisciplinary Introduction* (Palgrave Macmillan 2014); Lisa Tolfts and Rebecca Keay, 'Caught by His Lust for Call-Girls; a Chance Call about Cheque Fraud Led to Police Capturing Britain's Most Wanted Serial Rapist in the Bedroom of This Hotel in Rugby' (*The Free Library*, 15 April 1999) <https://www.thefreelibrary.com/Caught+by+his+lust+for+call-girls%3B+A+CHANCE+CALL+ABOUT+CHEQUE+FRAUD...-a060456713> accessed 19 January 2017; BBC News, 'Serial Rapist Jailed for Life' *BBC News* (14 April 1999) <http://news.bbc.co.uk/1/hi/uk/319446.stm> accessed 19 January 2017.

[58] FIND Strategy Board, *Annual Report 2017 to 2018* (n 16) 21.

[59] Forensic Science and Pathology Unit, 'DNA Expansion Programme 2000–2005: Reporting Achievement' (Home Office 2005).

[60] i.e. smaller quantities of DNA samples, sometimes referred to as 'touch DNA'

[61] Criminal Justice and Police Act 2001, s 82; Criminal Justice Act 2003, s 10.

[62] Carole McCartney, 'Forensic DNA Sampling and the England and Wales National DNA Database: A Sceptical Approach' (2004) 12 Critical Criminology 157; Nuffield Council on Bioethics (n 45); Victor Toom, 'Forensic DNA Databases in England and the Netherlands: Governance, Structure and Performance

debates on public security and privacy have shaped the evolution of retention regimes for the NDNAD.

1.4 Retention regimes

Forensic DNA databasing is generally governed by legislation to ensure that it operates lawfully, ethically and efficiently in the prevention and early resolution of crime. The retention regime refers to 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 an appropriate retention regime for forensic DNA data 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.[63] The different inclusion criteria used or proposed for DNA databases worldwide include a comprehensive/universal DNA database (UDNAD),[64] convicted individuals database, suspected individuals database, arrestee database, volunteer database or a combination of these with or without databanking[65]. The models for the length of DNA sample/profile retention include: indefinite; until the death of subject or one hundred years; temporal retention based on the seriousness or nature of the offence, age, the maximum length of sentence, recidivism or re-arrest record; until the sampling purpose is fulfilled or a mixture of these.[66]

Compared' (2012) 31 New Genetics and Society 311; *S and Marper v The United Kingdom* (n 44); Sheldon Krimsky and Tania Simoncelli, *Genetic Justice: DNA Data Banks, Criminal Investigations, and Civil Liberties* (Columbia University Press 2011); Jungnyum Lee, 'The Presence and Future of the Use of DNA-Information and the Protection of Genetic Informational Privacy: A Comparative Perspective' (2016) 44 International Journal of Law, Crime and Justice 212.

[63] Jim Fraser, *Forensic Science: A Very Short Introduction* (Oxford University Press 2010); Walsh, Curran and Buckleton (n 12); Dick Leary and Ken Pease, 'DNA and the Active Criminal Population' (2003) 5 Crime Prevention & Community Safety 7; Butler (n 8); Ken Pease, 'DNA Retention after S and Marper' in Home Office, *Keeping the right people on the DNA database: Science and Public Protection* (Home Office 2009); Andromachi Tseloni and Ken Pease, 'DNA Retention after Arrest: Balancing Privacy Interests and Public Protection' (2011) 8 European Journal of Criminology 32.

[64] Robert Williamson and Rony Duncan, 'DNA Testing for All: There Are Two Fair Possibilities for Forensic DNA Testing: Everyone or No One.' (2002) 418 Nature 585; DH Kaye and Michael E Smith, 'DNA Identification Databases: Legality, Legitimacy, and the Case for Population-Wide Coverage' (2003) 2003 Wisconsin Law Review 413; *R (on the application of S) v Chief Constable of South Yorkshire and R (on the application of Marper) v Chief Constable of South Yorkshire* [2002] EWCA Civ 1275.

[65] i.e. storage of the actual DNA sample

[66] See para 4.1, ENFSI DNA Working Group, *DNA Database Management Review and Recommendations* (ENFSI 2017).

1.4.1 Retention regimes for the 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 currently share several similarities (Table 1.2). The law in England, Wales, and Northern Ireland are relatively the same. Table 1.2 summarises the current retention regime applied in each jurisdiction. The 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 to PACE by the Criminal Justice and Public Order Act 1994 (CJPOA), is characterised by indefinite retention of all DNA samples and profiles from convicted individuals, and destruction of DNA records after an individual is acquitted or the case is discontinued.[67] All loaded profiles are subjected to speculative searching against other profiles. Challenges associated with this regime include delays in the destruction of unconvicted individuals' DNA records, which renders some relevant database hits unlawful and inadmissible in court.[68] Another challenge is repeated sampling of unconvicted suspects.[69]

The expansive regime was introduced following amendments to PACE by section 82 of the Criminal Justice and Police Act 2001 (CJPA) and section 10 of the Criminal Justice Act 2003 (CJA). This regime removed the obligation for the police to destroy DNA records of unconvicted individuals and permitted the indefinite retention of DNA samples and profiles of almost every individual who encounters the police. In December 2005, the records of 200,300 individuals who had been arrested but not charged were retained in the NDNAD. About 4.2% (8,493) of these individuals were identified as suspects in 13,964 other offences including murders, sexual assaults, aggravated burglaries and the supply of controlled drugs.[70] This statistical evidence suggests that the retention of DNA records from unconvicted individuals could aid future investigations, improve early detection of crime and possibly serve as a crime deterrent. The major challenge with the expansive regime is the infringement of the right to privacy of innocent individuals. Studies and reviews that evaluated the English/Welsh, Scottish, Dutch and Canadian retention regimes note the disproportionality of the expansive model against the right to privacy of unconvicted

[67] Criminal Justice and Public Order Act 1994, pt IV.
[68] Bramley (n 42).
[69] Bramley (n 42).
[70] Bramley (n 42).

individuals.[71] Prior to 2008, the UK Court of Appeal and the House of Lords supported the expansive regime.[72]

Table 1.2 - Summary of current retention regimes for forensic DNA data in the UK[73]

Retention category		**England/Wales system (2013 – present)**	**Northern Ireland system (2013 – present)**	**Scottish system (2007 – present)**
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
Penalty Notice for Disorder (PND)		2 years	2 years	2 years
Terrorist suspects		Retention under relevant legislation* (+2-year renewal(s) with NSD by Chief Constable)	Retention under relevant legislation* (+2-year renewal(s) with NSD by Chief Constable)	Retention under relevant legislation* (+2-year renewal(s) with NSD by Chief Constable)

**Including 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).*

In 2008, the European Court of Human Rights (ECHR) ruled that the expansive regime does not maintain a fair balance between the individual's right to privacy and public security. This

[71] Michelle Kisluk, 'Comparison of Data Protection in Forensic DNA Databanks in Canada and the United Kingdom' (Masters, Unpublished, Central European University 2008) <http://www.etd.ceu.hu/2009/kisluk_michelle.pdf> accessed 12 May 2016; J Fraser and Scottish Government (Funder), 'Acquisition and Retention of DNA and Fingerprint Data in Scotland' (University of Strathclyde 2009) Report <http://strathprints.strath.ac.uk/18671/> accessed 11 October 2016; Toom (n 62).
[72] *R v Chief Constable of South Yorkshire Police (Respondent) ex parte LS (by his mother and litigation friend JB) (FC) (Appellant) and R v Chief Constable of South Yorkshire Police (Respondent) ex parte Marper (FC) (Appellant)* [2004] UKHL 39; *R (on the application of S) v Chief Constable of South Yorkshire and R (on the application of Marper) v Chief Constable of South Yorkshire* (n 64).
[73] Protection of Freedoms Act 2012; Criminal Justice Act (Northern Ireland) 2013; Criminal Procedure (Scotland) Act 1995.

ruling in the case of *S and Marper v the United Kingdom*[74] informed the development of the PoFA regime, which is described as semi-restrictive. The regime requires the destruction of all DNA samples after profiling or within six months,[75] recognising the sensitivity of the actual DNA material. DNA profiles of most convicted individuals can be stored indefinitely and profiles from some first-time convicted minors and unconvicted individuals can be stored for a short period of time (Table 1.2 above).

Since the implementation of the PoFA regime in October 2013, over 1.7 million profiles of unconvicted individuals have been deleted from the database and over 7.7 million DNA samples have been destroyed after DNA profiling.[76] These deletions were carried out to ensure compliance with the PoFA regime that seeks to balance public and individual interests. Following the implementation of the new regime, reports of the NDNAD Strategy Board (now Forensic Information Database (FIND) Strategy Board[77]),[78] the Ethics Group (now Biometrics and Forensics Ethics Group (BFEG))[79] and the Biometrics Commissioner[80] indicate an improvement in the protection of the genetic privacy of individuals, particularly the retention of DNA records from unconvicted individuals. The new regime has also improved the match rate of the database compared to previous retention regimes (Figure 1.2). This suggests that the current regime may be potentially more effective in protecting public security than previous regimes. However, it is not clear whether the increasing trend

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[74] *S and Marper v The United Kingdom* (n 44).

[75] Retention of DNA samples can be extended beyond six months when required for prosecution disclosure purposes under the Criminal Procedure and Investigations Act 1996. The sample must however be destroyed after fulfilling its purpose.

[76] Home Office and James Brokenshire, 'Protection of Freedoms Act Implementation and National DNA Database Annual Report 2012 to 2013' (*GOV.UK*, 24 October 2013) <https://www.gov.uk/government/speeches/protection-of-freedoms-act-implementation-and-national-dna-database-annual-report-2012-to-2013> accessed 11 March 2016; Alastair MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (Office of the Biometrics Commissioner, UK 2014) <https://www.gov.uk/government/publications/biometrics-commissioner-annual-report-2013-2014> accessed 11 October 2016.

[77] The remit of FIND Strategy Board now includes the National Fingerprint Database.

[78] National DNA Database Strategy Board, *National DNA Database: Annual Report, 2013 to 2014* (National DNA Database Strategy Board 2014); National DNA Database Strategy Board, *National DNA Database: Annual Report, 2014 to 2015* (National DNA Database Strategy Board 2015); National DNA Database Strategy Board, *National DNA Database: Annual Report, 2015 to 2016* (National DNA Database Strategy Board 2017); FIND Strategy Board, *National DNA Database: Annual Report, 2016 to 2017* (Forensic Information Database Strategy Board 2018).

[79] National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2014* (n 17); National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2015* (National DNA Database Ethics Group 2016).

[80] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76); Alastair MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (Office of the Biometrics Commissioner, UK 2016) <https://www.gov.uk/government/publications/biometrics-commissioner-annual-report-2014-to-2015> accessed 11 October 2016.

in the match rate is associated with the deletion of profiles or changes in the law. The match rate trend should be interpreted cautiously because the number of reference and crime scene profiles loaded in the NDNAD has decreased whilst the number of matches remains relatively similar between 2003 to 2017 (See Appendix XI).

According to reports of the Biometrics Commissioner, some profiles that require retention have been deleted from the NDNAD, creating a potential risk to public security.[81] 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.[82] 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.[83] Further details of the benefits, challenges and risks of the current regime are provided in Chapter 3.

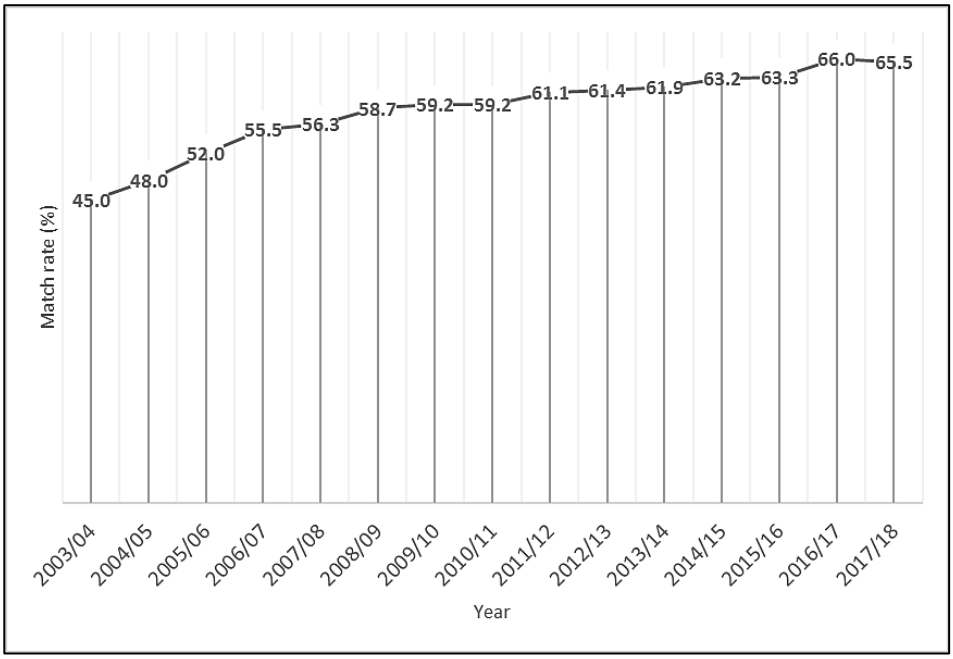

Figure 1.2 - Trend of NDNAD match rate from 2003/04 to 2017/18.[84] The match rate measures the chance that a crime scene profile loaded on the database matches a subject profile. The graph shows a gradual increase in the match rate, with highest rates observed within the PoFA period 2013/14 to 2017/18.

[81] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76); MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80), para 108.
[82] MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80).
[83] MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80).
[84] National DNA Database Strategy Board, *Annual Report 2015 to 2016* (n 78); FIND Strategy Board, *Annual Report 2017 to 2018* (n 16); See Appendix XI.

1.5 Efficacy, effectiveness and efficiency of DNA database retention regimes

Efficacy can be described as the ability of a substance, intervention, instrument, method or system to yield the desired output or outcome for which it was designed after making the required input.[85] Efficacy is closely related to effectiveness, which measures the level at which actual outcomes meet expectations.[86] Efficiency measures the value or worth of a system by comparing its actual outcomes to that of alternative systems or a cost/input-benefit analysis of a system.[87]

In the context of forensic DNA databasing and criminal investigation, an efficacious retention regime should ensure that the data of the 'active or previously active criminal population' are retained in the database for a justifiable period whereby it will assist in the maintenance of public security. As established in existing literature and European court cases,[88] the public interest in the creation of databases should be balanced with the civil liberties of individuals, particularly the right to privacy. Hence, an efficacious retention regime should also be compatible with human rights law. The database itself can be said to be efficacious when it contains both reference and crime scene profiles and generates relevant hits. An effective database system should contribute to public security and an efficient forensic DNA database system should result in better public security outcomes than alternative systems or its public security outcomes should merit the input required in its operation or implementation. This research is focused on the efficacy or effectiveness of the legislative regime for the NDNAD because the size and contents of the database are shaped by the law.

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[85] The Law Dictionary, 'What Is EFFICACY? Definition of EFFICACY (Black's Law Dictionary)' (*The Law Dictionary*, 19 October 2012) <http://thelawdictionary.org/efficacy/> accessed 3 April 2017; Business Dictionary, 'What Is Efficacy? Definition and Meaning' (*BusinessDictionary.com*) <http://www.businessdictionary.com/definition/efficacy.html> accessed 3 April 2017; Cambridge Dictionary, 'Meaning of "Efficacy" in the English Dictionary' (*Cambridge Dictionary*) <http://dictionary.cambridge.org/dictionary/english/efficacy> accessed 3 April 2017.

[86] The Law Dictionary, 'What Is EFFECTIVENESS? Definition of EFFECTIVENESS (Black's Law Dictionary)' (*The Law Dictionary*, 19 October 2012) <http://thelawdictionary.org/effectiveness/> accessed 8 April 2017.

[87] Kees van der Beek, 'Measuring the Effectiveness and Efficiency of Forensic DNA-Databases' (Promega Corporation 2015) <https://www.promega.com/-/media/files/products-and-services/genetic-identity/ishi-26-oral-abstracts/9-van-der-beek.pdf> accessed 9 April 2017; The Law Dictionary, 'What Is EFFICIENCY? Definition of EFFICIENCY (Black's Law Dictionary)' (*The Law Dictionary*, 19 October 2012) <http://thelawdictionary.org/efficiency/> accessed 9 April 2017.

[88] *S and Marper v The United Kingdom* (n 44); Forensic Genetics Policy Initiative, *Establishing Best Practice for Forensic DNA Databases* (FGPI 2017) <http://dnapolicyinitiative.org/wp-content/uploads/2017/08/BestPractice-Report-plus-cover-final.pdf> accessed 3 October 2017; *Aycaguer v France* [2017] ECHR 587; Independent Advisory Group on the Use of Biometric Data in Scotland, *Report of the Independent Advisory Group on the Use of Biometric Data in Scotland* (Scottish Government 2018).

1.5.1 Measuring the efficacy or effectiveness of retention regimes

One approach to measuring the success of forensic DNA database laws is the assessment of the outcome of its resultant database. Bieber[89] highlights three broad outcomes of DNA databasing to focus on when measuring effectiveness: 1) Case resolution; 2) Crime reduction and prevention; and, 3) societal and individual interests.

1.5.1.1 Outcome 1 – Case resolution

The first outcome, case resolution, can be described as the extent of utilisation of the database during the criminal justice process – from the investigation of incidents/crime to court and/or final disposal.[90] Presently, there is limited statistical evidence of the actual case resolution rate (including conviction rates) of DNA databases. This is associated with the fact that DNA evidence is rarely used as the only evidence in a case.[91] Although the legal authorities in England and Wales have established that 'where DNA is directly deposited in the course of the commission of a crime by the offender, a very high DNA match with the defendant is sufficient to raise a case for the defendant to answer',[92] this principle infers that DNA 'only' cases are dependent on the overall circumstances of the case.[93] Therefore, it is difficult to exclusively ascribe the resolution of a case to a DNA database hit. This makes it complicated to determine the 'independent' case resolution effectiveness of DNA databasing though its value has been demonstrated in many individual serious crimes, such as, the case of Keith Samuels and Joseph Kappen.[94]

One way of evaluating how effective the database could be in resolving crime is the assessment of its output metric, match or hit rates. Based on the recommendations of the NDNAD Ethics Group,[95] the 'potential' impact of the database on case resolution could be demonstrated by assessing the match rate data filtered by:

a) retention regimes (e.g. PoFA/semi-restrictive vs expansive regimes);

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[89] Frederick R Bieber, 'Turning Base Hits into Earned Runs: Improving the Effectiveness of Forensic DNA Data Bank Programs' (2006) 34 Journal of Law, Medicine & Ethics 222.
[90] Bieber (n 89).
[91] FIND Strategy Board, *Annual Report 2016 to 2017* (n 78).
[92] *R v FNC* [2015] EWCA Crim 1732, para 27.
[93] *R v FNC* (n 92); *R v Tsekiri* [2017] EWCA Crim 40; *R v Bryon* [2015] EWCA Crim 997.
[94] Tolfts and Keay (n 57); Nicole Martin, 'Dead Man Named as Triple Murderer after DNA Tests' (6 June 2002) <https://www.telegraph.co.uk/news/uknews/1396492/Dead-man-named-as-triple-murderer-after-DNA-tests.html> accessed 4 September 2019.
[95] National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2014* (n 17) 20.

b) inclusion criteria or retention categories (e.g. data of those convicted of serious offence vs minor offence vs arrestees); and
c) retention periods (e.g. 3 years old subjects' data vs 9 years).

The filtered match rate data could provide a general understanding of who to include in the database and how long data should be stored to maximize the utility of the database and enhance the protection of public and private interests. One limitation, however, is that a DNA hit does not indicate necessarily that a crime will be 'solved' or the hit will be probative in solving the crime. For example, only 37 of 625 international DNA hits reported to Dutch authorities in 2010 proceeded to court.[96] Although the total number of NDNAD hits that are used in court or contribute to crime resolution is unknown,[97] the number of probative hits is expected to be lower than the initial hits generated from the database. There are several 'innocent' reasons an individual's DNA may be found at a crime scene. Other evidence is required in most cases to corroborate DNA match evidence to secure a conviction or solve a crime. This is because the DNA hit only suggest the possible presence (but not actions) of an individual at the crime/incident scene before, during or after the crime incident. Though limited in demonstrating database effectiveness, a DNA hit suggests that a crime could potentially be solved speedily and efficiently either by identifying unknown offenders and witnesses or eliminating suspects. Hence, the filtered match rate analysis could show if the composition of the database is adequate and can aid the police in resolving crime.

As part of this research, the proposed filtered match rate analysis was considered in assessing the efficacy of retention regimes. As stated earlier, a match rate project was designed, and approval was sought and granted by the NDNAD Strategy Board/Ethics Group.[98] However, there were difficulties in obtaining the filtered match rate data due to the way records are stored in England and Wales. The NDNAD does not store conviction/arrest records. These are stored separately on the PNC. Hence, it was not possible to filter the match rate by retention regime, inclusion criteria or retention periods.

1.5.1.2 Outcome 2 – Crime reduction and prevention

This outcome considers the incapacitation and deterrence effects of the database. Firstly, it is hypothesised that when a true offender is identified using the DNA database, this may lead

[96] ENFSI DNA Working Group, *DNA Database Management Review and Recommendations* (n 66) 28-29.
[97] FIND Strategy Board, *Annual Report 2016 to 2017* (n 78).
[98] See Appendix I – methodology for match rate project

to a reduction in crime rates.[99] A reason for this claim is that the offender may be convicted and held in custody. A lengthy custodial sentence means that such an offender will not be available to commit further crimes, thereby preventing crime and reducing crime rates.[100] The second hypothesis holds that retaining DNA records from individuals could reduce crime rates. An explanation for this claim is that once people are aware that their DNA records are held on the database, they will desist from committing crime since the database increases the chances of being caught.[101] There have been attempts to measure outcome 2 in the United States and Denmark by assessing crime rates and recidivistic behaviour.[102] Although the studies recorded some positive results, there are several confounders with the association of DNA databasing to crime rates and recidivism. Firstly, crime rates are not representative of all crimes that occur due to recording practices. For example, estimates by the Crime Survey for England and Wales (CSEW) show that whilst about 11.2 million crimes were committed in the 2019 reporting year, about 5.9 million crimes were recorded by the police.[103] Secondly, there are several factors that impact on the crime rates. These include socio-economic factors, gender, age, recidivism, incomplete crimes, reporting patterns, the definition of crime and variations in court disposals. Considering these limitations, 'proof that any single new program in the justice system directly reduces crime rates would be difficult to convincingly demonstrate statistically'.[104] Lastly, according to research by McCartney,[105] a deterrence effect may be difficult to prove for many reasons. One of these is that recidivistic offenders are likely to change their *modus operandi* to prevent being caught rather than desisting from crime.

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[99] Jennifer L Doleac, 'The Effects of DNA Databases on Crime' (Social Science Research Network 2016) SSRN Scholarly Paper ID 2556948.
[100] Bieber (n 89).
[101] Doleac (n 99).
[102] Doleac (n 99); Jennifer L Doleac, 'How Do State Crime Policies Affect Other States? The Externalities of State DNA Database Laws' (Social Science Research Network 2016) SSRN Scholarly Paper ID 2892046 <https://papers.ssrn.com/abstract=2892046> accessed 11 January 2017; Jennifer L Doleac and others, 'The Effects of DNA Databases on the Deterrence and Detection of Offenders' (Social Science Research Network 2016) SSRN Scholarly Paper ID 2811790 <https://papers.ssrn.com/abstract=2811790> accessed 22 May 2017.
[103] Office for National Statistics, 'Crime in England and Wales: Year Ending March 2019' (Office for National Statistics 2019) <https://www.ons.gov.uk/peoplepopulationandcommunity/crimeandjustice/bulletins/crimeinenglandandwales/yearendingmarch2019> accessed 4 September 2019.
[104] Bieber (n 89) 230.
[105] McCartney, 'The DNA Expansion Programme and Criminal Investigation' (n 14).

1.5.1.3 Outcome 3 – Societal and individual interests

The third outcome, societal and individual interests, can be described as the relationship between the operation of the database and, actual and perceived public safety, privacy and other civil liberties.[106] This outcome is important because it establishes the legitimacy or acceptability of the operation of the database and demonstrates whether the database is perceived as an effective crime control tool. An assessment of outcome 3 can inform policymakers about public support for the establishment and continuous development of DNA databases. As explained earlier, due to challenges in obtaining reliable statistical data to address the case resolution and crime prevention outcomes of the database, this study focused on outcome 3, specifically on perceived societal and individual interests of the database.

1.6 Problem statement and justification

The *Marper* decision in 2008 and reviews of the legislative framework governing the NDNAD have established the need to ensure proportionality in the operation of DNA databases.[107] However, successive Governments have interpreted proportionality differently and provided disparate responses to the questions: whose DNA data should be stored on the NDNAD? And for how long? This is partly because there is limited empirical evidence to adequately demonstrate the actual and overall effectiveness of DNA retention in ensuring public security (described as the '*Marper gap'* in this thesis). Existing policies on DNA databasing are mainly informed by the perspectives of different members of the public,[108] judicial decisions, and criminal career research.[109]

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[106] Bieber (n 89).

[107] McCartney, 'Of Weighty Reasons and Indiscriminate Blankets' (n 44); Helen Wallace and others, 'Forensic DNA Databases–Ethical and Legal Standards: A Global Review' (2014) 4 Egyptian Journal of Forensic Sciences 57; Brian Blakemore and Christoper Blake, 'Can the National DNA Database Be Effective and Comply with Human Rights Legislation?' (2012) 85 The Police Journal 191; Lee (n 62).

[108] The public is defined as a dynamic and diverse group made up of the different members of society including but not limited to government institutions, professionals, stakeholders, students and citizens. (see Julian Roberta and Manon Jendly, 'A Rendezvous between Forensic Science and Criminology: Toward a Public Forensic Criminology?' in Quentin Rossy and others (eds), *The Routledge International Handbook of Forensic Intelligence and Criminology* (Routledge 2017)).

[109] Home Office, *Keeping the Right People on the DNA Database: Science and Public Protection* (n 47); MPA Civil Liberties Panel (n 40); Alastair MacGregor, *Biometrics Commissioner: Consultation under the Protection of Freedoms Act 2012* (Office of the Biometrics Commissioner 2013); *R v Chief Constable of South Yorkshire Police (Respondent) ex parte LS (by his mother and litigation friend JB) (FC) (Appellant) and R v Chief Constable of South Yorkshire Police (Respondent) ex parte Marper (FC) (Appellant)* (n 72); *S and Marper v The United Kingdom* (n 44); Crime and Policing Analysis Unit, 'DNA Retention Policy: Results of Analysis Relating to the Protections of the "the Scottish Model"' (Home Office 2011)

The last major assessment of public perspectives about DNA retention in England and Wales was carried out in 2011 by the Metropolitan Police Authority Civil Liberties Panel (MPACLP), prior to the implementation of PoFA.[110] The study included engagement with criminal justice professionals and organisations, civil liberty groups and the 'general' public and an online survey of the views of Londoners (*n = 615*). Most respondents to the online survey (84%) supported the view that DNA records from unconvicted individuals should not be retained on the NDNAD. Criminal justice professionals who participated in the study expressed concerns about public security risks with the 'majority view' in the survey. In 2014, Wallace *et al.*[111] reviewed the ethical and legal standards governing national DNA databases around the world. The review highlighted a growing global consensus to limit forensic DNA databanking[112] by destroying samples after profiling and the exclusion of DNA data of unconvicted individuals from databases. Whilst the majority view in the 2011 study and the suggested global trends are partly consistent with PoFA, the literature suggests that public views may not be well-informed due to a lacuna in public education about DNA databases and limited information about the actual effectiveness of DNA databases.[113]

According to the reports of the Biometrics Commissioner, the introduction of PoFA has resulted in some benefits including an improvement in the output of the NDNAD.[114] However, several challenges and potential risks to public security and civil liberties have been identified (see detailed analysis in Chapter 3). Moreover, the PoFA regime has not yet been subjected to a research-informed review since it was enacted.[115] Although some cases in Europe have approved the principles established by the *Marper* ruling,[116] available literature related to forensic DNA databasing in England and Wales suggests that

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<https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/98399/dna-retention-policy.pdf> accessed 6 June 2017.

[110] MPA Civil Liberties Panel (n 40).

[111] Wallace and others (n 107).

[112] i.e. storage of the physical DNA samples and DNA extracts

[113] McCartney, 'Of Weighty Reasons and Indiscriminate Blankets' (n 44); Blakemore and Blake (n 107); MPA Civil Liberties Panel (n 40).

[114] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76); MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80); Alastair MacGregor, *Further Report by the Biometrics Commissioner on Issues Raised in His 2015 Annual Report* (Office of the Biometrics Commissioner, UK 2016); Wiles, *Annual Report 2016* (n 26); Paul Wiles, *Annual Report 2017: Commissioner for the Retention and Use of Biometric Material* (Office of the Biometrics Commissioner 2018).

[115] Wiles, *Annual Report 2016* (n 26); Paul Wiles, *Annual Report 2018: Commissioner for the Retention and Use of Biometric Material* (Office of the Biometrics Commissioner 2019); Home Office, *Memorandum to the Home Affairs Committee: Post-Legislative Scrutiny of the Protection of Freedoms Act 2012* (Home Office 2018), para 19.

[116] *MK v France* [2013] ECHR 341; *Aycaguer v France* (n 88); *Catt v The United Kingdom* [2019] ECHR 76.

proportionality may still be lacking.[117] The contributing factors to this gap include the temporal retention of DNA data from some unconvicted individuals without adequate support of the value of retention.[118] Another factor is the indefinite retention of DNA data from all adults convicted of a recordable offence without considering the type or seriousness of offence and effectiveness of retention.[119] This issue is yet to be decided by the ECHR in the UK case of *Gaughran*.[120] A third factor relates to the position that the non-retention of all arrestee data after the conclusion of investigations/proceedings may lead to public security risks by reducing the capacity of the police to detect crime.[121] These factors may result in legal challenges in future.

To help fill the research gaps identified above, this thesis firstly analysed the reports of the oversight bodies of the NDNAD to identify recurrent themes on the benefits, challenges and emerging issues associated with the implementation of PoFA. Secondly, as a follow-up to the 2011 MPACLP study, this research explored the current views of the public about the retention of forensic DNA data in England and Wales using an online survey. Thirdly, the perception of primary stakeholders (such as, law enforcement professionals) who are well informed about the legal framework and operation of the NDAND was assessed. The stakeholders' survey focused on the effectiveness of the different NDNAD retention regimes. Unlike the general public, the stakeholders are directly exposed to the benefits, challenges and risks of the DNA retention regime. In summary, the research found inconsistencies between the views of respondents to the surveys and the current retention regime for the NDNAD. The public survey indicated support for discriminatory retention of

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[117] McCartney, Wilson and Williams (n 44); McCartney, 'Of Weighty Reasons and Indiscriminate Blankets' (n 44); Blakemore and Blake (n 107); Max Rowland, 'UK: Government's "Clumsy, Indiscriminate and Disproportionate" Approach to DNA Retention' <http://database.statewatch.org/article.asp?aid=29534> accessed 2 July 2018; Liberty, 'Liberty's Second Reading Briefing on the DNA Provisions in the Crime and Security Bill in the House of Commons' (Liberty 2010); Liberty, 'Liberty's Second Reading Briefing on the Protection of Freedoms Bill in the House of Commons' (Liberty 2011); Wiles, *Annual Report 2018: Commissioner for the Retention and Use of Biometric Material* (n 115), para 3.

[118] Rowland (n 117); Liberty, 'Liberty's Second Reading Briefing on the DNA Provisions in the Crime and Security Bill in the House of Commons' (n 117); Liberty, 'Liberty's Second Reading Briefing on the Protection of Freedoms Bill in the House of Commons' (n 117); Blakemore and Blake (n 107).

[119] McCartney, 'Of Weighty Reasons and Indiscriminate Blankets' (n 44); Chris Hughes, 'RE: Ethical Advice on the Retention of DNA Profiles, Fingerprints and Custody Images from Convicted Persons until They Are 100 Years Old' (2 November 2017) <https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/657875/Ethical_advice_on_the_retention_of_DNA_profiles_fingerprints_and_custody_images_from_convicted_persons_until_they_are_100_years_old.pdf> accessed 4 May 2018.

[120] *Gaughran v Chief Constable of the Police Service of Northern Ireland (Secretary of State for the Home Department intervening)* [2015] UKSC 29.

[121] MPA Civil Liberties Panel (n 40); MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80).

data from convicted adults based on offence seriousness. In contrast, participants of the stakeholder survey thought the expansive regime is the most effective system for the NDNAD. This thesis suggests a need for reform of the current indefinite retention rule for convicted adults and adoption of efficient elements of the expansive regime such as automation of procedures or 'bright-line' rules and creation of a national intelligence network.

1.7 Significance and original research contribution

There are no public security and human rights standards for the retention of forensic DNA data worldwide.[122] This is mainly due to variations in the interpretation of proportionality and how to ensure a balance between public security and privacy. The assessment of the different aspects of the efficacy and impact of NDNAD regimes can be useful to the criminal justice system of England and Wales, other jurisdictions in the UK and potentially the world. In the absence of systematic and objective data on the effectiveness of the NDNAD regimes, this study focused on the aspect of the societal and individual interest outcome of DNA databasing.

Figure 1.3 summarises the specific and original contributions of the research based on the overall findings. The figure highlights areas of possible reform, such as the legal definition of the NDNAD functions, and how proportionality and effectiveness may be improved. The research is significant because the determination of an appropriate law to govern DNA databases has been described as a societal choice.[123] The findings from the study are relevant as they can inform policymakers about the 'choices' of the society they represent, including perceptions about the effectiveness, inclusion and retention criteria for databases.

It is noteworthy that the proportionality issues of forensic DNA data retention are not unique to DNA databases or databanks. These issues also apply to other biometric databases, such as, fingerprint databases (e.g. the UK's IDENT 1) and the proposed custody images database in England and Wales. The NDNAD Ethics Group previously recommended the application of the PoFA retention regime to the proposed custody images database which currently holds

[122] Wallace and others (n 107); Smilja Teodorović and others, 'Attitudes Regarding the National Forensic DNA Database: Survey Data from the General Public, Prison Inmates and Prosecutors' Offices in the Republic of Serbia' (2017) 28 Forensic Science International: Genetics 44.
[123] Annemie Patyn and Kris Dierickx, 'Forensic DNA Databases: Genetic Testing as a Societal Choice' (2010) 36 Journal of Medical Ethics; London 319.

over 19 million images of both convicted and non-convicted individuals.[124] There is a need to generate empirical evidence to establish the efficacy of the PoFA regime and assess whether it can be applied to other forensic biometric technologies. The findings of this project would, therefore, help in setting public security and human rights standards for other forensic biometric databases.

[124] National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2015* (n 79); Home Office, *Review of the Use and Retention of Custody Images* (Home Office 2017) <https://www.gov.uk/government/publications/custody-images-review-of-their-use-and-retention> accessed 9 April 2017.

Areas of possible reform to current law

- Amending the legal definition/scope of the public security functions of the NDNAD to fit its actual outcomes
- Introduction of a legal requirement to evidence the public security functions of the NDNAD
- Discriminatory retention for convicted adults based on offence seriousness
- Reflection and adoption of best practices and efficient elements of the expansive regime
- Establishment of a simplified and statutory channel to sensitize the public about the facts of DNA databasing & other biometrics
- Development of a statutory scheme to regularly assess public perceptions about DNA databasing and other biometrics (Biometrics Perception Index)

Advancement of the literature

- Establishment of the benefits, challenges and risks of the current PoFA retention regime
- Assessment of attempts to measure the effectiveness of the NDNAD and DNA databases in general; and key indicators to assess effectiveness
- Review of public perspective studies on DNA databasing in the UK and other jurisdictions
- Review of challenges in the international exchange of forensic DNA data
- Empirical & quantitative data on public views in England & Wales about DNA databasing for criminal justice system entrants (arrestees to the convicted)
- Empirical & quantitative data on public views in England & Wales about voluntary participation in the NDNAD
- Empirical & quantitative data about public views in England & Wales about the public security functions of the NDNAD and expert views on the effectiveness of retention regimes

Figure 1.3 - Original and specific contributions of the present research on the efficacy of the retention regimes governing the National DNA Database

1.8 Conclusion: chapters overview

This chapter established the focus of this research, emphasising the inconsistencies in the definition and scope of proportionality in DNA databasing, lack of systematic data on the actual effectiveness of the NDNAD and justification for the empirical method for this research. To aid in the understanding of the research, Chapter 2 provides a detailed account of the trajectory of forensic DNA typing and databasing, providing context to the relevance of debates on effectiveness, public security, privacy and proportionality.

The first aim of the research, namely to establish the status of the implementation of the PoFA regime, is addressed in Chapter 3. This examines the impact of the PoFA regime through document analysis of reports of NDNAD oversight bodies. The review found that the regime may represent a 'double-edged sword', improving performance whilst creating some public security and privacy risks. Chapter 4 provides a literature review of research on or related to the effectiveness of DNA retention regimes. This review identified seven key indicators for effectiveness that informed the design of research questionnaires. Chapter 5 covers the methodology for the public survey which received 201 responses.

In Chapter 6, the second aim of the research is addressed, exploring the views of the public about the public security functions of the NDNAD. The results showed a positive belief in the NDNAD as a tool for detecting, investigating and prosecuting crime. The function of the NDNAD in preventing crime was doubted. Chapter 7 evaluates the survey results about the entry of DNA data in the NDNAD (Aim 3). The results indicated general support for the inclusion of data from arrestees, charged and convicted individuals. However, there was an indication for a selective approach based on offence seriousness. Chapter 8 examines the survey results on the retention periods for convicted and unconvicted individuals (Aim 3). This generally confirmed support for the PoFA regime. However, participants favoured a discriminatory retention criterion for convicted adults based on the gravity of offence. Chapter 9 examines the survey results on voluntary participation in the NDNAD (Aim 3). The most important trigger for participation was whether the data will assist the police to solve crime.

Chapter 10 addresses the views of primary stakeholders about the effectiveness of the three retention regimes (Aim 4). The survey received 31 responses. The results indicated wide support for the expansive regime as the most effective for public security and implementation efficiency/cost reasons. The last chapter (Chapter 11) brings together the findings from the research and outlines recommendations for potential future legal reform

(Aim 5). The main limitations of the study are also highlighted and suggestions for future research in this area are outlined.

Chapter 2: Evolution of forensic DNA databases

The purpose of this chapter is to provide context to the debates on public security, privacy, proportionality and the effectiveness of DNA databases. The chapter shows the progress of forensic DNA analysis to databasing, and currently the transnational exchange of DNA data. Section 2.1 explains the scientific terms in DNA analysis. This is followed by the timeline for the analytical procedures in section 2.2. In the third section, the process of establishing a national DNA database is described with a brief overview of the historical proliferation of databases globally. Section 2.4 considers the NDNAD in detail, focussing on its size and composition, the legislative, operational and governance framework. The fifth section reviews the oldest and/or largest national databases around the world and how they compare to the NDNAD. Section 2.6 reviews the international exchange of forensic DNA data. The chapter concludes in section 2.7 with an outline of patterns in the development of DNA databasing and the need to measure effectiveness.

2.1 Introduction to DNA and terminology

As noted in Chapter 1, the subunits of the DNA molecule are the nucleotides. These are made up of three chemical compounds: a nitrogenous base, a pentose sugar (2-deoxy-D-ribose) and a phosphate.[125] There are two types of nitrogenous bases: purines and pyrimidines. The purines in DNA are guanine (G) and adenine (A); the pyrimidines are cytosine (C) and thymine (T). In the DNA double helix structure, G in one strand pairs with C on the other strand, and A pairs with T based on the Chargaff's rule, a phenomenon referred to as complementary base pairing or Watson-Crick base pairing.[126] The nucleotides in each strand are joined through the phosphate group by forming a type of bond called phosphodiester bonds. Details of the basics, structure and chemistry of nucleotides and DNA are detailed in Nelson and Cox,[127] Garrett and Grisham,[128] and Berg *et al.*[129]

The human nuclear genome consists of ~3.2 billion base pairs (bp) of which ~2000 – 2500 genes have been identified.[130] In addition to nuclear DNA, the cell mitochondria contain

[125] Garrett and Grisham (n 1); Berg, Tymoczko and Stryer (n 1); David L Nelson and Michael M Cox, *Lehninger Principles of Biochemistry* (4th edn, WH Freeman and Company 2005).
[126] Garrett and Grisham (n 1).
[127] Nelson and Cox (n 125).
[128] Garrett and Grisham (n 1).
[129] Berg, Tymoczko and Stryer (n 1).
[130] Harry Mountain, 'The Analysis of Deoxyribonucleic Acid (DNA): DNA Profiling' in Andrew Jackson and Julie Jackson (eds), *Forensic science* (3rd edn, Pearson Education Ltd 2011).

circular DNA of 16,569 bp, which has 37 genes.[131] The DNA sequence of genes is made up of protein-coding and noncoding regions called exons and introns, respectively. The protein-coding regions make up only ~1.5% of the genome.[132] Sequences called intergenic sequences separate the different genes. In the cell, the complete DNA molecule is organised as chromosomes. All but sex cells have 22 pairs of autosomal chromosomes and either the XY sex chromosome for males or XX for females. Sex cells are haploid and hence contain only one of each pair of the 46 chromosomes. For the diploid set of chromosomes, one of each pair is inherited from each parent.

The term locus refers to the location of a gene or specific DNA sequence on a chromosome. Alternative forms of a gene are referred to as alleles. When the same allele is found on both chromosomes within a pair, this is termed homozygous. The term used for different alleles is heterozygous. Heterozygosity is characterized by variation in DNA sequences resulting from mutation events that introduce base pair insertions, deletions or changes.[133] Insertion of base pairs increases the length or size of the DNA sequence whereas deletion of base pairs decrease size. Base pair changes (termed point mutation, e.g. change of a C nucleotide to T) do not alter the length of the DNA sequence at a locus.[134] In the forensic context, the variability in the size of specific DNA sequences at a locus is also termed allele.[135]

Tandem repeat is a term that refers to specific core sequences of DNA that are repeated consecutively in the noncoding regions.[136] These are classified based on the size as variable number tandem repeats (VNTRs) and short tandem repeats (STRs).[137] The core sequences of VNTRs and STRs have a size range of 6 – 100 bp and 2 – 7 bp, respectively.[138] Forensic DNA typing is predominantly based on analyses of these tandem repeats and tetra-nucleotide repeats (i.e. 4 bp core sequence) of STRs are currently the most common in commercial test kits.[139] The number of repeats is the allele for a STR or VNTR locus. The structure of a STR

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[131] Butler (n 5); Butler (n 8); Salvatore DiMauro and Guido Davidzon, 'Mitochondrial DNA and Disease' (2005) 37 Annals of Medicine 222.
[132] Terence A Brown, *Genomes* (2nd edn, Wiley-Liss 2002).
[133] Mountain (n 130).
[134] Berg, Tymoczko and Stryer (n 1).
[135] Butler (n 8).
[136] Keiji Tamaki and Alec J Jeffreys, 'Human Tandem Repeat Sequences in Forensic DNA Typing' (2005) 7 Legal Medicine 244; Mountain (n 130); Butler (n 5); Butler (n 8).
[137] Mountain (n 130); Tamaki and Jeffreys (n 136).
[138] Tamaki and Jeffreys (n 136); Mountain (n 130); Butler (n 5); Butler (n 8).
[139] Butler (n 8); Sherif H El-Alfy and Ahmed F Abd El-Hafez, 'Paternity Testing and Forensic DNA Typing by Multiplex STR Analysis Using ABI PRISM 310 Genetic Analyzer' (2012) 10 Journal of Genetic Engineering and Biotechnology 101; William Goodwin, 'DNA Profiling: The First 30 Years' (2015) 55 Science & Justice 375.

is illustrated in Figure 2.1. It shows alleles 7 and 8 of the tetra-nucleotide repeat AATG of the TH01 STR locus.[140]

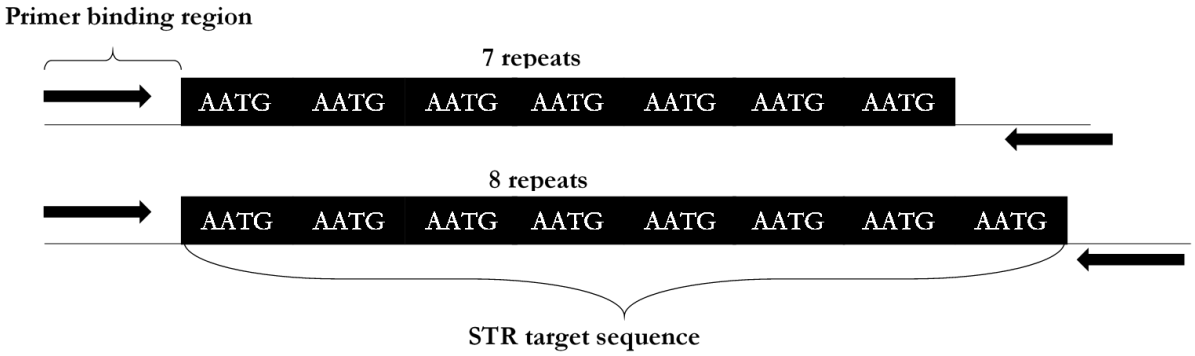

Figure 2.1 - Structure of different alleles of the TH01 STR locus

Forensic DNA identity testing is possible because the number of times the STR/VNTR core sequences repeat vary within and among individuals. The human genome consists of thousands of STR loci resulting in the generation of individual-specific combinations of alleles.[141] The discriminatory nature of DNA profiles allows the identification of individuals with a high degree of confidence. The next section details the historical development of forensic DNA testing.

2.2 History of forensic DNA analysis

The first method used for forensic DNA identity testing is DNA fingerprinting.[142] Sir Alec Jeffreys pioneered this method in the 1980s, which uses a technique called restriction fragment length polymorphism (RFLP).[143] The RFLP technique is based on the analysis of VNTRs. It involves the digestion of DNA using restriction enzymes. These cut the DNA at specific sites that vary among individuals, hence generating DNA fragments of different sizes. After digestion, radiolabelled DNA probes (either multi-locus probe (MLP) or single-

[140] Katherine Butler Gettings and others, 'STR Allele Sequence Variation: Current Knowledge and Future Issues' (2015) 18 Forensic Science International: Genetics 118.
[141] Butler (n 8); Gettings and others (n 140).
[142] DNA fingerprinting is also used as a general term to refer to STR typing or other polymorphic DNA identity tests such as Y-STR analysis.
[143] AJ Jeffreys, V Wilson and SL Thein, 'Individual-Specific "fingerprints" of Human DNA' (1985) 316 Nature 76; AJ Jeffreys, V Wilson and SL Thein, 'Hypervariable "minisatellite" Regions in Human DNA' (1985) 314 Nature 67; AJ Jeffreys and others, 'DNA "Fingerprints" and Segregation Analysis of Multiple Markers in Human Pedigrees.' (1986) 39 American Journal of Human Genetics 11; Tamaki and Jeffreys (n 136); Peter Gill, Alec J Jeffreys and David J Werrett, 'Forensic Application of DNA "Fingerprints"' (1985) 318 Nature 577; Alec J Jeffreys, John FY Brookfield and Robert Semeonoff, 'Positive Identification of an Immigration Test-Case Using Human DNA Fingerprints' (1985) 317 Nature 818.

locus probe (SLP)) are used to detect the DNA fragments in a technique called Southern blotting.[144] The probes are designed to hybridize with regions of DNA containing VNTRs. The variability of VNTRs between individuals allows the generation of individual-specific profiles ('DNA fingerprints'). Though discriminatory, the VNTR-based method has several limitations:

1) a large quantity of DNA is required for analysis and it takes several days to weeks to obtain results;
2) the method works on intact DNA, and double-stranded DNA (dsDNA) is required for restriction enzyme digestion;
3) the DNA fingerprints for multi-locus probes are difficult to interpret and the technique lacks automation;
4) there are difficulties in inter-laboratory comparison of profiles due to variations in results.[145]

The second and most common forensic DNA typing method was developed in the 1990s and is called DNA profiling[146] or STR typing.[147] The STR-based method uses the polymerase chain reaction (PCR) technique developed by Kary Mullis in 1985.[148] The PCR allows DNA amplification or synthesis of specific DNA sequences *in vitro* using *Taq* DNA polymerase, an enzyme derived from *Thermus acquaticus* (a thermophilic bacterium).[149] Millions of copies of a specific DNA sequence are created within 2 hours through multiple replications by PCR. During this process, the double-stranded DNA molecule is separated into single strands. Short DNA sequences (oligonucleotides) called primers are used to initiate the synthesis of new strands of complementary DNA. Forward and reverse primers that

[144] Mike DR Croning and others, 'Automated Design of Genomic Southern Blot Probes' (2010) 11 BMC Genomics 74; Martin, Schmitter and Schneider (n 21).
[145] Butler (n 5); A Mansuet-Lupo, P Rouger and V Van Huffel, 'Les Empreintes Génétiques: État de l'art En 2007, Techniques, Applications et Législation' (2007) 14 Transfusion Clinique et Biologique 334; Bramley (n 42).
[146] DNA profiling is also used as a general term for VNTR typing or other types of DNA identity testing.
[147] Jobling and Gill (n 7); Butler (n 8); Mansuet-Lupo, Rouger and Van Huffel (n 145); Mountain (n 130); Peter Gill and Tim Clayton, 'The Current Status of DNA Profiling in the UK' in Jim Fraser and Robin Williams (eds), *Handbook of forensic science* (Willan Publishing 2009); Martin, Schmitter and Schneider (n 21); A Edwards and others, 'DNA Typing and Genetic Mapping with Trimeric and Tetrameric Tandem Repeats.' (1991) 49 American Journal of Human Genetics 746.
[148] Mountain (n 130); Butler (n 8); Mansuet-Lupo, Rouger and Van Huffel (n 145); RK Saiki and others, 'Primer-Directed Enzymatic Amplification of DNA with a Thermostable DNA Polymerase' (1988) 239 Science 487.
[149] Butler (n 8); Saiki and others (n 148).

hybridize with the ends of the target sequence are used. The PCR mechanism and its application in forensic DNA typing are detailed in Butler.[150]

STR typing has several advantages over the RFLP VNTR-based method. Firstly, multiple loci can be analysed in a single reaction using multiple primer sets (referred to as multiplexing).[151] Secondly, results can be obtained in less than 24 hours. Thirdly, minute quantities of DNA and degraded DNA can be analysed. Lastly, the process is automated, and the results can be interpreted easily.[152]

Forensic DNA profiling or STR typing involves five main stages: 1) preparation of the biological sample and DNA extraction, 2) determination of the quantity of DNA, 3) STR amplification, 4) capillary electrophoresis, and 5) interpretation of results. The sample preparation stage involves mechanical, chemical and enzymatic treatment of the biological sample to release the cellular DNA in solution.[153] The sample treatment depends on the source or nature of the biological material. For a solid tissue, such as, bone, mechanical treatment by crushing and grinding fragments of the bone into a fine powder for downstream processing is adopted. The powdered sample is incubated in a buffer and agitation releases the cells in solution. Detergents, such as, sodium dodecyl sulphate (SDS) are added to the sample to break the cell and nuclear membrane. This is followed by treatment with proteinase K, an enzyme that digests proteins. The purified DNA is obtained by washing all proteins, lipids and other contaminants away. There are several methods for purifying the DNA: phenol-chloroform extraction method, Chelex method and the solid-phase silica gel column (SSGC) extraction method.[154] Currently, the most common, safe and efficient method is the SSGC extraction method.[155] The QIAGEN QIAamp DNA Investigator Kit uses this technique for extraction and purification of DNA.[156] An advantage of this protocol is that it can be automated using the QIAcube instrument.[157]

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[150] Butler (n 5).
[151] MC Edwards and RA Gibbs, 'Multiplex PCR: Advantages, Development, and Applications.' (1994) 3 Genome Research S65.
[152] Butler (n 5); Butler (n 8).
[153] QIAGEN, *QIAamp® DNA Investigator Handbook* (QIAGEN 2012).
[154] SA Greenspoon and others, 'QIAamp Spin Columns as a Method of DNA Isolation for Forensic Casework' (1998) 43 Journal of Forensic Sciences 1024; Butler (n 5); QIAGEN, *QIAamp® DNA Investigator Handbook* (n 153); Butler (n 8).
[155] Butler (n 8).
[156] QIAGEN, *QIAamp® DNA Investigator Handbook* (n 153).
[157] Kirsty Phillips, Nicola McCallum and Lindsey Welch, 'A Comparison of Methods for Forensic DNA Extraction: Chelex-100® and the QIAGEN DNA Investigator Kit (Manual and Automated)' (2012) 6 Forensic Science International: Genetics 282.

Following extraction and purification, the DNA is quantified to ensure that the right amount of DNA (0.2 – 1 ng) is used in the subsequent stage.[158] DNA profiling produces quality results when an optimal quantity of DNA is used in the amplification stage. Too little or high amount of DNA may lead to errors in the interpretation of the results. Early methods for quantifying forensic DNA samples included UV absorbance spectroscopy, fluorescent spectroscopy, gel electrophoresis, human-specific probe hybridisation and end-point PCR methods.[159] The current and most common method for quantifying DNA is based on the PCR technique and is known as *quantitative real-time PCR (qPCR)*.[160] The method involves the amplification of a target DNA sequence complementary to a designed fluorescent DNA probe (such as, the Scorpion probe used in the QIAGEN DNA Quantiplex Kit).[161] As new DNA is synthesised, the amount of DNA is detected by comparing the level of fluorescence with a standard curve. One advantage of the qPCR method is that the probe detects only human DNA and serves as a quality check. Further, it helps determine the type of DNA analysis to carry out on the sample.

In the amplification stage, the target STR markers are co-amplified using specially designed primer sets. The first STR typing multiplex system developed by the former Forensic Science Service (FSS) targeted four STR loci and was known as the Quad or Quadruplex.[162] The target STRs were, TH01, FES/FPS, F13A1 and vWA.[163] A *random match probability* (RMP) is the statistical approach for determining the value of DNA evidence. It measures the chance of a matching DNA profile from a random individual selected from the

[158] Butler (n 8); C Martins and others, 'DNA Quantification by Real-Time PCR in Different Forensic Samples' (2015) 5 Forensic Science International: Genetics Supplement Series e545; Francesca Di Pasquale and others, 'Investigator® Quantiplex Kit: For Reliable Quantification of Human DNA in Forensic Samples' (2011) 3 Forensic Science International: Genetics Supplement Series e413; Steven B Lee, Bruce McCord and Eric Buel, 'Advances in Forensic DNA Quantification: A Review' (2014) 35 ELECTROPHORESIS 3044; Miroslav Vraneš, Mario Scherer and Keith Elliott, 'Development and Validation of the Investigator® Quantiplex Pro Kit for QPCR-Based Examination of the Quantity and Quality of Human DNA in Forensic Samples' (2017) 6 Forensic Science International: Genetics Supplement Series e518.
[159] Butler (n 8); Lee, McCord and Buel (n 158).
[160] Lee, McCord and Buel (n 158); Butler (n 8).
[161] QIAGEN, *Investigator® Quantiplex Handbook* (QIAGEN 2014).
[162] Gill and Clayton (n 147); CP Kimpton and others, 'Automated DNA Profiling Employing Multiplex Amplification of Short Tandem Repeat Loci.' (1993) 3 Genome Research 13; C Kimpton and others, 'Evaluation of an Automated DNA Profiling System Employing Multiplex Amplification of Four Tetrameric STR Loci' (1994) 106 International Journal of Legal Medicine 302; TM Clayton and others, 'Further Validation of a Quadruplex STR DNA Typing System: A Collaborative Effort to Identify Victims of a Mass Disaster' (1995) 76 Forensic Science International 17.
[163] Kimpton and others, 'Evaluation of an Automated DNA Profiling System Employing Multiplex Amplification of Four Tetrameric STR Loci' (n 162).

population.[164] The RMP calculation assumes that the sources of the two matching profiles are unrelated. The RMP for the Quad was ~1 in 10000, indicating a high significance.[165]

The second multiplex system of the FSS was developed in 1995. This was based on 6 STR loci and the amelogenin locus found on the sex chromosomes.[166] Females are homozygous for the amelogenin locus whereas males are heterozygous. The 6 loci system was known as the second-generation multiplex (SGM) and consisted of the TH01, D8S1179, D18S51, D21S11, FGA and vWA STR loci.[167] The SGM decreased the RMP to 1 in 50 million, increasing the discriminatory power of the DNA test. The NDNAD was set up in 1995 using the SGM system.[168] In 1999, the United Kingdom adopted the AmpFlSTR®SGM Plus™ (SGM+) system developed by Applied Biosystems.[169] The SGM+ tests 10 STR loci including the SGM loci and the amelogenin locus. The four additional loci to the SGM were D3S1358, D16S539, D2S1338 and D19S433. The RMP for a full SGM+ profile is less than 1 in a trillion.[170] However, this is reported conservatively in UK courts as less than 1 in a billion because the relevant population is less than a billion.[171]

Since 2009 there has been a substantial expansion of STR markers used in the UK and Europe. The aim of these markers is to prevent the chance of adventitious matches,[172] harmonise DNA testing and databases globally, and facilitate forensic DNA data sharing across different jurisdictions.[173] The European Standard Set loci (ESS) was established in 1998 following an Interpol initiative to create a DNA record of sexual offenders.[174] This comprised 4 STR markers: FGA, TH01, vWA and D21S11. The ESS was expanded in 1999 with 3 additional loci (D3S1358, D8S1179 and D18S51), and in 2009 with 5 other loci (D1S1656, D2S441, D10S1248, D12S391 and D22S1045).[175] The European standard has further expanded to 16 loci with the addition of 4 extra loci (D2S1338, D16S539, D19S433

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[164] Butler (n 8).
[165] Gill and Clayton (n 147).
[166] Gill and Clayton (n 147); KM Sullivan and others, 'A Rapid and Quantitative DNA Sex Test: Fluorescence-Based PCR Analysis of X-Y Homologous Gene Amelogenin' (1993) 15 BioTechniques 636.
[167] Butler (n 8).
[168] DJ Werrett, 'The National DNA Database' (1997) 88 Forensic Science International 33.
[169] EA Cotton and others, 'Validation of the AMPFlSTR® SGM Plus™ System for Use in Forensic Casework' (2000) 112 Forensic Science International 151; Butler (n 8).
[170] Butler (n 8).
[171] Cotton and others (n 169).
[172] i.e. the probability that profiles from two unrelated individuals match by chance
[173] Wang and others (n 9); Gill and Clayton (n 147).
[174] Martin, Schmitter and Schneider (n 21).
[175] Martin, Schmitter and Schneider (n 21); LA Welch and others, 'European Network of Forensic Science Institutes (ENFSI): Evaluation of New Commercial STR Multiplexes That Include the European Standard Set (ESS) of Markers' (2012) 6 Forensic Science International: Genetics 819.

and SE33) in commercial kits.[176] In July 2014, the UK moved from the SGM+ kit to the Next Generation Multiplexing (NGM) or DNA-17 profiling system which tests for all the European standard markers which include the SGM+ loci. The DNA-17 system has been further expanded in Scotland with the introduction of the DNA-24 or GlobalFiler system developed by Thermo Fisher Scientific.[177] The GlobalFiler system tests for 22 STR markers including the DNA-17 loci, one male-specific marker (Y indel) and amelogenin.[178] The six extra markers in DNA-24 are CSF1PO, TPOX, D5S818, D13S317, D7S820, and DYS391.[179]

Like Europe, parallel developments have also occurred in North America. The United States established the Combined DNA Index System (CODIS) loci of 13 STR markers in 1997.[180] Canada and more than 50 countries in the world subsequently adopted the CODIS software.[181] The CODIS markers have now (since January 2017) been expanded to 20 markers including the 12 ESS loci.[182] Table 2.1 shows the common STR markers in the United Kingdom, United States of America, Europe and Interpol.

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[176] Welch and others (n 175); NIST, 'Core STR Loci Used in Human Identity Testing' (*National Institute of Standards and Technology*, 26 August 2015) <http://strbase.nist.gov/coreSTRs.htm> accessed 11 October 2017.

[177] Scottish Police Authority (n 9); BBC News, 'New DNA Facility Gives Hope of "cold Case" Justice in Scotland' *BBC News* (2 February 2015) <https://www.bbc.com/news/uk-scotland-glasgow-west-31091812> accessed 29 September 2019.

[178] Wang and others (n 9).

[179] Applied Biosystems, *GlobalFiler™ PCR Amplification Kit: User Guide* (Thermo Fisher Scientific Inc 2016).

[180] Bruce Budowle and others, 'CODIS and PCR-Based Short Tandem Repeat Loci: Law Enforcement Tools' (Promega Corporation 1998) <https://www.promega.co.uk/-/media/files/resources/conference-proceedings/ishi-02/oral-presentations/17.pdf?la=en> accessed 17 October 2017; Butler (n 8).

[181] FBI, 'Combined DNA Index System (CODIS)' (*Federal Bureau of Investigation*) <https://www.fbi.gov/services/laboratory/biometric-analysis/codis> accessed 17 October 2017; Emmanuel Milot and others, 'The National DNA Data Bank of Canada: A Quebecer Perspective' (2013) 4 Frontiers in Genetics 1; RCMP, 'Technology: The Canadian National DNA Data Bank' (*Royal Canadian Mounted Police*, 16 July 2003) <http://www.rcmp-grc.gc.ca/nddb-bndg/techno-eng.htm> accessed 17 October 2017.

[182] NIST (n 176); Douglas R Hares, 'Selection and Implementation of Expanded CODIS Core Loci in the United States' (2015) 17 Forensic Science International: Genetics 33.

Table 2.1 - Standard set STR markers in the United Kingdom (England and Wales), United States, Europe and Interpol.[183] *(Common STR markers among the standard sets are in coloured font)*

United Kingdom NDNAD core loci	United States core loci (CODIS)	European standard set loci	Interpol standard set loci
Amelogenin	Amelogenin	Amelogenin	Amelogenin
TH01	TH01	TH01	TH01
D3S1358	D3S1358	D3S1358	D3S1358
vWA	vWA	vWA	vWA
D21S11	D21S11	D21S11	D21S11
D8S1179	D8S1179	D8S1179	D8S1179
D18S51	D18S51	D18S51	D18S51
FGA	FGA	FGA	FGA
D10S1248	D10S1248	D10S1248	
D22S1045	D22S1045	D22S1045	
D12S391	D12S391	D12S391	
D2S441	D2S441	D2S441	
D1S1656	D1S1656	D1S1656	
D19S433	D19S433	D19S433	
D16S539	D16S539	D16S539	
D2S1338	D2S1338	D2S1338	
SE33	CSF1PO	SE33	
	D7S820		
	D13S317		
	TPOX		
	D5S818		

The fourth stage of DNA profiling is the detection and identification of the amplified STR markers using a technique called capillary electrophoresis (CE).[184] The technique separates the different alleles (amplicons) based on their size (bp) and charge. The CE consists of a gel polymer (polyacrylamide) in a glass capillary tube that serves as a molecular sieve to separate the DNA fragments. DNA is negatively charged hence moves towards the positive electrode end (anode) of an electric field set across the gel. Smaller DNA fragments move faster than larger fragments and the CE detects the time it takes for the fragment to reach the end (retention time). Using a combination of size and colour of the fluorescent-labelled fragments, the amplicons are detected and compared to standard-sized DNA makers and a standard of all alleles found at each locus (referred to as allelic ladder).

In the final stage, the output of the CE is interpreted using a software called Gene Mapper.[185] This allows the scientist to identify the alleles at each locus for the DNA sample. A string of

[183] Home Office, 'DNA Population Data to Support the Implementation of National DNA Database DNA-17 Profiling' (*DATA.GOV.UK*, 7 September 2014) <https://data.gov.uk/dataset/dna-population-data-to-support-the-implementation-of-national-dna-database-dna-17-profiling>; NIST (n 176); Hares (n 182); ENFSI DNA Working Group, *DNA Database Management Review and Recommendations* (n 31).
[184] Butler (n 8); Mountain (n 130).
[185] Butler (n 8).

numbers ‘unique’ to the DNA sample is obtained and recorded as the DNA profile. Figure 2.2 illustrates an electropherogram of a full DNA profile obtained after DNA profiling. Two peaks at a locus indicate the DNA donor is heterozygous at that particular locus. A single peak indicates the individual is homozygous. The DNA profile, which is the string of numbers is recorded as shown in Table 2.2. The random match probability of the DNA profile is then calculated using available data from a population database. Using the profile in Table 2.2, the RMP calculation from the ENFSI website called STRs for Identity ENFSI Reference Database (STRidER)[186] yields a value of 1.3554 x 10^{-39} from the European population database (Figure 2.3). In the UK, the RMP value will be reported as 1 x 10^{-9} (i.e. 1 in a billion), which indicates an extremely strong significance of the DNA match.

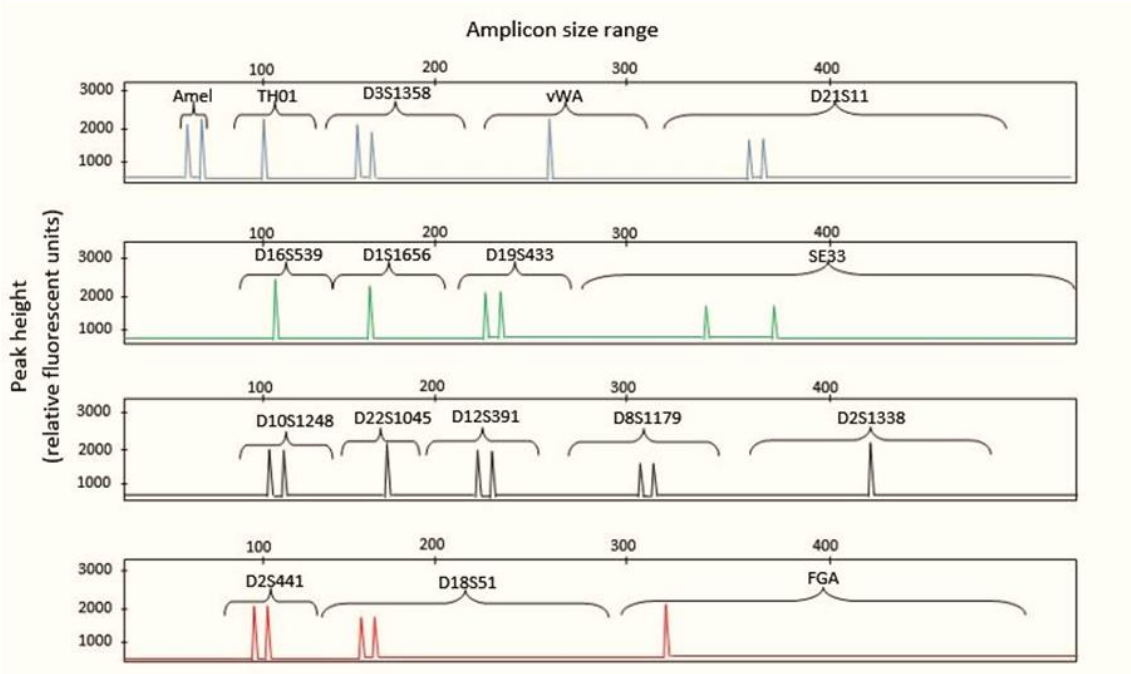

Figure 2.2 - Illustration of a DNA profile electropherogram of a single individual. The alleles at each locus are presented as peaks. One peak at a locus indicates the DNA donor is homozygous at that locus whereas two peaks indicate a heterozygote.

[186] ENFSI DNA Working Group, ‘STRidER 2.0’ (*STRidER*) <https://strider.online/> accessed 11 October 2017.

Table 2.2 - Example of a DNA profile obtained using the QIAGEN ESSplex SE QS Kit.[187] *The same number indicates the DNA donor is homozygous at that locus whilst different numbers indicate the donor is heterozygous.*

Locus	Amelogenin	TH01	D3S1358	vWA	D21S11
Allele	X, X	7, 8	9, 11	14, 15	29, 30
Locus	**D16S539**	**D1S1656**	**D19S433**	**SE33**	
Allele	8, 12	16, 16	12.2, 18.2	27.2, 28.2	
Locus	**D10S1248**	**D22S1045**	**D12S391**	**D8S1179**	**D2S1338**
Allele	15, 15	12, 16	16, 17.3	14, 14	12, 23
Locus	**D2S441**	**D18S51**	**FGA**		
Allele	11.3, 12	17, 17	23, 23		

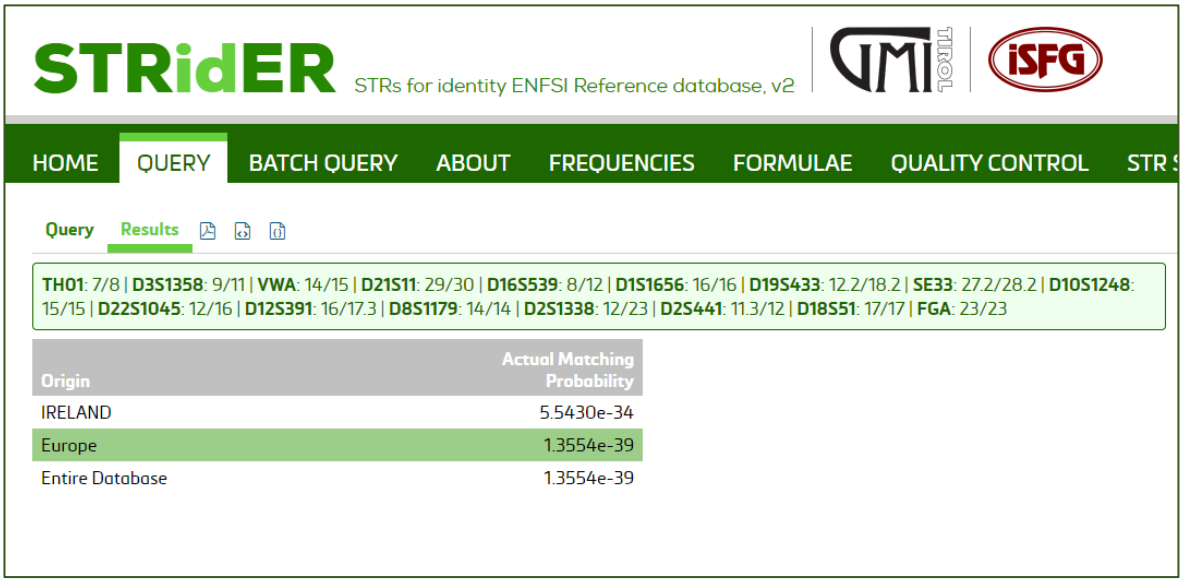

Figure 2.3 - Random Match Probability calculation using the ENFSI STRidER online software.

The DNA profile/fingerprint can play an important role in police detective work. Firstly, it can help the police identify, associate or eliminate individuals from a criminal investigation. Secondly, it can help the police to corroborate events. The utility of DNA in terms of its reliability has established it as the gold standard of forensic science.[188] In the UK, the first criminal case utilising DNA as an investigative tool was the case of Colin Pitchfork in 1987.[189] Two teenage girls, Lynda Mann and Dawn Ashworth, were found raped and fatally strangled in 1983 and 1986, respectively. Richard Buckland initially confessed to the murder

[187] QIAGEN, *Investigator® ESSplex SE QS Handbook* (QIAGEN 2015).
[188] Michael Lynch, 'God's Signature: DNA Profiling, the New Gold Standard in Forensic Science' (2003) 27 Endeavour 93.
[189] Butler (n 8); Jobling and Gill (n 7); Colin Dale, 'The Impact of DNA on Criminal Investigation' (2016) 7 Journal of Intellectual Disabilities and Offending Behaviour 105; Ian Cobain, 'Killer Breakthrough – the Day DNA Evidence First Nailed a Murderer' *The Guardian* (7 June 2016) <http://www.theguardian.com/uk-news/2016/jun/07/killer-dna-evidence-genetic-profiling-criminal-investigation> accessed 18 October 2017.

of Ashworth, but DNA fingerprinting of semen samples recovered from the two victims revealed that the same perpetrator committed the offences. The DNA evidence also excluded Buckland as the offender. Leicestershire Constabulary, in collaboration with the FSS, conducted a mass screening of 5000 local males with the aim of identifying the offender via a DNA match. Unfortunately, the operation found no such DNA match. A breakthrough in the case occurred when a colleague of Colin Pitchfork, Ian Kelly, was overheard in a pub proclaiming that he had donated his DNA on Pitchfork's behalf during the mass screen. The police subsequently arrested Pitchfork in 1987 and his DNA matched the crime scene samples. He admitted to the crimes, pled guilty in court, and was sentenced to life imprisonment. This case illustrates how individuals can be identified or excluded as suspects in a crime using DNA.

2.2.1 Additional forensic DNA testing methods and procedures

Other polymorphic DNA analyses are also employed in forensic DNA testing. One method is Y-STR profiling which uses the same method as autosomal STR profiling.[190] The method is based on analysis of the 100s of STRs identified on the Y chromosome. The DYS391 found in the DNA-24 profiling system is a Y-STR marker. This test is not as discriminatory as autosomal STR profiling. The Y chromosome is only found in males and is inherited as a single haplotype block through the paternal lineage. All males with the same paternal lineage have the same Y-STR profile. The Y-STR profiling is useful in alleged rape offences for distinguishing male DNA from female DNA, which tends to dominate in mixed samples.[191] Further, it can be used to confirm the number of perpetrators in cases involving multiple male suspects. Lastly, Y-STR profiling can be used to narrow down suspects in familial searching.

Another type of forensic DNA testing is mitochondrial DNA (mtDNA) analysis.[192] The mtDNA analysis method uses another type of polymorphism called single nucleotide polymorphism (SNP).[193] Although the specific sequence of DNA may have the same sizes,

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[190] MA Jobling, A Pandya and C Tyler-Smith, 'The Y Chromosome in Forensic Analysis and Paternity Testing' (1997) 110 International Journal of Legal Medicine 118; Mountain (n 130); Butler (n 8); Jobling and Gill (n 7); Manfred Kayser, 'Forensic Use of Y-Chromosome DNA: A General Overview' (2017) 136 Human Genetics 621.
[191] Butler (n 8).
[192] Butler (n 8); Jobling and Gill (n 7); Mark R Wilson and others, 'Validation of Mitochondrial DNA Sequencing for Forensic Casework Analysis' (1995) 108 International Journal of Legal Medicine 68.
[193] B Quintáns and others, 'Typing of Mitochondrial DNA Coding Region SNPs of Forensic and Anthropological Interest Using SNaPshot Minisequencing' (2004) 140 Forensic Science International 251;

the base composition may differ due to point mutations[194]. There are variations in the base composition of specific regions of the DNA within and between individuals. Specific regions of the mtDNA called hypervariable (HV) regions demonstrate these characteristics and can be typed for identity testing.[195] The early method used for sequencing the HV regions was the Sanger Sequencing technique.[196] Massively parallel DNA sequencing (MPS) or next-generation DNA sequencing (NGS) techniques have superseded this technique.[197] MtDNA is useful when DNA is highly degraded (for example, DNA extracted from bones) and STR profiling yields inconclusive results. Like Y-STR profiling, the discriminatory power of mtDNA analysis is low since it is a lineage marker. The mtDNA is inherited as a single block from the maternal lineage and all individuals who share the same maternal lineage have the same mtDNA sequence.[198] The mtDNA is not transmitted through the paternal lineage because the mitochondria found in the tail of spermatozoa is dissociated during fertilization in the womb.[199]

The SNP MPS method is also now being applied together with STR typing in autosomal DNA analysis.[200] The advantage of the SNP/STR MPS combination is that both length and sequence polymorphism can be detected, hence improving the discriminatory power of the DNA identity test. Further, where the length polymorphism test is not possible, the MPS method can be employed to identify individuals. One other advantage of the MPS based

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Stephan Köhnemann and Heidi Pfeiffer, 'Application of MtDNA SNP Analysis in Forensic Casework' (2011) 5 Forensic Science International: Genetics 216; Butler (n 8); Mountain (n 130).

[194] i.e. the substitution of the base at a specific DNA site; also referred to as locus

[195] Butler (n 8).

[196] F Sanger, S Nicklen and AR Coulson, 'DNA Sequencing with Chain-Terminating Inhibitors' (1977) 74 Proceedings of the National Academy of Sciences of the United States of America 5463; Wilson and others (n 192); Elizabeth A Lyons and others, 'A High-Throughput Sanger Strategy for Human Mitochondrial Genome Sequencing' (2013) 14 BMC Genomics 881.

[197] Jodi Irwin and others, 'Assessing the Potential of next Generation Sequencing Technologies for Missing Persons Identification Efforts' (2011) 3 Forensic Science International: Genetics Supplement Series e447; Kevin M Kiesler, Katherine B Gettings and Peter M Vallone, 'A Strategy for Characterization of Single Nucleotide Polymorphisms in a Reference Material' (2015) 5 Forensic Science International: Genetics Supplement Series e363; N Gouveia and others, 'Massively Parallel Sequencing of Forensic Samples Using Precision ID MtDNA Whole Genome Panel on the Ion S5™ System' (2017) 6 Forensic Science International: Genetics Supplement Series e167.

[198] Miyuki Sato and Ken Sato, 'Maternal Inheritance of Mitochondrial DNA by Diverse Mechanisms to Eliminate Paternal Mitochondrial DNA' (2013) 1833 Biochimica et Biophysica Acta (BBA) - Molecular Cell Research 1979.

[199] Sato and Sato (n 198).

[200] Butler (n 8); Walther Parson and others, 'Massively Parallel Sequencing of Forensic STRs: Considerations of the DNA Commission of the International Society for Forensic Genetics (ISFG) on Minimal Nomenclature Requirements' (2016) 22 Forensic Science International: Genetics 54; Katherine Butler Gettings and others, 'Sequence Variation of 22 Autosomal STR Loci Detected by next Generation Sequencing' (2016) 21 Forensic Science International: Genetics 15; Claus Børsting and Niels Morling, 'Next Generation Sequencing and Its Applications in Forensic Genetics' (2015) 18 Forensic Science International: Genetics 78.

system is that mRNA (messenger ribonucleic acid), STRs, SNPs and insertion/deletions can be analysed simultaneously.[201]

It is also worth mentioning another developing forensic DNA analysis method called FDP.[202] This technique involves the prediction of physical or phenotypical characteristics of individuals by analysing the genes. Current genetic markers used for this purpose are genes that predict hair, skin and eye colour. FDP can be useful in criminal inquiries where the DNA of a suspect is not available for comparison. The technology seeks to provide intelligence about the biological appearance of the crime scene DNA donor, thereby narrowing down the investigative search.

Other current trends in forensic DNA analysis include the development of Rapid DNA Profiling (RDP).[203] The RDP utilises a portable technology that allows the police or crime scene investigators to analyse DNA at the crime scene. Results can be obtained in approximately 1 hour. In 2016, RDP was approved in the UK following a pilot test of the technology by Police Forces.[204] DNA profiles obtained from the RDP are exported to the NDNAD.

Standard STR profiling is not always possible and modifications of the standard procedure may be required. Two other important procedures are the low copy number (LCN) and DNA mixture analyses. The LCN is the analysis of low quantities of DNA recovered from minute amounts of biological fluids or touched surfaces (containing ~15-30 cells or less than 100-200 picograms of genomic DNA).[205] The analytic procedure for LCN DNA is similar to standard STR analysis with a few modifications to enhance the sensitivity of the profiling test. One approach is to increase the number of PCR cycles from 28 cycles (standard) to 30-34 cycles.[206] Another approach is to modify the parameters of the capillary electrophoresis stage.[207] Other approaches include the purification of the sample after the PCR stage or

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[201] Børsting and Morling (n 200).
[202] Fan Liu and others, 'A Genome-Wide Association Study Identifies Five Loci Influencing Facial Morphology in Europeans' (2012) 8 PLOS Genetics e1002932; Kayser (n 3).
[203] National DNA Database Strategy Board, *Annual Report, 2014 to 2015* (n 78); National DNA Database Strategy Board, *Annual Report 2015 to 2016* (n 78).
[204] National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2015* (n 79); National DNA Database Strategy Board, *Annual Report 2015 to 2016* (n 78).
[205] van Oorschot and Jones (n 7); Butler (n 8); Brian Caddy, Graham R Taylor and Adrian MT Linacre, 'A Review of the Science of Low Template DNA Analysis' (Home Office 2008).
[206] Roland AH van Oorschot, Kaye N Ballantyne and R John Mitchell, 'Forensic Trace DNA: A Review' (2010) 1 Investigative Genetics 14.
[207] Antoinette A Westen and others, 'Higher Capillary Electrophoresis Injection Settings as an Efficient Approach to Increase the Sensitivity of STR Typing' (2009) 54 Journal of Forensic Sciences 591.

reduction of the volume of the PCR sample.[208] LCN DNA can be transferred directly or via secondary and tertiary means.[209] There is also variation in the persistence of LCN DNA on different objects. The transfer and persistence characteristics of LCN DNA and the analytical procedures utilised affect the interpretation and probative value of LCN DNA in criminal investigations.[210]

A DNA mixture occurs when a biological sample has more than one source.[211] This is common in sexual offences, sampling of objects handled by multiple individuals and DNA contamination cases. STR profiling of mixed samples generates an output profile of more than one individual.[212] The analysis of mixtures is more of an interpretation of the DNA results rather than modification of the technical procedure and there are several computer software developed to aid this process.[213] The approaches for mixture interpretation include subtraction of the reference profile from the output profile, peak-height analysis of the electropherogram and residual analysis of profiles to determine the most probable profile of the mixture contributors.[214] These complex approaches can provide investigative leads including the identification or elimination of individuals from a criminal or missing person investigation.[215]

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[208] Michelle L Gaines and others, 'Reduced Volume PCR Amplification Reactions Using the AmpFlSTR Profiler Plus™ Kit' (2002) 47 Journal of forensic sciences 1224; Pamela J Smith and Jack Ballantyne, 'Simplified Low-Copy-Number DNA Analysis by Post-PCR Purification' (2007) 52 Journal of Forensic Sciences 820.
[209] Ignacio Quinones and Barbara Daniel, 'Cell Free DNA as a Component of Forensic Evidence Recovered from Touched Surfaces' (2012) 6 Forensic Science International: Genetics 26; Alex Lowe and others, 'The Propensity of Individuals to Deposit DNA and Secondary Transfer of Low Level DNA from Individuals to Inert Surfaces' (2002) 129 Forensic Science International 25.
[210] Caddy, Taylor and Linacre (n 205); Corina CG Benschop and others, 'Low Template STR Typing: Effect of Replicate Number and Consensus Method on Genotyping Reliability and DNA Database Search Results' (2011) 5 Forensic Science International: Genetics 316; Butler (n 8); Carole McCartney, 'LCN DNA: Proof beyond Reasonable Doubt?' (2008) 9 Nature Reviews Genetics 325.
[211] Frederick R Bieber and others, 'Evaluation of Forensic DNA Mixture Evidence: Protocol for Evaluation, Interpretation, and Statistical Calculations Using the Combined Probability of Inclusion' (2016) 17 BMC Genetics <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5007818/> accessed 15 November 2017; Na Hu and others, 'Current Developments in Forensic Interpretation of Mixed DNA Samples (Review)' (2014) 2 Biomedical Reports 309; Butler (n 5).
[212] Butler (n 5).
[213] Butler (n 5); Mark W Perlin and others, 'Validating TrueAllele® DNA Mixture Interpretation' (2011) 56 Journal of Forensic Sciences 1430; Butler (n 8); Giorgia Tasselli and others, 'Complex DNA Mixture Analysis: Report of Two Cases' (2015) 5 Forensic Science International: Genetics Supplement Series e664.
[214] TM Clayton and others, 'Analysis and Interpretation of Mixed Forensic Stains Using DNA STR Profiling' (1998) 91 Forensic Science International 55; H Haned and others, 'The Predictive Value of the Maximum Likelihood Estimator of the Number of Contributors to a DNA Mixture' (2011) 5 Forensic Science International: Genetics 281; Hinda Haned and others, 'Estimating the Number of Contributors to Forensic DNA Mixtures: Does Maximum Likelihood Perform Better Than Maximum Allele Count?' (2011) 56 Journal of Forensic Sciences 23; P Gill and others, 'Interpreting Simple STR Mixtures Using Allele Peak Areas' (1998) 91 Forensic Science International 41; Butler (n 5).
[215] Tasselli and others (n 213).

This section demonstrated the advancement of technology for forensic DNA analysis. There appears to be a trend towards harmonisation of the technology around the world and a focus on increasing the discriminatory power of profiles. Whilst the reliability of DNA analyses has significantly improved, it is yet to be demonstrated how effective they are in contributing to the overall crime problem.[216] The next sections consider national forensic DNA databases and their development, particularly in the UK but also other selected states around the world.

