



postnote

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THE NATIONAL DNA DATABASE

Over 3 million DNA profiles from individuals are now on the National DNA Database® (NDNAD) and this number continues to increase. A series of legislative changes have contributed to the extensive expansion of the NDNAD. While there is overall support for the Database as an intelligence tool, there is a need to balance the benefits to society and individual rights. This POSTnote will provide an overview of the NDNAD and cover issues such as the retention of samples, ethical oversight of the Database and the extraction of information from DNA.

Background

DNA profiling

Deoxyribonucleic acid (DNA), found in virtually every cell in the body, contains genetic information that helps determine physical characteristics. A person's DNA is unique with the exception of identical twins. An individual inherits half their DNA from their father and half from their mother. Closely related individuals such as siblings have more similarities in their DNA than unrelated individuals. DNA profiling examines discrete parts of an individual's DNA that vary greatly from one person to another (Box 1). DNA profiles are derived from samples such as semen, saliva and blood.

The NDNAD

The National DNA Database, a world first, was established in 1995 in England and Wales. Scotland and Northern Ireland have their own DNA databases and submit profiles to the NDNAD. Following a series of legislative changes, DNA samples can be taken by the police from anyone arrested and detained in police custody in connection with a recordable offence. These are offences that have to be recorded on the Police National Computer to form part of a person's criminal record, and include most offences other than traffic offences. Samples can be non-intimate samples (typically

a mouth swab), which can be taken without the person's consent, or intimate samples (for example blood), which can be taken with the person's consent (known as criminal justice or CJ samples). A further two types of sample are stored on the Database: crime scene samples and samples taken from volunteers. The NDNAD contains the largest number of DNA profiles in absolute numbers and in terms of the proportion of the population represented on the Database (5.2% in the UK compared to 1.13% in the European Union and 0.5% in the USA¹) in the world. At the end of December 2005, the NDNAD held around 3.45 million CJ and elimination profiles and 263,923 crime scene sample profiles¹.

Box 1. DNA profiling

The technique currently used for DNA profiling in the UK is SGM Plus® (SGM+). It tests for ten markers known as Short Tandem Repeats (STRs) and a gender marker. STRs are short sequences of DNA that are repeated several times. The number of repeats varies between individuals. A DNA profile consists of 20 numbers and a gender indicator. The probability of the DNA profiles of two unrelated individuals matching is on average less than 1 in 1 billion (1,000,000,000). The discriminatory power of the analysis decreases for related individuals.

SGM, used prior to SGM+, analysed six of the same markers plus the gender marker and had a lower discriminatory power. Some profiles on the NDNAD are based on SGM (22% of CJ samples, 19% of crime scene samples²). SGM profiles are upgraded to SGM+ in the case of a match.

DNA profiles can be derived from minute samples of, for example saliva, blood and semen recovered from crime scenes. They can be used for identification, or to determine the extent to which people are related and may provide indications of ethnic origin. They do not provide any information on genetic disorders or susceptibilities.

The NDNAD and legislation

There is no specific legislation that set up the Database but legislation has provided for samples to be taken, stored and searched against records held by, or on behalf of, the Police. The progressive widening of police powers to take samples from suspects together with the permitted retention of samples and profiles, irrespective of whether an individual is acquitted or not charged, has resulted in a big expansion of the Database (Box 2).

Box 2. Legislation relating to the NDNAD

The following legislation has supported the establishment and use of the NDNAD in its current state: Police and Criminal Evidence (PACE) Act 1984; Criminal Justice and Public Order Act 1994; Criminal Evidence Act 1997; Criminal Justice and Police Act (CJPA) 2001; Criminal Justice Act (CJA) 2003; Serious Organised Crime and Police Act 2005. This legislation has resulted in the following:

- Rooted hair and mouth swabs have been reclassified from 'intimate' to 'non-intimate' samples.
- Non-intimate samples can be taken, without consent, from any individual arrested for a recordable offence and detained in a police station, irrespective of whether the sample is relevant to the crime being investigated.
- DNA samples and profiles may now be retained and the latter held on the Database for comparison with other profiles from individuals and crime scenes, irrespective of whether the person is cleared of the offence or not prosecuted. Prior to 2001, samples and profiles from those not prosecuted or acquitted had to be destroyed.
- Samples and profiles may only be used for purposes related to preventing and detecting crime, investigating an offence, conducting a prosecution or identifying a deceased person or a body part (for example as a result of death from natural causes or mass disasters).
- Samples taken from volunteers may be loaded onto the Database with written consent, which is irrevocable.

