



DNA and Criminal Justice

Genetic Fanatics

There has been much recent enthusiasm expressed about the potential of forensic DNA testing to solve crime and even to free the wrongly convicted. An international campaign initiated by Alec Jeffries (the UK geneticist who coined the deceptive term 'DNA fingerprinting' and who receives a royalty on every forensic DNA test performed worldwide) has been taken up by New York police chief Howard Safir and OJ Simpson lawyer Barry Scheck as well as many police forces and politicians throughout the English speaking world.

Many interests stand to gain from the promotion of genetic technology. DNA testing labs, both private and government can expect a bonanza. Lawyers will benefit from the increase in cases requiring extended testimony from expert witnesses and new grounds for appeal. The data gathered via forensic DNA testing will be of great value to drug and insurance companies, potential employers and private investigators. It also has the potential for abuse by racists and eugenicists, such as currently occurs in several US jurisdictions where racial profiling is used to indicate the likelihood that an unknown offender is from a particular ethnic group.

This enthusiasm has led to a rush to implement new technology without considering possible drawbacks or safeguards. It has also led to proposals which would severely compromise privacy and civil rights were they to be implemented in NSW.

The Technology

The public has been regaled with stories of the new wonder technology which will solve crime using a single hair or speck of saliva, that will positively identify the criminal with 1 million to 1 certainty, freeing the innocent, condemning the guilty and ushering in a brave new world of crime fighting. Of course the truth is somewhat less spectacular.

The older technology currently used (Restricted Fragment Length Polymorphism or RFLP) is subject to errors in each of its six stages, including the mysterious 'band-shift' which recently resulted in the accidental release of a rapist in NZ, who went on to commit at least three more rapes before retesting with newer technology detected the error.

The newer technology (Polymerase Chain Reaction amplification or PCR) requires better quality, though smaller, samples and extremely high lab standards to be successful. Due to

cross contamination between samples from a Christchurch assault scene and two Wellington murder scenes, a NZ man spent four months under police investigation for double murder. Fortunately he had an airtight alibi, he was in Christchurch being assaulted. NZ Justice Minister Phil Goff said of the case "What worried me was that, okay, this was a very clear-cut case where the man couldn't have committed the crimes. Had he been a gang member and lived in Wellington ..."

It needs to be remembered that DNA testing does not produce 'fingerprint' like results positively linking a suspect with a crime scene, rather it produces a statistical probability such as "there is a one in a million chance that a randomly selected person will have a DNA profile as close to the sample as that of the suspect". This may seem conclusive when linking a single suspect to a single crime scene but were someone to be tested against the 15,000 profiles currently in the NSW police database a one in a million chance becomes one in 67. If all of NSW's 8000 prisoners are subjected to such tests it becomes a near certainty, with simple chance indicating that around 120 false positives will result. Should such a test be applied to the Australian population as a whole, the labs would find around 300,000 'culprits' for the 15,000 unsolved crimes.

It must also be remembered that the 'one in a million' probabilities talked about relate to comparisons with a large standard population, usually the US population. This has serious implications when tests are performed against an accused member of an ethnic minority.

While the chance that a randomly selected Australian citizen may have a DNA profile matching a Brewarrina Aborigine may be a million to one, a randomly selected Brewarrina Aborigine may be at much higher chance of matching. Concerns like these have led to the EU adopting a recommendation that such odds are only given in relation to the profile of the defendant's ethnic group. Unfortunately such profiles have been done for very few ethnic groups.

Some enthusiasm has been expressed, by NY police chief Howard Safir among others, for the potential of mitochondrial DNA from hair to be used to profile even the most degraded samples. While mitochondrial DNA might be used to aid in the identification of corpses by linking them with female ancestors, it is identical in all individuals of the same female line of descent. Therefore a single profile is common across large sections of the population, even those who do not share a common surname or known family relationship, making it entirely unsuitable for cases of criminal identification. The possibility that testing or collection procedures may allow a common segment of mitochondrial DNA to be misidentified as a rare sequence of nuclear DNA should not be overlooked when establishing collection and testing standards.