2.3 National Forensic DNA databases

An important aspect of forensic DNA analyses is the possibility of storing DNA records in searchable electronic databases. The technology creates the potential for the police to identify suspects where there are none known to the police. Further, such databases can help the police to find links between different crime scenes. The retention of DNA records has also helped in verifying the innocence of previously imprisoned individuals through post-conviction DNA testing. Several post-conviction inquiries, particularly in the United States, have led to the freeing of some victims of wrongful conviction.[217]

Forensic DNA databases are commonly built with autosomal STR profiles. 'Criminal' databases based on Y-STR profiling or other polymorphic systems are still in the developmental stage.[218] In addition to the storage of STR profiles, some jurisdictions allow the storage of the physical DNA samples. The process of developing a national forensic DNA database involves:[219]

1. Building a forensic DNA analysis infrastructure: DNA databases are effective when they hold DNA profiles from known individuals and crime scenes. Establishing a DNA database needs investment in the basic infrastructure to collect and process DNA samples for retention in the database. This includes the establishment of laboratory facilities, training of personnel and research as well as ensuring that DNA is collected from scenes of crime and suspects.

[216] Science and Technology Committee, 'Forensic Science Strategy: Fourth Report of Session 2016–17' (House of Commons 2016); Wiles, *Annual Report 2016* (n 26) 10.
[217] P Johnson and R Williams, 'Post-Conviction DNA Testing: The UK's First "Exoneration" Case?' (2004) 44 Science & Justice 77; Margaret A Berger, 'The Impact of DNA Exonerations on the Criminal Justice System' (2006) 34 The Journal of Law, Medicine & Ethics 320.
[218] National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2015* (n 79).
[219] Butler (n 8); ENFSI DNA Working Group, *DNA Database Management Review and Recommendations* (n 31).

2. Establishment of a common set of DNA markers: a standard set of STR loci are required to allow comparison of DNA samples among all participating law enforcement units and to allow genetic information sharing among different jurisdictions (see section 2.2 for established common markers).
3. Creation of an appropriate population database: the current DNA profiling technology targets very few segments of the entire human genome. This implies that DNA profiles cannot be considered 'unique' thus making the interpretation of matching profiles a statistical probability exercise. Population databases provide information about the frequency of each possible STR allele or genotype in a specific population. This ethnic or racial-specific data allows forensic scientists to estimate the random chance of occurrence of a profile in the relevant population. The ENFSI STRidER [220] online database holds available population data from different populations in the world. The database is regularly updated with new information to ensure that RMPs are reliable for use in court.
4. Development of a specific legislative framework: The use of DNA evidence constitutes an infringement of the privacy of individuals thus appropriate legislation is required to ensure that the sampling, retention, use and destruction of DNA records is legal, proportionate, necessary and ethical.
5. Formation of dedicated governance and operational framework for the database: Due to the ethical implications of running a forensic DNA database, proper structures must be in place to keep a high level of public trust, transparency and accountability. In some jurisdictions, law enforcement agencies handle the oversight of the database. Other jurisdictions have set up independent interagency boards including public body representatives to govern the operation of the database. This latter arrangement is perceived as necessary for maintaining public confidence and transparency in Government surveillance and intelligence strategies.
6. Development of database software and secure networked computer system to store, analyse and transfer data: DNA databases store large data that needs software with powerful algorithms for managing profiles, searching and matching data, and calculating match probabilities. To avoid security threats or cyber-attacks, a secure network must be established in the operation of the database. The system must incorporate the CIA (confidentiality, integrity and availability) model for

[220] ENFSI DNA Working Group, 'STRidER 2.0' (n 186).

information security, ensuring that database information is accessible to only the participating law enforcement agencies.

7. Establishment of a quality management system to guarantee the reliability of data fed into the database and results from the database: maintenance of data quality in the operation of DNA databases is critical to ensure that DNA match evidence is admissible in court. This is achieved by ensuring that the forensic DNA data 'supply chain' including individuals follow international quality standards such as ISO/IEC 17025.[221] Compliance with quality standards prevents or reduces errors and database contamination. In addition to international standards, law enforcement agencies or an independent forensic science regulator, depending on the jurisdiction, issue quality assurance standards.

The list of countries with operational national forensic DNA databases as of 2019 is provided in Table 1.1 (Chapter 1). In Europe, five national DNA databases were created within the first five years of the establishment of the NDNAD: Netherlands and Austria in 1997, Germany in 1998, and Finland and Norway in 1999.[222] These early databases shared common STR loci with the SGM markers.[223] Since 2000, the number of national databases in Europe has increased to forty, all sharing common markers in the ESS standard set loci to facilitate the exchange of forensic DNA data. Most European databases run on either a nationally designed or CODIS-based software or both.[224]

The United States of America pioneered the development of national databases in North and South America with the creation of the CODIS national database in 1998.[225] Canada followed with the establishment of the CODIS-based National DNA Data Bank in 2000.[226] The last two decades have seen an emergence of limited CODIS-based national DNA databases in other countries across the Americas, such as, Jamaica (2002),[227] Argentina

[221] ISO, 'ISO/IEC 17025:2005 - General Requirements for the Competence of Testing and Calibration Laboratories' (*International Organization for Standardization*, May 2005) <https://www.iso.org/standard/39883.html> accessed 8 November 2017.
[222] Peter M Schneider, 'DNA Databases for Offender Identification in Europe: The Need for Technical, Legal and Political Harmonization', *Second European Symposium on Human Identification* (Promega Corporation 1998) <https://www.promega.com/~/media/files/resources/conference%20proceedings/ishi%2002/oral%20presentations/11.pdf> accessed 19 October 2017; Martin, Schmitter and Schneider (n 21).
[223] Martin, Schmitter and Schneider (n 21).
[224] INTERPOL DNA Unit, *INTERPOL Global DNA Profiling Survey: Results and Analysis 2008* (ICPO-INTERPOL 2009).
[225] Butler (n 8).
[226] Milot and others (n 181).
[227] INTERPOL DNA Unit (n 224).

(initiated in 2004),[228] Panama (2006),[229] Chile (operational in 2008),[230] Colombia (2008),[231] and Brazil (formalised in 2013/14)[232].

The first database to be established in Asia was the Jordan DNA Database in 2000, followed by Hong Kong (China) and Bahrain in 2001, Kuwait and the United Arab Emirates in 2002, Saudi Arabia in 2003, China and Japan in 2004, and Malaysia in 2005.[233] The number of databases has since increased to seventeen as of 2019. These run on a nationally designed or CODIS-based software.

In Africa, South Africa pioneered the development of national DNA databases by setting up their database in 1997.[234] The second database was established in 2000 by Tunisia. Between 2000 and 2017, the number of operational DNA databases has risen to eight: Egypt and Morocco (2004), Botswana (2006), Mauritius (initiated in 2009), Namibia (2011), and Sudan.[235] The database software utilized is nationally designed, based on CODIS or the South African STRlab.[236]

Lastly in Australasia, the New Zealand DPD was established in 1995 and the Australian National Criminal Investigation DNA Database (NCIDD) became operational in 2001, both running on nationally designed database software.[237]

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[228] GA Penacino, 'Organizing the Argentinean Combined DNA Index System (CODIS)' (2006) 1288 Progress in Forensic Genetics 11Proceedings of the 21st International ISFG Congress held in Ponta Delgada, The Azores, Portugal between 13 and 16 September 2005 780; GA Penacino, 'The New Genetic Database of Argentina' (2008) 1 Forensic Science International: Genetics Supplement Series 658.
[229] INTERPOL DNA Unit (n 224).
[230] Pedro Cayuqueo, 'Gobierno Chileno Impulsa Registro de ADN de Presos Políticos Mapuches' (*América Latina en movimiento*, 28 January 2009) <https://www.alainet.org/es/active/28694> accessed 8 November 2017; FGPI, 'Chile - FDNAPI Wiki' (*Forensic Genetics Policy Initiative*, 2015) <http://dnapolicyinitiative.org/wiki/index.php?title=Chile#cite_note-ftn3-3> accessed 8 November 2017.
[231] INTERPOL DNA Unit (n 224).
[232] RIBPG Management Committee, 'Report of the Integrated Network of Banks of Genetic Profiles (May/2017)' (Management Committee of RIBPG 2017) <http://www.justica.gov.br/sua-seguranca/ribpg/relatorio/vi-relatorio-da-rede-integrada-de-bancos-de-perfis-geneticos-_versao-final.pdf/view>; RIBPG Management Committee, 'Report of the Integrated Network of Banks of Genetic Profiles (November/2014)' (Management Committee of RIBPG 2015) <http://www.justica.gov.br/sua-seguranca/ribpg/relatorio/relatorio_ribpg_nov_2014.pdf/view>.
[233] INTERPOL DNA Unit (n 224).
[234] INTERPOL DNA Unit (n 224).
[235] INTERPOL DNA Unit (n 224); Forensic Genetics Policy Initiative, 'DNA Policy Info by Country' (n 27).
[236] INTERPOL DNA Unit (n 224); FBI National Press Office, 'FBI Brings CODIS Software to Mauritius' (*FBI*, 22 August 2012) <https://www.fbi.gov/news/pressrel/press-releases/fbi-brings-codis-software-to-mauritius> accessed 10 November 2017.
[237] SA Harbison, JF Hamilton and SJ Walsh, 'The New Zealand DNA Databank: Its Development and Significance as a Crime Solving Tool' (2001) 41 Science & Justice 33; INTERPOL DNA Unit (n 224); SallyAnn Harbison and Jo-Anne Bright, 'New Zealand's DNA Profile Databank– Celebrating 20 Years of Success' (Auckland, 2015); Australian Criminal Intelligence Commission, 'National Criminal Investigation DNA Database' (*Australian Criminal Intelligence Commission*, 24 June 2016) <https://www.acic.gov.au/our-

In summary, this section shows a trend towards a continuous establishment of national DNA databases globally. However, it is not yet clear how effective this policing technology is.[238] The next section details the size and composition of the NDNAD, its legislative and governance structure and operational framework. The oldest and/or largest national DNA databases around the world are also discussed and compared to the NDNAD in section 2.5.

2.4 The UK National DNA Database

The size of the UK NDNAD has risen from 42,593 DNA profiles (subject + crime scene) in the 1995/96 fiscal year to more than 7 million profiles as of June 2019.[239] Within the 2001/02 to 2017/18 period, the number of subject load (i.e. the number of reference profiles loaded on the database) and crime scene load (i.e. the number of crime scene profiles) has decreased from 566,026 to 259,099 and 53,235 to 40,078, respectively.[240] The main trigger for subject sampling and inclusion in the NDNAD is an arrest for a recordable offence. The fall in the annual subject profiles has been attributed to an increase in the use of alternatives of arrest, such as, voluntary attendance and a reform of the police bail policy.[241] The decline in the annual crime scene load has been linked to changes in policing priorities and allocation of resources for criminal investigation.[242] Table 2.3 shows the records of the NDNAD as of June 2019. More than 91% of the subject records are profiles from sampled individuals in England and Wales, reflecting the relatively large population of England and Wales. The statistics also indicate that ~14% of the subject profiles are duplicates, representing the difference between the number of individuals and subject profiles held in the database (Table 2.3). The duplicates are due to multiple independent sampling of the same individual with different names.[243]

services/biometric-matching/national-criminal-investigation-dna-database> accessed 12 July 2017; Forensic Genetics Policy Initiative, 'DNA Policy Info by Country' (n 27).

[238] Wiles, *Annual Report 2016* (n 26).

[239] National DNA Database Board, *National DNA Database: Annual Report, 2002 to 2003* (Forensic Science Service 2003); Home Office, 'National DNA Database Statistics: Q1 2019 to 2020' (n 25).

[240] National DNA Database Board, *Annual Report 2002/03* (n 239); FIND Strategy Board, *Annual Report 2017 to 2018* (n 16).

[241] Wiles, *Annual Report 2018: Commissioner for the Retention and Use of Biometric Material* (n 115).

[242] Wiles, *Annual Report 2016* (n 26).

[243] Home Office, 'National DNA Database Statistics: Q1 2019 to 2020' (n 25).

Table 2.3 - Records of the UK NDNAD as of 30th June 2019[244]

	Reference/subject profiles	Number of individuals	Crime scene profiles	Volunteer profiles
All UK law enforcement agencies	6,423,123	5,514,904	631,026	4,182
England and Wales	5,854,247	5,038,468	602,875	2,012

The information associated with subject profiles held in the NDNAD includes the subject's gender, ethnic appearance, and date of birth. The profile record on the NDNAD is linked to corresponding arrest details held on the separate PNC.[245] There is a substantial difference in the number of subject profiles held in the NDNAD for males and females. Whilst males represent ~80% of the total subject profiles for all UK forces and in England and Wales, females represent ~19%.[246] Less than 1% of the subject profiles have no assigned gender. The gender disparity mirrors the fact that males perpetrate a relatively high proportion of crimes.[247] The ethnic composition of subject profiles held on the NDNAD (as assigned by the subjective judgement of police officers) is ~75.5% White North European, ~7.6% Black, ~5.3% Asian, ~2.3% White South European, ~0.8% Middle Eastern, ~0.6% Chinese, Japanese or SE Asian, and ~8% unknown.[248] The age composition is ~99% adults (18 and over) and ~0.6% juveniles (from 10-17 years).[249] A similar ethnic and age composition is observed for data obtained from England and Wales alone.

2.4.1 Legislative framework of the UK (England and Wales) NDNAD

The law governing forensic biometric data in the UK can be categorised as general and specific legislation. The general statutes include the *Data Protection Act 2018 (DPA)*[250] and the *Human Rights Act 1998 (HRA)*[251]. The DPA incorporates the EU General Data Protection

[244] Home Office, 'National DNA Database Statistics: Q1 2019 to 2020' (n 25).
[245] MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80).
[246] Home Office, 'National DNA Database Statistics: Q1 2019 to 2020' (n 25).
[247] Office for National Statistics, 'Overview of Violent Crime and Sexual Offences' (*Office for National Statistics*, 11 February 2016) <https://www.ons.gov.uk/peoplepopulationandcommunity/crimeandjustice/compendium/focusonviolentcrimeandsexualoffences/yearendingmarch2015/chapter1overviewofviolentcrimeandsexualoffences> accessed 13 November 2017.
[248] Home Office, 'National DNA Database Statistics: Q1 2019 to 2020' (n 25).
[249] Home Office, 'National DNA Database Statistics: Q1 2019 to 2020' (n 25).
[250] Data Protection Act 2018.
[251] Human Rights Act.

Regulation 2016 (GDPR)[252] into UK law. Section 205(1) of the DPA defines biometric information as:

> Personal data resulting from specific technical processing relating to the physical, physiological or behavioural characteristics of an individual, which allows or confirms the unique identification of that individual, such as facial images or dactyloscopic data.[253]

Biometric data is described as sensitive information that requires strict regulation for its collection, processing, retention and use. The HRA specifies the rights of individuals and circumstances under which these rights may be limited. The principal right with respect to biometrics is the right to privacy (Article 8 of the Convention).[254] Two principles upheld by the general laws, with respect to the limitation of rights, are the principles of proportionality and necessity in the processing of biometric information.

Part V of PACE established the statutory rules for sampling, retention, use and destruction of DNA for criminal investigation purposes.[255] The initial provisions of PACE classified blood, semen, urine, saliva, pubic hair and swabs of body orifices as intimate samples.[256] Samples taken from other body parts including the nail or under the nail, and 'non-pubic' hair were classified as non-intimate samples.[257] A DNA sample could be collected from suspects only when it was relevant to the investigation of a serious offence.[258] Except for urine and saliva samples, the collection of intimate samples required the authority of a superintendent of police or above, sampling by a registered medical practitioner, and written consent of the individual.[259] Refusal to consent to intimate sampling could be treated as corroborative evidence.[260] The same rules applied to non-intimate samples except that a police officer could take samples.[261] Further, non-consensual sampling was permitted where a person was held in police custody.[262]

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[252] European Parliament and Council of the European Union, 'Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the Protection of Natural Persons with Regard to the Processing of Personal Data and on the Free Movement of Such Data, and Repealing Directive 95/46/EC (General Data Protection Regulation)' (2016) 119 Official Journal of the European Union 1.
[253] Data Protection Act 2018.
[254] Human Rights Act 1998.
[255] Police and Criminal Evidence Act 1984, pt V.
[256] Police and Criminal Evidence Act 1984, s 65.
[257] Police and Criminal Evidence Act 1984, s 65.
[258] Police and Criminal Evidence Act 1984, s 62.
[259] Police and Criminal Evidence Act 1984, s 62.
[260] Police and Criminal Evidence Act 1984, s 62 (10).
[261] Police and Criminal Evidence Act 1984, s 63.
[262] Police and Criminal Evidence Act 1984, s 63.

The initial PACE retention regime permitted indefinite retention of DNA records (both sample and derived information) of convicted individuals and required the destruction of DNA records of 'innocent' individuals on completion of investigation or any proceedings.[263] This regime applied to the limited SLP RFLP-based database established by the FSS in the early 1990s.[264] Following collaborative work between the FSS and the police, and recommendations by the Royal Commission on Criminal Justice,[265] a new database and less restrictive legislation were proposed in 1993. The proposed legislative regime was included in the CJPOA[266] which amended PACE.

The provisions in CJPOA allowed DNA samples to be taken from individuals charged with less serious offences and removed the 'relevance requirement' for sampling.[267] This is because saliva and mouth swab were reclassified as non-intimate samples, allowing non-consensual sampling of individuals by the police.[268] Other changes introduced by CJPOA were the revocation of the evidential use of refusal to consent to intimate sampling and the introduction of speculative searching of all profiles held in the database against other profiles.[269] The provision for deletion and retention of DNA records under PACE was maintained. Additionally, under circumstances where the profile of an innocent individual is retained, it could not be used as evidence or for investigative purposes.[270] Further changes to the DNA legislation was introduced by the *Criminal Evidence (Amendment) Act 1997* which permitted sampling of some individuals held in custody under the *Mental Health Act 1983*.[271]

Following the establishment of the STR-based NDNAD in April 1995, the CJPOA retention regime led to a series of issues including multiple sampling of non-convicted suspects, procedural delays in the destruction of samples/profiles and challenges in court.[272] In the murder case of *R v Weir*,[273] for example, a conviction was secured using DNA match

[263] Police and Criminal Evidence Act 1984, s 64.
[264] Bramley (n 42).
[265] Royal Commission on Criminal Justice, 'The Royal Commission on Criminal Justice: Runciman Report' (Royal Commission on Criminal Justice 1993) <https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/271971/2263.pdf> accessed 14 November 2017.
[266] Criminal Justice and Public Order Act 1994, pt IV.
[267] Criminal Justice and Public Order Act 1994, s 55.
[268] Criminal Justice and Public Order Act 1994, s 58.
[269] Criminal Justice and Public Order Act 1994, ss 56 and 168.
[270] Criminal Justice and Public Order Act 1994, s 57.
[271] Criminal Evidence (Amendment) Act 1997, s 3.
[272] Bramley (n 42).
[273] *R v Weir* [2000] EWCA Crim 43.

intelligence arising from an unlawfully retained subject profile in the NDNAD. The initial conviction was overturned at the Appeal Court due to the unlawful retention of the DNA profile. In another rape case, *R v B*,[274] the defendant was found not guilty because the prosecution relied on an unlawful DNA match intelligence. Such issues generated concerns about public security and the House of Lords ruled that a trial judge should exercise discretion on the admissibility of evidence related to unlawful matches.[275]

The *Criminal Justice and Police Act 2001,* section 82, removed the obligation for the police to destroy DNA records of unconvicted individuals suspected of a recordable offence (i.e. generally an imprisonable offence). Additionally, the law permitted profiles obtained from volunteers with written consent to be speculatively searched on the NDNAD. Volunteers under CJPA could not withdraw consent. Further changes were made by section 10 of the CJA which permitted DNA records of all arrestees of a recordable offence to be retained indefinitely whether convicted or not. The sampling authority was reduced to the rank of Inspector, and a civilian detention officer[276] could take non-intimate samples. The changes in the law paved the way for a significant expansion of the NDNAD. Other additional changes during the expansive DNA retention regime was the use of the NDNAD in cases of missing persons and disaster investigation.[277]

2.4.1.1 S and Marper v the United Kingdom 2008

The expansive regime raised genetic privacy concerns about the retention of DNA from unconvicted individuals. The compatibility of the regime with Article 8 of the Convention was questioned for individuals arrested and charged, but not convicted of a recordable offence. This issue featured in the appeal cases of 'S' and 'Marper' in the UK and the ECHR. In 2001, S, a 12-year-old boy with no previous convictions, and Mr Marper, then 38 years old, were arrested and charged separately with attempted robbery and harassment, respectively. The police legally took their biometric records (fingerprints, DNA samples and profiles) after each was charged with the respective offences. In June 2001, S was acquitted of all charges and Mr Marper's case was discontinued. The law, however, permitted their biometric records to be retained indefinitely despite their lack of criminal convictions. The

[274] *Attorney General's Reference No 3 of 1999* [2000] UKHL 71.
[275] *Attorney General's Reference No. 3 of 1999* (n 274).
[276] Police Reform Act 2002, sch 4 para 31.
[277] Serious Organised Crime and Police Act 2005, s 117 (7).

Chief Constable of South Yorkshire Police denied a request for the destruction of their biometric records.

At the Divisional Court in March 2002, S and Marper challenged the compatibility of the expansive regime with Articles 8 (right to privacy) and 14 of the Convention.[278] Article 14 (prohibition of discrimination) stipulates that:

> The enjoyment of the rights and freedoms set forth in this Convention shall be secured without discrimination on any ground such as sex, race, colour, language, religion, political or other opinion, national or social origin, association with a national minority, property, birth or other status.

Following a critical analysis of the law, the Divisional Court ruled that the indefinite retention of biometric records from charged but unconvicted individuals is justified for public security reasons. The discretionary powers of Chief Constables to retain biometric records was ruled to be proportionate and compatible with Articles 8 and 14 of the Convention. The Court dismissed the application for judicial review.

In September 2002, the judgement was upheld at the Court of Appeal by a majority of 2 (Lord Woolf CJ and Waller LJ) out of 3.[279] Demurring from the majority, Sedley LJ stated that retention of DNA from unconvicted individuals should be dependent on the level of suspicion of the individual. A further appeal to the House of Lords in 2004 was also unsuccessful.[280] A majority of the Law Lords thought that the retention of biometric records does not or may not constitute an interference with privacy. Baroness Hale of Richmond dissented from the majority, noting the retention of DNA and fingerprint data interferes with the right to privacy and requires justification. The Law Lords, however, unanimously 'balanced' the competing interests in favour of public security, establishing the expansive regime as a compatible system with the Convention rights.

The case of *S and Marper* was heard at the ECHR in 2008.[281] The Grand Chamber unanimously held that the expansive regime was disproportionate and incompatible with Article 8. The court emphasised the absence of 'weighty reasons' to support the retention of biometric data from the applicants. The ECHR judgment of incompatibility demanded legal

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[278] *S, R (on the application of) v Chief Constable of South Yorkshire & Anor* [2002] EWHC 478 (Admin).
[279] *R (on the application of S) v Chief Constable of South Yorkshire and R (on the application of Marper) v Chief Constable of South Yorkshire* (n 64).
[280] *R v Chief Constable of South Yorkshire Police (Respondent) ex parte LS (by his mother and litigation friend JB) (FC) (Appellant) and R v Chief Constable of South Yorkshire Police (Respondent) ex parte Marper (FC) (Appellant)* (n 72).
[281] *S and Marper v The United Kingdom* (n 44).

reform so that the law became compliant with the Convention and achieved an appropriate balance between the rights of the individual and the State efforts to maintain law and order.

2.4.1.2 The Crime and Security Act 2010 (CSA)

The initial response of the Labour Government to the *Marper* ruling was to introduce section 14 of the Crime and Security Act 2010 (CSA). The new provisions required that all DNA samples be destroyed after DNA profiling or within 6 months after sampling. DNA profiles of convicted adults and juveniles (under 18) convicted of a serious offence or at least two minor offences were subject to indefinite retention. DNA profiles of juveniles convicted of only one minor offence were subject to 5 years' retention. For unconvicted individuals, the DNA profiles of adults and individuals aged 16 or 17 charged or arrested for a serious offence were subject to 6 years' retention. Whilst the same 6-year retention length applied to adults charged or arrested for a minor crime, a retention length of 3 years applied to juveniles. The retention of DNA profiles of terrorist suspects had a 6 years limit and multiple 2 years extension following a national security determination (NSD) by a Chief Constable. The CSA rules further introduced the withdrawal of consent for the retention of DNA profiles from volunteers.

The CSA retention model was informed by consultations and research carried out by the Jill Dando Institute of Crime Science. The research attempted to determine the risk of re-arrest among unconvicted arrestees, estimated at ~52% in 6 years.[282] The re-arrest rate over a period of 15 years was estimated to be higher in unconvicted arrestees than the general population.[283] The research analysis was heavily criticised primarily because the data relied upon was unclear.[284] Due to a change in government, the CSA regime was never brought into force. Instead, PoFA was drafted by the subsequent Coalition Government to govern DNA and fingerprint data retention in England and Wales.[285]

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[282] Home Office, *Keeping the Right People on the DNA Database: Science and Public Protection* (n 47).
[283] Home Office, *Keeping the Right People on the DNA Database: Science and Public Protection* (n 47).
[284] McCartney, 'Of Weighty Reasons and Indiscriminate Blankets' (n 44).
[285] Home Office, 'Protection of Freedoms Act 2012: How DNA and Fingerprint Evidence Is Protected in Law' (*GOV.UK*, 4 April 2013) <https://www.gov.uk/government/publications/protection-of-freedoms-act-2012-dna-and-fingerprint-provisions/protection-of-freedoms-act-2012-how-dna-and-fingerprint-evidence-is-protected-in-law> accessed 8 October 2016.

2.4.1.3 The Protection of Freedoms Act 2012 (PoFA)

The current legislative regime governing the NDNAD is the Protection of Freedoms Act 2012.[286] Like the CSA rules, the new biometric regime requires the destruction of DNA samples after profiling or within 6 months of collection. This recognises the sensitivity of the information that can 'theoretically'[287] be obtained from the DNA sample. Section 2 of PoFA generally permits DNA data retention until the conclusion of investigation or any proceedings. The continued retention of DNA profiles of individuals arrested or charged with a minor offence, but unconvicted – is unlawful.[288] For all convicted individuals (including cautions and warnings), DNA profiles can be retained indefinitely in the NDNAD.[289] The only exception is the DNA profiles of juveniles convicted of a first minor offence with a sentence of fewer than 5 years. These are subject to 5 years' data retention plus the duration of their sentence.[290]

A 'qualifying offence' is a legal term that describes offences that are serious including murder, sexual or violent crime, terrorist offences or burglary.[291] Under the PoFA regime, the DNA profile of individuals arrested or charged with a qualifying offence is subject to 3 years' retention, even if they remain unconvicted.[292] This rule applies where the individual has no prior criminal record. For the unconvicted arrestees, this 3-year retention period is subject to the approval of a Biometrics Commissioner. On the expiry of the 3-year period, retention can be extended for 2 years with the consent of a District Judge. Other retention categories set out in the new law are individuals issued with a penalty notice for disorder (PND) and cases where an NSD has been made. Both PND and NSD cases are subject to 2 years' biometric data retention.[293] The latter can be renewed continuously.

Further changes to the PoFA regime were introduced by the Anti-Social Behaviour, Crime and Policing Act 2014 (ASBCPA) and the Policing and Crime Act 2017 (PCA). Section 144 of the ASBCPA permits non-consensual resampling upon data deletion. Initially, PoFA

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[286] Protection of Freedoms Act 2012, pt 1.
[287] Further analysis of DNA samples can predict the health status of an individual and their biological relatives. Other concerns about the sensitivity of DNA samples is the possibility of predicting behavioural characteristics of an individual. Currently, forensic DNA profiling does not provide or infer such private information.
[288] Protection of Freedoms Act 2012, ss 1 and 4.
[289] Protection of Freedoms Act 2012, s 5.
[290] Protection of Freedoms Act 2012, s 7.
[291] Police and Criminal Evidence Act 1984, s 65A.
[292] Protection of Freedoms Act 2012, s 3.
[293] Protection of Freedoms Act 2012, ss 8 and 9.

required a causal relationship between the taking of DNA (sampling arrest) and any charge or conviction before data retention.[294] Section 145 of ASBCPA removed this requirement, allowing a sample taken in one offence to be used for another offence.

Section 70 of the PCA provided for the retention of biometric data taken from an unrelated arrest of an individual who has a criminal record outside England and Wales. Individuals who fall under this retention category are subject to PoFA rules and the scope of sampling applies to all offences equivalent to a recordable offence under English and Welsh law.

Analysis of the legislative framework in this section reveals the contrast in the interpretation of proportionality by successive governments and the courts. The result of this challenge is the implementation of arbitrary retention regimes for the NDNAD. The implementation and impact of the current PoFA regime are discussed in Chapter 3. The next section details the governance and operational structure of the NDNAD.

2.4.2 Governance and operational framework of the NDNAD

On the establishment of the NDNAD in 1995, an NDNAD User Board (NUB) was constituted to oversee its operation.[295] The NUB comprised representatives of the Association of Chief Police Officers (ACPO) and FSS. The FSS held the Custodianship position for the NDNAD. The Custodian's role was to set standards, provide accreditation and carry out compliance checks on laboratories involved in the processing of DNA for the database.[296] To be accredited as a forensic DNA supplier, laboratories must receive independent accreditation from the United Kingdom Accreditation Service (UKAS) based on ISO/IEC 17025.[297] Additionally, the Custodian established a proficiency-testing programme and quality standards review for laboratories. This process served as a check to ensure that quality standards recommended by the ENFSI DWG are maintained.[298] Another

[294] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76); National DNA Database Strategy Board, *Annual Report, 2013 to 2014* (n 78); National DNA Database Strategy Board, *Annual Report, 2014 to 2015* (n 78).
[295] National DNA Database Board, *National DNA Database: Annual Report, 2003 to 2004* (Forensic Science Service 2004); Bramley (n 42).
[296] National DNA Database Board, *Annual Report 2002/03* (n 239).
[297] National DNA Database Board, *Annual Report 2002/03* (n 239); United Kingdom Accreditation Service, 'Lab 32: Accreditation for Suppliers to the UK National DNA Database' (UKAS 2018) Issue 5.
[298] National DNA Database Board, *Annual Report 2002/03* (n 239); Bramley (n 42).

role of the Custodian is to ensure that information held in the NDNAD is linked to arrest, sampling and demographic records held on the PNC.[299]

Prior to 2003, the NUB was transformed into the NDNAD Board comprising representatives of the Home Office, ACPO, police forces, ACPO Scotland, the Custodian, and the FSS. The Chairmanship of the Board was held by ACPO. In addition to its oversight function, the Board was responsible for the strategic development of the database. Significant changes to the membership of the Board was brought about following criticism and recommendations by the Science and Technology Select Committee (House of Lords) in 2001 and the Human Genetics Commission (HGC) in 2002.[300] Both bodies called for an independent Board that includes lay members. A separate research ethics group was also proposed by HGC to scrutinize research involving the NDNAD.

The NDNAD Board was reconstituted in 2003 with the previous membership and a representative of the HGC. The first annual report of the Board was also published in the same year.[301] As part of the response to form an independent governing body for the NDNAD, the Custodianship was initially held by the FSS 'independent' Chief Scientist. In 2005, the NDNAD Board became the NDNAD Strategy Board with three core members: ACPO, Home Office and the Association of Police Authorities (APA).[302] The Custodianship role was then transferred to the Home Office following the privatisation of the FSS in December 2005.[303] In 2007, the National Policing Improvement Agency (NPIA) took over the Custodianship of the database and the NDNAD Ethics Group was formed to oversee the ethical aspects of the database.[304] The Custodian, representatives of HGC, NPIA, ACPO Scotland, the Ethics Group, Information Commissioners Office (ICO), the Forensic Science Regulator (formed in 2008), the police and administration in Scotland and Northern Ireland became non-voting members of the Strategy Board. The new arrangements excluded police

[299] National DNA Database Board, *Annual Report 2002/03* (n 239); National DNA Database Strategy Board, *National DNA Database: Annual Report, 2005 to 2006* (NDNAD Strategy Board 2006).
[300] House of Lords Select Committee on Science and Technology, *Human Genetic Databases: Challenges and Opportunities* (HL 2001); Human Genetics Commission, 'Inside Information: Balancing Interests in the Use of Personal Genetic Data' (Human Genetics Commission 2002).
[301] National DNA Database Board, *Annual Report 2002/03* (n 239).
[302] National DNA Database Board, *National DNA Database: Annual Report, 2004 to 2005* (NDNAD Board 2006).
[303] National DNA Database Strategy Board, *National DNA Database: Annual Report, 2005 to 2006* (n 299).
[304] National DNA Database Strategy Board, *National DNA Database: Annual Report, 2006 to 2007* (NDNAD Strategy Board 2012).

forces and DNA laboratories as members of the Board. This ensured a level of independence of the governance structure from users of the database.

The last seven years have seen significant changes in the governance and operation of the database. In the 2012/13 fiscal year, the operation of the database was transferred from the NPIA to the Home Office.[305] The Forensic Information Database Service (FINDS) of the Home Office operates the database.[306] Another significant change is the establishment of the Strategy Board and the Biometrics Commissioner as statutory bodies responsible for the oversight of the database. The statutory role of the Strategy Board is provided in section 24 of PoFA, being required by law to provide guidance on the retention and destruction of DNA profiles, governance rules for the database, and to produce an annual report about the exercise of its functions. The Strategy Board is comprised of the National Police Chiefs' Council [307] (NPCC), the Home Office and the Association of Police and Crime Commissioners[308] (APCC) as core members.[309] The NDNAD Strategy Board continues to run independently from direct users of the database.

The statutory functions of the Biometrics Commissioner are set out under sections 20 and 21 of PoFA. The Commissioner's role is to keep under review the retention and use of biometric records and to produce an annual report of its functions. The Biometrics Commissioner is a non-voting member of the Strategy Board. Other changes include the transformation of the NDNAD Ethics Group to the Biometrics and Forensics Ethics Group.[310] The Ethics Group operates on a non-statutory basis and its ethical oversight now covers the operation of the NDNAD and other forensic biometrics, such as, fingerprints and facial images. The Ethics Group also produces an annual report about its work and makes recommendations.

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[305] National DNA Database Strategy Board, *National DNA Database: Annual Report, 2012 to 2013* (NDNAD Strategy Board 2013).
[306] FIND Strategy Board, *Annual Report 2017 to 2018* (n 16).
[307] Formerly Association of Chief Police Officers (ACPO)
[308] Formerly Association of Police Authorities (APA)
[309] Home Office, *Governance Rules for the National DNA Database Strategy Board.* (Home Office 2014); 'National DNA Database Strategy Board' (*GOV.UK*) <https://www.gov.uk/government/groups/national-dna-database-strategy-board> accessed 26 October 2017.
[310] Home Office, 'Biometrics and Forensics Ethics Group Terms of Reference, Code of Practice & Working Protocol' (Home Office 2017).

2.5 International comparison of forensic DNA databases

Forensic DNA databasing has become a common technology in policing within the past two and a half decades. More than 94 countries have fully implemented an operational database or are developing legislation to establish one (see Chapter 1). There are significant differences in the legal, governance and operational framework governing databases across the world and in different jurisdictions within a single country. These differences have been noted as a setback in realising the full potential of DNA databases in protecting the public and enhancing national or international collaboration between different law enforcement agencies.[311] This section employs the traditional comparative research method to review selected database systems around the world.[312] The approach follows four general steps: 1) preliminary considerations – identification of research aim and choice of systems; 2) description of the systems; 3) comparison; and 4) critical evaluation.[313] The aim of the analysis was to gain insight into how the oldest and/or largest DNA databases are implemented across different continents and how they compare with the England and Wales regime. This is relevant to the research aims because it identifies practices that may inform the local reforms proposed in this research. The basis of the comparison is the shared purpose of forensic DNA databases in assisting the justice system to resolve legal issues.

2.5.1 Europe

Europe currently leads in the number of national DNA databases per continent. The region also operates the largest network of national DNA databases.[314] Due to these reasons, Europe was analysed as a whole. There are more than 13.5 million reference profiles and 2 million crime scene profiles in European DNA databases.[315] Over 2.7 million reference-to-crime scene profile matches and 0.6 million crime scene-to-crime scene matches are estimated from these databases.[316] The reference match rate (i.e. number of reference-to-crime scene matches per total number of reference profiles) is estimated at 24%.[317] The UK (England and Wales) holds the largest proportion of all profiles in European national

[311] Oriola Sallavaci, 'Cross Border Exchange of Forensic DNA and Human Rights Protection' (2015) 5 Forensic Science International: Genetics Supplement Series e86.
[312] Alan Bryman, *Social Research Methods* (5th edn, Oxford University Press 2016); Mathias Siems, *Comparative Law* (Cambridge University Press 2018).
[313] Siems (n 312).
[314] Victor Toom, *Cross-Border Exchange and Comparison of Forensic DNA Data in the Context of the Prüm Decision* (European Parliament 2018).
[315] INTERPOL, 'Global DNA Profiling Survey Results 2016' (n 24); ENFSI (n 24).
[316] ENFSI (n 24).
[317] ENFSI (n 24).

databases, more than 47% of reference profiles and 30% of crime scene profiles.[318] In 2016, the reference match rate of the UK NDNAD (44%) was estimated to be higher than other European national databases.[319] This suggests the NDNAD may be more representative of the active or previously active criminal population than other European DNA databases. The match rate statistics and the size of the UK database reflect the differences in the regime governing the national databases across Europe.[320]

The establishment of a compatible national DNA database was recommended for the Member States of the EU in 1997.[321] The EU Prüm Decision of 2008 requires all EU Member States to create a national DNA database.[322] All the 28 States of the EU (including the UK) currently have an operational national DNA database.[323] The custodianship of EU national databases is held by either law enforcement agencies or independent departments under the interior (Home Office, UK) or justice ministry. The EU legal framework for forensic DNA databasing generally provides that:

i. DNA samples and profiles are personal data and hence should be subject to national data protection legislation derived from the European Data Protection Directive 95/46[324] and standards of data protection set out in the Data Protection Convention 1981 and Recommendation No. R (87) 15 1987[325].
ii. National DNA databases should be governed by specific national legislation that prescribes the conditions for the taking, retention, use, destruction and sharing of DNA records. The national legislation should take into consideration the principles and recommendations set out in Recommendation No. R (92) 1 1992.[326]
iii. Public security safeguards and human right protections of data subjects should be consistent with the European Convention on Human Rights and rulings on the interpretation of the Convention at the European Court of Human Rights (for

[318] Home Office, 'National DNA Database Statistics: Q1 2019 to 2020' (n 25).
[319] ENFSI (n 24).
[320] Santos, Machado and Silva (n 29).
[321] Council of the European Union, 'Council Resolution of 9 June 1997 on the Exchange of DNA Analysis Results' (1997) C 193 Official Journal of the European Communities 2.
[322] Council of the European Union, 'Council Decision 2008/615/JHA of 23 June 2008 on the Stepping up of Cross-Border Cooperation, Particularly in Combating Terrorism and Cross-Border Crime' (2008) L 210 Official Journal of the European Union 1.
[323] ENFSI (n 24); Forensic Genetics Policy Initiative, 'DNA Policy Info by Country' (n 27).
[324] Now superseded by the GDPR. See European Parliament and Council of the European Union (n 252).
[325] Committee of Ministers, 'Recommendation No. R(87) 15 to the Member States on Regulating the Use of Personal Data in the Police Sector' (1987) I.22 668 Council of Europe 1.
[326] Committee of Ministers, 'Recommendation No. R (92) 1 of the Committee of Ministers to Member States on the Use of Analysis of Deoxyribonucleic Acid (DNA) within the Framework of the Criminal Justice System' (1992) I 25 899 Council of Europe 1.

example, the case of *S & Marper v the United Kingdom [2008] ECHR 1581,* and the case of *Aycaguer v France [2017] ECHR 587*).

The goal of EU DNA legislation is to ensure consistency and compatibility in the operation of DNA databases to facilitate cross-border cooperation.[327] Whilst there has been significant progress, the operation of databases differs across the EU States. The sampling regime can be divided into four categories: those that allow sampling on arrest or detention, on charge (i.e. suspect), conviction, and on specific judicial order. The inclusion/retention regime ranges from indefinite to fixed retention based on conviction, type of offence, sentence, and age. Most EU countries run a system combining the different sampling and retention criteria.[328] Compared to the United Kingdom, most EU national databases include data from only convicted individuals and those suspected of serious offences. This partly explains the large size of the UK NDNAD. All national databases are used to compare crime scene and reference profiles to assist in the identification of individuals involved in a crime and to link different crimes. Some databases are also used for identification purposes in cases of mass disaster and missing person inquiries. Following the *Marper* ruling in 2008, DNA records from individuals with no criminal conviction are required to be destroyed after fulfilling its purpose or on expiry of any stipulated retention period. Unlike the UK where data from most convicted individuals are subject to indefinite retention, most EU States require data from convicted individuals to be destroyed after a fixed retention period (i.e. where indefinite retention is prohibited).[329]

2.5.2 North and South America: United States

DNA databasing in the United States has a distinct framework compared to the UK system. The CODIS database operates on a three-tier system: National DNA Index (NDIS), State DNA Index (SDIS) and Local DNA Index (LDIS) systems. The NDIS operates at the national level and includes data from all the 50 states, the District of Columbia, the federal

[327] Santos (n 32); Council of the European Union, 'Council Resolution of 9 June 1997' (n 321); Council of the European Union, 'Council Decision 2008/615/JHA of 23 June 2008 on the Stepping up of Cross-Border Cooperation, Particularly in Combating Terrorism and Cross-Border Crime' (n 322); Council of the European Union, 'Council Resolution of 25 June 2001 on the Exchange of DNA Analysis Results' (2001) C 187 Official Journal of the European Communities 1.
[328] Santos, Machado and Silva (n 29); Chris Asplen, 'ENFSI Survey on the DNA Profile Inclusion, Removal, and Retention of Member State's Forensic DNA Database' <http://enfsi.eu/wp-content/uploads/2016/09/enfsi_report_on_dna_legislation_in_europe_0.pdf> accessed 19 February 2018; Marjanović and others (n 15); Forensic Genetics Policy Initiative, 'DNA Policy Info by Country' (n 27).
[329] Santos, Machado and Silva (n 29).

government, the U.S. Army Criminal Investigation Laboratory, and Puerto Rico.[330] The SDIS operates at the State level and the LDIS at the local level. The flow of DNA profile information is from the LDIS to the SDIS and then to the NDIS, which is operated by the FBI Laboratory.[331] Unlike the UK NDNAD, different information categories (indices) exist within the CODIS system, such as, the convicted offender, arrestee and forensic (crime scene) indices, and other information categories for missing persons. When measured by the number of profiles retained, the NDIS is the second largest database in the world. As of July 2019, the NDIS held more than 17.5 million reference profiles.[332] About 79% of these profiles are from convicted and detained individuals, and profiles marked as 'legal profiles'. The other reference profiles (~21%) are from arrestees. The number of crime scene profiles held on NDIS was about 0.95 million. The performance of the NDIS is measured by counting the number of investigations aided by DNA matches/hits.[333] The match count of the NDIS was about 0.48 million matches as of July 2019.[334] These matches contributed to about 0.47 million investigations.

Compared to the UK NDNAD, the information linked to subject profiles on the NDIS is limited to the identifier of the laboratory that submitted the profile, the DNA sample, and the DNA analyst.[335] No names, personal demographic data or criminal record information of the subject are stored on the NDIS.[336] The only exception applies to the missing persons' database within NDIS, where personal information, such as, the date of birth of the subject may be stored.[337]

The legal framework for DNA databasing in the United States is based on federal and state laws. The DNA Identification Act 1994 (DIA) provided the legal authority for the establishment of the NDIS. At the federal level, the inclusion criteria initially covered individuals convicted of specified federal offences including terrorism and crimes of violence.[338] The scope of sampling and inclusion on NDIS was progressively expanded to

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[330] FBI, 'CODIS - NDIS Statistics as of July 2019' (n 25).
[331] Butler (n 8).
[332] FBI, 'CODIS - NDIS Statistics as of July 2019' (n 25).
[333] FBI, 'CODIS and NDIS Fact Sheet' (*Federal Bureau of Investigation*, 2018) <https://www.fbi.gov/services/laboratory/biometric-analysis/codis/codis-and-ndis-fact-sheet> accessed 8 February 2018.
[334] FBI, 'CODIS - NDIS Statistics as of July 2019' (n 25).
[335] FBI, 'CODIS and NDIS Fact Sheet' (n 333).
[336] Butler (n 8).
[337] FBI, 'CODIS and NDIS Fact Sheet' (n 333).
[338] DNA Analysis Backlog Elimination Act 2000; USA Patriot Act 2001.

indicted persons,[339] all convicted individuals, arrestees and detained foreigners.[340] The circumstances under which DNA data is deleted from the NDIS and other databases include when a conviction is overturned and when the case of an arrestee results in acquittal or the case is discontinued.[341] At the state level, the inclusion criteria differ considerably. The minimum provision in all the 50 states is the inclusion of DNA records from convicted individuals. However, this requirement applies to specific offences that vary by state. Whilst some states require the inclusion of data from some arrestees, others limit databasing to convicted individuals. In the case of *Maryland v King,*[342] the United States Supreme Court, by a majority of 5 to 4, ruled that sampling an individual arrested for a serious offence and including their DNA records in a state's database is proportionate for the purposes of public security. No infringement of the privacy provisions of the Fourth Amendment was found by the '*King* majority'. This ruling, as well as public campaigns, has been considered as a gateway for the expansion of DNA databasing in the United States.[343]

A multi-agency board at the federal, state and local levels governs the operation of the NDIS. The NDIS Procedures Board, set up by the FBI, provides operational procedures for the database.[344] The Board is made up of representatives from the FBI, selected state and local laboratories, and the Scientific Working Group on DNA Analysis Methods (SWGDAM). The SWGDAM took over the responsibilities of the former DNA Advisory Board established by the DIA in 2000.[345] The working group is responsible for setting up quality assurance standards for DNA analysis and databasing.[346] Unlike the current governance arrangement of the UK NDNAD, the custodianship/management of the NDIS is held within a law enforcement agency, the FBI Laboratory CODIS Unit, with the support of the NDIS Board.[347]

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[339] Justice for All Act 2004.
[340] DNA Fingerprint Act 2005.
[341] FBI, 'CODIS and NDIS Fact Sheet' (n 333).
[342] *Maryland v King* [2013] USSC 12–207.
[343] Andrea Roth, 'Maryland v. King and the Wonderful, Horrible DNA Revolution in Law Enforcement' (2013) 11 Ohio State Journal of Criminal Law 295; Greg Brower and Norman Reimer, 'Maryland v. King: Possibly the Most Important Criminal Procedure Case in Decades' (2013) 14 Engage 29; David H Kaye, 'Why So Contrived? Fourth Amendment Balancing, Per Se Rules, and DNA Databases after Maryland v. King' (2014) 104 Journal of Criminal Law and Criminology 535.
[344] FBI Laboratory, *National DNA Index System (NDIS) Operational Procedures Manual* (FBI Laboratory 2017).
[345] Butler (n 8).
[346] SWGDAM, 'History of Scientific Working Group on DNA Analysis Methods (SWGDAM)' (*Scientific Working Group on DNA Analysis Methods (SWGDAM)*) <https://www.swgdam.org/about-us> accessed 26 February 2018; FBI, 'Combined DNA Index System (CODIS)' (n 181).
[347] Butler (n 8); FBI, 'Combined DNA Index System (CODIS)' (n 181).

2.5.3 Asia: China

There is limited literature on DNA databasing in China available in the English language. Most publications included in this section were thus originally in Mandarin and were translated using Google Translate and then checked with the assistance of PhD researchers proficient in the Mandarin language. The Chinese national DNA database is the largest forensic DNA database in the world.[348] The proportion of the Chinese population in the database is ~3% (less than the UK (~8%) and the US (~5%)). However, the current trend towards an expansive model of DNA databasing may increase the proportion of citizens on the database. As of May 2016, the database held more than 44 million DNA records of which 40.7 million were from individuals with criminal records and 1.5 million were from crime scenes.[349] A separate database for the investigation of human trafficking cases held about 0.5 million DNA records. The number of hits generated by the national database[350] was about 4.4 million as of May 2016.[351] The separate 'trafficking' database contributed to the identification of 4,265 missing children. The management or custodianship of the national database is under the Ministry of Public Security, the main law enforcement department in China.[352] Like the United States system, the operational model of DNA databasing in China involves three tiers: ministry, province and prefectural or county level. The local databases (~400) are linked together within the Ministry of Public Security's database system.[353] In 2013, Sheng[354] reported several key challenges in realizing the full potential of the Chinese database including issues with standardization of laboratories and quality assurance, data security, and a gap between data processing capacity and demands of service delivery.

The inclusion and retention regime governing the Chinese DNA database covers convicted individuals and crime suspects.[355] Article 130 of the Criminal Procedure Law of the People's Republic of China (as amended on 14 March 2012) allows consensual and non-consensual sampling of individuals connected to crime. However, there are reported cases where individuals who are not involved in any crime, such as passport applicants, have been

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[348] Jianye Ge and others, 'Future Directions of Forensic DNA Databases' (2014) 55 Croatian Medical Journal 163.
[349] Baichuan, Jianxiong and Bing (n 25).
[350] The database was established in 2004
[351] Baichuan, Jianxiong and Bing (n 25).
[352] Li Sheng, 'Thinking about the Construction of Next Generation DNA Database' (2013) 38 Forensic Science and Technology 49.
[353] Sheng (n 352).
[354] Sheng (n 352).
[355] Ministry of Public Security, *法庭科学 DNA 数据库建设规范 GA/T418—2003* (MPS 2003) <http://doc.mbalib.com/view/a114bddce06eeb3474cf3baff5c434aa.html>.

sampled for inclusion in local databases.[356] Compared to the UK, Europe and the US, the legal framework governing the Chinese DNA database(s) is thought to be inadequate and lacks privacy safeguards for the innocent.[357] There are limited statutory rules on the period of retention, use and sharing of DNA information and rights of individuals subjected to DNA sampling.[358]

2.5.4 Africa: South Africa

Forensic DNA databasing commenced in South Africa (SA) within two years of the establishment of the UK NDNAD. However, DNA database legislation, the *Criminal Law (Forensic Procedures) Amendment Act 37* (CLFPA), was developed in 2013 and implemented from 1st January 2015.[359] As of March 2018, the South African National Forensic DNA Database (NFDD) held more than 1 million DNA profiles of which 0.4 million were from the Crime Scene Index, 0.5 million from Arrestee Index, 0.026 million from Elimination Index, 0.007 million from Investigative Index, 0.067 million from the Convicted Offenders Index, and 0.011 million from Missing Persons Index.[360] Over 47% of the DNA profiles were added to the NFDD following the implementation of the DNA Act.[361] The estimated investigative leads resulting from a search of the NFDD is about 0.024 million for known suspects and 0.011 million for unknown suspects as of March 2018.[362]

The type of information linked to DNA records on the NFDD excludes appearance, medical, historical and behavioural information of the data subject.[363] Unlike the UK, the time window to destroy DNA samples collected from individuals is within 3 months after obtaining a DNA profile and its later inclusion in the NFDD.[364] The legislative regime for

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[356] Human Rights Watch (n 25); Wenxin Fan, Natasha Khan and Liza Lin, 'China Snares Innocent and Guilty Alike to Build World's Biggest DNA Database' *Wall Street Journal* (27 December 2017) <https://www.wsj.com/articles/china-snares-innocent-and-guilty-alike-to-build-worlds-biggest-dna-database-1514310353> accessed 27 February 2018.
[357] Chen Yumei, 'On Legal Protection of Genetic Privacy of DNA Databases in China' [2015] Hunan Social Science 84; Fan, Khan and Lin (n 356); Human Rights Watch (n 25).
[358] Yumei (n 357); Human Rights Watch (n 25); David Cyranoski, 'China Expands DNA Data Grab in Troubled Western Region' (2017) 545 Nature News 395.
[359] Criminal Law (Forensic Procedures) Amendment Act No. 37 2013; Police Committee, 'DNA Board on Its 2015/16 Annual Report' (*Parliamentary Monitoring Group (PMG)*, 23 November 2016) <https://pmg.org.za/committee-meeting/23726/> accessed 12 March 2018.
[360] National Forensic Oversight and Ethics Board, 'Annual Report 2017/18' (NFOEB 2018).
[361] National Forensic Oversight and Ethics Board, 'Annual Report of the National Forensic Oversight and Ethics Board for the Period: 1 April 2015 - 31 March 2016; and Progress Report for the Period: 1 April 2016 - 16 November 2016' (NFOEB 2016).
[362] National Forensic Oversight and Ethics Board (n 360).
[363] Criminal Law (Forensic Procedures) Amendment Act No. 37 2013, s 6.
[364] Criminal Law (Forensic Procedures) Amendment Act No. 37 2013, s 6.

the NFDD supports the indefinite retention of DNA profiles from individuals convicted of a Schedule 8 offence (mainly serious offences including theft).[365] The DNA profiles of adults and children arrested for a Schedule 8 offence are subject to 3 years and 12 months retention, respectively. Profiles retained in the Investigative Index (i.e. individuals who are of interest in an investigation) are subject to a retention period of 3 months after the conclusion of the investigation. DNA profiles on the Elimination and Missing Persons Indices are required to be deleted after fulfilling their purpose.

Compared to the UK NDNAD, the custodianship of the NFDD is held by the Forensic Science Division of the South African Police Service (SAPS).[366] The custodian develops and recommends quality management standards for forensic DNA analysis and the operation of the NFDD. The National Commissioner of SAPS has a statutory role to manage and set standards on data access and security of the NFDD.[367] The Secretary of Police under the Ministry of Police oversees and monitors the role of the National Commissioner regarding the NFDD. Section 6 of the CLFPA established the National Forensic Oversight and Ethics Board (NFOEB) who oversee the implementation of the DNA regime. Generally, the statutory roles of the NFOEB share significant similarities with the roles of the Strategy Board, the Ethics Group and the Biometrics Commissioner for the UK NDNAD (section 2.4.2). The CLFPA allows a membership of up to ten in the NFOEB and requires half of the members to be individuals outside the public sector, a retired judge or senior advocate as Chair of the Board, and a representative each from the Secretary of Police, Department of Health, Department of Justice and Constitutional Development and Department of Correctional Services.[368]

Whilst there are some considerable differences between the SA NFDD and the UK NDNAD systems, the legislative regime in both countries share similar features. In the 2008 *Marper ruling*, the Scottish legislative regime was considered to be consistent with principles set out in Recommendation No. R(92)1,[369] which recommends different inclusion/retention criteria for different types of cases. The PoFA regime was developed based on the Scottish model.

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[365] Criminal Law (Forensic Procedures) Amendment Act No. 37 2013; DNA Project, 'Summary: Criminal Law (Forensic Procedure) Amendment Act 37 of 2013' <http://dnaproject.co.za/legislation-homepage/legislation/dna-act-summary>.
[366] Criminal Law (Forensic Procedures) Amendment Act No. 37 2013; DNA Project (n 365).
[367] Criminal Law (Forensic Procedures) Amendment Act No. 37 2013, s 6.
[368] National Forensic Oversight and Ethics Board (n 361).
[369] Committee of Ministers (n 326).

According to the DNA Project,[370] the CLFPA regime ensures an adequate balance between public security and the civil liberty rights of individuals. However, there are concerns about safeguards on confidentiality of possible sensitive genetic information such as chromosomal abnormalities linked to forensic DNA profiles.[371]

2.5.5 Australasia: Australia and New Zealand

2.5.5.1 Australia

The largest database in Australasia is the NCIDD of Australia. According to the Australian Criminal Intelligence Commission (ACIC), the NCIDD holds over 1.22 million DNA profiles.[372] The NCIDD stores profiles from convicted individuals, suspects, missing or deceased persons, volunteers and crime scenes.[373] Profiles from these categories of individuals are organised as separate indices in the NCIDD. Within the 2017/18 period, the NCIDD recorded 0.089 million reference-to-crime scene matches and 0.029 million crime scene-to-crime scene matches.[374] Like the US and South African systems, there is a level of dissociation between DNA profiles and personal information of data subjects on the NCIDD.[375] Names, date of birth, address and information related to appearance are not recorded on the NCIDD.[376] The process of identifying matched subjects is managed separately. In addition to the NCIDD which operates at the national or federal level, the six states and two territories in Australia maintain their own DNA database with some differences in DNA legislation. Full participation of all jurisdictions in the NCIDD was achieved in 2009. However, the differences in state/territory DNA legislation has been highlighted as a set-back in maximizing the utility of the NCIDD. Reviews into the legal framework of the NCIDD have recommended reforms to achieve some level of harmonisation in legislation.[377]

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[370] DNA Project, 'A New DNA Act' (*DNA Project - South Africa*) <http://dnaproject.co.za/legislation-homepage/legislation/a-new-dna-act> accessed 13 March 2018.
[371] Laura J Heathfield, 'Policy Required for Entry of DNA Profiles onto the National Forensic DNA Database of South Africa' (2014) 110 South African Journal of Science 1.
[372] Australian Criminal Intelligence Commission, *2017-18 Annual Report* (ACIC 2018).
[373] Crimes Act 1914, pt ID.
[374] Australian Criminal Intelligence Commission, *2017-18 Annual Report* (n 372).
[375] CRIMTRAC, *Annual Report 2006-07* (CRIMTRAC 2007).
[376] CRIMTRAC (n 375); Peter Ford, 'DNA Forensic Procedures: Further Independent Review of Part 1D of the Crimes Act 1914' (Forensic Procedures Review Committee 2010).
[377] Peter Ford, 'Discussion Paper: Further Independent Review of Part 1D of the Crimes Act 1914' (Forensic Procedures Review Committee 2009); Ford (n 376).

The *Crimes Act 1914*[378] is the main statute governing the operation of the Australia NCIDD. Generally, the legal framework permits indefinite retention of DNA samples and profiles from individuals convicted of specified serious offences, for example, murder. For suspects, the retention period for DNA samples is 12 months after sampling if the case is discontinued or no proceedings are instituted against the individual. The sample must be destroyed as soon as possible if the suspect is acquitted or no conviction is recorded. Under the authority of a magistrate, the retention period may be extended. The national legislative regime uses a concept of de-identification of DNA profiles for suspects and volunteer data. It involves the removal of any identifying information associated with DNA profiles after a maximum period of 12 months for suspects, and in the case of volunteers, after the purpose for which the profile was loaded has been fulfilled. As mentioned earlier, there are some differences in state/territory DNA legislative regimes. In Queensland and Victoria, for example, the state provisions require the destruction of DNA samples and profiles of suspects if no charge is instituted after 12 months or when found not guilty. Whilst there are provisions for the destruction of DNA samples in other jurisdictions, provisions on retention limits and destruction of DNA profiles are not clear.[379]

The operation of the NCIDD is under the management of the ACIC on behalf of the police. The ACIC is a government agency under the Home Affairs Portfolio established in December 2017. Until July 2016, the database was managed by CrimTrac which has now merged with the Australian Crime Commission (ACC) to form the ACIC.[380] The external oversight of ACIC functions, including management of the NCIDD, is carried out by the ACIC Board, the Inter-Governmental Committee on the ACC, the Parliamentary Joint Committee on Law Enforcement, the Commonwealth Ombudsman, the Australian Commission for Law Enforcement Integrity, and Australian National Audit Office.[381] Unlike the UK NDNAD system, there appear to be no specific independent oversight bodies or offices, such as the Strategy Board, Ethics Group and Biometrics Commissioner for the NCIDD.

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[378] Crimes Act 1914, pt ID.

[379] Linzi Wilson-Wilde and Fiona Pitman, 'Legislative and Policy Implications for the Use of Rapid DNA Technology in the Australian Context' (2017) 8 Forensic Science Policy & Management: An International Journal 26; FGPI, 'DNA Databases in Australia and New Zealand' <http://www.genewatch.org/uploads/f03c6d66a9b354535738483c1c3d49e4/Australia_and_New_Zealand.pdf> accessed 19 March 2018.

[380] CRIMTRAC, *Annual Report 2015 - 2016* (Australian Criminal Intelligence Commission 2016).

[381] Australian Criminal Intelligence Commission, 'Submission to Productivity Commission's Inquiry into Data Availability and Use' (ACIC 2016).

2.5.5.2 New Zealand

The New Zealand DPD is the second oldest national DNA database in the world. The national database is organized into two databases: a reference sample database and a crime scene database. The DPD holds over 0.19 million subject profiles (~3.5% of the population) and 0.039 million crime scene samples.[382] The crime scene match rate is estimated at 70% and the match rate for crime scene-to-crime scene matches is about 30%.[383] Compared to the other databases, the DPD has the highest crime scene match rate[384]. Harbison and Bright[385] suggest a possible future integration of information from massively parallel DNA sequencing to the DPD.

The legal framework for the DPD is provided in the *Criminal Investigations (Bodily Samples) Act 1995 (CIBSA).* The current form of the Act, following several amendments, allows the retention of DNA samples from individuals convicted, charged or suspected of imprisonable offences or specified offences in Part 3 of the CIBSA Schedule (mainly serious offences). The regime requires the destruction of DNA samples if charges are dropped or if a conviction is quashed. If no charges are progressed against an individual after 24 months, DNA records must be destroyed. Apart from these exceptions, samples must be destroyed after generating a DNA profile.[386] DNA profiles that can be retained on the DPD are restricted to data from convicted individuals.[387] The Act permits indefinite retention of data but fixed retention periods (4 or 10 years + possible 4 years extensions) apply to data from certain convicted juveniles (aged 14 to 16), and in some cases, juveniles can apply for data deletion.[388]

Section 24O of the CIBSA provides for the operation of a temporary DNA database in addition to the DPD. The temporary database stores profiles of individuals charged with an imprisonable or a Part 3 Schedule offence.[389] As of the 2017/18 reporting period, there were

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[382] ESR, 'Forensic: Crime Science & Intelligence' <https://www.esr.cri.nz/assets/Uploads/Forensic-Brochure-WEB-spreads.pdf> accessed 21 March 2018; ESR, 'Annual Report 2018' (Environmental Science and Research 2018) <https://www.esr.cri.nz/assets/Uploads/ESR-ANNUAL-REPORT-2018-WEB-FINAL2.pdf> accessed 2 September 2019.
[383] ESR, 'Forensic: Crime Science & Intelligence' (n 382); ESR, 'ESR 2017 Annual Report' (Environmental Science and Research 2017); ESR, 'Annual Report 2018' (n 382).
[384] i.e. the number of annual crime scene-to-reference matches divided by the number of crime scene profiles loaded that year
[385] Harbison and Bright (n 237).
[386] Criminal Investigations (Bodily Samples) Act 1995, s 60 (2A).
[387] Criminal Investigations (Bodily Samples) Act 1995, s 26.
[388] Criminal Investigations (Bodily Samples) Act 1995, s 26A.
[389] Criminal Investigations (Bodily Samples) Act 1995, s 24P.

about 0.0082 million profiles in a temporary database.[390] Profiles on both the DPD and the temporary database can be used for forensic comparisons (i.e. comparison to crime scene profiles). The retention period for profiles in the temporary database is until 2 months if no charges or the conclusion of any proceedings, acquittal or withdrawal of charges or transfer to the DPD if required by law.

The Environmental Science and Research Institute (ESR) manages the New Zealand DPD and temporary database for the police.[391] The ESR is a government-owned agency that provides scientific and clinical services such as forensic, food, pharmaceutical and environmental analyses. Unlike the UK, the governance of DNA databasing in New Zealand lacks a robust independent oversight arrangement. Whilst the Privacy Commissioner can audit the compliance of databases to privacy rules, this is not mandatory.[392] Lynch and Campbell[393] recommend adoption of the UK model of a statutory advisory board to monitor the implementation of the law as well as the compliance of DNA practices to legal requirements.

In summary, the holdings and matching performance of the selected databases differ from the UK NDNAD. Due to the limited information on match outcomes and variations in match counts, it is difficult to determine the relative aggregate effectiveness of the databases. However, the match output demonstrates the utility of the databases in resolving crime by identifying offenders or eliminating suspects. Secondly, the selected systems show variation in the type of information associated with retained DNA profiles in databases. Butler[394] supports the policy of excluding personal information of data subjects in databases as a means of protecting privacy. 'Profile anonymity' as a privacy measure has been applied successfully in the operation of elimination databases for crime scene workers.[395] This policy is practised to some extent for the US, South Africa and Australia national DNA databases. Although this measure could be useful in maintaining the security of data, it is not clear how this ensures a balance between public security and individual privacy rights. The personal information of data subjects is still accessible to the local laboratory or local police force

[390] New Zealand Police, 'Annual Report 2017/18' (New Zealand Police 2018).
[391] ESR, '2017 Annual Report' (n 383).
[392] Nessa Lynch and Liz Campbell, *The Collection and Retention of DNA from Suspects in New Zealand* (Victoria University Press 2015).
[393] Lynch and Campbell (n 392).
[394] Butler, *Advanced Topics in Forensic DNA Typing: Methodology* (n 8) 240.
[395] Martine Lapointe and others, 'Leading-Edge Forensic DNA Analyses and the Necessity of Including Crime Scene Investigators, Police Officers and Technicians in a DNA Elimination Database' (2015) 19 Forensic Science International: Genetics 50.

that submitted the data.[396] The differences in the legislative regimes reflect the complex interpretation of proportionality between public and private interests. The rules on inclusion criteria and how long to store data appear to be 'arbitrary decisions'.[397] Comments from the literature on the governance arrangement of DNA databases favour the current UK model of an independent oversight body rather than a law enforcement agency or government-owned agency.[398] This model is thought to be more transparent and ensures that the police are accountable in the use of individuals' personal genetic data and allow objective ethical scrutiny of the use of forensic DNA.[399]

2.6 International exchange of forensic DNA data[400]

With the increase in cross border crime, the international exchange of intelligence for policing purposes has become very necessary. Approaches to the transnational exchange of DNA data can be categorised into four: international DNA databasing, linked national DNA databases, request-based exchange of data and a combination of these.[401] As demonstrated below, most countries operate a combination system of data exchange.

2.6.1 International DNA databasing

International DNA databases are either 'global' or regional. An example of the global system is the Interpol DNA Gateway platform that was established in 2002.[402] Currently, 84 member countries participate in the Interpol DNA Database (IDD) with a holding of more than 0.18 million DNA profiles.[403] Although it takes minutes to generate hits from the database,[404] it

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[396] CRIMTRAC (n 375); Butler (n 8).
[397] MPA Civil Liberties Panel (n 40).
[398] House of Lords Select Committee on Science and Technology (n 300); Law Reform Commission, *Consultation Paper on the Establishment of a DNA Database* (LRC 2004); Law Reform Commission, *Report: The Establishment of a DNA Database* (LRC 2005); Nuffield Council on Bioethics (n 45); Lynch and Campbell (n 392); Forensic Genetics Policy Initiative, *Establishing Best Practice for Forensic DNA Databases* (n 88).
[399] Human Genetics Commission, 'Inside Information: Balancing Interests in the Use of Personal Genetic Data' (n 300); Nuffield Council on Bioethics (n 45); Forensic Genetics Policy Initiative, *Establishing Best Practice for Forensic DNA Databases* (n 88); Independent Advisory Group on the Use of Biometric Data in Scotland (n 88).
[400] An earlier version of this section is published in Forensic Sciences Research: Amankwaa AO, 'Trends in Forensic DNA Database: Transnational Exchange of DNA Data' [2019] Forensic Sciences Research <https://doi.org/10.1080/20961790.2019.1565651> accessed 15 March 2019
[401] CTED and UNOCT, *United Nations Compendium of Recommended Practices for the Responsible Use and Sharing of Biometrics in Counter-Terrorism* (Counter-Terrorism Committee Executive Directorate 2018); Butler (n 8); INTERPOL, *INTERPOL Handbook on DNA Data Exchange and Practice* (Second, INTERPOL 2009).
[402] INTERPOL, *INTERPOL Handbook on DNA Data Exchange and Practice* (n 401).
[403] INTERPOL, 'DNA' (*INTERPOL*, 2019) <https://www.interpol.int/How-we-work/Forensics/DNA> accessed 7 September 2019.
[404] INTERPOL, 'DNA' (n 403).

has been reported that the Interpol exchange process can take about 143 days.[405] The United Kingdom is a participant of the IDD and exports a limited number of DNA profiles to the Interpol database.[406] The IDD holds DNA profiles from convicted individuals, suspects, missing persons and 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. This policy indicates that, overall, domestic laws dictate access and uses of data and the protection of the rights of IDD data subjects. According to Interpol,[407] the database was instrumental in Project Pink Panther (2007 - 2016), where a group of individuals involved in transnational jewellery thefts were apprehended.

The Europol Information System (EIS) is a regional criminal intelligence and information database that includes a DNA database containing profiles from the EU Member States.[408] The EIS was established in 2005 and stores information on serious international crime, convicted and suspected individuals and other information related to crime. Like the Interpol database, profiles stored on the EIS are subject to national laws of the submitting agency. Access to data stored on the EIS can be restricted by the submitting agency and may only allow access where a hit is obtained.[409] According to Europol,[410] the EIS holds more than 0.147 million data of persons as of 2017. The Europol Programming Document indicates the agency is considering a partnership with the EU Prüm framework to increase the scope and capabilities of its DNA and biometric exchange system with third countries.[411]

2.6.2 Linked or networked national DNA databases

The EU Prüm arrangement is modelled as a network of separate national databases of member countries.[412] Austria, Belgium, France, Germany, Luxembourg, Netherlands and

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[405] Home Office, 'Government Sets out Case for Joining Prüm' (*GOV.UK*, 26 November 2015) <https://www.gov.uk/government/news/government-sets-out-case-for-joining-prum> accessed 5 July 2018.
[406] Home Office, *Prüm Business and Implementation Case* (Home Office 2015).
[407] INTERPOL, *INTERPOL Handbook on DNA Data Exchange and Practice* (n 401); INTERPOL, 'Project Pink Panthers' (*INTERPOL*, 2018) <https://www.interpol.int/Crime-areas/Organized-crime/Project-Pink-Panthers#> accessed 28 March 2018.
[408] Europol, 'Europol Information System (EIS) Leaflet' (*Europol*, 9 December 2013) <https://www.europol.europa.eu/publications-documents/europol-information-system-eis-leaflet> accessed 6 June 2018.
[409] Europol (n 408).
[410] Europol, *Europol Programming Document: 2018 – 2020* (Europol 2018).
[411] Europol (n 410); Council of the European Union, 'Draft Council Conclusions on the Implementation of the "PRÜM DECISIONS" Ten Years after Their Adoption' (Council of the European Union 2018) <http://data.consilium.europa.eu/doc/document/ST-10550-2018-INIT/en/pdf> accessed 11 July 2018.
[412] Council of the European Union, 'Council Decision 2008/615/JHA of 23 June 2008 on the Stepping up of Cross-Border Cooperation, Particularly in Combating Terrorism and Cross-Border Crime' (n 322); Council

Spain signed the Prüm Treaty on 27th May 2005. The arrangement was adopted into EU legislation in 2008, requiring all member states to create a database that can be accessed by other member countries. Council Decision 2008/615/JHA and Council Decision 2008/616/JHA provide the legal framework for the EU Prüm regime. The types of intelligence covered under Prüm include DNA, fingerprints and vehicle registration information. The DNA data exchange operates under two stages: hit/no-hit query and further information sharing.[413] In the first stage, DNA data from one country is automatically searched on the database of another country to identify any matches. If a match is obtained, the case progresses to the second stage where identifying information of the data subject is shared with the requesting country. Currently, between 6 and 13.5 million subject profiles, and 2 million crime scene profiles may be available for exchange under Prüm. This is due to the inclusion of the UK in June 2019.[414] Conditions for UK participation include the restriction of searching to data of convicted individuals, crime scene profiles and unidentified human remains, and the establishment of an independent Prüm Oversight Board.[415] Compared to the Interpol exchange process, it takes approximately 15 minutes to exchange data via Prüm.[416] The regime requires all EU states to establish national contact points (NCPs) to facilitate and manage the exchange of intelligence data.[417] The operation of the data exchange scheme is governed by national legislation that determines the powers of NCPs.

As of July 2019, 25-member states (including the UK) were actively exchanging DNA data with other member states under the Prüm regime.[418] Whilst some countries, such as, the

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of the European Union, 'Council Decision 2008/616/JHA of 23 June 2008 on the Implementation of Decision 2008/615/JHA on the Stepping up of Cross-Border Cooperation, Particularly in Combating Terrorism and Cross-Border Crime' (2008) L 210 Official Journal of the European Union 12.

[413] See Articles 3, 4 and 5 of Council of the European Union, 'Council Decision 2008/615/JHA of 23 June 2008 on the Stepping up of Cross-Border Cooperation, Particularly in Combating Terrorism and Cross-Border Crime' (n 322).

[414] Home Office, 'UK and EU Law Enforcement Boost Co-Operation on DNA Databases' (*GOV.UK*, 13 June 2019) <https://www.gov.uk/government/news/uk-and-eu-law-enforcement-boost-co-operation-on-dna-databases> accessed 7 September 2019.

[415] House of Lords, 'Prüm: UK Opt-In' (*Hansard Online*, 9 December 2015) <https://hansard.parliament.uk/Lords/2015-12-09/debates/15120956000220/Pr%C3%BCmUKOpt-In> accessed 26 March 2018; European Union Committee, 'The United Kingdom's Participation in Prüm' (House of Lords 2015); Wiles, *Annual Report 2016* (n 26); Council of the European Union, 'Implementation of the provisions on information exchange of the "Prüm Decisions"' (Council of the European Union 2017).

[416] Home Office, 'Government Sets out Case for Joining Prüm' (n 405).

[417] See Article 6 of Council of the European Union, 'Council Decision 2008/615/JHA of 23 June 2008 on the Stepping up of Cross-Border Cooperation, Particularly in Combating Terrorism and Cross-Border Crime' (n 322).

[418] Council of the European Union, 'Draft Council Conclusions on the Implementation of the "PRÜM DECISIONS" Ten Years after Their Adoption' (n 411); VIEmedia, 'Great Britain Started on July 8, 2019 with Austria Prüm-DNA-Cooperation' (19 July 2019)

Netherlands, Germany and Austria exchange data with 20 or more other states, countries, such as, Belgium, Denmark and the UK exchange data with a few other states.[419] The non-operational states are Greece, Ireland and Italy.[420] Available studies[421] on the performance of the Prüm regime have found a disproportionate impact in the transnational exchange of DNA data among member states. Factors contributing to this observation include differences in legislation, size and age of databases, variation in operational procedures, and uneven connection between states.[422] Presently, there's scarce information on the actual effectiveness of the regime and some studies have recommended a follow-up of confirmed DNA hits to address this gap.[423] Another recommendation is the assessment of stage 2 of the Prüm regime to enhance transparency, accountability and trust in the regime.[424]

2.6.3 Request-based exchange of DNA data

The request-based exchange of DNA data is practised by several countries around the world. Countries with bilateral agreements allow conditional automated searching of databases for public security reasons. Features of this scheme include the requirement that the exchange of DNA information must be 'necessary' or 'relevant' and 'proportionate' for a policing purpose and the prioritisation of serious crimes.[425] Generally, the sharing of DNA data follows the two-stage process of Prüm. In the UK, the National Crime Agency (NCA) manages the international exchange of DNA data under this model.[426] The Interpol I-24/7 network is used as a channel for sharing data. One major disadvantage of this approach is the time taken to share information. The process has been described as time-consuming

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<https://www.ots.at/presseaussendung/OTS_20190719_OTS0083/grossbritannien-startete-am-8-juli-2019-mit-oesterreich-pruem-dna-kooperation> accessed 7 September 2019.

[419] Kees van der Beek, 'The Prüm System: Taking Stock of over 10 Years of Transnational DNA Data Comparison and Looking Ahead' (Exchange International Conference, Braga, 12 November 2018); VIEmedia (n 418).

[420] van der Beek (n 419).

[421] Filipe Santos and Helena Machado, 'Patterns of Exchange of Forensic DNA Data in the European Union through the Prüm System' (2017) 57 Science & Justice 307; Carole McCartney, Tim J Wilson and Robin Williams, 'Transnational Exchange of Forensic DNA: Viability, Legitimacy, and Acceptability' (2011) 17 European Journal of Criminal Policy and Research 305; Carole McCartney, 'Forensic Data Exchange: Ensuring Integrity' (2014) 47 Australian Journal of Forensic Sciences 36; Helena Machado, Rafaela Granja and Nina Amelung, 'Constructing Suspicion Through Forensic DNA Databases in the EU. The Views of the Prüm Professionals' The British Journal of Criminology <https://academic.oup.com/bjc/advance-article/doi/10.1093/bjc/azz057/5555659> accessed 7 September 2019.

[422] Santos and Machado (n 421); MD Taverne and APA Broeders, *The Light's at the End of the Funnel! - Evaluating the Effectiveness of the Transnational Exchange of DNA Profiles between the Netherlands and Other Prüm Countries* (Paris Legal Publishers 2015).

[423] Santos and Machado (n 421).

[424] McCartney, Wilson and Williams (n 421); McCartney, 'Forensic Data Exchange' (n 421).

[425] Home Office, 'International DNA Exchange Policy for the United Kingdom' (Home Office 2015).

[426] Wiles, *Annual Report 2016* (n 26).

compared to other approaches.[427] The small number of profiles exchanged under this approach may reflect this challenge.

According to the UK Biometrics Commissioner's 2018 report,[428] 23 subject profiles and 155 crime scene profiles were sent from the UK from January – December 2018. Of the searches completed in foreign databases, the subject profiles yielded no positive or potential match whilst the crime scene profiles yielded 9 matches. Within the same period, 125 subject profiles and 475 crime scene profiles were sent to the UK. The respective matches were 15 for the subject profiles and 50 for the crime scene profiles. Contrary to UK policy on international DNA exchange,[429] the 2016 report of the Biometrics Commissioner indicates instances where data of subjects have been exchanged with associated personal information at the first stage.[430] A second issue identified was the searching of DNA data related to offences other than qualifying (serious) offences.[431] Thirdly, there were instances where NDNAD searches were conducted without the approval of the database Strategy Board.[432] The Biometrics Commissioner notes that these issues have been addressed to prevent future occurrence.

Like the UK, the request-based system is practised through bi-lateral agreements between the United States and at least 30 countries around the world. These include Argentina, Australia, Austria, Bulgaria, Chile, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Liechtenstein, Lithuania, Malta, New Zealand, Portugal, Romania, Slovenia, Slovakia, Sweden, the UK (only crime scene profiles)[433] and the Netherlands.[434] These bilateral agreements are

[427] Toom (n 314); ENFSI DNA Working Group, *DNA Database Management Review and Recommendations* (n 66).
[428] Wiles, *Annual Report 2017: Commissioner for the Retention and Use of Biometric Material* (n 114).
[429] Home Office, 'International DNA Exchange Policy for the United Kingdom' (n 425).
[430] Wiles, *Annual Report 2016* (n 26).
[431] Wiles, *Annual Report 2016* (n 26); Wiles, *Annual Report 2017: Commissioner for the Retention and Use of Biometric Material* (n 114).
[432] Wiles, *Annual Report 2016* (n 26); Wiles, *Annual Report 2017: Commissioner for the Retention and Use of Biometric Material* (n 114).
[433] Wiles, *Annual Report 2018: Commissioner for the Retention and Use of Biometric Material* (n 115) 56.
[434] Law Enforcement Cooperation: Agreement Between the United States of America and ARGENTINA 2016; Law Enforcement Cooperation: Agreement Between the United States of America and CYPRUS 2015; Law Enforcement Cooperation: Agreement Between the United States of America and ROMANIA 2015; Law Enforcement Cooperation: Agreement Between the United States of America and CHILE 2013; Law Enforcement Cooperation: Agreement Between the United States of America and NEW ZEALAND 2013; Law Enforcement Cooperation: Agreement Between the United States of America and BULGARIA 2012; Law Enforcement Cooperation: Agreement Between the United States of America and SLOVENIA 2012; Law Enforcement Cooperation: Agreement Between the United States of America and LIECHTENSTEIN 2012; Law Enforcement Cooperation: Agreement Between the United States of America and ICELAND 2012; Law Enforcement Cooperation: Agreement Between the United States of America and FRANCE 2012;

modelled as the EU Prüm regime. However, there is a focus on serious crime and parties exercise autonomy in permitting automated searches of databases based on the principle of reciprocity. The extent of implementation of the United States bilateral agreements for DNA data exchange is not clear due to legislative restrictions.[435]

In summary, the transnational exchange of forensic DNA data has become a common trend in fighting cross-border crime, terrorism and illegal immigration. It appears the largest exchange system is the EU Prüm framework, involving a network of multiple national DNA databases. There is a possibility for non-EU national (such as, Norway, Iceland, Switzerland and Liechtenstein),[436] international or regional law enforcement agencies to partner the Prüm Framework. This potential global network of databases may introduce significant 'administrative burdens' on national database managers. Further, due to the volume of exchanges, databases may encounter difficulties in managing searches and false-positive matches. These challenges imply a need to develop strong algorithms for comparison as well as an expansion of existing standard set loci to increase the discriminatory power of profiles.

A common policy in DNA data exchange is the governance of data by domestic legislation and implementation of the two-stage Prüm process. Several studies have noted that national differences in operational, legal and ethical policies including privacy safeguards and interpretation of proportionality appear to limit the full potential of the DNA data exchange systems.[437] The current trend dictates a need for legal and operational harmonisation of

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Law Enforcement Cooperation: Agreement Between the United States of America and SWEDEN 2011; Law Enforcement Cooperation: Agreement Between the United States of America and IRELAND 2011; Law Enforcement Cooperation: Agreement Between the United States of America and CROATIA 2011; Law Enforcement Cooperation: Agreement Between the United States of America and AUSTRIA 2010; Law Enforcement Cooperation: Agreement Between the United States of America and DENMARK 2010; Law Enforcement Cooperation: Agreement Between the United States of America and FINLAND 2010; Law Enforcement Cooperation: Agreement Between the United States of America and PORTUGAL 2009; Law Enforcement Cooperation: Agreement Between the United States of America and GREECE 2009; Law Enforcement Cooperation: Agreement Between the United States of America and ITALY 2009; Law Enforcement Cooperation: Agreement Between the United States of America and the CZECH REPUBLIC 2008; Judicial Assistance Cooperation: Agreement Between the United States of America and LITHUANIA 2008; Judicial Assistance Cooperation: Agreement Between the United States of America and the SLOVAK REPUBLIC 2008; Judicial Assistance Cooperation: Agreement Between the United States of America and MALTA 2008; Law Enforcement Cooperation: Agreement Between the United States of America and GERMANY 2008; Judicial Assistance Cooperation: Agreement Between the United States of America and HUNGARY 2008; Judicial Assistance Cooperation: Agreement Between the United States of America and ESTONIA 2008; Agreement between the Government of the United States of America and the Government of the Republic of Latvia on enhancing cooperation in preventing and combating serious crime 2008.

[435] ENFSI DNA Working Group, *DNA Database Management Review and Recommendations* (n 66); van der Beek (n 419).

[436] Council of the European Union, 'Draft Council Conclusions on the Implementation of the "PRÜM DECISIONS" Ten Years after Their Adoption' (n 411).

[437] McCartney, Wilson and Williams (n 421); McCartney, 'Forensic Data Exchange' (n 421); Derek Johnson, Anika Ludwig and Bethany Younger, 'The Prüm Implementation, Evaluation and Strengthening (P.I.E.S.) of

domestic policies to protect both public security and individual civil liberties. This underscores the importance of establishing the actual effectiveness of these databases.[438]

Whilst the utility of the DNA exchange system has been demonstrated in resolving serious crimes, such as, gang and serial rape, murder and armed robbery,[439] there is limited information on the overall effectiveness and efficiency of this crime-fighting tool.[440] This knowledge base is critical to help establish whether the creation and operation of DNA exchange systems is 'a good return on investment'.

2.7 Conclusion

To provide context to the relevance of the national and global debates on public security, privacy, proportionality and effectiveness in forensic DNA databasing, this chapter explored the development of the science and technology, legal and operational framework of forensic DNA databasing. The NDNAD was analysed in detail and compared to selected databases around the world: European national databases, the United States NDIS, Chinese national DNA database, South African NFDD, Australian NCIDD and New Zealand databases. The different approaches to the international exchange of forensic DNA data were also discussed.

