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NUFFIELD COUNCIL ON BIOETHICS

FORENSIC USE OF BIOINFORMATION: ETHICAL ISSUES

Comments on

THE NATIONAL DNA DATABASE (NDNAD)

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Introduction

These comments, submitted in response to the Consultation Paper issued by the Council, focus on ethical issues raised by the existing arrangements for the National DNA database (NDNAD) in England and Wales, but they also address possible future developments.[2]

The most significant ethical issues appear to arise from those arrangements in England and Wales that are apparently unique with respect to legal provisions in that they permit the police to retain for an indefinite period DNA samples and profiles of persons who were required to provide such samples in the legitimate investigation of a recordable offence. The following comments aim i) to explore the ethical validity of these arrangements as they relate to the criminal justice system in England and Wales, and ii) on the basis of the analysis presented, to make certain recommendations. The analysis and recommendations are offered as a personal contribution to the debate.

There are doubtless several ways of addressing these issues from an ethical perspective, but there would appear to be a strong case for characterising the principal concerns as manifestations of the outcome of two competing ethical theories. One perspective, which emphasises the perceived overall benefits of the NDNAD for criminal justice, is based, implicitly or explicitly, on *utilitarian theory*, which stresses the considerable benefits which may be provided without incurring commensurate costs. On the other hand, from the perspective of a *deontological theory* which emphasises respect for the rights and autonomy of individual members of society, the NDNAD may be considered to represent an unwarranted intrusion into personal privacy.

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[2] Recognising that (some of) these comments may appear on the Council's website, efforts have been made to ensure that non-technical language has been used wherever possible.

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However, since most people deploy ethical arguments in ways that are particularly sensitive to context, it is generally the case that decision-making calls on both theories (as well as other factors) in achieving a, so-called, 'reflective equilibrium.'

The NDNAD in forensic investigations

DNA databases are used for the following types of purpose:

a) as a means of identifying genetic (familial) relatedness between individuals (alive or dead)
b) as a means of identifying body parts recovered from sites of accidental or terrorist events
c) for academic research
d) for forensic purposes to provide evidence (as in the NDNA) of i) criminality or ii) innocence; or iii) to act as a deterrent to the performance criminal acts

It is possible that, in future, there might be requests for DNA collected for one of these purposes, to be used for another purpose that was not originally intended: and, as noted by the Human Genetics Commission, this would clearly have some important ethical implications.[3] The following comments refer almost exclusively to the use of the NDNAD for purposes of criminal justice.

The advantages of an NDNAD for criminal justice

In ideal circumstances:

i) incontrovertible evidence should support all criminal prosecutions; and
ii) no innocent person should be accused of committing a crime.

The rationale for compiling the NDNAD is that for certain crimes it provides a highly (possibly the most) efficient and accurate means of satisfying both of these objectives. It is also a reasonable expectation that:

iii) the existence of the NDNAD acts as a deterrent to individuals who might otherwise contemplate committing a crime.

Three scenarios for the NDNAD

However, there are various ways in which an NDNAD might be operated, depending on the extent of coverage of the whole population that is introduced. Three (among other) possible scenarios are that the NDNAD:

- includes data from all citizens: such data would be collected at birth, and compulsorily from all others not on the database (i.e. currently, 95% population[4]) [*comprehensive system*]

[3] Human Genetics Commission (2005) Profiling the newborn: a prospective gene technology? The report makes specific reference to the fact that 'the information might be used by the police for unwarranted purposes.' www.hgc.gov.uk. p.5

[4] Parliamentary Office of Science and Technology (2006) The National DNA Database (Postnote 258) www.parliament.uk/parliamentary_offices/post/pubs2006.cfm

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- is compiled by an extension of the current practices in England and Wales: (i.e. from individuals arrested for a recordable offence; and from victims, witnesses and volunteers for elimination purposes) [*current system*]
- contains only data from convicted criminals: this would entail that the data of those found innocent, or not charged, would be removed from the database. [*conviction only system*]

The aim of the following discussion is to explore the ethical implications of these three scenarios, described above as the *comprehensive, current* and *conviction-only* systems.