The probabilities quoted in court regarding DNA evidence completely neglect the error rates of the testing laboratories. An external DNA proficiency test conducted by the

California Association of Crime Laboratory Directors upon the Lifecodes, Cellmark and FBI laboratories found a 1% error rate, mostly false positives. The labs were notified that they were being tested and so can be expected to have taken special care. It can be seen that odds like 'one in a million' are meaningless when the lab error rate is one in a hundred.

In the UK forensic DNA testing laboratories are subject to random blind testing to enable their error rates to be accurately estimated. Procedures in US FBI laboratories were condemned following a 1997 Justice Department investigation which revealed deliberate faking of data to obtain convictions. Nicholas Cowdery QC has called NSW forensic services 'the worst in the world'.

While the new technology may look impressive, ways of rorting it are equally impressive. It requires no expertise in fingerprint lifting and transfer to plant genetic material on a crime scene and it is far less risky than 'loading someone up' with heroin. Samples for such actions can easily be obtained and it is not inconceivable that a police officer might inadvertently contaminate a crime scene with material gained by handling a suspect, such as a hair or flake of dandruff.

In the US several innovative methods are already in use to foil genetic testing, including prisoners spitting into each others mouths before a swab and a case where an imprisoned rapist sent a sample of his semen to a female friend so that she might register a rape case with a DNA profile exactly matching his. As the technology becomes more common, doubtless so to will ways of beating it.

Adequate education about the new technology must be given to any police expected to use it. While this may seem obvious, recent revelations that NSW police attribute an accuracy to their radar cameras beyond that claimed by the manufacturer reveals that sufficient attention is not always given to such 'details'.

Data and Samples

The genetic material contained in a forensic sample holds far more intimate information about the subject than that contained in a fingerprint. Physical, racial and behavioural information about the subject will all be available to the skilled geneticist of the near future, with the completion of the Human Genome Project. The data available from these samples can be expected to become more and more valuable as genetic science progresses. This information will be of obvious use to drug and insurance companies but the coming decades will see new and unimagined commercial applications for such data.

The data extracted from the these samples with current forensic technology is far more limited, but still contains information that may be used other than in criminal investigation. They would provide valuable evidence for a private investigator on a paternity case for example. Their very existence would be of interest to potential

employers, especially if they indicated that the subject had once been under suspicion of an offence. They might be used to track someone who had undergone a change of identity under the witness protection program.

The existence of the samples in storage or the data on computers will provide unique temptations to corruption for those charged with accessing them and will present unique security problems due to the data value of a microscopic speck of material. If this data is to be stored on computers with internet connections it can be expected to become the target of attacks from well resourced hackers with an interest in duplicating or altering it.

It is important that all police and lab staff with access to such material and data be made aware of its sensitivity and the need to ensure its security. While there is probably no need to introduce new legislative penalties for the dissemination of such information, those with the motive or opportunity to abuse such data should be made fully cogniscent of the penalties for doing so.

There is no reason that sample material taken from a suspect should be retained after the completion of legal proceedings. Should the defendant fall under suspicion again later another sample can be taken. The retention of this material would represent a worthless storage expense and security/privacy risk. All samples should be immediately destroyed when they are no longer required for the case being investigated or tried.

PCR technology involves the mass duplication of part of a subject's DNA. Laws concerning the ownership of such material produced by a laboratory need to be reviewed. While the testing material and procedures are doubtless the property of the lab, the information duplicated belongs to the DNA donor. In this age of 'patenting' DNA sequences it is important that the donor retain ownership of all information contained in his/her DNA, regardless of how it may be copied or disseminated. Following testing, DNA laboratories should be required to surrender or destroy any material which may contain originals or copies of a subject's DNA as well as any digital or physical record of such data.

The genetic profiles resulting from the tests should only be entered onto a police database following a conviction for a serious offence. Fingerprint records are destroyed if a conviction is not obtained although they do not contain information which might be used for other purposes and provide positive identification, unlike DNA tests.