The review shows a global trend to set up, develop and link national DNA databases for criminal investigation purposes. Whilst there has been significant progress in the realisation of the usefulness of DNA databases, several public security and investigative issues, legal and ethical issues have been identified. There seems to be a trend to remove DNA data of unconvicted individuals from databases. Further, the legal framework of many jurisdictions includes rules to prevent or limit the retention of DNA data from unconvicted individuals. The goal of these strategies is to protect the civil liberty rights of individuals and ensure proportionality. However, there is presently a lack of data to demonstrate the effectiveness of retention regimes and databases.

Forensic DNA Data Exchange: Northumbria University Final Report' (Northumbria University 2015); Filipe Santos, 'Overview of the Implementation of the Prüm Decisions' (EXCHANGE 2016); Santos (n 32); Machado and Granja (n 32).

[438] Wiles, *Annual Report 2018: Commissioner for the Retention and Use of Biometric Material* (n 115) 46-47.

[439] INTERPOL, *INTERPOL Handbook on DNA Data Exchange and Practice* (n 401); INTERPOL, 'Forensics: DNA' (*INTERPOL*, 2018) <https://www.interpol.int/INTERPOL-expertise/Forensics/DNA> accessed 23 March 2018; INTERPOL, 'Project Pink Panthers' (n 407); Toom (n 314).

[440] Santos and Machado (n 421); Taverne and Broeders (n 422).

One contributing factor to the investigative issues and debates on ethics and privacy is the limited understanding of the category of individuals whose profiles should be retained on national databases. There is limited empirical evidence to justify the retention of DNA data from innocent individuals and how long data should be retained for innocent and convicted individuals. A consequence of this limitation is a gap in determining an adequate balance between public security and civil liberty rights of individuals. To help fill this gap, this research aimed to assess the efficacy of NDNAD regimes. The goal was to identify legal changes that may improve the utility of the database and proportionality between public and individual interests. Overall, the public survey suggested that an effective regime should limit the inclusion and retention of data from unconvicted individuals. The results also showed a need to reform the indefinite retention of DNA data from convicted adults in the NDNAD. The surveyed expert group thought the expansive regime was the most effective for reasons of security and ease of implementation. This suggested a need to assess and adopt effective/efficient elements of the expansive regime, such as, the automation of retention procedures or the use of bright-line rules and the establishment of an intelligence network to support police work.

Chapter 3: Implementation of the PoFA regime: document analysis[441]

3.1 Introduction

The first specific aim of the research was 'to identify the benefits, challenges, risks and emerging issues associated with the implementation of the provisions of Part 1 of the Protection of Freedoms Act 2012 (PoFA) governing the retention of forensic DNA records.' A document analysis of reports of the main NDNAD oversight bodies was carried out to achieve this aim. The PoFA regime was brought into force in October 2013. As described in Chapter 2, the regime has transformed the governance, operation, and legal framework of the database. More than a million profiles from unconvicted people and millions of DNA samples have been destroyed.[442] Critical reviews of the PoFA regime highlight the potential incommensurate treatment of public and private interests and the continuing lack of 'weighty reasons' for the retention of data from innocent individuals.[443] This chapter reviews the annual reports of the Strategy Board, the Ethics Group and the Biometrics Commissioner published since the implementation of PoFA. The rationale for this review was to establish the direction of research into the efficacy of NDNAD retention regimes and, secondly, advance the literature on the PoFA regime, which has not yet been subjected to a research-informed review.[444]

3.2 Methodology

Fourteen annual reports of the three independent bodies with specific oversight functions for the NDNAD were analysed for recurrent themes on the benefits and best practice, challenges, risks, and emerging issues associated with the implementation of PoFA. The review includes five annual reports of the Strategy Board (2013/14 – 2017/18),[445] three

[441] An earlier version of this Chapter is published in Forensic Science International: Amankwaa AO and McCartney C, 'The UK National DNA Database: Implementation of the Protection of Freedoms Act 2012' (2018) 284 Forensic Science International 117
[442] Home Office and Brokenshire (n 76).
[443] McCartney, 'Of Weighty Reasons and Indiscriminate Blankets' (n 44); Blakemore and Blake (n 107); Lee (n 62).
[444] Wiles, *Annual Report 2018: Commissioner for the Retention and Use of Biometric Material* (n 115); Home Office, *Memorandum to the Home Affairs Committee* (n 115).
[445] National DNA Database Strategy Board, *Annual Report, 2013 to 2014* (n 78); National DNA Database Strategy Board, *Annual Report, 2014 to 2015* (n 78); National DNA Database Strategy Board, *Annual Report 2015 to 2016* (n 78); FIND Strategy Board, *Annual Report 2016 to 2017* (n 78); FIND Strategy Board, *Annual Report 2017 to 2018* (n 16).

annual reports of the Ethics Group (2014 – 2016)[446] and five annual reports (2014 – 2018)[447] and a supplementary report[448] of the Biometrics Commissioner. The general principles of thematic synthesis of literature and qualitative data were used to generate the key themes in the review.[449] The iterative process involved the coding of text, sorting of relevant codes into key themes, comparing the generated themes to the original report and then between the reports for similarities and differences.

3.3 Results of document analysis

The key themes identified from the fourteen reports are summarised in Table 3.1. This section describes the themes from the included reports. These are critically discussed in the context of the available literature in section 3.4. There were 21 key themes in relation to forensic DNA. As observed in the description below, the reports of the Biometrics Commissioner produced more themes than the other independent bodies. This is explained by the comprehensive nature of the Commissioner's reports, as well as the dedicated focus upon the PoFA regime, covering the retention, use, transnational exchange and destruction of DNA records and fingerprints, and PoFA compliance.[450] In contrast, the Strategy Board and Ethics Group reports cover other issues that are indirectly related to PoFA.

[446] National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2014* (n 17); National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2015* (n 79); National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2016* (National DNA Database Ethics Group 2017).
[447] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76); MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80); Wiles, *Annual Report 2016* (n 26); Wiles, *Annual Report 2017: Commissioner for the Retention and Use of Biometric Material* (n 114); Wiles, *Annual Report 2018: Commissioner for the Retention and Use of Biometric Material* (n 115).
[448] MacGregor, *Further Report on 2015 Annual Report.* (n 114).
[449] Bryman (n 312); Emma Nicholson and others, 'Protocol for a Thematic Synthesis to Identify Key Themes and Messages from a Palliative Care Research Network' (2016) 9 BMC Research Notes.
[450] PoFA gave rise to the statutory duties of the Biometrics Commissioner

Table 3.1 - Main themes identified from the reviewed reports

Category	Themes
Benefits of PoFA	Improved proportionality
	Increased match rate
	Decreased sample storage cost
	Strengthened retention compliance checks
	Opportunity for case review
Challenges of PoFA implementation	Police National Computer (PNC) limitations
	Non-engagement of police forces with PoFA
	Limited data on case resolution rate
	Database contamination and error rates
	Inadequate enforcement of PoFA rules for Counter-terrorism DNA Database (CTDNAD)
	Limited statutory guidance on discretionary retention
	Misapplication of Criminal Procedure and Investigations Act 1996 (CPIA) exception
	Inadequate rules for volunteer sampling and samples
Risks/emerging issues associated with PoFA implementation	Public security risk due to non-retention of data
	Breach of privacy due to unlawful retention
	Contention surrounding future benefits of retention
	Need for expansion of qualifying offences
	Retention after a match but without arrest
	Complex National Security Determination (NSD) process
	Resource needs for compliance checks
	Limited statutory guidance for new genetic technologies

3.3.1 Benefits of PoFA implementation

Five main themes related to the benefits of the PoFA regime were identified from the analysed reports. The implications of these benefits are discussed in section 3.4.1. This section describes the key benefits identified in the reports.

3.3.1.1 Improved proportionality

The implementation of the PoFA regime is reported to have strengthened the level of protection of the privacy interests of innocent individuals.[451] For example, in cases where the retention of DNA profiles of unconvicted individuals is deemed necessary, the PoFA

[451] National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2014* (n 17); National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2015* (n 79); MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76); MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80); National DNA Database Strategy Board, *Annual Report, 2013 to 2014* (n 78); National DNA Database Strategy Board, *Annual Report, 2014 to 2015* (n 78); National DNA Database Strategy Board, *Annual Report 2015 to 2016* (n 78); Wiles, *Annual Report 2016* (n 26); National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2016* (n 446).

procedures require corroboration of the suspicious involvement of the individual.[452] Further, the process has reinforced the requirement to provide suspected individuals with detailed information on the grounds for the retention of their data and their right to make representations.[453] Most of the reports indicate a wide acceptance of the PoFA regime as a more proportionate system.[454] The implementation of the new regime has increased awareness of ethical and legal considerations, including privacy rights, proportionality and necessity. The regime has also established critical monitoring and assessment of legal compliance with PoFA when retaining DNA profiles, in order to fulfil obligations upon the State to respect human rights,[455] as demanded by *Marper*.[456] Interestingly, some of the reports recommended the application of PoFA rules to new/unregulated biometric technologies.[457] The Ethics Group specifically recommended that 'the retention times directed in the Protection of Freedoms Act 2012 for the retention of DNA samples and fingerprints should also be applied to the retention of custody images'.[458] Whilst the retention of custody images is considered by some as less intrusive than DNA, the Ethics Group believed their retention raise significant privacy concerns. Hence, the need to apply the PoFA rules to custody images.[459]

3.3.1.2 Increased match rate

Match rate is an output metric used to assess the performance of the NDNAD. It measures the chance that a crime scene profile loaded on the NDNAD matches a subject profile.[460]

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[452] National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2014* (n 17).
[453] National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2014* (n 17).
[454] Wiles, *Annual Report 2016* (n 26); National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2014* (n 17); National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2015* (n 79); MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80); MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76); National DNA Database Strategy Board, *Annual Report, 2013 to 2014* (n 78); National DNA Database Strategy Board, *Annual Report, 2014 to 2015* (n 78); National DNA Database Strategy Board, *Annual Report 2015 to 2016* (n 78); National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2016* (n 446).
[455] Human Rights Act 1998.
[456] Wiles, *Annual Report 2017: Commissioner for the Retention and Use of Biometric Material* (n 114); Wiles, *Annual Report 2018: Commissioner for the Retention and Use of Biometric Material* (n 115).
[457] National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2015* (n 79); MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76); MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80).
[458] National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2015* (n 79) 15.
[459] National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2015* (n 79).
[460] National DNA Database Strategy Board, *Annual Report 2015 to 2016* (n 78).

Since its establishment in 1995, the NDNAD has provided the highest match rates (62% - 66% from 2013/14 to 2017/18) following the introduction of the PoFA regime.[461] The current match rate is reported to be one of the highest across DNA databases in Europe. The Ethics Group noted that 'the initial impression is that the removal of large numbers of "unconvicted" profiles has not significantly affected the effectiveness of the database, although it is too early to draw firm conclusions'.[462] Most of the reports suggested that the new regime seems to have had a positive impact on the match output of the database.[463]

3.3.1.3 Decreased sample storage cost and strengthened compliance

Another potential benefit of the PoFA regime, as suggested in the 2014 Commissioner's report, is that it has significantly decreased costs and resources required for storing millions of DNA samples indefinitely under previous regimes.[464] The new regime has also led to the introduction of PoFA compliance checks by UKAS and the Biometrics Commissioner for accredited Forensic Science Providers (FSPs) and police forces, respectively.[465] This has mandated the introduction of adequate processes by FSPs and police forces to demonstrate compliance with the new regime. Although compliance checks have not been completed for all police forces, the Office of the Biometrics Commissioner asserts that the bulk of samples/data that need to be retained or destroyed have indeed been retained or destroyed.[466]

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[461] National DNA Database Strategy Board, *Annual Report, 2013 to 2014* (n 78); National DNA Database Strategy Board, *Annual Report, 2014 to 2015* (n 78); National DNA Database Strategy Board, *Annual Report 2015 to 2016* (n 78); FIND Strategy Board, *Annual Report 2016 to 2017* (n 78); FIND Strategy Board, *Annual Report 2017 to 2018* (n 16).

[462] National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2014* (n 17) 19.

[463] National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2014* (n 17); National DNA Database Strategy Board, *Annual Report, 2013 to 2014* (n 78); National DNA Database Strategy Board, *Annual Report, 2014 to 2015* (n 78); MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76); MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80); National DNA Database Strategy Board, *Annual Report 2015 to 2016* (n 78); Wiles, *Annual Report 2016* (n 26); FIND Strategy Board, *Annual Report 2016 to 2017* (n 78); FIND Strategy Board, *Annual Report 2017 to 2018* (n 16).

[464] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76) 62.

[465] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76); MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80).

[466] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76); MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80); Wiles, *Annual Report 2016* (n 26); Wiles, *Annual Report 2017: Commissioner for the Retention and Use of Biometric Material* (n 114); Wiles, *Annual Report 2018: Commissioner for the Retention and Use of Biometric Material* (n 115).

3.3.1.4 Opportunity for case review

Finally, another practical value of the new regime is the opportunity for case reviews.[467] Best practice has been identified when Biometrics Retention Units (BRU) are established within police forces.[468] A BRU can assess cases and identify those that may benefit from extended biometric data retention.[469] This has led to the identification of shortcomings in some cases. For example, the BRU of the Metropolitan Police Service identified a sexual assault case with a suspect for whom a No Further Action (NFA) entry had been made but should have been charged (the suspect was subsequently convicted).[470] Other cases where no biometric data were taken have also been identified and the data of the individuals involved have now been obtained and added to the NDNAD.

3.3.2 Challenges of PoFA implementation

There were 8 main themes associated with the challenges of the PoFA regime. These challenges are issues that directly impact the enforcement and/or achievement of the general principles of the regime such as proportionality and necessity of data retention, protection of public security and civil liberties. In this section, the key challenges from the reports are outlined. A discussion of the themes is covered in section 3.4.2.

3.3.2.1 Police National Computer (PNC) limitations

The automatic deletion of biometric records on the NDNAD is driven by the PNC, which contains records of all arrestees. One critical challenge with the implementation of PoFA is the limitation of the PNC configuration.[471] The Commissioner's reports[472] extensively detail the technical and procedural challenges encountered with the PNC. Firstly, the PNC programme requires manual entries to drive the 'automatic' deletion of data on the

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[467] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76); MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80).
[468] MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80).
[469] Wiles, *Annual Report 2018: Commissioner for the Retention and Use of Biometric Material* (n 115).
[470] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76) 38.
[471] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76); MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80); Wiles, *Annual Report 2016* (n 26); Wiles, *Annual Report 2017: Commissioner for the Retention and Use of Biometric Material* (n 114); Wiles, *Annual Report 2018: Commissioner for the Retention and Use of Biometric Material* (n 115).
[472] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76); MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80).

NDNAD.[473] Although improvement of the programme could support the new regime, its high-cost and resource implications have compelled the police to settle for the current 'compromise'.[474] This has led to some erroneous retention of biometric data.[475] Available guidance requires forces to confirm the legality of every match generated before progressing an investigation.[476]

Secondly, the PNC is incompatible with the PoFA concept, 'the conclusion of the investigation of an offence', that triggers the automatic deletion of data from innocent individuals.[477] A substituted trigger is the 'NFA' entry made on the PNC.[478] For protracted investigations where an individual is 'NFA-ed' but extended retention is necessary, the current guidance requires the Biometrics Commissioner to provide discretionary retention advice.[479] Thirdly, the efficiency of the PNC is determined by the timeliness and accuracy of entries made by forces. Delays in updating the PNC or erroneous entries due to misunderstanding of retention markers have resulted in unlawful retention or loss of data in some instances.[480]

3.3.2.2 Non-engagement of police forces with PoFA

Another critical challenge with PoFA implementation is poor engagement by police forces. The reports of the Biometrics Commissioner emphasised the limited applications made by police forces (26 out of 43 forces as of 2018) in the case of individuals arrested for a serious

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[473] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76); MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80); Wiles, *Annual Report 2018: Commissioner for the Retention and Use of Biometric Material* (n 115).
[474] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 75) 70; MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 79).
[475] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76); MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80); Wiles, *Annual Report 2018: Commissioner for the Retention and Use of Biometric Material* (n 115).
[476] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76); MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80).
[477] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76); MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80) 10-11.
[478] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76); MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80).
[479] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76); MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80) 73-74.
[480] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76); MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80); Wiles, *Annual Report 2016* (n 26); Wiles, *Annual Report 2017: Commissioner for the Retention and Use of Biometric Material* (n 114); Wiles, *Annual Report 2018: Commissioner for the Retention and Use of Biometric Material* (n 115).

offence (or s63G applications).[481] Although the expected annual applications were estimated at ~1000 per year, there were 570 applications from October 2013 to December 2018, with over 62% (354) of applications by the Metropolitan Police alone.[482] Further, there were only six applications in the case of individuals charged with qualifying offences (or s63F(7) applications) – all made by the Metropolitan Police.[483] The reasons for non-engagement include financial and resource demands; dissatisfaction among some forces about the transfer of risk from legislators; the perception that individuals can be sampled in future offences when they become suspects; and difficulties in identifying cases or understanding the circumstances in which retention is required.[484]

3.3.2.3 Limited data on case resolution rate

Most of the reports noted the limited data to demonstrate the effectiveness of the new retention regime.[485] To address this gap, the Ethics Group[486] proposed the collection of data on the size of each retention category, the match rate of the database before and after PoFA implementation, and the match rate for each retention criteria. It is indicated that there has been some progress made in this respect.[487] However, post-legislative scrutiny of the PoFA regime is yet to be completed,[488] and the Biometrics Commissioner's reports have emphasised that such a review should be informed by rigorous research into the efficacy of the new retention regime.[489]

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[481] Wiles, *Annual Report 2018: Commissioner for the Retention and Use of Biometric Material* (n 115).
[482] MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80); Wiles, *Annual Report 2016* (n 26); Wiles, *Annual Report 2018: Commissioner for the Retention and Use of Biometric Material* (n 115).
[483] MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80); Wiles, *Annual Report 2016* (n 26); Wiles, *Annual Report 2018: Commissioner for the Retention and Use of Biometric Material* (n 115).
[484] MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80); Wiles, *Annual Report 2016* (n 26).
[485] National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2014* (n 17); MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76); MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80); National DNA Database Strategy Board, *Annual Report, 2013 to 2014* (n 78); National DNA Database Strategy Board, *Annual Report, 2014 to 2015* (n 78); National DNA Database Strategy Board, *Annual Report 2015 to 2016* (n 78); Wiles, *Annual Report 2016* (n 26).
[486] National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2014* (n 17).
[487] National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2014* (n 17) 19-20.
[488] Home Office, *Memorandum to the Home Affairs Committee* (n 115).
[489] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76); MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80); Wiles, *Annual Report 2018: Commissioner for the Retention and Use of Biometric Material* (n 115).

The reports of the Strategy Board include data on the output of the database[490] and 'positive match outcomes'[491] which was 41.6% in 2014/15 and 50.4% in 2015/16.[492] The third report of the Biometrics Commissioner provided further statistics on the impact of DNA evidence. This noted that DNA is linked to case outcome in only 0.3% of all recorded crime (0.9% for theft of vehicles, 1.4% for domestic burglaries, 0.6% for rapes and 8.4% for homicides).[493] There is still no information, however, on how DNA contributes to case resolution.[494] In this regard, the Ethics Group recommended the collection of data on NDNAD match conviction rates in sexual assault cases.[495] One difficulty in determining these rates is that the DNA match is normally one element in a larger body of evidence or, because of the different circumstances of each case, it cannot be easily determined if the DNA evidence alone 'led' to a conviction.[496] Moreover, offenders may have been identified by other means and the DNA match may have only confirmed identity.[497] The Ethics Group indicated that preliminary research had been initiated to address this issue.[498]

3.3.2.4 Database contamination and error rates

The Ethics Group noted that some 'contaminated data' may be retained on the NDNAD, a situation that undermines principles of data protection[499] and the goal of ensuring proportionality.[500] This problem is partly due to the non-routine checking of the Police Elimination Databases (PED). An ongoing project to establish a Contamination Elimination Database (CED) that will be subject to weekly searching is proposed to address this issue.[501]

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[490] i.e. The annual crime scene match rate of the database
[491] This data is reported in only two reports and includes charges/summons, caution/warnings, issuance of a penalty notice for disorder (PND) and community resolution
[492] National DNA Database Strategy Board, *Annual Report, 2014 to 2015* (n 78) 16; National DNA Database Strategy Board, *Annual Report 2015 to 2016* (n 78) 17.
[493] Wiles, *Annual Report 2016* (n 26).
[494] Wiles, *Annual Report 2016* (n 26); Wiles, *Annual Report 2018: Commissioner for the Retention and Use of Biometric Material* (n 115).
[495] National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2015* (n 79); National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2016* (n 446) 19.
[496] National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2014* (n 17) 18; Wiles, *Annual Report 2016* (n 26).
[497] Wiles, *Annual Report 2016* (n 26), para 34.
[498] National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2015* (n 79) 23; National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2016* (n 446) 19.
[499] Data Protection Act 2018.
[500] National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2014* (n 17).
[501] National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2015* (n 79); National DNA Database Strategy Board, *Annual Report, 2014 to 2015* (n 78); National DNA Database Strategy Board, *Annual Report 2015 to 2016* (n 78); National DNA Database Ethics Group, *Annual*

Another related problem is the limited information on the scale of errors associated with the use of DNA.[502] This information is important because the rate of subject sampling error had been found to be 'unacceptably high'.[503] Issues related to DNA sampling errors and database contamination are currently under review and on-going developments.[504]

3.3.2.5 Inadequate enforcement of PoFA rules for CTDNAD

The Counter-terrorism DNA Database is a standalone database that stores DNA profiles related to counter-terrorism policing. Prior to the third report of the Biometrics Commissioner, the holdings of the CTDNAD was unknown.[505] Available data now indicates the CTDNAD holds 8,109 DNA profiles of which 17% (1,406) are from unconvicted individuals.[506] There has been a 'governance deficit' and IT issues with the operation of the CTDNAD, resulting in the inadequate enforcement of the PoFA regime.[507] This challenge has resulted in unlawful retention and loss of some data.[508] The difficulties with the operation of the CTDNAD are compounded by expiry problems due to procedural delays in sample transfer from ports[509] to the Secure Operations – Forensic Services[510].[511] Another issue is delays in the referral of cases to the Joint Forensic Intelligence Team[512] and provision of summary assessments and incorrect estimation of expiry dates due to incompatible IT-systems.[513] Further, the Biometrics Commissioner noted '(…) difficulty of obtaining reliable statistical information about the biometric material on the CT databases [including the

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Report of the Ethics Group: National DNA Database 2016 (n 446); FIND Strategy Board, *Annual Report 2017 to 2018* (n 16).

[502] National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2014* (n 17); Wiles, *Annual Report 2016* (n 26); Wiles, *Annual Report 2018: Commissioner for the Retention and Use of Biometric Material* (n 115).

[503] Wiles, *Annual Report 2016* (n 26) 11; Wiles, *Annual Report 2018: Commissioner for the Retention and Use of Biometric Material* (n 115) 44-45.

[504] National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2015* (n 79); Wiles, *Annual Report 2016* (n 26); National DNA Database Strategy Board, *Annual Report 2015 to 2016* (n 78); FIND Strategy Board, *Annual Report 2017 to 2018* (n 16); Wiles, *Annual Report 2018: Commissioner for the Retention and Use of Biometric Material* (n 115).

[505] Wiles, *Annual Report 2016* (n 26).

[506] Wiles, *Annual Report 2018: Commissioner for the Retention and Use of Biometric Material* (n 115).

[507] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76); MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80); MacGregor, *Further Report on 2015 Annual Report.* (n 114); National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2014* (n 17); National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2015* (n 79).

[508] MacGregor, *Further Report on 2015 Annual Report.* (n 114); Wiles, *Annual Report 2018: Commissioner for the Retention and Use of Biometric Material* (n 115).

[509] Entry points to the country

[510] Formerly known as Counter Terrorism Forensic Services, the unit that operates the CTDNAD

[511] MacGregor, *Further Report on 2015 Annual Report.* (n 114).

[512] The team that makes National Security Determination (NSD) Assessments

[513] MacGregor, *Further Report on 2015 Annual Report.* (n 114); Wiles, *Annual Report 2018: Commissioner for the Retention and Use of Biometric Material* (n 115).

CTDNAD] that is subject to the requirements of PoFA'.[514] This means that some material that requires an NSD application may have been overlooked or data that requires deletion may have been retained.[515] The establishment of a dedicated unit, oversight by the Strategy Board and the development of new IT are expected to minimise the risks associated with the above issues.[516]

3.3.2.6 Limited statutory guidance on discretionary retention

Statutory guidance on retention decisions under section 63G of PACE is considered to be limited.[517] Further, there is no indication of the extent of disclosure when informing unconvicted individuals about the grounds for data retention.[518] A consultation to develop core principles and guidelines was carried out in May 2013.[519] Detailed processes consistent with the guidance of the Strategy Board have now been developed.[520] This considers factors such as the seriousness of the offence, characteristics of the individual, value, proportionality and necessity of retention, and whether the individual has been informed of the retention of data and their right to make representations.[521]

Another issue with discretionary retention is that there is no legal definition or guidelines for the section 63E of PACE concept 'the conclusion of the investigation of the offence', which triggers data deletion.[522] This makes it difficult to determine when an application for extended retention is necessary.[523] The substituted NFA entry on the PNC for arrestees is

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[514] MacGregor, *Further Report on 2015 Annual Report.* (n 114).
[515] MacGregor, *Further Report on 2015 Annual Report.* (n 114); Wiles, *Annual Report 2018: Commissioner for the Retention and Use of Biometric Material* (n 115).
[516] Wiles, *Annual Report 2016* (n 26); MacGregor, *Further Report on 2015 Annual Report.* (n 114); Wiles, *Annual Report 2018: Commissioner for the Retention and Use of Biometric Material* (n 115).
[517] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76); MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80).
[518] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76); MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80); Wiles, *Annual Report 2016* (n 26).
[519] Biometrics Commissioner, 'Consultation Paper on Applications to the Biometrics Commissioner under s.63G PACE Summary of Responses' (Office of the Biometrics Commissioner 2013).
[520] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76); MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80); Wiles, *Annual Report 2016* (n 26).
[521] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76); MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80); Wiles, *Annual Report 2016* (n 26).
[522] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76); MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80); Wiles, *Annual Report 2016* (n 26).
[523] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76); MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80).

limited.[524] The discretionary retention procedure is perceived to be complicated and a 'bright-line rule' may be preferable because it is easier and cheaper to implement.[525] A bright-line rule is when, for example, samples or data of those charged with a qualifying offence are automatically subjected to three years' retention. It is also suggested that the abolition of discretionary retention under section 63G and 63F (7) of PACE may not significantly endanger public security or decrease the efficiency of the NDNAD.[526]

Other guidance gaps with discretionary retention are resampling of individuals after data deletion and the PoFA requirement for a causal relationship between sampling arrest and any conviction.[527] For the former, initial policy permitted resampling by consent when an investigation is reopened. Currently, section 144 of the ASBCPA permits resampling without consent. For the causal relationship requirement, new section 145 of ASBCPA now provides that there is no need for a sampling arrest to lead to charge or conviction before retention. This permits a sample taken in one offence to be used in an unrelated offence.

3.3.2.7 Misapplication of CPIA exception

The CPIA exception permits extended retention of DNA samples for prosecution disclosure purposes.[528] Changes under PoFA considered the exception for DNA profiles for all offences and DNA samples of individuals involved in a serious offence. A wider application of the CPIA exception for samples was introduced by section 146 of the ASBCPA. This applies to only the relevant offence for which the sample was taken. The oversight of the CPIA exception is inadequate, and some forces, due to uncertainty of the circumstances requiring its application, may misapply the rule.[529] A new system introduced in January 2016 requires

[524] MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80).
[525] MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80).
[526] MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80).
[527] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76); National DNA Database Strategy Board, *Annual Report, 2013 to 2014* (n 78); National DNA Database Strategy Board, *Annual Report, 2014 to 2015* (n 78).
[528] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76); MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80); Wiles, *Annual Report 2016* (n 26).
[529] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76); MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80); Wiles, *Annual Report 2016* (n 26); Wiles, *Annual Report 2018: Commissioner for the Retention and Use of Biometric Material* (n 115).

a quarterly review of all 'CPIA samples' by police forces.[530] This has allowed an estimation of the number of CPIA samples, although its application issues persist.[531]

3.3.2.8 Inadequate rules for volunteer sampling and samples

Another challenge with the implementation of PoFA is the lack of adequate rules for volunteer or elimination samples.[532] This oversight has resulted in prolonged retention of volunteer DNA samples since they are subjected to indefinite retention – a situation that may discourage individuals from donating samples for use in criminal investigations.[533] The third report of the Biometrics Commissioner indicated this issue has been resolved and volunteer samples are now subjected to PoFA rules (since January 2016).[534] A second issue with volunteer sampling is the lack of information provided to volunteers on consent forms regarding the grounds for retention of their DNA.[535] The Ethics Group had indicated that 'the consent forms used do not show that the rights of individuals concerned are sufficiently protected'.[536] This concern was raised in the first Ethics Group report, prior to the implementation of PoFA.[537] An appropriate consent form was finalised by relevant stakeholders in 2015 and this was introduced in January 2016.[538]

3.3.3 Risks and emerging issues

The document analysis revealed 8 main themes about the risks and gaps in the implementation of the new NDNAD regime. These themes are described below. The

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[530] Wiles, *Annual Report 2016* (n 26).
[531] As of December 2018, there were 6,952 CPIA samples from arrestees/PACE individuals and 6,290 elimination subjects. See Wiles, *Annual Report 2018: Commissioner for the Retention and Use of Biometric Material* (n 115).
[532] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76); MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80); National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2014* (n 17); National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2015* (n 79).
[533] MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80).
[534] Wiles, *Annual Report 2016* (n 26).
[535] MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80).
[536] National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2014* (n 17) 18.
[537] National DNA Database Ethics Group, *1st Annual Report of the Ethics Group: National DNA Database* (National DNA Database Ethics Group 2008).
[538] MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80); National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2015* (n 79); Wiles, *Annual Report 2016* (n 26); National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2016* (n 446).

analysis shows links between the identified challenges and the consequences of the regime. Section 3.4.3 covers the discussion of the themes.

3.3.3.1 Public security risk due to non-retention of data

The complexities of discretionary retention have led to and anticipated to result in the loss of DNA data and/or deletion of some DNA profiles that need to be retained.[539] This problem may negatively impact the efficient detection or prevention of crime in the UK. Another matter of concern is legal, technical and resource issues related to data retention of individuals convicted of serious offences outside the UK. The biometric records (including DNA) of thousands of individuals who have foreign convictions have not been subjected to indefinite retention (as permitted by law) and hence data have been deleted or will be deleted from the database, exposing the public to potential security risks.[540] A related ethical issue on this subject is that, though permitted under the law, sampling arrests on the grounds of having a foreign conviction may constitute a greater breach of privacy than the retention of material already obtained. This ethical concern has recently been resolved through the Policing and Crime Act 2017,[541] which allows the retention of already obtained material indefinitely.

Another public security risk identified in the reports relates to changes in police arrests and bail procedures. It is reported that the number of subject samples has declined due to the diversion of a significant number of individuals to the new 'voluntary attendance' (VA) route rather than arrest.[542] This is mainly because whilst an arrest may trigger DNA sampling and inclusion in the NDNAD, a VA does not. There is limited guidance on this gap and the issue is currently under review.[543]

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[539] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76); MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80); Wiles, *Annual Report 2016* (n 26); Wiles, *Annual Report 2017: Commissioner for the Retention and Use of Biometric Material* (n 114); Wiles, *Annual Report 2018: Commissioner for the Retention and Use of Biometric Material* (n 115).
[540] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76).
[541] Wiles, *Annual Report 2016* (n 26).
[542] Wiles, *Annual Report 2018: Commissioner for the Retention and Use of Biometric Material* (n 115).
[543] Wiles, *Annual Report 2018: Commissioner for the Retention and Use of Biometric Material* (n 115); Baroness Williams of Trafford, 'Response to the Biometrics Commissioner's Annual Report 2018' (27 June 2019) <https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/812404/Government_response_to_BC_annual_report_2018.pdf> accessed 11 September 2019.

Lastly, although the current PoFA regime seeks to ensure proportionality between public and private interests, the Biometrics Commissioner noted that:

> Absent indefinite retention of every arrestee's biometrics, there will inevitably be times when crimes will go undetected or un-prevented because material obtained from individuals who have been arrested but not convicted is not retained for an indefinite period.[544]

3.3.3.2 Breach of privacy due to unlawful retention

Whilst the bulk of data that are required to be deleted from the NDNAD has been deleted, challenges with the PNC, misapplication of the CPIA, oversight, and limited enforcement of rules for the CTDNAD have led to the potential unlawful retention of data from thousands of individuals.[545] These retained data are also subjected to automatic speculative searching, the same as lawfully retained samples. Existing guidance to mitigate this privacy risk is the requirement that forces check the lawfulness of NDNAD matches before acting upon them.[546] However, police forces have adopted a policy of using unlawful matches for intelligence purposes, an emerging issue which the Biometrics Commissioner indicated may potentially breach section 63T of PACE.[547]

3.3.3.3 Contention surrounding future benefits of retention

An emerging contention arising from the implementation of the PoFA regime is whether the retention of data from innocent individuals under section 63G(2) of PACE will contribute to the prevention or detection of crime in future.[548] Whilst some forces believed that retention for cases involving domestic violence, for example, will be useful in detecting or preventing similar future crimes, the Biometrics Commissioner noted that 'there will rarely be compelling reasons to believe that the retention of the material at issue may assist in the prevention or detection of crime'.[549] The reasons given are that such suspects will readily be

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[544] MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80).
[545] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76); MacGregor, *Further Report on 2015 Annual Report.* (n 114); MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80); Wiles, *Annual Report 2016* (n 26); Wiles, *Annual Report 2017: Commissioner for the Retention and Use of Biometric Material* (n 114); Wiles, *Annual Report 2018: Commissioner for the Retention and Use of Biometric Material* (n 115).
[546] MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80).
[547] MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80).
[548] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76); MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80); Wiles, *Annual Report 2016* (n 26).
[549] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76) 28.

identified by the victim or will be obvious suspects and the police will be able to sample them at that time.[550]

3.3.3.4 Need for expansion of qualifying offences

Section 65A of PACE provides the list of qualifying offences that merit extended biometric data retention for innocent people. The Police and Criminal Evidence Act 1984 (Amendment: Qualifying Offences) Order 2013 expanded this list but excluded the possession of prohibited weapons and the importation of Class A drugs and their possession with intent to supply.[551] It is indicated that Parliament was to consider a legislative instrument covering those offences and other offences of a similar substance in mid-2016.[552] The Commissioner's fifth report indicated this legal issue may be considered by parliament in 2019.[553]

3.3.3.5 Retention after a match but without arrest

Following an NDNAD match, current police policy permits retention of DNA profiles without an arrest. There is no time limit for how long the sample can be retained whilst the match is being investigated. The Biometrics Commissioner had indicated that this policy breaches sections 63D(3), 63E, 63P and 63T(2) of PACE which seems to proscribe the investigation of an offence without an arrest.[554] An amendment to the law and/or police guidance policy has been suggested to resolve this issue but this is yet to be considered and implemented.[555]

3.3.3.6 Complex NSD process

A National Security Determination is made by a Chief Constable in writing to extend retention of data of unconvicted individuals on national security grounds.[556] This NSD

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[550] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76).
[551] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76); MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80).
[552] MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80).
[553] Wiles, *Annual Report 2018: Commissioner for the Retention and Use of Biometric Material* (n 115).
[554] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76); MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80).
[555] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76); MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80); Wiles, *Annual Report 2016* (n 26); Wiles, *Annual Report 2017: Commissioner for the Retention and Use of Biometric Material* (n 114); Wiles, *Annual Report 2018: Commissioner for the Retention and Use of Biometric Material* (n 115).
[556] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76).

expires after two years[557] and can be subjected to two years' renewals afterwards. Individuals whose data are considered for an 'NSD retention' are not informed about the existence of an NSD or the reasons for retention.[558] The Secretary of State, in consultation with the Biometrics Commissioner and the Lord Advocate, provides the statutory guidance on NSDs. The role of the Biometrics Commissioner is to review the NSDs and the use of retained material.[559] The NSD process runs on a dedicated IT system but the Biometrics Commissioner has no automatic access to the NSD applications' underlying information, a situation described as time-consuming and labour intensive.[560]

Another issue with the NSD process is guidance inadequacies. The Biometrics Commissioner had indicated that the statutory guidance on NSDs could be more useful if illustrative examples that demonstrate when an NSD is appropriate are included.[561] Further, changes introduced by section 146 of the ASBCP should be included in the guidance.[562] Other specific issues that make the NSD process complicated include: sample/data transfer delays; use of IT system that is incompatible with PoFA – a problem which has led to the calculation of wrong expiry dates for some data; NSDs made by officers of insufficient rank in a few cases; and reliability issues with statistical information on the number of individuals whose data are being held on national security grounds.[563]

3.3.3.7 Resource needs for compliance checks

Following the implementation of PoFA, arrangements were made for UKAS to include PoFA compliance checks in its existing annual assessment scheme for FSPs.[564] This

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[557] This is to be changed to 5 years. See Counter-Terrorism and Border Security Act 2019, sch 2.
[558] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76).
[559] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76); MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80); Wiles, *Annual Report 2016* (n 26).
[560] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76), para 151; MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80), para 132; Wiles, *Annual Report 2016* (n 26), para 17; Wiles, *Annual Report 2018: Commissioner for the Retention and Use of Biometric Material* (n 115), para 17.
[561] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76) 42-43.
[562] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76); MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80).
[563] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76); MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80); MacGregor, *Further Report on 2015 Annual Report.* (n 114).
[564] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76); MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80); Wiles, *Annual Report 2016* (n 26).

arrangement is yet to be formalised.[565] Whilst an assessment by UKAS was considered for police forces, this was perceived to be 'unnecessary' and 'disproportionate' among stakeholders.[566] Hence, the Biometrics Commissioner has been carrying out this duty. About six PoFA compliance checks for police forces had been carried out as of the 2014/15 fiscal year.[567] The third report of the Commissioner indicated a transition to internal PoFA compliance checks by police forces.[568] This internal system will be evaluated by the Commissioner to assure PoFA compliance by forces. It has been emphasised that additional resources will be needed to carry out PoFA compliance checks effectively.[569] In 2018, about 56% (24) of police forces had received PoFA compliance checks/visits due to an increase in the staffing of the Biometrics Commissioner's office.[570]

3.3.3.8 Limited statutory guidance for new genetic technologies

The reports of the Ethics Group emphasised the need for proper guidance and regulations for the introduction of Y-STR profiling and databasing, and DNA phenotyping or massively parallel sequencing.[571] A comprehensive ethical impact assessment had been proposed on this issue.[572] Further, wide consultation and debate had been recommended to evaluate the ethical issues associated with these genetic technologies.[573] Some of the ethical issues include the possibility of searching for genetic links among males using Y-STR profiling and discriminatory genetic investigation against males.[574] The phenotyping/sequencing technology can facilitate the prediction of the phenotypic characteristics of individuals

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[565] Wiles, *Annual Report 2016* (n 26), para 54; Wiles, *Annual Report 2017: Commissioner for the Retention and Use of Biometric Material* (n 114), para 52.
[566] MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80), para 177.
[567] MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80).
[568] Wiles, *Annual Report 2016* (n 26).
[569] MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80); Wiles, *Annual Report 2016* (n 26).
[570] Wiles, *Annual Report 2018: Commissioner for the Retention and Use of Biometric Material* (n 115), para 14.
[571] National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2014* (n 17); National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2015* (n 79); National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2016* (n 446).
[572] National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2014* (n 17); National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2015* (n 79).
[573] National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2014* (n 17); National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2015* (n 79); National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2016* (n 446).
[574] National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2014* (n 17); National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2016* (n 446).

including eye and hair colour, age, ancestry, geographical area of origin, and health or disease risk.[575]

In summary, the results suggest that whilst the PoFA regime has resulted in some benefits, multiple challenges have limited the realisation of its underlying principles. Further, the limitations of the regime have created some public security and civil liberty risks and bureaucratic complexities. The next section discusses the themes identified in the document analysis.

3.4 Discussion and conclusion of document analysis

The aim of this review was to identify the benefits, challenges, risks, and emerging issues associated with the implementation of the PoFA DNA retention regime. The key themes and findings identified from the analysed reports are discussed together under each topic below.

3.4.1 Benefits of PoFA implementation

Against the backdrop that forensic DNA retention has been subjected to political influence and restrictions by country-specific laws, there is a need to establish standards to safeguard the privacy of individuals and the safety of the public. This is particularly important with the increasing requirement of data exchange among different organisations, the increase in cross-border police investigations and the demand for international collaboration in law enforcement.[576] The PoFA regime takes consideration of the principles of proportionality and necessity as emphasised in the *Marper* decision.[577] Though some practical benefits have been realised, there are still gaps that need urgent attention.

In 2014, Wallace *et al*[578] carried out a global review of DNA database legislation, focussing on human right standards for the effective operation of forensic DNA databases. The review concluded that there is a growing global consensus to exclude the DNA records of unconvicted individuals from databases. A previous survey by the MPACLP also showed that eight out of ten Londoners support the deletion of DNA data of non-convicted

[575] National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2015* (n 79).
[576] McCartney, Wilson and Williams (n 421); McCartney, 'Forensic Data Exchange' (n 421); Sallavaci (n 311).
[577] *S and Marper v The United Kingdom* (n 44).
[578] Wallace and others (n 107).

individuals.[579] This model is perceived to be proportionate or balanced.[580] The PoFA regime appears to be only partially consistent with these views. The DNA records of most unconvicted individuals are excluded from retention. Though data of individuals arrested/charged with serious offences can be retained, 'administrative checkpoints' including the independent Biometrics Commissioner have been instituted to ensure that their human rights are adequately protected. This policy could enhance public confidence in the operation of the NDNAD.[581] The new regime could also improve the level of transparency in DNA retention by keeping innocent individuals fully informed when the police request extended retention.

While the PoFA regime would appear to offer a good level of genetic privacy protection for the innocent, the system is in sharp contrast with the health service model of informed consent, which is applied in medical research and the operation of medical biobanks.[582] The extended retention of forensic DNA profiles of individuals arrested/charged with a serious offence takes no regard of the informed consent of the individual, their right to withdraw consent and deletion of data. It appears that the State has more power over these arrestee/charged unconvicted individuals, and indirectly this category of individuals seems to be less 'innocent' than other unconvicted individuals or volunteers. This raises the question of the proportionality of the PoFA regime for unconvicted individuals.[583]

Another concern with the genetic privacy of individuals is that the PoFA regime focuses upon the data of the innocent. Although the DNA profiles of some first-time convicted minors are subjected to fixed retention, the bulk of convicted individuals are subjected to indefinite retention. There is no consideration of the seriousness of offence and severity of the sentence as emphasised by the ECHR in *W v The Netherlands*[584] and characteristic of the Dutch system and many others internationally.[585] The indefinite retention rule for all convicted adults was considered in the *Gaughran* case at the UK Supreme Court.[586] The case

[579] MPA Civil Liberties Panel (n 40).
[580] Forensic Genetics Policy Initiative, *Establishing Best Practice for Forensic DNA Databases* (n 88).
[581] Forensic Genetics Policy Initiative, *Establishing Best Practice for Forensic DNA Databases* (n 88).
[582] Mairi Levitt, 'Forensic Databases: Benefits and Ethical and Social Costs' (2007) 83 British Medical Bulletin 235; Elizabeth R Eisenhauer and others, 'Participants' Understanding of Informed Consent for Biobanking: A Systematic Review' (2019) 28 Clinical Nursing Research 30.
[583] Blakemore and Blake (n 107); McCartney, 'Of Weighty Reasons and Indiscriminate Blankets' (n 44).
[584] *W v The Netherlands* [2009] ECHR 277.
[585] John AE Vervaele, FCW de Graaf and N Tielemans, 'The Dutch Focus on DNA in the Criminal Justice System: Net-Widening of Judicial Data' (2013) Vol. 83 Revue Internationale de Droit Pénal 459.
[586] *Gaughran v Chief Constable of the Police Service of Northern Ireland (Secretary of State for the Home Department intervening)* (n 120).

concerned the indefinite retention of biometric records (including DNA) taken from an adult convicted of the offence of driving with excess alcohol. The majority decision favoured the blanket rule for reasons of the potential benefits of DNA in incriminating or eliminating individuals from a criminal inquiry.[587] Further, it was thought that the PoFA rule for convicted individuals was within the '*margin of appreciation*' across Europe.[588] In Lord Kerr's dissent, the rule was thought to be disproportionate for lack of regard for the principle of spent convictions, the gravity of the offence, and the relevance and sufficiency of the reasons for retention.[589] The case is yet to be decided by the ECHR, which will examine the proportionality of the PoFA regime for convicted adults.

The PoFA model may be problematic because the stored DNA profile can be used to track biological relatives through familial searching. This means that the family of the individual may be subjected to indefinite bio-surveillance though innocent. Some issues raised are whether individuals have the right to surrender their genetic information to the government along with that of their innocent biological family without their knowledge or informed consent.[590] Further, what assurances are required to ensure that the privacy of biological relatives is adequately protected? These are vital considerations in establishing a proportionate regime. This is important because the legal system operates by the principle of the presumption of innocence, and the retention of genetic information tends to treat individuals as suspects through speculative and familial searching.[591]

A second benefit of the PoFA regime was an improvement in the match output of the NDNAD (current match rate of 66%). This suggests that, potentially, the database may be representative of the active criminal population and, if adequately utilised, could improve crime detection and case resolution. Nevertheless, given that DNA hits do not always lead to case resolution due to changes in legislation, investigative and prosecutorial problems, and witness or suspect issues,[592] the match rate does not demonstrate the efficacy of the database. Database hit outcomes such as the resolution of cold crimes, crime deterrence and

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[587] *Gaughran v Chief Constable of the Police Service of Northern Ireland (Secretary of State for the Home Department intervening)* (n 120), paras 40-41.
[588] *Gaughran v Chief Constable of the Police Service of Northern Ireland (Secretary of State for the Home Department intervening)* (n 120), paras 42-44.
[589] *Gaughran v Chief Constable of the Police Service of Northern Ireland (Secretary of State for the Home Department intervening)* (n 120), paras 60-103.
[590] Lee (n 62).
[591] Helen Wallace, 'The UK National DNA Database: Balancing Crime Detection, Human Rights and Privacy' (2006) 7 EMBO Reports S26.
[592] Bieber (n 89).

reduction of crime, the efficiency of investigations (e.g. through DNA intelligence hits) and prosecution, and conviction rates have been recommended in previous studies as adequate measures of database efficacy.[593] Although the positive match outcome is a step towards a more detailed understanding of database effectiveness, it is limited in scope and the efficacy metrics suggested in previous studies,[594] for example, investigative efficiency, should be considered.

The document analysis also showed that the PoFA regime has accrued other important secondary benefits, such as, decreased cost of DNA sample storage, improvement of retention compliance checks, and opportunity for case review. In 2006, McCartney[595] reviewed the DNA Expansion Programme and highlighted the high financial cost and resourcing required for the operation of the database, which may be detrimental to resourcing other demands upon the police. The requirement to destroy millions of DNA samples and profiles under the new regime would, therefore, potentially create opportunities for reinvestment in other areas of policing. However, it is not clear if such benefits have been realised since new costs (e.g. funding of Biometrics Commissioner) have also been created by the regime. Another challenge is that the destruction of all DNA samples means that investigators cannot confirm or verify matches without resampling the relevant subject. The verification of DNA hits may be relevant in cases involving a low number of matching loci, which may be common in the advent of transnational exchange of data. Further, the DNA sample may be crucial in cases where further testing, such as Y-STR analysis, is required to narrow down suspects in partial profile or familial searches. These factors suggest a careful evaluation of the sample retention regime and its ethical impact on resampling of subjects.

The introduction of compliance checks for DNA sample retention is an important approach to scrutinise police and FSP retention practices. This will help identify gaps between law/policy and practice to support the continuous development of effective systems. The periodic assessment will also inform the public how retained DNA material is being used, significantly improving transparency, accountability, public confidence and the assurance of genetic privacy protection. The value of compliance checks requires that the Commissioner is adequately resourced to cover all forces.

[593] Bieber (n 89); Gabriel, Boland and Holt (n 12).
[594] Bieber (n 89); Gabriel, Boland and Holt (n 12).
[595] McCartney, *Forensic Identification and Criminal Justice: Forensic Science, Justice and Risk* (n 42).

Lastly, whilst there is provision for criminal case reviews in the UK, this is mainly focused on cases where injustice is suspected and a first appeal has failed.[596] The selection of cases for cold case investigative reviews is also highly dependent on the seriousness of the offence, availability of resources, opportunities to apply new technology and prospects of case progression.[597] These factors inform the prioritisation of cases hence some cases may be overlooked or re-investigation of the cold case may be delayed. The introduction of BRUs offers an opportunity for the police to review all cases to identify those that require an extension of biometric data. This means that gaps, shortcomings and opportunities in some cases may be identified early for re-investigation. For example, the BRU of the Metropolitan Police identified a case where an NFA-ed person should have been prosecuted and convicted based on the available evidence.[598]

3.4.2 Challenges of PoFA implementation

The PoFA retention regime is not problem-free. Firstly, there are critical challenges with the configuration of the PNC that drives the retention and deletion of DNA profiles on the NDNAD. The incompatibility of the PNC undermines the goal of achieving a proportionate DNA data retention system. The implication of the current 'compromise' system is that police can potentially manipulate the system to unlawfully retain or delete data of arrestees.[599] There is a need for thorough audit systems for the technology and PNC processes to identify the scale of potential breaches and resolve technical problems.

Secondly, the success of the PoFA regime is highly dependent on the cooperation of the police. Poor police engagement puts the public at risk since some crimes (that failed to be prevented) may go undetected. Alternatively, the genetic privacy of some individuals may be breached. In 2008, Fraser[600] reviewed the Scottish retention regime, focussing on the temporal retention of DNA data of unconvicted individuals. The review emphasised that an approach to biometric retention that coordinates policies and practices of all relevant stakeholders is crucial to achieving the aims of the law. The current discretionary PoFA

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[596] CCRC, 'Who We Are' (*Criminal Cases Review Commission*) <http://www.ccrc.gov.uk/about-us/who-we-are/> accessed 14 March 2017.
[597] J Fraser, 'Cold-Case Review: UK Experience', *Encyclopedia of Forensic and Legal Medicine (Second Edition)* (Elsevier 2016).
[598] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76).
[599] Alexander Martin, 'Cops Hacked the Police National Computer to Unlawfully Retain Suspects' Biometric Data' (*The Register*, 14 March 2016) <https://www.theregister.co.uk/2016/03/14/cops_hack_police_national_computer_unlawfully_retain_biometric_data/> accessed 14 March 2017.
[600] Fraser and Scottish Government (Funder) (n 71).

regime seems to have been developed without taking account of the views of the police or adequate consideration of police investigative or intelligence-gathering practices and principles. This analysis indicated some police forces are dissatisfied with the transfer of biometric data retention risks from legislators to the police. The new regime places a demand upon police budgets and resources, and other policing areas may suffer if PoFA is implemented to the letter. Another reason for poor police engagement is potential PoFA awareness or guidance gaps. A thorough appraisal and survey of police perceptions about the PoFA retention regime are recommended to understand the underlying issues to resolve this challenge.

The analysis also indicated a potential challenge with database contamination. DNA of police officers or crime scene examiners can contaminate crime scenes.[601] Due to improper handling or poor anti-contamination techniques, laboratory analysts can also contaminate evidence items.[602] Furthermore, manufacturers, as revealed in the famous 'Phantom of Heilbronn' case, may contaminate forensic DNA consumables, such as, cotton swabs.[603] These factors, together with record handling errors, interpretation and transcription of data errors, may contribute to database contamination.[604] One effective strategy to overcome database contamination is the establishment of elimination databases, which can be crosschecked to eliminate unwanted DNA data.[605] Another strategy is routine integrity checks of loaded DNA data.[606] The presence of unwanted profiles on the database can mislead the police or delay the resolution of cases.[607] Another crucial consequence is that

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[601] Forensic Science Regulator, *DNA Contamination Detection -The Management and Use of Staff Elimination DNA Databases* (Forensic Science Regulator 2014) <https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/355995/DNAcontamination Detection.pdf> accessed 31 August 2017; Forensic Science Regulator, *The Control and Avoidance of Contamination in Crime Scene Examination Involving DNA Evidence Recovery* (Forensic Science Regulator 2016) <https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/536827/FSR-anti-contamination.pdf>.

[602] Forensic Science Regulator, *DNA Contamination Detection -The Management and Use of Staff Elimination DNA Databases* (n 601); Forensic Science Regulator, *The Control and Avoidance of Contamination in Crime Scene Examination Involving DNA Evidence Recovery* (n 601).

[603] Franz Neuhuber and others, 'Female Criminals—It's Not Always the Offender!' (2009) 2 Forensic Science International: Genetics Supplement Series 145; Lapointe and others (n 395).

[604] National DNA Database Strategy Board, *Annual Report 2015 to 2016* (n 78).

[605] Ines Pickrahn and others, 'Contamination When Collecting Trace Evidence—An Issue More Relevant than Ever?' (2015) 5 Forensic Science International: Genetics Supplement Series e603; Kevin Sullivan and others, 'New Developments and Challenges in the Use of the UK DNA Database: Addressing the Issue of Contaminated Consumables' (2004) 146S Forensic Science International S175; Ane Elida Fonneløp and others, 'Contamination during Criminal Investigation: Detecting Police Contamination and Secondary DNA Transfer from Evidence Bags' (2016) 23 Forensic Science International: Genetics 121; Lapointe and others (n 395).

[606] National DNA Database Strategy Board, *Annual Report, 2014 to 2015* (n 78).

[607] Forensic Science Regulator, *DNA Contamination Detection -The Management and Use of Staff Elimination DNA Databases* (n 601).

where a subject profile is matched with wrong arrestee/sampling information, data may be unlawfully retained or deleted under the current PoFA regime. Moreover, database contamination can lead to the wrong estimation of database effectiveness output or outcome metrics. The challenge of database contamination is acknowledged in the reports and initiatives, such as, the establishment of the CED, may help eradicate contamination and mitigate its associated risks.

Most of the reports indicated that the governance of the CTDNAD is inadequate. This may be a contributing factor in the emerging issues associated with the complex NSD process. Although the Strategy Board has an oversight function of the CTDNAD, this is mainly focused on the technical, scientific and operational aspects.[608] To maintain transparency, accountability and public confidence in the retention and use of individuals' data, the current statutory governance arrangements for the NDNAD should be applied to the CTDNAD. Information about governance, guidance policies, statistics of profiles held on the database per retention category, the primary (and any secondary) use of individual's data and match rate should be in the public domain. This is crucial because unlike the NDNAD, unconvicted individuals are not informed about the grounds for extended retention of their data through the NSD process.

One key characteristic of the PoFA regime is discretionary retention. This policy introduces a level of subjectivity in deciding when the retention of some unconvicted individuals' data is necessary. There could be biases in the number of cases selected or approved for extended retention. This is problematic because specific guidance and legal definitions are lacking. Although the Biometrics Commissioner and the Strategy Board have developed some guidance, this has not been subjected to robust public or Parliamentary debate. Another problem is that the discretionary retention policy appears bureaucratic and expensive to implement – potentially delaying police work. As suggested by the Biometrics Commissioner, it may be worth abolishing the discretionary retention policy and introducing a bright-line rule, which could be more cost-efficient. Another issue with discretionary retention is the non-consensual resampling of individuals after data deletion.[609] The initial policy of resampling by consent may be more ethical than the current rule. The new rule may have adverse psychological impacts or ethical implications for unconvicted individuals. For

[608] National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2014* (n 17).
[609] Anti-social Behaviour, Crime and Policing Act 2014, s 144.

example, after an individual has been acquitted of an offence (or an investigation/ prosecution halted), the person should note that compulsory resampling is still open – granting more power to the State over its citizens' genetic property. There is a need for public debate and consultation with relevant agencies to consider the ethical impact of this policy.

Another challenge identified in the analysis was the misapplication of the CPIA exception. The PoFA regime provides for the destruction of the DNA sample after profiling because of its sensitivity. Under some circumstances, however, the DNA sample of a known individual may be required for prosecution disclosure purposes, which is provided for by the current law.[610] The CPIA exception permits the sample to be stored beyond the statutory 6 months' period but it must be destroyed after its purpose has been fulfilled. As stated earlier, sensitive private information such as health and disease risk can be predicted using DNA sequencing technologies.[611] This type of analysis requires the original DNA sample and its retention is perceived to be disproportionate and unnecessary in the prevention and detection of crime.[612] To maintain public confidence in the temporal retention and proper use of DNA samples, there is a need for transparent and accountable oversight. An effective audit system must be established to prevent the misapplication of the CPIA rule by police forces. Access to retained DNA samples should be restricted to vetted officers and sufficient information about governance, the number of samples held, and use should be in the public domain.

The final challenge with PoFA implementation was volunteer sampling and samples. Volunteer DNA data plays a crucial role in investigative work. It can be used to detect contamination or eliminate people who are unlikely to be suspected in a case such as victims, relatives or friends. The sensitivity of the DNA sample calls for restrictive access and adequate protection against misuse. Although new policy guidance consistent with PoFA is being developed, there is a need for clear statutory regulations informed by public debate and consultation with stakeholders. This is important because volunteer data can be subjected to the same treatment as arrestees – including speculative and familial searching.

[610] Anti-social Behaviour, Crime and Policing Act 2014, s 146.
[611] Hans Lehrach, 'DNA Sequencing Methods in Human Genetics and Disease Research' (2013) 5 F1000Prime Reports; Børsting and Morling (n 200).
[612] Krimsky and Simoncelli (n 62); Forensic Genetics Policy Initiative, *Establishing Best Practice for Forensic DNA Databases* (n 88).

3.4.3 Risks and emerging issues

Though there is limited information to justify the retention of DNA material of unconvicted individuals, it is known that some individuals within this category may be actual offenders or may commit crime in the future.[613] This is also true, however, for the entire population who are presumed innocent. Preliminary studies by Pease[614] and Tseloni and Pease[615] show subsequent re-arrest and conviction among unconvicted individuals. The re-arrest rate is estimated to be at the same rate as that of individuals cautioned or given non-custodial sentences – approximately 52% within 6 years.[616] Whilst the reliability of this statistic has been questioned,[617] both preliminary studies suggest that discretionary retention of DNA data from unconvicted individuals based on the seriousness of offence or age may diminish crime detection efforts. These conclusions are consistent with the assertion of the Biometrics Commissioner that some crimes may go undetected or fail to be prevented because not all arrestee data are subjected to indefinite retention. These views, coupled with the introduction of the VA route, suggest that the PoFA regime may be slightly skewed towards individual privacy rights and there is a need for careful consideration of the competing public interests. This consideration is also important because extended retention is mainly considered for serious offences.

Regarding the ethical issues associated with the re-sampling arrest of individuals with foreign convictions, the new Policing and Crime Act 2017[618] permits indefinite retention of material taken from an unrelated arrest. The scope of sampling has also been expanded to include all offences equivalent to a recordable offence under English and Welsh law. These changes are on par with individuals convicted of recordable crimes in England and Wales. It may be safe to assume that the public security risks associated with non-retention of the biometric material of this category of individuals will be mitigated by including their DNA data in the NDNAD.

Another important emerging issue identified in the analysis was the contention surrounding the future benefits of retention, particularly for domestic violence offences. There is extant

[613] Wallace (n 591).
[614] Pease (n 63).
[615] Tseloni and Pease (n 63).
[616] Home Office, *Keeping the Right People on the DNA Database: Science and Public Protection* (n 47).
[617] McCartney, 'Of Weighty Reasons and Indiscriminate Blankets' (n 44).
[618] Policing and Crime Act 2017.

research that establishes the heterogeneity of offences committed by individual offenders.[619] Though retention may not be beneficial to a domestic offence investigation involving the same victim, retention may be valuable to other offences, such as, stranger rape. Indirectly, DNA retention may have a 'secondary' deterrence effect on the NFA-ed arrestee of a domestic offence. This means the value of data retention should be carefully weighed to prevent any possible public security risks.

Clearly, the restrictions of PoFA may limit the intelligence-gathering efforts of the police. There should be adequate guidance and statutory rules on the use of unlawful matches to avoid the public security concerns and legal challenges encountered previously under the restrictive regime.[620] The question remains, if an unlawful match is obtained and the DNA link is the only evidence that can progress a case, should it be acted upon? What should be the procedure under such circumstances? As pointed out by the Biometrics Commissioner, current police practice may be contrary to the law. However, there may be circumstances whereby an unlawful match may be the only investigative lead in an unsolved crime. These factors should be carefully considered in striking the right balance between public and private interests.

In the Government's response to the 2015 annual report of the Biometrics Commissioner, it was indicated that Parliament would consider a legislative instrument expanding the list of qualifying offences by the end of 2016.[621] It is not clear what other offences may be considered apart from those suggested by the Commissioner. It appears that the opportunity to expand the list may widen the inclusion criteria and facilitate database expansion. It is highly recommended that the core principles and relevant factors applied by the Commissioner, including the relevance of DNA and the potential crime reduction or detection value of retention, are considered. The Government's response also stated that new guidance would be issued to resolve the issue of retaining DNA data after a match without arrest.

Finally, the analysis identified limited statutory regulation for 'new' genetic technologies that are not specifically covered by PoFA. It appears that Y-STR profiling and databasing

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[619] Leary and Pease (n 63); Michael Townsley, Chloe Smith and Ken Pease, 'Using DNA to Catch Offenders Quicker: Serious Detections Arising from Criminal Justice Samples.' (2006) 2 Genomics, Society and Policy 28; Tseloni and Pease (n 63).
[620] See *Attorney General's Reference No. 3 of 1999* (n 274); *R v Weir* (n 273).
[621] Brandon Lewis, 'Response to the Biometrics Commissioner's Annual Report 2015' (12 September 2016) <https://www.gov.uk/government/publications/response-to-the-biometrics-commissioners-annual-report-2015> accessed 16 March 2017.

are being applied, though under strict regulation, without dedicated legislation or comprehensive public consultation and debate. In a review of the legislative framework governing the NDNAD and the Netherlands DNA database, Toom[622] concluded that the 'Dutch model' of dedicated legislation to genetic technology implementation offers civil rights advantages over the English and Welsh model of technology implementation to 'legislative fixes'. This is consistent with recent recommendations by the Forensic Genetics Policy Initiative.[623] The inclusion of privacy rules in legislation and from the onset of establishing genetic databases is perceived to be easier than its introduction after establishing the database.[624] To avoid the historical legal challenges associated with the NDNAD, the Dutch model should be considered for new genetic technologies.

3.5 Conclusion

The document analysis reviewed a total of 14 reports of the two independent statutory authorities (FIND Strategy Board and the Office of the Biometrics Commissioner) and an independent non-statutory advisory public body (NDNAD Ethics Group) specifically tasked with the oversight of the NDNAD. The purpose of the document analysis was to identify the benefits, challenges, risks and emerging issues associated with the implementation of the new PoFA regime for the NDNAD. The review indicated that the regime may have improved the match output of the database, with a current match rate of 66%. Compared to previous regimes, it appears the composition of the database under the PoFA regime may be more representative of the active criminal population and the regime may improve the crime-solving capacity of the database. Additionally, the new regime has strengthened the genetic privacy protection of UK citizens, particularly the genetic privacy of the innocent. This benefit may improve public confidence in the operation of the database. The implementation challenges identified ranges from the PNC configuration, legal and procedural issues to sufficient understanding of the requirements of PoFA by police forces. The analysis showed that some 'retainable' profiles have been deleted and this may potentially diminish crime detection or reduction and raise public security concerns. In addition, some DNA data have been unlawfully retained and the current police practice permits the use of unlawful matches for intelligence purposes. This policy may lead to privacy issues and challenges in court.

[622] Toom (n 62).
[623] Forensic Genetics Policy Initiative, *Establishing Best Practice for Forensic DNA Databases* (n 88).
[624] Forensic Genetics Policy Initiative, *Establishing Best Practice for Forensic DNA Databases* (n 88).

Although limited in scope, the analysis advances the literature on the global evolution of forensic DNA database policy. The review shows that the current law in the UK could potentially improve the effectiveness of forensic DNA databases whilst complying with human rights law. The challenges identified, however, suggest that there may be a significant gap between the law and implementation. Overall, the analysis emphasises the need for comparative empirical research to demonstrate the efficacy of forensic DNA databases. Systematic and objective research is vital because this analysis focused on reports of government bodies and there is a possibility of framing or reporting bias. The crucial areas to consider include the perception of the public (as potential subjects and beneficiaries of DNA sampling) and stakeholders directly involved in the operation and use of the database, and the impact of different retention criteria and retention lengths on the performance or effectiveness of the database. This may help establish adequate public security and human rights standards for the NDNAD and potentially forensic biometric databases worldwide.

Chapter 4: Efficacy of forensic DNA retention regimes: a literature review

4.1 Introduction

Forensic DNA retention practices are suspected to be disproportionate.[625] This concern has arisen primarily because of the limited statistical evidence to prove the effectiveness of DNA databases or to justify DNA data retention, particularly data of the innocent.[626] Other concerns noted in the literature include poor engagement of the public in the development of DNA legislation;[627] diminishing returns on the expansion of DNA databases;[628] and poor consideration of good practices in ethics and principles of justice.[629]

The scarcity of empirical evidence on the efficacy of forensic DNA retention regimes and the value of DNA retention has been highlighted by several authors.[630] Empirical research is relevant because it can assist policymakers to make evidence-based decisions on retention policies and establish appropriate safeguards to protect private and public interests. The annual reports of the Biometrics Commissioner have emphasised the need for rigorous research into the effectiveness of the current semi-restrictive regime in England and Wales.[631] It is thought that this will 'inform policymakers and others as to the effectiveness and proportionality of that new regime and as to whether the relevant "lines" have been drawn in the right place'.[632]

This review assessed the existing body of original research on the efficacy/effectiveness of different retention regimes, focussing primarily upon the NDNAD. The analysis was carried

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[625] McCartney, 'Forensic DNA Sampling and the England and Wales National DNA Database' (n 62); Robin Williams and Paul Johnson, 'Inclusiveness, Effectiveness and Intrusiveness: Issues in the Developing Uses of DNA Profiling in Support of Criminal Investigations' (2005) 33 The Journal of Law, Medicine & Ethics 545; Wallace (n 591); McCartney, 'Of Weighty Reasons and Indiscriminate Blankets' (n 44); Toom (n 62); Blakemore and Blake (n 107); MPA Civil Liberties Panel (n 40).
[626] McCartney, 'The DNA Expansion Programme and Criminal Investigation' (n 14); Bieber (n 89); MPA Civil Liberties Panel (n 40); *S and Marper v The United Kingdom* (n 44).
[627] McCartney, 'Of Weighty Reasons and Indiscriminate Blankets' (n 44); Wallace (n 591); Bieber (n 89); Blakemore and Blake (n 107).
[628] Wallace (n 591); Wallace and others (n 107); Santos, Machado and Silva (n 29); Krimsky and Simoncelli (n 62).
[629] McCartney, 'Of Weighty Reasons and Indiscriminate Blankets' (n 44).
[630] Anika Ludwig and Jim Fraser, 'Effective Use of Forensic Science in Volume Crime Investigations: Identifying Recurring Themes in the Literature' (2014) 54 Science & Justice 81; Santos, Machado and Silva (n 29); Walsh, Curran and Buckleton (n 12); Simon J Walsh and others, 'Comparing the Growth and Effectiveness of Forensic DNA Databases' (2008) 1 Forensic Science International: Genetics Supplement Series 667.
[631] Wiles, *Annual Report 2018: Commissioner for the Retention and Use of Biometric Material* (n 115).
[632] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76).

out to inform the direction of this present research. The specific aims of the review were: (1) to establish existing knowledge on the efficacy of the NDNAD retention regimes; (2) to identify methods or research approaches that have been used to assess the efficacy of the different regimes; (3) to identify key performance indicators for measuring the efficacy of forensic DNA retention regimes; and (4) to identify research gaps on the efficacy of NDNAD retention regimes.

4.2 Literature review method

The two methods of conducting literature reviews are narrative and systematic.[633] The former is mainly focused on a critical synthesis of the 'best evidence' on a defined topic. Its major limitation is the lack of a robust methodology for searching and analysing literature sources. This is superseded by the systematic review method which employs replicable and transparent procedures in searching the literature, and an audit trail of the entire review process.[634] Due to this enhanced objectivity, narrative reviews currently employ elements of the systematic review.[635] A systematic review that combines and summarises the results of quantitative studies is referred to as a meta-analysis.[636] Some of the practical disadvantages of systematic reviews include bias in the selection of databases and decisions on inclusion/exclusion criteria. Further, the method involves rigid processes that may be time-consuming and labour intensive.[637] In this research, the narrative review was chosen as the most appropriate method due to its analysis and reporting flexibility.[638] To reduce bias in the selection and analysis of literature sources, the general process of the systematic review was adopted (Figure 4.1).[639]

A scoping review for the PhD research was initially conducted in 2017. The narrative review, herein, was carried out in June 2019 to update and revise the earlier version. Firstly, keywords were generated from the research topic and specific research aims. These were

[633] Bryman (n 312).
[634] David Tranfield, David Denyer and Palminder Smart, 'Towards a Methodology for Developing Evidence-Informed Management Knowledge by Means of Systematic Review' (2003) 14 British Journal of Management 207.
[635] Bryman (n 312); Bart N Green, Claire D Johnson and Alan Adams, 'Writing Narrative Literature Reviews for Peer-Reviewed Journals: Secrets of the Trade' (2006) 5 Journal of Chiropractic Medicine 101.
[636] Bryman (n 312).
[637] Bryman (n 312).
[638] Bryman (n 312).
[639] David Moher, 'Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement' (2009) 151 Annals of Internal Medicine 264; Ann T Gregory and A Robert Denniss, 'An Introduction to Writing Narrative and Systematic Reviews — Tasks, Tips and Traps for Aspiring Authors' (2018) 27 Heart, Lung and Circulation 893.

used to identify publications from four electronic research databases: HeinOnline, Web of Science™, PubMed and the SAGE. The research topic lies at the interface between law and science; thus, it was necessary to search both legal and non-legal databases to identify relevant literature. The database search was limited to peer-reviewed and primary research published in English between January 1995 and June 2019. This ensured that the research was not too broad and unwieldy. The inclusion criteria covered publications worldwide. The global context was considered because the issues of forensic DNA databasing applies to all jurisdictions in the world, and the England and Wales system has had a strong influence on the development of legislation worldwide. Literature primarily focused on Medical or Clinical DNA Databases, DNA biobanks, Population DNA Databases and Wildlife DNA databases were excluded because they are outside the scope of the research. Publications with no original and empirical research content were also excluded from the analysis.

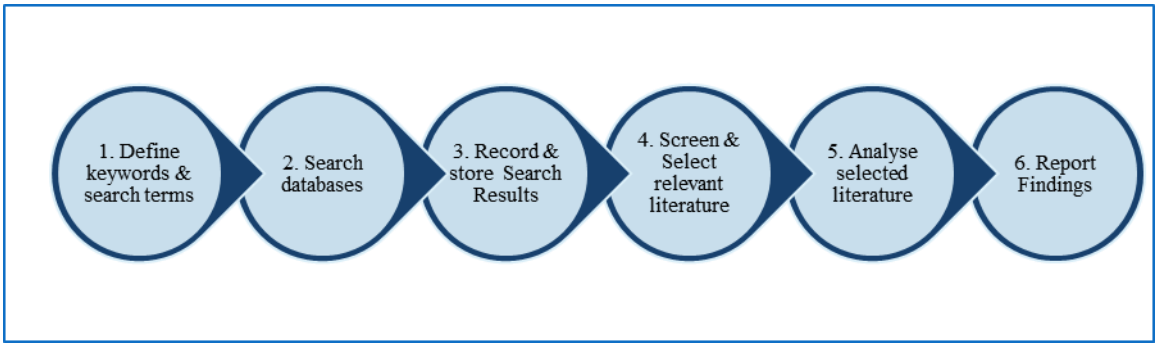

Figure 4.1 - Literature review process

4.2.1 Keywords, search terms or phrases for database search

The defined keywords and search terms presented in Appendix II were used to search and identify relevant literature from the four research databases. To narrow down the number of hits in the databases and identify the most relevant literature, parenthesis, Boolean and phrase searching operators ('AND', 'OR' and quotation marks ("")) were used.[640] Where 'AND' is used, the relevant literature includes both the keywords and/or terms. The operator 'OR' is used to identify literature containing closely related keywords or terms. Search terms or phrases in quotation marks are considered as a phrase and the relevant hits include all the words in the quotation. The search results from the databases were first exported into citation management software for further screening. The initial search in HeinOnline returned many hits and additional filters were added to narrow down the search. The filters selected were

[640] Renata Phelps, Kath Fisher and Allan Ellis, *Organizing and Managing Your Research* (SAGE Publications, Ltd 2007).

‘Articles’, ‘Science and Technology’, ‘Criminal law and procedures’ and ‘Evidence’. During the eligibility analysis, the titles of the hits were screened first, followed by the abstracts and full text for inclusion. A non-systematic search was also carried out to identify other publications that were missed in the database search. This was carried out to minimise publication bias, ensure a rigorous literature review and an accurate representation of existing literature. The non-systematic approach involved screening of the references of the included publications, and research network referrals.

4.3 Literature review results and discussion

A total of 738 publications were identified from the database search. The SAGE database returned the highest number of hits (*n = 325*). The results for the remaining databases were 279 for HeinOnline, 116 for PubMed and 18 for Web of Science™. Figure 4.2 shows the screening process for the included articles. A total of 698 publications were screened after excluding duplicates. Seventeen primary research relevant to the topic were identified from the database search. Forty-seven additional research publications and grey literature were identified from the non-systematic search. The 64 publications were critically analysed under three general areas based on the nature/type of research: 1. Public perspective studies; 2. Research evaluating DNA or database outputs and outcomes; and 3. Criminal career research.

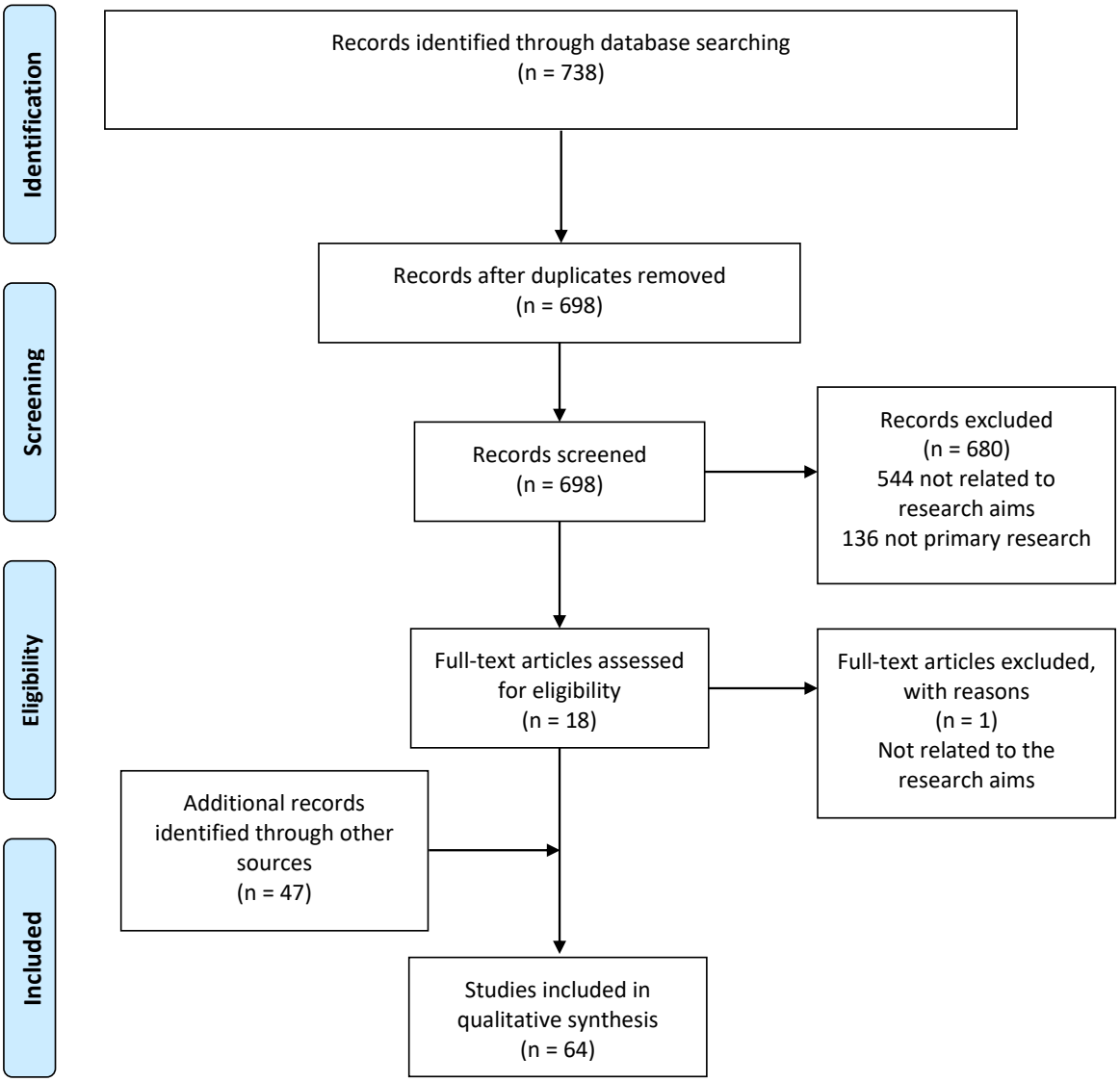

Figure 4.2 - Flow chart for the selection of included literature

4.3.1 Public perspectives about forensic DNA database retention regimes[641]

Discourses about national forensic DNA databases are limited in the public domain.[642] The dissemination of information regarding the actual effectiveness of these databases is also inadequate and public views are suspected to be influenced by the media and fictional investigative television programs (CSI effect).[643] Public perspectives about DNA retention can help policy-makers develop publicly 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.[644] Lastly, public views can shape the design of public education programmes on forensic biometrics and databases. Several empirical studies (quantitative and qualitative) in this area have been carried out in the UK and different national contexts to fill this lacuna. Table 4.1 summarises the publications included in this section and their research focus.

[641] An earlier version of this section is published in Science and Justice: Amankwaa AO, 'Forensic DNA Retention: Public Perspective Studies in the United Kingdom and around the World' (2018) 58 Science & Justice 455

[642] McCartney, 'Of Weighty Reasons and Indiscriminate Blankets' (n 44); Cate Curtis, 'Public Understandings of the Forensic Use of DNA: Positivity, Misunderstandings, and Cultural Concerns' (2014) 34 Bulletin of Science, Technology & Society 21; Cate Curtis, 'Public Perceptions and Expectations of the Forensic Use of DNA: Results of a Preliminary Study' (2009) 29 Bulletin of Science, Technology & Society 313.

[643] Teodorović and others (n 122); Curtis, 'Public Understandings of the Forensic Use of DNA' (n 642); MPA Civil Liberties Panel (n 40).

[644] Robin Williams and Matthias Wienroth, *Public Perspectives on Established and Emerging Forensic Genetics Technologies in Europe* (EUROFORGEN-NoE 2014) <https://www.euroforgen.eu/fileadmin/websites/euroforgen/images/Dissemination_Documents/WP4/Williams_and_Wienroth_-_2014_-_Public_perspectives.pdf> accessed 21 May 2017.

Table 4.1 - Characteristics of primary studies assessing views on DNA databasing (n = 30)

Country	Author(s) (Publication year)	Sample	Method	Research focus
Quantitative studies				
South Korea	Lee *et al.* (2019)	1,013 respondents (public)	Survey questionnaire, stratified cluster sampling	Criminal DNA Databases
USA	Guerrini *et al.* (2018)	1,587 respondents (public)	Survey questionnaire, non-probability sampling (NPS)	Genealogy DNA Databases
Italy	Tozzo *et al.* (2017)	959 university students	Survey questionnaire, NPS	Biobanks and Forensic DNA Databases
Serbia	Teodorović *et al.* (2017)	558 respondents (public)	Survey questionnaire, NPS	Criminal DNA Database
Switzerland	Zieger and Utz (2015)	284 respondents (public)	Survey questionnaire, NPS	Forensic DNA phenotyping
Portugal	Machado and Silva (2015)	628 respondents (public)	Survey questionnaire, NPS	Volunteer DNA Databasing
Portugal	Machado and Silva (2014)	628 respondents (public)	Survey questionnaire, NPS	Volunteer DNA Databasing
New Zealand	Curtis (2014)	394 respondents (public)	Survey questionnaire, random sampling (telephone numbers)	Use of forensic DNA
UK	MPA Civil Liberties Panel (2011)	615 Londoners	Survey questionnaire, NPS	Retention of forensic DNA
New Zealand	Curtis (2009)	100 respondents (public)	Survey questionnaire, random sampling (telephone numbers)	Use of forensic DNA
Spain	Gamero *et al.* (2008)	1654 respondents (public)	Survey questionnaire, random sampling (population)	Forensic DNA Database Governance
Spain	Gamero *et al.* (2007)	1654 respondents (public)	Survey questionnaire, random sampling (population)	Inclusion criteria for forensic DNA database
Spain	Gamero *et al.* (2006)	Not reported (public)	Survey questionnaire, random sampling (population)	Ethics of forensic DNA analysis and databases
Spain	Gamero *et al.* (2003)	1654 respondents (public)	Survey questionnaire, random sampling (population)	Criminal DNA Databases
UK	Human Genetics Commission (2001)	1038 respondents (public)	Survey questionnaire, random sampling (population)	Use of forensic DNA and databases
USA	Dundes (2001)	416 respondents in Maryland	Survey questionnaire, NPS	Criminal DNA Databases

Table 4.1 - Characteristics of primary studies assessing views on DNA databasing (n = 30) Cont'd

Country	Author(s) (Publication year)	Sample	Method	Research focus
Qualitative studies				
UK & Poland	Granja and Machado (2019)	25 stakeholders	Interviews	Familial searching
UK	Amelung and Machado (2019)	7 stakeholders	Semi-structured interviews	Issue-publics about UK NDNAD
Portugal	Machado and Silva (2016)	Analysis of open ended responses in questionnaire completed by 711 participants	Self-administered online questionnaire	Volunteer DNA Databasing
Portugal	Machado and Silva (2012)	31 male prisoners	Semi-structured interviews	DNA evidence and databasing
UK	Downey *et al.* (2012)	10 stakeholders	Interviews	Debates about DNA databasing
Portugal	Machado *et al.* (2011)	31 male prisoners	Semi-structured interviews	Expectations about DNA databases
UK	Anderson *et al.* (2011)	84 young people (age range: 12–19 years)	Focus group, citizens' jury method	Universal DNA Database
Austria	Prainsack & Kitzberger (2009)	26 prisoners	Interviews	DNA evidence and databasing
UK	Home Office (2009)	503 responses (including 402 individuals)	Public consultation	Retention of forensic biometric data
UK	Human Genetics Commission (2008)	25 – 30 citizens of UK	Inquiry sessions and interviews	Use of DNA and NDNAD
UK	Nuffield Council on Bioethics (2007)	135 responses (76% individuals)	Public consultation	Use of forensic biometric data
UK	McCartney (2006)	14 stakeholders	Interviews	Expansion of DNA databasing
UK	McCartney (2006)	14 stakeholders	Interviews	Expansion of DNA databasing
UK	Williams and Johnson (2004)	≥60 stakeholders	semi-structured interviews	Ethical positions about DNA databasing

4.3.1.1 Public perspective studies in the United Kingdom

Effectiveness of DNA databases

Analysis of existing views on the effectiveness of the UK NDNAD shows mixed attitudes among stakeholders. Through qualitative interviews, McCartney [645] investigated the perspectives of 14 criminal justice professionals and policymakers about the effectiveness of the UK DNA expansion programme and retention regimes. Two types of view emerged from the study, which can be described as utility and pragmatic views. These attitudes are represented in other qualitative studies.[646] Those who hold the 'utility view' perceive the NDNAD to be an effective tool in solving cold cases and generating intelligence. Further, it is thought that the retention of DNA samples allows authorities to upgrade the NDNAD when new technology (for example massively parallel sequencing[647]) becomes available, thus, justifying the need for the retention of DNA samples and profiles. For those who hold the 'pragmatic view', it is thought that the NDNAD is not always useful because not all cases involve DNA. Some of these express views supporting 'no conviction, no retention'. Further, they share concerns about overreliance on DNA and the NDNAD and its associated risk of abbreviating police detective work. It is also 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[648] concluded that a large database may not be effective in detecting crime. Given that retention of DNA from innocent individuals may constitute an infringement on privacy, the study emphasised the need for further investigation into the impact of DNA retention policy (and the NDNAD) on crime detection.