A Comprehensive NDNAD

Utilitarian arguments for a Comprehensive NDNAD

Arguments in favour of a *comprehensive system* are largely based on prospective consequences, i.e. in terms of the advantages for civil society that would be gained, by providing law enforcers with ready access to a fully comprehensive DNA database. This consequentialist approach depends on a weighing of costs and benefits, or more precisely (since outcomes are always prospective) on *predicted* costs and benefits, insofar as these are envisaged or calculable. Thus, predicted *benefits* to society would be the:

a) prospect of increasing numbers of safe convictions
b) increased facility to establish innocence

On this basis, the costs would be deemed minor, or at least 'proportionate'[5] to the substantial benefits obtained. In the words of Lord Brown of Eaton-under-Heywood:

"*I find it difficult to understand why anyone should object to the retention of their profile (and sample) on the database once it has been lawfully placed there. The only logical basis I can think of for such an objection is that it would increase the risk of the person's detection in the event of his offending in future*." Lord Brown continued: " .. *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*."[6]

The above statement provides implicit support for the compilation of a *comprehensive database*. Such support might also take into account the allegedly limited nature of the genetic information that is retained, and therefore deem the 'social costs' to be low. The SGM+ profile currently used tests for ten SRTs (short tandem repeats) plus a gender marker, so that an individual's DNA profile comprises 20 numbers plus a gender indicator. It is claimed that, apart from gender, the SGM+ profile currently provides no significant information of a physical or medical nature.

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[5] Nuffield Council on Bioethics (2006) Forensic use of bioinformation: ethical issues. Consultation paper. p.16
[6] Regina v. Chief Constable of Yorkshire Police ex parte LS: Regina v. Chief Constable of Yorkshire Police (Respondent) ex parte Marper Consolidated Appeals [2004] UKHL 39, para 86 [Cited by Cutter: see note 12]

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Arguments against a Comprehensive NDNAD

1) In purely utilitarian terms, several limitations need to be assessed:

a) DNA profiling is not necessarily the most appropriate tool in investigating many crimes,[7] and in some cases it would be totally inappropriate[8]
b) there would be substantial financial set up and maintenance costs[9]
c) even when it could provide reliable information, the NDNAD might not be as cost effective as other methods[10]
d) since crime knows no national borders, the system could only aspire to be fully effective if maintained on a global basis, an objective which seems totally unrealistic
e) it is reasonable to assume that some criminals (or criminal organisations) would devise strategies for avoiding detection by this means and/or exploit the technology to lay false trails that might seem to incriminate innocent people [11]
f) in general, the value of the NDNAD would depend to a significant degree on the: i) extent; ii) nature; iii) manner of collection; iv) storage conditions; v) retention; vi) accessibility; vii) interpretation, and viii) use made of the DNA data.

Errors, which might be unintentional or intentional (criminal), could be introduced at any of the above stages. The fact that six companies have been approved to provide DNA profiles for the NDNAD from criminal justice or crime scene sample may have a bearing on the possibilities for error.[12]

2) Counter arguments also arise from a deontological perspective which lays emphasis on the need to treat everyone as 'an end in themselves' and not, instrumentally, as 'a means to an end.' The existence of a *comprehensive* NDNAD may be said to offend the fundamental principle that one is assumed innocent until proved guilty - since mass scanning of the database would be performed to eliminate all citizens (except perpetrators of crimes). However, there must be a significant risk that, as noted by Williams and Johnson,[13] the "*criminal justice databases re-inscribe prior differences in the treatment of minority groups by the police and, in doing so, pose new threats to the already excluded*."