All criminal records, including fingerprints and DNA, should be expunged after the completion of a sentence. Someone who has completed their sentence and is in the process of rehabilitating themselves into society should not be the subject of police investigations everytime a 'fishing expedition' throws up a chance match. The duration of a sentence should be adequate time for police wishing to check DNA evidence against unsolved crimes of a similar type.

The police should not have access to a database of test results from innocent people to allow them to 'go fishing' for matches to unsolved crimes. They should certainly not be granted their request for access to the DNA records now routinely gathered when a child is born. Procedures like these will have the effect of making everyone in the country a 'permanent suspect'. As discussed above, the technology is completely unsuitable to such mass cross matching anyway and is no substitute for traditional detective work.

Samples and data from crime scenes which remain unlinked to a specific individual require no such protection however, and represent a valuable resource both in the solving of crime and the possible acquittal of the wrongly convicted. Should someone claims 'ownership' of this data though, (e.g. admits to being at the crime scene and that the DNA is his/hers) they should be granted the same rights over the samples and data as someone who has given a sample directly from their body.

It is vital that defendants and convicts be given full access to crime scene DNA samples where these samples may establish their innocence. Procedures in many US states make it very difficult to gain such access and of the 70 convicts freed when DNA evidence overturned their conviction, more than half had to take legal action to gain access to the samples, often signing away their right to compensation in the process. At least one man was executed while awaiting access to such material. Doubtless many more innocent people remain in prison because they do not have the legal resources necessary to access the evidence.

Sample Collection

From individuals

Although its enthusiasts refer to DNA profiling as 'genetic fingerprinting' it is both less precise and far more invasive than traditional fingerprinting. Modern techniques allow fingerprints to be taken without even the inconvenience of an inky hand. DNA sampling requires the insertion of a needle into the flesh or a swab into a bodily orifice.

Legislation in Victoria allows for prisoners to be held down and a swab to be forcibly inserted into their mouths. This is the closest thing to legalised rape since cavity searches for drugs. Yet body searches and fingerprinting can only be done when someone is strongly suspected of a criminal act. Under current proposals all NSW prisoners will be subject to such treatment in spite of being under no suspicion of committing an unsolved crime. There is also a proposal for all those arrested for any offence in NSW to be subject to such an invasion of their body.

No one should be forced to give up bodily material against their will. That people suspected of no crime could be forced to give DNA samples simply so that the police can

go fishing in an attempt to solve outstanding cases would represent a serious erosion of civil rights in this state.

Even suspicion of serious criminal activity does not of itself justify DNA testing. Only in a tiny minority of cases is DNA evidence relevant to investigation or prosecution. In most cases, such testing would represent not only an unnecessary expense and invasion of privacy, it would also serve to decrease the quality of important DNA testing through tying up resources and increasing contamination risk. Following the enthusiasm of New York police chief Howard Safir for mass DNA fishing expeditions, a large backlog has developed in the analysis of rape test kits which might be used to link (or eliminate) a known suspect with a recent crime.

From crime scenes

The nature of evidence used in forensic DNA testing makes it extremely prone to contamination, especially in the case of the new PCR technology. It is important that this evidence be protected from accidental or deliberate contamination during its collection.

Police who gather DNA samples from crime scenes should be especially trained and equipped to gather such material in a way that will minimise the chance of contamination. They should be separate from the investigating police in order to minimise opportunity or temptation for corruption of evidence. It is quite possible that an officer who has questioned a potential suspect may inadvertently get genetic material on his uniform which could contaminate DNA evidence should s/he attempt to gather it.

Consideration should be given to DNA testing all NSW police involved in the investigation of crimes as this would allow a database to be established which would exclude any genetic contamination of evidence originating from the officers themselves.

This would be particularly important in cases where officers may have attended a violent crime and received an injury. It seems likely that were this to be done, many of the 15,000 DNA samples now on file could be eliminated, with a correspondingly reduced cost in storage, testing and comparison. The existence of the personal information of police on any DNA database would also encourage police vigilance over DNA data security.