Inclusion and retention criteria for DNA databases

In 2000, MORI Social Research[649] investigated the attitudes of a random sample of the British public (*n = 1038*) towards human genetics information. The quantitative survey was

[645] McCartney, 'The DNA Expansion Programme and Criminal Investigation' (n 14); McCartney, *Forensic Identification and Criminal Justice: Forensic Science, Justice and Risk* (n 42).
[646] Robin Williams and Paul Johnson, '"Wonderment and Dread": Representations of DNA in Ethical Disputes about Forensic DNA Databases' (2004) 23 New Genetics and Society 205; John Downey, Mike Stephens and Jan Flaherty, 'The "Sluice-Gate" Public Sphere and the National DNA Database in the UK' (2012) 34 Media, Culture & Society 439; Nina Amelung and Helena Machado, 'Affected for Good or for Evil: The Formation of Issue-Publics That Relate to the UK National DNA Database' (2019) 28 Public Understanding of Science 590.
[647] Parson and others (n 200).
[648] McCartney, 'The DNA Expansion Programme and Criminal Investigation' (n 14).
[649] Human Genetics Commission, *Public Attitudes to Human Genetic Information* (Human Genetics Commission 2001).

sponsored by the HGC. With regards to forensic DNA information, most interviewees favoured 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'. The results generally suggest strong support for an NDNAD inclusion and retention criteria covering criminals.

Between November 2006 and January 2007, the Nuffield Council on Bioethics[650] 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 public. Citing the assumption of 'innocent until proven guilty', there was considerable support for 'no conviction, no retention' of DNA records, favouring a database of criminals. 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 reasons. Another reason in support of a 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 HGC[651] 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 generally 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 regarding the operation of the NDNAD. Concerning themes related to DNA retention policy, most participants opposed a UDNAD, 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 'discriminatory' 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

[650] Nuffield Council on Bioethics (n 45).
[651] Human Genetics Commission, *Citizens' Inquiry into the Forensic Use of DNA and the National DNA Database: Citizens' Report* (Human Genetics Commission 2008).

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[652] 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.[653] There was strong support for the destruction of all DNA samples after profiling. This policy was perceived to balance public interest and civil liberties. However, criminal justice professionals expressed utility views and were concerned that this policy may adversely affect the ability of the police to solve cold cases. Most respondents favoured the non-retention of DNA profiles for 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 below the criminal responsibility age (10 years). For children aged 10 to 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. This suggests that the views of the public on DNA retention policy may be limited by the lack of adequate evidence.

In June 2011, the MPACLP produced a report on public perspectives about the National DNA Database.[654] 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 from arrestees absent a conviction. Participants also expressed concern about the lack of justification for retaining DNA records of non-convicted individuals. Among the reasons

[652] Home Office, *Keeping the Right People on the DNA Database: Science and Public Protection* (n 47).
[653] Home Office, *Keeping the Right People on the DNA Database: Summary of Responses* (Home Office 2009) <http://webarchive.nationalarchives.gov.uk/20100418065544/http:/www.homeoffice.gov.uk/documents/cons-2009-dna-database/cons-2009-dna-response2835.pdf%3Fview%3DBinary> accessed 3 June 2017.
[654] MPA Civil Liberties Panel (n 40).

cited was the disproportionality between the high numbers 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 criminalization 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[655] 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 through familial searching, for example. 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 (genomic minimalism). 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. The ethical positions above have been identified in other studies.[656]

[655] Williams and Johnson, '"Wonderment and Dread"' (n 646).
[656] Rafaela Granja and Helena Machado, 'Ethical Controversies of Familial Searching: The Views of Stakeholders in the United Kingdom and in Poland' (2019) 44 Science, Technology, & Human Values 1068; Helena Machado and Susana Silva, 'What Influences Public Views on Forensic DNA Testing in the Criminal Field? A Scoping Review of Quantitative Evidence' (2019) 13 Human Genomics 23.

Anderson *et al*.[657] assessed the views of young offenders in South Wales about the National DNA Database in 2008. The study used a qualitative citizen's 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, however, 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 ('Practical and due process' ethical position). 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.

The analysis of public perspective studies carried out in the UK indicates that the current semi-restrictive regime (i.e. the PoFA regime and/or the 'Scottish model') is broadly representative of the recommendations of the public. However, there are several research gaps in the literature. Firstly, there is limited quantitative data on 'perceived effectiveness' of the NDNAD regimes among the public and stakeholders. Secondly, considering the NDNAD public education gap, it is difficult to ascertain whether existing public views are well informed. Thirdly, most studies feature a non-representative sample of the British population and therefore it is difficult to generalise the findings. Finally, the qualitative studies suggest conflicting views among criminal justice professionals and other members of the public. This indicates a need to investigate the current views of the public and stakeholders following the implementation of PoFA, as well as the actual effectiveness of the NDNAD regimes. This will help establish the relevant categories of individuals and appropriate retention periods to improve the performance and management of the database.

4.3.1.2 Other public perspective studies around the world

Effectiveness of DNA databases

There are limited studies on the 'perceived effectiveness' of national DNA databases globally.[658] In countries where quantitative survey data is available, DNA databases are thought to be effective in solving crime, supporting the utility view: 78.2 – 88.5% in

[657] Claudine Anderson and others, 'The National DNA Database on Trial: Engaging Young People in South Wales with Genetics' (2011) 20 Public Understanding of Science 146.
[658] Machado and Silva, 'What Influences Public Views on Forensic DNA Testing in the Criminal Field?' (n 656).

Portugal,[659] 67.2% in Serbia,[660] and 80.2% in South Korea[661]. National DNA databases are also perceived to be effective in deterring or preventing crime: 74.3% in South Korea and 47.9% in Portugal.[662] Additionally, other studies indicate strong support for the use of DNA, national DNA databases or genealogy databases in fighting crime: 88.7% in Switzerland,[663] 94 - 97% in New Zealand,[664] and 79% in the United States of America[665].

Inclusion and retention criteria for DNA databases

Like the results of studies completed in the UK, there appears to be strong support for a database of criminals in other jurisdictions.[666] Views on the retention period for DNA records or profiles appears mixed, and there is considerable opposition to the retention of data from the innocent. An international study by Wertz (2002) (as cited in Curtis[667]) surveyed the views of 4868 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%). An inclusion criterion covering such 'convicted serious offenders' and suspects is supported in South Korea (89.2%).[668] Wertz also found that 'indefinite DNA retention' was supported by 90% and 55% of participants for those convicted and charged, respectively. Most participants opposed the DNA typing of the innocent.

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[659] Helena Machado and Susana Silva, 'Public Perspectives on Risks and Benefits of Forensic DNA Databases: An Approach to the Influence of Professional Group, Education, and Age' (2015) 35 Bulletin of Science, Technology & Society 16.
[660] Teodorović and others (n 122).
[661] Ji Hyun Lee and others, 'Public Perception of a Criminal DNA Database in Korea' (2019) 7 Public Perception of a Criminal DNA Database in Korea 75.
[662] Machado and Silva, 'Public Perspectives on Risks and Benefits of Forensic DNA Databases' (n 659); Lee and others (n 661).
[663] Martin Zieger and Silvia Utz, 'About DNA Databasing and Investigative Genetic Analysis of Externally Visible Characteristics: A Public Survey' (2015) 17 Forensic Science International: Genetics 163.
[664] Curtis, 'Public Understandings of the Forensic Use of DNA' (n 642); Curtis, 'Public Perceptions and Expectations of the Forensic Use of DNA' (n 642).
[665] Christi J Guerrini and others, 'Should Police Have Access to Genetic Genealogy Databases? Capturing the Golden State Killer and Other Criminals Using a Controversial New Forensic Technique' (2018) 16 PLOS Biology <https://doi.org/10.1371/journal.pbio.2006906>.
[666] L Dundes, 'Is the American Public Ready to Embrace DNA as a Crime-Fighting Tool? A Survey Assessing Support for DNA Databases' (2001) 21 Bulletin of Science, Technology and Society 369; Curtis, 'Public Perceptions and Expectations of the Forensic Use of DNA' (n 642); Joaquín-Jose Gamero and others, 'A Study of Spanish Attitudes Regarding the Custody and Use of Forensic DNA Databases' (2008) 2 Forensic Science International: Genetics 138; Lee and others (n 661).
[667] Curtis, 'Public Perceptions and Expectations of the Forensic Use of DNA' (n 642).
[668] Lee and others (n 661).

In the United States, Dundes[669] surveyed 416 residents of Maryland using a convenience sampling approach in 1999. The study found strong support for a DNA database of 'convicted individuals' and some suspects. This ranged from 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[670] concluded that an expanded DNA database may be valuable to crime-fighting. However, there should be appropriate safeguards to prevent misuse of the database.

Gamero *et al.*[671] investigated public awareness of DNA databases in a representative sample (n = 1654) 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%, and 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%). There was strong support for a 'recidivistic violent offenders' DNA database (RVOD)' (79.9%), '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 RVOD, 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'. This retention period is also favoured among surveyed South Koreans (79.5%) for convicted serious/violent offenders.[672]

In New Zealand, Curtis[673] 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

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[669] Dundes (n 666).
[670] Dundes (n 666).
[671] Joaquín-Jose Gamero and others, 'Spanish Public Awareness Regarding DNA Profile Databases in Forensic Genetics: What Type of DNA Profiles Should Be Included?' (2007) 33 Journal of Medical Ethics 598; Gamero and others, 'A Study of Spanish Attitudes Regarding the Custody and Use of Forensic DNA Databases' (n 666); Joaquín-Jose Gamero and others, 'Some Social and Ethical Aspects of DNA Analyses and DNA Profile Databases' (2006) 1288 International Congress Series 777; Joaquín-Jose Gamero and others, 'Study of Spanish Public Awareness Regarding DNA Databases in Forensic Genetics' (2003) 1239 International Congress Series 773.
[672] Lee and others (n 661).
[673] Curtis, 'Public Perceptions and Expectations of the Forensic Use of DNA' (n 642).

telephone. There was a significant support for a database of 'convicted individuals, suspects and arrestees': 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 offences (52%). More than half of respondents opposed retention for arrestees or suspects of any crime and a UDNAD. Indefinite DNA retention was supported by 74% of participants. 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 identified limited knowledge about DNA analysis and databasing processes. Even though the study was representative, the small sample size limits the generalizability of the results.

Opinion of prisoners

Like the general population, prisoners also share views of restricting DNA databases to criminals or individuals who have had contact with the criminal justice system. In Austria, Prainsack and Kitzberger[674] interviewed 26 prisoners to ascertain their knowledge and views about forensic DNA technology in 2006 and 2007. Most interviewees thought the use of DNA is effective in solving crime or eliminating the 'usual' suspects in a criminal inquiry. The main source of DNA information in this population was 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 from 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.*[675] 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

[674] B Prainsack and M Kitzberger, 'DNA Behind Bars: Other Ways of Knowing Forensic DNA Technologies' (2009) 39 Social Studies of Science 51.
[675] Helena Machado, Filipe Santos and Susana Silva, 'Prisoners' Expectations of the National Forensic DNA Database: Surveillance and Reconfiguration of Individual Rights' (2011) 210 Forensic Science International 139; Helena Machado and Susana Silva, 'Criminal Genomic Pragmatism: Prisoners' Representations of DNA Technology and Biosecurity' (2012) 2012 Journal of Biomedicine and Biotechnology <https://dx.doi.org/10.1155%2F2012%2F592364>.

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 databases

Machado and Silva[676] in 2012 focused on the willingness of a non-representative sample ($n = 628$) of Portuguese citizens to accept the inclusion of their DNA profile in the DNA database. Voluntary participation was accepted by 46.5% respondents and this decreased significantly with age ($p < 0.001$) and education ($p = 0.011$). Most respondents (53.5%) answered 'perhaps' (30.3%) or would not accept (23.2%). 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 mainly influenced by the belief in the idea of 'nothing to hide, nothing to fear' (18.2%), the utility of databases (20.9%) and UDNAD (23.3%). Similar results have also been found in Italy[677] (35% acceptance, $n = 959$) and Switzerland[678] (34% acceptance, $n = 284$) among a non-probability sample of university students and the general public, respectively. The Switzerland study found that acceptance was significantly more likely among women and participants with no university education (*all* $p < 0.001$).[679]

In the Portuguese study, Machado and Silva[680] 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 forensic DNA database practices. Most participants agreed on the crime-solving efficiency (88.5%) and judicial efficiency (78.2%) of forensic DNA databases. However, there appeared to be

[676] Helena Machado and Susana Silva, '"Would You Accept Having Your DNA Profile Inserted in the National Forensic DNA Database? Why?" Results of a Questionnaire Applied in Portugal' (2014) 8 Forensic Science International: Genetics 132; Machado and Silva, 'Public Perspectives on Risks and Benefits of Forensic DNA Databases' (n 659); Helena Machado and Susana Silva, 'Voluntary Participation in Forensic DNA Databases: Altruism, Resistance, and Stigma' (2016) 41 Science, Technology, & Human Values 322.
[677] P Tozzo, A Fassina and L Caenazzo, 'Young People's Awareness on Biobanking and DNA Profiling: Results of a Questionnaire Administered to Italian University Students' (2017) 13 Life Sciences, Society and Policy.
[678] Zieger and Utz (n 663).
[679] Zieger and Utz (n 663).
[680] Machado and Silva, 'Public Perspectives on Risks and Benefits of Forensic DNA Databases' (n 659).

scepticism about the 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[681] also analysed the open-ended questions in the survey to determine the motivations for voluntary participation in DNA databases. The study found that voluntary participation is motivated by solidarity, altruism and civic responsibility to contribute to public protection; 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. These reasons have also been identified in subsequent surveys.[682] A limitation of these studies, however, is the use of non-probability sampling which limits the generalisation of the results. Secondly, the findings may be attributed to potential media or academic influence on the subject rather than actual experience or exposure to the DNA database system.

In contrast with the above studies, Curtis[683] investigated the understanding of a generally 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%). Further, most participants considered 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 included privacy issues (51.4%), errors (66.9%) and 'planting' of DNA (57.8%).

In summary, the available survey results suggest a mixed perspective about voluntary participation in DNA databases. The common themes in these studies are participation on grounds of contributing to public security and non-participation for privacy reasons and distrust of the databasing system.

[681] Machado and Silva, 'Voluntary Participation in Forensic DNA Databases' (n 676).
[682] Zieger and Utz (n 663); Tozzo, Fassina and Caenazzo (n 677).
[683] Curtis, 'Public Understandings of the Forensic Use of DNA' (n 642).

Views of criminal justice professionals versus other members of the public

In Serbia, Teodorović *et al.*[684] assessed the views of a non-representative sample (*n* = 558) of the Serbian public regarding 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). The study found that users of the database favoured permissive rules whilst subjects preferred restrictive rules. This observation is consistent with the findings of several public perspective studies in the UK.[685] Most respondents (57.9%) supported inclusion 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.

In summary, the public perspective studies emphasise the value placed upon the ability of forensic DNA databases to solve crime. The outcome of studies conducted in the UK and other jurisdictions show considerable public support for the retention of DNA from convicts, suspects and potentially all arrestees and the entire population, which is most likely predicated upon the belief that the database has 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

[684] Teodorović and others (n 122).
[685] Human Genetics Commission, *Citizens' Inquiry into the Forensic Use of DNA and the National DNA Database: Citizens' Report* (n 651); Home Office, *Keeping the Right People on the DNA Database: Summary of Responses* (n 653); MPA Civil Liberties Panel (n 40).

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. Further, 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 regimes among stakeholders. 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, FSPs, 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. To fill the identified research gap, this project sought to survey the views of these stakeholders and the current views of the general public.

4.3.2 Evaluative research on DNA and database outputs and outcomes[686]

Table 4.2 presents a summary of the included studies that have assessed the outputs and outcomes of using forensic DNA evidence and national DNA databases. Three groups of studies related to database performance or efficiency have been carried out. The first analyzes the overall contribution or value of DNA evidence and/or DNA databases to the detection of crime. These studies point to the marginal significance of DNA evidence and/or databases in crime detection or clearance overall. The second group of studies examine the impact of DNA evidence and/or the DNA database on crime detection or prevention compared to crimes that do not involve DNA. This group of studies show that crimes, where DNA evidence is available, are more likely to result in a detection or case resolution. Finally, the third group of studies consider defining statistical models to systematically evaluate the performance and efficiency of DNA databases. Only crude estimates of performance or effectiveness can be determined with the current models available.

[686] An earlier version of this section is published in Forensic Science International: Synergy: Amankwaa AO and McCartney C, 'The Effectiveness of the UK National DNA Database' (2019) 1 Forensic Science International: Synergy 45

Table 4.2 - Summary of primary studies assessing the outputs and outcomes of forensic DNA evidence and databases (n = 29)

Country	Author(s) (Publication year)	Number of cases/samples	Method	Main research focus
USA	Davis *et al.* (2019)	1712 cases loaded in National DNA Index System	Interrupted time series analysis (2008-2015) Descriptive analyses	Effect of law on sexual assault cases
Belgium	De Moor *et al.* (2018)	654 crimes	Social network analysis	Serial co-offending behaviour
Belgium	De Moor *et al.* (2018)	181483 crimes (police dataset) 1913 crimes (DNA dataset)	Descriptive and inferential statistical analysis	Behaviour of unknown offenders
USA	Cross *et al.* (2017)	3530 cases	Descriptive and inferential statistics	Sexual assault investigation: impact of DNA evidence on arrest
Belgium	Jeuniaux *et al.* (2016)	81968 genetic profiles	Descriptive and inferential statistics	Intelligence about association of offenders
Denmark	Doleac *et al.* (2016)	61,454 observations	Regression discontinuity design	Detection and deterrence effects of DNA databases
USA	Doleac (2016)	1.9 million violent offences 15.3 million property offences	Regression discontinuity design	Effects of DNA database on recidivism and crime rate
USA	Doleac (2016)	660 observations	Regression discontinuity design	Inter-state effects of DNA databasing
Netherlands	Mapes *et al.* (2015)	116 serious crimes; 2791 high volume crime	Descriptive	Impact of DNA databases in the identification of suspects
Netherlands	Lammers (2014)	1861 offenders	Descriptive statistics; Cox proportional hazards model	Intelligence about offending behaviour
USA	Fallik & Wells (2014)	259 cases	Descriptive	Examination of sexual assault kits
USA	Bhati & Roman (2014)	141697 samples	Multiple clock model	Deterrent effect of DNA databases
EU (including UK)	Santos *et al.* (2013)	19 national DNA databases	Descriptive; non-parametric testing	Relationship between retention regime and database performance
Netherlands	Lammers & Bernasco (2013)	4414 offenders	Descriptive statistics; Cox proportional hazards model	Intelligence about offending behaviour
Netherlands	Lammers *et al.* (2012)	4430 offenders	Descriptive statistics; Cox proportional hazards model	Intelligence about offending behaviour
USA	Baskin & Sommers (2011)	1263 cases	Descriptive	Impact of forensic evidence (including DNA) on burglary case outcome

Table 4.2 - Primary studies assessing the outputs and outcomes of forensic DNA evidence and databases (n = 29) Cont'd

Country	Author(s) (Publication year)	Number of cases/samples	Method	Main research focus
USA, UK, Canada, New Zealand	Walsh *et al.* (2010)	52 State DNA Index System (US) 3 national DNA databases	DNA performance inferential model	Performance of DNA databases
USA	Gabriel *et al.* (2010)	198 offender and case-to-case matches	Descriptive	Impact of cold hits
USA	Roman *et al.* (2009)	2160 cases	Prospective block random assignment design	Effectiveness of DNA in solving property crime
USA, UK, Canada	Walsh *et al.* (2008)	4 databases (US, California SDIS, UK NDNAD, Canada NDNAD)	DNA database performance model	Relationship between database growth and performance
Australia	Dunsmuir *et al.* (2008)	24548 individuals	Time series analysis	Impact of DNA testing prison inmates
USA	Schroeder (2007)	593 cases	Descriptive	Impact of DNA on homicide clearance
Canada	House *et al.* (2006)	191 cases	Descriptive	Relationship between DNA database inclusion criteria and resolution of sexual crime
Australia	Briody (2006)	200 cases	Descriptive; inferential statistical analysis	Effect of DNA evidence on property crime resolution
UK	Burrows & Tarling (2004)	1.8 million crimes (612000 crimes attended by Scene of Crime Officers)	Descriptive	Impact of forensic evidence (including DNA) on detection of property crime
Australia	Briody (2004)	150 cases	Descriptive; inferential statistical analysis	Effect of DNA evidence on homicide resolution
New Zealand	Walsh *et al.* (2002)	18101 reference profiles 2677 crime scene profiles	Descriptive	Intelligence effects of DNA databases
Australia	Briody (2002)	200 cases	Descriptive; inferential statistical analysis	Effect of DNA evidence on sexual assault resolution
UK	Carling *et al* (n.d.)	420 murder cases (91 matches) Separate 853 matches (Year 2009/10)	Descriptive	Contribution of NDNAD matches to serious crime investigation (murder/manslaughter/rape)

A number of the included studies assessed the intelligence function of DNA databases and its relevance in criminological research. These highlighted several regime-independent factors that may limit DNA databases in achieving their public security goals, such as, the prevention, detection, investigation and prosecution of crime. Walsh *et al.*[687] showed that low DNA submission and load success rates limit the performance of DNA databases. The study examined the DNA submission, analytical and match rate trend for the New Zealand DPD. Between 1996 and 2001, the reference sample submission (RSS) rate of most NZ Police Districts (8/12) was below 5.8 per 1000 population. The crime sample submission (CSS) rate for most Police Districts (7/12) was also below 1 per 1000 population between 1999 and 2001. Over 80% of CSS were related to property crime whilst 12% were related to violent crime. Low RSS and CSS were associated with low match rate, indicating a decrease in the crime-solving potential of the DNA databank. The analytical trend showed that not all CSS get loaded on the database and load success is dependent on evidence type with blood and semen yielding rates of 72.5% and 72.4%, respectively. Interestingly, property crimes, such as burglary (where the recovery of blood and semen is rare), were found to return higher match rates than violent crime, such as sexual assault. This was attributed to the high volume of property crime submissions. Overall, the study suggests that pre-loading challenges limit the effectiveness of DNA databases, regardless of the retention regime being implemented.

Using data from the Dutch DNA Database, Lammers and Bernasco[688] demonstrated that, though DNA databases can link crimes to identify serial offenders, their effectiveness may be limited by inadequate sharing of investigative information by police forces. The study tested the chance of arrest between 2132 identified and 2282 unidentified serial offenders in relation to their geographical mobility. The probability of arrest was found to be inversely related to the geographical spread of crime locations. This observation was attributed to the inadequate collaboration between different police jurisdictions. Similar studies that utilise data from forensic DNA databases and crime records have identified 'unknown accomplice networks' and 'serial offending patterns', which reinforce the importance of cross-jurisdictional collaboration in resolving and preventing crime.[689] This post-loading/hit

[687] SJ Walsh and others, 'The Collation of Forensic DNA Case Data into a Multi-Dimensional Intelligence Database' (2002) 42 Science & Justice 205.
[688] Marre Lammers and Wim Bernasco, 'Are Mobile Offenders Less Likely to Be Caught: The Influence of the Geographical Dispersion of Serial Offenders' Crime Locations on Their Probability of Arrest' (2013) 10 European Journal of Criminology 168.
[689] Sabine De Moor, Christophe Vandeviver and Tom Vander Beken, 'Integrating Police-Recorded Crime Data and DNA Data to Study Serial Co-Offending Behaviour' (2018) 15 European Journal of Criminology 632; Sabine De Moor, Christophe Vandeviver and Tom Vander Beken, 'Are DNA Data a Valid Source to Study the Spatial Behavior of Unknown Offenders?' (2018) 58 Science & Justice 315; Patrick Jeuniaux and others, 'Establishing Networks in a Forensic DNA Database to Gain Operational and Strategic Intelligence'

challenge suggests that irrespective of the type of retention regime, the public security outcomes of DNA databases may not be fully realised.

Other regime-independent factors that limit the effectiveness of DNA databases are detailed in review studies. These include investigative and prosecutorial problems, and victim, witness or suspect issues.[690] The first includes the probative value of the DNA hit in a case. Although the match establishes the presence of an individual at a crime scene, it does not always directly establish criminality, except in cases of sexual assaults of minors. Another challenge is the prioritisation of cases which may lead to delays in the follow-up of DNA hits by detectives or 'DNA hit cases" by prosecutors. Finally, other corroborative evidence may be lacking to prosecute a case. The victim, witness or suspect issues may include decline to pursue a case by victims or witnesses; the death of victims, witnesses or suspects; and inability to trace individuals linked to a crime.

Despite the limitations of DNA database efficiency, there are several isolated cases of its investigative value. However, systematic evidence of its total value to crime-fighting is lacking. This gap is linked to the minimal demand for the evaluation of DNA databases or difficulties in assessing efficacy due to inconsistency in data collection, unavailability of data and/or defined effectiveness metrics/models.[691] The three groups of studies on or related to database performance or effectiveness are considered below.

4.3.2.1 Contribution of DNA evidence and/or DNA databases

Burrows and Tarling[692] investigated the contribution of forensic evidence including DNA in the detection of property crime (burglary and vehicle crime). The study used data available from the Home Office 'Pathfinder Project' (June 2000 – May 2001) that focussed on two police forces, Greater Manchester Police and Lancashire Constabulary. Additional information from Morgan Harris Burrows' evaluation of the DNA Expansion Programme was also included in the analysis. Of approximately 1.8 million property crimes committed every year, it was estimated that 612,000 (34%) are visited by crime scene investigators.

(2016) 29 Security Journal 584; Marre Lammers, 'Are Arrested and Non-Arrested Serial Offenders Different? A Test of Spatial Offending Patterns Using DNA Found at Crime Scenes' (2014) 51 Journal of Research in Crime and Delinquency 143; Marre Lammers, Wim Bernasco and Henk Elffers, 'How Long Do Offenders Escape Arrest? Using DNA Traces to Analyse When Serial Offenders Are Caught' (2012) 9 Journal of Investigative Psychology and Offender Profiling 13.

[690] Bieber (n 89); Gabriel, Boland and Holt (n 12).

[691] Walsh, Curran and Buckleton (n 12).

[692] J Burrows and R Tarling, 'Measuring the Impact of Forensic Science in Detecting Burglary and Autocrime Offences' (2004) 44 Science & Justice 217.

Approximately 18% (110,040) of visited scenes yield DNA (either SGM+ (6%) or LCN DNA (12%)). The profiling success of the crime scene DNA was found to be 60% for SGM+ DNA and 18% for LCN DNA. The match rate for SGM+ DNA was 73.3% whilst LCN DNA was 66.7%. Overall, 4% of visited scenes led to suspect identification using DNA matches/hits. It was estimated that approximately 10% of property crimes are detected by the police and the contribution of forensic evidence (both fingerprints and DNA) is about 33.3%. The sole contribution of DNA and/or the NDNAD to the clear-up rates was not estimated. Nevertheless, the study shows that though DNA evidence appears to play a crucial role in property crime, its overall contribution seems to be very low compared to other crime-fighting approaches. This observation is also reported by early reviews in the US[693] and more recent comments in the UK[694] about the aggregate value of forensic DNA and/or forensic science in general. The implication of this is a need to ensure value for investment in the creation and use of DNA databases.

Like the results of Burrows and Tarling,[695] other reviews focused on property and serious crimes have found a low contribution of databases in resolving all crime. In England and Wales, the estimated contribution was found to be ~1% for property crimes as of 2002/2003[696] and 15.10% for all murders in 2009/2010[697]. The property crime review relied on publicly available data on the potential number of DNA-related convictions versus the number of reported property crimes as of 2002/2003. The murder crime study was based on the opinion of Senior Investigating Officers [84]. In the Kennemerland police region of the Netherlands, Mapes *et al.*[698] found that the national DNA database contributed to the resolution of 1% and 3% of property crimes and serious crimes (such as murder and sexual assaults), respectively. This study utilised data from forensic reports in 2011.

Briody and Prenzler[699] examined the potential effect of DNA databases on property crime levels in New South Wales, Australia. The evaluation report of the Vendas Police operation

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[693] Paul E Tracy and Vincent Morgan, 'Big Brother and His Science Kit: DNA Databases for 21st Century Crime Control Criminology' (2000) 90 Journal of Criminal Law and Criminology 635.
[694] Mark Walport, Claire Craig and Elizabeth Surkovic, 'Annual Report of the Government Chief Scientific Adviser 2015: Forensic Science and beyond: Authenticity, Provenance and Assurance' (Government Office for Science 2015); Science and Technology Committee (n 216); Wiles, *Annual Report 2016* (n 26).
[695] Burrows and Tarling (n 692).
[696] Michael Briody and Tim Prenzler, 'D.N.A. Databases and Property Crime: A False Promise?' (2005) 37 Australian Journal of Forensic Sciences 73.
[697] MJ Carling and others, 'The Contribution of Forensic Science to Murder and Other Serious Crime Investigation in England and Wales in 2009-10' (National Policing Improvement Agency; Unpublished).
[698] Anna A Mapes, Ate D Kloosterman and Christianne J de Poot, 'DNA in the Criminal Justice System: The DNA Success Story in Perspective' (2015) 60 Journal of Forensic Sciences 851.
[699] Briody and Prenzler (n 696).

in 2002/2003 was analysed. There was no significant reduction in property crime levels before and after the implementation of improved forensic biometric capabilities (DNA and fingerprints). A mixed picture was also observed by Dunsmuir *et al*.[700] about the impact of DNA database growth on the resolution of violent and property crimes in New South Wales from 1995 to 2007. Using police and court data, the study observed positive, zero and negative impacts on clear up, charge and conviction rates depending on the type of offence. These studies suggest that the realisation of criminal justice or policing outcomes may be complex.

In the United States, Wells *et al*.[701] found that only 1 out of 104 CODIS hits proceeded to charge in untested sexual assault kits (SAK). The study examined 491 kits from the Houston Police Department (HPD) and hit outcomes were assessed via interviews rather than actual follow up of cases. A previous study of 259 cases from the HPD found that only 3% of unsubmitted SAKs were useful following testing.[702] The above trend has been attributed to post-hit challenges and regime independent factors such as lack of cooperation by victims and instances where DNA evidence is of no value to the investigation.[703] In one study that assessed the impact of the law (Texas Senate Bill 1636) facilitating testing of untested SAKs, no significant impact on case outcomes was observed.[704] The trend of low impact of DNA evidence (including use of databases) has also been observed in burglary cases in the United States: ≤ 0.3% in 1263 incidents across five jurisdictions in 2003.[705] In this study, Baskin and Sommers[706] found that witness statements are relatively better predictors of case outcomes than forensic evidence in general.

Whilst the findings from the above studies are crude estimates and based on 'old' DNA analysis methodologies, they are generally consistent with previous reports and the current

[700] William TM Dunsmuir, Cuong Tran and Don Weatherburn, *Assessing the Impact of Mandatory DNA Testing of Prison Inmates in NSW on Clearance, Charge and Conviction Rates for Selected Crime Categories* (NSW Bureau of Crime Statistics and Research 2008).
[701] William Wells, Ashley K Fansher and Bradley A Campbell, 'The Results of CODIS-Hit Investigations in a Sample of Cases With Unsubmitted Sexual Assault Kits' (2019) 65 Crime & Delinquency 122.
[702] Seth Fallik and William Wells, 'Testing Previously Unsubmitted Sexual Assault Kits: What Are the Investigative Results?' (2014) 26 Criminal Justice Policy Review 598.
[703] Fallik and Wells (n 702).
[704] Robert C Davis and others, 'The Effects of Legislation Mandating DNA Testing in Sexual Assault Cases: Results in Texas' [2019] Violence Against Women <https://doi.org/10.1177/1077801219838330> accessed 8 June 2019.
[705] Deborah Baskin and Ira Sommers, 'Solving Residential Burglaries in the United States: The Impact of Forensic Evidence on Case Outcomes' (2011) 13 International Journal of Police Science & Management 70.
[706] Baskin and Sommers (n 705).

outlook of the UK NDNAD as a 'marginal' contributor to the resolution of all crime.[707] The findings generally suggest that DNA evidence and databases should be considered 'auxiliary' in achieving overall public security goals rather than a principal instrument in policing or delivering justice.[708] Further, the literature indicates that DNA and databases are more useful in solving specific types of cases and may have a potential impact in cases involving offenders of certain characteristics.[709] It is imperative that evaluative studies on the actual effectiveness of databases and its regimes are carried out to identify characteristic patterns in the applicable cases. This will ensure that databases are cost-effective and focused to assist the police.

4.3.2.2 Comparison of cases involving DNA and cases without DNA

DNA hit outcomes are favoured above performance metrics, such as, hit/match rates and/or the number of investigations aided.[710] Studies that have compared the outcome of criminal cases involving DNA evidence and cases without DNA were also included in this review to gain insight into the potential impact DNA hits could have on cases. In Australia, the work of Briody[711] assessed the effects of DNA evidence in selected sexual, homicide and property crime cases from 1994 to 2001. The Australian NCIDD was established in April 2001.[712] The selected cases were those in which DNA testing was used for confirmation of the involvement/identity of already identified or charged suspects. Data were analysed using a control-comparison approach to compare: 102 sexual offences with DNA to 98 cases without DNA;[713] 100 property crimes with DNA to 100 non-DNA cases;[714] and 75 homicide DNA cases versus 75 non-DNA cases[715]. In all three types of cases, it was found that those involving DNA are more likely to reach court than non-DNA cases. DNA evidence was associated with more guilty pleas in property offences but not sexual crimes and homicides.

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[707] Wiles, *Annual Report 2016* (n 26); DB Wilson, D McClure and D Weisburd, 'Does Forensic DNA Help to Solve Crime? The Benefit of Sophisticated Answers to Naive Questions' (2010) 26 Journal of Contemporary Criminal Justice 458; David A Schroeder, 'DNA and Homicide Clearance: What's Really Going On' (2007) 7 Journal of the Institute of Justice & International Studies 276.
[708] Baskin and Sommers (n 705).
[709] John House and others, 'Improving the Effectiveness of the National DNA Data Bank: A Consideration of the Criminal Antecedents of Predatory Sexual Offenders' [2006] Canadian Journal of Criminology and Criminal Justice <https://www.utpjournals.press/doi/abs/10.3138/cjccj.48.1.61> accessed 24 June 2019.
[710] Bieber (n 89).
[711] Michael Briody, 'The Effects of DNA Evidence on Sexual Offence Cases in Court' (2002) 14 Current Issues in Criminal Justice 159; Michael Briody, 'The Effects of DNA Evidence on Homicide Cases in Court' (2004) 37 Australian & New Zealand Journal of Criminology 231; Michael Briody, 'The Effects of DNA Evidence on Property Offences in Court' (2006) 17 Current Issues in Criminal Justice 380.
[712] Australian Criminal Intelligence Commission, 'National Criminal Investigation DNA Database' (n 237).
[713] Briody, 'The Effects of DNA Evidence on Sexual Offence Cases in Court' (n 711).
[714] Briody, 'The Effects of DNA Evidence on Property Offences in Court' (n 711).
[715] Briody, 'The Effects of DNA Evidence on Homicide Cases in Court' (n 711).

Sexual offence cases with DNA evidence were associated with more guilty verdicts by a jury, and more and longer custodial sentencing. The three studies suggest that coupled with a well-targeted and effectively utilised national DNA database, the judicial outcomes of sexual and property crimes and homicides could be improved.

In a similar prospective randomized study in the US, property crime cases involving DNA analysis/CODIS hit was associated with an increase in suspect identification, arrest rate and prosecution rate.[716] The study analysed a total of 2,160 cases between 2005 and 2007 in five cities in the US. Biological evidence was recovered from all the cases included in the study. The cases were randomly assigned into two groups: treatment group (DNA analysis group: n = 1,079) and control group (traditional investigation group (including fingerprint analysis): n = 1,081). Suspect identification, arrest rate and prosecution rate were higher in the treatment group (31%, 21.9% and 19.3%, respectively) than the control group (12.8%, 10.1% and 8.1% respectively).[717] These findings were consistent with that of Briody[718], demonstrating the potential value DNA data retention could have on crime resolution. Further analysis of the cost-effectiveness of 'DNA-assisted arrests' revealed an average cost of ~$14,000 across the different states.[719] According to the authors, this cost was higher than traditional investigation such as fingerprint analysis. Hence, though DNA may be effective in resolving crime, investment in DNA databases should be limited to those crimes where DNA is useful. Further, there should be consideration of the availability of resources for other policing work.

Lastly, Cross *et al.*[720] researched the impact of DNA on arrest in sexual offences. The study reviewed 528 cases from Massachusetts between 2008 and 2010. It was found that DNA could have been influential in only 8 cases where arrests occurred near to the time or after laboratory results were provided. This shows that the value of DNA profiling and databasing depends on when a profile or match is produced and what influence it can then have through the justice process. If a profile is generated more quickly and/or immediately loaded on the database, suspects may be identified and processed speedily using DNA evidence (i.e. in such DNA-related cases where the identity of the offender is unknown). In this regard, the

[716] John K Roman and others, 'The DNA Field Experiment: A Randomized Trial of the Cost-Effectiveness of Using DNA to Solve Property Crimes' (2009) 5 Journal of Experimental Criminology 345.
[717] Roman and others (n 716).
[718] Briody, 'The Effects of DNA Evidence on Property Offences in Court' (n 711).
[719] Roman and others (n 716).
[720] Theodore P Cross and others, 'Biological Evidence in Adult and Adolescent Sexual Assault Cases: Timing and Relationship to Arrest' [2017] Journal of Interpersonal Violence <http://dx.doi.org/10.1177/0886260517704229>.

introduction of rapid DNA testing may be useful in enhancing the potential of databases.[721] However, as shown in this study, the police may use alternative means to identify and subsequently arrest suspects. These alternative measures may be more effective than DNA profiling and databasing combined. Hence, the outcome of DNA analysis and databases may be low.[722] There is limited information on how DNA databasing compares with DNA profiling alone (i.e. without the use of the database) and other detective resources.[723] Such analysis is relevant because it will inform policy decisions on the investment and scope of DNA profiling and databasing.

Cross *et al*.[724] also compared the bulk of cases (91.5%) where the arrest occurred before DNA results and the DNA-related arrests. It was found that DNA arrest cases were more likely to link to other crimes on CODIS to identify serial offenders. Though limited in the number of cases, this study suggests that retaining DNA data from sexual crimes may be relevant.

4.3.2.3 Models to evaluate the performance/effectiveness of DNA databases

Gabriel *et al*.[725] developed three performance metrics to evaluate the effectiveness of DNA databases: 1) Significance of a database hit; 2) case progression and judicial resolution; 3) potential reduction of future criminal activity. These three metrics were tested using 198 DNA cold hits obtained by the San Francisco Police Department, USA, from 2001 to 2006. For the first metric, the study found that 90% of DNA hits aided police investigations including the identification of offenders. Approximately 40% of the cold hits reached judicial resolution including conviction, guilty plea or parole revocation. About 28% of the cases were still under investigation or yet to be tried in court. It was expected that the progress of pending cases could lead to ~70% judicial resolution. When broken down by offence type, the potential case progression/judicial resolution rate for sexual cases (*n = 110*)

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[721] FIND Strategy Board, *Annual Report 2017 to 2018* (n 16); FBI, 'Rapid DNA' (*Federal Bureau of Investigation*, 20 September 2017) <https://www.fbi.gov/services/laboratory/biometric-analysis/codis/rapid-dna> accessed 11 March 2019; Jacklyn Buscaino and others, 'Evaluation of a Rapid DNA Process with the RapidHIT® ID System Using a Specialized Cartridge for Extracted and Quantified Human DNA' (2018) 34 Forensic Science International: Genetics 116; David Shackleton and others, 'Development of Enhanced Sensitivity Protocols on the RapidHIT™ 200 with a View to Processing Casework Material' (2019) 58 Science & Justice 411.
[722] Goulka and others (n 20).
[723] Goulka and others (n 20).
[724] Cross and others (n 720).
[725] Gabriel, Boland and Holt (n 12).

was ~50%, homicide (*n = 24*) was ~91%, burglary (*n = 42*) was 88% and other crimes was 40%.

For the third performance metric, the criminal history of 12 recidivistic sex felons was analysed. On average, each felon committed ~25 offences including serious and minor offences. The average for sexual offences was ~4 per individual. Compared to published data indicating an average of 8 throughout the criminal career of serial sex offenders,[726] the authors estimated that more than 40 offences could be prevented by DNA databasing through its incapacitation effect. However, it was found that the proportion of offences committed by the 12 felons before (51%) and after (49%) the introduction of the CODIS national DNA database in 1998 was roughly similar. This suggests that the recidivistic behaviour of offenders may inhibit the crime reduction ability of DNA databases. For example, 45% of sexual crimes were committed during probationary periods of the felons. The authors noted that though DNA databases may interrupt criminal activity for a short period, recidivism may limit its full public security potential. An expansive inclusion/retention regime may, however, increase the periods of incapacitation of serial offenders through frequent detection and conviction.

Walsh *et al.*[727] also developed and tested two DNA database performance metrics: Match/hit rate (HR – crime-to-person matches per crime scene profiles loaded) and 'return index' (RI – total number of matches (NH) per total number of profiles (NS). The two metrics were tested using publicly available data from the UK NDNAD, CODIS NDIS (USA), California SDIS and the Canadian National DNA Databank (NDD-Canada) prior to 2008. Initially, the growth in the size of the databases was analysed. The UK NDNAD, CODIS NDIS and SDIS were found to fit a quadratic model with positive changes in growth linked to government/state policy (the DNA Expansion Programme (UK), President's DNA Initiative (USA), and Proposition 69 (California)). The growth of the Canadian NDD was found to closely fit a linear model, demonstrating consistency in sampling/retention regime. The RI and HR were found to be independent of database size, with no correlations observed. This refutes the hypothesis that as the size of the database increases, the match rate increases (effectiveness hypothesis).[728] Though the study establishes a model to assess effectiveness,

[726] Gabriel, Boland and Holt (n 12); A Nicholas Groth, Robert E Longo and J Bradley McFadin, 'Undetected Recidivism among Rapists and Child Molesters' (1982) 28 Crime & Delinquency 450.
[727] Walsh and others (n 630).
[728] Peter M Schneider and Peter D Martin, 'Criminal DNA Databases: The European Situation' (2001) 119 Forensic Science International 232.

the implications of the study are limited by the source of data used, the differences in what counts as a hit, and lack of detail about the characteristics of the databases examined. For example, it is not clear whether only 'cold hits' were assessed or all hits. If the main purpose of a database is to solve cold crimes, assessing all hits (cold and warm) may be inappropriate.

In 2010, Walsh *et al*.[729] published an inferential model for determining the performance and financial efficiency of forensic DNA databases. The performance formula, referred to as the return index (RI) is given by RI= $\frac{H}{NC}$; where H is the number of matches/hits, N is the number of reference profiles in the database and C is the number of crime scene profiles in the database. The variable H is given by the formula: $H = \frac{\alpha N \times \omega C}{M}$; where α refers to the average fraction of active offenders in the database, ω refers to the average fraction of actual offender crime samples, M is the proportion of active offenders from the population. The RI model was tested using publicly available data from the UK NDNAD, the USA CODIS NDIS and the Canadian NDD. A plot of H versus NC found that the number of matches initially increases with the product of the number of reference and crime scene profiles, but plateaus over time. The reasons attributed to this observation include the retirement of active criminals and/or incapacitation of offenders making them inactive.

The DNA Working Group (DWG) of ENFSI[730] criticised the Walsh Return Index, noting that the model suggests smaller databases are more effective than larger databases. This is because the RI is inversely proportional to the size of the database (NC). The ENFSI Working Group proposed two alternative performance metrics. The first metric is H/C – the number of matches per number of crime profiles loaded in the database. This formula demonstrates the 'potential' crime-solving capacity of the database and indicates whether the sampling of crime scenes is efficient. It is hypothesised that as the size of the database increases, H/C will increase. The second metric is H/N – the number of matches per number of reference profiles in the database. This metric shows whether the database is representative of the active criminal population and/or irrelevant reference profiles are being excluded from the database. A test of the H/N metric on European databases shows that the England and Wales NDNAD has the highest value (0.44) as at June 2016.[731] This suggests

[729] Walsh, Curran and Buckleton (n 12).
[730] ENFSI DNA Working Group, *DNA Database Management Review and Recommendations* (n 31).
[731] ENFSI (n 24).

that the NDNAD relatively holds data of the right people and the current PoFA retention regime may be more effective than other regimes across Europe.

In 2013, Santos *et al.*[732] classified the inclusion/retention regime of 22 EU states including the UK and assessed their database performances. The study used the H/N metric to evaluate performance. Two types of regimes emerged from the analysis: restrictive and expansive regimes. The first was generally characterised by limited temporal retention of DNA records of suspects and individuals convicted of a serious offence. The expansive regime generally allows longer periods of retention and/or indefinite retention for suspects and individuals convicted of any crime. The match rate data was extracted from the 2011 report of the ENFSI DWG. The then retention regime of England and Wales was expansive, allowing indefinite retention of all arrestee DNA data whether convicted or not for a recordable offence. The study compared the smaller, restrictive databases with bigger, expansive databases. Using the Mann-Whitney test, the study found no statistically significant difference in the median H/N between the restrictive (0.095) and expansive (0.100) regimes ($p > 0.5$). This suggests that the type of inclusion/retention regime, and therefore the size of the database, may be unrelated to the performance of the database.

Although Santos *et al.*[733] offer a basis for comparative analysis of national databases, many factors affect the performance metric used including variations in the implementation of legal systems, the age of the database, previous changes in the law, and differences in counting database hits. Moreover, the classification of the legal systems may be too broad both within and between the two categories. Further useful analysis to determine the impact of the law and the value of DNA retention could be filtering the performance ratio by retention category, retention period, and crime type in a single state.[734] Though there were genuine reasons for using the H/N metric, analysis of the crime-solving match rate – H/C could be useful in demonstrating the potential contribution of the database to public security. A research programme using both H/C and H/N for different retention regimes, inclusion criteria and retention lengths in a single state could offer a new understanding of the potential effectiveness of databases.

[732] Santos, Machado and Silva (n 29).
[733] Santos, Machado and Silva (n 29).
[734] A Thomson, 'NDNAD Effectiveness Metrics' (Home Office; Unpublished); National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2014* (n 17).

Another model used to assess database effectiveness is the instrument variable (IV) strategy developed by Doleac.[735] This was used to test the effect of DNA databases on crime in the United States.[736] Firstly, the study analysed the criminal history of offenders before and after DNA expansion in 7 states. The probability of re-convicting serious violent and property offenders was reduced by 17% and 6%, respectively, within 5 years of expansion. Secondly, the study compared the size of the DNA database to crime rates from 2000 to 2010. The growth of the database was associated with 7-45% and 5-35% decrease in violent and property crimes, respectively. Analysis of the cost-effectiveness of using DNA databases to investigate serious offences showed lower marginal cost than other alternative crime-fighting measures (<$600 vs $7,600 (longer sentences) or $26,300-$62,500 (police officers)). The results of this study were consistent with a similar study by Doleac *et al.*[737] that assessed the effectiveness of the Denmark DNA Database (DDD). An expansion of the DDD in 2005 was associated with a subsequent reduction in recidivism rate by 26% within 5 years and an increase in crime detection by 0.09 crimes. In comparison, Bhati and Roman[738] found mixed results across different types of offences, with only robbery and burglary showing 2-3% reduction in reoffending risk. This research used a multiple clock model to study prisoners released in Florida from 1996 to 2004. The above statistical evaluations suggest that the effects of DNA databases are not straightforward.

The IV strategy was also used by Doleac[739] to test the cross-state effect of DNA database policies in the USA. The study compared DNA database size and crime rates among states. It was found that an increase in the total size of databases in external states increases violent (0.0001) and property (0.0003) crime rates in the reference state ($p < 0.05$). Also, an increase in the size of a nearby state's database (< 500 miles) increases violent (0.0011) and property (0.0063) crime rates ($p < 0.01$). A similar trend was observed when the total profiles of external states were weighted by distance. Expansion of a nearby state database (100 miles) results in higher violent (0.0012 versus 0.00004) and property (0.0042 versus 0.00004) crime rates than far away states (3000 miles). It was hypothesised that expansive DNA database policies in one state lead to the migration of criminals whilst restrictive policies draw in criminals. An alternative effect is that the former lead to incapacitation or deterrence of crime

[735] Doleac (n 99).
[736] Doleac (n 99).
[737] Doleac and others (n 102).
[738] Avinash Bhati and Caterina G Roman, 'Evaluating and Quantifying the Specific Deterrent Effects of DNA Databases' (2014) 38 Evaluation Review 68.
[739] Doleac (n 102).

thereby reducing crime across states. The results of the study demonstrated a negative cross-state effect. It was recommended that to limit the migration of criminals, states must ensure equivalence in DNA database policy.

In summary, the statistical models demonstrate that expansive DNA databases could reduce crime rates and limit criminal activity. However, the results should be interpreted cautiously since the data relied upon were estimates – which may not be representative of the actual effects of DNA databases. Secondly, there are many confounders associated with criminal activity and crime rates in a specific state including age, gender, family structure, cultural context, educational level of residents, alternative law enforcement resources, employment and other crime-reduction policies (such as long custodial sentences and rehabilitation initiatives). These factors were not accounted for in the studies. Moreover, the usefulness of DNA and databases apply to a small proportion of all crimes as noted in section 4.3.2.1.

Overall, evidence from the database performance/effectiveness studies suggests that the aggregate contribution of DNA databases to crime may be negligible though it appears they may offer better criminal justice outcomes, such as high detection or conviction rates in specific types of offences. Secondly, models developed to assess the effectiveness of DNA databases only provide estimates that may not reflect actual effectiveness. Other studies also suggest that the expected performance of DNA databases may be difficult to achieve due to several implementation or operational factors. Therefore, considering the privacy issues associated with DNA retention, the central question that emerges is whose DNA data should be retained? And how long should the data be stored? In the absence of adequate systematic data, this research sought to address this question by assessing public and stakeholder views about the retention regime governing the NDNAD. The next section considers available criminal career research inquiries into the above question.

4.3.3 Criminal career research: justification for forensic DNA retention

A summary of the studies included in this section is presented in Table 4.3. All the studies were conducted in the UK and sought to understand the appropriate inclusion and retention criteria for DNA databases based on patterns in arrest or conviction history. The 2009 Home Office [740] consultation document on forensic biometric retention was supported by preliminary empirical evidence on recidivism rate and criminal career research authored by

[740] Home Office, *Keeping the Right People on the DNA Database: Science and Public Protection* (n 47).

Pease.[741] The study analysed Metropolitan Police Service data of individuals arrested on 1st June of 2004, 2005 and 2006 in London (a total of 532 cases). The inclusion criteria were arrestees who had been subjected to DNA sampling. The recidivism (re-arrest) rate period was up to a maximum of 4.5 years after DNA sampling. Comparison of recidivism rate among arrestees with NFA entry, those cautioned and individuals with noncustodial convictions showed no significant difference. The recidivism rate for violent crime was 59%, 63% and 64%, respectively. This result appears to suggest that deletion of NFA-arrestee DNA data may be detrimental to crime detection.

Table 4.3 - Summary of criminal career research to understand appropriate retention regimes for the National DNA Database (n = 5)

Country	Author(s) (Publication year)	Number of cases	Method	Research focus
UK	Tseloni & Pease (2011)	599 cases	Regression analysis	Prediction of appropriate DNA retention period by analysing offending behaviour
UK	Kazemian et al. (2011)	411 males (longitudinal survey)	Descriptive	Prediction of DNA database inclusion/retention criteria by assessing impact of offender characteristics and offence seriousness on recidivism
UK	Houlding & Wilson (2011)	17239 individuals	Hazard rate analysis	Prediction of DNA database retention period based on rearrest rate
UK	Crime & Policing Analysis Unit (2011)	84256 arrested individuals 483534 convicted individuals	Hazard rate analysis	Prediction of DNA database retention period based on conviction rate
UK	Pease (2009)	532 cases (re-arrest analysis)	Regression analysis	Prediction of appropriate DNA retention period by analysing offending behaviour

In 2011, a separate study of similar data source and characteristics was also published by Tseloni and Pease.[742] The total number of cases in the study was 599. This showed similar results with the previous analysis. The re-offending rate for violent offence was 65% for NFA-arrestees, 64% for cautions and 60% for non-custodial conviction. The extended

[741] Pease (n 63).
[742] Tseloni and Pease (n 63).

analysis in the second study showed that the recidivistic group were significantly younger than the non-recidivistic group ($p < 0.001$). There was also no significant difference in recidivism rate when the data considered the seriousness of offence and age of NFA-arrestees. The results generally indicate that deleting data of non-serious crime arrestees (required under PoFA regime) or deletion based on age may adversely affect public protection. On the other hand, the results may support the deletion of DNA records of all NFA-arrestees regardless of the seriousness of offence. This may be considered as a privacy-enhancing approach.

The 2009 Home Office analysis also utilised evidence from the Cambridge study on residual career length (RCL) and the residual number of offences (RNO) to assess criminal career patterns.[743] The risk curve showed that re-offending is relatively high within a period of 15-years and declines after a maximum period of 24-years. Detailed and further analysis is provided in a separate study published in 2011 by Kazemian *et al*.[744] The study aimed to propose a criminal career research approach to predict appropriate DNA retention periods for national DNA databases.

Kazemian *et al*.[745] utilized data of 170 convicted individuals extracted from the Cambridge Study in Delinquent Development (CSDD). The initial offence types of the study group were either serious or non-serious crime. The research focused on the number of subsequent DNA-related crimes committed by the group over time. It was assumed that the subsequent crimes represent the number of possible undetectable crimes due to non-retention of DNA data. It was found that ~72% ($n = 269$ *of* 374) and 63% ($n = 237/374$) of subsequent crimes could be undetectable if DNA data was destroyed after one and two years, respectively. A steady decrease in residual offences was observed until 15 years, after which the rate normalizes. The maximum limit of the subsequent offence was 25 years after initial conviction. This evidence seems to support lengthy but temporal retention periods for convicted individuals. When the data was filtered by age group, the juvenile group had a higher residual offence than the adult group for all hypothetical retention lengths, levelling off after 15 years. The percentage of residual offences were 41%, 19%, 7%, and 5% for minor theft, serious theft, crimes against the person, and other offences, respectively, if DNA data was deleted after one year. This was observed for all hypothetical retention periods. In

[743] Home Office, *Keeping the Right People on the DNA Database: Science and Public Protection* (n 47).
[744] L Kazemian, K Pease and DP Farrington, 'DNA Retention Policies: The Potential Contribution of Criminal Career Research' (2011) 8 European Journal of Criminology 48.
[745] Kazemian, Pease and Farrington (n 744).

general, the results are consistent with that of Tseloni and Pease[746] which demonstrate that deletion of DNA data based on offence seriousness or age may have a negative impact on crime detection.

While relevant, the criminal career research approach utilized in the Home Office[747] policy offer weak evidential support for the retention of DNA data. This is due to the assumption that the subsequent crimes would have been detected or solved using DNA hits. There is a need for direct measurement of the value of retaining DNA data from different groups of individuals and the impact of different retention periods.

Another Home Office study by the Economics and Resource Analysis Group[748] provides a detailed analysis of the first re-arrest rate among NFA arrestees compared to the general population. The study focused on 17, 238 individuals arrested in April 2006. A total of 6,748 (39%) were re-arrested within the monitoring period (May 2006 – 1 August 2009). The study extrapolated the re-arrest risk among the study population beyond the 3.25 years' mark to 8 years. The hazard risk curve showed that the reoffending rate (i.e. re-arrest rate) is higher than the general population within a period of six years. The risk was found to decrease from year 1 to year 6 at which point it intersects with the estimated HR for the general population (5%). Though there is a high level of uncertainty and potential inaccuracies in the statistical model used, the research appears to support a retention period of six years for NFA arrestees. Consideration of the reoffending rate among juveniles showed that they demonstrate a higher risk than adults and the general population. In summary, the findings of the study are consistent with the results of other criminal career research. However, the results are unreliable in estimating appropriate retention periods for DNA data due to the study assumptions.

As detailed in the study and the methodological review by Houlding and Wilson,[749] the proxy used to measure recidivism (i.e. re-arrest) is not representative of re-offending in the study population. The initial spikes in re-arrest may be impacted by arrests due to violations of bail rather than separate offences.[750] Secondly, the arrests may not be associated with intelligence generated from a match on the NDNAD. Thirdly, the statistical model assumes

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[746] Tseloni and Pease (n 63).
[747] Home Office, *Keeping the Right People on the DNA Database: Science and Public Protection* (n 47).
[748] Economics and Resource Analysis Group, 'DNA Retention Policy: Re-Arrest Hazard Rate Analysis' (Home Office 2009).
[749] Brett Houlding and Simon P Wilson, 'Considerations on the UK Re-Arrest Hazard Data Analysis' (2011) 10 Law, Probability & Risk 303.
[750] Houlding and Wilson (n 749).

that, compared to the NFA group, the arrest rate in the general population is constant and independent of time, which may be inaccurate.[751] Further, the general population and the NFA-arrestee groups are made up of subgroups which may have different hazard risks. Lastly, the model does not consider the impact of socio-economic factors, such as education level on re-arrest or re-offending rates.

Finally, in 2011, the Crime and Policing Analysis Unit (CPA)[752] of the Home Office also researched the risk of recidivism among individuals arrested for a serious offence, those charged with a serious offence, and convicted individuals. The study compared the hazard risks among the different groups to the general population. The goal of the study was to provide evidence justifying the retention lengths under the 'Scottish Retention Model'. Using data from the Police National Computer, the study estimated 'hazard rate curves' for the different retention categories. The study found that, following an initial arrest or charge, the hazard rate for the arrestee or charged group approximately decreases to the level of the general population (~4% per annum) within a minimum of 3 years. This shows that a minimum of 3-year retention period for arrestees or charged individuals may be beneficial to crime detection.

The hazard rate was found to be higher among individuals charged with a serious crime (4.3%) than those charged with a non-serious crime (2.6%) after four years of the initial charge. The arrestee group did not demonstrate any difference in hazard rate by the seriousness of the offence. The hazard rate for individuals issued with a fixed penalty notice was comparable to that of the arrestee or charged group. However, a lower hazard rate was observed when compared to convicted individuals. The hazard rate at four years was comparable for individuals with a first caution and those with a first non-custodial conviction. Those with a second caution and/or noncustodial conviction had a higher hazard rate than those with a first caution or non-custodial sentence. When the hazard rate was filtered by age, juveniles demonstrated a higher risk than adults in all comparisons. Generally, the results of this study are consistent with the findings and conclusions of the other criminal career research.

Although the CPA analysis provides useful indications of appropriate retention lengths, the study is limited by the characteristics of the general population used as a control for

[751] Houlding and Wilson (n 749).
[752] Crime and Policing Analysis Unit (n 109).

comparison purposes. The limitations of the hazard risk model detailed by Houlding and Wilson[753] also applies to this research. Another critical limitation is that no statistical tests of significance were applied in the comparisons. Lastly, the study does not offer information about the actual value of retaining DNA data for different retention categories and retention lengths.

In summary, the reliance on criminal career research to generate evidence to support DNA data retention is unsatisfactory. The statistical approach is not based on sound statistical assumptions and inferences drawn from such studies may be inaccurate.[754] There is a need to measure the crime detection value of retaining DNA data for different individuals included in the NDNAD and determine appropriate retention periods.

4.3.4 Metrics for the assessment of the efficacy of retention regimes

Analysis of the literature and reviews into the effectiveness of DNA databases reveal seven important indicators for assessing the efficacy of NDNAD retention regimes: (1) the ability of the database to assist criminal justice officials in case resolution (crime-solving capacity); (2) the ability of the database to reduce crime through incapacitation of offenders (incapacitation effect); (3) the preventative potential of the database through deterrence of individuals from committing crime (deterrence effect); (4) protection of the civil liberty rights of individuals (privacy protection); (5) compliance of the regime to the proportionality principle; (6) the time and non-monetary resource input required to implement the regime (implementation efficiency); and (7) the financial input required to implement the regime (implementation cost).[755]

One of the most important outcomes of the NDNAD is case resolution. Indeed, the statutory purposes of the database include assistance to the police in solving/resolving crime.[756] An increase in conviction is often perceived as the measure of the case resolution success of the NDNAD. However, it encompasses the contribution of DNA cold hits to the identification or elimination of suspects, linking of different crimes, the conviction of offenders, and

[753] Houlding and Wilson (n 749).
[754] Economics and Resource Analysis Group (n 748); Houlding and Wilson (n 749).
[755] Gabriel, Boland and Holt (n 12); Walsh, Curran and Buckleton (n 12); ENFSI DNA Working Group, *DNA Database Management Review and Recommendations* (n 31); Doleac (n 99); Doleac (n 102); Roman and others (n 716); Bieber (n 89); Nuffield Council on Bioethics (n 45); Wallace (n 591); MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80); McCartney, 'Of Weighty Reasons and Indiscriminate Blankets' (n 44); McCartney, Wilson and Williams (n 44); Wallace and others (n 107).
[756] Police and Criminal Evidence Act 1984.

saving time and resources of the criminal justice process.[757] Bieber[758] details four broad reasons why conviction may not be an accurate measure of the success of databases: variation in the treatment of DNA hits; failure/inability of individuals to testify; time; and problems associated with the trial or evidentiary criteria. Besides these challenges, it is also difficult to determine whether a DNA hit was the sole predictor of conviction since it is often considered with other corroborative evidence in court.[759] In the present study, the indicator 'crime-solving capacity' was tested among the stakeholder participants in the survey project. This measure was defined broadly as the ability of the database to assist criminal justice officials including the police and prosecutors to solve crime.

The lengthy and/or frequent incapacitation of offenders through imprisonment or other incapacitation disposals is perceived to reduce crime rates.[760] The impact of the incapacitation effect of DNA databases has been measured indirectly by some authors by assessing crime rates.[761] However, it is not clear whether the retention of DNA data and its downstream incapacitation effect can lead to a significant reduction in crime. Most criminal justice disposals are very short or do not involve incapacitation. With the high rate of recidivism among convicted individuals, it is more likely for crime rates to increase. Besides the fact that not all crimes are detected or reported, available statistics on crime rates are crude estimates and may not adequately reflect the success of DNA databases.[762] Further, crime rates are impacted by several socio-economic factors. Although the incapacitation effect may be a weak indicator of the success of DNA databases, it generally demonstrates its potential effectiveness towards crime reduction. Many serious crime offenders have been identified using the DNA database and their subsequent 'lengthy' incapacitation will prevent some crimes. This indicator should, therefore, be considered in assessing the efficacy of retention regimes.

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[757] Bieber (n 89).
[758] Bieber (n 89).
[759] National DNA Database Ethics Group, *Annual Report of the Ethics Group: National DNA Database 2014* (n 17).
[760] Bieber (n 89); Christy A Visher, 'Incapacitation and Crime Control: Does a "Lock 'Em up" Strategy Reduce Crime?' (1987) 4 Justice Quarterly 513; Alex R Piquero and Alfred Blumstein, 'Does Incapacitation Reduce Crime?' (2007) 23 Journal of Quantitative Criminology 267; Christina Stahlkopf, Mike Males and Daniel Macallair, 'Testing Incapacitation Theory: Youth Crime and Incarceration in California' (2010) 56 Crime & Delinquency 253; Steven N Durlauf and Daniel S Nagin, 'Imprisonment and Crime' (2011) 10 Criminology & Public Policy 13; Doleac (n 99).
[761] Doleac (n 99); Doleac (n 102); Doleac and others (n 102).
[762] Bieber (n 89).

The deterrence effect of DNA databases has been measured indirectly by Doleac.[763] Several reviews have also emphasized this indicator in assessing the success of DNA databasing.[764] Empirical evidence to adequately prove the deterrence effect of DNA databases is currently lacking. Some critics of this indicator are of the view that it may be difficult or impossible to prove this effect due to several confounding variables that impact on deterrence.[765] Currently, proposed research methods to estimate deterrence effect include measurement of perceived deterrence among first-time arrestees and convicted individuals and assessment of criminal records.[766] The comparison of the different groups may help determine whether the retention of DNA data can modify individual behaviour positively or prevent criminality. Preliminary studies of this nature indicate that DNA retention may have the potential to deter crime and previous offenders are likely to demonstrate subsequent 'good' behaviour.[767] Nevertheless, the HGC[768] indicates that recidivistic offenders may not be deterred by the retention of their DNA data. Rather, they may change their *modus operandi* to prevent being caught or move to a different jurisdiction where they may not be caught. Moreover, offending may be spontaneous or unplanned. Like the incapacitation effect, the deterrence effect of DNA databases may be a weak indicator of success. However, given that much emphasis has been given to this hypothetical benefit of databases, the deterrence effect should also be examined in assessing the efficacy of DNA databasing.

Several studies have discussed issues related to the genetic privacy protection of retention regimes.[769] The retention of DNA data of innocent individuals has been the challenge in most court cases about DNA databasing practices. The review clearly shows that an effective DNA database regime must be lawful and ethical. A database's public protection goals in solving/resolving, reducing or preventing crime must be balanced with the human rights of individuals. In the UK, the principal right in question is the right to privacy (Article 8 of the Convention) as emphasised at the Court of Appeal, the House of Lords and the ECHR in the

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[763] Doleac (n 102); Doleac (n 99).
[764] Bieber (n 89); Williams and Johnson, 'Inclusiveness, Effectiveness and Intrusiveness' (n 625).
[765] McCartney, *Forensic Identification and Criminal Justice: Forensic Science, Justice and Risk* (n 42); Bieber (n 89).
[766] Tseloni and Pease (n 63).
[767] Bhati and Roman (n 738); Doleac and others (n 102).
[768] Human Genetics Commission, 'Inside Information: Balancing Interests in the Use of Personal Genetic Data' (n 300).
[769] David Lazer (ed), *DNA and the Criminal Justice System: The Technology of Justice* (MIT Press 2004); McCartney, 'The DNA Expansion Programme and Criminal Investigation' (n 14); McCartney, *Forensic Identification and Criminal Justice: Forensic Science, Justice and Risk* (n 42); Williams and Johnson, *Genetic Policing: The Use of DNA in Criminal Investigations* (n 22); Krimsky and Simoncelli (n 62); McCartney, 'Of Weighty Reasons and Indiscriminate Blankets' (n 44); Lynch and Campbell (n 392); Lee (n 62).

Marper decisions.[770] Hence, a true measure of the efficacy of DNA retention regimes must include how well it protects the genetic privacy of individuals and its proportionality to public security interests. These indicators should, therefore, be considered in assessing the success of DNA databasing.

Finally, the time, effort and cost of implementing the DNA retention regime must be justified to demonstrate its efficacy. The implementation of the current PoFA regime has involved the establishment of the Office of the Commissioner for the Retention and Use of Biometric Material, destruction of DNA records, introduction of DNA retention assessment procedures, changes in IT infrastructure, DNA retention compliance checks, changes in DNA retention practices, establishment of Biometric Retention Units, and education of relevant stakeholders.[771] These changes mean that more time and effort is now required to operate the NDNAD. The annual budget for the Office of the Biometrics Commissioner is approximately £300,000.[772] This budget is likely to increase with the expansion of the Commissioner's functions to cover DNA retention compliance checks. In addition to direct and indirect costs of running the NDNAD (including sampling and processing of DNA), new financial costs have been generated with the PoFA regime. It is not yet clear how cost-effective the new regime is and whether the new roles established are important to DNA databasing.

Assessment of implementation efficiency and implementation cost is important because DNA databasing is only one aspect of crime-preventing and justice delivery programmes. There are other equally or more important aspects of crime-fighting which must not suffer at the expense of DNA databasing. This is particularly important with the limited data to convincingly demonstrate the aggregate value of DNA retention. These additional indicators should also be considered in assessing the efficacy of DNA database regimes.

Figure 4.3 summarises a possible conceptual framework about the relationship between the identified indicators and the various aspects of DNA databasing, such as the science and technology, law, the criminal justice process, legal and ethical concepts. This shows that the assessment of effectiveness is important because of its role in shaping the concepts of public

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[770] *R v Chief Constable of South Yorkshire Police (Respondent) ex parte LS (by his mother and litigation friend JB) (FC) (Appellant) and R v Chief Constable of South Yorkshire Police (Respondent) ex parte Marper (FC) (Appellant)* (n 72); *R (on the application of S) v Chief Constable of South Yorkshire and R (on the application of Marper) v Chief Constable of South Yorkshire* (n 64); *S and Marper v The United Kingdom* (n 44).
[771] Protection of Freedoms Act 2012, ss 20 and 21.
[772] MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80).

security and civil liberties. The perception of NDNAD stakeholders on the efficacy of the different retention regimes was tested against the seven effectiveness indicators in the survey project. The participants were asked to rank the importance of these indicators and suggest any other indicators that are relevant in assessing regime efficacy/effectiveness.

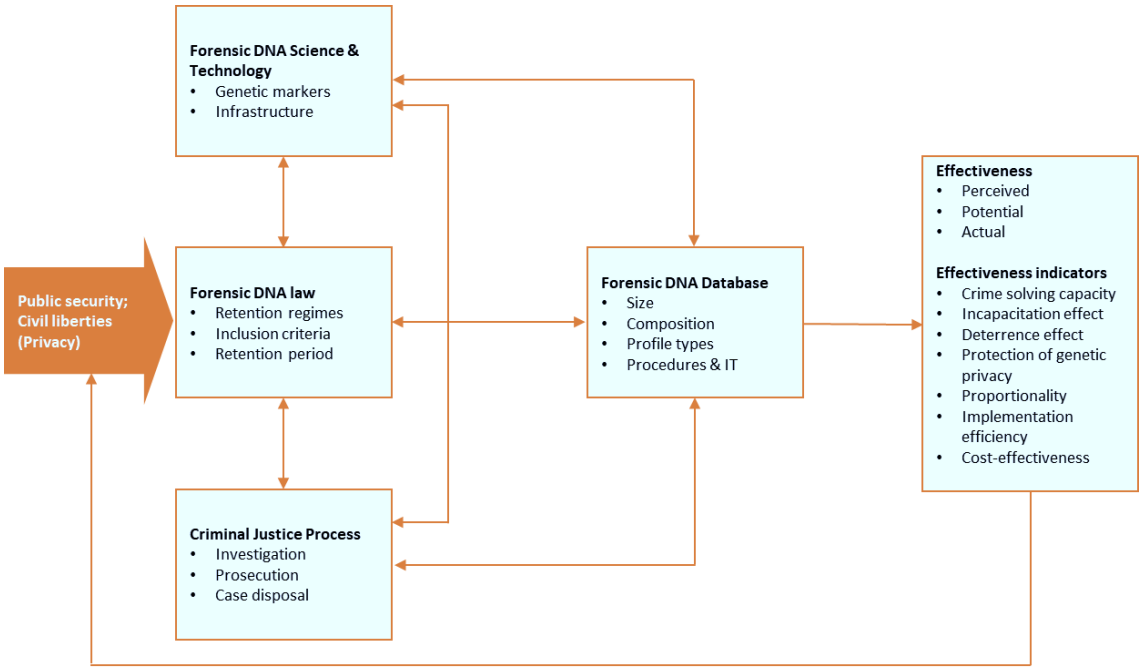

Figure 4.3 - Flow chart showing the relationship between effectiveness and DNA databasing

4.4 Conclusion

The literature review shows that the efficacy/effectiveness of forensic DNA retention regimes has not been adequately assessed. Consequently, commonly accepted standards for forensic DNA data retention are limited. The lack of solid empirical evidence indicates that existing retention policies are subjective, and the determination of appropriate retention criteria and retention limits is a matter of judgement.[773] The findings from this review are consistent with the conclusions of previous and current reviews.[774] Sociological research approaches to assess the value or effectiveness of DNA databases and retention policies show significant public support for DNA retention due to the crime-solving potential of databases. However, there are concerns about privacy and the proportionality of retention

[773] Crime and Policing Analysis Unit (n 109).
[774] McCartney, 'Forensic DNA Sampling and the England and Wales National DNA Database' (n 62); Williams and Johnson, 'Inclusiveness, Effectiveness and Intrusiveness' (n 625); Wallace (n 591); McCartney, 'Of Weighty Reasons and Indiscriminate Blankets' (n 44); Toom (n 62); Blakemore and Blake (n 107); Machado and Silva, 'What Influences Public Views on Forensic DNA Testing in the Criminal Field?' (n 656).

policies. Whilst important, sociological research methods should be complemented with a statistical analysis of DNA database output and outcome data. Presently, studies that have focused on this latter approach to evaluate the performance or effectiveness of DNA databasing only offer crude estimates which do not satisfactorily justify data retention. Lastly, findings from criminal career research methods are insufficient in providing evidence to determine the characteristics of an effective retention regime. In summary, there is still a need to assess the relative value of retaining DNA data from different groups of individuals included in the NDNAD and the relative value of different retention periods. A study of this nature, supported by current views of the public and relevant stakeholders based on the indicators identified from the review, will help establish appropriate standards for forensic DNA retention. These standards may also be applicable to other forensic biometric databases. Due to the limitations of collecting systematic data to assess potential and actual effectiveness, this research focused on the current views of the public and stakeholders about the effectiveness of the NDNAD regime. This study is important because it is complementary to the systematic evaluation of databases and serves as a starting point in assessing the effectiveness of NDNAD regimes.

Chapter 5: Public survey on forensic DNA databasing: methodology

5.1 Introduction

The second and third specific aims of this research were to investigate the current views of the public about the public security functions of the NDNAD, the inclusion criteria and retention periods for forensic DNA records. To achieve these aims, an online survey was designed based on the existing knowledge from the literature review. The survey was pre-tested and distributed using a non-probability sampling approach. The public survey project was approved by the Faculty of Business and Law Ethics Committee, Northumbria University (Appendix XVI). This chapter details the methodology for the survey and the general characteristics of the study participants.

5.2 Methodology

The public survey was carried out from 11 June to 1 October 2018 at the School of Law, Northumbria University, UK. The inclusion criteria for the study was all citizens or residents of England and Wales aged 18 and above. The survey link was first distributed via the mailing list of the researcher. The survey was also posted on the website of the Chartered Society of Forensic Sciences (CSFS) inviting visitors to complete the survey questionnaire. Further, friends and colleagues of the researcher were invited to participate in the research and circulate the survey among their contacts. The different faculties of Northumbria University were also sent the survey link to distribute among staff and students. This required organisational consent which was approved (See Appendix IV for organisational consent form). A copy of the public survey questionnaire including a cover letter and participant consent form is provided in Appendix III. Respondents were required to sign the consent form via a tick box as part of the online questionnaire before participating in the study. Information collected from the survey respondents was anonymous.

5.2.1 Survey methodology

A survey methodology is an approach used to gain insight into the knowledge, attitudes, views or behaviours of an entire population.[775] The technique primarily involves the

[775] Edith D de Leeuw, Joop J Hox and Don A Dillman, 'The Cornerstones of Survey Research' in Edith D de Leeuw, Joop J Hox and Don A Dillman (eds) (Taylor and Francis Group 2008); Robert M Groves and others, *Survey Methodology* (2nd edn, John Wiley & Sons Inc 2009); Carol Bennett and others, 'Reporting

collection of information from a sample of a target population. This is carried out by asking respondents the same set of questions systematically.[776] It allows qualitative concepts or constructs to be transformed into quantitative variables that can be tested using a questionnaire and analysed statistically.[777] The data collected from surveys can be analysed using descriptive statistics and/or inferential statistics to determine the relationship between variables. The foundation of the survey methodology is the definition of the concept or research question to be assessed, namely, the effectiveness of NDNAD retention regimes. This is followed by developing strategies to ensure accurate coverage and sampling of the target population, minimize nonresponse, and prevent measurement errors.[778] There are two main forms of surveys: self-administered questionnaires and interview surveys.[779] Examples of the former are internet or postal surveys, which do not involve the presence of the researcher. Interviews require the presence of the researcher; examples include face-to-face or telephone surveys.

The quality of data collected in surveys is determined by the form used.[780] In this study, the self-administered survey method was chosen as an appropriate approach for collecting information about the views of the public. This approach is relatively simple and cost-effective to administer to a large group.[781] Secondly, the approach minimizes the influence of the researcher on the responses of participants, ensuring a level of confidentiality and objectivity, and assuring anonymity.[782] The absence of the researcher in self-administered surveys allows respondents to disclose sensitive information and provide more honest and

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Guidelines for Survey Research: An Analysis of Published Guidance and Reporting Practices' (2011) 8 PLOS Medicine e1001069.

[776] Bryman (n 312); de Leeuw, Hox and Dillman (n 775); Groves and others (n 775).

[777] de Leeuw, Hox and Dillman (n 775); Groves and others (n 775).

[778] Donald L Harrison and JoLaine R Draugalis, 'Evaluating the Results of Mail Survey Research' (1997) 37 Journal of the American Pharmacists Association 662; de Leeuw, Hox and Dillman (n 775).

[779] Edith D de Leeuw, 'Choosing the Method of Data Collection' in Edith D de Leeuw, Joop J Hox and Don A Dillman (eds), *International Handbook of Survey Methodology* (Taylor and Francis Group 2008); Groves and others (n 775).

[780] de Leeuw (n 779); Arlene Fink, *How to Conduct Surveys: A Step-by-Step Guide* (6th edn, Sage Publications, Inc 2017); Edith D de Leeuw, *Data Quality in Mail, Telephone and Face to Face Surveys* (TT-Publikaties 1992).

[781] Georgios Tsakos and others, 'Comparison of the Self-Administered and Interviewer-Administered Modes of the Child-OIDP' (2008) 6 Health and Quality of Life Outcomes 40; Francisco Lozano and others, 'Self-Administered versus Interview-Based Questionnaires among Patients with Intermittent Claudication: Do They Give Different Results? A Cross-Sectional Study' (2016) 134 Sao Paulo Medical Journal 63; Lawrence W Neuman, *Social Research Methods: Qualitative and Quantitative Approaches.* (7th edn, Pearson Education Ltd 2014).

[782] Edith D de Leeuw and Joop J Hox, 'Self-Administered Questionnaires; Mail Surveys and Other Applications' in Edith D de Leeuw, Joop J Hox and Don A Dillman (eds), *International handbook of Survey Methodology* (Taylor and Francis Group 2008); Fink (n 780).

truthful responses.[783] Thirdly, the self-administered survey offers respondents control over when and where the questionnaire is completed.[784] Respondents can cross-check their responses for accuracy of information.[785] The absence of the researcher and high respondent control in self-administered surveys ensure that measurement errors are minimized. Lastly, the approach allows data to be collected from a relatively large sample made up of a varied group of individuals/participants.[786]

The question-answering process of the survey method can be challenged by several issues. The task of survey respondents includes understanding questions, recalling of relevant information, forming an answer/response, formatting the response, and editing the final response.[787] This task is affected by the way survey questions are phrased, and the characteristics of individuals and the sample population.[788] The generalisation of survey findings can be limited by these factors. This problem was addressed in this study by conducting a pre-test and pilot study prior to administration of the survey instrument.[789] Though self-administered surveys offer data of better quality than interviews, the problem of nonresponse is higher than in interviews.[790] Strategies to minimize nonresponse include attachment of a comprehensive cover letter that encourages response, ensuring that the survey instrument is professionally designed, and sending timely reminders to respondents.[791]

In a study comparing the response rate in Web-based survey (WBS) and Mail-based survey (MBS), Saunders[792] demonstrated a higher response rate in WBS (49.1%) than in MBS (33.5%). However, the quality of data recovered from WBS was lower than in MBS due to

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[783] Roger Tourangeau and Tom W Smith, 'Asking Sensitive Questions: The Impact of Data Collection Mode, Question Format, and Question Context' (1996) 60 The Public Opinion Quarterly 275.
[784] de Leeuw (n 780).
[785] de Leeuw (n 779).
[786] Neuman (n 781).
[787] Floyd J Fowler and Carol Cosenza, 'Writing Effective Questions' in Edith Desirée de. Leeuw, Joop J Hox and Don A Dillman (eds), *International Handbook of Survey Methodology:* (Taylor and Francis Group 2008).
[788] Norbert Schwarz and others, 'The Psychology of Asking Questions' in Edith Desirée de. Leeuw, Joop J Hox and Don A Dillman (eds), *International handbook of survey methodology* (Taylor and Francis Group 2008).
[789] Pamela Campanelli, 'Testing Survey Questions' in Edith Desirée de. Leeuw, Joop J Hox and Don A Dillman (eds), *International Handbook of Survey Methodology* (Taylor and Francis Group 2008); Kate Kelley and others, 'Good Practice in the Conduct and Reporting of Survey Research' (2003) 15 International Journal for Quality in Health Care 261.
[790] de Leeuw (n 780); Kelley and others (n 789).
[791] Neuman (n 781); de Leeuw and Hox (n 782).
[792] Mark NK Saunders, 'Web versus Mail: The Influence of Survey Distribution Mode on Employees' Response' (2012) 24 Field Methods 56.

partial response or abandonment of the survey. In this study, the WBS was selected as the most appropriate mode of data collection because of high internet penetration in the UK.[793] The target population were expected to be IT-literate with reliable and constant access to the internet; thus, minimising challenges with the quality of data. Another reason for selecting the WBS mode was that it minimises the respondent burden of having to post the completed survey questionnaire. In addition to creating a system of reminding participants to complete the survey, the WBS strategy can help to reduce nonresponse.[794]

5.2.2 Survey design

5.2.2.1 Questionnaire design

A set of questions including Likert scales and multiple-choice (MCQ) questions with closed and open-ended options were developed based on a review of the literature and the research aims. The initial questions were assessed and refined through an iterative process and in-depth discussions with the researcher's supervision team and informal consultations with academics specialising in forensic science policy research and potential respondents. The final research questionnaire consisted of 22 questions: 3 questions related to perceptions of the public security functions of the NDNAD; 3 on inclusion criteria; 4 on retention periods; 3 on volunteer DNA databasing; 1 on additional concerns about retention: and 8 questions about demographics and consent.

The public survey questionnaire (see Appendix III) began with a short cover letter and an introduction explaining the purpose of the research and the target population. This was followed by detailed research information for participants and a consent form. Since the NDNAD is governed by the laws of England and Wales, a screening question was added to restrict participation to citizens or residents of England and Wales. The introductory pages also captured a brief definition of a DNA sample and a DNA profile to aid the understanding of the questionnaire. This was informed by concerns about the need to clarify the distinction between a sample and a profile and the potential information that can be drawn from them.[795]

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[793] Katja Lozar Manfreda and Vasja Vehovar, 'Internet Surveys' in Edith Desirée de. Leeuw, Joop J Hox and Don A Dillman (eds), *International handbook of survey methodology* (Taylor and Francis Group 2008).
[794] Manfreda and Vehovar (n 793).
[795] *R (on the application of S) v Chief Constable of South Yorkshire and R (on the application of Marper) v Chief Constable of South Yorkshire* (n 64); *S and Marper v The United Kingdom* (n 44); Forensic Genetics Policy Initiative, *Establishing Best Practice for Forensic DNA Databases* (n 88).

Writing effective questions in a survey is critical to ensure the reliability and validity of the instrument.[796] Because the same questions are asked in a survey questionnaire, it is important to ensure that respondents understand the questions in the same way. Careful consideration was therefore given to the clarity and comprehension of the survey questions. Best practice requires that double-barrel questions are avoided (i.e. one question is asked at a time), technical and ambiguous terms or concepts are explained, embedded assumptions are avoided and where necessary, time frames are specified.[797] These strategies were applied to ensure equivalence in the understanding of questions and to avoid the possibility of respondents guessing responses or providing invalid responses.