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[7] Home Office (2005) DNA Expansion programme 2000-2005: Reporting Achievement (2005) Forensic Science and Pathology Unit

[8] "DNA profiles are successfully loaded onto the NDNAD for less than 1% of recorded crimes." Parliamentary Office of Science and Technology (2006) The National DNA Database (Postnote 258) www.parliament.uk/parliamentary_offices/post/pubs2006.cfm

[9] Williams R (2004) Genetic Information and Crime Investigation: social, ethical and public policy aspects of the establishment, expansion and police use of the National DNA database. This reference states that the initial investment in 1995 was 'enhanced by £34 million in September 1999 and further £109 million from September 2000.' http;//www.dur.ac.uk/robin.williams/project.html

[10] Nuffield Council on Bioethics (2006) Forensic use of bioinformation: ethical issues. Consultation paper. p.15

[11] The ease with which minute amounts of biological material (e.g. hairs from clothing, saliva from beer glasses) might be 'planted' appears to be a serious threat to criminal justice

[12] Parliamentary Office of Science and Technology (2006) The National DNA Database (Postnote 258) www.parliament.uk/parliamentary_offices/post/pubs2006.cfm

[13] Williams R and Johnson P (2005) Forensic DNA Databasing: a European perspective. www.dur.ac/p.j.johnson. p.11

Notwithstanding the limited nature of the SGM+ profile, it has been suggested that one marker may be associated with type 1 diabetes, and that it is not inconceivable that indicators of other conditions may be revealed by the profile as knowledge of the genome increases.[14] This might prove to be an important consideration for people who volunteer samples for DNA analysis, since in future it might be possible to derive much more information about the genome than is currently appreciated. Indeed, it has already been claimed that because markers in the NDNA profile have different frequencies of occurrence in different ethnic groups, it is possible to infer an individual's ethnic origin from DNA analysis[15] - raising the possibility of discriminatory practices. Whatever the explanation, it is a matter of concern that black and ethnic minority groups are disproportionately represented on the current NDNAD.

The fate of the DNA samples (from which the profile is derived) also raises critical issues. Samples are retained for quality assurance purposes and to resolve disputes that might arise in processing them, but in that they might subsequently be used to characterise an individual's complete genome, their retention has been seen as an intrusion of an individual's privacy.[16]

Another important consideration concerns the potential impact of fictional television programmes on common perceptions of the value of DNA evidence in solving serious crimes. According to Cutter, the forensic use of DNA in popular TV series in the USA such as 'CSI: Crime Scene Investigators' "*appears to be proliferating an apparently positive utopian view of the value of these technologies - producing a so-called 'CSI effect*."[17] Evidence from a symposium held at a meeting of the American Society for the Advancement of Science in 2005 suggests that an influence of the effect on police and prosecutors is also readily evident as "*submissions to forensic laboratories go through the roof*" following the screening of episodes illustrating the utility of DNA evidence.[18]

In summary, mass surveillance programmes may be said to undermine the fundamental respect which should, arguably, be accorded to all persons. Deontological concerns might thus be summarised as:

i) intrusion of privacy
ii) risks of prejudicial treatment[19]
iii) (remote) possibilities of wrongful accusation[20]
iv) vulnerability to misuse of the data for unintended purposes

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[14] The National DNA Database (Postnote 258) www.parliament.uk/parliamentary_offices/post/pubs2006.cfm
[15] Nuffield Council on Bioethics (2006) Forensic use of bioinformation: ethical issues. Consultation paper. p.21
[16] Parliamentary Office of Science and Technology (2006) The National DNA Database (Postnote 258) www.parliament.uk/parliamentary_offices/post/pubs2006.cfm
[17] Cutter AM (2006) To clear or to convict? the role of genomics in criminal justice. Genomics, Society and Policy 2, 1-15
[18] Ibid
[19] Genewatch UK (2005) The Police National DNA Database
[20] It is estimated that the probability of a chance match using the SGM+ is less than 1 in 1 billion, although chance matches are more likely for genetically related individuals. The National DNA Database (Postnote 258) www.parliament.uk/parliamentary_offices/post/pubs2006.cfm

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The Current NDNAD system

The foundation legislation for the collection of samples by police in England and Wales is the Criminal Evidence Act, 1984. However, several subsequent amendments to the Act have extended police powers and the range of people from whom samples and profiles can be collected and retained. Prior to 2001, when a person was not prosecuted or was acquitted, their DNA samples were destroyed and their profile removed from the NDNAD. But amendments introduced in the Criminal Justice and Police Act 2003 mean that the police now retain the DNA profile of all persons arrested for a recordable offence - and not, as previously, only from individuals charged with or reported for a recordable offence.