DNA evidence in the courts

DNA evidence is of extremely complex nature and deals with statistical analysis of the kind that surveys have shown the majority of the population to have a poor understanding. Allowance must be made for the extra time and resources (such as expert witnesses) required to prosecute or defend on such evidence. It is perhaps unreasonable to expect that a jury should become familiar with all of the factors relating to test type, defendant race, lab error margin etc needed to evaluate such evidence. The admissibility of

DNA evidence should probably best be determined in a pre trial hearing. Should it be deemed inadmissible, the DNA samples and records of the defendant should be destroyed.

DNA evidence is far easier to plant at a crime scene than fingerprints, and samples such as hair, dandruff or even blood can easily be obtained during interrogation of a suspect. Police in Utah once followed a suspect for days until he was observed spitting, whereupon the spit was promptly scooped into a sample container. The butt from a cigarette offered to a suspect during questioning might easily be later 'found' near a crime scene. Judges should be required to warn juries of the ease with which such evidence can be planted in much the same way that they are now required to warn about unsigned police statements of interview.

Consideration should be given to introducing guidelines over the way such evidence is presented to a jury. When DNA data is cited in serious scientific literature it is always given in the context of the limitations inherent in the testing and sampling methods (e.g. "the prevalence of this gene in the Cornwall population of the common European vole has been found to be 1:7,500 +/- 12.5%"). Forensic science has historically seen itself under no obligation to provide estimates regarding the accuracy of its test or control data, a situation long overdue for review.

When considering US cases of prisoners exonerated and released (when not already executed) after later DNA testing, it is worth noting that a large number of them had been originally convicted with the assistance of tainted forensic evidence. Australian history too is replete with such examples.

Few could forget the part Joy Kuhl's forensic evidence played in the wrongful murder conviction of Lindy Chamberlain. Harry Blackburn was investigated for rape as police withheld blood typing evidence that would have exonerated him. Hair samples taken from Belangalo forest which may have cast doubt on the conviction of Ivan Milat were conveniently 'lost' by police forensic investigators. One of the first cases in Australia where a conviction was gained on the basis of forensic evidence, the then new 'science' of hair matching, ultimately resulted in Colin Campbell Ross, an innocent man, being hung for the 1921 rape and murder of a 12 year old schoolgirl. Recent tests on the original evidence has confirmed long held suspicions that the testing for the case was bogus and a gross miscarriage of justice occurred.

While new techniques may lead at first to the exposure of previous abuses of forensic 'science', there can be little doubt that they will soon be integrated into the repertoire of those who would seek to gain conviction without due process. DNA profiling offers unique opportunities for abuse, due to the ease with which such evidence can be manufactured or distorted, the complex way in which the technology and its

interpretation must be presented in court and the sheer deceptiveness of statistics which imply a 'one in a million' chance that the prosecution has got its case wrong.

Testing procedures and laboratory standards

Although not as effective as fingerprints in establishing positive identification, DNA testing represents a quantum leap in complexity and cost required for examination and analysis of identification evidence. Following serious errors in DNA test results an inquiry commissioned by the New Zealand Justice Department found existing forensic laboratory standards there to be inadequate in dealing with the new technology. It seems likely that the huge amount of money pouring into the industry over the next decade or so will result in a proliferation of 'cowboys' out to cash in on the new gravy train with little regard for standards.

RFLP technology allows the introduction of errors at several points in the procedure unless good quality chemicals (especially in the separating gel) and experienced lab staff are assured. PCR techniques require hygiene standards unprecedented in NSW forensic labs. Not only do special sterile environments need to be provided, often the ventilation of the building must be redesigned. If the New Zealand experience is not to be repeated in NSW, considerable funds must be invested for the upgrading of laboratories and the hiring or retraining of lab staff. If the private sector is to be involved in service provision, strict standards must be set for the tendering process, 'the cheapest bid wins' principle is unlikely to result in services of adequate quality.