The questionnaire was primarily interested in the views of the public about the effectiveness of the NDNAD, the categories of individuals to include in the database and the periods of retention for different subject DNA records. The predominant type of questions asked were closed questions or rating questions using Likert scales.[798] Closed questions, such as the Likert questions on the effectiveness of the NDNAD, are designed to limit the number of respondent answers. This strategy allows easy coding and analysis of survey data whilst maintaining the reliability and validity of the instrument.[799]

One disadvantage of closed type questions is that respondents may be limited by the list of allowable options or they may not be able to provide a valid answer or answers that truly reflect their views, knowledge, attitudes or opinions.[800] This may also be a source of item nonresponse where respondents are not able to format their response to fit the alternative options provided.[801] To overcome this limitation, the closed-ended options were designed to be as mutually exclusive and exhaustive as possible.[802] Additionally, an 'other' option was included to allow respondents to enter any other answer of their choice that may not have

[796] NM Bradburn, S Sudman and B Wansink, *Asking Questions: The Definitive Guide to Questionnaire Design - for Market Research, Political Polls, and Social and Health Questionnaires* (2nd edn, Jossey-Bass 2004); Fowler and Cosenza (n 787); Schwarz and others (n 788); Groves and others (n 775); Jon A Krosnick and Stanley Presser, 'Question and Questionnaire Design' in Peter V Marsden and James D Wright (eds), *Handbook of Survey Research* (2nd edn, Emerald Group 2010).
[797] Fowler and Cosenza (n 787); Bradburn, Sudman and Wansink (n 796); P Murray, 'Fundamental Issues in Questionnaire Design' (1999) 7 Accident and Emergency Nursing 148; Krosnick and Presser (n 796); I Brace, *Questionnaire Design: How to Plan, Structure and Write Survey Material for Effective Market Research* (Kogan Page Ltd 2004).
[798] Brace (n 797); James Carifio and Rocco Perla, 'Resolving the 50-Year Debate around Using and Misusing Likert Scales' (2008) 42 Medical Education 1150.
[799] Brace (n 797); Bradburn, Sudman and Wansink (n 796).
[800] Brace (n 797); Fowler and Cosenza (n 787).
[801] Fowler and Cosenza (n 787).
[802] Fowler and Cosenza (n 787).

been captured, thereby improving the flexibility of responses.[803] Five-point Likert scales were used in the rating questions.[804] This approach was used to avoid the disadvantages of seven-point Likert scales. Carifio and Perla[805] report that respondents are more likely to choose neutral points in seven-point scales due to the increase in the number of options. Word labels were used for each point on the Likert scale rather than numbers or end-point labels to ensure the reliability of ratings.[806] The literature indicates that public engagement about forensic DNA databasing may be inadequate hence public views may be poorly-informed.[807] A 'do not know' option was added to the 5-point Likert scales to allow flexibility in responses and to help understand the scale of this gap.[808] Open-ended questions were also provided to allow respondents to provide any comments about the reasons for their answers or selections in the Likert scale and MCQ questions. Finally, the last part of the questionnaire included questions about general demographic information: gender, age range, level of education and profession. The literature on survey design posits that starting a questionnaire with demographic questions may put respondents at ease before answering the main questions.[809] However, this may be viewed as intrusive or may diminish enthusiasm to complete the questionnaire.[810] Considering these potential disadvantages, it was thought that including the demographic questions at the end may encourage a greater response from the public.

5.2.2.2 Pre-test and pilot study

The survey questionnaire was pre-tested and piloted for clarity, layout, time of completion, ease of understanding, the scope of misinterpretation or multiple interpretations, validity and form of data among potential respondents, academics and researchers at the Northumbria University School of Law and Centre for Forensic Science. This included approximately 21 respondents. The pilot questionnaire was run using the Online Surveys software. Participants were asked to provide informal feedback and comments to improve the survey instrument or comment on any items that are ambiguous or difficult to understand. Issues identified

[803] Murray (n 797).
[804] Brace (n 797); Carifio and Perla (n 798).
[805] Carifio and Perla (n 798); James Carifio and Rocco J Perla, 'Ten Common Misunderstandings, Misconceptions, Persistent Myths and Urban Legends about Likert Scales and Likert Response Formats and Their Antidotes' (2007) 3 Journal of Social Sciences 106.
[806] Fowler and Cosenza (n 787).
[807] MPA Civil Liberties Panel (n 40).
[808] Bryman (n 312) 256-258.
[809] Murray (n 797); AN Oppenheim, *Questionnaire Design, Interviewing and Attitude Measurement* (2nd edn, Continuum 1992).
[810] Oppenheim (n 809) 108-109.

from the pre-test and pilot study were analysed and resolved. Questions that were difficult to understand or answer were assessed, reworded and retested. The feedback and comments from the respondents resulted in very few changes to the survey. The form of data was found to be adequate to answer the research aims. The pilot study provided an opportunity to streamline the questionnaire by keeping it short and simple to maximise response.

5.2.2.3 Survey implementation

The Online Surveys software package was used to administer the final self-administered questionnaire. The link to the online survey was distributed to the researchers' contacts via email and social media inviting them to participate in the study. These participants were asked to forward the survey link to anybody who may be interested in filling out the questionnaire. In this project, the convenience and snowball sampling methods[811] were chosen as the most appropriate approach to gather meaningful views of the public. This was because, through engagement with the literature, experts and potential respondents, it became apparent that the topic appealed to people knowledgeable about forensic science or those who have had an experience of the use of biometrics in the legal system. At the completion of the survey, the respondent progress report showed that the survey was accessed 1,871 times (see Appendix V). Although this indicates a high level of coverage, this figure only represents the number of times the survey link was clicked and not the number of individuals. Overall, 201 individuals completed the survey questionnaire. Due to the sampling approach used and the small sample size, the results of this survey lack generalization to the entire England/Wales population. As shown in section 5.3, the convenience sample was skewed by region, level of education, age, gender and profession. However, the results provide information for comparison with existing findings of public views on DNA databasing. Secondly, the results provide a knowledge base for further research into the societal and individual interests (effectiveness outcome 3) in forensic DNA databasing.

5.2.3 Survey data analysis

Coded responses from the public survey were exported into the IBM SPSS statistical software version 22. The characteristics and responses of the study participants were summarized using descriptive statistics. This is normally used as a first stage analysis of

[811] Bryman (n 312).

quantitative data including discrete (categorical) and continuous variables.[812] Categorical variables can either be nominal data (such as, gender, which is unordered) or ordinal data (such as, level of agreement, which is ordered). The characteristic of discrete data is that they are fixed. Continuous variables are measured as a ratio, which has an absolute zero value (e.g. the NDNAD match rate) or numerical values with fixed intervals (e.g. temperature).[813]

Descriptive statistics are used to describe the distribution of data including the central tendency and variability or data spread. The central tendency measures include the mean, mode, and median, which are approximately equal when data is normally distributed. The dispersion/variability measures include standard deviation, range, and interquartile ranges. The results of descriptive statistics are presented using a combination of graphs (bar charts) and tables, which may reveal possible patterns or relationship between variables. The survey data comprised of both nominal and ordinal data. Respondents were asked to indicate their level of agreement or disagreement with specific statements about the public security functions and ethical implications of the NDNAD using Likert scales. Multiple-choice questions were used to seek the views of respondents on the inclusion and retention criteria for the NDNAD.

The differences in responses among the participants were analysed using non-parametric statistics.[814] Unlike classical statistical tests, nonparametric statistics does not require the data to be normally distributed.[815] This approach was chosen because of the small sample size and the type of variables explored, nominal and ordinal data.[816] The statistical tests carried out included the Chi-square (and Fisher's exact) test of association.

The Chi-square test of association is used to determine if there is a relationship between two discrete variables.[817] The Fisher's exact test is reported where the sample size is small and/or > 20% of cells have expected count less than 5. The tests were used to analyse the relationship between the demographics of participants (gender, age, educational level and

[812] David Lucy, *Introduction to Statistics for Forensic Scientists* (Wiley 2005) 7-15.
[813] Gregory W Corder and Dale I Foreman, *Nonparametric Statistics for Non-Statisticians: A Step-by-Step Approach* (Wiley 2009).
[814] Corder and Foreman (n 813); Jean Dickinson Gibbons and Subhabrata Chakraborti, *Nonparametric Statistical Inference* (4th edn, Marcel Dekker 2003).
[815] Corder and Foreman (n 813).
[816] Joaquim P Marques de Sá, *Applied Statistics: Using SPSS, Statistica, MATLAB, and R* (Second, Springer 2007) 171.
[817] Marques de Sá (n 816) 195-197.

area of specialisation) and the perceived level of agreement with the public security functions and ethical implication of the NDNAD as well as the preferred inclusion and retention criteria.

Finally, the NVivo 12 software was used to organise the free-text responses to the open-ended questions.[818] These were analysed using the thematic analysis approach for qualitative data.[819] The responses were coded to identify patterns and recurrent themes.

5.3 General characteristics of study participants

The total number of respondents to the public survey was 201. Figure 5.1 shows the distribution of respondents by region of England and Wales. There was a disproportionate number of responses by region, reflecting the sampling approach used in the survey – convenience and snowball sampling. A majority of respondents were from the North East of England (*n = 130*). The distribution for the other regions is as follows: 8 North West, 8 Yorkshire and the Humber, 10 East Midlands, 10 West Midlands, 5 East of England, 7 London, 11 South East, 5 South West, 2 Wales and 5 unknown (undisclosed).

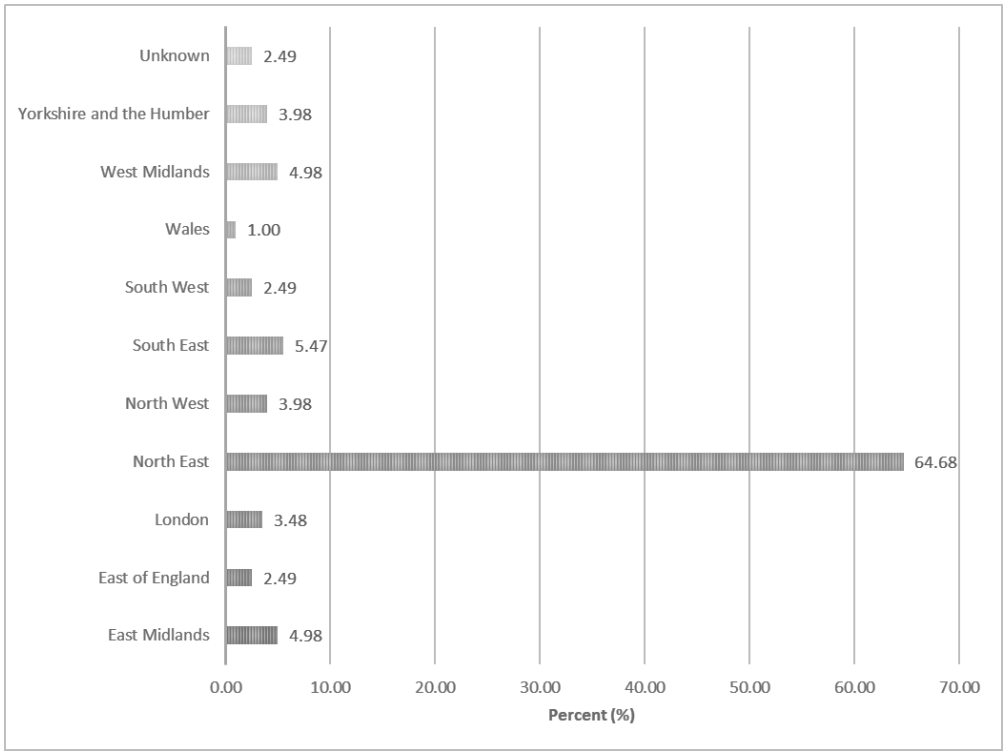

Figure 5.1 - Proportion of participants by region of England and Wales (n = 201)

[818] Bryman (n 312) 601-617.
[819] Bryman (n 312) 584-593.

The demographic characteristics of the survey participants are presented in Table 5.1. This shows that most participants (62%) were female. This is in contrast with the wider England and Wales population which is estimated to be made up of 51% females and 49% males.[820] Most participants (53%) were young adults (18-34 years). Middle and older adults (≥ 35 years) accounted for 47% of the respondents. The highest level of education for most participants (66%) was a PhD/Masters or equivalent higher university degree. Almost all participants had at least a secondary or high school education.

The survey respondents were asked to indicate their primary area of specialisation which was then coded into 4 categories (Table 5.1). The percentage of participants who disclosed this information was 86%. A higher proportion of respondents (32%) specialised within the field of Natural, Formal and Applied Sciences (NFAS). This was followed by the Business, Humanities and Social Sciences (BHSS) field (29%); and the Law, Criminology and Security (LCS) field (21%). A few participants (4%) were coded as 'other'. These were excluded from statistical analysis due to the small sample size (*n=8*), and because some professions were not specified. The next chapters examine the results of the public survey by topic: Public security functions of the NDNAD (Chapter 6); NDNAD inclusion criteria (Chapter 7); NDNAD retention periods (Chapter 8); and voluntary participation in the NDNAD (Chapter 9).

[820] Office for National Statistics, 'Male and Female Populations' (14 May 2019) <https://www.ethnicity-facts-figures.service.gov.uk/uk-population-by-ethnicity/demographics/male-and-female-populations/latest> accessed 17 May 2019.

Table 5.1 - Demographic characteristics of respondents to the DNA database public survey (n = 201)

Variable	**Levels**	**Respondents [*n (%)*]**
Gender	Male	76 (37.8)
	Female	125 (62.2)
Age	18-24	37 (18.4)
	25-34	70 (34.8)
	35-44	37 (18.4)
	45-54	32 (15.9)
	55-64	20 (10)
	≥ 65	5 (2.5)
Highest level of education	Secondary/high school	11 (5.5)
	University degree or equivalent	53 (26.4)
	Higher university degree (PhD/master's or equivalent)	132 (65.7)
	None	1 (0.5)
	Other	4 (2)
Primary area of specialisation	Business, Humanities & Social Sciences (BHSS)	58 (28.9)
	Law, Criminology & Security (LCS)	42 (20.9)
	Natural, Formal & Applied Sciences (NFAS)	64 (31.8)
	Other	8 (4)
	Undisclosed	29 (14.4)

Chapter 6: Public security functions of the National DNA Database

The law has been described as the 'final nail in the coffin' for forensic science.[821] It is considered as the most crucial factor that determines the effectiveness of DNA databases.[822] This is because the functions and composition of national databases are determined by law. In line with the second aim of this research, this chapter evaluates the perspectives of the public survey participants about the functions of the NDNAD as specified by existing law. The study focused on section 63T(1)(c) of PACE.

6.1 Public survey results on the functions of the NDNAD

The public survey assessed the security functions of the NDNAD using four 5-point Likert questions from 'definitely disagree' to 'definitely agree'. A sixth point (do not know) was included on the scale to allow flexibility in response where participants have no information about the NDNAD. The Cronbach's alpha (α)[823] was used to test the internal reliability of the dependent variable (termed perceived public security) on a sample of 191 participants. Ten participants were excluded because they selected 'do not know' or provided no response to at least one question. A high Cronbach's alpha (α) of 0.845 was found for the 4-item scale. This indicates an acceptable level of internal reliability.

Figure 6.1 presents the opinions of the participants on the four different public security functions of the NDNAD. This shows a pattern of an agreement to the enhancement of the investigation (83%), prosecution (76%) and detection (68%) of crime by most respondents. There appeared to be roughly equal agreement (41%) and disagreement (39%) on the enhancement of the prevention of crime. Less than 4% of participants indicated no knowledge about the enhancement of each of the public security functions by the NDNAD.

[821] Fraser (n 63).
[822] Marjanović and others (n 15).
[823] Bryman (n 312).

*Figure 6.1 - Opinion on the public security functions of the NDNAD (*n = 200, no response by one participant)*

The response of participants on the public security functions of the NDNAD was also analysed by demographic characteristics: gender, age, educational level and primary specialisation area. This analysis was carried out to understand the potential influence of the independent variables on the perceived enhancement of the four public security functions by the NDNAD. Table 6.1 – 6.4 summarises the opinions of the study participants. On the enhancement of the prevention of crime, there was no statistically significant association between gender, age, educational level or specialisation area and the perceived enhancement of the prevention of crime by the NDNAD. The results showed a similar trend by the demographics assessed except educational level. When stratified by gender, age and specialisation area, approximately equal proportion of participants agreed or disagreed with the statement 'the database enhances the prevention of crime' (Table 6.1). With educational level, a majority of less-educated participants (62%) were more likely to agree that the database enhances crime prevention.

The perception of the study participants on the detection of crime differed from the general trend observed for the prevention of crime. Table 6.2 shows that regardless of gender, age, educational level or specialisation area, most participants agreed with the statement 'the database enhances the detection of crime'. A higher percentage of males, middle and older adults (≥ 35 years), highly educated respondents and NFAS participants tended to agree that

the NDNAD enhances crime detection. However, there was no statistically significant association by the demographic categories examined.

Like the results for the detection of crime, a majority of respondents in each of the social categories agreed to the statement 'the database enhances the investigation of crime' (Table 6.3). Whilst there was no statistically significant difference among the groups, a higher percentage of males, highly educated and NFAS participants were more likely to agree that the database improves the investigation of crime.

The demographic analysis also showed no statistically significant difference regarding the statement 'the database enhances the prosecution of crime'. A majority of participants in each social group agreed with this statement (Table 6.4). Higher percentages of agreement were observed among females, middle and older adults, highly educated respondents and those specialised in the LCS fields.

Table 6.1 - Opinions of participants on the potential of the NDNAD to enhance crime prevention by gender, age, educational level and specialisation area.[824]

Demographic characteristic		**Disagree**	**Neither agree nor disagree**	**Agree**	***χ^2(df)***	***p-value***
Gender	Male (n=75)	42.7%	14.7%	42.7%	0.513 (2)	0.774
	Female (n=119)	39.5%	18.5%	42.0%		
Age (years)	18-34 (n=102)	43.1%	13.7%	43.1%	1.711 (2)	0.425
	≥ 35 (n=92)	38%	20.7%	41.3%		
Educational level	< University degree (n=13)	30.8%	7.7%	61.5%	2.335 (4)	0.674
	University degree (n=52)	40.4%	17.3%	42.3%		
	PhD/master's or equivalent (n=129)	41.9%	17.8%	40.3%		
Specialisation area	Business, Humanities & Social Sciences (BHSS) (n=56)	39.3%	17.9%	42.9%	0.804 (4)	0.938
	Law, Criminology & Security (LCS) (n=41)	46.3%	17.1%	36.6%		
	Natural, Formal & Applied Sciences (NFAS) (n=63)	39.7%	15.9%	44.4%		

[824] NB: Participants who selected 'do not know' were excluded from analysis

Table 6.2 - Opinions of participants on the potential of the NDNAD to enhance crime detection by gender, age, educational level and specialisation area.[825]

Demographic characteristic		**Disagree**	**Neither agree nor disagree**	**Agree**	***Fisher's Exact test or $\chi^2(df)$***	***p-value***
Gender	Male (n=75)	18.7%	10.7%	70.7%	0.074 (2)	0.964
	Female (n=122)	19.7%	11.5%	68.9%		
Age (years)	18-34 (n=104)	19.2%	14.4%	66.3%	2.415 (2)	0.299
	≥ 35 (n=93)	19.4%	7.5%	73.1%		
Educational level	< University degree (n=14)	14.3%	21.4%	64.3%	2.605	0.625
	University degree (n=53)	22.6%	7.5%	69.8%		
	PhD/master's or equivalent (n=130)	18.5%	11.5%	70.0%		
Specialisation area	Business, Humanities & Social Sciences (BHSS) (n=56)	21.4%	10.7%	67.9%	0.193 (4)	0.996
	Law, Criminology & Security (LCS) (n=41)	19.5%	12.2%	68.3%		
	Natural, Formal & Applied Sciences (NFAS) (n=64)	18.8%	10.9%	70.3%		

[825] NB: Participants who selected 'do not know' were excluded from analysis

Table 6.3 - Opinions of participants on the potential of the NDNAD to enhance crime investigation by gender, age, educational level and specialisation area.[826]

Demographic characteristic		**Disagree**	**Neither agree nor disagree**	**Agree**	***Fisher's Exact test or χ^2(df)***	***p-value***
Gender	Male (n=74)	9.5%	5.4%	85.1%	0.106 (2)	0.948
	Female (n=123)	9.8%	6.5%	83.7%		
Age (years)	18-34 (n=104)	9.6%	5.8%	84.6%	0.041 (2)	0.980
	≥ 35 (n=93)	9.7%	6.5%	83.9%		
Educational level	< University degree (n=13)	7.7%	15.4%	76.9%	4.713	0.258
	University degree (n=53)	13.2%	1.9%	84.9%		
	PhD/master's or equivalent (n=131)	8.4%	6.9%	84.7%		
Specialisation area	Business, Humanities & Social Sciences (BHSS) (n=57)	8.8%	8.8%	82.5%	4.600	0.331
	Law, Criminology & Security (LCS) (n=41)	9.8%	9.8%	80.5%		
	Natural, Formal & Applied Sciences (NFAS) (n=64)	12.5%	1.6%	85.9%		

[826] NB: Participants who selected 'do not know' were excluded from analysis

Table 6.4 - Opinions of participants on the potential of the NDNAD to enhance crime prosecution by gender, age, educational level and specialisation area.[827]

Demographic characteristic		Disagree	Neither agree nor disagree	Agree	*Fisher's Exact test or χ^2(df)*	*p-value*
Gender	Male (n=73)	13.7%	12.3%	74.0%	0.853 (2)	0.653
	Female (n=122)	11.5%	9.0%	79.5%		
Age (years)	18-34 (n=103)	13.6%	11.7%	74.8%	0.909 (2)	0.635
	≥ 35 (n=92)	10.9%	8.7%	80.4%		
Educational level	< University degree (n=13)	7.7%	23.1%	69.2%	5.344	0.218
	University degree (n=53)	15.1%	3.8%	81.1%		
	PhD/master's or equivalent (n=129)	11.6%	11.6%	76.7%		
Specialisation area	Business, Humanities & Social Sciences (BHSS) (n=56)	12.5%	8.9%	78.6%	1.884 (4)	0.757
	Law, Criminology & Security (LCS) (n=41)	9.8%	7.3%	82.9%		
	Natural, Formal & Applied Sciences (NFAS) (n=64)	17.2%	10.9%	71.9%		

As a follow-up to the questions about the public security functions of the NDNAD, participants were asked to rate their agreement/disagreement with the following statement about DNA retention: 'Its potential benefits outweigh any possible human rights or ethical concerns'. Only 3% of participants selected 'do not know' for this question, indicating that most participants were familiar with the ethical implications of forensic DNA databasing. Overall, a majority of respondents (57%) agreed to the statement (Figure 6.2). A little over a quarter (26%) disagreed and 14% neither agreed nor disagreed.

[827] NB: Participants who selected 'do not know' or provided no response were excluded from analysis

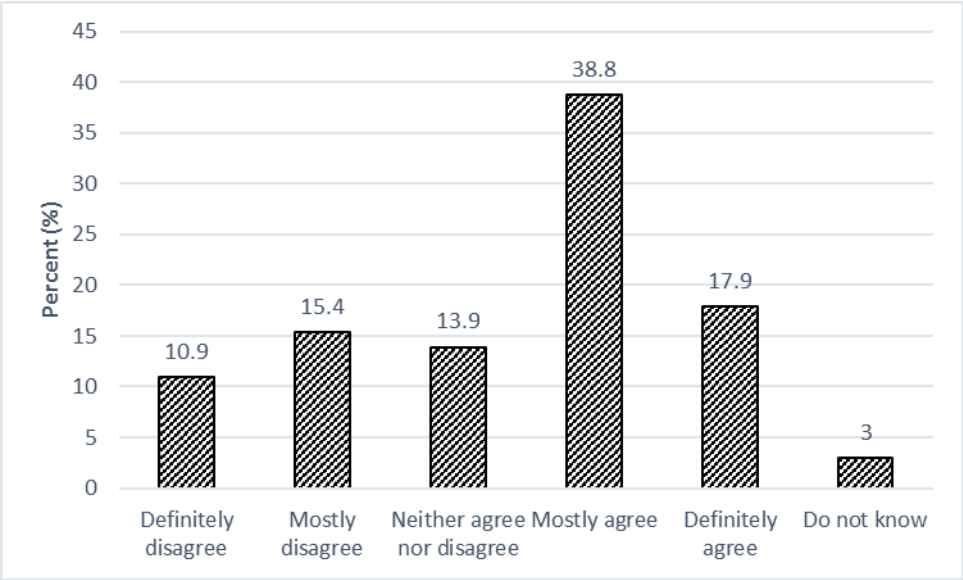

Figure 6.2 - Opinion on the statement that the potential benefits of forensic DNA retention outweigh any possible human rights or ethical concerns.

Table 6.5 presents a demographic analysis of the responses to the question comparing public security to the ethical implications of DNA retention. Two social groups, gender and age, showed a statistically significant association with the level of agreement. For the gender category, a majority of males (56%) and females (60%) agreed that the potential advantages of DNA retention take precedence over any ethical consequences. However, a higher percentage of males (37%) than females (21%) disagreed ($p = 0.012$). The age category also showed that a majority of young adults (62%) and middle/old adults (55%) agreed to the statement. Among those who disagreed, there was a higher proportion of middle/old adults (37%) than young adults (19%) ($p = 0.006$).

Within the educational level group, a majority of respondents with a bachelor's degree (68%) or higher qualification (56%) agreed that the benefits of DNA retention outweigh any ethical concerns. Half of those with less than a university degree (50%) agreed to the statement and were more likely to disagree (36%) than those with a bachelor's degree (19%) or higher university qualification (30%). However, these differences were not significant (Table 6.5).

The trend of responses within the specialisation area category was in favour of the benefits of DNA retention. A majority of respondents within each group agreed with the statement: 52% BHSS; 63% LCS; and 66% NFAS. Participants who specialised in BHSS were more likely to disagree than the other two areas, but these differences were not significant.

Table 6.5 - Opinions of participants to the statement that the benefits of forensic DNA retention outweigh any possible human rights or ethical concerns, by gender, age, educational level and specialisation area.[828]

Demographic characteristic		Disagree	Neither agree nor disagree	Agree	*Fisher's Exact test or $\chi^2(df)$*	*p-value*
Gender	Male (n=73)	37.0%	6.8%	56.2%	8.817 (2)	0.012
	Female (n=122)	21.3%	18.9%	59.8%		
Age (years)	18-34 (n=102)	18.6%	19.6%	61.8%	10.258 (2)	0.006
	≥ 35 (n=93)	36.6%	8.6%	54.8%		
Educational level	< University degree (n=14)	35.7%	14.3%	50.0%	3.417	0.490
	University degree (n=53)	18.9%	13.2%	67.9%		
	PhD/master's or equivalent (n=128)	29.7%	14.8%	55.5%		
Specialisation area	Business, Humanities & Social Sciences (BHSS) (n=56)	35.7%	12.5%	51.8%	4.012 (4)	0.404
	Law, Criminology & Security (LCS) (n=41)	26.8%	9.8%	63.4%		
	Natural, Formal & Applied Sciences (NFAS) (n=64)	20.3%	14.1%	65.6%		

6.1.1 Free-text responses on the public security functions of NDNAD

Participants of the survey were asked to provide comments on the public security role of the NDNAD. Overall, there were 42 responses of which 38 were informative. The four excluded respondents either stated no comments, insufficient knowledge to comment or provided unclear responses. Six broad themes were identified following coding of the responses: data security, function creep, the probative value of DNA, proportionality, crime control and due process.

Data security: The predominant concern among participants was the security and access of DNA data stored on the NDNAD. Whilst some comments were distinct from the issues of proportionality, others introduced further aspects of proportionality to consider. The first type of comments included issues of dis/trust in authorities managing databases and security of current systems. Some participants thought that law enforcement officers may be potentially corrupt and there may be an abuse of the database system. Others mentioned the potential exposure of the database to hacking and data misuse due to lack of stringent rules

[828] Participants who selected 'do not know' were excluded from analysis

and robust systems. Those who expressed these views cited recent cyber-attacks of online platforms. These comments mean that the perceived effectiveness of the NDNAD may be affected by externalities such as police misconduct and trends in crime:

> There are obviously issues around potential police corruption, which we would hope has been pretty much eradicated by now but given its prevalence in certain areas in living memory I would retain a hesitation as to the robustness of procedures. My major concern, however, would be the risk of hacking. Given recent exposure of hostile meddling in all manner of online arenas, and the number of emails I get from reputable companies apologising for the fact my details have been hacked from their websites, I would hope that the risk of hacking into the database and meddling with data is taken very seriously indeed. Rightly or wrongly, DNA evidence is subject to the 'CSI' effect and is seen by the general public as being conclusive. If there is potential for DNA records to be hacked or otherwise misused the effects could be catastrophic. (PSR109)

Other data security issues mentioned by some respondents were the potential in/accuracy of DNA results and the boundaries of data sharing. One of the challenges cited by participants was the possibility of bias in the analysis of results. This was attributed to the nature of the relationship between forensic providers and criminal justice agencies:[829]

> I am concerned that the use of external organisations to analyse forensic DNA are more interested in providing the results the Police and the CPS want than providing accurate results. I am also concerned about the retention and potential sharing of DNA information. (PSR153)

The second type of comments on data security was about speculative searching of the NDNAD. One respondent thought that speculative searches should be restricted and proposed a further controlled division of the NDNAD by demographics. This reveals that proportionality may not only be conceived within a context of the inclusion and retention criteria but also how searches are conducted on the database:

> NDNAD is a useful tool, but speculative searches should be limited to the demographic of the 'suspect' based only on 'known' information i.e. Suspect was a white male, then ONLY white males should be searched on the database. (PSR102)

Function creep: The second predominant theme from the text analysis was function creep.[830] The respondents thought that the use of the NDNAD should be restricted to its designed purpose and third-party agencies, such as insurance and commercial companies

[829] *R v Ward* [1993] Crim App 96; Paul C Giannelli, 'Independent Crime Laboratories: The Problem of Motivational and Cognitive Bias' [2010] Utah Law Review 247.
[830] Johanne Yttri Dahl and Ann Rudinow Sætnan, '"It All Happened so Slowly" – On Controlling Function Creep in Forensic DNA Databases' (2009) 37 International Journal of Law, Crime and Justice 83.

should be denied access. Some participants alluded to the concept of genetic exceptionalism[831] to make their argument: 'There is too much information contained in DNA for it to be used so freely, and signed over to private companies' (PSR12).

DNA probative value: The probative value of DNA evidence also featured in the concerns raised by participants. This was weighed into the debates on ensuring a balance between public security and privacy. Whilst the potential usefulness of the NDNAD was generally agreed by these respondents, overreliance on DNA was a common issue.[832] Some participants emphasised that DNA evidence is only one element of a large investigation or body of evidence and its value depends on both technical and legal factors. Reflecting on this challenge, one participant questioned whether the benefits of DNA outweigh civil liberties:

> The technical reliability of DNA evidence depends on a number of factors (quantity and quality of the sample analysed, and lab technique/equipment. I am therefore, mindful whether the potential benefits outweigh any possible human rights or ethical concerns. As a whole, I agree that National DNA Database would be good, if used appropriately and that people/law makers/lawyers are aware that DNA evidence is not fool proof. (PSR113)

Regarding the probative value of DNA evidence, another participant thought that the actual effectiveness of databases should be established. This information was thought to be essential evidence to inform the development and expansion of the database: 'I'm concerned about utility of databases. How many reported database hits contribute to prosecution? Answering that question is vital for determining issues regarding extending DNA retention.' (PSR49)

Proportionality: The fourth theme from the text analysis was safeguarding proportionality. There were mixed views on how proportionality may be ensured in running the database. Some participants placed emphasis on civil liberties, others on public security but with specific caveats. Among the first group of respondents, human rights were considered to be on a par or potentially superior to DNA databasing for public security reasons: 'Whilst DNA database have a legitimate place in the criminal justice system the benefits of mass retention of DNA cannot be said to outweigh ANY human rights concerns' (PSR9). Another respondent conceived privacy as an integral part of public security, which was in line with

[831] Williams and Johnson, '"Wonderment and Dread"' (n 646).
[832] McCartney, 'The DNA Expansion Programme and Criminal Investigation' (n 14).

comments by former Home Secretary, Jacqui Smith[833]: 'One needs to consider that a person's privacy is also part of their security (…)' (PSR13).

Participants who appeared to favour public security recommended two specific tests for the continuous retention of DNA: necessity and proportionality tests. Prior to the establishment of the NDNAD, PACE prescribed a necessity test or relevance requirement, namely, that the sample will confirm or disprove the involvement of the subject, for the initial collection of DNA samples from individuals (see section 2.4.1). However, this test was relaxed with the introduction of the CJPOA which classified saliva as a non-intimate sample.[834] The principal human right examined in the *Marper* ruling was the right to privacy (Article 8 of the Convention), which emphasises the need for proportionality and necessity. One respondent posited that the retention of DNA should only be allowed if the two tests are satisfied. This suggests a case-by-case approach or a clustered approach (i.e. cases of the same kind) to the retention of DNA data rather than a 'blanket' approach[835]:

> Concerning the issue of public security vs individual interests, I believe that in any case there should be proportionality. Retention of DNA should only be considered when it is absolutely necessary and should be proportionate in the specific case. If the case passes the necessity and proportionality test then the benefits should outweigh any possible human rights or ethical concerns (PSR5).

In addition to the above views, some participants commented that the initial decision to include data on the NDNAD should consider factors such as the type or seriousness of crime and the characteristics of the individual (convicted or suspect). Currently, the minimum threshold for inclusion on the NDNAD is an arrest for a recordable offence. The data can then be speculatively searched and retained until the conclusion of investigations or any proceedings. The only exceptions allowing continuous retention are when an individual is convicted or has a conviction history or other statutory criteria are met (see section 2.4.1). These opinions were generally consistent with the core principles established by the Biometrics Commissioner.[836] However, the recommended principles under the PoFA regime pertain to biometrics retention whilst the comments made by respondents consider the

[833] Home Office, *Keeping the Right People on the DNA Database: Science and Public Protection* (n 47).
[834] Criminal Justice and Public Order Act 1994, s 58 (3).
[835] McCartney, 'Of Weighty Reasons and Indiscriminate Blankets' (n 44).
[836] Office of the Biometrics Commissioner, 'Principles for Assessing Applications for Biometric Retention' (Office of the Biometrics Commissioner 2013) <https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/254444/Principles_for_Assessing_applications_under_PACE.pdf> accessed 4 February 2019.

criteria for initial inclusion in the NDNAD. This broadens the scope of proportionality in DNA databasing:

> The level of enhancement that a NDNAD would offer to either the investigation or prosecution of a crime is dependent on the crime in question. In relation to the protection of public security there would need to be safeguards/restrictions in place surrounding at what point you are entered into the database i.e. when you are convicted of a crime or when you were formally a suspect but have been cleared, major crime or minor crime, when are you removed from the database? (PSR36)

Crime control and due process: The final themes identified from the text analysis were crime control and due process. Views in favour of crime control tended to be based on a strong belief in the crime-solving capacity and deterrence effect of DNA evidence. Some thought that the retention of DNA is significant and essential in ensuring the safety of the public. Hence, a pragmatic retention approach informed by trends in crime was recommended here:

> I personally believe that in current times where crime appears to be on the increase and given the casual use of violence, particularly using weapons such as knives and guns we need fresh and pragmatic approach to how we use and retain forensic DNA. (PSR114)

Participants who expressed strong opinions in support of DNA retention gave little importance to civil liberties. They perceived DNA evidence to be accurate and conclusive in the prevention, detection and prosecution of crime. This was in line with the justifications of the *Gaughran* majority,[837] and the crime control perspective held by Lord Brown in the 2004 case involving *S and Marper*. The Law Lord reasoned that:

> The more complete the database, the better the chance of detecting criminals, both those guilty of crimes past and those whose crimes are yet to be committed. The better chance too of deterring from future crime those whose profiles are already on the database. And these, of course, are not the only benefits. The larger the database, the less call there will be to round up the usual suspects.[838]

In addition to the above opinions, one participant thought that emphasis on civil liberties and ethics was either influenced by criminality or philosophical complexities. This suggests that

[837] *Gaughran v Chief Constable of the Police Service of Northern Ireland (Secretary of State for the Home Department intervening)* (n 120), paras 40-41.
[838] *R v Chief Constable of South Yorkshire Police (Respondent) ex parte LS (by his mother and litigation friend JB) (FC) (Appellant) and R v Chief Constable of South Yorkshire Police (Respondent) ex parte Marper (FC) (Appellant)* (n 72), para 88.

meanings attached to the benefits of DNA retention may be rationalised within the concept of 'nothing to hide, nothing to fear':[839]

> Placing abstract concerns about ethics on something that very concretely stops people getting hurt and killed, and catches perpetrators, and provides 100% scientific confidence in prosecuting is invalid, and probably itself immoral. (…) The only people who do have a problem with a DNA database are 1) criminals, and 2) philosophy and ethics academics who struggle with polarised concepts of right and wrong, blame, etc. (PSR29)

In contrast to respondents who favoured crime control, some participants prioritised human rights (including privacy) of individuals. It was agreed by some participants that the NDNAD is a useful policing tool. However, civil liberties should be the foremost consideration in the retention of DNA. These views appeared to correspond with the *Guaghran* dissent[840] and the privacy-by-design approach promoted by the Forensic Genetics Initiative:[841]

> While the database is utilised by officers on a daily basis to make arrests, charge individuals, and for CPS to eventually prosecute, human rights law should always prevail. If serious flaws arise in the current system then the human rights of suspects comes first and the system must be revised. (PSR118)

In support of due process, one participant reasoned that recent advancements in the use of digital information mean there is a need to exercise caution in the storage of biometric information. This view illustrates the power dynamic between technology and privacy, and its recognition as an important consideration in the debates on proportionality:

> In an age where warfare has been placed into the digital realm and the players are not exclusively countries, but also includes political parties, companies and special interest groups, the less digital information of a person being stored, the better it is. (PSR195)

6.1.2 Summary of results

To sum up, the results show that participants are sceptical about the ability of the NDNAD to enhance crime prevention. However, their views on crime detection, investigation and

[839] Human Genetics Commission, *Nothing to Hide, Nothing to Fear?* (n 44); Machado and Silva, '"Would You Accept Having Your DNA Profile Inserted in the National Forensic DNA Database?' (n 676).
[840] *Gaughran v Chief Constable of the Police Service of Northern Ireland (Secretary of State for the Home Department intervening)* (n 120), paras 50-103.
[841] Forensic Genetics Policy Initiative, *Establishing Best Practice for Forensic DNA Databases* (n 88).

prosecution were positive. These benefits were thought to outweigh the civil liberty implications of retaining DNA data.

The text analysis revealed that the scope of proportionality does not only cover the inclusion and retention criteria for the NDNAD but also encompasses aspects such as speculative searching and the use of data. Methods suggested regulating these aspects of DNA databasing were the case-by-case, clustered, privacy-by-design and pragmatic approaches. Some participants appeared to favour a blanket or indiscriminate approach. The different regulatory modes were informed by issues of privacy and public security.

To some respondents, arriving at the most appropriate approach to regulate the database requires evidence of its actual utility or probative value of DNA hits. This information may be important because the text analysis showed that the perceived effectiveness of the NDNAD may be affected by external factors such as police actions, crime patterns and institutional relationships.

6.2 Discussion and conclusion

The results showed that the participants are optimistic about the ability of the NDNAD to assist the police in detecting, investigating and prosecuting crime. This finding is consistent with previous studies that show a positive outlook on the benefits of forensic DNA databases in solving crime.[842] The above finding may be attributed to the current output performance of the NDNAD, and the wide coverage of high-profile cases in reports of stakeholders and the media, where DNA hits were instrumental in apprehending offenders.[843] The literature suggests that the public may be susceptible to the inaccurate representation of forensic DNA applications in the media, where its benefits are highlighted at the expense of its limitations.[844] Whilst this may apply to members of the public who are unaware of the actual operation and effectiveness of the NDNAD, very few participants selected 'do not know'.

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[842] Machado and Silva, 'Public Perspectives on Risks and Benefits of Forensic DNA Databases' (n 659); Gamero and others, 'A Study of Spanish Attitudes Regarding the Custody and Use of Forensic DNA Databases' (n 666); Curtis, 'Public Perceptions and Expectations of the Forensic Use of DNA' (n 642); Curtis, 'Public Understandings of the Forensic Use of DNA' (n 642); Dundes (n 666); Teodorović and others (n 122).

[843] FIND Strategy Board, *Annual Report 2017 to 2018* (n 16); Gordon Thomas Honeywell Governmental Affairs, 'United Kingdom Murder Case Selected as 2018 DNA Hit of the Year' (*DNA Resource*, 4 May 2018) <http://www.dnaresource.com/documents/2018%20Hit%20of%20the%20Year/Rome%20Press%20Release%20Website%20Final%202.pdf> accessed 3 April 2019; BBC News, 'Melanie Road Murder: Man Jailed for 1984 Melanie Road Murder' *BBC News* (9 May 2016) <https://www.bbc.com/news/uk-england-somerset-36245888> accessed 6 December 2018.

[844] Machado and Silva, 'Public Perspectives on Risks and Benefits of Forensic DNA Databases' (n 659).

Further, the free-text responses showed that some participants were aware of the challenges of DNA analysis/databasing and the responses may reflect the available evidence on the pros and cons of the NDNAD.

The specified functions of the NDNAD considers its potential to prevent crime.[845] This may include the deterrence of crime and the incapacitation of offenders leading to a reduction in crime. The results revealed doubt about this public security function of the NDNAD. Similar findings have been reported by Machado and Silva [846] in Portugal and qualitative interviews[847] with criminal justice professionals in the UK. The literature indicates that offenders may change their modus operandi to prevent being caught. This may include taking DNA transfer precautions or migrating to a new jurisdiction where they are unknown to the system to commit crime.[848] Further, custodial periods may be short and the high rate of recidivism among offenders means the deterrent effect of forensic DNA databases may be negligible.

Across the social groups examined, there was no statistically significant association with the perception of the public security functions of the NDNAD. However, less educated participants tended to be positive about the ability of the NDNAD to prevent crime whilst the other groups were sceptical. Exposure to information about the benefits and limitations of DNA technology is more likely to be high among the more educated public than less educated members of the public. Further, members of the public with a lower level of education may be susceptible to biased media and television portrayal of DNA technology. These factors may partly explain the results of this study. Consistent with this result, Machado and Silva[849] found that scepticism about the public security functions of forensic DNA databases may be more common in groups with a higher level of education relative to those with less education.

The results suggested that the public may favour the benefits of the NDNAD over its civil liberty implications. This 'utilitarian view' suggests that the public gives special importance to the potential benefits of databases and may be willing to trade some of their privacy for security. However, the concept of a trade-off between privacy and security is thought to be

[845] Police and Criminal Evidence Act 1984, s 63T(1)(c).
[846] Machado and Silva, 'Public Perspectives on Risks and Benefits of Forensic DNA Databases' (n 659).
[847] McCartney, 'The DNA Expansion Programme and Criminal Investigation' (n 14); McCartney, *Forensic Identification and Criminal Justice: Forensic Science, Justice and Risk* (n 42).
[848] McCartney, *Forensic Identification and Criminal Justice: Forensic Science, Justice and Risk* (n 42); Doleac and others (n 102).
[849] Machado and Silva, 'Public Perspectives on Risks and Benefits of Forensic DNA Databases' (n 659).

problematic since security encompasses the protection of privacy.[850] Whilst this is emphasised in human rights law,[851] there are certain circumstances where the pursuance of specific security objectives, such as crime resolution, may require interference with another specific security objective, such as individual privacy protection. The utilitarian view may be significant where individuals consider the potential impact of DNA hits in resolving complex serious offences such as rape and murder. For example, there are occasional calls for a UDNAD or screening of some unconvicted groups when an unresolved serious crime comes to the attention of the public.[852] This may occur when people are drawn to empathize with individuals who are victims of crime or are directly affected by crime.[853]

The demographic analysis showed that females and young adults tended to favour the utilitarian view. The literature shows that females are more affected by crime than males.[854] Further, more crimes are committed by males than females and the composition of the NDNAD reflects this observation. More than 80% of the subject profiles on the database are from males.[855] Hence, males may be more concerned about civil liberties than females. This may explain why male participants were more likely to favour a restricted database than females.

According to the privacy paradox, there is a gap between the privacy attitudes and behaviour of individuals.[856] Whilst there is limited research on the influence of age on the privacy paradox, it has been hypothesised that young adults may be less concerned about privacy or are more likely to take actions to protect their privacy or trade their privacy for personal benefits.[857] This trend may be linked to the dis/agreement with the utilitarian view among the young study participants.

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[850] Daniel J Solove, *Nothing to Hide: The False Tradeoff between Privacy and Security* (Yale University Press 2011).
[851] See definition of public security in section 1.3.3 of Chapter 1.
[852] James Tapsfield and Daniel Bentley, 'Murdered Sally Anne Bowman's Mother Backs Gordon Brown over DNA' (*The Independent*, 9 April 2010) <http://www.independent.co.uk/news/uk/politics/murdered-sally-anne-bowmans-mother-backs-gordon-brown-over-dna-1940229.html> accessed 20 June 2018; Danny Brierley and Martin Bentham, 'Mother of Sally Anne Bowman: Store Everyone's DNA on a National Database' (*Evening Standard*, 31 March 2009) <http://www.standard.co.uk/news/mother-of-sally-anne-bowman-store-everyones-dna-on-a-national-database-6860416.html> accessed 20 June 2018.
[853] Jayann Sepich, 'DNA Databases – Solving Crimes and Saving Lives - A Mother's Story' (ThermoFisher Scientific 2017).
[854] Dana M Britton, Shannon K Jacobsen and Grace E Howard, *The Gender of Crime* (2nd edn, Rowman & Littlefield 2017).
[855] Home Office, 'National DNA Database Statistics: Q1 2019 to 2020' (n 25).
[856] Gerber, Gerber and Volkamer (n 36).
[857] Susan B Barnes, 'A Privacy Paradox: Social Networking in the United States' (2006) 11 First Monday <https://doi.org/10.5210/fm.v11i9.1394> accessed 21 May 2019; Grant Blank, Gillian Bolsover and

The qualitative insights about the public security functions of the NDNAD revealed a concern about data security and function creep. This was consistent with several studies that have reported concerns about the security of data including data misuse.[858] In this study, some participants were concerned about the risk of hacking. One of the key aspects of creating a national forensic DNA database is the development of a secure computer network platform to manage the database. The NDNAD, for example, is not available on the internet and access to the database is tightly regulated. Whilst the database is for the police, it is only accessed by a small number of vetted staff at the Home Office. Third-party agencies such as insurance companies have no direct access to the database. These operational strategies prevent any cyber-attacks, hacking of the system or any unintended uses. The data security issues raised by participants suggests that information about the technical security of the NDNAD may be inadequate in the public domain. This information may be crucial in enhancing transparency and public trust in the governance of the NDNAD.

It was clear from the responses that some participants were aware of the limitations of DNA evidence in a criminal investigation. These limitations have been critically scrutinised in the literature including issues of transfer and persistence of DNA, and interpretation of full/partial matches and mixed profiles.[859] Most criminal investigations are complex, involving tactical decisions by investigative officers, use of various technical and scientific techniques, interrogation of individuals and the utilisation of several evidence types. However, where DNA is available, it is often portrayed as the most (or only) significant aspect of the investigation, overlooking other critical aspects of the case. A risk highlighted by McCartney[860] is the potential overreliance on DNA due to a misunderstanding of its potential and limitations among criminal justice professionals. These reasons suggest that the optimistic and utilitarian view expressed by participants about the benefits of the NDNAD may not be based on reliable evidence about the probative value of DNA. Machado

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Elizabeth Dubois, 'A New Privacy Paradox: Young People and Privacy on Social Network Sites' (Social Science Research Network 2014) SSRN Scholarly Paper ID 2479938 <https://papers.ssrn.com/abstract=2479938> accessed 21 May 2019.

[858] Zieger and Utz (n 663); Teodorović and others (n 122); Joëlle Vailly and Yasmine Bouagga, 'Opposition to the Forensic Use of DNA in France: The Jurisdiction and Veridiction Effects' [2019] BioSocieties <https://doi.org/10.1057/s41292-019-00150-y> accessed 10 May 2019.

[859] Bianca Szkuta, Kaye N Ballantyne and Roland AH van Oorschot, 'Transfer and Persistence of DNA on the Hands and the Influence of Activities Performed' (2017) 28 Forensic Science International: Genetics 10; Jiawen Yang and others, 'The Advances in DNA Mixture Interpretation' (2019) 301 Forensic Science International 101.

[860] McCartney, 'The DNA Expansion Programme and Criminal Investigation' (n 14).

and Silva report that direct knowledge and experience of how DNA is used in criminal investigations may be linked to a more moderate view about its potential.[861]

The study participants inferred different modes of regulation for aspects of the NDNAD with justifications based on either civil liberty or public security reasons or both. One approach was the case-by-case regulatory model involving the assessment of each case to determine whether the inclusion and retention of DNA data in the NDNAD are necessary to enhance public security. It was thought that this approach may be compatible with the principle of proportionality. Whilst this may be ideal,[862] there are several uncertainties in predicting the future 'usefulness' of DNA data based on the nature or characteristics of the case and the relevant subject. Further, the case-by-case approach may be more difficult to manage since it will be based on the discretion of an officer. The approach may also lead to a loss of crime detection in some cases. The current PoFA regime includes a form of case-by-case retention for individuals arrested for a serious offence. According to the 2015 report of the Biometrics Commissioner,[863] a 'bright-line' rule for automatic retention or deletion may be cheaper than discretionary retention. Hence, a major disadvantage of the case-by-case approach is its administrative impact.

The second inferred mode was the clustered approach, which may be described as an improvement of the case-by-case model where cases of the same characteristics are subject to automatic inclusion and retention in the NDNAD. Such cases should be supported with adequate evidence of the relevance and usefulness of the inclusion and retention of data in the NDNAD. There is presently no such model under the PoFA regime. This may be attributed to difficulties in establishing such a knowledge-base.[864] The current regulatory model includes a blanket rule for inclusion and speculative searching (–arrest for a recordable offence) and mainly bright-line rules for continued retention of DNA data from different categories of individuals. These rules are not adequately supported by empirical evidence on the actual effectiveness of inclusion and retention, particularly data from unconvicted individuals.[865]

The analysis of the free-text responses also suggested a pragmatic model of regulation informed by crime control. Under this approach, the inclusion and retention of DNA data in

[861] Machado and Silva, 'Public Perspectives on Risks and Benefits of Forensic DNA Databases' (n 659).
[862] *Animal Defenders International v The United Kingdom* [2013] ECHR 362.
[863] MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80).
[864] Wiles, *Annual Report 2016* (n 26).
[865] McCartney, 'Of Weighty Reasons and Indiscriminate Blankets' (n 44); Wiles, *Annual Report 2016* (n 26).

the NDNAD, and the use of DNA data is determined by the nature and trends in crime. This could be compared to the occasional mass screening or intelligence-led screening (ILS) of defined groups of people to solve a specific serious DNA-related crime.[866] The ILS is sometimes commissioned in DNA-related cases where the perpetrator is unknown, and no matches are found in a national DNA database. According to a 2006 report by Wenzel,[867] the success rate of ILS in Europe is about 72%. This shows that the pragmatic approach could be potentially effective in solving such specific crimes. However, ILS is very expensive, laborious and may require the voluntary cooperation of the target individuals based on informed consent. In the investigation of the murder of Louise Smith in 1996, the UK spent over £200,000 in sampling more than 4500 individuals.[868] Regarding voluntary participation, this may be problematic where individuals exercise their right to refuse sampling. Further, samples cannot be used for other investigations and may be destroyed on completion of the case.[869] These challenges mean the pragmatic approach may be difficult to implement on a large scale.

The last model inferred from the qualitative responses of participants is the privacy-by-design approach. This model emphasises due process and the civil liberties of individuals and posits that human rights should be the principal consideration in the regulation of the key aspects of DNA databasing such as inclusion, retention and use of DNA data. Whilst this model is promoted in debates about DNA databasing,[870] it may be difficult to achieve the public security outcomes of databases under this approach. This is because strict adherence to civil liberties may preclude the inclusion and retention of data from all unconvicted individuals. This means the police may not be able to detect some crimes. The Portuguese national DNA database currently implements a form of strict privacy-by-design with an inclusion criterion covering individuals convicted of offences with ≥3 year's prison term.[871] It is not clear how its actual effectiveness compares with the UK NDNAD. However,

[866] Butler (n 8).
[867] Rainer Wenzel, 'Report on Criminal Cases in Europe Solved by ILS (DNA Mass Testing)' (European Network of Forensic Science Institutes 2006).
[868] House of Commons, 'House of Commons Hansard Debates for 10 March 1999: DNA Sampling' (*www.parliament.uk*, 10 March 1999) <https://publications.parliament.uk/pa/cm199899/cmhansrd/vo990310/debtext/90310-16.htm#90310-16_head0> accessed 8 May 2019.
[869] House of Commons (n 868).
[870] Forensic Genetics Policy Initiative, *Establishing Best Practice for Forensic DNA Databases* (n 88).
[871] Santos, Machado and Silva (n 29).

Santos *et al.*[872] found a higher performance ratio (H/N) for the UK NDNAD (0.31) compared to other EU countries (≤ 0.30).

In conclusion, the views of the study participants indicate high perceived effectiveness of the National DNA Database in terms of its utilisation in detecting, investigating and prosecuting crime. In considering the balance between public security and civil liberties, the respondents tended to favour a utilitarian view (i.e. for the greater good) which weighs the security of the society above individual interests. An appraisal of the regulatory models inferred from the qualitative responses indicates the clustered approach may be the most appropriate. This is an evidence-driven model that emphasises the relevance and usefulness of collecting DNA, the inclusion and retention of DNA data in the NDNAD and use of the data in solving crime. Since the law governing DNA databasing may be considered as a societal choice, it is important for the public to be fully informed about the actual benefits and risks of databases. The results obtained in this study suggest a public demand for such information to shape the law governing the NDNAD, ensuring that the law is specific, accurate and representative of the actual benefits of databases.

[872] Santos, Machado and Silva (n 29).

Chapter 7: Inclusion criteria for the National DNA Database

Forensic DNA comparisons can be carried out with or without a national DNA database. The use of a database is only relevant to solving cold cases or no-suspect crimes. The inclusion criteria can be described as the minimum requirement for the initial entry of a DNA profile from a known individual in the NDNAD. Several 'inclusion determiners' have been proposed in the literature including the seriousness of an offence, contact with the police or arrest, risk of crime, involvement in crime, recidivism, and citizenship/residency.[873] As part of the third aim of this research, this chapter examines the responses of participants to the public survey about who to include in the database. Section 7.1 presents the findings from the survey, followed by the discussion and conclusions in section 7.2. The original contribution of the chapter is the establishment of the current support for the NDNAD inclusion criteria. Further, the analysis provides insights into the justifications for the entry or non-entry of DNA profiles in the NDNAD.

7.1 Public survey results on inclusion criteria

The public survey sought to understand the views of the public about who to include in the NDNAD. The views of the study participants are presented in Figure 7.1. Overall, 39% of participants preferred an inclusion criterion ranging from arrestees to convicted individuals (termed 'suspect criteria'). The second preferred criterion was consistent with the current PACE inclusion criteria (named 'PACE criteria'), ranging from arrestees to convicted individuals plus volunteers (30%). This implies that at the minimum, most participants (69%) favour the inclusion of 'suspects'. However, there was no majority view for the composition of this suspect group (i.e. whether convicted, charged, arrested individuals or a combination of these (Figure 7.1)). About a quarter (25%) of the participants thought DNA data of all citizens/residents should be included in the NDNAD ('population criteria').

Of the 10 (5%) respondents who selected 'other', five indicated 'none' (i.e., nobody should be included in the NDNAD). One participant noted that 'anyone who has DNA taken (including victims of crime) should be stored' (PSR172). This inclusion criteria, termed 'crime criteria', suggest a non-discriminatory approach encompassing data from suspects, victims, officers and, possibly, witnesses. Another respondent thought the inclusion criteria should be restricted to those convicted of violent/sexual crimes ('serious offenders'

[873] Gamero and others, 'Spanish Public Awareness Regarding DNA Profile Databases in Forensic Genetics' (n 671); *S and Marper v The United Kingdom* (n 44); *Gaughran v Chief Constable of the Police Service of Northern Ireland (Secretary of State for the Home Department intervening)* (n 120), Annex B.

criteria'). Two other respondents preferred an inclusion criterion restricted to serious offenders' data plus either specific volunteers or subjects of a criminal investigation. One participant was 'not sure' about the inclusion criteria.

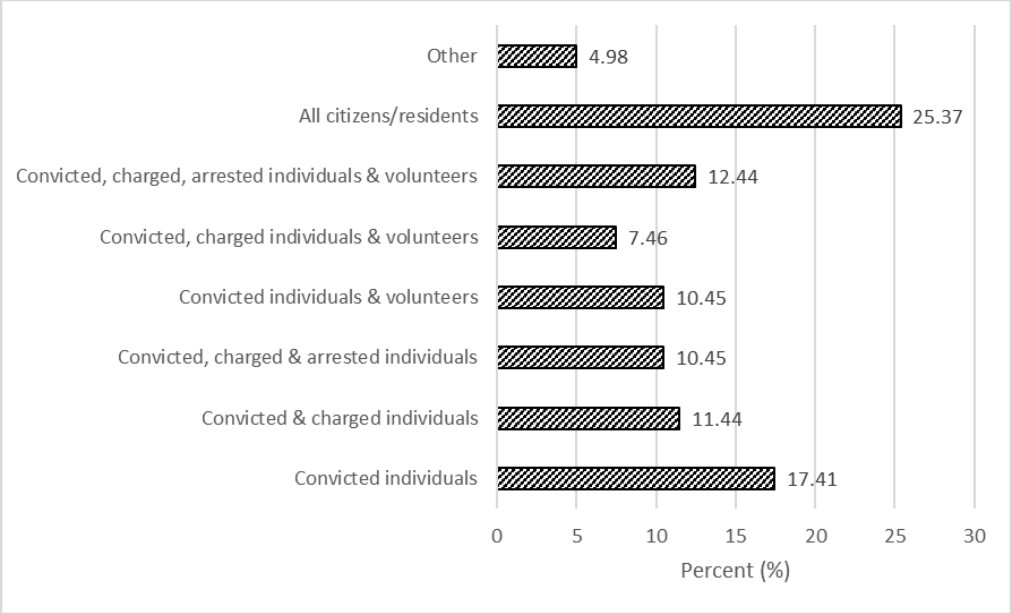

Figure 7.1 - Responses to the question 'In your opinion, which category of individuals should have their DNA profiles included in the National DNA Database' (n = 201).

Social groups of respondents showed a trend of differing views regarding the category of individuals to include in the NDNAD (Table 7.1). The responses of participants were coded under the following defined terms to simplify statistical analysis: suspect criteria, PACE criteria, population criteria and other. There was no statistically significant association between the social groups and the preferred inclusion criteria (all $p > 0.05$). A majority of both males (74%) and females (67%) preferred a minimum inclusion criterion of 'suspects'. A higher fraction of females were more likely to favour the population criteria than males (27% versus 22%). The trend for the age category showed that most participants in the different age groups favoured an inclusion criterion that includes at least suspects. Middle or older adults[874] (76%) were more likely to favour this criterion than young adults[875] (65%). For the population criteria, young adults (31%) tended to prefer this approach than middle or older adults (19%) but these differences were statistically insignificant.

The demographic analysis also showed that irrespective of educational level, most respondents prefer a minimum inclusion criterion of suspects. A higher percentage of

[874] i.e. ≥ 35 years
[875] i.e. 18-34 years

respondents with a bachelor's degree (81%) were more likely to favour this approach than those with a PhD/masters (66%) or < bachelor's degree (63%), showing that the preference of participants may not be linked to an increase in education. Preference for the population criteria was higher among participants with no bachelor's degree (38%) than those with a PhD/masters (26%) or bachelor's degree (19%).

For the specialisation area category, it was observed that most participants in each of the three groups preferred the minimum inclusion criteria of suspects: BHSS (71%); LCS (71%); NFAS (69%). Participants who specialised in NFAS (28%) were more likely to favour the population criteria than the others (22% BHSS; 19% LCS).

Table 7.1 - Opinions on category of individuals to include on the NDNAD by gender, age, educational level and specialisation area.

Demographic characteristic		**Suspect criteria**	**PACE criteria**	**Population criteria**	**Other**	***Fisher's Exact test or $\chi^2(df)$***	***p-value***
Gender	Male (*n = 76*)	48.7%	25.0%	22.4%	3.9%	4.582 (3)	0.205
	Female (*n = 125*)	33.6%	33.6%	27.2%	1.5%		
Age (years)	18-34 *(n = 107)*	32.7%	31.8%	30.8%	4.7%	5.422 (3)	0.143
	≥ 35 *(n = 94)*	46.8%	28.7%	19.1%	5.3%		
Educational level	< University degree *(n = 16)*	31.3%	31.3%	37.5%	0.0%	8.062	0.206
	University degree *(n = 53)*	47.2%	34.0%	18.9%	0.0%		
	PhD/master's or equivalent *(n = 132)*	37.1%	28.8%	26.5%	7.6%		
Specialisation area	Business, Humanities & Social Sciences (BHSS) *(n = 58)*	34.5%	36.2%	22.4%	6.9%	5.116	0.533
	Law, Criminology & Security (LCS) *(n = 42)*	47.6%	23.8%	19.0%	9.5%		
	Natural, Formal & Applied Sciences (NFAS) *(n = 64)*	37.5%	31.3%	28.1%	3.1%		

In addition to the category of individuals to include in the NDNAD, participants were asked separately about eligible types of offences for the inclusion of convicted individuals. Two hundred participants answered this question. Figure 7.2 shows mixed views on the type of offence for which DNA data of convicted individuals should be included in the NDNAD. The proportion of participants that favoured the inclusion of data for qualifying/serious

offences (35%) and all offences (32%) were relatively comparable. The percentage of those who chose all recordable offences was 16% and those who selected all qualifying and minor offences was 12%. Overall, whilst participants shared divergent views on the eligible offence types, the results suggest a near consensus (~94%) to include data from convicted individuals. Some participants (~5%) chose 'other' and provided comments on offence eligibility. The range of opinions among this group were 'none', only serious offences and 'justified' offences. A few participants also chose not applicable (2%). These were mainly participants who thought all citizens/residents should be included in the NDNAD.

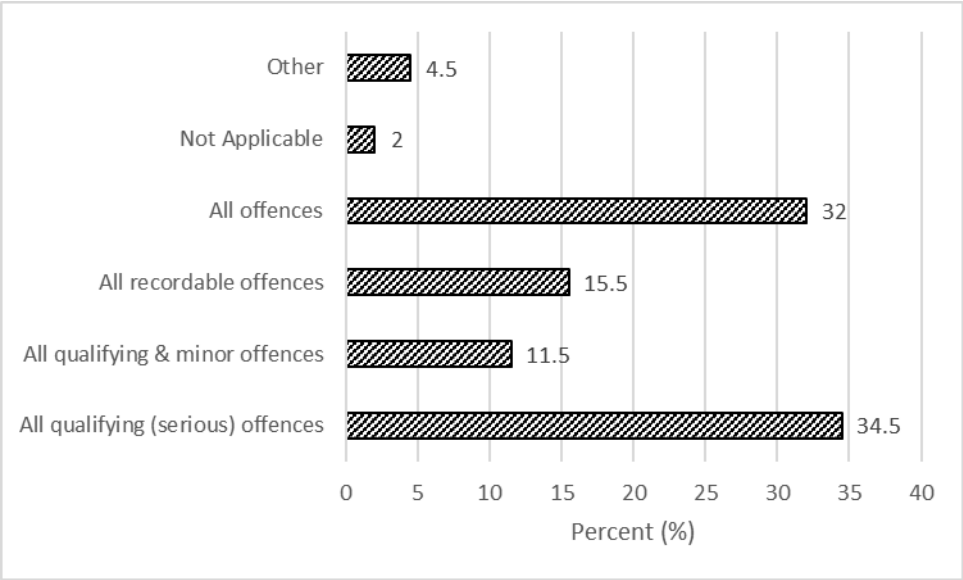

Figure 7.2 - Responses to the question 'In your opinion, for what types of offences should the DNA profile of a convicted individual be stored on the DNA database?' (n = 200).

To allow for statistical analysis, the offence type option 'all qualifying and minor offences' were recoded under 'all recordable offences' since they are broadly the main types of recordable offences. The demographic analysis showed no statistically significant association between gender, age or specialisation area and eligibility of offence type for convicted individuals (Table 7.2). The educational level category showed a statistically significant association *($p = 0.042$)*. Overall, the results suggest that most participants in each social group support the inclusion of data from convicted individuals. However, there were diverse views on the eligible type of offence except in the educational level category. Most participants with no university degree (63%) were more likely to favour an inclusion criterion covering individuals convicted of any offence. Relatively, 28% of participants with a university degree and 30% of those with a PhD/masters chose all offences. Those with a

university degree (42%) were more likely to favour 'all recordable offences (recoded)' than the PhD/masters (24%) and < university degree (6%) groups.

A further question asked under the NDNAD inclusion criteria was the eligible type of offences for 'innocent' individuals (i.e. those charged or arrested but not convicted of an offence). The total number of participants who answered this question was 199. As shown in Figure 7.3, the results suggest that most respondents (~70%) favour the inclusion of data from this category of individuals. However, opinions on the eligible type of offences were mixed with no majority preference: 29% for all qualifying offences; 25% for all offences; 13% for all recordable offences and 4% for all qualifying and minor offences. Some participants (22%) selected 'not applicable' for this question. These were mostly those who thought the inclusion criteria should be restricted to convicted individuals or cover all citizens/residents. Sixteen respondents (8%) chose 'other' and provided comments about their preference. The ranges of views were 'none' for charged and/or arrestees, all offences for only charged individuals, and case-by-case criteria.

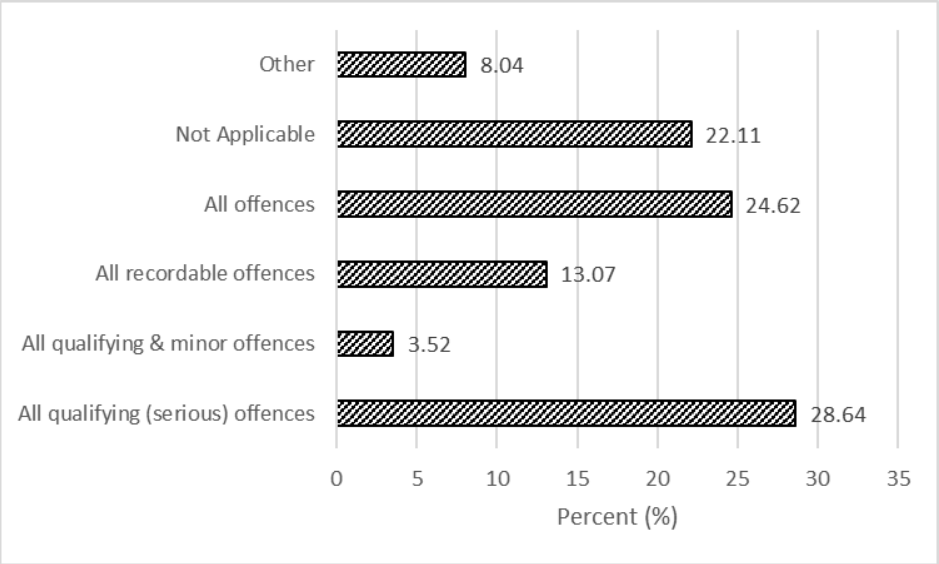

Figure 7.3 - Responses to the question 'In your opinion, for what types of offences should the DNA profile of a charged or arrested but not convicted individual be stored on the DNA database?' (n = 199).

The analysis of the social groups showed a statistically significant association between gender or age and eligibility of offence type for charged or arrested but not convicted individuals (Table 7.3). The educational level and specialisation area groups showed no statistical significance. Generally, it was apparent that most participants in each social group favoured the inclusion of data from this 'innocent' group but differed on the eligibility of the offence types. In the gender category, males (38%) were statistically significantly (p =

0.022) more likely to favour ‘all qualifying/serious offences’ than females (23%). Females (22%) were more likely to favour ‘all recordable offences (recoded)’ than males (8%). For the age category, the preference for all recordable offences was more likely in young adults (25%) than in middle or older adults (8%) ($p < 0.001$). Participants in the middle/older age group (31%) were more likely to select ‘not applicable’ than young adults (14%). These were predominantly those who thought the inclusion criteria should be limited to convicted individuals or preferred the inclusion of data from all citizens/residents.

Table 7.2 - Opinions on eligible type of offence to include on the NDNAD if convicted, by gender, age, educational level and specialisation area.

Demographic characteristic		**All qualifying (serious) offences**	**All recordable offences *(recoded)***	**All offences**	**Not Applicable**	**Other**	***Fisher's Exact test***	***p-value***
Gender	Male (*n = 76*)	40.8%	21.1%	28.9%	3.9%	5.3%	5.780	0.204
	Female (*n = 124*)	30.6%	30.6%	33.9%	0.8%	4.0%		
Age (years)	18-34 *(n = 106)*	33.0%	30.2%	32.1%	2.8%	1.9%	5.004	0.286
	≥ 35 *(n = 94)*	36.2%	23.4%	31.9%	1.1%	7.4%		
Educational level	< University degree *(n = 16)*	31.3%	6.3%	62.5%	0.0%	0.0%	14.663	0.042
	University degree *(n = 53)*	28.3%	41.5%	28.3%	0.0%	1.9%		
	PhD/master's or equivalent *(n = 131)*	37.4%	23.7%	29.8%	3.1%	6.1%		
Specialisation area	Business, Humanities & Social Sciences *(n = 58)*	34.5%	32.8%	25.9%	1.7%	5.2%	5.903	0.663
	Law, Criminology & Security *(n = 42)*	42.9%	19.0%	28.6%	2.4%	7.1%		
	Natural, Formal & Applied Sciences *(n = 64)*	26.6%	34.4%	32.8%	1.6%	4.7%		

Table 7.3 - Opinions on eligible type of offence to include on the NDNAD if charged or arrested but not convicted, by gender, age, educational level and specialisation area.

Demographic characteristic		**All qualifying (serious) offences**	**All recordable offences *(recoded)***	**All offences**	**Not Applicable**	**Other**	***Fisher's Exact test or χ^2(df)***	***p-value***
Gender	Male (*n = 76*)	38.2%	7.9%	21.1%	26.3%	6.6%	11.430 (4)	0.022
	Female (*n = 123*)	22.8%	22.0%	26.8%	19.5%	8.9%		
Age (years)	18-34 *(n = 106)*	31.1%	24.5%	26.4%	14.2%	3.8%	21.056 (4)	< 0.001
	≥ 35 *(n = 93)*	25.8%	7.5%	22.6%	31.2%	12.9%		
Educational level	< University degree *(n = 16)*	18.8%	12.5%	43.8%	25.0%	0.0%	13.673	0.072
	University degree *(n = 53)*	35.8%	22.6%	26.4%	13.2%	1.9%		
	PhD/master's or equivalent *(n = 130)*	26.9%	14.6%	21.5%	25.4%	11.5%		
Specialisation area	Business, Humanities & Social Sciences *(n = 57)*	28.1%	19.3%	24.6%	19.3%	8.8%	4.040	0.865
	Law, Criminology & Security *(n = 42)*	31.0%	11.9%	16.7%	28.6%	11.9%		
	Natural, Formal & Applied Sciences *(n = 64)*	28.1%	17.2%	26.6%	21.9%	6.3%		

7.1.1 Reasons for the category of individuals to include in the database

The qualitative responses about the NDNAD inclusion criteria provided insights into the reasons for the preference of participants. Regarding the category of individuals to include in the database, there were 88 responses (44% of participants). The comments were coded under five key themes: crime control, due process, proportionality, practical considerations and other inclusion categories.

Crime control and due process: The predominant themes in the qualitative responses were crime control and due process. Of those that inclined towards crime control, some expressed views that opposed the established principle of innocent until proven guilty. These participants either preferred an expansive database or a database of all citizens/residents (population criteria). They reasoned that every member of society could be or become a suspect or victim of a crime: 'Everyone, even me, is a potential criminal. And a potential victim. The database helps everyone' (PSR29). The crime control view was also supported by the idea that a larger database means a more effective database. Some participants thought a larger database can aid an investigation, resolve crimes quickly and deter criminals:

> We would be able to solve crimes and provide a safer country to live in. I believe this would deter people from believing they could commit a crime and get away with it. I have been interested in this idea for a long time now. This should be mandatory. We would save time, money and resources. (PSR105)

Another reason provided by participants who supported a crime control system was the concept of 'nothing to hide, nothing to fear'. Some thought a comprehensive database was a 'common sense' approach considering its potential effectiveness:

> I feel, and have always felt, that individual DNA data should be stored on the database from birth. A controversial opinion I know, but I believe that the classic argument prevails - unless you have something to hide you have nothing to fear. (PSR88)

The last reason in support of a comprehensive database was equity and its potential research benefits. Some participants thought such a system will be less discriminatory and fairer, with the database functioning as a civil register similar to a 'Register of Births, Deaths and Marriages' (PSR28). These participants also expressed concern about privacy but thought this was more of securing the data on the database and preventing misuse rather than avoiding data inclusion:

> It is fairer to have a record for all citizens rather than save the DNA profiles for specific groups. Plus, I assume this profile could be used for scientific/research

> reasons. It is important, however, to regulate access and storage of this information to safeguard privacy and fair use of the records. (PSR34)

Participants who leaned towards due process reasoned that the rights of an individual should not be compromised without adequate legal justifications. These participants thought that absent a conviction, the DNA records of innocent individuals should not be included in the database. The basis of this position was the established legal concept of 'innocent until proven guilty'. They thought the 'right to privacy of the innocent citizen outweighs the potential benefits to the state' (PSR37). Some participants linked privacy to personal freedom and reiterated the legal protections established for personal data in non-law enforcement domains. One participant cited the GDPR[876] as an example to illustrate the importance of upholding the basic human rights of innocent individuals:

> The process of collecting DNA can be intrusive, it is personal data, and personal data in every other walk of life is protected, especially given GDPR. The only people who have been demonstrated to be guilty of an offence are those convicted in court - everyone else is innocent until proven otherwise. (PSR13)

In addition to the above views supporting due process, some participants thought data from volunteers may be included. However, this should be limited to adults or specific people and adhere to the principles of informed consent, avoiding any form of coercion. One of these participants further thought an expansive database could introduce some form of bias in police detective work. This view was in line with the work of McCartney,[877] where some interviewees thought the reliance on DNA could abbreviate police investigations: 'I personally feel that a widespread database infringes human rights and could unfairly prejudice police work. It shouldn't be used to replace actual investigation and police work' (PSR151).

One participant who favoured the above views also thought due process should apply to data from convicted individuals. This was founded on the concept of 'spent convictions' under the Rehabilitation of Offenders Act 1974.[878] It was thought that the inclusion of data from convicted individuals should be limited to a fixed period:

> It is reasonable for DNA testing to be used to either clear suspects or provide evidence of crime. However, the principle that people are assumed to be innocent should not be compromised by this. This means that no-one who has not been convicted of a crime should have DNA stored. I can see why those

[876] European Parliament and Council of the European Union (n 252).
[877] McCartney, 'The DNA Expansion Programme and Criminal Investigation' (n 14) 185.
[878] Rehabilitation of Offenders Act 1974, s 1.

> convicted of a crime might have that right withdrawn, but that should be for a specified period (a bit like the way convictions become 'spent' after a certain period of time). I would not trust the police with anything beyond this. (PSR155)

Proportionality: Among participants who opposed the population inclusion criteria or a comprehensive database, some considered elements of the principle of proportionality rather than due process as their basis. Firstly, they thought the relevance or necessity of including the DNA data of a specific group should be established. This should consider whether the entry of the DNA data will improve the efficiency of the database or not. To some participants, this 'proportionality link' between the inclusion of data and the desired public security objectives may be justifiable for only convicted individuals, potential recidivistic individuals or some arrestees:

> It is not necessary to DNA fingerprint every individual to have an efficient NDNAD. Volunteers are relevant to boost numbers to give a better demographic of people on the database and to aid in research. (PSR7)

> Only retaining the DNA of convicted individuals ensures a critical link to proportionality. (PSR9)

> I chose this answer because this group of people [convicted and charged individuals] seem to be the most likely to reoffend. (PSR48)

One participant further mentioned that the police should make a case for every individual arrest. This participant reasoned that some arrestees may evade charging, making it difficult to identify serial offenders:

> I don't believe persons arrested and not charged should have their DNA profile stored. On the one hand, it may be the case that the person is a serial offender and perhaps escapes charges and therefore it will be harder to determine future offences committed by him in the future. On the other, large numbers of persons are arrested and are completely innocent. Your DNA should not be held, if you do not wish it to be, if the police cannot make a convincing case that you should be charged by CPS. (PSR118)

A second proportionality element considered by participants was whether the inclusion of DNA data was non/excessive relative to the desired objective of resolving crime. Some participants based their argument on the 'excess information' contained in DNA, consistent with the concept of genetic exceptionalism.[879] This was linked to a fear of function creep in future applications of DNA data. These participants thought only convicted individuals' merit the risk of giving up their DNA records because 'it's the price you pay for the crime

[879] Williams and Johnson, '"Wonderment and Dread"' (n 646).

you commit, you have demonstrated a ‘failure to reassure’ society by having committed a crime’ (PSR109). Another participant expressed the above views in the following terms:

> There is an argument for the retention of the DNA profile of all citizens and assuming that the profile holds no information that might be used to indicate health etc. then this would be acceptable. However, we don't know what information might be gleaned from the profiles in the future and therefore in my opinion it is safest and most supportable to retain only the profiles of those convicted of an offence. (PSR83)

Another proportionality element accentuated by respondents was the reliability/adequacy of the database technology and/or the system. These considered the accuracy of data, risk of security breach and contamination. Again, this was linked to a fear of function creep and the genetic exceptionalism of DNA:

> I hold a real tension in my mind; I can see the enormous risks in having a (potentially hackable) database of (potentially mis-classified or contaminated or fraudulently re-assigned) unique biological data. Who can say what future uses a government could put that to; what if someone claims to have identified a genetic marker for tax avoidance or sexual offending or violence or whatever and whichever government wants to win the next election runs on a platform that they will prevent X percentage of all crime by monitoring those with that marker. Which will quickly lead to arguments that the innocent have nothing to hide so everyone should be swabbed at birth. And then looms the prospect of pre-emptive detention. (PSR109)

A fourth proportionality reason was the belief that the inclusion of particular suspect groups ensures a right balance between civil liberties and public security. Another view linked to this balance element was that the inclusion of charged or arrested but unconvicted individuals unfairly increases their probability of arrest or conviction in the future. Some of these participants also emphasised that the NDNAD is for only offenders. The composition of the suspect group differed among these participants. Whilst some thought data from only serious crime offenders should be included, others thought it should cover all convicted individuals:

> This [those convicted of violent/sexual crimes] seems more proportionate in its balance of human rights (privacy under Article 8) than covering all convicted people – e.g. those convicted of petty theft or non-violent crimes. (PSR174)

> I think this [convicted individuals] strikes the best balance between distributive justice (best served by "all citizens") and respect for privacy. It doesn't seem fair that charged/arrested but unconvicted individuals should have their chances of future arrest/conviction increased by being on the database. (PSR179)

Practical reasons and other inclusion categories: The last themes from the qualitative responses on the category of individuals to include in the NDNAD were practical considerations on the inclusion criteria and other categories of individuals. These participants opposed either a database of unconvicted individuals, arrested but not convicted individuals or all citizens/residents. Some participants reasoned that authorities cannot be trusted with the management of DNA information: 'The police have not shown themselves overly keen on removing samples, so only people convicted of a crime by a jury or judge should have their DNA retained' (PSR12). Another participant cited the possibility of human error to support their preference: 'People make mistakes and that could include the recording of my details against an incorrect DNA profile etc. Only CONVICTED should therefore justify that risk' (PSR102).

Another practical consideration was that an arrestee database may create an opportunity for law enforcement to target specific groups of the population: 'I worry that including 'arrested' individuals can lead to an abuse of power, since arrests can be made for various reasons and can be used to target specific at-risk populations.' (PSR26). One participant also mentioned that a comprehensive database may drain scarce resources and increase the administrative burden on database managers. Further, a UDNAD means some individuals may be sampled against their will. This was described as unethical and a breach of privacy.

> The data of the entire population (majority who have no connection with crime) will be a drain on scarce resources. Further, it will increase the administrative burden on managers of databases. Additionally, such a database will be unethical and will infringe on the privacy of individuals if all are compelled to donate samples against their will. (PSR5)

Some participants highlighted consideration of re-arrest history or chances of recidivism to inform the category of individuals to include in the database. One of these participants thought the inclusion criteria should target re-arrested individuals and this data should be stored for a fixed retention period: 'Re-arrested individuals: this should be for a limited duration in the absence of a prosecution or, subject to quasi-judicial oversight, in exceptional circumstances' (PSR33). For convicted individuals, another participant mentioned that whilst data of convicted individuals should be included in the NDNAD, the retention period should be based on proof of future offending:

> Profiles should only be retained for a proscribed period of time. This period of time should be supported with evidence - for example if convicted individuals are most likely to reoffend in the 2 years following their release from prison then 2 years might be a sensible period. (PSR147)

7.1.2 Reasons for the eligible offence type if convicted of an offence

The NDNAD inclusion criteria for convicted individuals can either be blanket or selective based on the seriousness of offence(s). The quantitative responses showed mixed views with no majority preference for a particular offence category. There were 46 comments (23% of participants) to the question about the eligible type of offences if an individual is convicted of a crime. This provided some insights into the reasons for the preference of respondents. Three main themes were coded from the responses: effectiveness of DNA/database; proportionality; and punishment and other reasons.

Effectiveness of DNA/databases: Most of the comments were related to the enhancement of the effectiveness of the database. Participants thought the inclusion of data from individuals convicted of particular type of offences could improve crime prevention, investigation, detection and prosecution:

> [All offences:] Limited resources should not be deployed to investigate when the DNA database could support investigations. (PSR172)
>
> Recordable offences would need require DNA profiling to further convince in the argument in court. (PSR133)
>
> Essential for qualifying offences but typing of criminals that commit minor offences may have an impact on volume crime. (PSR7)
>
> DNA is crucial in the identification of offenders of sexual crimes. (PSR151)

Some participants held that judging the probability of future offending based on the offence type in current or past conviction is difficult. Thus, they thought the eligible offence criteria should either be all offences, all recordable offences or all qualifying and minor offences. The uncertainty in offending behaviour was linked to the heterogeneity of offences committed by one individual.

> It is difficult to predict all types of offences that an individual may be involved in. A person convicted of a minor offence may be involved in very serious offences. Hence, the threshold should be all offences. (PSR5)
>
> Small crimes often lead to bigger crimes. Number of historical cases solved because individual arrested on minor offence many years later. (PSR23)
>
> Individuals may begin offending on a minor scale and then have their offending escalate to more serious offences. For e.g., a flasher may later rape. (PSR83)

Besides uncertainty, one respondent linked their reasons to public security risks associated with the changing categorisation of offences. This may be linked to the 'jurisdiction effects' of DNA databasing as suggested by Vailly and Bouagga.[880] The participant expressed a strong belief in the capacity of the database to solve crime and thought the inclusion criteria should cover all offences. It was thought that this approach will prevent the exclusion of potential future offenders:

> All offences as the categories of crime could change suddenly which could lead to people being left off the database. If an (any) offence has been committed and a person charged then their biometric data should be stored (we can keep their personal data so why not biometric?) This could act as a future deterrent to more serious crime and/or could result in faster detection of future crimes. (PSR119)

Proportionality: Relying on the relevance element of proportionality, some participants thought the eligible offence type should be serious offences. They thought recidivism is low among minor offenders who are often innocuous. Others thought including all offenders may lead to a diminishing return. The discriminatory inclusion criteria suggested by participants placed emphasis on justifications for data storage. Some thought a case-by-case approach may be suitable for minor offenders: 'We need to be able to give a reason as to why we are storing it. It might be justifiable to store it for a less serious offence but it could be case dependent' (PSR198).

Some participants expressed views indicating the excessiveness of DNA databasing practices. It was thought that the category 'qualifying offences' is a deliberate attempt by the Government to expand the inclusion criteria for the NDNAD. This participant thought the inclusion criteria for convicted individuals should be limited to serious 'arrestable' offences. Another respondent shared a critical view linked to the causes of crime and genetic exceptionalism. It was thought that no individual (convicted or not) should have their data stored due to the possible future risk of associating DNA to the cause of crime: 'DNA might be used to show a proclivity to violence to assert guilt in criminal proceedings - an poor defendant who cannot afford legal advice would be unable to defend against such a spurious and subjective argument' (PSR89).

[880] Vailly and Bouagga (n 858).

One participant who disfavoured the inclusion of minor crime offenders thought there is no proof that such offenders go on to commit serious crimes. Further, minor offences can be investigated by other efficient means without relying on DNA:

> Some recordable offences are minor offences. There is no evidence that commission of these offences would make these offenders more likely to commit more serious offences. There is no legal or equitable justification to store DNA profiles for minor offences that can just as easily be investigated using other means, such as fingerprints or "eye-see" witnesses, etc. (PSR74)

Some of the reasons associated with proportionality were linked to a balance in offence punishment or security of data. It was thought that including traffic offenders in the database will be unfair. In contrast, another participant thought the inclusion criteria should cover all offenders if the security of data is assured.