The ease with which the police may obtain DNA samples has also been increased by the distinction now drawn between i) 'intimate samples' (of blood, semen, urine, pubic hair, or from any orifice other than the mouth) - which can only be taken by a registered medical practitioner - and ii) 'non-intimate samples' (i.e. from a mouth swab), which can be taken without consent by a non-medically registered person, provided that only "*reasonable force is exerted* ... *to remove* (such) *a sample*." The use of non-intimate samples "*is now one of the most common methods of obtaining a sample from an individual.*"[21] However, in all cases, authorisation to obtain a DNA sample must be given (though the rank of police officer is not specified) and the individual must be informed of the grounds for the authorisation, which must satisfy the condition that it is reasonable to believe that the sample will "*tend to confirm or disprove involvement in a recordable offence*."[22] Although volunteers providing elimination samples in a particular case must give written consent for their profiles to be added to the NDNAD (which accounts for 9,000 profiles currently included), this consent is essentially irrevocable. In contrast, under Scottish Law volunteer consent can be withdrawn.[23]

It does not seem too inaccurate to describe the *current system* as operating on an entirely opportunistic basis in which the (un-stated) objective of an ultimately comprehensive database is being achieved by stealth. The DNA data of those who have not been accused, charged or found guilty of a crime and of witnesses, volunteers and eliminated suspects - all these remain on the NDNAD. The DNA profiles so retained can subsequently be used in 'speculative searching.'[24] In discussing such arrangements, Williams, a leading authority on these issues, refers to the "*somewhat piecemeal" legal provisions which "threaten to destabilise the delicate balance between public security and individual freedom in the collection and use of genetic information*."[25]

The cases both *for* and *against* this system thus are qualitatively similar to those discussed above for the comprehensive system. The utilitarian rationale is that in

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[21] Kaye J (2006) Police collection and access to DNA samples. Genomics, Society and Policy 2, 16-27
[22] s63 (4). Police and Criminal Evidence Act (1984)
[23] Parliamentary Office of Science and Technology (2006) The National DNA Database (Postnote 258) www.parliament.uk/parliamentary_offices/post/pubs2006.cfm
[24] Williams R and Johnson P (2005) Forensic DNA Databasing: a European perspective. www.dur.ac/p.j.johnson. Appendices
[25] Durham University: News and Events (8/11/2004) Fears over future of DNS database as report calls for greater accountability. http://www.dur.ac.uk/news/newsitem/

terms of crime detection and in establishing innocence, the intrusion on privacy is 'proportionate,'[26] despite the allegation that retention of DNA may breach Article 8 of the European Convention on Human Rights. Thus, the Forensic Science Service, that runs the NDNAD, states that in matching a crime scene sample with a stored database profile it has a 45% success rate; and that even when an individual has not provided a sample it has often been possible to trace relatives through the NDNAD and thereby identify individuals involved in crime.[27]

As summarised by the Nuffield Council on Bioethics, "*Research suggests that whilst samples may be taken initially for minor offences, they can be linked subsequently to more serious crimes as a minority of offenders 'progress' in their criminal careers*." Thus, the Home Office has cited data showing that of 198,000 profiles that would have previously been removed under the Criminal Justice Act 2001, by March 2005, 7,591 had subsequently been linked to 'more serious crimes.'[28] On this basis, retention of the DNA of 96.2% of individuals not subsequently charged with a crime was justified (i.e. deemed 'proportionate') by the 3.8% who were subsequently charged.