The US experience has shown that law enforcement DNA labs are not above faking results in order to obtain a conviction. It seems possible that private DNA labs, seeing the police as their 'customers', may be inclined to err in favour of the prosecution in order to improve their chances of future contracts. Almost 70% of the errors found in the CACLD survey of commercial and government forensic DNA labs were false positives that would have favoured the prosecution had they represented real cases.

DNA laboratories need to be independently audited in order to determine their error rate. In the UK, such labs are subject to regular blind tests whereby a sample for which results are known is sent without any notice that would indicate that it was a test. However there is no legal requirement in the UK for the known error rate of a laboratory to be brought to the attention of jurors. All DNA evidence presented in NSW courts should be done alongside the most up to date error rate known for the lab(s) in question.

DNA labs are a point at which sample material and DNA data might be illicitly diverted. Contracts to provide DNA testing services must be conditional upon an agreement to take appropriate precautions regarding sample and data security and acceptance of liability should samples or information go astray.

Any lab found to have an error rate which exceeds a predetermined level should not be eligible for renewed government contracts until the error level returns to an acceptable range.

Any DNA lab found to provide deliberately or negligently misleading test results, misrepresenting the experience or training of their technicians or failing to ensure the security of samples and data, should have all contracts cancelled immediately and have its authority to conduct such tests withdrawn for a minimum of twelve months. Failures like these represent a dysfunctional lab environment which cannot be addressed by simply sacking one or two 'aberrant' employees.

Ancillary costs of forensic DNA testing

Care must be taken in allocating funds for the acquisition of new technology without proper consideration of supplemental funding requirements and possible vested interests among 'advisors'. Previous NSW police acquisitions of computer and communication technology provide excellent examples of what can go wrong when enthusiasm is allowed to override careful consideration.

It would probably be deceptive to try to estimate the unit cost of a forensic DNA test based on previous or overseas experiences. Old technology becomes cheaper, newer more expensive technology is introduced and the unit test cost is trivial when compared to the collection, data entry and storage security expense these tests would entail.

While doing multiple tests in independent laboratories upon each sample may increase the unit test cost, it seems likely that this would be outweighed by savings which would accrue by preventing the investigation of false leads, the wrongful elimination of prime suspects or the collapse of prosecution cases due to doubts about the testing. Examples of poor testing procedures will strengthen defence cases however, as doubt in criminal matters is to the benefit of the accused.

Police must be trained in the standards necessary to deal with collection and interpretation of DNA evidence in a way which will allow them to stay apace with ongoing changes in the technology. Special equipment, including protective clothing and contamination resistant sample containers, must be provided to those expected to attend crime scenes which might hold such evidence. A special squad of DNA technicians, independent of investigating police, should be set up with the expertise to collect DNA samples from crime scenes and responsibility for ensuring sample security & integrity during transport to testing laboratories.

Collection of DNA samples from suspects should be done by independent medical practitioners. While this may involve some extra expense it would prove cheaper than trying to ensure the integrity of DNA testing by a police service without the training or

culture to carry it out in a safe and reliable manner. Should someone suffer medical complications as the result of an enthusiastic police officer forcing a swab into his/her mouth the NSW police or the government may be exposed to legal liability. This is a real possibility if the suspect is not a native English speaker or is unaware of what is going on.

An independent body charged with monitoring standards in DNA laboratories should exist. It should have responsibility for checking error rates and policing data security. If the Ombudsman's office is found to have insufficient resources or expertise for such a task appropriate funding should be provided or a new body created.

Security for DNA data storage facilities must be assured. Computers containing such data must not be linked to the internet and strict procedures governing the removal of printed or digital storage material from the site must be implemented and maintained. Samples themselves are even more problematic and if they are not destroyed when no longer necessary, storage and security costs will simply balloon year after year. Samples should be stored in secure rooms or buildings with limited access. Good security must also be observed in the transport of samples to/from collection, lab and storage. Someone accused of a serious crime might find good reason to offer a courier considerable incentive to swap a sample.