Punishment and other reasons: There were a few respondents who maintained that inclusion in the database should be a default process for all offenders. This was generally in line with the notion of the 'law-abiding citizen' in the public perspective study by Machado and Silva[881] in Portugal. The participants thought the inclusion of convicted individuals should be a direct consequence of breaking the law regardless of the circumstances. Further, considering the impact of crime on victims, there may be bias in judging the seriousness of an offence:

> If you have committed any type of offence, then you have broken the law and should be subject to some sort of penalty regardless of the severity. Part of this process is to provide biometric data. Some offences may not seem serious but can cause as much distress for victims (ASB/harassment) as murder. (PSR42)

7.1.3 Reasons for the eligible offence type if charged or arrested but unconvicted

The quantitative results showed divergent views on the eligible offence types for individuals charged or arrested but not convicted of a crime. There were 48 comments (24% of participants) on the reasons for the preference of respondents. The key themes from the responses were coded as due process, proportionality, uncertainties about the individual's status, the effectiveness of DNA/database and other reasons.

Due process: Some respondents thought DNA data from unconvicted individuals should not be stored irrespective of the offence type. A few participants noted that the only exceptions

[881] Machado and Silva, '"Would You Accept Having Your DNA Profile Inserted in the National Forensic DNA Database?' (n 676).

to this rule are volunteers or individuals charged of particular offences. The reasoning of the participants was based on the principle of innocent until proven guilty. It was thought that the only justifiable trigger of inclusion in the NDNAD is a conviction. Some equated the storage of DNA records to being treated as a guilty person, a breach of personal and family freedom, abuse of power, stigmatisation and a threat to civil liberties. Referring to the bio-surveillance power of DNA and the risk of function creep, one participant suggested inclusion on the database should be on a voluntary basis (whether convicted or not):

> Mapping someone's criminality to their DNA (and consequently the DNA of their relatives, close relatives or descendants) would annihilate the freedom of those individuals. It is not a far step to then assess their DNA on job applications. For these reasons no contextual information whatsoever should be added to someone's DNA record unless they volunteer it. (PSR89)

Proportionality: Elements of proportionality that featured in the reasons of some participants were the relevance of DNA storage, non-/excessiveness, and balance of public and private interests. There were mixed views on the eligible offence type among this group. The opinions ranged from only serious offences to all offences or none. One participant reasoned that DNA records are relevant in serious crimes: 'Only serious offences (sexual, serious violence (s47 and above)), or other victim-based crimes only because other matters are less important and do not justify the need' (PSR102). Another respondent alluded to a limited justification for minor offences and the excessive collection of personal information: 'I do not see how a minor offence requires to show all your genetic code' (PSR101).

One participant held that limiting the inclusion criteria for unconvicted individuals to qualifying offences and exceptional cases is a 'reasonable compromise'. However, to others who preferred inclusion for all offences, this compromise or balance may be better calibrated if arrested (but not charged) individuals are excluded. It was thought that charged indicates a higher level of suspicion than an arrested individual:

> An arrest is aimed at assisting police with enquiries it does not mean that there is sufficient evidence to charge that person. If a person is charged then you would assume that there is evidence of their guilt. This should be assessed on a case by case basis. (PSR119)

The balance of interests was also referred to by a participant who supported a comprehensive database. It was thought that absent a UDNAD, only convicted individuals should have their DNA records stored: 'Only convicted individuals should have their profiles stored (unless the law is that all individuals should have theirs stored)' (PSR112).

Uncertainties: Participants emphasised the complexities in determining all crimes an unconvicted individual may be associated with. The fact that the offending behaviour of an individual may cut across minor and serious offences was highlighted. The respondents thought a charged or arrested individual may either be innocent or guilty of the current or other known/unknown crimes. Further, some individuals may not be convicted due to legal or procedural technicalities. Respondents who expressed these views thought the inclusion criteria should cover at least individuals arrested or charged (but unconvicted) for a serious offence. They reasoned that data from these individuals could enhance public security: 'Not sure on this, if you're brought to trial but not convicted due to a technicality or something similar then if circumstances of the case change the profile of a charged person could be advantageous' (PSR36).

In contrast to the above uncertainties, participants who were against the inclusion of data from unconvicted individuals placed emphasis on the fact that they could be innocent. Moreover, participants were concerned that permitting this criterion may create an opportunity for law enforcement officers to abuse their powers: 'Charged does not mean convicted. In this way you could press charges on everybody in the country and get their DNA' (PSR145).

Another aspect of uncertainties related to repeated arrests or charging of unconvicted individuals. One participant thought the eligible offence type for unconvicted individuals should probably be serious offences. However, it was held that repeated arrests or charges for other offences should trigger inclusion in the database:

> It might be suitable to do so if charged with a serious offence however if a person is repeatedly arrested and charged with offences it might be prudent to store their DNA as repeated offences could indicate possibility for further and more serious offences. (PSR198)

Effectiveness and other reasons: Some participants who preferred the inclusion of unconvicted individuals for all qualifying offences thought this will enhance the prosecution and investigation of crime. Others who preferred 'all qualifying and minor offences' or 'all offences' reasoned that this will make the database more effective in resolving crime. This reason was also cited by a participant who supported a UDNAD. The lack of evidence on effectiveness was mentioned by one participant who supported inclusion of only convicted individuals. It was thought that this evidence should be balanced with civil liberties: 'It

should depend on how effective storing DNA profiles actually is for law enforcement, balanced against people's right to privacy' (PSR82).

A participant who thought only convicted individuals should have their data stored commented that the criteria should cover individuals handled by out of court disposals: 'None. But the criteria needs to include non-judicial disposals such as cautions etc.' (PSR37).

7.1.4 Summary of results

The quantitative results suggest most participants support a minimum inclusion criterion of an undefined suspect group. There was an indication of a near consensus to include DNA data from convicted individuals in the NDNAD. Most respondents with less education preferred an inclusion criterion that captures all offenders. A majority of those with higher education preferred a selective approach. For unconvicted individuals, it was apparent that most participants preferred an inclusion criterion covering an undefined group of charged and/or arrested individuals. Whilst males were more likely to favour an inclusion criterion covering 'all qualifying/serious offences', females were more likely to favour 'all recordable offences'. Young adults were more favourable to 'all recordable offences' than middle/older adults.

Several reasons for the preference of participants emerged from the qualitative analysis of free-text responses. Reasons in support or opposed to the different categories of individuals ranged from crime control, due process, proportionality and practical considerations and uncertainties about criminality. Some of these reasons and views on punishment and effectiveness were cited in relation to the eligible type of offences for convicted and unconvicted individuals.

7.2 Discussion and conclusion

The comparison of a crime scene profile and the reference profile of an individual arrested for that crime can be carried out without entry of the reference profile in the NDNAD.[882] The inclusion of the reference profile in the NDNAD is relevant for detecting matches with other unsolved past crimes or enhancing the chances of detection in future crimes if there is a tendency for recidivism. Hence, entry in the NDNAD has been considered as treating

[882] Wallace (n 591).

individuals as potential suspects.[883] In this research, most participants favoured an inclusion criterion of at least 'suspects', ranging from arrestees to convicted individuals. This was consistent with the Serbian study that found that ~58% of respondents preferred the entry of DNA records from either 'convicted individuals', 'convicted individuals and suspects', or 'convicted individuals, suspects and volunteers'.[884] The results highlighted the uncertainties in determining the actual usefulness of DNA data inclusion from different categories of individuals, which is in line with the comments by some respondents. Whilst it was acknowledged by some participants that inclusion of data from unconvicted individuals may constitute a breach of privacy, others thought restricting the criteria to only convicted individuals could lead to missed opportunities in detecting some crime. This quandary has been noted in the UK reviews,[885] and by the Biometrics Commissioner in relation to biometric retention.[886]

The literature shows considerable support and opposition to a universal or comprehensive national DNA database.[887] This study found that a quarter of respondents favour a UDNAD, which was lower than more recent findings in countries such as Switzerland[888] (29%), Serbia[889] (~35%) and Italy[890] (35%). The result is generally consistent with the trend in the UK where qualitative research and reviews have found an objection to UDNAD by a majority of different groups.[891] Whilst a UDNAD could be beneficial in enhancing public security,[892] it has several practical limitations that require consideration.[893] One of the most important consideration is the fact that DNA is relevant in solving only a small fraction of all crime (currently < 1% in the UK).[894] This means a significant number of samples from

[883] Wallace (n 591).
[884] Teodorović and others (n 122).
[885] Home Office, *Keeping the Right People on the DNA Database: Science and Public Protection* (n 47); Home Office, *Keeping the Right People on the DNA Database: Summary of Responses* (n 653); MPA Civil Liberties Panel (n 40).
[886] MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80), para 108.
[887] Anderson and others (n 657); Curtis, 'Public Understandings of the Forensic Use of DNA' (n 642); Human Genetics Commission, *Citizens' Inquiry into the Forensic Use of DNA and the National DNA Database: Citizens' Report* (n 651).
[888] Zieger and Utz (n 663).
[889] Teodorović and others (n 122).
[890] Tozzo, Fassina and Caenazzo (n 677).
[891] Human Genetics Commission, *Citizens' Inquiry into the Forensic Use of DNA and the National DNA Database: Citizens' Report* (n 651).
[892] Kirsten Dedrickson, 'Universal DNA Databases: A Way to Improve Privacy?' (2017) 4 Journal of Law and the Biosciences 637; JW Hazel and others, 'Is It Time for a Universal Genetic Forensic Database?' (2018) 362 Science 898.
[893] Anderson and others (n 657).
[894] Wiles, *Annual Report 2016* (n 26).

the entire population will be of no value. A second challenge is a fact that such a database cannot be built without informed consent and a guarantee of the right to withdraw this consent. For this reason, it will be practically impossible to achieve universality. From a critical perspective, the right approach to the expansion of the NDNAD is through voluntary participation by clearly establishing the actual effectiveness of including data from volunteers.

Though statistically insignificant, the study found that females, young adults, participants with no university education and those specialising in science exhibited a more permissive view about the category of individuals to include in the NDNAD. Existing public perspective studies suggest some limited statistically significant association between socioeconomic factors and the inclusion criteria for DNA databases.[895] The Switzerland study found that females are more supportive of an expansive database and voluntary participation in databases.[896] Machado and Silva[897] found that young adults are more likely to favour voluntary participation in databases. A few studies have identified a higher preference for an expansive database and voluntary participation in databases among groups with lower levels of education.[898] There is presently no studies that have considered the association between academic background or specialisation and perceptions about DNA databasing. However, findings by Machado and Silva,[899] whilst insignificant, indicate a more optimistic view about DNA databasing among applied science (health) professionals. The above studies are indicative of the potential influence of socioeconomic characteristics on public views about DNA database inclusion criteria. Since most completed studies[900] in this area (including this present study) employ non-probability sampling,[901] this observation may require further investigation through representative surveys and qualitative interviews to confirm the effects of socioeconomic factors.

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[895] Machado and Silva, 'What Influences Public Views on Forensic DNA Testing in the Criminal Field?' (n 656).
[896] Zieger and Utz (n 663).
[897] Machado and Silva, '"Would You Accept Having Your DNA Profile Inserted in the National Forensic DNA Database?' (n 676).
[898] Dundes (n 666); Machado and Silva, '"Would You Accept Having Your DNA Profile Inserted in the National Forensic DNA Database?' (n 676); Zieger and Utz (n 663).
[899] Machado and Silva, 'Public Perspectives on Risks and Benefits of Forensic DNA Databases' (n 659).
[900] See section 4.3.1 of Chapter 4
[901] Machado and Silva, 'What Influences Public Views on Forensic DNA Testing in the Criminal Field?' (n 656).

Support for a DNA database of convicted individuals is very high among existing surveyed populations: 65% in the US study;[902] 72% in the Spanish study,[903] and 65% in the New Zealand survey[904]. In line with these findings, the results in this present study suggested very strong support (93.5%) for the inclusion of DNA data from convicted individuals in the NDNAD. However, there were mixed views whether this should be restricted to qualifying/serious offences, all qualifying and minor offences, all recordable offences or all offences. This indicates uncertainties about using the seriousness of an offence, which has been considered by the courts,[905] as a determiner of inclusion in the NDNAD. Several countries across Europe apply this in the operation of their national database.[906] For example, the criteria in Austria covers 'individuals suspected and/or convicted of a dangerous assault'.[907] In England and Wales, the seriousness of an offence is only considered in relation to the retention periods for data from juveniles convicted of an offence. Forensic DNA data from all recordable offenders are permitted to be entered in the NDNAD. The findings from this study suggest that the current inclusion criteria may be supported 'in spirit', but this may be due to a weak evidence base on the usefulness of inclusion of data from individuals convicted of specific types of offences.

Only participants with no university education favoured the inclusion of DNA data from individuals convicted of any offence and this was statistically significant. Those with a higher level of education were supportive of more restrictive inclusion criteria for convicted individuals. This result confirms the findings of Dundes[908] where support for a database of convicted violent offenders was high among more educated participants. Generally, less educated individuals tend to express permissive views about DNA databasing.[909] A possible explanation for this observation could be the level of exposure and awareness of DNA databasing. Firstly, Gamero *et al*.[910] found an increased awareness of DNA fingerprinting among individuals with a higher level of education. The qualitative study by Anderson *et*

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[902] Dundes (n 666).
[903] Gamero and others, 'Spanish Public Awareness Regarding DNA Profile Databases in Forensic Genetics' (n 671).
[904] Curtis, 'Public Perceptions and Expectations of the Forensic Use of DNA' (n 642).
[905] *S and Marper v The United Kingdom* (n 44); *Gaughran v Chief Constable of the Police Service of Northern Ireland (Secretary of State for the Home Department intervening)* (n 120).
[906] Santos, Machado and Silva (n 29); *Gaughran v Chief Constable of the Police Service of Northern Ireland (Secretary of State for the Home Department intervening)* (n 120), Annex B.
[907] Santos, Machado and Silva (n 29).
[908] Dundes (n 666).
[909] Machado and Silva, '"Would You Accept Having Your DNA Profile Inserted in the National Forensic DNA Database?' (n 676); Zieger and Utz (n 663).
[910] Gamero and others, 'A Study of Spanish Attitudes Regarding the Custody and Use of Forensic DNA Databases' (n 666).

al.[911] showed how awareness of the pros and cons of DNA databasing informed a change in support for a UDNAD to a more restricted database. The implication of the finding in this present study is that strategies should be adopted to promote the awareness of the benefits, limitations and risks of forensic DNA databasing among the public. This may ensure that the 'societal choice' about the law governing DNA databases is well informed across the different members of the public.

The category of unconvicted people arrested or charged with an offence has been described as an intermediary group between convicted individuals and the general unconvicted (innocent) population.[912] In New Zealand, Curtis[913] found high support (52-62%) for the inclusion of data from unconvicted individuals arrested or suspected of a sexual or violent offence. Support for those arrested or suspected of any crime was low (38-40%) in the study.[914] The results in this present study indicated general strong support (69.8%) for the inclusion of DNA data from the intermediary group. However, views on the eligible types of offence were mixed. This means that the public may be uncertain about the characteristics of unconvicted individuals who may be eligible for entry in the database. Whilst the seriousness of an offence may be an important factor for some members of the public, others may place less importance on the severity of offence as a determiner of inclusion in the NDNAD. The qualitative responses illustrated the different legitimate reasons that may be cited to justify the different positions. These included issues of civil liberties, proportionality, uncertainties about guilt/innocence and the utility of databases, which are in line with previous studies.[915] The results may be explained by the fact that there is limited information about the overall effectiveness of including data from unconvicted individuals arrested or charged with different types of offences. The *Marper* decision identified this as critical information that is required to justify the selective treatment of data from different individuals within the unconvicted population.[916]

It was found that females and young adults were more favourable of the inclusion of DNA data from unconvicted individuals arrested or charged of a recordable offence. Comparatively, males were more supportive of a restriction to serious offences whilst

[911] Anderson and others (n 657).
[912] Vailly and Bouagga (n 858).
[913] Curtis, 'Public Perceptions and Expectations of the Forensic Use of DNA' (n 642).
[914] Curtis, 'Public Perceptions and Expectations of the Forensic Use of DNA' (n 642).
[915] Curtis, 'Public Perceptions and Expectations of the Forensic Use of DNA' (n 642); Zieger and Utz (n 663); Teodorović and others (n 122).
[916] *S and Marper v The United Kingdom* (n 44), para 123.

middle/older adults were more supportive of no inclusion of data except convicted individuals. The results suggest that females and young adults are more likely to share permissive views about DNA databasing than males and middle or older adults. This is in line with the findings of views on the public security functions of the database.[917] There are several possible explanations for the results above. Firstly, females are more affected by crime; hence may have a stronger belief in the public security benefits of including data from the intermediary group. In contrast, males are more likely to be sampled than females; hence they may be more concerned about the civil liberty risks of inclusion in the database. With respect to age, young adults have been found to exhibit a privacy paradox[918] which may be linked to their perception about privacy-related technologies such as the national DNA database. This may explain the findings in this present study.

In conclusion, the public may be supportive of including DNA data from individuals who have had contact with the police in the NDNAD. The current inclusion criteria for the NDNAD allows entry of DNA data from all individuals who have been arrested for a recordable offence, whether convicted or unconvicted. However, the results in this present study suggest that a selective rather than a blanket inclusion criterion may be more appropriate. Nevertheless, it is not clear what restrictions the public may prefer due to uncertainties about the potential usefulness of data inclusion and issues of civil liberties. This implies that an evaluation of the actual value of including data from convicted individuals and arrested or charged but unconvicted individuals may help calibrate the composition of the NDNAD to enhance public security. Further, this will inform public opinion about the inclusion criteria for the NDNAD.

[917] See Chapter 6
[918] Barnes (n 857); Blank, Bolsover and Dubois (n 857).

Chapter 8: Retention periods for forensic DNA records

The retention periods for forensic DNA records have been scrutinised by several reviews and the courts.[919] The current law governing the NDNAD requires the retention of DNA profiles until the conclusion of investigations or proceedings except for data from individuals convicted of an offence, arrested or charged with a qualifying offence, and those subject to retention by statute[920]. The retention periods for the excepted categories of individuals range from a minimum of 2 – 5 years for unconvicted individuals and some convicted juveniles to a maximum of indefinite for all convicted adults and some convicted juveniles.[921] All DNA samples are required to be destroyed after profiling or within a 6 month period, or until its purpose is fulfilled if subject to the CPIA exception. As part of the third aim of this research, the public survey asked participants about their views on the length of retention for DNA samples and profiles from different categories of individuals, as specified by law. This Chapter details the survey results in section 8.1. A discussion of the results is presented in section 8.2. The Chapter makes an original contribution by identifying the current public views about the retention period for convicted and unconvicted individuals. Additionally, the chapter provides insights into the key justifications for the support of specific regimes.

8.1 Public survey results on retention periods

8.1.1 DNA sample retention period for convicted individuals

The results showed that most participants (68%) support a long-term retention period for DNA samples from serious crime offenders, ranging from indefinite, until death and 100 years (Figure 8.1). The current PACE sample retention window (until a profile is generated to 6 months) was supported by 28% of respondents. Those who selected other (5%) supported either 'no retention', a short period (such as 'until proceedings are complete') or intermediate and flexible periods (10 or 40 years, and 1 year after the end of their sentence).

In contrast to the above, most participants favoured a short-term sample retention period for adults and first-time juveniles convicted of a minor crime (Figure 8.1). The PACE sample window was supported by 51% and 54% of participants for adults and first-time juvenile minor offenders, respectively. Those who selected other (16% for adult minor offenders, and 18% for first-time juvenile minor offenders) preferred no retention/taking of samples from

[919] *S and Marper v The United Kingdom* (n 44); *Gaughran v Chief Constable of the Police Service of Northern Ireland (Secretary of State for the Home Department intervening)* (n 120).
[920] E.g. retention on grounds of national security
[921] See details in section 2.4.1 of Chapter 2

these groups or alternative short periods ranging from 'until completion of proceedings' to 1 or 5 years. A few participants suggested intermediate or flexible periods ranging from 'until length of sentence', 1 or 5 years plus the length of sentence, 10 or 15 years, and a case-dependent approach.

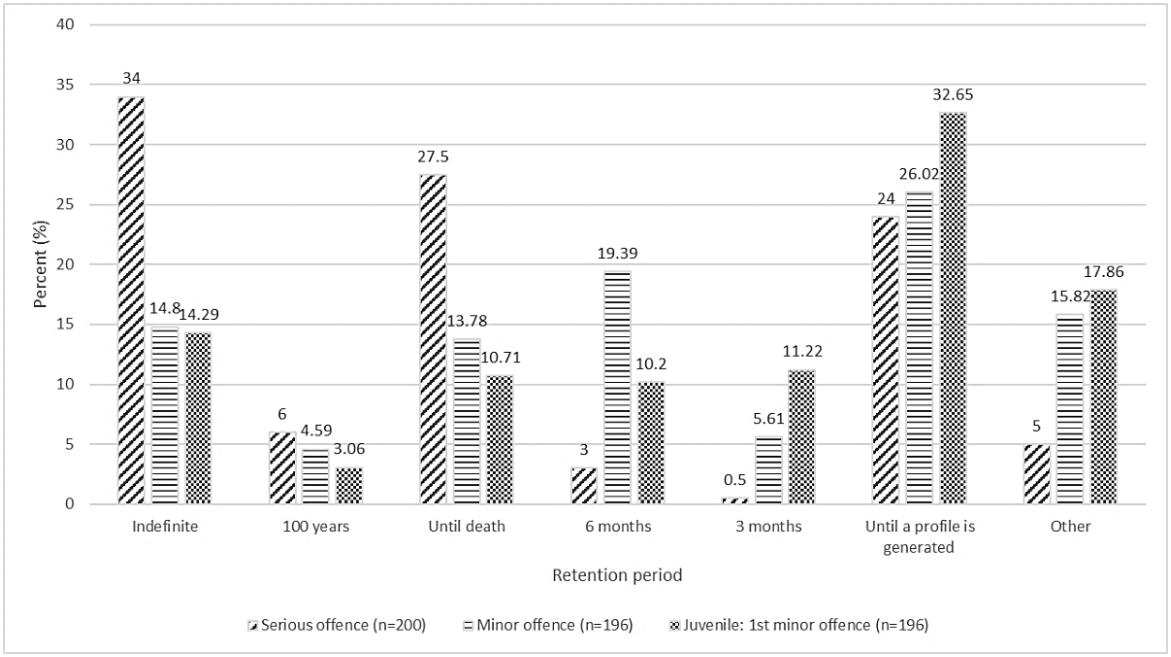

Figure 8.1- Opinions of participants on retention period of DNA samples from convicted individuals.

Demographic analysis

Social groups were analysed to determine whether there is an association between demographic characteristics and the perceived sample retention period. The different retention periods were recoded into three to simplify the statistical analysis: long-term (indefinite/100 years/until death), short-term (until a profile is generated/6 months/3 months) and other. For serious offenders, only the age category showed a statistical significance ($p = 0.014$) in association (Table 8.1). The majority of both young adults (68%) and middle or older adults (67%) preferred a long-term sample retention period for serious offenders. However, middle or older adults (10%) were more likely to select 'other' than young adults (1%). The short-term sample retention period was preferred by a higher percentage of young adults (31%) than middle or older adults (23%). Overall, most participants in the different social groups preferred a long-term sample retention period for individuals convicted of a serious offence (Table 8.1).

The data for minor offenders (Table 8.2) showed a significant association between educational level and preferred retention period ($p < 0.001$). A majority of participants with no university degree (67%) were more likely to favour a long-term sample retention period than those with a university degree (33%) or higher education (30%). Conversely, most participants with a university degree (65%) or higher education (50%) were more likely to select a short-term sample retention period than those without a university degree (13%). For all the other social groups, a majority or a larger proportion of participants favoured a short-term sample retention period for individuals convicted of a minor offence. There was no statistically significant association between gender, age, or specialisation area and the preferred retention period (Table 8.2).

Table 8.3 presents the demographic analysis of the views of participants regarding juveniles convicted of a first minor offence. There was a statistically significant association between the age ($p = 0.024$) or educational level ($p = 0.005$) of participants and the retention period. A large proportion of both young adults and middle or older adults preferred a short-term sample retention period for this category of juvenile offenders. Most young adults (62%) were more likely to select the short-term retention period than middle or older adults (44%). The short-term period was also preferred by most participants with a university degree (67%) or higher education (54%). A majority of respondents with no university degree (56%) were more favourable of a long-term sample retention period than those with a university degree (26%) or postgraduate education (26%). The two other social groups showed no statistically significant association with the retention period. Generally, it was observed that a large proportion of participants in each social group preferred a short-term sample retention period (Table 8.3). The implications of the above results are discussed in section 8.2.1.

Table 8.1 - Opinions on retention period for DNA samples if convicted of a serious offence; by gender, age, educational level and specialisation.

Demographic characteristics		**Retention period**			***Fisher's Exact test or $\chi^2(df)$***	***p-value***
		Long-term	**Short-term**	**Other**		
Gender	Male (n=75)	68%	25.3%	6.7%	0.876 (2)	0.645
	Female *(n=125)*	67.2%	28.8%	4%		
Age	18-34 *(n=106)*	67.9%	31.1%	0.9%	8.511 (2)	0.014
	≥ 35 *(n=94)*	67%	23.4%	9.6%		
Educational level	< University degree *(n=16)*	93.8%	6.3%	0	6.548	0.136
	University degree *(n=53)*	67.9%	30.2%	1.9%		
	PhD/master's or equivalent *(n=131)*	64.1%	29.0%	6.9%		
Specialisation	Business, Humanities & Social Sciences (BHSS) *(n=58)*	70.7%	24.1%	5.2%	6.340	0.164
	Law, Criminology & Security (LCS) *(n=42)*	54.8%	33.3%	11.9%		
	Natural, Formal & Applied Sciences (NFAS) *(n=63)*	68.3%	30.2%	1.6%		

Table 8.2 - Opinions on retention period for DNA samples if convicted of a minor offence; by gender, age, educational level and specialisation.

Demographic characteristics		**Retention period**			***Fisher's Exact test or $\chi^2(df)$***	***p-value***
		Long term	**Short-term**	**Other**		
Gender	Male (n=71)	31%	50.7%	18.3%	0.599(2)	0.741
	Female *(n=125)*	34.4%	51.2%	14.4%		
Age	18-34 *(n=106)*	31.1%	57.5%	11.3%	5.164(2)	0.076
	≥ 35 *(n=90)*	35.6%	43.3%	21.1%		
Educational level	< University degree *(n=15)*	66.7%	13.3%	20.0%	22.885	< 0.001
	University degree *(n=52)*	32.7%	65.4%	1.9%		
	PhD/master's or equivalent *(n=129)*	29.5%	49.6%	20.9%		
Specialisation	Business, Humanities & Social Sciences (BHSS) *(n=57)*	33.3%	47.4%	19.3%	8.534(4)	0.074
	Law, Criminology & Security (LCS) *(n=40)*	25%	45%	30%		
	Natural, Formal & Applied Sciences (NFAS) *(n=62)*	33.9%	58.1%	8.1%		

Table 8.3 - Opinions on retention period of DNA samples from juveniles convicted of a first minor offence; by gender, age, educational level and specialisation.

Demographic characteristics		**Retention period**			***Fisher's Exact test or $\chi^2(df)$***	***p-value***
		Long term	**Short-term**	**Other**		
Gender	Male (n=72)	27.8%	52.8%	19.4%	0.200(2)	0.905
	Female *(n=124)*	28.2%	54.8%	16.9%		
Age	18-34 *(n=106)*	25.5%	62.3%	12.3%	7.453(2)	0.024
	≥ 35 *(n=90)*	31.1%	44.4%	24.4%		
Educational level	< University degree *(n=16)*	56.3%	18.8%	25%	14.428	0.005
	University degree *(n=51)*	25.5%	66.7%	7.8%		
	PhD/master's or equivalent *(n=129)*	25.6%	53.5%	20.9%		
Specialisation	Business, Humanities & Social Sciences (BHSS) *(n=57)*	28.1%	47.4%	24.6%	6.935 (4)	0.139
	Law, Criminology & Security (LCS) *(n=40)*	22.5%	50%	27.5%		
	Natural, Formal & Applied Sciences (NFAS) *(n=62)*	27.4%	62.9%	9.7%		

8.1.2 DNA profile retention period for convicted individuals

Figure 8.2 shows that most participants (83%) favour a long-term (indefinite/until death/100 years) retention period of DNA profiles from individuals convicted of a serious crime. Relatively, 47% and 40% of participants favoured a long-term period for minor offenders and juveniles convicted of a first minor offence, respectively. Whilst only 11% of participants favoured a sentence-based retention period for serious offenders, this was preferred by 38% of participants for both minor offenders and the first-time juvenile offenders, respectively.

Some participants selected 'other' and provided alternative approaches or similar retention periods to the above. Of the 7% of participants who selected 'other' for serious offenders, many suggested 'no retention of data'. Others proposed either a '1 year + length of sentence', 'indefinite until conviction quashed', '40 years' or '5 years after death' retention periods. A similar trend was observed for those who selected 'other' for minor offenders (15%). Most of these respondents favoured no retention of data. A few proposed up to 12 months retention, 1 year plus the length of sentence, 10 years after imprisonment, less than 5 years or a case-by-case approach. Most of the participants who selected 'other' for the first-time juveniles (21%) suggested no retention of DNA profiles. Others proposed either retention until they are 18 years old, between 1 month and 5 years, 1 year + length of sentence, 5 years after imprisonment or a case dependent approach.

Figure 8.2 - Opinions of participants on retention period of DNA profiles from convicted individuals.

Demographic analysis

Table 8.4 presents a demographic analysis of the views of the study participants about the retention period for DNA profiles of serious offenders. To simplify the statistical analysis, the retention periods were recoded as long-term (indefinite/100 years/until death), sentence-based (length of sentence/10 years + length of sentence/5 years + length of sentence) and other. There was a statistically significant association between specialisation area and the perceived retention period for DNA profiles *(p = 0.003).* Whilst a majority of participants specialising in the various fields favoured a long-term retention period for serious offenders, BHSS (86%) and NFAS (89%) participants were more likely to select this option than LCS (59%) participants (Table 8.4). About a quarter of LCS participants (27%) preferred the sentence-based retention period compared to 7% BHSS and 6% NFAS. The 'other' option (mainly participants against data retention or who prefer other alternatives) was also preferred by a higher percentage of LCS (15%) participants than BHSS (7%) and NFAS (5%) participants. In all the other social groups, more than three-quarters of participants preferred a long-term retention period of DNA profiles from serious offenders (Table 8.4).

Unlike the results for serious offenders, the social groups showed a pattern of moderate views for the long-term retention of DNA profiles from minor offenders (Table 8.5). A larger proportion of participants (but less than two-thirds) in the gender, age and educational level groups preferred a long-term retention period followed by the sentence-based option. A similar trend was observed for the specialisation area group except for LCS participants who preferred the long-term and sentence-based retention periods equally. The Chi-square test showed a statistically significant association between age and the perceived retention period ($p = 0.048$). More than half (51%) of young adults favoured the long-term retention period compared to 42% of middle or older adults. The 'other' option (i.e. no retention or other alternatives) was favoured by 22% of middle or older adults compared to 9% of young adults.

The analysis of social groups revealed mixed and/or split views across the different lengths of retention of DNA profiles from juveniles convicted of a first minor offence (Table 8.6). Two social groups (age: $p = 0.018$; and specialisation: $p = 0.012$) showed a statistically significant association with the retention period of DNA profiles. For the age group, the 'other' option (i.e. no retention or other alternatives) was favoured by 30% of middle or older adults compared to 14% of young adults. The sentence-based retention period was preferred by 44% of young adults compared to 31% of middle or older adults. Preference for the long-

term retention period was relatively comparable in young (42%) and middle/older adults (39%). In the specialisation group, LCS (33%) and BHSS (30%) participants were more likely to select the ‘other’ option than NFAS participants (10%). The long-term retention period was favoured by 43% BHSS and 46% NFAS respondents compared to 28% LCS. The sentence-based retention period was preferred by 44% NFAS and 40% LCS participants compared to 27% BHSS participants.

Table 8.4 - Opinions on retention period for DNA profiles if convicted of a serious offence; by gender, age, educational level and specialisation

Demographic characteristics		**Retention period**			***Fisher's Exact test or $\chi^2(df)$***	***p-value***
		Long term	**Sentence-based**	**Other**		
Gender	Male (n=76)	84.2%	6.6%	9.2%	3.202 (2)	0.202
	Female *(n=124)*	82.3%	12.9%	4.8%		
Age	18-34 *(n=107)*	82.2%	14%	3.7%	5.429 (2)	0.066
	≥ 35 *(n=93)*	83.9%	6.5%	9.7%		
Educational level	< University degree *(n=16)*	100%	0%	0%	5.873	0.167
	University degree *(n=53)*	88.7%	9.4%	1.9%		
	PhD/master's or equivalent *(n=131)*	78.6%	12.2%	9.2%		
Specialisation	Business, Humanities & Social Sciences (BHSS) *(n=58)*	86.2%	6.9%	6.9%	15.273	0.003
	Law, Criminology & Security (LCS) *(n=41)*	58.5%	26.8%	14.6%		
	Natural, Formal & Applied Sciences (NFAS) *(n=64)*	89.1%	6.3%	4.7%		

Table 8.5 - Opinions on retention period for DNA profiles if convicted of a minor offence; by gender, age, educational level and specialisation.

Demographic characteristics		**Retention period**			***Fisher's Exact test or $\chi^2(df)$***	***p-value***
		Long term	**Sentence-based**	**Other**		
Gender	Male (n=73)	46.6%	31.5%	21.9%	4.721 (2)	0.094
	Female *(n=124)*	46.8%	41.9%	11.3%		
Age	18-34 *(n=106)*	50.9%	39.6%	9.4%	6.089 (2)	0.048
	≥ 35 *(n=91)*	41.8%	36.3%	22%		
Educational level	< University degree *(n=16)*	62.5%	25%	12.5%	4.135 (4)	0.388
	University degree *(n=52)*	51.9%	38.5%	9.6%		
	PhD/master's or equivalent *(n=129)*	42.6%	39.5%	17.8%		
Specialisation	Business, Humanities & Social Sciences (BHSS) *(n=56)*	44.6%	32.1%	23.2%	6.407 (4)	0.171
	Law, Criminology & Security (LCS) *(n=41)*	39%	39%	22%		
	Natural, Formal & Applied Sciences (NFAS) *(n=63)*	50.8%	41.3%	7.9%		

Table 8.6 - Opinions on retention period of DNA profiles from juveniles convicted of a first minor offence; by gender, age, educational level and specialisation.

Demographic characteristics		**Retention period**			***Fisher's Exact test or $\chi^2(df)$***	***p-value***
		Long-term	**Sentence-based**	**Other**		
Gender	Male (n=73)	41.1%	30.1%	28.8%	4.950 (2)	0.084
	Female *(n=123)*	39.8%	43.1%	17.1%		
Age	18-34 *(n=106)*	41.5%	44.3%	14.2%	8.015 (2)	0.018
	≥ 35 *(n=90)*	38.9%	31.1%	30%		
Educational level	< University degree *(n=16)*	56.3%	18.8%	25%	5.324 (4)	0.256
	University degree *(n=51)*	41.2%	45.1%	13.7%		
	PhD/master's or equivalent *(n=129)*	38%	38%	24%		
Specialisation	Business, Humanities & Social Sciences (BHSS) *(n=56)*	42.9%	26.8%	30.4%	12.823 (4)	0.012
	Law, Criminology & Security (LCS) *(n=40)*	27.5%	40%	32.5%		
	Natural, Formal & Applied Sciences (NFAS) *(n=63)*	46%	44.4%	9.5%		

8.1.3 Reasons for the DNA sample and profile retention periods for convicted individuals

Some participants provided qualitative insights into the retention periods for DNA samples *(n = 46; 23%)* and profiles *(n = 34; 17%)* taken from convicted individuals. The key themes from the responses were the usefulness of sample/profile retention, respect for civil liberties, DNA profile adequacy, and concepts of punishment and rehabilitation.

The basis for selecting a particular sample/profile retention period for convicted individuals was influenced by the idea that the sample/profile could be useful in future, either in the short-term or long-term. Some participants thought the reference sample could serve a quality assurance purpose, provide an opportunity to upgrade databases and reduce 'costly' resampling:[922]

> The DNA should be stored so that advantage can be taken of new technology in the future (e.g. whole genome sequencing). (PSR25)
>
> [I]t will be more costly to re-sample individuals than to store the already obtained sample. The focus should be on the security of the sample to guide against any misuse or unethical applications. (PSR5)

Other participants linked sample/profile retention (short or long-term) to the public security functions of the database, emphasising on the prevention or detection of crime, cold case review, resolution of miscarriage of justice and the potential of familial searching: 'Family links will be aided by retention, partial DNA hits can then be searched on families to track suspects' (PSR21). Some participants supported the above reason (i.e. safeguarding public security) by drawing on the concept of recidivism: 'This is because people can flip at any point in time so the longer we have it in the system, the better' (PSR192). A case was also made for the potential power of DNA in predicting criminal behaviour: 'In the future, DNA samples could be used to investigate if criminal behaviour was connected to a gene, for example' (PSR101).

Participants who strongly adhered to civil liberty reasons thought only samples of serious offenders should be retained either for a short or long-term period: 'This is such an intrusion into somebody's civil liberties that conviction of a minor offence should not warrant such breach of privacy' (PSR13). For DNA profiles, these participants (i.e. civil liberty advocates) raised concerns about using retained data in familial searches and function creep: 'I don't like the idea of using DNA against others who have not been convicted - who may be related'

[922] Bramley (n 42).

(PSR166). Such participants shared strong opinions and thought DNA records should not be retained, whether convicted or not: 'DNA profiles should not be stored regardless of type of the criminal offence' (PSR50).

The third reason cited by participants for sample retention periods was the adequacy of the DNA profile. These participants thought samples should be retained until a profile is generated since the profile is enough in identifying individuals: 'If a profile is what is needed to identify someone then surely the sample is no longer needed' (PSR194).

Lastly, some participants considered sample/profile retention as an integral part of the consequences of committing a crime and should be either proportionate/consistent with sentence or held indefinitely: 'The person has been convicted of a crime, indefinitely on a NDNAD should be standard as a result of that. If they never commit another crime then they have nothing to worry about in relation to being on a database' (PSR36). Many respondents who held this view (i.e. 'consequential' retention) thought the retention period should be 'analogous to time until conviction is "spent"' (PSR155) or reflect principles of rehabilitation of offenders. One participant questioned, '[W]hen a person has paid their dues, aren't they allowed to return to society?' (PSR195). This reasoning was elaborated in more detail by another participant in the following terms:

> [T]he offender should be able to feel that they have made amends for their offence through completing their sentence to be able to move on with their lives. The retention of their DNA signifies that the State does not believe they have changed and expects them to reoffend. 1 year after the end of their sentence should be sufficient to catch those prolific offenders who reoffend within a year of release… Juveniles should feel that they have a fresh start when they become an adult and their past mistakes do not overly affect them. It is a means of the state showing trust and respect for them. (PSR100).

8.1.4 DNA sample retention period for unconvicted individuals

Charged individuals

The opinions of participants on the retention of DNA samples from unconvicted individuals charged with a serious offence is presented in Figure 8.3. The results show that a majority (55%) of respondents favour a short-term[923] retention period for this category of individuals, with a large proportion (31%) favouring retention 'until the conclusion of

[923] i.e 6 months or 3 months or until a profile is generated or until the conclusion of investigations/proceedings

investigations/proceedings'. A little over one-third (38%) of participants favoured a long-term[924] retention period and 8% of participants selected 'other' (mainly no taking/retention of samples or up to 5 years retention). A similar trend was observed for unconvicted individuals charged with a minor offence. About 64% of participants preferred the short-term sample retention period compared to about 25% for the long-term period and about 11% for other approaches (no retention of samples, case-dependent or up to 5 years retention) (Figure 8.3).

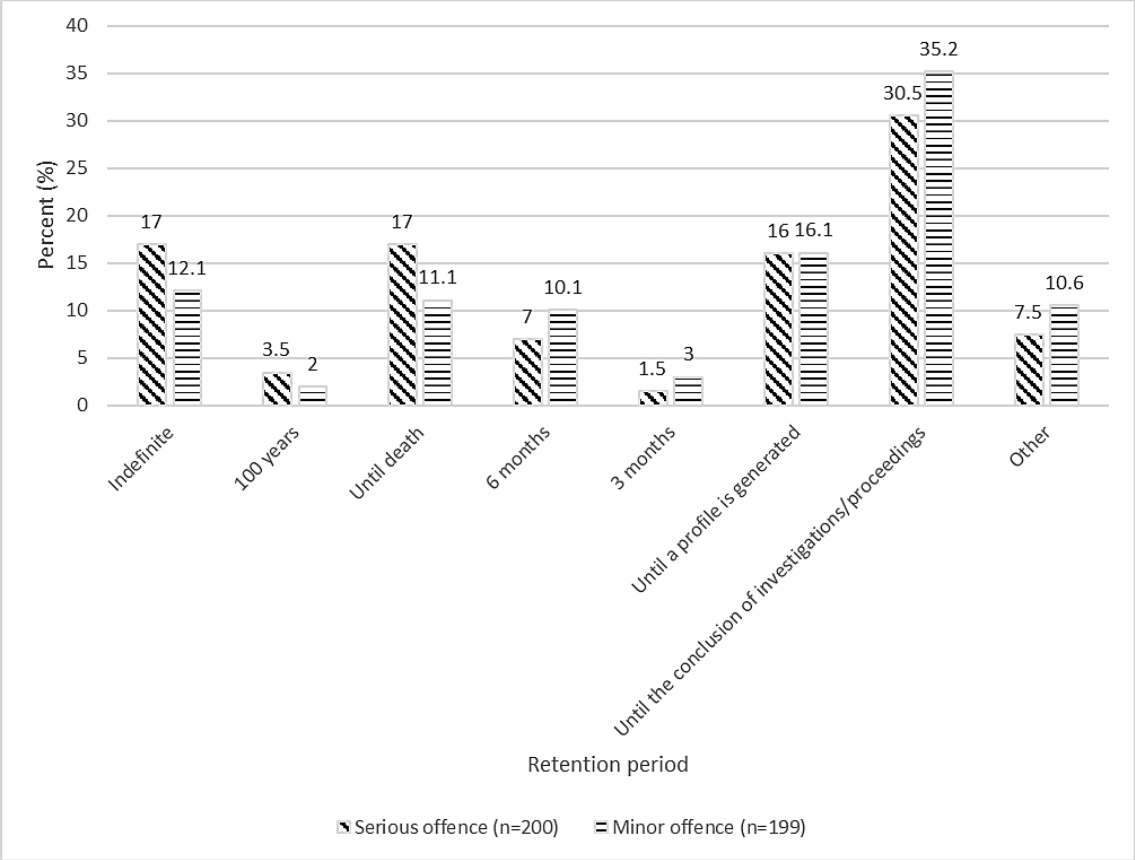

Figure 8.3 - Opinions of participants on retention period of DNA samples from unconvicted individuals charged with an offence.

Demographic analysis

Table 8.7 shows the analysis of the opinions of social groups about the sample retention periods for unconvicted individuals charged with a serious offence. A majority of participants in each social group favoured a short-term sample retention period except the educational level group. Whilst most participants with higher education favoured a short-term period, about three-quarters of those with no university degree preferred a long-term

[924] i.e. indefinite or 100 years or until death of subject

retention period. There was a statistically significant association between gender ($p = 0.012$), age ($p = 0.003$) or educational level ($p = 0.017$) and the DNA sample retention period. About 44% of females favoured the long-term sample retention period compared to 28% of males. Young adults (46%) were more likely to select the long-term retention period than middle or older adults (28%). Participants with no university degree (75%) were more likely to favour the long-term retention period than those with a university degree (40%) or higher education (32%). The opposite was observed for a short-term retention period (19% of those with no university degree versus 55% university degree and 60% postgraduate education).

The demographic analysis of the views of participants regarding the sample retention period for unconvicted individuals charged with a minor offence is shown in Table 8.8. The result was similar to those charged (but unconvicted) with a serious offence. In all but the educational level group, a majority of participants preferred a short-term sample retention period for unconvicted individuals charged with a minor offence. Fisher's Exact test showed a significant association between educational level and the sample retention period ($p = 0.025$). Most participants with no university degree (56%) preferred a long-term sample retention period relative to 28% of those with a university degree and 20% of those with postgraduate education. In contrast, a majority of participants with a university degree (66%) or higher education (67%) were more likely to select a short-term sample retention period than those without a university degree (38%).

Table 8.7 - Opinions on retention period for DNA samples from unconvicted individuals charged with a serious offence; by gender, age, educational level and specialisation.

Demographic characteristics		**Retention period**			***Fisher's Exact test or $\chi^2(df)$***	***p-value***
		Long- term	**Short-term**	**Other**		
Gender	Male (n=76)	27.6%	59.2%	13.2%	8.811 (2)	0.012
	Female *(n=124)*	43.5%	52.4%	4%		
Age	18-34 *(n=106)*	46.2%	50.9%	2.8%	11.812 (2)	0.003
	≥ 35 *(n=94)*	27.7%	59.6%	12.8%		
Educational level	< University degree *(n=16)*	75.0%	18.8%	6.3%	11.371	0.017
	University degree *(n=53)*	39.6%	54.7%	5.7%		
	PhD/master's or equivalent *(n=131)*	32.1%	59.5%	8.4%		
Specialisation	Business, Humanities & Social Sciences (BHSS) *(n=58)*	39.7%	58.6%	1.7%	6.244	0.178
	Law, Criminology & Security (LCS) *(n=42)*	33.3%	52.4%	14.3%		
	Natural, Formal & Applied Sciences (NFAS) *(n=64)*	31.3%	60.9%	7.8%		

Table 8.8 - Opinions on retention period for DNA samples from unconvicted individuals charged with a minor offence; by gender, age, educational level and specialisation.

Demographic characteristics		**Retention period**			***Fisher's Exact test or $\chi^2(df)$***	***p-value***
		Long term	**Short-term**	**Other**		
Gender	Male *(n=75)*	22.7%	61.3%	16%	3.841 (2)	0.147
	Female *(n=124)*	26.6%	66.1%	7.3%		
Age	18-34 *(n=106)*	27.4%	66.0%	6.6%	3.906 (2)	0.142
	≥ 35 *(n=93)*	22.6%	62.4%	15.1%		
Educational level	< University degree *(n=16)*	56.3%	37.5%	6.3%	10.550	0.025
	University degree *(n=53)*	28.3%	66.0%	5.7%		
	PhD/master's or equivalent *(n=130)*	20.0%	66.9%	13.1%		
Specialisation	Business, Humanities & Social Sciences (BHSS) *(n=58)*	24.1%	65.5%	10.3%	1.588 (4)	0.811
	Law, Criminology & Security (LCS) *(n=42)*	23.8%	59.5%	16.7%		
	Natural, Formal & Applied Sciences (NFAS) *(n=63)*	22.2%	68.3%	9.5%		

Arrested individuals

Like the results for unconvicted individuals charged with an offence, most participants favoured a short-term retention period for DNA samples from unconvicted individuals arrested for a serious (60%) or minor (66%) offence (Figure 8.4). A larger proportion of participants preferred retention of DNA samples 'until the conclusion of investigations/proceedings' (38% for serious offence and 42% for minor offence). The long-term retention period was favoured by 32% and 23% of participants for unconvicted individuals arrested for a serious and minor offence, respectively. The percentages of those who selected 'other' were 8% if arrested for a serious crime and 11% if arrested for a minor offence. These mainly suggested no retention or collection of DNA samples, up to 5 years retention or a case-dependent approach.

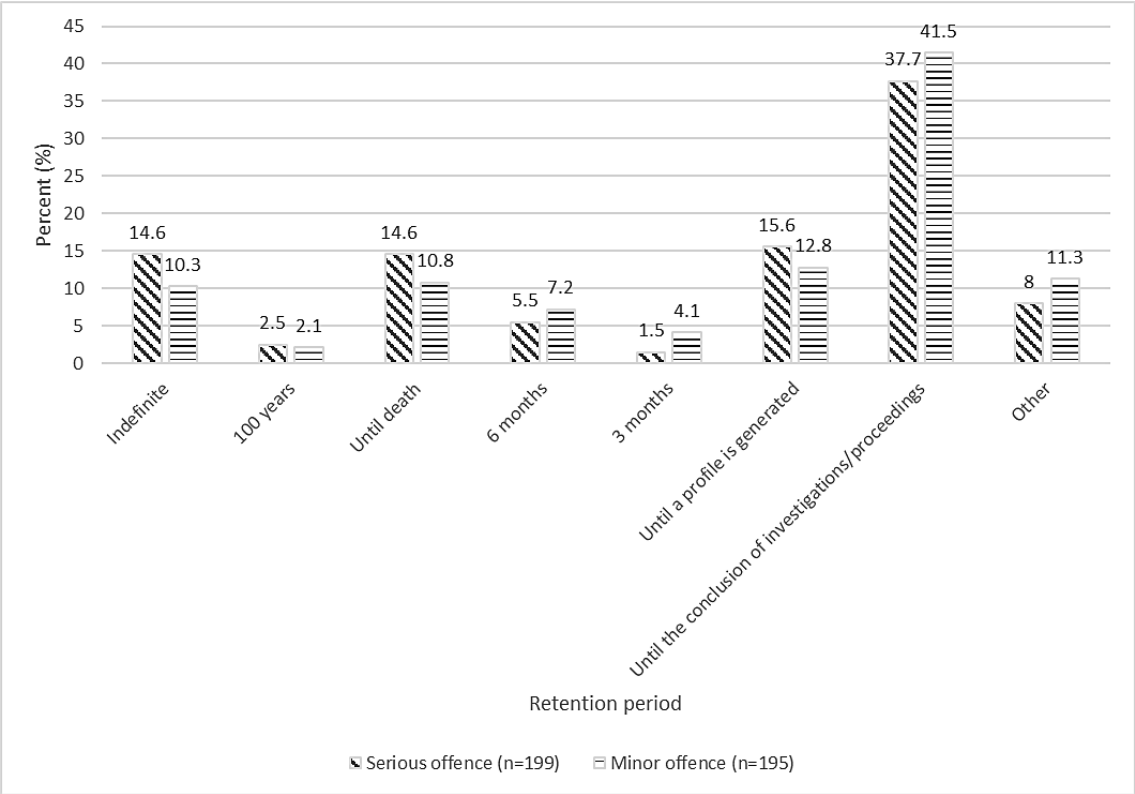

Figure 8.4 - Opinions of participants on retention period of DNA samples from unconvicted individuals arrested for an offence.

Demographic analysis

The analysis of the views of the survey participants showed that a majority of participants in all the social groups favoured a short-term sample retention period for unconvicted individuals arrested for a serious offence (Table 8.9). The only exception was the educational level group where most individuals with a university degree or above favoured a short-term

sample retention period, but a majority of those with no university degree preferred a long-term retention period. The educational level group showed a statistically significant association with the perceived DNA sample retention period ($p = 0.013$). Approximately 63% of respondents with no university degree chose the long-term sample retention period relative to 36% of those with a university degree and 26% of those with postgraduate education. Participants with a university degree (60%) or postgraduate education (65%) were more likely to favour the short-term period than those with no university degree (25%).

For unconvicted individuals arrested for a minor offence, the demographic analysis showed that support for the short-term sample retention period was common, except for the educational level group (Table 8.10). The trend of the results was comparable to those arrested for a serious offence. A statistically significant association was found between educational level and perceived sample retention period using Fisher's Exact test ($p = 0.010$). A majority of respondents with no university degree (53%) chose the long-term sample retention period compared to 27% of those with a bachelor's degree and 18% of those with postgraduate education. In contrast, most participants with a university degree (69%) or postgraduate education (67%) were more likely to favour the short-term sample retention period than those without a university degree (40%). Section 8.2.2 discusses the above results for unconvicted subjects in the context of the available literature.

Table 8.9 - Opinions on retention period for DNA samples from unconvicted individuals arrested for a serious offence; by gender, age, educational level and specialisation.

Demographic characteristics		**Retention period**			***Fisher's Exact test or $\chi^2(df)$***	***p-value***
		Long term	**Short-term**	**Other**		
Gender	Male (n=75)	26.7%	60%	13.3%	5.143 (2)	0.076
	Female *(n=124)*	34.7%	60.5%	4.8%		
Age	18-34 *(n=106)*	38.7%	55.7%	5.7%	5.940 (2)	0.051
	≥ 35 *(n=93)*	23.7%	65.6%	10.8%		
Educational level	< University degree *(n=16)*	62.5%	25.0%	12.5%	11.893	0.013
	University degree *(n=53)*	35.8%	60.4%	3.8%		
	PhD/master's or equivalent *(n=130)*	26.2%	64.6%	9.2%		
Specialisation	Business, Humanities & Social Sciences (BHSS) *(n=58)*	32.8%	60.3%	6.9%	2.775	0.604
	Law, Criminology & Security (LCS) *(n=42)*	23.8%	61.9%	14.3%		
	Natural, Formal & Applied Sciences (NFAS) *(n=63)*	28.6%	65.1%	6.3%		

Table 8.10 - Opinions on retention period for DNA samples from unconvicted individuals arrested for a minor offence; by gender, age, educational level and specialisation.

Demographic characteristics		**Retention period**			***Fisher's Exact test or $\chi^2(df)$***	***p-value***
		Long term	**Short-term**	**Other**		
Gender	Male (n=74)	23%	60.8%	16.2%	2.998(2)	0.223
	Female *(n=121)*	23.1%	68.6%	8.3%		
Age	18-34 *(n=104)*	23.1%	69.2%	7.7%	2.983 (2)	0.225
	≥ 35 *(n=91)*	23.1%	61.5%	15.4%		
Educational level	< University degree *(n=15)*	53.3%	40.0%	6.7%	12.470	0.010
	University degree *(n=52)*	26.9%	69.2%	3.8%		
	PhD/master's or equivalent *(n=128)*	18.0%	67.2%	14.8%		
Specialisation	Business, Humanities & Social Sciences (BHSS) *(n=58)*	24.1%	62.1%	13.8%	2.938 (4)	0.568
	Law, Criminology & Security (LCS) *(n=40)*	22.5%	60.0%	17.5%		
	Natural, Formal & Applied Sciences (NFAS) *(n=62)*	19.4%	72.6%	8.1%		

8.1.5 DNA profile retention period for unconvicted individuals

Charged individuals

Generally, the long-term profile retention period (indefinite/100 years/until death) was supported by 45% of the study participants if an unconvicted individual is charged with a serious offence (Figure 8.5). This was almost equal (46%) to those who favoured a short-term profile retention period (6-years/3-years/until the conclusion of investigations or proceedings). In contrast, a majority of participants (57%) favoured the short-term period for those charged with a minor offence whilst 31% preferred the long-term retention period. A large proportion of participants favoured the retention of DNA profiles until the conclusion of investigations or proceedings if an unconvicted individual is charged with a serious (34%) or minor offence (44%) (Figure 8.5).

About 9% of participants selected ‘other’ for unconvicted individuals charged with a serious offence. Many of these respondents proposed ‘no retention of data’. Others suggested that the current PoFA regime should be maintained or a case-dependent approach should be adopted. Those who selected ‘other’ for unconvicted individuals charged with a minor offence (13%) also suggested no profile retention or a case-dependent approach. One participant suggested up to 10 years of retention of profiles.

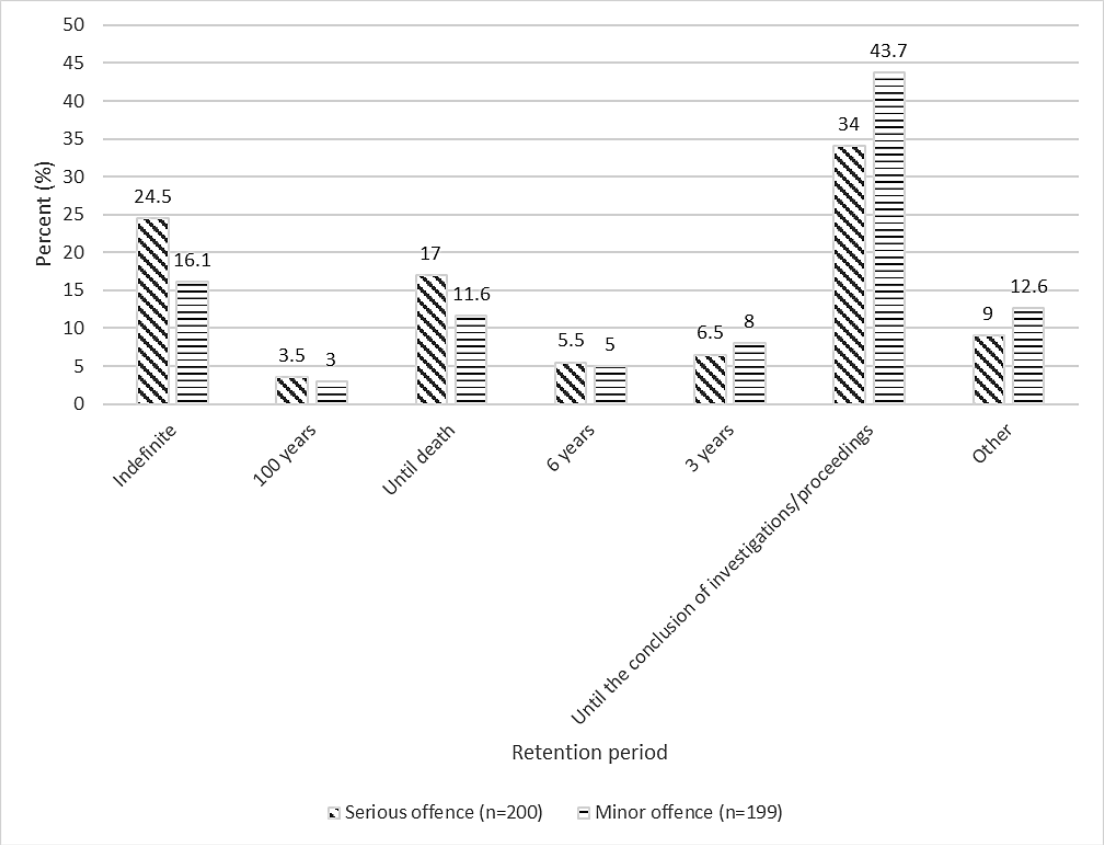

Figure 8.5 - Opinions of participants on retention period of DNA profiles from unconvicted individuals charged with an offence.

Demographic analysis

Table 8.11 presents a demographic analysis of the views of the study participants about the retention period for DNA profiles of unconvicted individuals charged with a serious offence. There was a statistically significant association between gender ($p = 0.008$) or age ($p = 0.002$) and the retention period for DNA profiles. More than half of females (51%) preferred long-term retention of profiles compared to 35% of males. A larger proportion of males (49%) preferred the short-term retention period. Most young adults (55%) were more likely to select the long-term retention period than middle or older adults (34%). A majority of middle or older adults (51%) favoured the short-term retention period.

In the educational level group, a majority of participants with no university degree (63%) were more likely to select the long-term retention period than those with a university degree (51%) or higher education (41%). However, this was not statistically significant. Most LCS participants (52%) preferred the short-term retention period. Support for the long-term or short-term retention periods was split equally in the BHSS and NFAS participants.

The Chi-square test showed a statistically significant association between age and the profile retention period ($p = 0.038$) for unconvicted individuals charged with a minor offence (Table 8.12). A majority of both young adults (57%) and middle or older adults (57%) favoured the short-term retention period. However, 36% of young adults favoured the long-term retention period compared to 25% of middle or older adults. The 'other' option (i.e. no data retention or other alternatives) was chosen by 18% of middle or older adults relative to 8% of young adults. Overall, most participants in each of the social groups favoured the short-term retention period except those with no university education (Table 8.12).

Table 8.11 - Opinions on retention period for DNA profiles from unconvicted individuals charged with a serious offence; by gender, age, educational level and specialisation.

Demographic characteristics		**Retention period**			***Fisher's Exact test or $\chi^2(df)$***	***p-value***
		Long term	**Short-term**	**Other**		
Gender	Male (n=75)	34.7%	49.3%	16.0%	9.671 (2)	0.008
	Female *(n=125)*	51.2%	44.0%	4.8%		
Age	18-34 *(n=106)*	54.7%	41.5%	3.8%	12.566 (2)	0.002
	≥ 35 *(n=94)*	34.0%	51.1%	14.9%		
Educational level	< University degree *(n=16)*	62.5%	31.3%	6.3%	4.027	0.381
	University degree *(n=53)*	50.9%	43.4%	5.7%		
	PhD/master's or equivalent *(n=131)*	40.5%	48.9%	10.7%		
Specialisation	Business, Humanities & Social Sciences (BHSS) *(n=58)*	46.6%	46.6%	6.9%	1.719 (4)	0.787
	Law, Criminology & Security (LCS) *(n=42)*	35.7%	52.4%	11.9%		
	Natural, Formal & Applied Sciences (NFAS) *(n=64)*	45.3%	45.3%	9.4%		

Table 8.12 - Opinions on retention period for DNA profiles from unconvicted individuals charged with a minor offence; by gender, age, educational level and specialisation.

Demographic characteristics		**Retention period**			***Fisher's Exact test or $\chi^2(df)$***	***p-value***
		Long term	**Short-term**	**Other**		
Gender	Male *(n=74)*	25.7%	55.4%	18.9%	4.780 (2)	0.092
	Female *(n=125)*	33.6%	57.6%	8.8%		
Age	18-34 *(n=106)*	35.8%	56.6%	7.5%	6.541 (2)	0.038
	≥ 35 *(n=93)*	24.7%	57.0%	18.3%		
Educational level	< University degree *(n=16)*	50.0%	43.8%	6.3%	6.525	0.149
	University degree *(n=53)*	37.7%	54.7%	7.5%		
	PhD/master's or equivalent *(n=130)*	25.4%	59.2%	15.4%		
Specialisation	Business, Humanities & Social Sciences (BHSS) *(n=58)*	31.0%	56.9%	12.1%	4.351 (4)	0.361
	Law, Criminology & Security (LCS) *(n=42)*	21.4%	57.1%	21.4%		
	Natural, Formal & Applied Sciences (NFAS) *(n=63)*	34.9%	55.6%	9.5%		

Arrested individuals

A majority of participants favoured the short-term (6-years/3-years/until the conclusion of investigations or proceedings) retention of DNA profiles from unconvicted individuals arrested for a serious (53%) or minor offences (58%) (Figure 8.6). A greater part of respondents preferred the retention of DNA profiles until the conclusion of investigations or proceedings if an unconvicted individual is arrested for a serious (43%) or minor offence (46%).

Many respondents who chose 'other' for unconvicted arrestees (10% for serious arrestees and 14% for minor arrestees) preferred 'no retention of data'. A few participants recommended that the current PoFA periods should apply or retention on a case-by-case basis. A 10-year retention period was suggested by one participant for unconvicted individuals arrested for a minor offence.

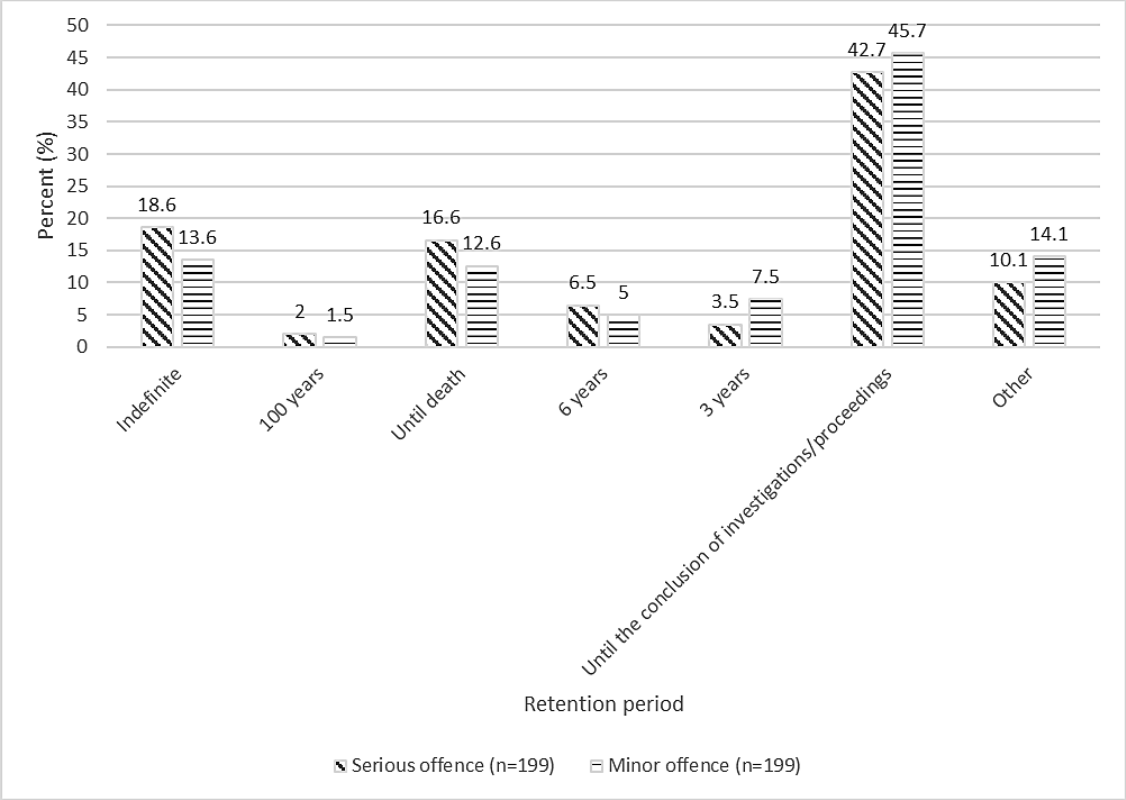

Figure 8.6 - Opinions of participants on retention period for DNA profiles from unconvicted individuals arrested for an offence.

Demographic analysis

Table 8.13 presents a demographic analysis of the views of the study participants about the retention period for DNA profiles from unconvicted individuals arrested for a serious

offence. A large part of participants in all the social groups preferred the short-term retention period except respondents with no university degree who favoured the long-term retention period (63%). Only the age group showed a statistically significant association with the perceived retention period for DNA profiles *($p = 0.002$).* Young adults (46%) were more likely to favour the long-term retention period than middle or older adults (27%). About 16% of middle or older adults chose 'other' (mainly no retention or other approaches) compared to 5% of young adults.

Like the results above, most participants in each of the social groups supported the short-term retention of DNA profiles from unconvicted individuals arrested for a minor offence (Table 8.14). The only exception was participants with no university degree who favoured long-term retention. The age ($p = 0.035$) and educational level ($p = 0.022$) groups showed a statistically significant association with the perceived retention period (Table 8.14). Both young adults and middle or older adults almost equally preferred the short-term retention period. However, middle or older adults (20%) were more likely to select 'other' (no retention or other alternatives) than young adults (9%). About 32% of young adults favoured the long-term retention period compared to 23% of middle or older adults.

For the educational level group, participants with a university degree (34%) or higher (22%) were less likely to select the long-term retention period than those without a university degree (56%). The opposite was observed for the short-term retention period (38% < university degree versus 61% postgraduates and 59% university degree).

Table 8.13 - Opinions on retention period for DNA profiles from unconvicted individuals arrested for a serious offence; by gender, age, educational level and specialisation.

Demographic characteristics		**Retention period**			***Fisher's Exact test or $\chi^2(df)$***	***p-value***
		Long term	**Short-term**	**Other**		
Gender	Male (n=74)	35.1%	48.6%	16.2%	4.968 (2)	0.083
	Female *(n=125)*	38.4%	55.2%	6.4%		
Age	18-34 *(n=106)*	46.2%	49.1%	4.7%	11.995 (2)	0.002
	≥ 35 *(n=93)*	26.9%	57.0%	16.1%		
Educational level	< University degree *(n=16)*	62.5%	31.3%	6.3%	8.047 (4)	0.090
	University degree *(n=53)*	43.4%	50.9%	5.7%		
	PhD/master's or equivalent *(n=130)*	31.5%	56.2%	12.3%		
Specialisation	Business, Humanities & Social Sciences (BHSS) *(n=58)*	37.9%	55.2%	6.9%	2.944 (4)	0.567
	Law, Criminology & Security (LCS) *(n=42)*	28.6%	54.8%	16.7%		
	Natural, Formal & Applied Sciences (NFAS) *(n=63)*	34.9%	55.6%	9.5%		

Table 8.14 - Opinions on retention period for DNA profiles from unconvicted individuals arrested for a minor offence; by gender, age, educational level and specialisation.

Demographic characteristics		**Retention period**			***Fisher's Exact test or $\chi^2(df)$***	***p-value***
		Long term	**Short-term**	**Other**		
Gender	Male (n=74)	24.3%	55.4%	20.3%	3.855 (2)	0.146
	Female *(n=125)*	29.6%	60.0%	10.4%		
Age	18-34 *(n=106)*	32.1%	59.4%	8.5%	6.686 (2)	0.035
	≥ 35 *(n=93)*	22.6%	57.0%	20.4%		
Educational level	< University degree *(n=16)*	56.3%	37.5%	6.3%	10.992	0.022
	University degree *(n=53)*	34.0%	58.5%	7.5%		
	PhD/master's or equivalent *(n=130)*	21.5%	60.8%	17.7%		
Specialisation	Business, Humanities & Social Sciences (BHSS) *(n=58)*	29.3%	55.2%	15.5%	3.125 (4)	0.537
	Law, Criminology & Security (LCS) *(n=42)*	19.0%	59.5%	21.4%		
	Natural, Formal & Applied Sciences (NFAS) *(n=43)*	25.4%	63.5%	11.1%		

8.1.6 Reasons for the DNA sample and profile retention period for unconvicted individuals

Among the study participants, the short-term retention period was the most common for DNA samples/profiles from unconvicted individuals. The free-text responses provided some useful insights into the preference of participants about the retention periods for DNA samples (*n = 29; 14%*) and profiles (*n = 30; 15%*). The main coded themes were respect for civil liberties, the usefulness of retention, DNA profile adequacy, and concepts of punishment and rehabilitation.

Many participants who provided qualitative feedback cited civil liberties to support their preference for specific short retention periods or no collection of DNA. Legal and ethical principles such as innocent until proven guilty, informed consent, right to privacy, and personal freedom were the main reasons provided by these participants:

> Unconvicted people are innocent until proven guilty and convicted. There is no difference between them and anyone else walking about, so this is tantamount to saying everyone should have samples retained, and this is a step too far. (PSR13)

Some participants felt retaining the DNA would 'undermine the criminal justice system' (PSR170) and invite 'overzealous arrest/charging of marginalised individuals' (PSR92). Others thought the continuous retention of samples/profiles from unconvicted individuals was unnecessary and lacked justification: 'If not convicted of an offence, there should be no need to store the DNA sample, beyond the end of the proceedings' (PSR74). Some participants felt the retention of profiles may only be justified in the case of serious offences: 'If there is evidentiary value in serious offences, this may outweigh the human rights infringement. However, if the person is not convicted, the sample and profile should be destroyed' (PSR174).

There were comments that justified the short or long-term retention of DNA samples/profiles by citing potential future uses such as upgrading the database, maintaining public security, preventing a miscarriage of justice and repeated sampling of individuals. A further justification was the need to allow a reasonable time to destroy DNA samples. One participant conceptualised the utilisation of DNA within the principle of solidarity,[925] reasoning that:

[925] Helena Machado and Susana Silva, 'Public Participation in Genetic Databases: Crossing the Boundaries between Biobanks and Forensic DNA Databases through the Principle of Solidarity' (2015) 41 Journal of Medical Ethics 820.

> We are all potential criminals and victims. I believe all our DNA should be stored, even if we have never committed a crime, or feel we never would, (in which case surely you've nothing to worry about!) DNA identifies VICTIMS too, a point which the paranoid and scientifically illiterate gutter press never mentions! (PSR29)

Some participants who leaned toward the usefulness of DNA also raised concerns about function creep and maintained that DNA profiles should be limited to comparison with crime scene profiles: 'Storing the profiles isn't the issue; it's what is done with those profiles involuntarily that is. Using to compare to DNA found at a crime? Okay. Using them to plot Jo Schmo's family tree? No.' (PSR26).

Another reason mentioned by participants was the adequacy of the DNA profile. These participants felt only the DNA profile is required for identification and hence the samples should be destroyed after profiling.

Finally, one participant expressed views suggesting that contact with the police (arrested/charged) indicates potential to commit subsequent crime, justifying a long-term retention of samples/profiles: 'No smoke without fire, so if I am arrested but not charged but subsequently commit a crime and get caught I should suffer the consequences' (PSR96).

8.1.7 Summary of results

The quantitative analysis showed strong support (61 - 80%) for the long-term retention of DNA samples from only serious offenders. The most common long-term retention period was indefinite. There was moderately strong support to strong support (41 - 80%) for the short-term retention of DNA samples from minor offenders, juveniles convicted of a first minor offence, and charged or arrested but unconvicted individuals. Sample retention until a profile is generated, until the conclusion of investigations/proceedings or until its purpose is fulfilled were the most common short-term periods. Support for other retention periods was either limited (1 - 20%) or moderate (21 - 40%).

Regarding the retention of DNA profiles, there was very strong support (81-100%) for the long-term retention of profiles from serious offenders, with indefinite retention as the most common. The results revealed moderately strong support (41 – 60%) for the long-term retention of profiles from minor offenders, first-time juvenile offenders (minor), and unconvicted individuals charged with a serious offence. Support for the short-term retention

period was moderately strong for unconvicted individuals charged or arrested for an offence. The most common short-period was until the conclusion of investigations or proceedings.

The qualitative responses showed that preference for a particular retention period was influenced by the following reasons: respect for civil liberties, usefulness/effectiveness of DNA sample/profile retention, DNA profile adequacy, and concepts of punishment and rehabilitation. The next section discusses the results on the retention periods for DNA samples and profiles included in the NDNAD.

8.2 Discussion and conclusion

8.2.1 Convicted individuals

The results obtained in this study showed that the public may favour a long-term retention period for DNA samples and profiles from serious offenders. The opposite was observed for minor offenders in relation to DNA sample retention. Views on the retention period for profiles from minor offenders was almost split between long-term and sentence-based periods. In comparison to the current PoFA regime, there are some discrepancies between the position of the study participants and the current rules. Firstly, the current law applies a short retention period for all DNA samples. However, the study participants favoured a long-term period for serious offenders. Secondly, the PoFA rules allow indefinite retention of profiles from all offenders except juveniles convicted of a first minor offence. The support for this rule was not as clear as the views on the retention of data from serious offenders. These findings mean that the seriousness of an offence may be a determiner of the beliefs of the public about how long DNA records from convicted individuals are retained.

Several reviews and consultations completed in the UK have cited consideration of the gravity of an offence in determining retention periods for data from convicted individuals.[926] This factor is accounted for in the decision process of the Biometrics Commissioner in relation to the extended retention of data from unconvicted individuals.[927] A possible

[926] Nuffield Council on Bioethics (n 45); Human Genetics Commission, *Citizens' Inquiry into the Forensic Use of DNA and the National DNA Database: Citizens' Report* (n 651); Home Office, *Keeping the Right People on the DNA Database: Summary of Responses* (n 653); *Gaughran v Chief Constable of the Police Service of Northern Ireland (Secretary of State for the Home Department intervening)* (n 120).
[927] Office of the Biometrics Commissioner (n 836); FIND Strategy Board, 'Applications to the Biometrics Commissioner under PACE' (Forensic Information Database Strategy Board 2018) <https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/764558/Applications_to_the_Biometrics_Commissioner_under_PACE__September_2018.pdf> accessed 18 September 2019.

explanation for this position (i.e. retention based on offence seriousness) may be linked to the conceptualisation of national DNA databases as a criminal electronic archive and a means of punishment for offenders.[928] In line with this, some participants highlighted concepts of punishment to justify their position about the length of retention for the different convicted groups. The results generally suggest that a more discriminatory approach for the retention period of data from convicted individuals may be more acceptable to the public. A possible reform could be a sentence-based retention period of data from adults convicted of a minor offence. However, this policy should be empirically supported to strike the right balance between the competing public and individual interests.

The pattern of responses by young adults and middle/older adults showed that the latter may exhibit a more restrictive view. This is because the middle/older participants were more likely to select other (mainly no retention or other alternatives) for DNA samples from serious offenders and the convicted juvenile group. Also, young adults tended to be more favourable of the long-term retention of DNA profiles from minor offenders and the sentence-based period or long-term period for juveniles. The results corroborate the finding that young adults may be more optimistic about the benefits of DNA databases (Chapter 6). Thus, they may be more supportive of the retention of data from convicted individuals, whether in the short-term or long-term.

It was found that participants with no university education favoured a long-term retention period for DNA samples and profiles from adult minor offenders and juveniles convicted of a first minor offence. This indicates educational level may have an influence on beliefs about the retention criteria for the NDNAD. Several studies have found that individuals with a higher level of education are likely to express restrictive views about DNA databasing.[929] This is thought to be due to an increased awareness of the practical details of DNA databases among this group.[930] The apparent consistency of this trend suggests a need to promote

[928] Machado and Silva, '"Would You Accept Having Your DNA Profile Inserted in the National Forensic DNA Database?' (n 676); Machado and Silva, 'Voluntary Participation in Forensic DNA Databases' (n 676).
[929] Zieger and Utz (n 663); Machado and Silva, '"Would You Accept Having Your DNA Profile Inserted in the National Forensic DNA Database?' (n 676); Machado and Silva, 'What Influences Public Views on Forensic DNA Testing in the Criminal Field?' (n 656).
[930] Gamero and others, 'A Study of Spanish Attitudes Regarding the Custody and Use of Forensic DNA Databases' (n 666); Machado and Silva, 'Public Perspectives on Risks and Benefits of Forensic DNA Databases' (n 659); Machado and Silva, '"Would You Accept Having Your DNA Profile Inserted in the National Forensic DNA Database?' (n 676).

awareness of DNA databases among the lay public, particularly members of the public with a lower level of education.

In this study, participants specialising in law, criminology and security were significantly more sceptical about the long-term retention of DNA profiles from offenders. This may reflect an enhanced level of awareness of the actual benefits and limitations of DNA databasing among these members of the public.[931] However, Teodorović *et al*.[932] found that legal professionals (62%) in Serbia were more likely to favour indefinite retention of DNA data relative to the general public (39%). This finding was attributed to the fact that these group may lack technical knowledge and training about DNA databasing. Hence, their views may be influenced by the overemphasis of the benefits of DNA in the media (CSI effect). The more restrictive view exhibited by the participants in this study may be due to a more balanced awareness of DNA databasing through the popularity of legal challenges in the UK and European courts,[933] consistent publication of reports and reviews about DNA and the NDNAD, government consultations about DNA/biometric policy, and application of DNA evidence in casework ('Forensic effect').

8.2.2 Unconvicted individuals

The 2011 survey by the MPA Civil Liberties Panel found that 84% of respondents opposed the retention of DNA profiles from unconvicted individuals in the NDNAD.[934] In this study, most participants favoured the short-term retention of DNA samples and profiles from unconvicted individuals charged or arrested for an offence. The only exception was the retention of DNA profiles from those charged with a serious offence. There were split views between long-term and short-term retention of data. The results generally support the *Mapper* decision to differentiate between convicted individuals and unconvicted individuals in DNA databasing.[935] It also shows that, unlike the MPA Civil Liberties Panel survey, the respondents in this study consider the retention of DNA from unconvicted individuals to be potentially valuable. The results also suggest a possible differential treatment of unconvicted individuals based on the gravity of the offence and the weight of evidence in the relevant case. Generally, the views expressed by the participants support the 'spirit' of the current

[931] Machado and Silva, 'Public Perspectives on Risks and Benefits of Forensic DNA Databases' (n 659); Zieger and Utz (n 663).
[932] Teodorović and others (n 122).
[933] *S and Marper v The United Kingdom* (n 44); *Gaughran v Chief Constable of the Police Service of Northern Ireland (Secretary of State for the Home Department intervening)* (n 120).
[934] MPA Civil Liberties Panel (n 40).
[935] *S and Marper v The United Kingdom* (n 44).

law (PoFA) to retain DNA records of unconvicted individuals for a relatively short period and informed by offence seriousness and the evidence of the case.

The study found that females are more likely to support the long-term retention of DNA samples and profiles from unconvicted individuals charged with a serious offence. This may be linked to the gender effects of crime. Women have been reported to be more supportive of crime prevention efforts than males.[936] This means they may be more optimistic about DNA databasing and are likely to express permissive views.[937] On the other hand, males may express restrictive views because they are more likely to be sampled and included in the NDNAD. The high proportion of data from males in the NDNAD means men may be more concerned about civil liberties. The abovementioned factors may explain the gender differences in views about DNA databasing.

It was also found that young adults tended to be more supportive of the prolonged retention of DNA samples and profiles from unconvicted individuals charged or arrested with an offence. As noted in the qualitative responses, this view is primarily supported by reasons for improving the effectiveness of the database and controlling crime.[938] The trend of permissive views among young adults is consistent throughout the results, confirming the possible influence of age on views about DNA databasing. The actual reasons for the differences in views among young adults and middle/older adults are not clear. However, this observation may be linked to the privacy paradox (attitudes and behaviours towards privacy technology),[939] and a further quantitative and qualitative research among young adults may clarify this hypothesis.

As stated earlier, the literature suggests that educational level may be linked to attitudes toward DNA databasing.[940] Similar to the results for convicted individuals, a majority of participants with no university education were more likely to favour the lengthy retention of DNA samples and profiles from unconvicted individuals. This clearly confirms a possible relationship between the level of awareness and attitudes towards DNA databasing. The implication of these results is the development of public sensitisation programmes to ensure

[936] Jon Hurwitz and Shannon Smithey, 'Gender Differences on Crime and Punishment' (1998) 51 Political Research Quarterly 89.
[937] Zieger and Utz (n 663); Tozzo, Fassina and Caenazzo (n 677); Guerrini and others (n 665).
[938] Machado and Silva, 'Public Perspectives on Risks and Benefits of Forensic DNA Databases' (n 659); Teodorović and others (n 122).
[939] Barnes (n 857); Gerber, Gerber and Volkamer (n 36).
[940] Dundes (n 666); Machado and Silva, 'Public Perspectives on Risks and Benefits of Forensic DNA Databases' (n 659); Teodorović and others (n 122); Zieger and Utz (n 663).

that all members of the public are able to make an informed choice about the law and policy governing the national DNA database.

To summarise, this study found that a discriminatory retention model for convicted individuals may be more acceptable to the public. Presently, only DNA data from convicted juveniles are subject to a discriminatory retention arrangement based on offence seriousness and recidivism. All DNA data from convicted adults are subject to indefinite retention. The discriminatory approach generally considers the gravity of an offence, with most participants favouring a long-term retention period for serious offenders and a short-term, long-term or sentence-based period for minor offenders. The discriminatory model was also preferred for unconvicted individuals, which was generally consistent with the current arrangement under PoFA. The findings suggested that the public may be more accepting of a short retention period for unconvicted individuals. However, this policy should consider the seriousness of the offence and the evidence in the relevant case. It is worth noting that this study is based on a non-representative sample of the public hence the results cannot be generalised. However, the findings make an original contribution by furthering the understanding of the existing positions and views about forensic DNA retention in England and Wales. This may be useful in pending court appeals, such as the *Gaughran* case, about the proportionality of the current regime.[941] The findings may also be valuable to policymakers and contribute to the development of the legal framework for the NDNAD and other biometric databases. As observed in the responses, there is limited clarity about the specific length of retention for the different categories of individuals. To avoid arbitrary decisions on specific long-term or short-term periods, evidence on the actual benefits of retaining data for a particular period (e.g. 5 years versus 10 years) should be provided and shared with the public. This will help ensure that the 'societal choice' of the public about the rules to govern DNA databases is informed, robust, balanced and transparent.

[941] *Gaughran v Chief Constable of the Police Service of Northern Ireland (Secretary of State for the Home Department intervening)* (n 120); Wiles, *Annual Report 2018: Commissioner for the Retention and Use of Biometric Material* (n 115), para 3.

Chapter 9: Voluntary participation in the National DNA Database

Voluntary participation in forensic DNA databases has been explored by several studies.[942] This aspect of DNA databasing is important because the collection of reference DNA is gradually becoming a common routine or administrative process[943] for individuals linked to the chain of custody in DNA-related incidents or offences. This may include victims, law enforcement officers, DNA consumable manufacturers, crime scene officers, witnesses and arrestees. The current law governing the NDNAD allows individuals to voluntarily provide their DNA data to be held in the database.[944] This applies if the individual cannot be included in the database on any other statutory grounds (such as being arrested, charged or convicted of a crime). As part of this process, the volunteer is required to provide informed written consent; consent can be withdrawn at any time, and if consent is given, the profile can be retained until the purpose for which it was taken is fulfilled. The general rule for DNA samples applies to volunteers – destruction after profiling or up to 6 months. In line with the third aim of this research, the survey explored the conditions that may influence volunteers to participate in the NDNAD by asking participants whether they would be willing to provide their DNA records under certain given circumstances. Participants were also asked about the retention periods for DNA samples and profiles taken from volunteers. The results of the public survey are presented in section 9.1 below. This is followed by the discussion in section 9.2. The Chapter makes an original contribution by identifying the main motivations and justifications for voluntary participation in the NDNAD.