Even so, there must be serious concerns about the authenticity of the 'consent' given in providing DNA samples which may be secured from witnesses, victims, and mass screening volunteers, especially as the consent secured is currently irrevocable. It is clearly inappropriate to secure and retain samples that are provided in haste, without due consideration and possibly under duress. In the opinion of moral philosopher, Onora O'Neil: "*It is important that data are obtained only by acceptable procedures, and that in particular there is no unacceptable coercion or deception. ...If consent procedures are inadequate, or if public authority is exercised for purposes that are not essential, or in ways that do not command trust, obtaining genetic profiles will be ethically suspect*."[29] Such concerns are accentuated when juveniles are involved. In January 2006 it was alleged that the NDNAD contained 750,000 profiles from juveniles, including 24,000 from juveniles who had not been charged with any offence.[30] (Even so, somewhat anomalously, juveniles issued with antisocial behaviour orders in the street often escape providing a sample for DNA analysis.[31])

While there is undoubtedly a strong argument for retaining the data of convicted criminals, especially in cases of serious crime where there remains a possibility that they might re-offend, the case for retaining data from others could only be ethically justified by appeal to a utilitarian argument that assigns little weight to individual rights and privacy.

From a perspective that assigns high priority to ensuring respect for civil liberties, the compilation of the NDNAD by this means has been described as just one aspect of a *"new culture of crime control, which has... shaped the way society has*

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[26] Nuffield Council on Bioethics (2006) Forensic use of bioinformation: ethical issues. Consultation paper. p.16
[27] Forensic Science Service (2004) The National DNA Database Annual Report 2003/4
[28] Nuffield Council on Bioethics (2006) Forensic use of bioinformation: ethical issues. Consultation paper. p.16
[29] O'Neill O (2002) Autonomy and Trust in Bioethics. Cambridge University Press.p.107
[30] Kaye J (2006) Police collection and access to DNA samples. Genomics, Society and Policy 2, 16-27
[31] Dr D Gennard (personal communication).

installed…more intensive regimes of regulation, inspection and control [whilst] *our civic culture becomes increasingly less tolerant and inclusive, less capable of trust*."[32]

However, despite the apparent rigour of the arrangements some exceptions seem to set precedents which challenge the spirit of the law.

a) The case of Ms Philippa Jones suggests that the courts will take action to ensure that samples are taken in lawful circumstances. Ms Jones, a teacher, was arrested but not prosecuted for allegedly hitting a child with a ruler. She applied to the High Court for a declaration that it had been unlawful to take a DNA sample from her after the Crown Prosecution Service had decided not to prosecute. Mr Justice Wilkie agreed with this argument and ordered that Ms Jones' DNA sample, photograph and fingerprints be destroyed, and damages paid.[33]
b) The process of 'intelligence screening' involves the police asking for volunteers to provide DNA samples for elimination purposes in areas where a serious crime has been committed. By early 2006, there had apparently been 282 intelligence-led screens in England and Wales from which over 80,000 samples had been processed. In such cases the samples are not added to the NDNAD.(However, the fear that refusal to participate in such screening exercises might arouse police suspicions of guilt questions the voluntary basis of the consent.[34])
c) "*It is legally permissible to request the removal of DNA samples … from police databases*." Guidance from ACPO states that "*discretion to remove records should only be exercised in 'exceptional,' cases*.[35]

These anomalies need to be examined with a view to determining their impacts on future practice.