As DNA evidence becomes more common in court more time will be taken over highly technical argument requiring expert witnesses. This will be the case even if DNA evidence is evaluated for admissibility pre-trial. If juries are expected to weigh the technical aspects of such evidence, added cost and delays will be multiplied. As well as the implication for court queues, this will have a serious effect on the ability of low income earners to mount a defence against a well resourced prosecutor armed with DNA evidence.

While there seems little doubt that prosecutors will receive sufficient funding to allow them to effectively prosecute cases involving DNA evidence care must also be taken to ensure that defence lawyers and the courts themselves are adequately resourced to meet the new expenses. Monitoring the amount spent by prosecution on DNA evidence should provide good indication as to what additional funding must be provided to Legal Aid in order to ensure that defendants are not placed at unfair disadvantage by the complexities of the new technology. It would seem likely that the escalating cost of cases will require a periodic upwards review of the income/asset threshold beneath which a defendant becomes eligible for Legal Aid.

DNA tests in the US have resulted in several dozen cases of wrongful imprisonment being exposed, but the ability of the innocent to gain an appeal on these grounds is severely restricted in many states. Most of those released have had to mount extended legal or media campaigns simply to gain access to the samples which eventually exonerated them, usually signing away their right to compensation for wrongful imprisonment in the

process. Some US prisoners were executed before being proven innocent by DNA evidence, at least one while trying to gain access to the sample which would posthumously clear him.

NSW prisoners need to have unambiguous legal access to any DNA evidence which might serve to clear them of the crime for which they are serving sentence, and to the legal resources necessary to evaluate the evidence and mount an appeal if appropriate. Any post trial impediments to appeal, such as previously exhausting the appeal process, must be waived in cases where DNA evidence may cast doubt on the original verdict.

Following the naming of many corrupt NSW police during and after the Wood Royal Commission, very few prisoners gained access to resources which would have enabled them to appeal against cases prosecuted on evidence given by corrupt police. This disregard for the consequences of a known breakdown in due process must not be allowed to recur with the introduction of widespread DNA testing which may challenge older forensic evidence.

Unlike their US counterparts, Australian law enforcement bodies rarely have the luxury of burying their mistakes following a judicial murder, even though NSW prisoners seem to practice elective execution at a disturbing rate. DNA testing will doubtless result in a number of claims for compensation following wrongful imprisonment. Funds should be set aside for this contingency, although as it is to be hoped that fewer people will be imprisoned in future if DNA evidence could exonerate them, this expense is unlikely to be recurrent.

Conclusion

Although forensic DNA does not represent the major crimefighting breakthrough that its proponents may have us believe, there is little doubt that it has many uses and will become more prevalent in the future. It is no substitute for detective work however and will doubtless lead to major abuses if allowed to be seen as such.

The successful integration of forensic DNA technology into the NSW justice system requires careful consideration and substantial funding. While this paper raises some concerns, it does not purport to be exhaustive regarding the pros and cons of DNA profiling in all of its possible implementations.

It is hard to see how a purportedly democratic society could consider such a major shakeup of its criminal justice procedures without full public consultation. The only voices heard so far in the public debate have come from enthusiasts with something to gain from the rapid, unregulated introduction of the technology.

Justice Action does not feel that sufficient public consultation or parliamentary consideration has been applied to the issue of forensic DNA testing, especially proposals to set up huge unsecured databases and mass test prisoners and arrestees. Until this happens, the only responsible course is a moratorium on the further introduction DNA technology into the NSW criminal justice system.

Recommendations

Before forensic DNA testing and data storage is allowed to proliferate further the following safeguards must be implemented.

Sample Collection

- All collection must take place with the informed consent of the sample donor. Compulsory DNA testing would represent an unprecedented breach of the individual's right to privacy.
- No-one who is not a prime suspect to a serious crime should be subject to forensic DNA testing. 'Fishing' for culprits for unsolved crimes is not only a breach of civil liberties, it is of extremely dubious value within the limits of the technology.
- Collection of DNA from suspects should be done by independent medical practitioners in order to prevent dubious and possibly dangerous collection by police untrained in medical matters.
- Police required to collect DNA evidence from crime scenes must be trained in the appropriate hygiene techniques and use protective clothing.
- Procedures must be established to ensure that other police or citizens do not contaminate crime scenes before DNA evidence is collected.
- Consideration should be given to DNA testing all NSW police to enable the elimination of any genetic contaminants arising from them during testing.

