

# DNA testing for all

There are two fair possibilities for forensic DNA testing: everyone or no one.

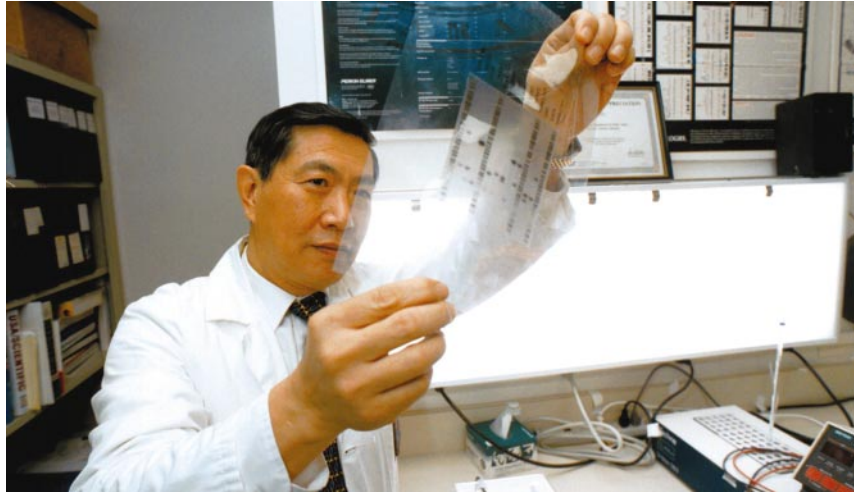
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DNA testing is the most important advance in forensics in our generation, and probably in the whole of human history. Whether convicting the guilty or acquitting the innocent, a DNA sample is the ultimate form of evidence. But if DNA testing is so valuable, why are we not testing everyone at birth, or at school, or when registering to vote or acquiring a driving licence? The answer is simple: we are scared. Genetics involves the things we really care about — ethnicity and race, sex and family, parents and children. The fears associated with DNA testing run so deep, they simply cannot be ignored.

The police want to catch criminals, and the public wants criminals to be caught. Nobody wants to be wrongly convicted, whether by mistake or through being set up for a crime that they did not commit. The public also wants to know that information about individuals' genes will be kept private<sup>1,2</sup>. We believe safeguards can be put in place that will protect civil liberties and allay public concern, while allowing police forces use of this extremely powerful technology. The key safeguards are that DNA samples are not retained and that the DNA data are placed on a database that is independent of the police. More important, we believe that there are only two possible fair practices when it comes to DNA testing for forensic purposes. Either test everyone, or test no one. We argue that the former is the smarter option.

## The facts

DNA testing relies on the fact that each human has a unique DNA sequence, and that this sequence can be used to link a person to — or eliminate them from — any crime



A database of DNA samples could be invaluable for forensics, but it would need careful regulation.

scene where a sample of human tissue for DNA analysis has been left. DNA tests have become extremely sensitive during the past 10 years. Gene amplification techniques now allow a unique DNA fingerprint to be obtained from a single nucleated blood cell, cheek epithelial cells from saliva, sperm, a single hair follicle or the skin cells from a fingerprint (see Box 1).

It is difficult to give those who do not work with DNA a realistic feel for the exceptional power of these tests. It has been estimated that if 10 DNA sites (or loci) are tested, the chance of a random match between two people is one in a billion<sup>3</sup>.

DNA forensic databases have been set up by police forces around the world. The protocol for DNA testing differs from country to country and from state to state. The United Kingdom has the most liberal stance — samples are taken from anyone who is suspected

of, charged with, reported for or convicted of a recordable offence<sup>4</sup>. The United Kingdom is aiming to hold the DNA profile of nearly 1 in every 15 people in Britain<sup>5</sup>.

## The fears

It was once suggested that members of the police in Tasmania should voluntarily submit DNA samples from themselves to allow the elimination of any police tissue that might contaminate crime scenes. Despite — or perhaps because of — their close knowledge of DNA testing, they refused to undertake testing on the grounds that it would infringe their civil liberties<sup>5</sup>. The fears about this practice are clearly not a consequence of ignorance, but extend throughout the community, including those most knowledgeable about the technology's power. So what are we most scared about?

There are two fundamental aspects to the fears surrounding DNA testing. First, there are general fears that DNA data will be used to violate privacy and that the government, insurance companies, employers, colleagues or family will access genetic information that we, as individuals, don't even have ourselves (let alone understand). People are worried that the database will be used for paternity tests or genetic research. The second fear is related to wrongful convictions. People are frightened of being wrongly convicted as a result of contamination or even an error in the testing process, and they are petrified of being set up for a crime they did not commit.

It is crucial that specific safeguards are introduced to protect the community and address these fears. These safeguards must address all four aspects of the testing process:

## Box 1 The PCR technique

The polymerase chain reaction (PCR) is an experimental technique that amplifies a specific sequence of DNA, usually from a few hundred to a few thousand base pairs in length, using a sample of an individual's cells.