DNA Expansion Programme

A £240 million DNA Expansion Programme (April 2000–March 2005) aimed to gather the DNA profiles of all known 'active offenders'. Funding was provided to increase the collection and analysis of DNA material, with emphasis on volume crimes such as burglary and vehicle crime. DNA awareness training for police officers and scientific support personnel was also funded². The work is being continued as part of the Forensic Integration Strategy. The Home Office published an evaluation report of the Programme in January 2005.

Management and oversight of the NDNAD

There are currently three main strands to the NDNAD:

- A Custodian, now housed within the Home Office, responsible for ensuring the integrity of the NDNAD by setting standards for procedures and profiling, and by approving and monitoring supplier laboratories.
- A Strategic Board, responsible for oversight of the NDNAD. This consists of the Home Office, the Association of Chief Police Officers and the Association of Police Authorities. A member of the Human Genetics Commission (HGC) acts as a lay representative (an additional HGC member has been proposed). The Custodian attends Board meetings.
- The Forensic Science Service® (FSS®), which became a Government-owned Company (GovCo) in December

2005, has the contract to provide operational services for the NDNAD. It receives and loads profiles to the NDNAD and searches it for matches. The award of the contract will be reviewed in 2008. Prior to becoming a GovCo, the FSS acted as Custodian and supplier of profiles to the Database. The role of Custodian has been separated to ensure that it stays in the public sector and is independent of commercial factors.

Safeguards and quality standards

Strict protocols are followed throughout the collection, submission and analysis of DNA samples to minimise the possibility of administrative or analytical error and contamination. Six organisations in the UK are approved to provide DNA profiles from CJ and/or crime scene samples to the NDNAD. They are accredited both by the United Kingdom Accreditation Service and the Custodian and are monitored continuously by the Custodian. Access to the Database itself is limited to a small number of people authorised by the Custodian.

Issues

The application of the NDNAD, its oversight, the technology it uses and what information is derived from DNA profiles are current policy issues.

The impact of DNA on crime detection

Crimes are more successfully solved when DNA is recovered from the crime scene and the DNA profiles are successfully loaded onto the NDNAD (Table 1). The chance of a new crime scene profile loaded onto the NDNAD matching an individual's profile already held is now 45%². DNA profiles are, however, successfully loaded for less than 1% of recorded crimes², as DNA is not always left at crime scenes, not all crimes are associated with a scene where DNA could be left and there is variation between police forces in how they collect and use DNA³. A DNA match is not used alone in a prosecution: other supporting evidence is required. DNA is also used in the exoneration of the innocent. A review of the impact of the NDNAD on crime detection has been recommended by the House of Commons Science and Technology Committee⁴.

Table 1. Impact of DNA recovery on crime detection¹

Crime category	National detection rate ^a 04/05	DNA detection rate ^b 04/05
All recorded crime	26	40
Domestic burglary	16	41
Non-domestic burglary	11	50
Theft of vehicle	15	24
Theft from vehicle	8	63
Criminal damage	14	51

^aOverall % of crime detected. ^b% of crimes detected where DNA crime scene samples are loaded on the Database.

Representativeness and discrimination

Concerns have been raised that Black and ethnic minorities are disproportionately represented on the Database^{4,5}. Under previous legislation, DNA samples could only be collected once the individual had been charged. This was viewed by GeneWatch UK as a safeguard against discriminatory policing⁵. Some have

also questioned the extent to which the NDNAD complies with the first principle of the Data Protection Act: that personal data must be processed fairly⁶. The Home Office has stated that “Persons who do not go on to commit an offence have no reason to fear the retention of this information”⁷.

Chance matches and DNA profiles

The probability of a chance match using SGM Plus[®] is less than 1 in 1 billion (Box 1). To date, there have been no chance matches between full SGM+ profiles from unrelated individuals. Chance matches are, however, more likely to arise: with partial profiles (which are often obtained from crime scene samples that have become degraded or that involve low quantities of DNA); between related individuals; and as the size of the NDNAD grows. An international collaboration is currently looking at potential additional markers to improve the discriminating power of profiles and to allow fuller profiles to be obtained from degraded material. An international approach is needed because of the growing requirement for exchange of profiles between countries (which may use other DNA profiling techniques).