9.1 Public survey results on voluntary participation in the NDNAD

The responses of the participants are presented in Figure 9.1. A majority of participants (52%) answered 'Yes' if their DNA records can assist the police in resolving crime. More than half (51%) of respondents answered 'No' if they are only a witness to a crime. A relatively large percentage of participants answered 'Yes' if they are a victim of an offence (41%) and if their data is stored in a separate volunteer's database (43%).

[942] Machado and Silva, '"Would You Accept Having Your DNA Profile Inserted in the National Forensic DNA Database?' (n 676); Machado and Silva, 'Voluntary Participation in Forensic DNA Databases' (n 676); Teodorović and others (n 122).
[943] i.e. similar to taking the name, age and residence of a person
[944] Police and Criminal Evidence Act 1984, ss 63N and 63O

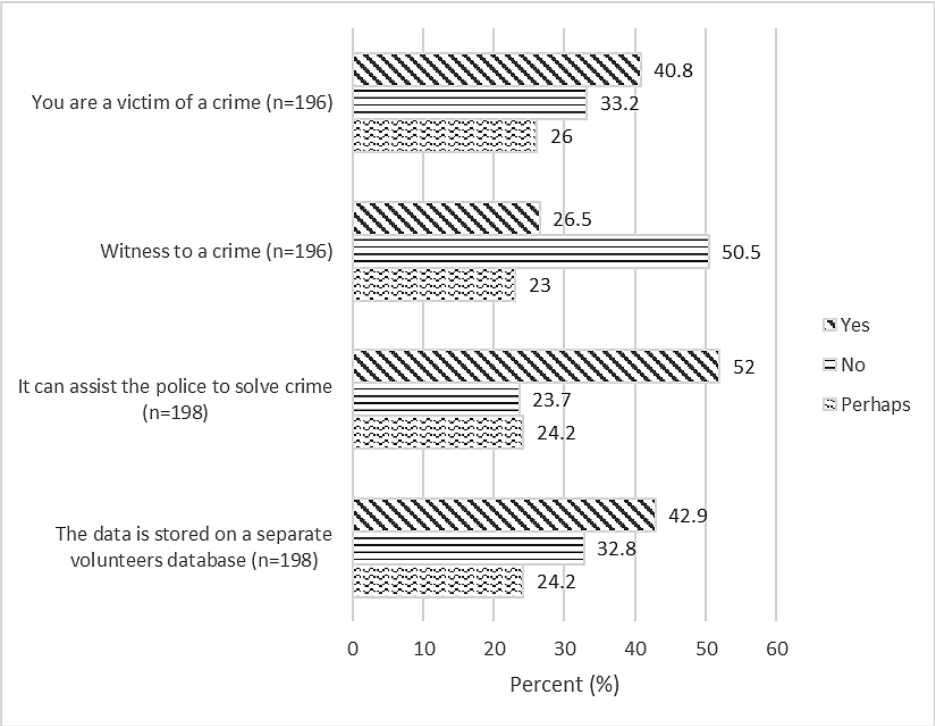

Figure 9.1 - Opinion of participants to the question 'Would you volunteer to donate your DNA records to be retained on the National DNA Database if...'

Demographic analysis

The analysis of the responses of social groups about voluntary participation in the NDNAD if one is a victim of a crime is summarised in Table 9.1. Generally, a greater proportion of males, females, young adults, participants specialising in NFAS and those with a university degree or higher answered 'yes' to this question. Only the specialisation area showed a statistically significant association with the perceived participation in the NDNAD if one is a victim of a crime ($p = 0.040$). A majority of NFAS participants (51%) were more likely to answer yes than LCS (31%) and BHSS (30%) participants. The NFAS respondents were less likely to select 'perhaps' than the other two groups (16% versus 36% BHSS and 38% LCS).

Table 9.2 shows a similar pattern of response across the different social groups in relation to voluntary participation in the NDNAD if one is a witness to a crime. A majority or a large part of participants in each social group answered 'No' to this question. No statistically significant associations were found between the social groups and responses.

The analysis of the responses of social groups showed that a majority of females, young adults, participants with a university degree or lower, and those specialising in LCS and NFAS are willing to provide their DNA records if it can assist the police in resolving crime

(Table 9.3). A relatively large proportion of males, participants with postgraduate education and those specialising in BHSS also answered yes. The social groups showed no statistically significant association with the perceived voluntary participation in the NDNAD if the data can assist the police.

In relation to participation in the NDNAD if the data is stored in a separate database, a large proportion of participants in each social group answered in the affirmative except the LCS participants who answered no (Table 9.4). Most participants with no university degree (53%) answered yes to this question. Again, there was no statistically significant association between the social groups and responses.

Table 9.1 - Opinions on voluntary participation in the National DNA Database if one is a victim of a crime; by gender, age, educational level and specialisation.

Demographic characteristics		**Retention period**			***Fisher's Exact test or $\chi^2(df)$***	***p-value***
		Yes	**No**	**Perhaps**		
Gender	Male *(n=75)*	42.7%	32.0%	25.3%	0.174 (2)	0.917
	Female *(n=121)*	39.7%	33.9%	26.4%		
Age	18-34 *(n=104)*	46.2%	26.9%	26.9%	4.217 (2)	0.121
	≥ 35 *(n=92)*	34.8%	40.2%	25.0%		
Educational level	< University degree *(n=15)*	40.0%	46.7%	13.3%	3.390	0.503
	University degree *(n=52)*	48.1%	26.9%	25.0%		
	PhD/master's or equivalent *(n=129)*	38.0%	34.1%	27.9%		
Specialisation	Business, Humanities & Social Sciences (BHSS) *(n=56)*	30.4%	33.9%	35.7%	10.017 (4)	0.040
	Law, Criminology & Security (LCS) *(n=42)*	31.0%	31.0%	38.1%		
	Natural, Formal & Applied Sciences (NFAS) *(n=63)*	50.8%	33.3%	15.9%		

Table 9.2 - Opinions on voluntary participation in the National DNA Database if one is a witness to a crime; by gender, age, educational level and specialisation.

Demographic characteristics		**Retention period**			***Fisher's Exact test or $\chi^2(df)$***	***p-value***
		Yes	**No**	**Perhaps**		
Gender	Male (n=75)	24.0%	52.0%	24.0%	0.404 (2)	0.817
	Female *(n=121)*	28.1%	49.6%	22.3%		
Age	18-34 *(n=105)*	28.6%	49.5%	21.9%	0.508 (2)	0.776
	≥ 35 *(n=91)*	24.2%	51.6%	24.2%		
Educational level	< University degree *(n=15)*	26.7%	60.0%	13.3%	1.577	0.829
	University degree *(n=52)*	30.8%	46.2%	23.1%		
	PhD/master's or equivalent *(n=129)*	24.8%	51.2%	24.0%		
Specialisation	Business, Humanities & Social Sciences (BHSS) *(n=57)*	21.1%	54.4%	24.6%	2.319 (4)	0.677
	Law, Criminology & Security (LCS) *(n=41)*	22.0%	51.2%	26.8%		
	Natural, Formal & Applied Sciences (NFAS) *(n=63)*	31.7%	47.6%	20.6%		

Table 9.3 - Opinions on voluntary participation in the National DNA Database if the data can assist the police in resolving crime; by gender, age, educational level and specialisation.

Demographic characteristics		**Retention period**			***Fisher's Exact test or $\chi^2(df)$***	***p-value***
		Yes	**No**	**Perhaps**		
Gender	Male *(n=75)*	49.3%	26.7%	24.0%	0.607 (2)	0.738
	Female *(n=123)*	53.7%	22.0%	24.4%		
Age	18-34 *(n=105)*	57.1%	18.1%	24.8%	4.151 (2)	0.126
	≥ 35 *(n=93)*	46.2%	30.1%	23.7%		
Educational level	< University degree *(n=16)*	75.0%	12.5%	12.5%	5.363	0.245
	University degree *(n=52)*	55.8%	17.3%	26.9%		
	PhD/master's or equivalent *(n=130)*	47.7%	27.7%	24.6%		
Specialisation	Business, Humanities & Social Sciences (BHSS) *(n=57)*	42.1%	31.6%	26.3%	4.453 (4)	0.348
	Law, Criminology & Security (LCS) *(n=42)*	52.4%	16.7%	31.0%		
	Natural, Formal & Applied Sciences (NFAS) *(n=63)*	55.6%	23.8%	20.6%		

Table 9.4 - Opinions on voluntary participation in the National DNA Database if the data is stored in a separate database; by gender, age, educational level and specialisation.

Demographic characteristics		**Retention period**			***Fisher's Exact test or $\chi^2(df)$***	***p-value***
		Yes	**No**	**Perhaps**		
Gender	Male *(n=75)*	38.7%	34.7%	26.7%	0.928 (2)	0.629
	Female *(n=123)*	45.5%	31.7%	22.8%		
Age	18-34 *(n=105)*	47.6%	29.5%	22.9%	2.066 (2)	0.356
	≥ 35 *(n=93)*	37.6%	36.6%	25.8%		
Educational level	< University degree *(n=15)*	53.3%	13.3%	33.3%	4.457	0.342
	University degree *(n=53)*	49.1%	30.2%	20.8%		
	PhD/master's or equivalent *(n=130)*	39.2%	36.2%	24.6%		
Specialisation	Business, Humanities & Social Sciences (BHSS) *(n=56)*	39.3%	33.9%	26.8%	2.088 (4)	0.719
	Law, Criminology & Security (LCS) *(n=42)*	38.1%	40.5%	21.4%		
	Natural, Formal & Applied Sciences (NFAS) *(n=64)*	48.4%	31.3%	20.3%		

9.1.1 Retention period for DNA samples from volunteers

About three quarters (73%) of participants preferred a short-term retention period for DNA samples from volunteers, ranging from until its purpose is fulfilled to 6 months (Figure 9.2). A large proportion of the participants (42%) were in favour of retention of samples until the purpose for which it was taken is fulfilled. The long-term retention period (indefinite/100 years/until death) was favoured by 20% of participants. Those who selected 'other' (~8%) mainly thought the retention period should be determined by the volunteer. Some maintained that samples should not be taken or retained. One participant thought retention of volunteers' data should be informed by statistical evidence of its potential value.

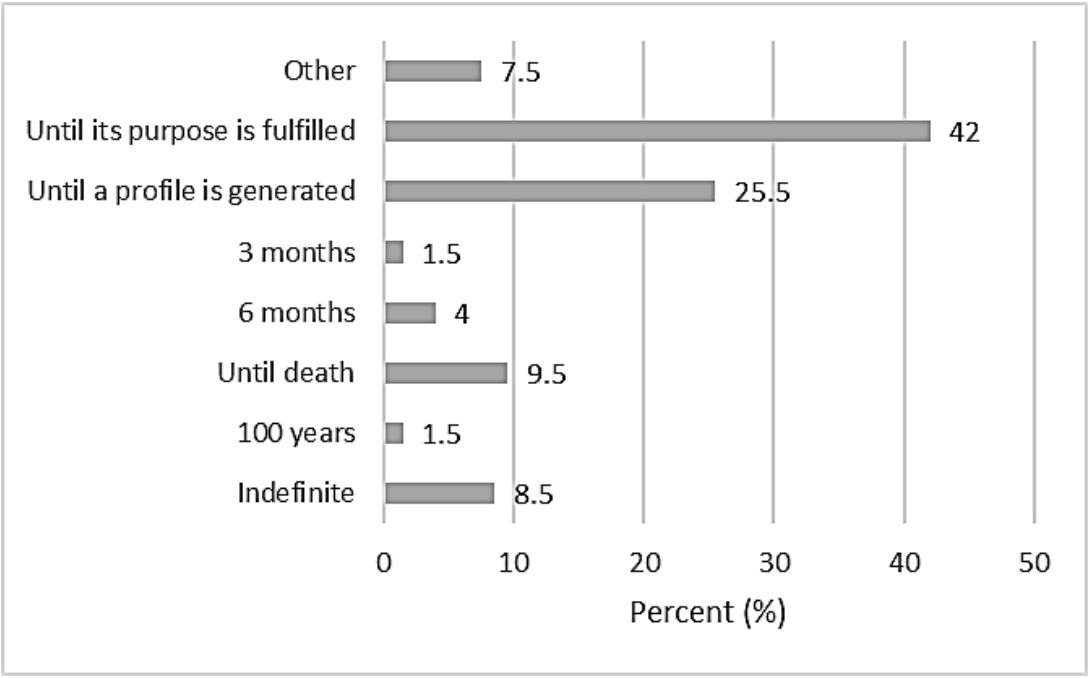

Figure 9.2 - Opinion of participants to the question 'How long should the physical DNA sample taken from volunteers be retained?' (n = 200)

The analysis of social groups revealed no statistically significant association between demographic characteristics and the perceived sample retention period for volunteers (all $p > 0.05$; Table 9.5). A majority of participants in all the social groups favoured the short-term sample retention period.

Table 9.5 - Opinions on retention period for DNA samples taken from volunteers; by gender, age, educational level and specialisation

Demographic characteristics		**Retention period**			***Fisher's Exact test or $\chi^2(df)$***	***p-value***
		Long-term	**Short-term**	**Other**		
Gender	Male *(n=76)*	18.4%	71.1%	10.5%	1.634 (2)	0.442
	Female *(n=124)*	20.2%	74.2%	5.6%		
Age	18-34 *(n=106)*	18.9%	76.4%	4.7%	2.736 (2)	0.255
	≥ 35 *(n=94)*	20.2%	69.1%	10.6%		
Educational level	< University degree *(n=16)*	37.5%	56.3%	6.3%	5.052	0.256
	University degree *(n=53)*	20.8%	75.5%	3.8%		
	PhD/master's or equivalent *(n=131)*	16.8%	74.0%	9.2%		
Specialisation	Business, Humanities & Social Sciences (BHSS) *(n=58)*	19.0%	70.7%	10.3%	3.264	0.523
	Law, Criminology & Security (LCS) *(n=42)*	19.0%	71.4%	9.5%		
	Natural, Formal & Applied Sciences (NFAS) *(n=64)*	17.2%	79.7%	3.1%		

9.1.2 Retention period for DNA profiles from volunteers

A majority of participants (54%) favoured the retention of volunteer DNA profiles until its purpose is fulfilled (Figure 9.3). Overall, 61% of participants supported a short-retention period (until its purpose is fulfilled/3-years/6-years). A little over a quarter of respondents (28%) preferred the long-term retention period (indefinite/100 years/until death). Participants who chose 'other' (11%) either thought the retention period should be determined by the volunteer or the profile should not be retained on the database.

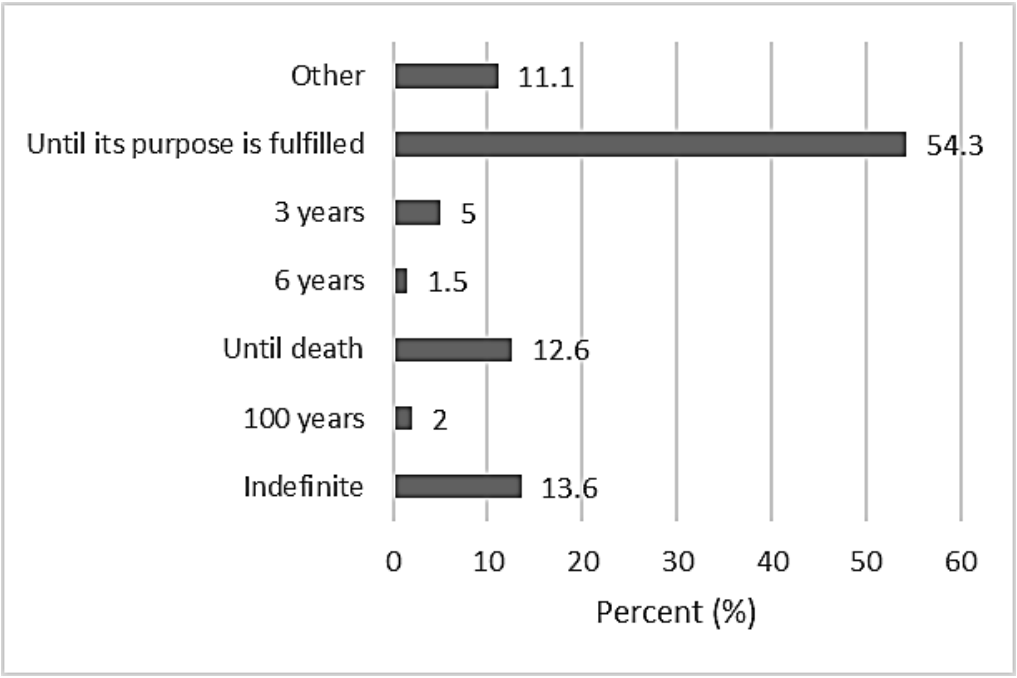

Figure 9.3 - Opinion of participants to the question 'How long should the DNA profile of volunteers be retained on the database?' (n = 199)

Table 9.6 shows the statistical analysis of social groups about the retention of volunteer DNA profiles. Generally, a majority of participants in each social group preferred a short-term profile retention period except participants with no university education who were split between long-term and short-term periods. Only age was statistically significantly associated with the perceived retention period for DNA profiles of volunteers ($p = 0.035$). Preference for the short-term (64% versus 57%) and long-term (30% versus 26%) periods was higher among young adults than middle or older adults. Conversely, young adults (6%) were less likely to select 'other' (i.e. volunteer-determined period or no retention) than middle or older adults (17%).

Table 9.6 - Opinions on retention period for DNA profiles of volunteers; by gender, age, educational level and specialisation

Demographic characteristics		Retention period			*Fisher's Exact test or $\chi^2(df)$*	*p-value*
		Long-term	Short-term	Other		
Gender	Male *(n=76)*	27.6%	56.6%	15.8%	2.865 (2)	0.239
	Female *(n=123)*	28.5%	63.4%	8.1%		
Age	18-34 *(n=106)*	30.2%	64.2%	5.7%	6.727 (2)	0.035
	≥ 35 *(n=93)*	25.8%	57.0%	17.2%		
Educational level	< University degree *(n=16)*	43.8%	43.8%	12.5%	4.178	0.371
	University degree *(n=52)*	32.7%	59.6%	7.7%		
	PhD/master's or equivalent *(n=131)*	24.4%	63.4%	12.2%		
Specialisation	Business, Humanities & Social Sciences (BHSS) *(n=58)*	24.1%	60.3%	15.5%	4.743 (4)	0.315
	Law, Criminology & Security (LCS) *(n=42)*	26.2%	59.5%	14.3%		
	Natural, Formal & Applied Sciences (NFAS) *(n=64)*	32.8%	62.5%	4.7%		

9.1.3 Reasons for voluntary participation in the National DNA Database

The quantitative results showed that most respondents are likely to participate in the database if their DNA profile can assist the police. The qualitative responses revealed some of the reasoning of participants. The key themes from the 40 comments (20%) were the usefulness of DNA information and consideration of civil liberties.

Participants who subscribed to the usefulness of DNA information reasoned that their DNA could establish their innocence, eliminate them from an inquiry, and assist police investigations: 'I sometimes hear of cases where groups of people are asked to volunteer to solve a particularly horrific crime where the police are struggling for leads. I think I'd agree, but I'm not sure I'd want it retained' (PSR142). Some justified their position by drawing on the concept of 'nothing to hide, nothing to fear': 'I have nothing to hide! As crass as it sounds I think this is the crux of it all' (PSR114). Others based their reasoning on the principle of solidarity and their experience of the criminal justice system:

> I would consent to my DNA being stored on any database. It doesn't do me any harm whatsoever, and if I became a victim of crime it could help me. If I committed a crime it could help those victims. (PSR29)

> I used to work as a CSI for the UK police so understand the value of DNA in investigations. (PSR42)

Some of the above respondents provided additional conditions for voluntary participation in the database. These were the destruction of records after fulfilling its purpose, one-time search of the NDNAD, and use of records in only serious offences.

Respect for civil liberties was the predominant reason for participants who would be reluctant or refuse to participate in the NDNAD voluntarily. The specific concerns were distrust of authorities, the usefulness of databases, the abuse of power, function creep, data security, autonomy, personal freedom and proportionality. Some of these participants linked their reasoning to their experience in the criminal justice system:

> I work in the field of forensic DNA and genetics, and I appreciate the problems around the information and technology. I should be definitely in favour of such a database, but other technologies are misused to such an extent that I don't think we should be using DNA in the same way, given the vastly increased amount of personal information stored in DNA. (PSR12)

Some participants who expressed strong restrictive views thought the use of DNA should be limited to research in population genetics and diseases. However, such databases should be based on the ethical principles of medical research:

> I am interested in the outcomes of mapping heredity, transmission and resistance to disease etc. But databases around these can be ran on a voluntary basis, openly and democratically and people can opt out at their discretion. (PSR89)

Regarding the length of volunteer sample and profile retention, there were 21 (10.4%) and 27 (13.4%)) comments respectively. Two main themes emerged from the qualitative responses: usefulness of sample/profile retention and civil liberties. Some participants who inclined to the former reasoned that long-term retention of DNA samples/profiles from volunteers can assist the police ‘to catch criminals’ (PSR96) or help the police resolve cases. However, others thought it is unnecessary to retain samples/profiles after the purpose for which they were taken has been fulfilled. To one participant, this regime ‘will encourage volunteers to help with elimination’ (PSR114). A few participants thought only the DNA profile is useful (profile adequacy), hence the sample should be destroyed after profiling:

> If there is nothing riding on the accuracy of the profile, then it doesn't need to be stored beyond the profile's generation. Plus, I assume that a volunteer would be willing to submit a sample again, barring any significant change in circumstances. (PSR26)

In contrast to the above, participants who placed emphasis on civil liberties posited that volunteers are not criminals and hence should be treated with higher protection than offenders. These participants favoured a short-term sample/profile retention period. The specific protections recommended were participation by informed consent; withdrawal of consent and destruction of records at any point in time; restriction of the use of data to cases beneficial to the individual or the specific purpose for which it was taken; and autonomy of volunteers to specify retention periods:

> [T]he DNA of volunteers should be treated with greater care than that of those on the criminal database as they haven't been accused or have committed any crime so their rights require greater protection as they pose no particular threat to the public. (PSR70)

9.1.4 Other comments on DNA retention

Some participants *(n = 42; 21%)* provided additional comments on their concerns about forensic DNA retention and DNA analysis in general. The predominant themes were civil liberties, the effectiveness of DNA and the implementation efficiency/cost of retention regimes.

Most participants were concerned about civil liberties. The issues raised were the privacy of genetic data, misuse of genetic records or unknown uses of personal data, informed consent, function creep, distrust of authorities, the likelihood of wrong arrests and charges, and overreliance on DNA. Some felt there should be adequate assurance of the protection of data to encourage voluntary participation. In relation to this concern, a few participants criticised the inconsistent interpretation of consent by authorities:

> At present, there is an almost sanctioned policy of taking samples before people are charged under the pretext of this being by consent. In my experience, this does not happen, and samples should not be taken until after charge. (PSR13)

> Previous evidence shows the government misinterprets consent to suit their needs. The potential for misuse is too great (PSR37).

In contrast to the comments above, some participants reiterated their support for DNA profiling or databasing on grounds of enhancing public security: ‘I support DNA profiling. I think it’s the biggest investigative tool in the 20/21st century and it keeps developing’ (PSR114). Those who favoured a more expansive database reasoned that ‘innocent people have nothing to fear’ (PSR96). Others considered that the usefulness of DNA is contextual

and subject to appropriate interpretation. Hence, the retention and use of DNA should be 'necessary and not just in case' (PSR170).

Lastly, a few participants thought the administrative aspects of DNA retention is inefficient and expensive. There were concerns about discretionary retention practices, availability of resources and compliance. It was thought that aspects of data retention that require police discretion should be independently assessed and recorded. The concerns about the implementation efficiency/cost of DNA databasing was expressed by one participant in the following terms: 'My main concern is whether for resource reasons (esp. with fiscal austerity), police organisation/culture and the historically unreliable PNR systems, the statutory retention regime is fully complied with' (PSR33).

9.1.5 Summary of results

In summary, the quantitative results showed that the predominant condition for voluntary participation in the database is the usefulness of the volunteer's data in case resolution. There was strong support for the short-term retention of samples and profiles from volunteers, with a majority favouring retention until the purpose for which the DNA (and derived data) was taken is fulfilled. The preference for a particular retention period was influenced by reasons of civil liberties, usefulness/effectiveness of DNA sample/profile retention, DNA profile adequacy, and concepts of punishment and rehabilitation. Participants also highlighted concerns about the implementation efficiency or cost of DNA databasing.

9.2 Discussion and conclusion

This study found that the main condition that could influence the public to voluntarily participate in the NDNAD is the value of their own DNA records in helping the police solve crime. This reason was noted by some participants in the qualitative responses and has been cited in studies about voluntary participation in national DNA databases.[945] It has been observed that some members of the public may neutralise the risks of DNA databases (infringement of civil liberties) by appealing to moral concepts of solidarity, altruism, and

[945] Curtis, 'Public Perceptions and Expectations of the Forensic Use of DNA' (n 642); Machado and Silva, 'Voluntary Participation in Forensic DNA Databases' (n 676); Curtis, 'Public Understandings of the Forensic Use of DNA' (n 642).

utilitarianism.[946] The results suggest that an awareness of the direct contribution of DNA data may encourage voluntary participation in the NDNAD.

It was observed that conditions of status, such as a victim or witness of crime or creation of a separate volunteer's database may be limited in encouraging voluntary participation in the NDNAD. This means the inclusion of volunteer data in the NDNAD as a routine or administrative process is unsupported. One of the main reasons for including DNA data of victims and witnesses in the NDNAD is to facilitate their elimination from a criminal inquiry. However, this type of elimination can be carried out without entry of the data in the NDNAD. The crime scene profile from the relevant crime for which they have been sampled can be directly compared to their reference profile. This may be a possible explanation for the refusal or reluctance to voluntarily participate in the database on these grounds. Other possible reasons, as cited in the free-text responses, may be issues of civil liberties, distrust of authorities and the conceptualisation of the database as a criminal database and a means of punishment.[947]

The establishment of separate elimination databases has been either proposed or implemented for law enforcement officers or individuals involved in the chain of custody of biological samples from crime scenes in many countries. As stated earlier, the PED and CED serve this purpose in England and Wales. Inclusion in these types of databases may be voluntary and/or anonymous, and the database may be speculatively searched. Whilst the available evidence show some acceptance of such databases, there has been resistance to participation among crime scene workers (CSWs) based on civil liberty reasons.[948] In a Canadian study, it was observed that participation in elimination databases increased when CSWs were introduced to the benefits of inclusion in such a database – preventing specious investigative leads.[949] Whilst elimination databases may be justified for CSWs and other officers who are frequently involved in the chain of custody of evidence, this may not be appropriate for the general public. This is because a hit in a civilian elimination database may lead to a risk of surveillance and arrest. Further such databases may be subject to familial searching. These factors may explain the reasons why a separate volunteer's database may not encourage voluntary participation. Overall, the results in this present study

[946] Machado and Silva, 'Voluntary Participation in Forensic DNA Databases' (n 676).
[947] Curtis, 'Public Understandings of the Forensic Use of DNA' (n 642); Machado and Silva, 'Voluntary Participation in Forensic DNA Databases' (n 676).
[948] Lapointe and others (n 395).
[949] Lapointe and others (n 395).

suggest that the major factor to encourage individuals to voluntarily partake in the NDNAD is the potential contribution of the volunteer's data to crime resolution. This implies a requirement for authorities to establish how the DNA records of a specific volunteer can contribute to police investigations prior to sampling and inclusion. Further to this evidence, a system could be initiated to alert volunteers about how their DNA records assisted law enforcement officers to resolve crime. This may be done through text messages or email.

The specialisation of participants was significantly associated with the voluntary participation in the NDNAD if one is a victim of crime. The participants who specialised in the fields of natural, formal and applied sciences were more likely to answer 'yes', suggesting a more permissive view than those specialising in law, criminology and security or business, humanities and social sciences. The literature indicates scientists may be more optimistic of the potential of databases than professionals working in law enforcement.[950] This view may be drawn from a more theoretical perspective about the benefits of science including the value of DNA. Comparatively, it is thought that criminal justice professionals may be influenced by a more practical 'forensic-effect' compared to other members of the public.[951] This exposure suggests a high awareness of both the positives and negatives of DNA, informing a more moderate view among this group. Regarding participants specialising in business, humanities and social sciences, their views may be influenced by a high appreciation of civil liberties and less knowledge about the benefits of science and technology. However, there is a need for further research to explore this hypothesis.

A majority of participants in this study thought volunteer samples and profiles should be retained for a short period of time, mainly until the sampling purpose is achieved. This suggests a wide acceptance of the current law on the retention of DNA records from volunteers. The age range of participants was found to be significantly associated with views on retention periods for DNA profiles from volunteers. Middle or older adults were less likely to favour the retention of DNA data from volunteers. This appears to support the literature about the relatively more permissive view of young adults about biometric data.[952]

In summary, the results of the public survey about voluntary participation in the NDNAD is in agreement with the PoFA regime. However, the data showed that clarity on the value of

[950] Machado and Silva, 'Public Perspectives on Risks and Benefits of Forensic DNA Databases' (n 659).
[951] Machado and Silva, 'Public Perspectives on Risks and Benefits of Forensic DNA Databases' (n 659).
[952] Machado and Silva, '"Would You Accept Having Your DNA Profile Inserted in the National Forensic DNA Database?' (n 676).

volunteer's data to crime resolution may encourage participation in the NDNAD. The value of volunteer DNA databases has become popular in the advent of private genealogy databases which use DNA records to build the family tree of individuals.[953] These have been used by law enforcement officers to help resolve some serious cold cases, such as the Golden State Killer case in the United States.[954] Issues of privacy with such databases have prompted the development of policies that favour privacy-by-design and informed consent.[955] Whilst this policy has led to the exclusion or unavailability of this non-criminal justice data for law enforcement purposes, some individuals have voluntarily opted-in.[956] This trend may be influenced by the emphasis of the benefits or value of such data in the media. However, it is not clear whether the overall contribution of such data is significant to the resolution of all DNA-related crime and whether such databases present any practical risks to the individual and their biological relatives (such as unwanted surveillance, investigation, and potential criminalisation of a family).[957] In some cases where private genealogy databases have been used, it has been observed that these cases could have been solved using familial searching in a database of convicted individuals.[958] This is because the identified suspects already had biological relatives with conviction records. An understanding of the necessity of volunteers' databases and their actual advantages and disadvantages may inform the public about whether to voluntarily participate or not participate in such databases.

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[953] Debbie Kennett, 'Using Genetic Genealogy Databases in Missing Persons Cases and to Develop Suspect Leads in Violent Crimes' (2019) 301 Forensic Science International 107.
[954] BBC News, 'US Suspect Traced Using Genealogy Sites' *BBC News* (27 April 2018) <https://www.bbc.com/news/world-us-canada-43916830> accessed 25 July 2018.
[955] Seth Augenstein, 'GEDmatch Changes Are "Blow" to Law Enforcement – and Forensic Genealogy' (*Forensic Magazine*, 20 May 2019) <https://www.forensicmag.com/news/2019/05/gedmatch-changes-blow-law-enforcement-and-forensic-genealogy> accessed 7 June 2019.
[956] Seth Augenstein, 'GEDmatch Update: Genealogy Database "Opt-in" Numbers Climb' (*Forensic Magazine*, 30 May 2019) <https://www.forensicmag.com/news/2019/05/gedmatch-update-genealogy-database-opt-numbers-climb> accessed 7 June 2019.
[957] Granja and Machado (n 656).
[958] Kennett (n 953).

Chapter 10: Effectiveness of DNA retention regimes: stakeholder views

10.1 Introduction

The fourth aim of this research was to understand the views of primary stakeholders ('experts') about the effectiveness of the different retentions regimes for the NDNAD. Seven effectiveness criteria were identified from the literature review, which served as a basis for the development of an online questionnaire. This was piloted and sent to 109 identified NDNAD stakeholder bodies/organisations involved in the collection and processing of DNA samples, use of the NDNAD, oversight and operation of the NDNAD, and those with a special interest in the operation/use of the NDNAD in England and Wales. The study was conducted following approval by the Northumbria Faculty of Business and Law Ethics Committee (Appendix XIV). This chapter is organised as follows. Section 10.2 details the survey methodology for this project. The results of the stakeholder survey are presented in section 10.3. The implications of the findings are discussed and summarized in sections 10.4 and 10.5, respectively. The original contribution of this chapter is the identification of the regime considered as the most effective among stakeholders. Further, the chapter provides insights into the justifications of members of the expert group and how the NDNAD regime may be improved.

10.2 Methodology

The details of the survey methodology, including its advantages and challenges, are covered in Chapter 5. In this project, a survey questionnaire was developed and emailed to the NDNAD stakeholder organisations/bodies/individuals between November 2017 and July 2018. The stakeholder agencies/groups were invited to circulate the link to the online questionnaire among staff, members or employees. The NDNAD stakeholders included in the study were the 43 Police Forces in England and Wales; the British Transport Police (BTP); 3 FSPs; 3 managers and oversight bodies of the NDNAD; and 59 relevant criminal justice institutions, policymakers and forensic genetics and human rights agencies. A copy of the questionnaire, organization and participant consent forms are provided in Appendix VI, VII and VIII, respectively. Organizations and respondents were required to sign the consent forms before participating in the study. Information collected from the survey respondents were anonymised.

10.2.1 Survey design

10.2.1.1 Questionnaire design

After establishing the aims and objectives of this project, a review of the literature identified seven effectiveness criteria for assessing the efficacy of forensic DNA data retention regimes:

(1) the crime-solving capacity of the DNA database,
(2) incapacitation effect the database,
(3) deterrence effect of DNA data retention,
(4) protection of genetic privacy of individuals,
(5) proportionality of the retention regime,
(6) the time, resources and effort required to implement the retention regime (implementation efficiency), and
(7) the cost of implementation or cost-effectiveness.[959]

The seven effectiveness criteria informed the set of questions considered in the survey. These included a combination of open-ended and closed-ended questions using Likert scales, checkbox (CBQ), and MCQ questions. Twenty questions related to the effectiveness criteria were initially generated for inclusion in the survey instrument. To refine these questions, in-depth discussions were held with the researcher's supervision team, law and forensic science academics, law enforcement policy professionals and potential respondents were also consulted to streamline the set of questions for the survey.

The first section of the final questionnaire consisted of a short introduction of the effectiveness criteria being assessed and the different retention regimes governing the England and Wales NDNAD. The second section covered questions related to the general demographic information of participants including gender, age range, and employment information. These set of simple and easy to answer questions were included at the beginning to put respondents at ease before responding to the main questions.[960] Questions related to all seven effectiveness criteria were captured in the subsequent sections of the questionnaire.

[959] Bieber (n 89); Nuffield Council on Bioethics (n 45); *S and Marper v The United Kingdom* (n 44); Gabriel, Boland and Holt (n 12); Wallace (n 591); MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80); McCartney, 'Of Weighty Reasons and Indiscriminate Blankets' (n 44); McCartney, Wilson and Williams (n 44); Wallace and others (n 107).
[960] Murray (n 797); Oppenheim (n 809).

The primary aim of the questionnaire was to gather the perspectives of stakeholders on the efficacy of the NDNAD retention regimes, focussing on their effectiveness rating of the regimes based on the seven criteria. The questionnaire also sought the views of respondents on ways the retention regime for the NDNAD could be improved. The attached introductory letter explained the focus of the survey (see Appendix VI). The standard type of questions asked were Likert scales and closed questions. To ensure flexibility in the responses, an 'other' or free-text option was included as part of the fixed question options. Like the public survey instrument, the Likert scale options were word-labelled to ensure that the ratings are reliable.[961] The last section of the questionnaire included a ranking question which was aimed at assessing the level of importance of the seven effectiveness criteria. Finally, open-ended questions were provided to allow respondents to comment on the implementation efficiency of the PoFA regime, any additional effectiveness criterion that was not measured or provide any other general comments.

10.2.1.2 Pre-test and pilot study

A pre-test of the stakeholder questionnaire was conducted among potential respondents, academics and researchers at the Northumbria University School of Law and Centre for Forensic Science. The purpose was to assess the clarity, layout, comprehensibility and validity of the questionnaire. Items that were difficult to understand or answer by respondents, such as the meaning of the effectiveness criteria, were reworded or explained and retested. The form of data and reliability of the questionnaire was assessed in a pilot test among attendees of the ESRC Research Seminar series on genetics, technology, security and justice. These include forensic genetics academics, forensic scientists, criminal justice officials and forensic biometrics policymakers. The assessment criteria/questions considered by participants in the pre-test and pilot test of the instrument is provided in Appendix IX. The questionnaire assessment form measured how long it takes to complete the survey questionnaire, and the rating of the level of appropriateness of the instrument in terms of length, layout, content and design. Participants were also asked to indicate the level of difficulty in completing the survey questionnaire. Open-ended questions were provided for participants to suggest improvements to the survey instrument or comment on any items that are ambiguous or difficult to understand. The feedback from the pre-test and pilot study

[961] Fowler and Cosenza (n 787).

were analysed to identify any issues with the form of data, reliability and validity. This resulted in minor changes to the questionnaire.

10.2.1.3 Survey implementation

The final self-administered questionnaire was designed and administered using the Online Surveys software. A cover letter was emailed to 109 NDNAD stakeholder organisations/agencies with the link to the online survey. The introductory email asked the agencies to forward the survey to their staff mailing list inviting them to participate in the study. Agencies that replied to the email requested that the responses of employees should be treated as individual responses and should not be associated with the organisation. Others replied that staff or members of the agency or organisation should be contacted directly in their individual capacity. Due to this challenge, organisational consent forms were not signed. However, all individual respondents were required to sign the participant consent form before completing the questionnaire.

Participants were required to rate each retention regime based on the seven effectiveness criteria. They were also asked to suggest ways of improving the retention regime for the NDNAD. Initially, a rough estimate of the average number of participants per organization/agency was 5, resulting in an expected total population size of 540 respondents. A nonprobability sampling was chosen because of difficulty in estimating the exact number of the target population. This is due to unavailability of a reliable sampling frame. However, the inclusion of all the relevant stakeholder organizations was to ensure that the data is representative of the population. The respondent progress report for the stakeholder survey is shown in Appendix X. This shows that the survey was accessed 384 times (this may include multiple clicks by an individual). Thirty-one complete responses were received at the end of the stakeholder survey. The low sample size may be due to the reluctance of organisations/bodies to be associated with the study. This means that the results of the survey cannot be generalised. However, descriptive analysis of the data could provide useful information for further research about the views of stakeholders on the effectiveness of the NDNAD retention regimes. The findings also complement the results of the public survey in creating a more balanced picture on DNA databasing. This is significant because the study is the first to quantitatively assess perceived effectiveness of NDNAD retention regimes

among this expert group, building on previous qualitative studies/reviews on this specific subject.[962]

10.2.2 Survey data analysis

The IBM SPSS statistical software version 24 was used to analyse the responses from the survey. The Shapiro-Wilk test[963] was used to assess whether the distribution of the dataset was normal or not. A non-normal distribution confirms the appropriateness of non-parametric statistics which makes no distributional assumptions that require parameters, such as, the mean and standard deviation.[964] The non-parametric Friedman test or Friedman ANOVA[965] was used in assessing the differences in the rating of the effectiveness of the three different retention regimes. The Friedman test was used because the dependent variable was measured using Likert scales (i.e. ordinal data). Further, the rating of the three regimes was carried out by the same group of participants.[966] The qualitative or free-text responses were analysed with the aid of the NVivo software which aids in the organisation and coding of qualitative data.[967]

10.3 Results

10.3.1 Characteristics of respondents

Out of the 31 respondents to the stakeholder questionnaire, a majority (68%) were law enforcement experts, 16% were forensic science specialists, 13% specialised in law and legislation, and 3% specialised in medicine (Table 10.1). Most participants (94%) were in their middle ages or older (35 to ≥ 65 years) and there were more males (74%) than females (26%). The total years of experience of most respondents (90%) was more than 10 years, indicating that most respondents were working within the criminal justice system prior to the *Marper* ruling in 2008.

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[962] Williams and Johnson, '"Wonderment and Dread"' (n 646); Home Office, *Keeping the Right People on the DNA Database: Summary of Responses* (n 653).
[963] Andy Field, *Discovering Statistics Using IBM SPSS* (4th edn, SAGE Publications, Ltd 2013).
[964] Lucy (n 812); Craig Adam, *Essential Mathematics and Statistics for Forensic Science* (Wiley-Blackwell 2010).
[965] Field (n 963).
[966] Field (n 963).
[967] Bryman (n 312) 601-617.

Table 10.1 - Characteristics of respondents to the NDNAD stakeholder survey (n = 31)

Characteristic		Number	Percent (%)
Gender	Male	23	74.2
	Female	8	25.8
Age (years)	25-34	2	6.5
	35-44	11	35.5
	45-54	9	29
	55-64	6	19.4
	≥65	3	9.7
Specialisation	Law enforcement	21	67.7
	Forensic science	5	16.1
	Law/Legislation/Minister	4	12.9
	Medicine	1	3.2
Experience (years)	1-10	3	9.7
	11-20	14	45.2
	21-30	10	32.3
	31-40	4	12.9

10.3.2 Level of importance of the seven effectiveness criteria

The survey tested seven effectiveness criteria derived from the literature review. Using a 7-point scale (*1 = low importance; 7 = extremely important*), the respondents were asked to rate the level of importance of each criterion. Figure 10.1 presents a box plot of the ratings of the study participants. Overall, most respondents rated each criterion to be important. However, crime-solving capacity was rated as an extremely important criterion (median score of 7) in assessing the effectiveness of retention regimes. The median scores for the other criteria were 5 for incapacitation effect, deterrence effect and proportionality; 4.5 for implementation efficiency and implementation cost; and 4 for protection of genetic privacy.

Five respondents provided additional comments to the open-ended question about other criteria to measure in assessing the effectiveness of DNA retention regimes. The free-text responses were coded with the aid of NVivo and five general themes emerged: effectiveness of the Scottish Model; the impact of technological advancements; efficiency of investigations; impact of the level of crime; and efficiency of legal checks of DNA hits. These themes are discussed in section 10.4.

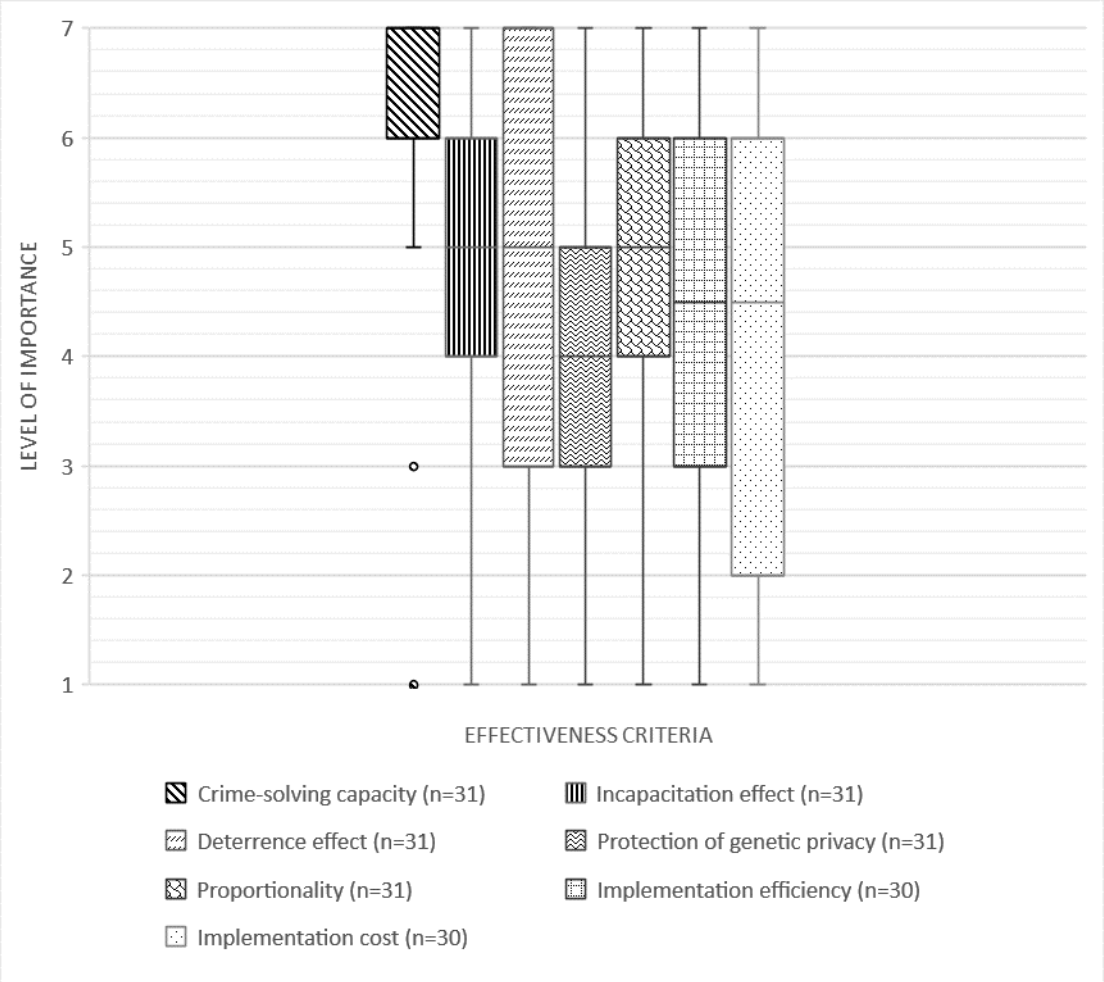

Figure 10.1 - Box plot of participant responses to the question 'How would you rate the level of importance of the seven effectiveness criteria?' (1 = low importance; 7 = extremely important).

10.3.3 Crime-solving capacity

A majority (94%) of the 31 respondents thought that the expansive regime is the most effective regime for solving crime. The data for the level of effectiveness of the retention regimes were first tested for normality using the Shapiro-Wilk test. The data was found to be non-normal ($p < 0.05; \alpha = 0.05$) hence confirming the need for non-parametric testing using the Friedman test. There was a statistically significant difference in the perceived level of effectiveness of the three retention regimes, $\chi^2 (2) = 39.851, p < 0.001$. The Wilcoxon signed-rank test was carried out in a post hoc analysis with a Bonferroni correction (p set at < 0.017).[968] As shown in Table 10.2, the expansive regime was rated to be of much higher effectiveness than either the restrictive ($Z = -4.419; p < 0.001$) or semi-restrictive regimes ($Z = -4.500; p < 0.001$). Among the participants, a DNA database regulated by an expansive

[968] Field (n 963).

regime regarded as extremely effective in solving crime, with an average score of 4.5 on a 5-point Likert scale. The average score for both the restrictive and the semi-restrictive regimes was 3 and there was no significant difference in the rating of these two regimes ($Z = -1.418$; $p = 0.156$).

Table 10.2 - Average level of effectiveness of the retention regimes by crime-solving capacity (1 = Not at all effective; 5 = extremely effective)

Retention regime	Level of effectiveness *(Median (IQR))*
Restrictive *(n = 30)* *	3 (2-3)
Expansive *(n = 30)*	4.5 (4-5)
Semi-restrictive *(n = 30)*	3 (3-4)

**The total number of participants was 31. One participant was excluded because the ratings of the two other regimes were not completed.*

When asked about what could improve the crime-solving capacity of the database, most respondents (*84%, n = 26*) favoured indefinite or long-term (100 years/until death) retention of DNA samples and/or profiles of arrestees (Table 10.3). One respondent selected 'other' and suggested 'unrestricted retention of DNA material. Ideally taken at birth and linked to biometric identification record' (R2/FS).

Table 10.3 - Opinions regarding what could improve the crime-solving capacity of the NDNAD

Option	Number (%)
Indefinite retention of all arrestee DNA samples and profiles	9 (29)
Indefinite retention of all arrestee DNA profiles	3 (9.7)
100 years retention of all arrestee DNA samples and profiles	8 (25.8)
Retention of DNA samples and profiles until death of arrestee	4 (12.9)
Retention of DNA profiles until death of arrestee	2 (6.5)
6 years' retention of all unconvicted people's DNA profiles	3 (9.7)
3 years' retention of all unconvicted people's DNA profiles	1 (3.2)
Other	1 (3.2)
Total	**31 (100)**

10.3.4 Incapacitation effect

Most respondents (90%) thought that a DNA database governed by an expansive regime has the most effective incapacitation effect. Two respondents (7%) chose the restrictive regime whilst one respondent (3%) chose the semi-restrictive regime. The Friedman test was carried out on the data for the level of effectiveness of the incapacitation effect following the Shapiro

Wilk test for normality. The data was found to be non-normally distributed ($p < 0.05; \alpha = 0.05$). The Friedman test showed a statistically significant difference in the level of perceived effectiveness of the incapacitation effect of the different regimes, $\chi^2(2) = 36.072, p < 0.001$. Table 10.4 shows the median (IQR) perceived level of effectiveness for the different retention regimes. On a 5-point scale, the median scores of the regimes were 4 for the expansive regime and 3 for both the restrictive and semi-restrictive regimes.

Like the results for crime-solving capacity, the expansive regime rated significantly higher than both the restrictive ($Z = -3.892; p < 0.001$) and semi-restrictive ($Z = -3.629; p < 0.001$) regimes following the Wilcoxon signed-rank test with a Bonferroni correction ($p < 0.017$). Although the median scores for the restrictive and semi-restrictive were the same, there was a significant variation ($Z = -2.840; p = 0.005$). The IQR shows that ~25% of the ratings for the semi-restrictive regime was lower than a score of 3 whilst ~25% for the restrictive regime was lower than 2. On average, the expansive regime was perceived to have a very effective incapacitation effect whilst the other two regimes were thought to be moderately effective.

Table 10.4 - Average level of effectiveness of the retention regimes by incapacitation effect (1 = Not at all effective; 5 = extremely effective)

Retention regime	**Level of effectiveness** *(Median (IQR))*
Restrictive *(n = 31)*	3 (2-3)
Expansive *(n = 31)*	4 (3-5)
Semi-restrictive *(n = 31)*	3 (3-4)

Table 10.5 presents the response to the question about what will improve the incapacitation effect of the NDNAD. A similar trend of responses as the crime-solving capacity was observed. A majority of respondents (*84%, n = 26*) favoured the long-term or indefinite retention of DNA samples and/or profiles of all arrestees. One respondent favoured DNA databasing from birth (R2/FS).

Table 10.5 - Opinions regarding what could improve the incapacitation effect of the NDNAD

Option	Number (%)
Indefinite retention of all arrestee DNA samples and profiles	10 (32.3)
Indefinite retention of all arrestee DNA profiles	2 (6.5)
100 years retention of all arrestee DNA samples and profiles	8 (25.8)
Retention of DNA samples and profiles until death of arrestee	4 (12.9)
Retention of DNA profiles until death of arrestee	2 (6.5)
6 years' retention of all unconvicted people's DNA profiles	3 (9.7)
3 years' retention of all unconvicted people's DNA profiles	1 (3.2)
Other	1 (3.2)
Total	**31 (100)**

10.3.5 Deterrence effect

A majority of respondents (90%) chose the expansive regime as the regime with the most effective deterrence effect. Two respondents (7%) chose the restrictive regime and one respondent (3%) chose the semi-restrictive regime. The data for the level of effectiveness of the deterrent effect of the different regimes were found to be non-normal using the Shapiro-Wilk test ($p < 0.05; \alpha = 0.05$). On a 5-point scale, the average scores for the restrictive, expansive and semi-restrictive regimes were 2, 3.5 and 3, respectively. The median (IQR) ratings of the different regimes are shown in Table 10.6. The Friedman test showed a statistically significant difference in the rating of the different retention regimes ($\chi^2 (2) = 23.754; p < 0.001$). Post hoc analysis using the Wilcoxon signed-rank test with a Bonferroni correction ($p < 0.017$) showed that the expansive regime performed better than the restrictive ($Z = - 3.461; p = 0.001$) and semi-restrictive regimes ($Z = -3.727; p < 0.001$). There was no statistically significant difference between the restrictive and semi-restrictive regimes ($Z = -0.774; p = 0.439$).

Table 10.6 - Average level of effectiveness of the retention regimes by deterrent effect (1 = Not at all effective; 5 = extremely effective)

Retention regime	Level of effectiveness *(Median (IQR))*
Restrictive *(n = 30)**	2 (2-3)
Expansive *(n = 30)**	3.5 (2-4.25)
Semi-restrictive *(n = 30)*	3 (2-3)

**The total number of participants was 31. One participant was excluded because the ratings of the regimes were not completed.*

Respondents were also asked about what could improve the deterrence effect of the NDNAD. Table 10.7 shows the distribution of responses amongst the study population. A majority of respondents expressed expansive views to enhance the deterrence effect of the NDNAD. Fourteen participants (45%) favoured indefinite or long-term retention of DNA samples and/or profiles of all arrestees. More than a quarter of respondents (32%) suggested indefinite retention of DNA samples and/or profiles of all citizens. Three respondents (10%) selected a retention period of 6 years for DNA profiles of all unconvicted individuals. The free-text response by four participants (13%) who selected 'other' was coded using NVivo and two main themes emerged: support for DNA databasing from birth and lack of evidence to demonstrate the deterrent effect of DNA. These themes are discussed in section 10.4.

Table 10.7 - Opinions regarding what could improve the deterrence effect of the NDNAD

Option	Number (%)
Indefinite retention of DNA samples and profiles of all citizens	9 (29)
Indefinite retention of DNA profiles of all citizens	1 (3.2)
Indefinite retention of all arrestee DNA samples and profiles	2 (6.5)
Indefinite retention of all arrestee DNA profiles	1 (3.2)
100 years retention of all arrestee DNA samples and profiles	5 (16.1)
Retention of DNA samples and profiles until death of arrestee	4 (12.9)
Retention of DNA profiles until death of arrestee	2 (6.5)
6 years' retention of all unconvicted people's DNA profiles	3 (9.7)
Other	4 (12.9)
Total	**31 (100)**

10.3.6 Proportionality

In addition to the rating of the public security functions of the DNA database, participants were asked to rate the level of proportionality of the three retention regimes (Table 10.8). There were 30 complete responses to this question out of the 31 respondents. The Shapiro-Wilk test showed that the data was not normally distributed ($p < 0.05; \alpha = 0.05$). The median (IQR) for the different retention regimes is shown in Table 10.8. The median scores on a 5-point scale were 4 for the restrictive regime, 2 for the expansive regime and 4 for the semi-restrictive regime. There was a statistically significant difference in the rating of the level of proportionality of the regimes using the Friedman test ($\chi^2 (2) = 35.320; p < 0.001$). Following the Wilcoxon signed-rank test with a Bonferroni correction ($p < 0.017$), the rating of both the restrictive and semi-restrictive regimes differed significantly with the expansive

regime. On average, the expansive regime was rated to be slightly skewed toward public interest whilst the restrictive and semi-restrictive were perceived to be slightly skewed toward individual interest.

Table 10.8 - Average level of proportionality of the retention regimes (1 = extremely skewed toward public interest; 5 = extremely skewed toward individual interest)

Retention regime	**Level of proportionality** *(Median (IQR)*
Restrictive *(n = 30)*	4 (3-5)
Expansive *(n = 30)**	2 (1-3)
Semi-restrictive *(n = 30)**	4 (3-4)

**The total number of participants was 31. One participant was excluded because the rating of one regime was not completed.*

10.3.7 Implementation efficiency

This criterion measured the level of the perceived difficulty in the implementation of the different retention regimes. There were 30 complete responses to this question. The test for normality showed that the data was not normally distributed, requiring nonparametric statistics (Shapiro-Wilk test: $p < 0.05; \alpha = 0.05$). Table 10.9 presents the median (IQR) rating of the different regimes. The average scores on a 5-point scale were: 3 for restrictive regime, 2 for expansive regime and 3 for semi-restrictive. The Friedman test showed a statistically significant difference in the ratings of perceived difficulty in implementation ($\chi^2 (2) = 15.728; p < 0.001$). Pairwise comparisons were performed using the Wilcoxon signed-rank test with a Bonferroni correction ($p < 0.017$). This revealed that the expansive regime was perceived to be easier to implement than the semi-restrictive regime ($Z = -3.095; p = 0.002$). There was no statistically significant difference in the rating of the expansive versus the restrictive regime ($Z = -2.224; p = 0.026$) or the semi-restrictive versus the restrictive ($Z = -1.822; p = 0.068$).

Table 10.9 - Average level of difficulty with the implementation of the retention regimes (1 = very easy; 5 = very difficult)

Retention regime	**Difficulty** *(Median (IQR))*
Restrictive *(n = 30)*	3 (2-4)
Expansive *(n = 30)*	2 (1-3)
Semi-restrictive *(n = 30)*	3 (2.75-4)

Six out of the 30 respondents to this question provided further comments on the implementation efficiency of the current semi-restrictive (PoFA) regime. These were coded in NVivo and the main themes were: labour-intensive and time-consuming processes and procedures; questioned proportionality; understanding of the legislation; and complexity. Section 10.4 covers the discussion of these themes.

10.3.8 Implementation cost

The cost-effectiveness of implementing the three different retention regimes was also assessed using the questionnaire. Participants were asked to rate the retention regimes based on their perception about the level of resources and financial input required to implement the regimes. This question was answered by 29 out of the 31 respondents. The Shapiro-Wilk test showed that the data was not normally distributed ($p < 0.05; \alpha = 0.05$). Table 10.10 shows the median (IQR) for the different regimes. The median score on a 5-point scale for each regime was 3. There was a statistically significant difference in the rating of the cost-effectiveness of the regimes using the Friedman test ($\chi^2 (2) = 9.465; p = 0.009$). The Wilcoxon signed-rank test with a Bonferroni correction ($p < 0.017$) was used to carry out pairwise comparisons. There were no significant differences between the expansive and restrictive regimes ($Z = -1.947; p = 0.052$) or the semi-restrictive and restrictive regimes ($Z = -1.252; p = 0.210$). However, there was a significant difference between the semi-restrictive and expansive regimes ($Z = -2.688; p = 0.007$). Although the median score for the different regimes was the same, the Wilcoxon signed-rank test is based on rank sums which may differ significantly. From Table 10.10, it can be observed that ~25% of the ratings for the expansive regime were below 3 whereas ~25% were below 2 for the semi-restrictive regime. This shows that the expansive regime received higher ratings than the semi-restrictive.

Table 10.10 - Average level of cost-effectiveness of the retention regimes (1 = Not cost-effective; 5 = extremely cost-effective)

Retention regime	**Cost-effectiveness** *(Median (IQR))*
Restrictive *(n = 29)*	3 (2-3.5)
Expansive *(n = 29)*	3 (3-4)
Semi-restrictive *(n = 29)*	3 (2-3)

10.3.9 Protection of genetic privacy

The protection of genetic privacy criterion had the lowest median rating (4) in terms of the level of importance. Participants were asked to select the most appropriate regime for protecting the genetic privacy of individuals. Twenty-nine out of the 31 respondents answered this question. More than half of respondents (55%) selected the restrictive regime. Six participants (21%) selected the expansive regime whilst 7 (24%) chose the semi-restrictive regime. Using a 5-point Likert scale, participants were asked to rate their level of satisfaction with the genetic privacy protection of the three regimes. All 31 participants answered this question. The median (IQR) rating is presented in Table 10.11. The data was found to be non-normal when tested with the Shapiro-Wilk test ($p < 0.05; \alpha = 0.05$). On average, each regime was rated to be satisfactory (median score of 4). The Friedman test revealed a statistically significant difference in the level of satisfaction of the three regimes ($\chi^2 (2) = 13.830; p = 0.001$). Again, post hoc analysis was conducted using the Wilcoxon signed ranks test with a Bonferroni correction ($p < 0.017$). There was no statistically significant difference between the semi-restrictive and restrictive regimes ($Z = - 1.667; p = 0.096$). However, the two other pairs of regimes were statistically significant: expansive vs. restrictive regime ($Z = -2.886; p = 0.004$); expansive vs semi-restrictive ($Z = -2.804; p = 0.005$). Whilst the median scores for the different regimes are equal, the non-parametric test used is a rank-sum test hence may reveal a significant difference in the ratings. The IQR for the different regimes shows that ~25% of the ratings were below a score of 2 for the expansive regime compared to 4 and 3 for the restrictive and semi-restrictive regimes, respectively. This indicates that most of the ratings for the restrictive and semi-restrictive regimes were higher than the expansive.

Table 10.11 - Average level of satisfaction with the genetic privacy protection of the retention regimes (1 = not at all satisfactory; 5 = very satisfactory)

Retention regime	**Satisfaction** *(Median (IQR))*
Restrictive *(n = 31)*	4 (4-4)
Expansive *(n = 31)*	4 (2-4)
Semi-restrictive *(n = 31)*	4 (3-4)

When asked what could improve the protection of genetic privacy in a multiple selection question, 10 respondents (32%) selected 'Fixed retention of profiles of all convicted individuals based on maximum sentence of offence'. Four respondents (13%) supported 'Fixed retention of profiles of all convicted individuals based on duration of actual sentence'.

For unconvicted individuals, 11 respondents (36%) chose deletion of all DNA records whilst 10 (32%) chose retention of DNA profiles based on informed consent.

Six participants (19%) provided comments on what could improve the genetic privacy protection of individuals. These responses were coded with the help of the NVivo software. The main themes identified were privacy restrictions and data security considerations, which are discussed in section 10.4.

10.3.10 Overall effectiveness

In addition to questions on the individual effectiveness criteria, participants were asked to rate the overall effectiveness of the different retention regimes. All 31 respondents answered this question. The Shapiro-Wilk test for normality showed that the data was not normally distributed ($p < 0.05; \alpha = 0.05$). The median (IQR) rating of the different retention regimes is shown in Table 10.12. The 5-point average scores were 3, 4 and 3 for the restrictive, expansive and semi-restrictive regimes, respectively. There was a statistically significant difference in the ratings using the non-parametric Friedman test ($\chi^2 (2) = 31.605; p < 0.001$). The Wilcoxon signed-rank test with a Bonferroni correction ($p < 0.017$) showed that the expansive regime was perceived to be more effective than the restrictive regime ($Z = -4.128; p < 0.001$) and the semi-restrictive regime ($Z = -4.109; p < 0.001$). There was no statistically significant difference between the restrictive and semi-restrictive regimes ($Z = -1.713; p = 0.087$). Overall, the expansive regime was rated to be very effective whilst the other two regimes were rated to be moderately effective on average.

Table 10.12 - Average level of overall effectiveness of the retention regimes (1 = not at all effective; 5 = extremely effective)

Retention regime	Effectiveness *(Median (IQR))*
Restrictive *(n = 31)*	3 (2-3)
Expansive *(n = 31)*	4 (3-5)
Semi-restrictive *(n = 31)*	3 (3-4)

Lastly, participants were asked to provide any other comments related to DNA retention. Four participants responded to this question. These responses were coded in NVivo to identify the key themes in the responses. The main codes generated were: an overemphasis on privacy; expansive DNA databasing and factors that impact on effectiveness. Section 10.4 covers the discussion of these themes.

10.4 Discussion

10.4.1 Effectiveness criteria for retention regimes

Generally, the seven effectiveness criteria were rated to be important among the primary stakeholders, considered as an expert group, confirming these as possible performance indicators for DNA retention regimes and DNA databases. The results showed that the participants placed more importance on the crime-solving capacity of the NDNAD than any other outcome. This result was expected since most participants worked in law enforcement and crime-solving is part of their primary functions. The result is also consistent with studies that suggest that criminal justice professionals may consider the crime-fighting potential of databases as a top priority.[969]

In addition to the seven effectiveness criteria, participants suggested other areas that may be important in assessing the effectiveness of retention regimes. The first was the effectiveness of the 'Scottish Model' which has not yet been tested.[970] The main difference between the PoFA regime and the Scottish Model is the retention of data from juveniles convicted of a first minor offence (minimum of 5 years plus the length of sentence versus indefinite) and unconvicted individuals arrested for a serious offence (minimum of 3 years by discretion versus automatic deletion). This shows that the Scottish Model operates by bright-line rules whilst the PoFA regime is more selective in some respects. One participant was of the view that the Scottish Model should have been adopted fully for the NDNAD. It was thought that the implementation of the PoFA regime was complicated. The ease of implementation of bright-line rules was noted in the 2015 annual report of the Biometrics Commissioner.[971] However, the benefits of the Scottish Model compared to the PoFA regime may require further exploration to determine whether it is more effective in achieving the functions of the NDNAD whilst protecting privacy. There are difficulties with the Scottish Model which are considered in section 10.4.3. The respondent's view suggests the importance of considering '*comparative regime analysis*' as part of the seven effectiveness criteria.

Another aspect of effectiveness stressed by some participants was the impact of technological advancements on the public security functions of the NDNAD. In addition to the quality of the law, factors, such as science and technology, and the criminal justice

[969] MPA Civil Liberties Panel (n 40); Machado and Silva, 'Public Perspectives on Risks and Benefits of Forensic DNA Databases' (n 659); Teodorović and others (n 122).
[970] MPA Civil Liberties Panel (n 40).
[971] MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80).

process can contribute to the actual effectiveness of DNA databases.[972] This implies that the assessment of the effectiveness of the law governing the NDNAD should control for such factors. It was thought that improvements in the sensitivity of DNA testing may have an adverse effect on DNA identifications:

> The interaction between [the] number of DNA 'identifications' produced each year to the retention regime, DNA chemistry changes and use of technology to resolve mixtures (DNAboost & statistical DNA mixture resolution). I suspect that DNA Idents may have fallen due to increased DNA chemistry sensitivity (less inhibition) leading to more mixtures and less direct DNA matches (eg introduction of DNA17 & 24). (R6/LE)

In relation to technological advancements, one participant mentioned the cost implications of carrying out profile upgrades in the NDNAD. This suggestion may be considered under the implementation cost criterion which assesses the financial inputs required to implement the retention regime. The respondent also implied the ethical cost of obtaining further DNA samples if upgrades are required. Again, this proposal may be placed under the privacy protection criterion which is concerned about the protection of individual civil liberties:

> The upgrade of samples from SGM to SGM+ to DNA17 means there are three different levels of profile held. One issue we have is, which profiles already on the system need upgrading (at an extra cost to the force). There is another issue in getting further samples where a DNA 17 is required by the Forensic Provider to do a better comparison. (R4/FS)

The third aspect of effectiveness assessment mentioned by one participant was the efficiency of police investigations. The investigation of crime involves the use of several techniques and procedures. This may or may not include DNA evidence. Several studies have attempted to assess the detection rate for crimes involving DNA and non-DNA cases.[973] Although the detection rate appears to be relatively high in DNA related cases, the findings suggest that not all DNA crimes are solved. In some cases, this may be attributed to the fact that the reference profile of the suspect is not on record. Hence, no hits are generated from the national database. One participant suggested a comparative assessment of the effectiveness of police investigations in no-hit cases:

> I would be more interested in the effectiveness and efficiency of police investigation when there is DNA evidence but no result on the database because the offender has never been put on record. I have seen hundreds of officers on a

[972] See illustration of conceptual framework in Figure 4.3.
[973] Briody, 'The Effects of DNA Evidence on Sexual Offence Cases in Court' (n 711); Briody, 'The Effects of DNA Evidence on Homicide Cases in Court' (n 711); Briody, 'The Effects of DNA Evidence on Property Offences in Court' (n 711); Roman and others (n 716).

> murder investigation having to pursue other lines of enquiry despite having the offender's DNA sample due to his lack of previous conviction. (R2/FS)

In a qualitative study with law enforcement officers, forensic professionals and political campaigners, McCartney[974] found concerns about the potential abbreviation of police investigative work due to overreliance on DNA. The suggestion above is important because it can reveal whether other police detective techniques are effective or not, and also whether DNA is actually necessary to solve a crime. This highlights a consideration of '*investigative efficiency assessments*' as part of the effectiveness criteria for retention regimes.

Other aspects of regime assessment proposed by some participants were the impact of the level of crime and the efficiency of legal checks of DNA hits. As shown in the public survey,[975] there appears to be considerable support for a discriminatory retention regime that is based on the seriousness of offences or level of crime. However, this is thought to be a potential public security risk due to the level of variation in the criminal career of individuals.[976] An analysis of the seriousness of offences as an indicator of retention in the NDNAD may help resolve this dilemma. Further, this will help determine the most appropriate composition of the NDNAD that will improve public security and privacy. The '*crime level assessment'* may be carried out by applying the seven effectiveness criteria.

The limitations of the PoFA IT configuration for the NDNAD has led to a need to check the lawfulness of DNA hits.[977] This procedure may have cost implications in the operation of the database. This point was highlighted by one participant as an issue that is worth considering in effectiveness assessments. This suggestion may be considered as part of the implementation cost criterion.

In summary, the results confirmed the seven effectiveness criteria from the literature review in the assessment of retention regimes: crime-solving capacity of the NDNAD, incapacitation effect, deterrent effect, implementation efficiency, implementation cost, proportionality and genetic privacy protection. Additional criteria deduced from the qualitative responses were comparative regime analysis and investigative efficiency assessments. The former compares the effectiveness of two simultaneous retention regimes

[974] McCartney, 'The DNA Expansion Programme and Criminal Investigation' (n 14).
[975] See Chapter 8
[976] MPA Civil Liberties Panel (n 40).
[977] See Chapter 3 for detailed analysis of the implementation of PoFA

in two or more jurisdictions. The latter compares the effectiveness of different police investigative approaches to DNA databasing.

10.4.2 Comparison of the public security impact of retention regimes

An expansive regime is a permissive legal framework that allows the inclusion of all arrestee DNA data in a database and the indefinite retention of the data. In this study, the specialist group thought a DNA database regulated by an expansive regime is more effective for the prevention and resolution of crime. This was reflected in their responses on what could improve the current retention regime. Most participants chose a long-term retention period for data from all arrestees with one participant suggesting DNA databasing from birth. For the purposes of deterring crime, about one-third of participants supported a UDNAD. The results suggest a more solid belief in the potential of DNA databasing among law enforcement professionals. The trend is consistent with the results of Teodorovic *et al*.,[978] which found a general permissive outlook among criminal justice professionals in Serbia. However, the public survey results and other studies suggest scepticism among criminal justice professionals about DNA databasing due to enhanced knowledge about its benefits and limitations.[979] This was observed in a few comments by some participants in the stakeholder survey about the deterrent effect of the NDNAD. Whilst these selected the expansive regime as the most effective, they thought repeated offenders may take greater precautions and the available evidence on recidivism cast doubts on this potential effect:

> Deterrence is a hard one to judge as no-one can ever know what the true numbers might be of people that were deterred from committing a crime simply because their DNA was on record. We see many, many repeat offenders so it wouldn't matter which regime was in place as they would still undertake their crimes. I suspect there will always be a percentage that do 'change their ways' or have a conscience and so might be deterred but I simply don't know. (R3/FS)

In light of the available literature[980] and the public survey results, there appears to be a potential ‘crime control paradox’ among criminal justice professionals where they may generally favour the expansion DNA databases ‘in theory’ but may be sceptical about its impact due to the influence of their professional experience. Further exploration of this finding is needed to understand the nature of this ‘paradox’.

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[978] Teodorović and others (n 122).
[979] Machado and Silva, ‘Public Perspectives on Risks and Benefits of Forensic DNA Databases’ (n 659).
[980] Machado and Silva, ‘What Influences Public Views on Forensic DNA Testing in the Criminal Field?’ (n 656).

10.4.3 Comparison of the implementation efficiency and cost of retention regimes

A forensic DNA database competes with other police investigative/intelligence tools on scarce resources. Hence to ensure efficiency in the delivery of a database, it is imperative to develop a system that is easy to operate and manage. The study found that the primary stakeholder group considered the expansive regime to be the easiest system to implement. Firstly, the expansive regime operates mainly via bright-line rules or blanket criteria. This may be easier to embed in automated IT systems than a system that includes case-by-case criteria or regular updates and changes. This was evident in comments about the current semi-restrictive regime where participants mentioned that it is labour-intensive, time-consuming and complex. These responses were generally consistent with comments by the Biometrics Commissioner[981] about the complexity of discretionary retention under the PoFA regime:

> It took literally months and months to meet the compliance of the current regime. We're a small force in comparison to others and it took us at least 2-3 months to do the various stages of the DNA implementation and that was deemed to be the easier of the two (fingerprints being the other) as DNA is done solely on databases. (…) [T]he on-going work involved (as obviously it adjusts every day) isn't too time-consuming, but it is all extra work that wasn't necessary on the expansive regime. (R3/FS)

> The Restrictive requires loads of man hours checking court results before samples could be submitted this also caused delays in getting the profiles onto the DNA database. The Semi-restrictive the problem is checking the retention period of the profiles. (R4/FS)

In the 2011 report of the MPA Civil Liberties Panel,[982] Gary Pugh, then Chair of the NDNAD Strategy Board, expressed concerns about administrative difficulties with the 'Scottish Model' which is similar to PoFA. In line with this observation, some participants questioned the proportionality of the PoFA regime and highlighted concerns about the management and resource demands of the current law:

> The original legislation (PoFA) was flawed needing changes. I suspect there will be future challenges on the proportionality of the legislation potentially leading to more complex management demands and cost. (R6/LE)

The document analysis (Chapter 3) identified a gap in the understanding of the current semi-restrictive regime. This was identified as part of the complexities with the PoFA regime:

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[981] MacGregor, *Annual Report 2015: Commissioner for the Retention and Use of Biometric Material* (n 80).
[982] MPA Civil Liberties Panel (n 40).

> It was about knowledge and understanding of the legislation and the expected timeframes. These need to be clear and understood right from the outset to prevent any failings in practice (RS7/LE).

Clearly, the comments about the efficiency of the PoFA regime reflects a low input or engagement of specialist groups in the development of the legislation. It is indicative that decisions about the appropriate law to govern forensic DNA records may not be balanced. Apart from administrative difficulties, this approach may introduce public security risks, with one participant stating that the PoFA regime 'favours criminals' (R11/LW).

In relation to implementation efficiency is the financial cost of operating the NDNAD. The annual budget for operating the database is reported to be between £1 million and £4 million as of 2015 to 2019.[983] Among the study participants, the expansive regime was thought to be a more cost-effective system than the semi-restrictive regime. Reviews into the cost implications of the retention regimes indicate that the restrictive regime and the semi-restrictive regime may lead to multiple sampling of the same individuals.[984] In contrast, the Biometrics Commissioner suggests that the destruction of DNA samples may reduce the cost of sample storage.[985] It is not clear if the deletion of profiles from unconvicted individuals following a short retention period may also reduce the cost of running the database. Whilst the semi-restrictive regime may have reduced the cost of sample storage, it is worth noting that it has introduced new offices and procedures which may add to the cost of operations. For example, the office of the Biometrics Commissioner and its work require funding. The PoFA regime also requires an upgrade of the database IT system. These multiple factors may explain the views of the study participants on the cost-effectiveness of the different retention regimes.

The actual financial gains of the NDNAD is not known and difficult to measure due to several confounders. One challenge is the fact that no case is resolved by DNA alone or DNA-only cases are very rare. In the United States, Speaker[986] found that the estimated return on investment (ROI) of testing the backlog of untested sexual assault kits was about 9,874% to 12,962% for a caseload of 100. Whilst a crude estimate, it suggests high cost-effectiveness in relation to sexual offences. An analysis of the overall and actual ROI of the

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[983] FIND Strategy Board, *Annual Report 2017 to 2018* (n 16) 31; National DNA Database Strategy Board, *Annual Report, 2014 to 2015* (n 78) 25.
[984] Bramley (n 42).
[985] MacGregor, *Annual Report 2014: Commissioner for the Retention and Use of Biometric Material* (n 76).
[986] Paul J Speaker, 'The Jurisdictional Return on Investment from Processing the Backlog of Untested Sexual Assault Kits' (2019) 1 Forensic Science International: Synergy 18.

NDNAD may allow a more objective assessment of its cost-effectiveness under different retention regimes.

10.4.4 Comparison of the proportionality and privacy impact of retention regimes

Proportionality has been a central concept in the regulation of forensic biometrics. The principle has been considered within the framework of balancing the interests of the public and the civil liberties of the individual. However, there is no consistent method for measuring proportionality and how this balance may be achieved.[987] In this study, none of the retention regimes was considered to be proportional by the expert group. Whilst the expansive regime was rated to be biased towards public interests, the restrictive and semi-restrictive regimes were thought to favour individual interest.

The results showed that the current semi-restrictive regime and the restrictive regime are perceived to be better in protecting the genetic privacy of individuals. This view is generally consistent with the literature that advocates for the civil liberties of individuals and the promotion of a privacy-by-design system.[988] There were mixed views on what could enhance the protection of privacy in the operation of the NDNAD, with one respondent emphasising the need to establish an appropriate balance. Some participants were of the view that the retention of data from convicted individuals should be commensurate with either the maximum sentence for their offence, the duration of their offence or until death (- for reasons of recidivism). In the case of unconvicted individuals, some participants thought all data should be deleted or retained based on informed consent or dependent on offence types (such as terrorism and sexual offences).

However, a few participants made comments that tended to devalue the privacy implications of data retention, which was in agreement with views of criminal justice professionals in the qualitative study by Johnson and Williams.[989] Whilst some of these participants emphasised the benefits of DNA data retention, others thought that the only privacy issue with the retention of DNA profiles is the identifying information linked to the data:

> The region of the DNA profiled for the current DNA database (STR not Y-STR or mtDNA) is non-coding apart from determining the sex genes of the donor. As such I do not interpret this information as a genetic privacy issue (profile only

[987] Adam Ramshaw, 'The Case for Replicable Structured Full Proportionality Analysis in All Cases Concerning Fundamental Rights' (2019) 39 Legal Studies 120.
[988] Forensic Genetics Policy Initiative, *Establishing Best Practice for Forensic DNA Databases* (n 88).
[989] Williams and Johnson, '"Wonderment and Dread"' (n 646).

> separate to the sample). The privacy issue is the personal information connected to the DNA profile. A person's privacy is impacted by retention of this personal data. Retention of the DNA sample, I would consider as a privacy issue as it contains the complete genomic information for that person. (R6/LE)

In line with the above comment, another participant thought the focus should be on securing the information in the database and not what is included in the NDNAD. Although this participant selected the restrictive regime as the most effective in protecting privacy, it was thought that the inclusion of all residents/citizens in the database may eliminate bias in court proceedings:

> At this time the presence of a DNA database [match] as part of prosecution informs the court the suspect has previous convictions. If the database included everyone's profile this would eliminate bias. It is only a problem if the database is not secure or used outside the present legal restrictions. Database restrictions should only be on how it is used not what information is put on it. (R2/FS)

In conclusion, the comments on the protection of privacy highlight the difficulties in configuring the right balance between civil liberties and the protection of public security. Firstly, the conception of privacy varies between individuals, which informs the relative value placed on different competing interests in DNA data retention. Whilst a restricted regime may be supported for privacy reasons and 'in principle', criminal justice professionals may be concerned about the effect of such a regime on their role to ensure the safe delivery of justice. This may reflect why the specialist group rate privacy lower than other outcomes of operating the NDNAD.

10.4.5 Overall effectiveness of retention regimes

Overall, the expert group thought the expansive regime was the most effective among the three regimes. This means whilst civil liberties (including privacy) may be important in DNA databasing, this may be outweighed by the potential public security benefits of databasing and the ease of implementation of the database system. This overall view is generally consistent with the utilitarian view expressed by participants in the public survey. In the qualitative responses, one participant reflected on the misunderstanding of DNA databases by the public and overemphasis on privacy. This was consistent with the devaluing of civil liberties among some criminal justice professionals.[990] The participant reasoned that the

[990] Williams and Johnson, '"Wonderment and Dread"' (n 646).

NDNAD is robust and there is limited evidence to demonstrate the actual privacy risks of inclusion in the database:

> A rating of privacy implies that a sliding scale exists and that a more expansive database would increase a rate of misuse or false conviction. Has there been any false convictions based on having a profile on the database? I would claim the database and its use is robust and therefore restriction serves no apparent purpose other than to appease public concern due to a lack of understanding of how the database functions and is used. (R2/FS)

The *Marper* ruling noted that concerns about the conceivable future uses of private information is legitimate and relevant in DNA databasing.[991] Whilst this is important, the comment above highlights a need to also determine (quantify) the real civil liberty risks of DNA databasing. This information will help policymakers in determining the appropriate balance between public and private interests.

Two respondents further emphasised the potential benefits of an expanded database, with one commenting that 'PACE [Expansive regime] was very effective in detecting crime. PoFA has had the opposite effect and less crime is detected' (R13/FS). The accuracy of this claim is unknown. However, the current output data shows that the match rate of the NDNAD has increased under PoFA.[992] An investigation of the actual value and impact of NDNAD hits may help substantiate this hypothesis. The second respondent favoured a UDNAD, reasoning that the PoFA regime is complex and introduces public security risks:

> The 'issue' with the introduction of PoFA and the new regime is that there is the potential to play the system. If you get NFA'd for a crime then it will drop off PNC and you become a first-time arrestee the next time you come in....NFA'd again and your biometrics are wiped again and so it goes on. Each time you are NFA'd another record of arrest is removed from PNC (obviously local records will hold intelligence but other forces won't be aware of this) and then this leads to the whole DBS thing and will we have another Ian Huntley scenario? I appreciate this might be a rare occurrence but surely once is once too often? But then the only way to fully resolve this (and possibly increase the deterrence rate) would be to obtain biometrics across the board from all people aged 10 and above for instance. Big Brother-ish absolutely, do I agree, no not really but it depends what the overall 'want' is - do we want to be able to conclude all crimes and know whose biometrics are at them at all times, or are we satisfied with only knowing a proportion? My musings anyway... (R3/FS)

Although a comprehensive database may resolve the technical issues with the NDNAD and assist in the resolution of crime, this may not be cost-effective or lead to a diminishing

[991] *S and Marper v The United Kingdom* (n 44).
[992] FIND Strategy Board, *Annual Report 2017 to 2018* (n 16).

return.[993] This is because DNA is only applicable in a small proportion of crime and the DNA of a majority of individuals in such a database will be redundant. The goal to maximise the utility of the NDNAD may be achieved by investigating its actual effectiveness and identifying patterns in the records included in the database; this would ensure that the database is aimed at the right individuals. Lastly, the technical challenge with the NFA issue may be resolved by developing an effective intelligence network among local forces.

The impact of external factors (such as, crime scene processing, police efficiency, intelligence practices, tactical crime investigations and evidentiary management) on the effectiveness of NDNAD hits has been highlighted in several studies.[994] One respondent reflected on these regime independent factors, emphasising the need to consider these as part of effectiveness assessments:

> The effectiveness of DNA under all three schemes is dependent on factors such as how good is the profile obtained from the scene, where has the profile been obtained from and supporting evidence. (R4/FS)

It is worth noting that the findings in this study lack generalisation to the entire primary stakeholder group for the NDNAD due to the small sample size. Nevertheless, the findings balance the general view expressed in the public survey, which supports a selective regime that considers individual privacy and the protection of public security. The findings are important in ensuring a more balanced decision-making process about the development of the legal framework for the NDNAD.

10.5 Conclusion

The stakeholder survey assessed the views of individuals with a direct functional or special interest in the operation of the NDNAD. In addition to the seven effectiveness criteria, two additional criteria were identified for consideration in the assessment of the effectiveness of retention regimes. Hence, factors that may be considered as key indicators of an effective retention regime are crime-solving capacity, incapacitation effect, deterrent effect, privacy protection, proportionality, implementation efficiency and cost, comparative performance of regimes, and investigative efficiency. Overall, the primary stakeholder group considered the expansive regime to be the most effective for two main reasons: 1) the enhancement of the public security of the society in terms of solving crime and preventing or deterring crime; 2)

[993] Krimsky and Simoncelli (n 62).
[994] Walsh and others (n 687); Lammers and Bernasco (n 688); Bieber (n 89).

ease of implementation and cost-effectiveness of the operation of the database. The study participants thought case resolution and other outcomes of the database were more important than individual interests, supporting a utilitarian view. The results imply a need for reflection on the actual positive aspects of the expansive regime that may be incorporated in the current law to maximise the utility of the NDNAD.

Chapter 11: General discussion and conclusion

This research sought to assess the efficacy of NDNAD retention regimes. In this chapter, the findings of the different aspects of the research are collectively analysed and discussed. The chapter answers the fifth aim of the research by drawing out possible reforms that may improve the law governing the NDNAD. Firstly, a document analysis of reports of oversight bodies was carried out to answer the first aim of the research; this was to identify the benefits, challenges, risks and emerging issues associated with the implementation of the PoFA regime. The findings showed some positive impact on the match rate of the NDNAD compared to previous regimes. This suggests an enhancement of the potential effectiveness of the NDNAD under the PoFA regime. Another positive outcome was an improvement in the protection of the genetic privacy of individuals, which may reinforce public confidence in the operation of the NDNAD.