Disposal of data and samples

- DNA samples taken from suspects must be immediately destroyed upon completion of legal proceedings, regardless of the verdict. If the defendant becomes a suspect in any other crimes further tests can be done.
- 'Duplicates' of tested DNA created with PCR technology is to be treated in all ways as the original DNA of the testee. PCR amplification medium which may contain such duplicated material must be destroyed under stringent oversight following testing. It must not be allowed to be considered the property of a testing laboratory or drug company.
- Data arising from DNA tests of suspects must be immediately destroyed should the suspect be cleared as is currently the case for fingerprints. Police should not

have access to a database of 'potential suspects' who are in fact innocent of any crime.

- Only DNA test results from those convicted of serious offences where biological evidence was relevant should be available for storage and crossmatching on any police database.
- All criminal records, including fingerprints and DNA data, should be expunged after the completion of sentence. Those who have paid their debt to society have the right to rehabilitation, they should not be considered criminals for the rest of their lives.
- Explicit penalties for unauthorised passing on of DNA information should be stated and made clear to police and lab staff with access to this data.
- Police computers containing DNA data should not be linked to the internet to ensure security from well resourced hackers
- Someone accused of a crime for which DNA evidence was gathered from the crime scene (e.g. semen in a rape case) must be given full access to these samples if they might be used to establish his/her innocence. This should include sentenced prisoners who may have grounds for appeal with the new technology.

Testing Procedures

- Laboratories should only be authorised to conduct DNA tests if they sign a code of compliance regarding testing procedures and data & sample security.
- Forensic DNA laboratories should be subject to random blind testing as in the UK to determine their error rate
- Wherever possible, DNA samples should be sent to multiple labs for testing. If all tests fail to return the same result juries should be informed of this.
- Any DNA laboratories which have been shown to fake evidence, as is the case with the FBI laboratory in the US, must have their authorisation to conduct such tests immediately revoked. Such problems cannot be sheeted home to employees, they represent serious management failures.

Court Proceedings

- All DNA evidence should be examined for admissibility prior to presentation to a jury. It should not be up to juries to gain an education in technical aspects of the evidence during the trial process.
- Judges should be required to warn juries that DNA evidence does not establish identity with the certainty of fingerprints and that the planting of such materials on crime scenes is an extremely simple procedure.
- When DNA match 'probabilities' are stated to juries they must include factors such as the error rate of the testing laboratory and the number of tests done to obtain a 'hit'. (e.g. If twenty samples were tested in order to get one which gave a

'million to one' match probability, the actual ratio is twenty times one in a million, ie one in fifty thousand.)

- If the ethnic group of the defendant is not the same as that of the control data used for comparison this needs to be stated to the jury along with the implications for the accuracy of the test. Evidence like this should probably be excluded in pre-trial proceedings.
- Post conviction bars against appeal should be waived if DNA evidence which might overturn the original verdict is available.

Funding requisites

- Sufficient funding must be available to ensure high quality forensic DNA testing and thorough review and oversight of the process. DNA testing on the cheap is not acceptable.
- Extra funds must be made available to Legal Aid to cover the increased cost of mounting defences against highly technical DNA evidence.
- Extra funds must be made available to the courts to prevent an increased backlog due to the need to evaluate complex DNA evidence
- Proper equipment and training must be made available to all police who may be expected to attend a crime scene at which DNA evidence is to be gathered.
- Legal resources must be made available to serving prisoners who might win an appeal with the help of DNA evidence and a fund must be set up to allow for compensation of (ex-)prisoners who win their appeal after a wrongful conviction.
- Sufficient funding must be provided to the Ombudsman, Inspector General of Prisons and any other body charged with the oversight of DNA collection, storage and databasing to enable them to fully meet their responsibilities.

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