Retention of profiles

Retaining profiles of the unconvicted and uncharged has led to profiles from a greater proportion of the population being held on the NDNAD and has been criticised. This has been the subject of a Judicial Review (Box 3). The Information Commissioner for Scotland believes that the indefinite retention of DNA profiles of individuals arrested but not convicted of any offence, and where there are no longer any policing concerns about them, is an ongoing intrusion into their private lives⁶. Under present Scottish Law, an individual’s profile is removed from the Scottish database and the NDNAD following acquittal. It is argued by the Home Office that the benefits of retaining profiles can be clearly demonstrated. Around 181,000 DNA profiles currently held on the Database would have been removed prior to CIPA 2001 (Box 2). Of these, 8,251 (5%) have been linked with crime scene samples relating to 13,709 offences including over 570 serious offences such as murder, attempted murder and rape.¹ Further, following CJA 2003 (Box 2), DNA profiles of thousands of arrestees who have not been proceeded against have been linked to crime scene profiles including serious offences⁸. DNA profiles have been linked with crime scene profiles relating to over 3,000 offences including 37 murders, 16 attempted murders, 90 rapes, 92 drug-related offences and 1,136 burglary offences¹.

Volunteers providing elimination samples in a particular case must give separate written consent for their DNA profiles to be added to the NDNAD, which is irrevocable. This is contrary to standard practice in medical science and has been criticised. Under current Scottish Law volunteer consent can be withdrawn. Some 9,000 profiles from samples provided voluntarily are held on the NDNAD². As a result of this and the increasing number of profiles from arrestees who were not charged, not all individuals on the NDNAD are criminals, although it is widely incorrectly perceived as a criminal database.

There is also the issue of how long profiles (and samples, see below) should be retained. Some suggest that they should not be retained indefinitely except in the case of serious and sexual crimes^{5,6}. For lesser crimes, samples could be destroyed and profiles deleted after a defined time (after the sentence has been served). This is the case in some other European countries⁹. But serious offenders in the UK have been identified and caught via the Database after having had their DNA sampled on a previous occasion for a relatively minor offence.

Box 3. R v Chief Constable of South Yorkshire (ex parte S and Marper)¹⁰

The claimants appealed against the decision to retain their fingerprint and DNA samples after they were cleared of criminal charges. It was argued that this was a breach of Articles 8 and 14 of the European Convention on Human Rights (adopted by the Human Rights Act 1998). The case has been heard in the Divisional Court, the Court of Appeal and the House of Lords. The Court of Appeal dismissed the appeals, ruling that although there was a breach of Article 8(1), this was proportionate and justified under Article 8(2) and that there was no breach of Article 14. The House of Lords also dismissed the appeals. The case has been submitted to the European Court of Human Rights.

Retention of DNA samples

DNA samples (from which the profile is derived) are retained primarily to enable profiles to be upgraded as new technology becomes available. They are also used for quality assurance purposes and in case of disputes regarding sample processing. Samples are stored by the laboratory that profiled them, but owned by the police. Samples can only be used for those purposes outlined in Box 2 but some would argue for tighter legislation to control the use of the DNA samples^{4,10}. The Home Office has recognised that DNA sample retention is a sensitive issue but has concluded that any intrusion on personal liberty is both necessary and proportionate to the benefits for victims of crime and society generally. The HGC would like more discussions about the justification for retaining samples, in particular those from unconvicted individuals and volunteers⁶.

Extraction of information from DNA profiles

Inference from DNA profiles

Apart from gender, SGM+ profiles currently provide no information of a physical or medical nature. It has been suggested that one marker may be associated with Type 1 diabetes¹⁰. Other indicators may be discovered as knowledge and understanding of the human genome increases. The relative frequency of some of the markers may give indications of the possible ethnicity of an offender from analysis of the crime scene sample.

Familial searching

Familial searching (developed by the FSS) of the NDNAD is used to identify potential relatives of the person who left a crime scene sample, when that person is not on the Database. It is carried out only for the most serious offences, following specific guidelines. Other scientific techniques (Box 4) can be used to increase the effectiveness of this process by eliminating some of the

potential relatives, thus minimising public intrusion. Concerns surround the possibility of revealing possible familial relationships that were previously unknown^{5,10}.

Box 4. DNA analysis and forensic science

Mitochondrial DNA analysis

Mitochondrial DNA is inherited from the mother by all offspring, providing a genetic link through the female line. Siblings will have the same mitochondrial DNA type as their mother. It is particularly useful for decomposed samples as mitochondrial DNA is more resistant to degradation.