A Conviction only NDNAD system

The unique basis of the NDNAD in England and Wales is perhaps most clearly evident when the manner in which data are added to it is compared with the situation existing in Scotland.[36] Whereas in England and Wales the DNA profiles of suspects and volunteers, as well as of convicted offenders, can be retained on the NDNAD for 'speculative searching' until the individual's death, in Scotland the profiles of suspects and volunteers must be destroyed. The Information Commissioner for Scotland has argued that the indefinite retention of DNA profiles of individuals arrested but not convicted of an offence, and where there are no

[32] Garland (2000) cited by Williams R and Johnson P (2005) Forensic DNA Databasing: a European perspective. www.dur.ac/p.j.johnson. p.10
[33] Kaye J (2006) Police collection and access to DNA samples. Genomics, Society and Policy 2, 16-27
[34] Ibid
[35] Nuffield Council on Bioethics On-line Consultation (2006) https://consultation.nuffield.org/go/BioinformationUse/Section/Background
[36] Williams R and Johnson P (2005) Forensic DNA Databasing: a European perspective. www.dur.ac/p.j.johnson. Appendices

continuing policing concerns about them, constitutes an ongoing intrusion into their private lives.[37]

As noted above, there is a strong utilitarian argument for retaining the data of convicted criminals, especially in cases of serious crime where there remains a possibility that they might re-offend. But the Home Office argument that speculative searching of the current NDNAD is 'proportionate' in terms of subsequent success in securing convictions implies that social benefit can be traded for civil liberty or personal rights to privacy. Essentially, this denies that rights have any sanctioning role that cannot be overruled by perceived 'benefits', and while this is an intellectually plausible position it effectively undermines the whole concept of human rights. For a government that is a signatory to the UN Declaration of Human Rights, it appears totally inconsistent to deny innocent citizens the right to privacy - an outcome that is implicit in the compulsory retention of many DNA profiles under current arrangements.

The reality is that everything 'comes at a cost.' The deontological benchmarks of freedom and justice inevitably challenge utilitarian notions of 'efficiency', but it is arguable that they are prerequisites of civilised society. For the eminent political scientist John Rawls, *"Justice is the first virtue of social institutions as truth is of systems of thought. A theory, however elegant and economical, must be rejected or revised if it is untrue; likewise laws and institutions, no matter how efficient or well arranged, must be reformed or abolished if they are unjust*."[38] While there is clearly room for argument as to what is meant by the term 'justice,' and even by the 'fairness' to which Rawls famously equated it, this telling quotation is a potent reminder of the need for a civilized society to conscientiously protect individuals' rights in the face of ever-increasing state powers.

Access to other DNA databases

The three scenarios discussed above do not exhaust the possibilities that might in theory be used to investigate crimes or identify personal identities for other purposes. An alternative approach to extending the existing NDNAD, that does not attempt to compile a comprehensive system, could entail widening access to alternative databases that have been assembled for other purposes.

For example, following the scandals involving the retention of children's body parts without parental consent at Bristol and Alder Hay hospitals, the Chief Medical Officer carried out an audit of body parts and samples retained post-mortem by NHS Trusts and medical schools which revealed that tissue was retained from about half of the 3 million post-mortem examinations carried out between 1970 and 1999.[39] In theory, these tissue samples might be used criminal investigations, e.g. of relatives of deceased persons.

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[37] Scottish Executive (2005) Police retention of prints and samples: proposals for legislation. Consultation paper.
[38] Rawls (1972) A Theory of Justice. Oxford University Press
[39] Chief Medical Officer (2001) Report of a census of organs and tissues retained by pathology services in England - conducted in 2000. London, Crown Stationary Office

A possibly more significant concern relates to the UK Biobank, which was established in 2003 with the aims of supporting research to improve the prevention, diagnosis and treatment of illnesses and the promotion of health. Backed by the Medical Research Council, the Wellcome Trust and Department of Health, the project will follow the health of up to 500,000 volunteers over many years, collecting data on environmental and lifestyle factors, and linking them to medical records and to biochemical and genetic analyses of blood samples. Pharmaceutical companies will be allowed access to the information on the database, but all data will be anonymized. and insurance companies will have access to neither individual nor anonymized data. However, in an important provision "the police may gain access under the terms of a court order."[40]