The review indicated challenges with the configuration of the Police National Computer, legal and procedural issues and understanding of the law among stakeholders. It was apparent that public security and privacy risks are still present with the PoFA regime as some data may have been unlawfully deleted or retained or legally destroyed at the potential risk of crime detection or resolution. The findings from the document analysis imply that whilst the PoFA regime may be beneficial in some respects, there is a considerable gap between the law and practice. This gap suggests a need to re-evaluate the proportionality of the present regime.[995] One critical lacuna identified in the review was the inadequate or absence of systematic data about the actual effectiveness of retaining DNA records from different categories of individuals and for different retention periods.[996] This is mainly due to difficulties in isolating the sole impact of DNA hits on case resolution, which is attributed to the fact that DNA evidence is usually used in conjunction with other evidence.[997] However, it should be possible to determine the initial role of DNA hits (i.e. the generation of unknown investigative leads that are relevant to a case) which can offer insights on the effectiveness of retention regimes.

To inform the direction of the empirical research for this study, a narrative literature review was carried out on the efficacy of DNA databasing. The literature review confirmed the gaps identified in the document analysis: discrepancies between law and practice, and the limited

[995] Wiles, *Annual Report 2018: Commissioner for the Retention and Use of Biometric Material* (n 115), para 3.
[996] Wiles, *Annual Report 2018: Commissioner for the Retention and Use of Biometric Material* (n 115).
[997] FIND Strategy Board, *Annual Report 2017 to 2018* (n 16).

information on the actual effectiveness of DNA databasing. The effect of these gaps has been the development of DNA database policy and standards set by arbitrary decisions by policymakers.[998] These decisions are sometimes made in consultation with the public, which may be driven by the idea that the legal framework for databases is a societal choice rather than being based on individual preference.[999] A democratic approach has thus been proposed for the development of the NDNAD regime.[1000]

The review identified several sociological studies focused on the database effectiveness and its governing rules. Overall, significant public support for DNA databasing was observed; this was justified by a belief in the enhancement of public security via this investigative tool. However, views on the inclusion criteria and retention periods for reference profiles were mixed. The key concerns of the public are the security of genetic data, privacy, proportionality and effectiveness of databases. The social research findings clearly demonstrate a need for authorities to articulate to the public: 1) the actual effectiveness of DNA databases; and 2) the actual risks of running the database. This information would assist the public in making an informed decision on how DNA databases should be regulated.

Another aspect of the narrative review was an examination of the literature on the potential and/or actual effectiveness of DNA databasing. Overall, the available evidence is only indicative of the effectiveness of DNA databases, particularly in serious violent and sexual crimes. The literature suggests that the contribution of DNA and databases to the resolution of all crime is low and multiple reasons account for this observation. Firstly, most crimes do not involve DNA. Secondly, a very limited proportion of crime scenes are screened for DNA. A third reason is that the utility of DNA matches is dependent on the competency and efficiency of the police, prosecutors and other participants in the criminal justice process. These factors imply that DNA databases should be a specialised rather than a generalised system (or perceived as a 'catch-all' investigative tool). However, a gap identified in the literature is the lack of evidence to demonstrate the actual value of retaining data from specific groups of convicted and unconvicted individuals. Further, there are limited studies that compare the value of DNA profiling alone and DNA databases. These findings confirm the concerns of the Biometrics Commissioner regarding the complex evidence on the

[998] Crime and Policing Analysis Unit (n 109).
[999] Patyn and Dierickx (n 123).
[1000] Patyn and Dierickx (n 123); Wallace (n 591); McCartney, 'Of Weighty Reasons and Indiscriminate Blankets' (n 44).

attrition rate and effectiveness of the NDNAD.[1001] This presents a hurdle in attempting to define inclusion and retention criteria for the NDNAD that would maximise its effectiveness.[1002]

Considering the above findings, a key question emerges: Is the current law (PoFA) legitimate? The second and third aims of this research explored this question via an online public survey. The survey results showed high perceived effectiveness of the NDNAD in enhancing the specified legal purposes of detecting, investigating and prosecuting crime, which is consistent with other studies.[1003] Similar to findings from the Portuguese study,[1004] the survey results showed scepticism regarding the effectiveness of the NDNAD in enhancing crime prevention. However, a utilitarian view was favoured by the respondents. The insight from the survey is a need to make the effectiveness of the NDNAD towards its legal functions (section 63T(1)(c) of PACE) more demonstrable. This is relevant to ensure that the law is specific, accurate and representative of the actual roles of the NDNAD (for example, the generation of unknown investigative leads). Further, an accurate understanding of the actual benefits and risks of the NDNAD will allow the public to make an informed choice about the rules to govern its operation.

Another aspect of the survey explored views of participants about the inclusion criteria for the NDNAD. Under the current PoFA law, the minimum criteria for entry of DNA data in the NDNAD is an arrest for a recordable offence. The survey results indicated a more selective approach may be preferred by the public although views on the characteristics of eligible individuals were mixed. This was due to uncertainties about the value of including data of specific individuals and concerns about civil liberties. The results support the need for a continuous evaluation of how data from individuals with conviction records, arrestees and charged individuals can contribute to public security goals. This is relevant because it may allow the public to make an informed judgement about who to include in the database, which will support the decisions of policymakers.

The survey also examined views on how long data from different individuals should be retained. The PoFA regime allows the indefinite retention of DNA data from convicted

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[1001] Wiles, *Annual Report 2016* (n 26); Wiles, *Annual Report 2018: Commissioner for the Retention and Use of Biometric Material* (n 115).
[1002] Blakemore and Blake (n 107).
[1003] Teodorović and others (n 122); Machado and Silva, 'Public Perspectives on Risks and Benefits of Forensic DNA Databases' (n 659).
[1004] Machado and Silva, 'Public Perspectives on Risks and Benefits of Forensic DNA Databases' (n 659).

adults. The results, however, showed that a discriminatory approach may be preferable to members of the public. Factors considered under this approach include the seriousness of an offence and reoffending history. Most participants thought data from serious offenders should be retained for a long period of time whereas data from less serious offenders should be retained for a short time period or should be based on the length of their sentence. The basis of this view is mainly drawn from civil liberty concerns and due process. A similar trend was also observed for data from unconvicted individuals, which is currently supported by PoFA. However, decisions on specific long-term or short-term periods should be considered cautiously and supported by adequate systematic evidence on the actual value of retention. Information about the potential or actual impact of existing retention periods or categories on public security should be made available to the public. This type of analysis is currently being pursued by the Biometrics Commissioner for section 63G data. The available evidence suggests a 9% match rate (H/N) for individuals whose data are included under section 63G.[1005] However, it is not clear whether these matches are cold or warm hits, and how they contributed to police investigations.

Lastly, the public survey inquired about whether participants would be willing to voluntarily participate in the NDNAD. The views of participants were generally consistent with PoFA rules which require informed consent, provides a right to withdraw consent, and require retention of data until its sampling purpose is fulfilled. The above rules apply in the absence of any mandatory inclusion/retention conditions. The survey results showed that the main condition that could influence voluntary participation in the NDNAD is the potential contribution of the volunteer's data to crime resolution. This reinforces the general trend in this study of a need to evaluate the actual effectiveness of existing retention regimes. Evidence on the actual impact of existing retention regimes would allow the public to make an informed choice to voluntarily participate or not participate in the NDNAD.

Using the seven effectiveness criteria from the literature review as a basis, the stakeholder survey examined the views of experts about the effectiveness of NDNAD retention regimes. The participants considered the expansive regime to be more effective than the restrictive and PoFA regimes. One of the reasons for this preference was that the expansive regime enhances the resolution and prevention of crime. Further, the expansive regime is easier to implement. Overall, the results from the surveys indicate that the PoFA regime requires

[1005] Wiles, *Annual Report 2018: Commissioner for the Retention and Use of Biometric Material* (n 115).

reform. However, these changes should not be based on arbitrary decisions but should be supported by systematic evidence on the actual benefits and risks of operating the NDNAD. A critical understanding of the interaction between the law and the operation of the database, its impact on public security and civil liberty outcomes should allow the identification of appropriate systems that can be incorporated in the law to enhance the utility of the NDNAD. The survey findings provide an empirical basis to inform decisions on the development of the current legal framework for the National DNA Database.

11.1 Limitations of the study

One of the main limitations of the surveys was the non-probability sampling approach used. This means the findings cannot be generalised to the entire population in England and Wales or the 'expert' population. However, the results provide an empirical basis to advise on policies to develop the National DNA Database. As noted in the survey methodology, the topic of DNA databasing appeals to a limited number of members of the public. This makes it difficult to conduct surveys employing the probability sampling method. A possible way of overcoming this challenge, and improving future research, is through consistent sensitisation of the 'lay' public about DNA databasing and forensic biometrics. This could be in the form of a government-sponsored television programme on forensic biometrics that brings together experts and different stakeholders for panel discussions. Additionally, targeted sensitisation conferences may be organised as part of public engagement activities to promote science. Short and simplified surveys could be conducted as part of such sensitisation and awareness programmes to generate a more representative view of the public and stakeholders about the different aspects of DNA databases and other biometrics.

Another limitation of the surveys relates to the potential for leading questions, and implied positive assumptions or misunderstanding of terminologies by some members of the public and stakeholders. For example, one participant thought the questions carried an assumption supporting the police use of DNA databases. Whilst acknowledging the potential for this misunderstanding, all closed-ended questions in the public survey included an 'other' option to allow for flexibility of responses. A few participants in the public survey were not sure about the meaning of the classification of offences as a qualifying offence, serious offence, minor offence and recordable offence. These participants suggested including examples of such offences in a future questionnaire. Whilst this was considered at the preparatory stage of the questionnaire, it was thought that most members of the public will be familiar with

the meaning of the classification of crime in England and Wales. Further, it was thought that an incomplete list of examples may introduce bias in the responses. Since very few participants mentioned such issues, the results should not be impacted significantly. Moreover, these participants indicated their preferences/opinions in the free-text responses, allowing for coding and analysis. A future research suggestion may be an inclusion of a comprehensive glossary of terms in the survey questionnaire. Participants with no knowledge or limited understanding of certain terminologies may refer to the glossary before or during the completion of the questionnaire.

11.2 Study recommendations

Based on the findings from this study, the recommendations below are suggested to improve the development of the legal framework governing the National DNA Database. These suggestions may also be pursued in future research to support decisions of policymakers.

1. Possible amendment of the legal definition/scope of the public security functions of the NDNAD to fit its actual outcomes. For example, the purpose of DNA retention may be framed as to generate unknown and probative investigative leads. The current anticipated legal outcomes, including the prevention, detection, investigation and prosecution of crime, should be investigated systematically.

2. Introduction of a legal requirement to evidence the public security functions of the NDNAD. This will ensure that evaluation programmes are prioritised by relevant stakeholders from the onset of the development of NDNAD policies and legal reforms. Under such reform, any technical or IT infrastructure developed to implement the law should allow for the effectiveness (potential or actual) of the regime to be assessed.

3. Given that the public survey results favoured a discriminatory retention approach for convicted adults based on offence seriousness, there should be a wide government consultation and analysis of output and outcome data from the NDNAD to ascertain whether the current indefinite retention regime for convicted adults should be amended to enhance proportionality.

4. With the potentially high level of support for the expansive regime among primary stakeholders, the proposed/implied best practices (such as, automation of regime procedures) and efficient elements (such as, national intelligence network) of the

expansive regime should be evaluated and adopted into the current retention regime, where appropriate.

5. To maximise the effectiveness of the database and inform policy and public confidence in the use of the NDNAD, an independent programme of research should be established to systematically review the effectiveness of retention regimes against specific key indicators. This should include indicators about the public security outcomes and the actual/perceived civil liberty risks of the NDNAD.

6. In relation to the importance of empowering the public to make an informed decision about the rules governing the NDNAD, a simplified and statutory channel (such as, media broadcast) should be created to sensitize the public about the facts of DNA databasing (and other forensic biometrics).

7. To partly account for the public support and legitimacy of the NDNAD, there should be a statutory scheme to regularly assess public perceptions about DNA databasing and other biometrics. This may be in the form of a Biometrics Perception Index (BPI), a survey that evaluates perceived effectiveness and views on inclusion and retention criteria.

Appendices

Appendix I – Match rate analysis project

The initial aims of this research were to assess the potential effectiveness of the NDNAD using match rates (MR). The challenges with the configuration of the database limited the type of data that could be extracted to answer the aims of the project. The data that could be obtained from the database is presented in Appendix XI. This appendix outlines the proposed methodology for this project. As illustrated in the framework for this research, it is expected that changes in the law will result in differences in the composition of the database within a given period or retention regime. This will impact the overall performance of the database and potentially its significance to public security. It is also expected that the different retention categories (e.g. convicted, charged and arrested individuals) defined by law will contribute to the output of the database differently. The research, therefore, sought to determine the potential value of DNA data retention towards crime detection, investigation, prosecution and resolution for different retention categories. Finally, the value of the database is dependent on the length of DNA data retention. Hence, the different time limits introduced by the law will impact on the performance of the database. The research sought to determine the value of different retention lengths (e.g. 3 years old data versus 6 years old data).

Match rate analysis methodology

The research aimed to statistically determine the potential effectiveness of the different retention regimes by analysing available match rate data from the NDNAD. The statistical analysis study was approved by the NDNAD Strategy Board and the Ethics Group (Appendix XV).

NDNAD Match rate analysis

The justification for forensic DNA data retention has mainly relied on criminal career research including re-offending and/or re-arrest rates.[1006] This empirical approach, though important, only offers limited insight into the categories of individuals to include in DNA databases and the appropriate length of retention. In this study, match rate analysis was considered to be a more appropriate method to estimate the actual potential value of DNA

[1006] Crime and Policing Analysis Unit (n 109); Tseloni and Pease (n 63); Houlding and Wilson (n 749); Kazemian, Pease and Farrington (n 744); Home Office, *Keeping the Right People on the DNA Database: Science and Public Protection* (n 47).

retention to crime-fighting, and thus determine the most effective retention regime. The approach can help establish the relative value of convicted individuals and non-convicted arrestee's DNA data. Additionally, it can show the time frame within which DNA retention is of value to crime detection or investigation. The two types of match rates proposed by ENFSI (H/C and H/N) were considered in this research because they offer different perspectives on the value of DNA retention. The crime-solving match rate (H/C) shows the fraction of crimes that can be detected or solved by the database. The database-size match rate (H/N) expresses the fraction of individuals in the database who are linked to crime scenes via their DNA profile. A high H/C shows that more crimes are likely to be detected by the police whilst a high H/N indicates that the database is representative of the active or previously active criminal population.[1007]

One of the major limitations of using match rate analyses is that it only provides a snapshot of the potential value of DNA databases. This limits its applicability in demonstrating the efficacy of DNA retention regimes. A DNA hit does not automatically solve a crime or conclusively establish that a matched individual is the perpetrator of the crime. Several factors affect the usefulness of a DNA hit. Whilst the crime-solving match rate of one data set (such as convicted individuals' data) may be higher than another (such as non-convicted arrestee data), a follow-up of the DNA hits may show reverse case resolution or conviction rates. The literature review shows that database hit outcomes such as conviction rate are more accurate measures of the DNA database and/or retention regime efficacy.[1008] However, there are no reliable data on DNA conviction rates. Secondly, it is difficult to establish the isolated impact of DNA hits on conviction since it is rarely used as the sole evidence in criminal cases. Other types of evidence are normally required to secure a conviction. The match rate analysis was chosen as a suitable method for this study for the above-mentioned reasons. Also, match rate data are already available or could be estimated easily.

Description of the dataset and empirical strategy

Historical NDNAD MR data and corresponding database size (number of crime scene profiles and reference profiles) from 1995 to 2017 will be accessed from the NDNAD Delivery Unit (NDU). The SGM, SGM+ and NGM reference-crime DNA matches will be included. Firstly, the match rates (H/C and H/N) will be classified by the three different retention regimes. The annual rate observations for the regimes are 6 restrictive, 12

[1007] Santos, Machado and Silva (n 29).
[1008] Bieber (n 89); Gabriel, Boland and Holt (n 12).

expansive and 4 semi-restrictive. The average H/C and H/N for each regime will be compared. Secondly, the H/C and H/N will be filtered by retention categories and compared within and between each retention regime. The retention categories considered in this study are presented in Table AI.1. There are 7 categories within the restrictive regime, 14 within the expansive regime, and 15 within the semi-restrictive regime. The categories were based on the characteristics of each retention regime as defined by law and concepts derived from literature.

Table AI.1 – Retention categories considered for match rate comparisons

Retention regime	Retention category
Restrictive regime (1995 -2001)	All convicted individuals
	All individuals convicted of qualified offence
	All individuals convicted of minor offence
	Adults convicted of qualified offence
	Adults convicted of minor offence
	Under 18 convicted of qualified offence
	Under 18 convicted of minor offence
Expansive regime (2001 – 2013)	All convicted individuals
	All individuals convicted of qualified offence
	All individuals convicted of minor offence
	Adults convicted of qualified offence
	Adults convicted of minor offence
	Under 18 convicted of qualified offence
	Under 18 convicted of minor offence
	All non-convicted arrestees/individuals charged
	Non-convicted individuals arrested/charged for qualified offence
	Non-convicted individuals arrested/charged for minor offence
	Non-convicted adults arrested/charged for qualified offence
	Non-convicted adults arrested/charged for minor offence
	Non-convicted minors arrested/charged for qualified offence
	Non-convicted minors arrested/charged for minor offence
Semi-restrictive regime (2013 – 2017)	All convicted individuals
	All individuals convicted of qualified offence
	All individuals convicted of minor offence
	Adults convicted of qualified offence
	Adults convicted of minor offence
	Under 18 convicted of qualified offence
	Under 18 convicted of first minor offence
	Under 18 convicted of two or more minor offences
	All non-convicted arrestees/individuals charged
	Non-convicted individuals charged for qualified offence
	Non-convicted individuals arrested for qualified offence
	Non-convicted adults charged for qualified offence
	Non-convicted adults arrested for qualified offence
	Non-convicted minors charged for qualified offence
	Non-convicted minors arrested for qualified offence

Finally, the annual match rates will be filtered by subject profile retention lengths (in years) for each retention regime and for the different retention categories. Table AI.2 illustrates the strategy for the retention length filtering. The retention length ranges from ≤ 1 year to 22

years, with a total of 253 rate observations. The match rates for the different retention lengths in each financial year will be compared (*row comparisons: e.g. 2009/10: a – o (Table AI.2)*). The average match rates for each retention length column (*i.e. MR for all financial years: a vs b, etc.*) will also be compared.

Table AI.2 – Illustration of the classification of match rates by subject profile retention lengths

Year	**DNA data retention length (years)**																					
	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v
1995/96	≤ 1																					
1996/97	≤ 1	>1 – 2																				
1997/98	≤ 1	>1 – 2	>2-3																			
1998/99	≤ 1	>1 – 2	>2-3	>3-4																		
1999/2000	≤ 1	>1 – 2	>2-3	>3-4	>4-5																	
2000/01	≤ 1	>1 – 2	>2-3	>3-4	>4-5	>5-6																
2001/02	≤ 1	>1 – 2	>2-3	>3-4	>4-5	>5-6	>6-7															
2002/03	≤ 1	>1 – 2	>2-3	>3-4	>4-5	>5-6	>6-7	>7-8														
2003/04	≤ 1	>1 – 2	>2-3	>3-4	>4-5	>5-6	>6-7	>7-8	>8-9													
2004/05	≤ 1	>1 – 2	>2-3	>3-4	>4-5	>5-6	>6-7	>7-8	>8-9	>9-10												
2005/06	≤ 1	>1 – 2	>2-3	>3-4	>4-5	>5-6	>6-7	>7-8	>8-9	>9-10	>10-11											
2006/07	≤ 1	>1 – 2	>2-3	>3-4	>4-5	>5-6	>6-7	>7-8	>8-9	>9-10	>10-11	>11-12										
2007/08	≤ 1	>1 – 2	>2-3	>3-4	>4-5	>5-6	>6-7	>7-8	>8-9	>9-10	>10-11	>11-12	>12-13									
2008/09	≤ 1	>1 – 2	>2-3	>3-4	>4-5	>5-6	>6-7	>7-8	>8-9	>9-10	>10-11	>11-12	>12-13	>13-14								
2009/10	≤ 1	>1 – 2	>2-3	>3-4	>4-5	>5-6	>6-7	>7-8	>8-9	>9-10	>10-11	>11-12	>12-13	>13-14	>14-15							
2010/11	≤ 1	>1 – 2	>2-3	>3-4	>4-5	>5-6	>6-7	>7-8	>8-9	>9-10	>10-11	>11-12	>12-13	>13-14	>14-15	>15-16						
2011/12	≤ 1	>1 – 2	>2-3	>3-4	>4-5	>5-6	>6-7	>7-8	>8-9	>9-10	>10-11	>11-12	>12-13	>13-14	>14-15	>15-16	>16-17					
2012/13	≤ 1	>1 – 2	>2-3	>3-4	>4-5	>5-6	>6-7	>7-8	>8-9	>9-10	>10-11	>11-12	>12-13	>13-14	>14-15	>15-16	>16-17	>17-18				
2013/14	≤ 1	>1 – 2	>2-3	>3-4	>4-5	>5-6	>6-7	>7-8	>8-9	>9-10	>10-11	>11-12	>12-13	>13-14	>14-15	>15-16	>16-17	>17-18	>18-19			
2014/15	≤ 1	>1 – 2	>2-3	>3-4	>4-5	>5-6	>6-7	>7-8	>8-9	>9-10	>10-11	>11-12	>12-13	>13-14	>14-15	>15-16	>16-17	>17-18	>18-19	>19-20		
2015/16	≤ 1	>1 – 2	>2-3	>3-4	>4-5	>5-6	>6-7	>7-8	>8-9	>9-10	>10-11	>11-12	>12-13	>13-14	>14-15	>15-16	>16-17	>17-18	>18-19	>19-20	>20-21	
2016/17	≤ 1	>1 – 2	>2-3	>3-4	>4-5	>5-6	>6-7	>7-8	>8-9	>9-10	>10-11	>11-12	>12-13	>13-14	>14-15	>15-16	>16-17	>17-18	>18-19	>19-20	>20-21	>21-22

Statistical analysis of match rate data

The match rate data will be analysed using the IBM SPSS Statistics software (version 24). It is expected that the MR data will include all the annual rates within the period being studied therefore descriptive statistics (DS)[1009] will be used for analysis. Inferential statistics (IS)[1010] was considered inappropriate because it examines a statistical sample drawn from a population (i.e. the complete set of data or observations) to make generalisations about the entire population. Further, the sample size for some categories is too small to allow comparisons.

Appendix II – Search terms and keywords for academic database search

1. (“National DNA Database” OR “Forensic DNA Database” OR “Forensic DNA Databank” OR “DNA profiling” OR “DNA analysis”) AND (“law” OR “legislation” OR “retention regimes” OR “legal framework” OR “Inclusion criteria” OR “retention period”) AND (“United Kingdom” OR “England and Wales”) 2. (“National DNA Database” OR “Forensic DNA Database” OR “Forensic DNA Databank” OR “DNA profiling” OR “DNA analysis”) AND (“effectiveness” OR “efficiency” OR “efficacy” OR “performance” OR “impact”) AND (“United Kingdom” OR “England and Wales”) 3. (“National DNA Database” OR “Forensic DNA Database” OR “Forensic DNA Databank” OR “DNA profiling” OR “DNA analysis”) AND (“public security” OR “public safety” OR “national security” OR “public protection” OR “crime resolution” OR “crime detection” OR “crime prevention” OR “crime prosecution”) AND (“United Kingdom” OR “England and Wales”) 4. (“National DNA Database” OR “Forensic DNA Database” OR “Forensic DNA Databank” OR “DNA profiling” OR “DNA analysis”) AND (“privacy” OR “civil liberties” OR “human rights” OR “proportionality” OR “ethics”) AND (“United Kingdom” OR “England and Wales”) 5. (“National DNA Database” OR “Forensic DNA Database” OR “Forensic DNA Databank” OR “DNA profiling” OR “DNA analysis”) AND (“interview” OR “survey” OR “public views” OR “public understanding” OR “public attitudes” OR “stakeholders”) AND (“United Kingdom” OR “England and Wales”)

[1009] Lucy (n 812); Martin G Larson, ‘Descriptive Statistics and Graphical Displays’ (2006) 114 Circulation 76; Murray J Fisher and Andrea P Marshall, ‘Understanding Descriptive Statistics’ (2009) 22 Australian Critical Care 93; Gill Marshall and Leon Jonker, ‘An Introduction to Descriptive Statistics: A Review and Practical Guide’ (2010) 16 Radiography e1.
[1010] Shane Allua and Cheryl Bagley Thompson, ‘Inferential Statistics’ (2009) 28 Air Medical Journal 168.

Appendix III – Public survey questionnaire

Northumbria University NEWCASTLE

Forensic DNA retention: public survey

Page 1: Cover letter & Introduction

Dear Participant,

My name is Aaron Amankwaa and I am a doctoral student (PhD) at Northumbria University Law School. My research is assessing the effectiveness of the law governing the England and Wales National DNA Database (NDNAD). The aim is to identify any legal changes that may maximize the utility of the NDNAD and enhance the protection of public security and the individual's right to privacy. This research has been approved by the Northumbria University Research Ethics Committee.

In addition to analysis of the output metric of the NDNAD, the study is interested in the views of the public including criminal justice professionals, law enforcement policy officers and policymakers in England and Wales. The goal of the survey is to identify consensus among the public and primary stakeholders about the most appropriate rules to govern the category of individuals whose DNA records should be retained on the NDNAD and how long the data should be retained.

The data collected from the survey will be anonymised and it will be impossible to identify participants from the results. The survey questionnaire should take around 15 minutes to complete.

The survey closes on **Wednesday 31st October 2018**.

To answer the survey, click on the Next button below.

For more information please contact the researcher. Thank you for your time and for considering my request.

Yours sincerely,
Aaron Amankwaa.
Tel: +44 (0)7442929880
Email: aaron.amankwaa@northumbria.ac.uk

Page 2: Informed Consent Form for research participants

Title of Study: Public perspectives about forensic DNA retention in UK

Person(s) conducting the research: Aaron Opoku Amankwaa (Researcher), Dr Carole McCartney (Principal Supervisor), Dr Nicola Wake (Second Supervisor)

Description of the broad nature of the research:

This project is part of my PhD assessing the efficacy of retention regimes governing the National DNA Database (NDNAD). The overall aim of the PhD is to identify any legal changes that may maximize the utility of the database and enhance the protection of public security and the individual's right to privacy. This project explores the current views of the public about the retention of forensic DNA data following the enactment of the Protection of Freedoms Act 2012. We would like your help to generate ideas to answer the questions: Whose DNA data should be retained on the NDNAD? And how long should the data be retained?

Description of the involvement expected of participants including the broad nature of questions to be answered or events to be observed or activities to be undertaken, and the expected time commitment:

As a participant in this study, you will be asked to complete a self-administered semi-structured questionnaire. The data will be collected using the Online Surveys (formerly BOS) package. The questionnaire will take a maximum of 15 minutes to complete.

You will be asked to rate your agreement with statements about the effectiveness of the NDNAD. Additionally, you will be asked about your opinion on the categories of individuals to include in the database (inclusion criteria) and how long the data of these different groups should be retained on the database (retention criteria). You will also be asked whether you would volunteer your DNA data to be retained on the database and any reasons for your answer.

Lastly, you will be asked some general demographic questions to help us in categorising the data. All information about you will have a code to maintain anonymity.

Description of how the data you provide will be securely stored and/or destroyed upon completion of the project.

Hard copies of data collected from you will be retained in locked filing cabinets accessible to the researcher and you will be unidentifiable by the records. Electronic versions of the data will be stored on a password protected computer accessible to the researcher. Access to the data will be restricted to the researcher and the supervision team.

The collected data will be retained for a maximum of 10 years after the conclusion of the research project (30th September 2019). In accordance with Northumbria University's guidance, electronic materials will be archived within the Law School. Hard copy records will be retained at Northumbria University's offsite storage facility. A record of archived material will be retained centrally within the Law School together with a clear indication of the length of retention, with Law School staff having sufficient access to ensure authorised and certified destruction of the data by 30th September 2029.

All hard copies and electronic materials will be destroyed after the retention period.

Additional information:

Information obtained in this study, including this consent form, will be kept strictly confidential (i.e. will not be passed to others) and anonymous (i.e. individuals and organisations will not be identified unless this is expressly excluded in the details given above).

Data obtained through this research may be reproduced and published in a variety of forms and for a variety of audiences related to the broad nature of the research detailed above. It will not be used for purposes other than those outlined above without your permission.

Participation is entirely voluntary and you may withdraw at any time.
By signing this consent form, you are indicating that you fully understand the above information and agree to participate in this study on the basis of the above information.

Please sign and keep the attached copy of this form for your own records.

1. I consent to participate in this study ✱ *Required*

○ Yes ○ No

Page 3: Respondent screening question

2. Do you currently live in England or Wales? ✱ *Required*

○ Yes ○ No

2.a. Which city/town do you live in?

Page 4: Glossary of key terms in questionnaire

DNA sample: the police may take a sample of saliva from a person involved in a crime. DNA is extracted from this saliva sample for further analysis (profiling) to aid in identification or verification of identity. The saliva sample and the DNA extract is referred to as the DNA sample. The DNA contains genetic information that can predict the health status, disease risk or ancestry of an individual and their biological relatives.

DNA profile refers to a unique set of 10 – 24 pairs of numbers and a pair of gender-specific letters (XX for female, and XY for Male). The numbers are derived from the areas of the DNA that are not known to be associated with the health or disease risk of a person. The DNA profile is stored in the electronic National DNA Database for identification of individuals. It can also provide information about whether two or more people are related genetically.

Page 5: Effectiveness of the National DNA Database

3. To what extent do you agree or disagree with the following statements about the ability of the National DNA Database to protect public security?

Please don't select more than 1 answer(s) per row.

	Definitely disagree	Mostly disagree	Neither agree nor disagree	Mostly agree	Definitely agree	Do not know
The database enhances the prevention of crime	☐	☐	☐	☐	☐	☐
The database enhances the detection of crime	☐	☐	☐	☐	☐	☐
The database enhances the investigation of crime	☐	☐	☐	☐	☐	☐
The database enhances the prosecution of crime	☐	☐	☐	☐	☐	☐

4. To what extent do you agree or disagree with the following statement about the retention of forensic DNA?

Please don't select more than 1 answer(s) per row.

	Definitely disagree	Mostly disagree	Neither agree nor disagree	Mostly agree	Definitely agree	Do not know
Its potential benefits outweigh any possible human rights or ethical concerns	☐	☐	☐	☐	☐	☐

5. If you have any additional comments about the protection of public security, please write them in here:

Page 6: Who should be included in the National DNA Database?

6. In your opinion, which category of individuals should have their DNA profiles included in the National DNA Database?

- Convicted individuals
- Convicted and charged individuals
- Convicted, charged and arrested individuals
- Convicted individuals and volunteers
- Convicted, charged individuals and volunteers
- Convicted, charged, arrested individuals and volunteers
- All citizens/residents
- Other

6.a. If you selected Other, please specify:

6.b. If you have any reasons for your answer to the question above, please write them in here:

7. In your opinion, for what types of offences should the DNA profile of a convicted individual be stored on the DNA database?

- All qualifying (serious) offences
- All qualifying and minor offences
- All recordable offences
- All offences
- Not Applicable
- Other

7.a. If you selected Other, please specify:

7.b. If you have any reasons for your answer to the question above, please write them in here:

8. In your opinion, for what types of offences should the DNA profile of a charged or arrested but not convicted individual be stored on the DNA database?

- All qualifying (serious) offences
- All qualifying and minor offences
- All recordable offences
- All offences
- Not applicable
- Other

8.a. If you selected Other, please specify:

8.b. If you have any reasons for your answer to the question above, please write them in here:

Page 7: Retention period for convicted individuals

9. How long should the physical ***DNA sample*** taken from the following categories of individuals be stored?

	Indefinite	100 years	Until death	6 months	3 months	Until a profile is generated	Other	If you selected Other, please specify:
Individuals convicted of a serious offence								
Individuals convicted of a minor offence								
Juvenile convicted of a first minor offence								

9.a. If you have any reasons for your selections in the question above, please write them in here:

10. How long should the ***DNA profiles*** of the following categories of individuals be retained on the database?

	Indefinite	100 years	Until death	Length of sentence	10 years plus length of sentence	5 years plus length of sentence	Other	If you selected Other, please specify:
Individuals convicted of a serious offence								
Individuals convicted of a minor offence								
Juvenile convicted of a first minor offence								

10.a. If you have any reasons for your selections in the question above, please write them in here:

Page 8: Retention period for non-convicted individuals

11. How long should the physical ***DNA sample*** taken from the following categories of *unconvicted* individuals be stored?

	Indefinite	100 years	Until death	6 months	3 months	Until a profile is generated	Until the conclusion of investigation/proceedings	Other	If you selected Other, please specify:
Individuals charged with a serious offence	○	○	○	○	○	○	○	○	
Individuals charged with a minor offence	○	○	○	○	○	○	○	○	
Individuals arrested for a serious offence	○	○	○	○	○	○	○	○	
Individuals arrested for a minor offence	○	○	○	○	○	○	○	○	

11.a. If you have any reasons for your selections in the question above, please write them in here:

12. How long should the ***DNA profiles*** of the following categories of *unconvicted* individuals be retained on the database?

	Indefinite	100 years	Until death	6 years	3 years	Until the conclusion of investigation/proceedings	Other	If you selected Other, please specify:
Individuals charged with a serious offence	○	○	○	○	○	○	○	
Individuals charged with a minor offence	○	○	○	○	○	○	○	
Individuals arrested for a serious offence	○	○	○	○	○	○	○	
Individuals arrested for a minor offence	○	○	○	○	○	○	○	

12.a. If you have any reasons for your selections in the question above, please write them in here:

Page 9: Additional questions

13. Would you volunteer to donate your DNA records to be retained on the National DNA Database if...

	Yes	No	Perhaps
You are a victim of a crime	○	○	○
Witness to a crime	○	○	○
It can assist the police to solve crime	○	○	○
The data is stored on a separate volunteers database	○	○	○

13.a. If you have any reasons for your selections in the question above, please write them in here:

14. How long should the physical ***DNA sample*** taken from volunteers be retained?

- ○ Indefinite
- ○ 100 years
- ○ Until death
- ○ 6 months
- ○ 3 months
- ○ Until a profile is generated
- ○ Until its purpose is fulfilled
- ○ Other

14.a. If you selected Other, please specify:

14.b. If you have any reasons for your answer in the question above, please write them in here:

15. How long should the **DNA profile** of volunteers be retained on the database?

- Indefinite
- 100 years
- Until death
- 6 years
- 3 years
- Until its purpose is fulfilled
- Other

15.a. If you selected Other, please specify:

15.b. If you have any reasons for your answer in the question above, please write them in here:

16. Do you have any other concerns about the retention of DNA profiles on the NDNAD?

Page 10: Demographic details

17. Gender ✱ *Required*

- Male
- Female
- Other

17.a. If you selected Other, please specify:

18. Age: ✱ *Required*

- 18-24
- 25-34
- 35-44
- 45-54
- 55-64
- 65 or older

19. What is the highest educational level that you have achieved to date?

- Secondary/high school
- University degree or equivalent professional qualification
- Higher University degree (Doctorate/Masters or equivalent)
- No formal education
- None of the above
- Other

19.a. If you selected Other, please specify:

20. What is your primary area of specialisation?

20.a. Total years of experience:

21. If a student, what is your level of study?

- ○ BSc
- ○ MSc
- ○ MPhil
- ○ PhD
- ○ Other

21.a. If you selected Other, please specify:

21.b. Year of study (e.g. 1st Year, 2nd Year):

21.c. Discipline:

22. Reference ID: Please write your preferred memorable initials/year (Example, RAA/1994) (This is to help the researcher to identify your response should you wish to withdraw from the study): ✱ *Required*

Page 11: Thank you for your responses

Appendix IV – Public survey organisation consent form

RESEARCH **ORGANISATION** INFORMED CONSENT FORM

Faculty of Business and Law
University of Northumbria

Completion of this form is required whenever research is being undertaken by Business and Law staff or students within any organisation. This applies to research that is carried out on the premises, or is about an organisation, or members of that organisation or its customers, as specifically targeted as subjects of research.

The researcher must supply an explanation to inform the organisation of the purpose of the study, who is carrying out the study, and who will eventually have access to the results. In particular issues of anonymity and avenues of dissemination and publications of the findings should be brought to the organisations' attention.

Researcher's Name: Aaron Opoku Amankwaa

Student ID No. (if applicable): 16029525

Researcher's Statement:

Project Title
Public perspectives about forensic DNA retention in UK

Research Purpose
This project is part of my PhD assessing the efficacy of retention regimes governing the National DNA Database (NDNAD). The overall aim of the PhD is to identify any legal changes that may be needed to maximize the utility of the database and enhance the protection of public security and the individual's right to privacy. This project explores the current views of the public about the retention of forensic DNA data following the enactment of the Protection of Freedoms Act 2012. The project seeks to generate ideas to answer the questions: Whose DNA data should be retained on the NDNAD? And how long should the data be retained?

Parties Involved?
- The target participants for this research project are citizens and residents of England and Wales aged 18 and above.
- The research is being conducted by Aaron Opoku Amankwaa, a doctoral research student at Northumbria University School of Law. Aaron's background is in Forensic Science.
- Individual participation is entirely voluntary and participants may withdraw at any time.

Research Methods
A self-administered semi-structured questionnaire will be used to collect data from participants of the study. The data will be collected using the Online Surveys (formerly BOS) package. Participants will be provided with a research information and consent form which they will be required to sign before completing the survey questionnaire.

Timescale
The timescale for the research project is from June 2018 – September 2019.

Time Commitment
The survey questionnaire will require a maximum of 15 minutes to complete.

Anonymity
All information about the study participants will be anonymised.

Confidentiality
Your right to confidentiality will be respected and where participant data is published the anonymity of participants will be maintained.[1] All data will be stored securely in a locked filing cabinet and electronic versions of the data will be stored on a password protected computer. Access to data will be restricted to the researcher and the supervision team.

The collected data will be retained for a maximum of 10 years after the conclusion of the research project (30th September 2019). In accordance with Northumbria University's guidance on *Data Protection and Secure Storage of Research Record*, *para. 18*, electronic materials will be archived within the Law School. Hard copy records will be retained at Northumbria University's offsite storage facility. A record of archived material will be retained centrally within the Law School together with a clear indication of the length of retention, with Law School staff having sufficient access to ensure authorised and certified destruction of the data by 30th September 2029.

All hard copies and electronic materials will be destroyed after the retention period.

Research Dissemination
Data obtained through this research will be reproduced and published in a variety of forms and for a variety of audiences related to the broad nature of the research detailed above (i.e. conferences, peer reviewed journals, articles etc.).

Queries
Please direct any queries regarding this research to Aaron Opoku Amankwaa on 07442929880 or aaron.amankwaa@northumbria.ac.uk

[1] In an unlikely event disclosure may be required by law or necessary in the public interest

Any organisation manager or representative who is empowered to give consent may do so here:

Name: _____

Position/Title: _____

Organisation Name: _____

Location: _____

If the organisation is the Faculty of Business and Law, please complete the following:

Start/End Date of Research / Consultancy project:	Start: End:
Programme Year Sample to be used: seminar group, entire year etc.	
Has Programme Director/Leader, Module Tutor being consulted, informed.	

Anonymity must be offered to the organisation if it does not wish to be identified in the research report. Confidentiality is more complex and cannot extend to the markers of student work or the reviewers of staff work, but can apply to the published outcomes. If confidentiality is required, what form applies?

[ ] No confidentiality required
[ ] Masking of organisation name in research report
[ ] No publication of the research results without specific organisational consent
[ ] Other by agreement as specified by addendum

Signature: _____ Date: _____

This form can be signed via email if the accompanying email is attached with the signer's personal email address included. The form cannot be completed by phone, rather should be handled via post.

Appendix V – Public survey respondent progress

Page	p.1	p.2	p.3	P.4	p.5	p.6	p.7	p.8	p.9	p.10	p.11 – complete responses
Number	1543	59	11	1	27	4	8	9	3	5	201

Appendix VI – Stakeholder survey questionnaire

Northumbria University NEWCASTLE

Forensic DNA Data Retention: Stakeholder Survey

Page 1

Cover Letter

Dear Participant,

My name is Aaron Amankwaa and I am a doctoral student (PhD) at Northumbria University School of Law. My research is assessing the efficacy of different retention regimes governing the England and Wales National DNA Database (NDNAD). The aim is to identify any reforms that may maximize the utility of the NDNAD and enhance the protection of public security and the individual's right to privacy. This research has been approved by the Northumbria University Research Ethics Committee.

In addition to analysis of NDNAD match rate data, the study is interested in the views of Criminal Justice Professionals, Law Enforcement Policy Officers and Policymakers in England and Wales. The goal of the survey is to identify consensus among primary stakeholders about the most appropriate DNA retention regime for the NDNAD.

The survey focuses on the three retention regimes that have governed the NDNAD:

1. Restrictive regime (1995 – 2001): introduced by the Criminal Justice and Public Order Act 1994 (CJPOA); permitted indefinite retention of DNA samples and profiles of only convicted individuals.
2. Expansive regime (2001 – 2013): introduced by the Criminal Justice and Police Act 2001 (CJPA) and Criminal Justice Act 2003 (CJA); permitted indefinite retention of DNA samples and profiles of all individuals charged or arrested for any crime whether convicted or not.
3. Semi-restrictive regime (2013 – present): introduced by the Protection of Freedoms Act 2012 (PoFA); requires the destruction of DNA samples after profiling and indefinite retention of DNA profiles of all convicted individuals except some first-time convicted minors and conditional temporal retention for individuals charged or arrested for a serious offence.

The data collected from the survey will be anonymised and it will be impossible to identify participants from the results. The survey questionnaire includes 20 short questions and should take around 15 minutes to complete.

To answer the survey, click on the Next button below.

The survey closes on **Tuesday 31st July 2018**.

For more information please contact the researcher. Thank you for your time and considering my request.

Yours sincerely,

Aaron Amankwaa.

Tel: +44 (0)7442929880

Email: aaron.amankwaa@northumbria.ac.uk

Page 2

Informed Consent Form for research participants

I have read, understood and signed the attached Participants Informed Consent Form. I consent to participate in this study ✱ *Required*

- ○ Yes
- ○ No

Page 3

Questionnaire about forensic DNA data retention regimes in England and Wales

Introduction

This survey focuses on seven effectiveness criteria identified from the literature: crime-solving capacity; incapacitation effect; deterrence effect; protection of genetic privacy; proportionality; implementation efficiency; and implementation cost.

The survey seeks your views about the effectiveness of the three DNA retention regimes: Restrictive (1995-2001), Expansive (2001-2013) and Semi-restrictive (2013 - present) regimes. Please respond to all the questions to the best of your knowledge. There are no right or wrong answers. The data collected from this survey will be anonymised and it will be impossible to identify participants from the results. Access to the data will be restricted to the researcher and the supervision team.

Thank you for participating in this survey. Your feedback is important.

Page 4

Your Details

Gender: ✱ *Required*

- ○ Male
- ○ Female
- ○ Other

If you selected Other, please specify:

Age ✱ *Required*

Employment information:

Organization/agency/committee:

Current rank/job title/job level:

What is your primary area of specialisation?

If you selected Other, please specify:

Total years of experience:

Page 5

Crime-solving Capacity

(Ability of the DNA database to help the police solve crime)

1. How would you rate the crime-solving capacity of the different retention regimes?

	Not at all effective	Slightly effective	Moderately effective	Very effective	Extremely effective
Restrictive regime	○	○	○	○	○
Expansive regime	○	○	○	○	○
Semi-restrictive regime	○	○	○	○	○

2. In your opinion, which regime is the most effective in solving crime?

- ○ Restrictive regime
- ○ Expansive regime
- ○ Semi-restrictive regime

3. In your opinion, what would improve the crime-solving capacity of the NDNAD?

If you selected Other, please specify:

Incapacitation Effect

(The ability of DNA database matches/hits to lead to or assist in the incapacitation of offenders through imprisonment or other custodial disposals)

4. How would you rate the incapacitation effect of the different retention regimes?

	Not at all effective	Slightly effective	Moderately effective	Very effective	Extremely effective
Restrictive regime	○	○	○	○	○
Expansive regime	○	○	○	○	○
Semi-restrictive regime	○	○	○	○	○

5. In your opinion, which retention regime has the most effective incapacitation effect?

- ○ Restrictive regime
- ○ Expansive regime
- ○ Semi-restrictive regime

6. In your opinion, what would improve the incapacitation effect of the NDNAD?

If you selected Other, please specify:

Page 6

Deterrence Effect

(Ability of the DNA database to deter people from committing crime)

7. How would you rate the deterrence effect of the different retention regimes?

	Not at all effective	Slightly effective	Moderately effective	Very effective	Extremely effective
Restrictive regime	○	○	○	○	○
Expansive regime	○	○	○	○	○
Semi-restrictive regime	○	○	○	○	○

8. In your opinion, which of the three retention regimes has the most effective deterrence effect?

- ○ Restrictive regime
- ○ Expansive regime
- ○ Semi-restrictive regime

9. In your opinion, what would improve the deterrence effect of the NDNAD?

If you selected Other, please specify:

Page 7

Protection of Genetic Privacy

(How well the retention regime prevents the invasion of the genetic privacy of individuals)

10. How would you rate the genetic privacy protection of individuals under each retention regime?

	Not at all satisfactory	Not satisfactory	Somewhat satisfactory	Satisfactory	Very satisfactory
Restrictive regime	○	○	○	○	○
Expansive regime	○	○	○	○	○
Semi-restrictive regime	○	○	○	○	○

11. In your opinion, the most appropriate retention regime for protecting the genetic privacy of individuals is the...

- ○ Restrictive regime
- ○ Expansive regime
- ○ Semi-restrictive regime

12. In your opinion, what would improve the genetic privacy protection of individuals in the operation of the NDNAD? *(**More than one answer may be selected**)*

- ☐ Fixed retention of profiles of all convicted individuals based on maximum sentence of offence
- ☐ Fixed retention of profiles of all convicted individuals based on duration of actual sentence
- ☐ Deletion of DNA records of all unconvicted individuals
- ☐ Retention of DNA profiles of all unconvicted individuals based on informed consent
- ☐ Other

If you selected Other, please specify:

Proportionality

(How well the retention regime balances public and individual interests)

13. How would you rate the proportionality of each retention regime?

	Extremely skewed toward public interest	Slightly skewed toward public interest	Proportional	Slightly skewed toward individual interest	Extremely skewed toward individual interest
Restrictive regime	○	○	○	○	○
Expansive regime	○	○	○	○	○
Semi-restrictive regime	○	○	○	○	○

Page 8

Implementation Efficiency

(How easy it is to implement the retention regime in terms of time and effort)

14. In your opinion, how easy is it to implement each type of retention regime?

	Very easy	Easy	Medium	Difficult	Very difficult
Restrictive regime	○	○	○	○	○
Expansive regime	○	○	○	○	○
Semi-restrictive regime	○	○	○	○	○

15. Do you have any other comments on the implementation efficiency of the current semi-restrictive (PoFA) regime?

Implementation Cost

(Resources or financial input into the implementation of the retention regime)

16. In your opinion, the implementation of each retention regime is...

	Not cost-effective	Slightly cost-effective	Moderately cost-effective	Very cost-effective	Extremely cost-effective
Restrictive regime	○	○	○	○	○
Expansive regime	○	○	○	○	○
Semi-restrictive regime	○	○	○	○	○

Page 9

Overall Effectiveness Rating

17. Overall, how would you rate each retention regime at ensuring an effective NDNAD?

	Not at all effective	Slightly effective	Moderately effective	Very effective	Extremely effective
Restrictive regime	○	○	○	○	○
Expansive regime	○	○	○	○	○
Semi-restrictive regime	○	○	○	○	○

18. How would you rate the level of importance of the seven effectiveness criteria? *(1 = low importance; 7 = extremely important)*

Please don't select more than 1 answer(s) per row.

	1	2	3	4	5	6	7
Crime-solving capacity	☐	☐	☐	☐	☐	☐	☐
Incapacitation effect	☐	☐	☐	☐	☐	☐	☐
Deterrence effect	☐	☐	☐	☐	☐	☐	☐
Protection of genetic privacy	☐	☐	☐	☐	☐	☐	☐
Proportionality	☐	☐	☐	☐	☐	☐	☐
Implementation efficiency	☐	☐	☐	☐	☐	☐	☐
Implementation cost	☐	☐	☐	☐	☐	☐	☐

19. Are there any other criteria to measure in terms of effectiveness?

20. Any other comments:

Reference ID: Please write your initials/birth year *(Example, RAA/1994)*:

Key for selection options

3 - Age

18-24
25-34
35-44
45-54
55-64
65 or older

6 - What is your primary area of specialisation?

Forensic Science
Law
Law Enforcement
Criminology
Medicine
Bioethics and Human rights
Other

10 - 3. In your opinion, what would improve the crime-solving capacity of the NDNAD?

Indefinite retention of all arrestee DNA samples and profiles
Indefinite retention of all arrestee DNA profiles
100 years retention of all arrestee DNA samples and profiles
100 years retention of all arrestee DNA profiles
Retention of DNA samples and profiles until death of arrestee
Retention of DNA profiles until death of arrestee
6 years' retention of all unconvicted people's DNA profiles
3 years' retention of all unconvicted people's DNA profiles
Other

13 - 6. In your opinion, what would improve the incapacitation effect of the NDNAD?

Indefinite retention of all arrestee DNA samples and profiles
Indefinite retention of all arrestee DNA profiles
100 years retention of all arrestee DNA samples and profiles
100 years retention of all arrestee DNA profiles
Retention of DNA samples and profiles until death of arrestee
Retention of DNA profiles until death of arrestee
6 years' retention of all unconvicted people's DNA profiles
3 years' retention of all unconvicted people's DNA profiles
Other

16 - 9. In your opinion, what would improve the deterrence effect of the NDNAD?

Indefinite retention of DNA samples and profiles of all citizens
Indefinite retention of DNA profiles of all citizens
Indefinite retention of all arrestee DNA samples and profiles
Indefinite retention of all arrestee DNA profiles
100 years retention of all arrestee DNA samples and profiles
100 years retention of all arrestee DNA profiles
Retention of DNA samples and profiles until death of arrestee
Retention of DNA profiles until death of arrestee
6 years' retention of all unconvicted people's DNA profiles
3 years' retention of all unconvicted people's DNA profiles
Other

Appendix VII – Organisation consent form: stakeholder survey

RESEARCH **ORGANISATION** INFORMED CONSENT FORM

Faculty of Business and Law
University of Northumbria

Completion of this form is required whenever research is being undertaken by Business and Law staff or students within any organisation. This applies to research that is carried out on the premises, or is about an organisation, or members of that organisation or its customers, as specifically targeted as subjects of research.

The researcher must supply an explanation to inform the organisation of the purpose of the study, who is carrying out the study, and who will eventually have access to the results. In particular issues of anonymity and avenues of dissemination and publications of the findings should be brought to the organisations' attention.

Researcher's Name: Aaron Opoku Amankwaa

Student ID No. (if applicable): 16029525

Researcher's Statement:

Research Purpose
The purpose of this research is to assess the efficacy and impact of the different retention regimes governing the United Kingdom National DNA Database (NDNAD). The study aims to determine any reforms that may be needed to maximize the utility of the NDNAD and enhance the protection of public security and the individual's right to privacy. In addition to statistical analysis of available NDNAD match rate data, the research seeks the views of criminal justice professionals, law enforcement policy officers and policy makers in England and Wales.

Parties Involved?
- The NDNAD stakeholder agency/organization/group/committee.
- Staff/members/employees of stakeholder organizations who are happy to participate in the study. The researcher will send a letter of invitation explaining the details of the research to each stakeholder and prospective respondents to participate in the study.
- The research will be conducted by Aaron Opoku Amankwaa, a doctoral research student at Northumbria University School of Law. Aaron's background is in Forensic Science.
- Organization and individual participation is entirely voluntary and each may withdraw at any time.

Research Methods
A self-administered semi-structured questionnaire will be used to collect data from participants of the study. The data will be collected using the Bristol Online Survey (BOS) package. Organizations and individual participants will be provided with a research information leaflet and consent form which they will be required to sign before completing the survey questionnaire. The consent form must be returned to the researcher via post or email.

Timescale
The data collection timescale is from October 2017 – July 2018.

Time Commitment
The survey questionnaire will require a maximum of 30 minutes to complete.

Anonymity
All information in this study will be anonymised, with all names of organizations and people coded.

Confidentiality
Your right to confidentiality will be respected and where participant data is published the anonymity of participants will be maintained.[1] All data will be stored securely in a locked filing cabinet and electronic versions of the data will be stored on a password protected computer. Access to data will be restricted to the researcher and the supervision team.

Information collected from participants will be retained for a maximum of 10 years after data collection (31st July, 2018). In accordance with Northumbria University's guidance on *Data Protection and Secure Storage of Research*

[1] In an unlikely event disclosure may be required by law or necessary in the public interest

Record, para. 18, electronic materials will be archived within the Law School. Hard copy records will be retained at Northumbria University's offsite storage facility. A record of archived material will be retained centrally within the Law School together with a clear indication of the length of retention, with Law School staff having sufficient access to ensure authorised and certified destruction of the data by 31st July 2028.

All hard copies and electronic materials will be destroyed after the retention period.

Research Dissemination
Data obtained through this research will be reproduced and published in a variety of forms and for a variety of audiences related to the broad nature of the research detailed above (i.e. conferences, peer reviewed journals, articles etc.).

Queries
Please direct any queries regarding this research to Aaron Opoku Amankwaa on 07442929880 or aaron.amankwaa@northumbria.ac.uk

Any organisation manager or representative who is empowered to give consent may do so here:

Name: _____

Position/Title: _____

Organisation Name: _____

Location: _____

If the organisation is the Faculty of Business and Law, please complete the following:

Start/End Date of Research / Consultancy project:	Start: End:
Programme Year Sample to be used: seminar group, entire year etc.	
Has Programme Director/Leader, Module Tutor being consulted, informed.	

Anonymity must be offered to the organisation if it does not wish to be identified in the research report. Confidentiality is more complex and cannot extend to the markers of student work or the reviewers of staff work, but can apply to the published outcomes. If confidentiality is required, what form applies?

[ ] No confidentiality required
[ ] Masking of organisation name in research report
[ ] No publication of the research results without specific organisational consent
[ ] Other by agreement as specified by addendum

Signature: _____ Date: _____

This form can be signed via email if the accompanying email is attached with the signer's personal email address included. The form cannot be completed by phone, rather should be handled via post.

Appendix VIII – Participant consent form: stakeholder survey

Faculty of Business and Law
Informed Consent Form for research participants

Title of Study:	Forensic DNA Databasing: Retention Regimes and Efficacy
Person(s) conducting the research:	Researcher: Aaron Opoku Amankwaa Principal Supervisor: Dr Carole McCartney Second Supervisor: Dr Nicola Wake
Programme of study:	Law PhD
Address of the researcher for correspondence:	School of Law Northumbria University Newcastle upon Tyne NE1 8ST
Telephone:	07442929880
E-mail:	aaron.amankwaa@northumbria.ac.uk
Description of the broad nature of the research:	This research is assessing the efficacy and impact of the different retention regimes governing the United Kingdom National DNA Database (NDNAD). The purpose of the research is to determine any reforms that may be needed to maximize the utility of the NDNAD and enhance the protection of public security and the individual's right to privacy. The research is seeking the views of criminal justice professionals, law enforcement policy officers and policy makers in England and Wales.
Description of the involvement expected of participants including the broad nature of questions to be answered or events to be observed or activities to be undertaken, and the expected time commitment:	As a participant of this study, you will be asked to complete a self-administered semi-structured questionnaire. The data will be collected using the Bristol Online Survey (BOS) package. The questionnaire will take a maximum of 30 minutes to complete. You will be asked to rate the effectiveness of the different NDNAD retention regimes against effectiveness criteria identified from literature. You will also be asked to suggest how the NDNAD retention regime can be improved. All information about you will have a code instead of your name/address to maintain anonymity.
Description of how the data you provide will be securely stored and/or destroyed upon completion of the project.	Data collected from you will be retained in locked filing cabinets and participants will be unidentifiable by the records. Electronic versions of the data will be stored on a password protected computer.

	Access to the data will be restricted to the researcher and the supervision team. The collected data will be retained for a maximum of 10 years after the conclusion of data collection (31st July, 2018). In accordance with Northumbria University's guidance, electronic materials will be archived within the Law School. Hard copy records will be retained at Northumbria University's offsite storage facility. A record of archived material will be retained centrally within the Law School together with a clear indication of the length of retention, with Law School staff having sufficient access to ensure authorised and certified destruction of the data by 31st July 2028. All hard copies and electronic materials will be destroyed after the retention period.

Information obtained in this study, including this consent form, will be kept strictly confidential (i.e. will not be passed to others) and anonymous (i.e. individuals and organisations will not be identified *unless this is expressly excluded in the details given above*).

Data obtained through this research may be reproduced and published in a variety of forms and for a variety of audiences related to the broad nature of the research detailed above. It will not be used for purposes other than those outlined above without your permission.

Participation is entirely voluntary and you may withdraw at any time.

By signing this consent form, you are indicating that you fully understand the above information and agree to participate in this study on the basis of the above information.

Participant's signature:		**Date:**
Student's signature:		**Date:**

Please keep one copy of this form for your own records

Appendix IX – Questionnaire assessment form

Northumbria University NEWCASTLE

Questionnaire Assessment Form

Page 1

1. Approximately how many minutes did it take for you to complete the questionnaire?

2. Please rate the questionnaire on the following parameters?

	Appropriate	Slightly appropriate	Neutral	Slightly inappropriate	Inappropriate
Length	○	○	○	○	○
Layout	○	○	○	○	○
Content	○	○	○	○	○
Design	○	○	○	○	○

2.a. Any comments/suggestions/improvements?

3. Please rate how easy or difficult it was to complete the questionnaire:

- ○ Very easy
- ○ Easy
- ○ Neutral
- ○ Difficult
- ○ Very difficult

3.a. Any comments/suggestions/improvements?

4. Were any of the items ambiguous or difficult to comprehend?

5. Please provide any other comments, suggestions or improvements:

6. Reference ID: Please write your initials/birth year (Example, RAA/1994): ✱ *Required*

Appendix X – Stakeholder survey respondent progress

Page	p.1	p.2	p.3	P.4	p.5	p.6	p.7	p.8	p.9	p.10 – complete responses
Number	207	46	7	23	60	3	2	0	5	31

Appendix XI – National DNA Database match statistics from 2003/04 – 2016/17

Month	No. of Crime Scene Matches	Crime Scene Profile Load	Scene Load Match Rate (%)	No. of Subject Matches	Subject Profile Load	Subject Load Match Rate (%)		Total Crime Scene Load retained	Total Subject Load retained	Annual Scene Load Match Rate (%)	Annual Subject Load Match Rate (%)	Annual subject matches per total scene load retained (%)	Annual crime scene matches per total subject load retained (%)
Apr-03	1153.00	4793.00	24.06	541.00	33322.00	1.62							
May-03	1272.00	4840.00	26.28	716.00	38871.00	1.84							
Jun-03	1330.00	5449.00	24.41	714.00	37856.00	1.89							
Jul-03	1344.00	5327.00	25.23	801.00	45359.00	1.77							
Aug-03	1178.00	4365.00	26.99	638.00	38375.00	1.66							
Sep-03	1474.00	5437.00	27.11	655.00	36603.00	1.79							
Oct-03	1544.00	5664.00	27.26	663.00	38108.00	1.74							
Nov-03	1102.00	4127.00	26.70	645.00	35069.00	1.84							
Dec-03	1181.00	4401.00	26.83	553.00	33149.00	1.67							
Jan-04	1280.00	4827.00	26.52	774.00	39335.00	1.97							
Feb-04	1513.00	5210.00	29.04	702.00	42220.00	1.66							
Mar-04	1686.00	5786.00	29.14	788.00	57030.00	1.38		228463	2527728	26.63	1.74	3.58	0.635234
Apr-04	1270.00	4673.00	27.18	576.00	36877.00	1.56							
May-04	1401.00	4492.00	31.19	633.00	32507.00	1.95							
Jun-04	1650.00	5290.00	31.19	793.00	42825.00	1.85							
Jul-04	1689.00	4821.00	35.03	783.00	43291.00	1.81							
Aug-04	1566.00	4509.00	34.73	829.00	49153.00	1.69							
Sep-04	1447.00	4478.00	32.31	622.00	31832.00	1.95							
Oct-04	1773.00	4931.00	35.96	931.00	48573.00	1.92							
Nov-04	1634.00	4921.00	33.20	896.00	49035.00	1.83							
Dec-04	1584.00	4762.00	33.26	831.00	48064.00	1.73							

Jan-05	1958.00	5286.00	37.04	818.00	44039.00	1.86						
Feb-05	2168.00	5443.00	39.83	807.00	45925.00	1.76						
Mar-05	2263.00	5642.00	40.11	850.00	48996.00	1.73	232343	3085766	34.25	1.80	4.03	0.661197
Apr-05	2263.00	5217.00	43.38	961.00	50577.00	1.90						
May-05	3543.00	10719.00	33.05	918.00	52704.00	1.74						
Jun-05	3097.00	6884.00	44.99	937.00	53404.00	1.75						
Jul-05	2647.00	5097.00	51.93	800.00	50578.00	1.58						
Aug-05	2697.00	5153.00	52.34	907.00	54437.00	1.67						
Sep-05	2930.00	5646.00	51.90	1049.00	64118.00	1.64						
Oct-05	2894.00	5173.00	55.94	920.00	61915.00	1.49						
Nov-05	2756.00	5309.00	51.91	1024.00	67869.00	1.51						
Dec-05	2190.00	3965.00	55.23	856.00	55153.00	1.55						
Jan-06	2864.00	5481.00	52.25	960.00	63247.00	1.52						
Feb-06	2527.00	4966.00	50.89	910.00	70888.00	1.28						
Mar-06	2684.00	5164.00	51.98	974.00	70349.00	1.38	271903	3785571	49.65	1.58	4.13	0.874161
Apr-06	2477.00	4637.00	53.42	865.00	49407.00	1.75						
May-06	2584.00	4926.00	52.46	1011.00	70413.00	1.44						
Jun-06	2582.00	4793.00	53.87	899.00	55778.00	1.61						
Jul-06	2483.00	4871.00	50.98	1001.00	66370.00	1.51						
Aug-06	2513.00	4663.00	53.89	1097.00	78647.00	1.39						
Sep-06	2660.00	4647.00	57.24	1018.00	64478.00	1.58						
Oct-06	2395.00	4716.00	50.78	951.00	59470.00	1.60						
Nov-06	2354.00	4503.00	52.28	905.00	63636.00	1.42						
Dec-06	2125.00	3715.00	57.20	738.00	48701.00	1.52						
Jan-07	2628.00	4756.00	55.26	849.00	55135.00	1.54						

Feb-07	2336.00	4407.00	53.01	822.00	54461.00	1.51						
Mar-07	2542.00	4583.00	55.47	888.00	55968.00	1.59	285848	4428376	53.82	1.54	3.86	0.670201
Apr-07	2606.00	4643.00	56.13	788.00	50077.00	1.57						
May-07	2451.00	4430.00	55.33	808.00	54718.00	1.48						
Jun-07	2567.00	4325.00	59.35	857.00	49701.00	1.72						
Jul-07	2382.00	4282.00	55.63	913.00	55273.00	1.65						
Aug-07	2416.00	4388.00	55.06	764.00	49025.00	1.56						
Sep-07	2591.00	4256.00	60.88	839.00	48632.00	1.73						
Oct-07	2486.00	4261.00	58.34	732.00	55322.00	1.32						
Nov-07	2313.00	4550.00	50.84	706.00	48716.00	1.45						
Dec-07	1858.00	3169.00	58.63	587.00	38827.00	1.51						
Jan-08	2277.00	4131.00	55.12	825.00	52176.00	1.58						
Feb-08	2188.00	4016.00	54.48	581.00	41707.00	1.39						
Mar-08	2284.00	4128.00	55.33	677.00	46854.00	1.44	324400	5056740	56.26	1.53	2.80	0.562002
Apr-08	2639.00	4593.00	57.46	847.00	48849.00	1.73						
May-08	2596.00	4331.00	59.94	822.00	47059.00	1.75						
Jun-08	2534.00	4216.00	60.10	766.00	48983.00	1.56						
Jul-08	2543.00	4214.00	60.35	938.00	50190.00	1.87						
Aug-08	2419.00	3906.00	61.93	901.00	54260.00	1.66						
Sep-08	2467.00	4278.00	57.67	803.00	45214.00	1.78						
Oct-08	2549.00	4275.00	59.63	802.00	47159.00	1.70						
Nov-08	2201.00	3727.00	59.06	840.00	49276.00	1.70						
Dec-08	2071.00	3501.00	59.15	1277.00	43675.00	2.92						
Jan-09	2689.00	4353.00	61.77	1764.00	48117.00	3.67						
Feb-09	2162.00	3668.00	58.94	1254.00	44959.00	2.79						

Mar-09	2501.00	5157.00	48.50	2088.00	53069.00	3.93	350033	5617604	58.71	2.26	3.74	0.522839
Apr-09	2368.00	4588.00	51.61	1805.00	45570.00	3.96						
May-09	2306.00	3887.00	59.33	2078.00	48771.00	4.26						
Jun-09	2271.00	4465.00	50.86	1665.00	50568.00	3.29						
Jul-09	2206.00	3694.00	59.72	1586.00	48756.00	3.25						
Aug-09	2103.00	3707.00	56.73	1344.00	43614.00	3.08						
Sep-09	2595.00	4465.00	58.12	1368.00	45291.00	3.02						
Oct-09	2087.00	3549.00	58.81	1227.00	46380.00	2.65						
Nov-09	1619.00	2775.00	58.34	1356.00	36555.00	3.71						
Dec-09	2065.00	3379.00	61.11	1356.00	47926.00	2.83						
Jan-10	2010.00	2949.00	68.16	1405.00	36892.00	3.81						
Feb-10	1953.00	3028.00	64.50	1255.00	34232.00	3.67						
Mar-10	2088.00	3487.00	59.88	1341.00	37823.00	3.55	375620	6135990	58.93	3.42	4.74	0.418368
Apr-10	2134.00	3532.00	60.00	1284.00	38255.00	3.36						
May-10	2195.00	3461.00	63.00	1051.00	33824.00	3.11						
Jun-10	2293.00	3528.00	65.00	1537.00	36911.00	4.16						
Jul-10	2195.00	3337.00	66.00	1155.00	37665.00	3.07						
Aug-10	2068.00	3180.00	65.00	1185.00	35303.00	3.36						
Sep-10	1893.00	3081.00	61.00	1054.00	35671.00	2.95						
Oct-10	1779.00	2746.00	65.00	1228.00	35342.00	3.47						
Nov-10	1845.00	2945.00	63.00	1486.00	35241.00	4.22						
Dec-10	1462.00	2335.00	63.00	1323.00	30897.00	4.28						
Jan-11	1882.00	3090.00	61.00	1192.00	36698.00	3.25						
Feb-11	1802.00	3045.00	59.00	1051.00	35104.00	2.99						
Mar-11	2110.00	3625.00	58.00	1018.00	37391.00	2.72	400786	6171950	62.42	3.41	3.63	0.383315

Apr-11	1858.00	3040.00	61.00	784.00	31673.00	2.48						
May-11	2186.00	3547.00	62.00	863.00	37952.00	2.27						
Jun-11	2166.00	3554.00	61.00	811.00	35885.00	2.26						
Jul-11	2080.00	3384.00	61.00	846.00	34242.00	2.47						
Aug-11	2530.00	3917.00	65.00	911.00	36360.00	2.51						
Sep-11	2037.00	3394.00	60.00	889.00	34873.00	2.55						
Oct-11	1948.00	3206.00	61.00	661.00	30979.00	2.13						
Nov-11	1914.00	3221.00	59.00	689.00	33967.00	2.03						
Dec-11	1560.00	2567.00	61.00	569.00	30236.00	1.88						
Jan-12	1929.00	3198.00	60.00	732.00	32987.00	2.22						
Feb-12	1671.00	2793.00	60.00	538.00	29227.00	1.84						
Mar-12	1892.00	3046.00	62.00	550.00	30464.00	1.81	405848	6969396	61.08	2.20	2.18	0.341077
Apr-12	1664.00	2755.00	60.40	419.00	27138.00	1.54						
May-12	1681.00	2774.00	60.60	538.00	29934.00	1.80						
Jun-12	1642.00	2611.00	62.89	419.00	27564.00	1.52						
Jul-12	1803.00	3023.00	59.64	440.00	30684.00	1.43						
Aug-12	1809.00	2957.00	61.18	528.00	33339.00	1.58						
Sep-12	1754.00	2692.00	65.16	582.00	29478.00	1.97						
Oct-12	1690.00	2803.00	60.29	650.00	33907.00	1.92						
Nov-12	1701.00	2794.00	60.88	663.00	31918.00	2.08						
Dec-12	1526.00	2339.00	65.24	546.00	27227.00	2.01						
Jan-13	1904.00	2896.00	65.75	521.00	32233.00	1.62						
Feb-13	1801.00	2729.00	65.99	439.00	28777.00	1.53						
Mar-13	1835.00	2817.00	65.14	466.00	30119.00	1.55	428634	6737973	62.76	1.71	1.45	0.308847

Apr-13	1829.00	2824.00	64.77	350.00	28960.00	1.21						
May-13	1881.00	2920.00	64.42	375.00	30844.00	1.22						
Jun-13	1914.00	2907.00	65.84	370.00	28305.00	1.31						
Jul-13	2071.00	3018.00	68.62	409.00	32002.00	1.28						
Aug-13	1992.00	2915.00	68.34	388.00	29007.00	1.34						
Sep-13	1938.00	2879.00	67.32	351.00	28878.00	1.22						
Oct-13	1978.00	3121.00	63.38	433.00	30180.00	1.43						
Nov-13	1711.00	2741.00	62.42	426.00	28659.00	1.49						
Dec-13	1714.00	2650.00	64.68	421.00	29649.00	1.42						
Jan-14	1734.00	2987.00	58.05	424.00	35908.00	1.18						
Feb-14	1847.00	2813.00	65.66	376.00	28571.00	1.32						
Mar-14	2029.00	3252.00	62.39	472.00	31160.00	1.51	456856	5716085	64.66	1.33	1.05	0.39604
Apr-14	1833.00	2798.00	65.51	388.00	26617.00	1.46						
May-14	2119.00	3226.00	65.69	476.00	31322.00	1.52						
Jun-14	1930.00	2909.00	66.35	447.00	30083.00	1.49						
Jul-14	2073.00	3072.00	67.48	802.00	25206.00	3.18						
Aug-14	1874.00	2877.00	65.14	397.00	23736.00	1.67						
Sep-14	2034.00	3138.00	64.82	452.00	24528.00	1.84						
Oct-14	2068.00	3274.00	63.16	493.00	27387.00	1.80						
Nov-14	1937.00	3140.00	61.69	378.00	24333.00	1.55						
Dec-14	1951.00	3064.00	63.67	441.00	25048.00	1.76						
Jan-15	1941.00	3137.00	61.87	489.00	25520.00	1.92						
Feb-15	1813.00	2977.00	60.90	405.00	24161.00	1.68						
Mar-15	2047.00	3321.00	61.64	454.00	23805.00	1.91	486691	5766369	63.99	1.82	1.16	0.409617
Apr-15	1841.00	3336.00	55.19	417.00	24400.00	1.71						

May-15	2137.00	3510.00	60.88	433.00	23648.00	1.83						
Jun-15	2136.00	3358.00	63.61	451.00	24786.00	1.82						
Jul-15	2283.00	3659.00	62.39	518.00	26071.00	1.99						
Aug-15	1952.00	3119.00	62.58	394.00	22389.00	1.76						
Sep-15	2220.00	3410.00	65.10	430.00	23670.00	1.82						
Oct-15	2220.00	3451.00	64.33	486.00	25808.00	1.88						
Nov-15	2035.00	3179.00	64.01	401.00	22510.00	1.78						
Dec-15	1824.00	2806.00	65.00	385.00	22826.00	1.69						
Jan-16	2062.00	3111.00	66.28	471.00	27615.00	1.71						
Feb-16	1961.00	3043.00	64.44	367.00	23049.00	1.59						
Mar-16	2218.00	3388.00	65.47	481.00	25539.00	1.88	519678	5860642	63.27	1.79	1.01	0.42468
Apr-16	2234.00	3329.00	67.10	481.00	25448.00	1.89						
May-16	2196.00	3341.00	65.70	404.00	23971.00	1.69						
Jun-16	2218.00	3388.00	65.47	481.00	25539.00	1.88						
Jul-16	2219.00	3300.00	67.20	453.00	24550.00	1.85						
Aug-16	2254.00	3306.00	68.18	434.00	22984.00	1.89						
Sep-16	2376.00	3546.00	67.00	428.00	21153.00	2.02						
Oct-16	2313.00	3431.00	67.40	476.00	20384.00	2.34						
Nov-16	2288.00	3529.00	64.80	444.00	21032.00	2.11						
Dec-16	2190.00	3387.00	64.70	382.00	18145.00	2.11						
Jan-17	2348.00	3523.00	66.60	468.00	23506.00	1.99						
Feb-17	2025.00	3193.00	63.40	392.00	20170.00	1.94						
Mar-17	2294.00	3556.00	64.50	434.00	22607.00	1.92	555,362	6,024,032	66.00	1.97	0.95	0.447458

Appendix XII – Publications and presentations derived from this research

Journal publications

1. Amankwaa, A. O. (2019). Towards a reformed policy for immigrant DNA tests, a commentary. Journal of Forensic and Legal Medicine, 66, 117–119. https://doi.org/10.1016/j.jflm.2019.06.016

2. Amankwaa, A. O., & McCartney, C. (2019). The effectiveness of the UK national DNA database. Forensic Science International: Synergy, 1, 45–55. https://doi.org/10.1016/j.fsisyn.2019.03.004

3. Amankwaa, A. O. (2019). Trends in forensic DNA database: transnational exchange of DNA data. Forensic Sciences Research, 0(0), 1–7. https://doi.org/10.1080/20961790.2019.1565651

4. Amankwaa, A. O., & McCartney, C. (2018). The UK National DNA Database: Implementation of the Protection of Freedoms Act 2012. Forensic Science International, 284, 117–128. https://doi.org/10.1016/j.forsciint.2017.12.041

5. Amankwaa, A. O. (2018). Forensic DNA retention: Public perspective studies in the United Kingdom and around the world. Science & Justice, 58(6), 455–464. https://doi.org/10.1016/j.scijus.2018.05.002

Technical reports to parliamentary committees

1. McCartney, C., & Amankwaa, A. (2019). Scottish Biometrics Commissioner Bill: Submission from Professor Carole McCartney and Aaron Amankwaa, Northumbria University. https://doi.org/10.13140/RG.2.2.33785.62561

2. McCartney, C., Evison, M., Amoako, E. N., & Amankwaa, A. (2019). Written evidence submitted by the Science and Justice Research Interest Group, University of Northumbria to the Science and Technology Committee (Commons) inquiry on the work of the Biometrics Commissioner and Forensic Science Regulator (WBC0004). Retrieved from Science and Technology Committee (Commons) website: http://data.parliament.uk/writtenevidence/committeeevidence.svc/evidencedocument/science-and-technology-committee/the-work-of-the-biometrics-commissioner-and-the-forensic-science-regulator/written/97821.pdf

3. McCartney, C., Evison, M., Ward, T., Wortley, N., Piasecki, E., Amoako, E. N., Amankwaa, A. & Jackson, A. (2018). Science and Justice Research Interest Group (RIG), Northumbria University - written evidence to the Science and Technology Committee (Lords) inquiry on forensic science (FRS0051) (No. FRS0051). Retrieved from Science and Technology Committee (Lords) website: http://data.parliament.uk/writtenevidence/committeeevidence.svc/evidencedocument/science-and-technology-committee-lords/forensic-science/written/89775.pdf

Oral presentations

1. Amankwaa, OA. *"Forensic DNA retention: Public perspective studies in the United Kingdom and around the world."* 2018 EASST conference: Meetings – Making Science, Technology and Society together, Lancaster University, Lancaster, 27th July 2018.

2. Amankwaa, OA. "*Trends in forensic DNA databasing: transnational exchange of DNA data.*" Doctoral and Faculty Research Conference 2018, Faculty of Business and Law, Northumbria University, Newcastle, 28th June 2018.

3. Amankwaa, OA. *"The England & Wales National DNA Database: retention regimes & efficacy."* Autumn Conference & AGM 2017: Forensic Biometrics: the future, Chartered Society of Forensic Sciences, Novotel Nottingham Derby Hotel, Nottingham, 3rd November 2017.

4. Amankwaa, OA. *"The UK National DNA Database: retention regimes and efficacy"*, Northumbria University Forensic Science Research Group, Home Office Briefing, Northumbria University, Newcastle Upon Tyne, 19th July 2017.

5. Amankwaa, OA. *"The UK National DNA Database: Implementation of the Protection of Freedoms Act 2012",* North-East Law Forum (NELF) PGR Conference, Northumbria University, Newcastle Upon Tyne, 30th June 2017.

6. Amankwaa, OA. "*How to assess the efficacy of forensic DNA database retention regimes?"* Doctoral and Faculty Research Conference (DFRC), Faculty of Business and Law, Northumbria University, Newcastle upon Tyne, 29th June 2017.

7. Amankwaa, OA. *"The UK National DNA Database: Implementation of the Protection of Freedoms Act 2012",* Northumbria University Postgraduate Research Society Seminar, Northumbria University, Newcastle Upon Tyne, 28th April 2017.

8. Amankwaa, OA. *"Forensic DNA databasing: retention regimes and efficacy",* Northumbria University Forensic Science Research Group, Home Office Briefing, Northumbria University, Newcastle Upon Tyne, 23rd March 2017.

Poster presentations

1. Amankwaa, OA. *"Is the public willing to voluntarily participate in the UK National DNA Database?"* Doctoral and Faculty Research Conference 2019, Faculty of Business and Law, Northumbria University, Newcastle, 18-19th June 2019.

2. Amankwaa, OA. *"Public security functions of the UK National DNA Database."* Doctoral and Faculty Research Conference 2019, Faculty of Business and Law, Northumbria University, Newcastle, 18-19th June 2019.

3. Amankwaa, OA & McCartney, C. "*Efficacy of different retention regimes for the United Kingdom National DNA Database",* ThermoFisher Scientific, Human Identification Solutions (HIDS) 2017 Conference, Austria Trend Hotel Savoyen, Vienna, Austria, 16th – 17th May 2017.

4. Amankwaa, OA. *"Forensic DNA Databasing: Retention Regimes and Efficacy"*, Socio-Legal Studies Association (SLSA) 2017 Conference, Newcastle University, Newcastle upon Tyne, 5th – 7th April 2017.

Appendix XIII – Normality Testing

Crime-solving capacity

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Restrictive regime	.268	30	.000	.853	30	.001
Expansive regime	.311	30	.000	.760	30	.000
Semi-restrictive regime	.288	30	.000	.858	30	.001

a. Lilliefors Significance Correction

Incapacitation effect

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Restrictive regime	.270	31	.000	.859	31	.001
Expansive regime	.237	31	.000	.817	31	.000
Semi-restrictive regime	.298	31	.000	.807	31	.000

a. Lilliefors Significance Correction

Deterrence Effect

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Restrictive regime	.293	30	.000	.854	30	.001
Expansive regime	.185	30	.011	.903	30	.010
Semi-restrictive regime	.231	30	.000	.882	30	.003

a. Lilliefors Significance Correction

Proportionality

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Restrictive regime	.242	30	.000	.857	30	.001
Expansive regime	.227	30	.000	.862	30	.001
Semi-restrictive regime	.260	30	.000	.857	30	.001

a. Lilliefors Significance Correction

Implementation efficiency

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Restrictive regime	.240	30	.000	.904	30	.011
Expansive regime	.233	30	.000	.841	30	.000
Semi-restrictive regime	.224	30	.001	.869	30	.002

a. Lilliefors Significance Correction

Implementation cost

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Restrictive regime	.223	29	.001	.912	29	.019
Expansive regime	.243	29	.000	.894	29	.007
Semi-restrictive regime	.268	29	.000	.867	29	.002

a. Lilliefors Significance Correction

Protection of genetic privacy

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Restrictive regime	.306	31	.000	.819	31	.000
Expansive regime	.210	31	.001	.900	31	.007
Semi-restrictive regime	.297	31	.000	.840	31	.000

a. Lilliefors Significance Correction

Overall effectiveness

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Restrictive regime	.219	31	.001	.883	31	.003
Expansive regime	.227	31	.000	.847	31	.000
Semi-restrictive regime	.244	31	.000	.889	31	.004

a. Lilliefors Significance Correction

Appendix XIV – Ethics approval for PhD project

RE: Ethics Application - Amendments required

ethicssupport

Fri 27/01/2017 13:42

To: aaron.amankwaa <aaron.amankwaa@northumbria.ac.uk>
Cc: Carole McCartney <carole.mccartney@northumbria.ac.uk>; Nicola Wake <nicola.wake@northumbria.ac.uk>; ethicssupport <ethicssupport@northumbria.ac.uk>

Dear Aaron,

Faculty of Business and Law Ethics Review
Title: Forensic DNA Databasing: Retention Regimes and Efficacy

I am pleased to confirm that following review of the above proposal, ethical approval has been granted on the basis of this proposal and subject to compliance with the University policies on ethics and consent and any other policies applicable to your individual research.

The reviewer left the following comment "there is no need to give a detailed reference to the University policy on the consent form – it's better kept simple."

All researchers must also notify this office of the following:

- Any significant changes to the study design;
- Any incidents which have an adverse effect on participants, researchers or study outcomes;
- Any suspension or abandonment of the study;

Best wishes,

Frances Leach | Research Administrator (Ethics) | Research and Business Services

northumbria UNIVERSITY NEWCASTLE

T: +44 (0)191 227 3656
E: frances2.leach@northumbria.ac.uk
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HR EXCELLENCE IN RESEARCH

Improving Sustainability Together

Appendix XV – Ethics approval for NDNAD match rate research

NDNAD Match rate research

Goryll Caroline <Caroline.Goryll@homeoffice.pnn.police.uk>

Thu 22/06/2017 11:40

To: aaron.amankwaa <aaron.amankwaa@northumbria.ac.uk>; Carole McCartney <carole.mccartney@northumbria.ac.uk>; Nicola Wake <nicola.wake@northumbria.ac.uk>

Cc: Faulkner Kirsty <Kirsty.Faulkner@homeoffice.pnn.police.uk>

Hello,

Your research proposal requesting access to data from the NDNAD on match rates was discussed at the Strategy Board yesterday.

The Strategy board accepted the proposal and thought it would be a valuable piece of research. This acceptance is reliant on the need for appropriate peer review of the research and that the output of the research is presented to the Strategy Board.

Kind Regards,

Caroline

Caroline Goryll
Performance & Impact Analyst

Forensic Information Database Service,
HO Security, Science and Innovation,
Home Office

Office: 0845 015 1214

Please note my working days are Wednesday - Friday

Appendix XVI – Ethics approval for public survey

Research Ethics: Your submission has been approved

EthicsOnline@Northumbria

Tue 12/06/2018 14:10

To: aaron.amankwaa <aaron.amankwaa@northumbria.ac.uk>

Dear aaron.amankwaa,

Submission Ref: 9718

Following independent peer review of the above proposal*, I am pleased to inform you that **APPROVAL** has been granted on the basis of this proposal and subject to continued compliance with the University policies on ethics, informed consent, and any other policies applicable to your individual research. You should also have current Disclosure & Barring Service (DBS) clearance if your research involves working with children and/or vulnerable adults.

* note: Staff Low Risk applications are auto-approved without independent peer review.

The University's Policies and Procedures are here

All researchers must also notify this office of the following:

- Any significant changes to the study design, by submitting an 'Ethics Amendment Form'
- Any incidents which have an adverse effect on participants, researchers or study outcomes, by submitting an 'Ethical incident Form'
- Any suspension or abandonment of the study.

Please check your approved proposal for any Approval Conditions upon which approval has been made.

Use this link to view the submission: View Submission

Research Ethics Home: Research Ethics Home

Please do not reply to this email. This is an unmonitored mailbox. If you are a student, queries should be discussed with your Module Tutor/Supervisor. If you are a member of staff please consult your Department Ethics Lead.

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