Y-chromosome STR analysis

The Y-chromosome is inherited through the male line of a family. It is extremely useful in sexual assault cases where samples may contain mixed male and female cells.

The need for greater debate

There has been criticism of the lack of parliamentary and public debate about the NDNAD and its use, and a call for greater discussion of any future proposals^{4,5,10}. In a public consultation conducted by the HGC (2000), strong support existed for collecting samples in serious crimes, but less so for minor offences such as fraud and shop-lifting. Mixed responses surrounded the length of time samples and/or profiles should be stored. The HGC recommended improved public dialogue and that any proposals to use sensitive genetic information should be subject to a full public debate¹¹. The House of Commons Science and Technology Committee highlighted that no research has been conducted since to assess public attitudes towards retention of DNA samples⁴. The Scottish Executive recently held a limited public consultation on the retention of DNA samples: 44% supported the retention of samples from those arrested or detained on suspicion of a recordable offence irrespective of whether they are later convicted; 47% were against. The majority were in favour of the proposal to maintain the current Scottish position on volunteer elimination samples whereby written consent must be given for them to be held on the databases and can be withdrawn⁶.

Ethical oversight of the NDNAD

The HGC and the Select Committees on Science and Technology in both Houses have recommended that independent ethical oversight with lay input is needed to ensure samples and profiles are used appropriately^{4,11,12}. The Home Office is currently establishing an Ethics Committee to advise the NDNAD Strategy Board on new proposed uses of the database and research proposals, and to review decisions it makes. The composition of this panel is as yet unknown.

The NDNAD and other databases

An inquiry set up by the Home Secretary called for better police intelligence handling¹³. In response, increased integration of national forensic and intelligence databases including the NDNAD will happen in the future. Safeguards are in place to maintain integrity and further protections are in development². Criminals do not only offend within their national boundaries. Protocols exist for the exchange of DNA data between countries through

Interpol and the searching against another country's database. This is done on a case by case basis. Strict protocols must be followed and risk assessments made as not all countries have the same legislation/safeguards as the UK. Work continues to improve the compatibilities of countries to exchange information.

Future developments

DNA profiling is increasingly being used to identify suspects rather than simply linking known suspects to a crime. As DNA analysis gets faster, it may one day be possible to take and run an arrestee sample against the NDNAD in a matter of minutes (as is the case for fingerprints), aiding crime detection and prevention.

Overview

- The NDNAD is a powerful tool in crime prevention and detection, and the exoneration of the innocent.
- The criteria for individuals whose profiles can be added to the Database have been the subject of legislative changes and remain controversial.
- Debate surrounds the length of time samples and profiles are retained, and protocols for the collection and retention of volunteer elimination samples.
- Techniques such as familial searching used to generate intelligence from the NDNAD have proven valuable but are contentious and need further debate.
- Future technologies will refine DNA analysis and make the NDNAD potentially more powerful.
- Ethical oversight and public debate of the NDNAD and its uses will become increasingly important.

Endnotes

- 1 Home Office, December 2005
- 2 FSS, *The National DNA Database Annual Report 03/04*
- 3 Her Majesty's Inspectorate of Constabulary, *Under the Microscope Refocused*, 2002
- 4 Science & Technology Committee, Seventh Report of Session 2004–05, *Forensic Science on Trial*, HC 96-I
- 5 GeneWatch UK, *The Police National DNA Database*, 2005
- 6 Scottish Executive, *Police Retention of Prints and Samples: Proposals for legislation*, Consultation paper June 2005
- 7 Science & Technology Committee, First Special Report of Session 2005–06, *Forensic Science on Trial: Government Response*, HC 427, p 6
- 8 DNA and Fingerprint Retention Project, October 2005
- 9 ENFSI, *Report on DNA Legislation in Europe*, www.enfsi.org
- 10 www.dur.ac.uk/p.j.johnson/Williams_Johnson_Martin_NDNAD_report_2004.pdf
- 11 Human Genetics Commission, *Inside Information*, 2002
- 12 House of Lords, Fourth Report of the Select Committee on Science and Technology, Session 2000–01, *Human Genetic Databases: challenges and opportunities*, HL 57, para 7.66
- 13 www.bichardinquiry.org.uk

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The Parliamentary Office of Science and Technology, 7 Millbank, London, SW1P 3JA; Tel: 020 7219 2840; email: post@parliament.uk

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