Each of us, apart from identical twins, differs at several million places in our DNA sequence from any other human being. Because 'scene of crime' samples often contain blood, sperm or other body tissue, the personal genetic fingerprint, or profile, is easily obtained when the amplified DNA bands are separated and sequenced.

If the same short DNA sequences are amplified

by labs in all countries, it will be easy to create an international 'identity' database. Most variation occurs in non-coding sequences, so it will be simple to avoid data giving information about the appearance or phenotype of any individual.

If run by experienced technologists, PCR is free of artefacts, and contamination cannot occur. What can happen is identification of a person who was present at the crime scene, but who was not involved. It is therefore important to be explicit about the type of DNA sample in a court of law. A jury may, for example, give more weight to a sperm sample than to a saliva sample from a cigarette butt.

(1) the preservation and handling of DNA samples taken from crime scenes; (2) access to DNA samples taken from convicted offenders, suspects or the general community; (3) accreditation of the laboratories carrying out the analysis (and the scientists working in these laboratories), and access to independent expert advice by the defence, to check that no contamination or error has taken place; and (4) access to and storage of the DNA profiles that are the result of the analysis (see Box 2). It is also critical that any database used for criminal-justice purposes must not be used for any other purpose (such as research), or the public will lose confidence in its independence. Once people's fears are allayed, the real issue, and perhaps the most controversial aspect of DNA testing, is the question of whom to test.

All or nothing

Let us assume that credible safeguards are created and maintained, and that DNA databases are set up across the world with checks in place. From whom should DNA samples be taken? There are three possible alternatives. First, samples could be taken only from convicted criminals — and perhaps even for specific crimes, such as crimes of violence. Second, samples could be taken not only from convicted criminals, but also from suspects and anyone who comes under suspicion and is willing to give consent. Third, samples could be taken from every person in the community, at birth, for example.

Taking samples only from convicted criminals would send a message to the public that, as members of our society, individuals have the right to keep their genetic profile private. But if convicted of a crime, a person loses that right. In other words, the taking of a DNA profile acts not only as a punishment, but also as a deterrent — at least in theory.

The concept of DNA testing as a punishment has negative connotations and is likely to increase public concern. If deterrence



Sample case: a DNA test showed that Thomas Webb (centre) had been wrongly convicted of rape.

from future crime is the true motivation in taking DNA samples from convicted criminals, why would we not want to deter all members of society from criminal activity by collecting DNA samples at birth? The possibility of sending a message about social and racial inequality is another concern with testing only those who have been convicted of a crime because, in many societies, members of minority ethnic groups are convicted at a higher rate than other members of the community and are overrepresented in the prison population<sup>6</sup>.

If samples are to be taken from the convicted, from suspects and from anyone who volunteers to have a sample taken, the rules of consent become clouded. If individuals

refuse to have a sample taken, the immediate assumption is that they have something to hide. It has therefore been suggested that, because a failure to consent could raise suspicion, such consent is not truly voluntary<sup>7</sup>.

The most logical and fair practice — and also the most controversial — would be to DNA-test all individuals at birth. This would not only act as a deterrent from crime for all members of the community, but would make the task of catching criminals easier for police. If the correct safeguards are in place to protect civil liberties, why should a proposal to test everyone at birth be a frightening one? On the other hand, if the correct safeguards are not in place, and the fears are justified, why are we daring to test anyone at all? ■

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1. Nowlan, W. *Science* **297**, 195–196 (2002).
2. Rothenberg, K. H. & Terry, S. F. *Science* **297**, 196–197 (2002).
3. Concar, D. *New Scientist* **10** (5 May 2001).
4. Australian Law Reform Commission and Australian Health Ethics Committee *Protection of Human Genetic Information: Issues* (2001).
5. Police Association of Tasmania Newsletter (March 2002).
6. Reilly, P. *Nature Rev. Genet.* **2**, 313–317 (2001).
7. Kimmelman, J. *Nature Biotechnol.* **18**, 695–696 (2000).

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Box 2 Safeguards for forensic DNA databases

We propose the following five measures to safeguard civil liberties and allay public concern. Of primary importance is the independence of both the laboratories that test DNA samples and the DNA database itself.

1. Forensic laboratories responsible for DNA analysis should be independent of the police, and should be fully accredited using a national scheme, including definition of acceptable staff qualifications, periodic assessment and an enforceable code of conduct.
2. Any DNA sample taken from a crime scene should be sent directly to the laboratory for storage and testing. Where possible, it should be divided, and one portion should be reserved

for the defence. Samples should always be kept in tamper-evident packaging.

3. Blood, cheek swabs or other samples from suspects, convicted offenders or volunteers should be sent directly to the laboratory for testing, and not be placed in police custody. These samples should be destroyed after analysis has taken place and DNA profiles entered as data.
4. All DNA profiles should be computerized and held on a national or international DNA database that is independent of police. The database needs to be accessible by police for effective use, but it is critical that police cannot enter or alter any data.
5. Any data accessed from a DNA database outside this accredited, independent process should not be admissible as evidence.