It seems unlikely that, to date, medical research databases have been used extensively for forensic purposes, but it is important to consider the possible scenarios. For example, a challenge to the integrity of medical professionals would result if the police were to attempt to access a person's medical DNA database by directly approaching the custodian of the data, arguing that this was necessary in the public interest. Although handing over such data would normally constitute a breach of confidence, it might be argued that in some cases - e.g. to prevent serious harm to others through terrorist attacks - the breach could be justified. If the medical professional considered the reasons given did not constitute grounds for breaching the obligation to protect patient confidentiality, this might result in a police application to the circuit judge for a court order. This would again put a weighty responsibility on the shoulders of health professionals in deciding on whether to appear before a judge to challenge the application.

The critical issue in such cases is that volunteers who have in good faith participated in medical research unaware that their medical records might be appropriated for a totally unrelated, non-medical, purpose, might not have consented had the possibility originally been made apparent. Moreover, there are likely to be negative effects on future participation in such research. It would certainly be unreasonable to assume that people who do not wish their personal medical data to be made available to the police could only be motivated by a desire to escape criminal prosecution

A procedure used in the USA to protect the privacy of research participants and the integrity of researchers is the issue of *certificates of confidentiality* that was developed by the National Institutes of Health. These certificates "protect the privacy of research subjects by protecting investigators and institutions from being compelled to release information that could be used to identify subjects with a research project." Persons authorized by the NIH to protect the privacy of research subjects may not be compelled in any Federal, State, or local criminal, civil, administrative, legislative or other proceedings to identify them by name or other identifying characteristic."[41]

Given the more extensive provision for obtaining and retaining DNA samples that operates in England and Wales, it is arguable that there is a pressing need to introduce certificates of confidentiality similar to those used in the USA.

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[40] The UK Biobank (2004) http://www.ukbiobank.ac.org

[41] National Institutes of Health (2007) Certificates of confidentiality: background information. http://grants1.nih.gov/grants/policy/coc/background.htm

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Conclusions

- It is suggested that the NDNAD is an indispensable forensic tool, which has proved invaluable in solving many crimes. For this reason, there would seem to be a strong utilitarian basis for maintaining a form of NDNAD. However, it is not a panacea, and has some severe limitations in applicability, efficiency of operation and vulnerability to misuse.

- The current system operating in England and Wales, which uniquely legitimizes the retention of the DNA profiles of people who have not been convicted (or often even accused) of a crime, is anomalous, and contrary to human rights. In that it appears to serve the un-stated objective of assembling a comprehensive NDNAD by default (or stealth), it is unjustifiable in terms of deontological theory that underpins much human rights legislation

- It follows that the limitations and flaws of the current NDNA would be exacerbated by attempts to extend it to all citizens of England and Wales (the *Comprehensive system*), a system which would seriously undermine civil liberties and human rights.

Recommendations

The foregoing discussion suggests the following recommendations:

1) The current procedures operating in England and Wales for collecting, using and retaining DNA samples for use in the criminal justice system should be revised, in line with the system operating in Scotland.
2) There is a need to address and resolve anomalies in the ways in which DNA profiles have been treated when they have been obtained from certain volunteers, juveniles and persons not accused of crimes.
3) A comprehensive review should be carried out of the scientific and technological foundations of the NDNAD, no report of which appears to have been published in the scientific peer-reviewed literature. [42]

[42] Wallace S (2004) Report on the social and ethical issues of the national DNA database released. http://www.phgu.org.uk/ecard?_ID=1442

4) The complexity of the current arrangements for securing, using and retaining DNA samples should be the subject of a public education campaign, of which the use of a well-designed flow chart could be highly beneficial element.
5) The complexity of the current arrangements also suggests the need to establish an advisory committee, with a significant membership of non-expert members, to provide sound oversight and public scrutiny.
6) With respect to the use of DNA databases compiled for other purposes (e.g. for medical purposes and medical research) it would be both just and prudent to introduce a system similar to that used in the USA in which privacy is protected by 'certificates of confidentiality.'

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