FORENSIC DNA DATABASE: ETHICAL, SOCIAL AND LEGAL CONCERNS

By

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ABSTRACT

This qualitative research is designed to study the ethical, social and legal concerns pertaining to the establishment of a forensic DNA database in Pakistan. Although Pakistan is using DNA profiling to solve the criminal investigations but still there is no definite DNA legislation or DNA database available. Two government bodies, viz. the National Forensic Science Agency (NFSA) and the Punjab Forensic Science Agency (PFSA), are looking forward to work in this regard. In this study we presented a broad spectrum of ethical and legal concerns that were faced by the countries who had established their DNA databases. We also carried out a survey in order to find out the viewpoint of Pakistani population regarding the DNA database in general and in particular to its establishment in Pakistan. The subjects of our survey included forensic scientists, lawyers, policemen, administrators, teachers and students (graduate and post-graduates). Our survey revealed that although there is a wave of awareness regarding the significance of DNA database but still there is a doubt to the secure nature of such a database at Pakistan. Therefore, it should be the utmost priority of the forensic workers, law enforcement agencies and the judiciary to formulate such a scheme for the establishment of a DNA database in Pakistan that not only protect the civil rights of the citizens of Pakistan but also ensure that such a database could not be manipulated by the anti-social elements. This study is a pioneer work for bringing the ethical and social concerns of the society of Pakistan in front of the authorities that are linked with the establishment of DNA database of Pakistan.
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INTRODUCTION
BACKGROUND

This thesis investigates the impacts and implications for governance of one of the most successful and yet controversial developments in recent science and technology history: the introduction of DNA profiling and data-basing into the criminal justice system, which began in 1988, when English baker Colin Pitchfork was the first person convicted through the use of DNA evidence (Jeffreys et al., 1985). The increasing use of DNA evidence in criminal investigations and in court soon assumed the role of a new language of truth, following from traditional fingerprinting. While DNA profiling, on a case-by-case basis, had been used since the late 1980s, it was the establishment of centralized national registries of DNA profiles for police and forensic use 5 to 10 years later which made possible the wider and systematic use of DNA technologies in criminal investigation. Computerized forensic DNA databases enabled authorities to compare profiles from crime scenes and subjects against and between each other on an automated basis and on a large scale. The first national forensic DNA database of this kind was implemented in 1995 in the UK, followed by New Zealand, several European countries, and the USA and Canada (Walsh et al., 2004). Australia and many other countries across the globe followed suit.

Forensic genetics applies the knowledge and techniques of genetics to policing and the justice system. Currently, DNA samples are taken from crime scenes, from suspects (which suspects and in what circumstances vary by country) and from ‘volunteers’ for elimination purposes. Depending on legislation in the country concerned, samples and profiles may be stored permanently or for a limited time, routinely searched for matches with crime scene samples, used for familial searching and for research relevant to crime detection. New techniques of DNA analysis, including ‘low copy number’ (LCN), can generate a profile from smaller and lower quality DNA samples. DNA evidence can, of course, be used to exonerate as well as to inculpate suspects, and the US Innocence Project is reported to have cleared 195 convicted criminals in this way; the average time they had served in prison was 12 years (Levitt, 2007).

Over the last 10 years, the availability of DNA samples and of techniques for rapid DNA sequencing has created a vast body of human genetic variation research for forensic purposes. Standardized systems have been developed and rapidly adopted
worldwide for determining whether DNA in a sample from a suspect matches that in a sample from a crime scene. The most commonly used systems in the US and the UK analyze fixed sets of short tandem repeat (STR) loci (Budowle and Moretti, 1999). Setting laboratory error aside, lack of a match between the STRs in a crime scene sample and those in the suspect’s DNA sample eliminates that person as a suspect. It is for this reason that the Federal Bureau of Investigation (FBI) has standardized the use of 13 STRs in order to reduce the probability of two persons having the same DNA profile (Budowle et al., 2000).

In the next decade, the use of forensic DNA databases will increase in breadth and scope at national, transnational and international levels. Moreover, the importance and use of DNA profiling and data-basing will increase and broaden with the rise of security, biometrics and anti-terrorist issues on public and political agendas. Parallel to such expansion, which is also occurring in developing countries, will be an increasing need to balance the benefits of the new genetic technologies of identification, surveillance and security against civic concerns, informed by criminal, genealogical and, potentially, medical and health histories, and new shifting definitions and identities and stakes pertaining to the criminal and the suspect. One of the biggest challenges will be building and maintaining public trust, which involves the creation of arenas where multiple viewpoints, interests and values can be articulated and heard.

Although genetic testing and the collection, storage and use of DNA data for medical research have been debated all over the world, there has been less public debate about the use of DNA data as criminal evidence. Public support has been presumed on the grounds that all law-abiding people want criminals to be caught and convicted and the ‘innocent’ have nothing to fear from DNA technology. Personal genetic information collected with consent for medical treatment or research may, subject to judicial authority, be accessed for police investigation in spite of the stated opposition of governance bodies. The collection, storage and use of sensitive and identifying personal data always raise ethical, social and legal issues. If it is argued that any connection with criminal investigation or control means that there is no need for the usual scrutiny, then there is a price to pay in terms of civil liberties, especially by those who are on the database despite not being guilty of any crime. It is therefore of
utmost priority of every country to come up with the legislation regarding DNA forensics that is in harmony with the social and ethical norms of its respective society.

Formulation of regulatory laws regarding DNA databases is worldwide phenomenon. Many European countries have legislated laws for initiating and regulating their own databases (Martin et al., 2001; Schneider and Martin, 2001).

Dealing with databases and their regulation is a matter of what local communities are willing to accept, since such decisions can affect the whole community (Romeo-Casabona, 1994). There are currently three available approaches concerning forensic DNA databases, each with its advantages and drawbacks (Guillén et al., 2000). The first one, which is the most permissive, is based on the genotyping and the inclusion of the general population on the database. The second one, which is more conservative, which permits DNA fingerprinting and the inclusion of profiles on the database only for a specific list of crimes and only for individuals linked to a high degree with a crime. Finally, the third one, which is against the preparation of DNA databases for criminal investigation. According to this approach, the forced subjection of the individual to testing is ordered only when there is clear proof that the individual is closely linked to the crime committed. Nevertheless, the results of the DNA analysis are not stored in a database, and, according to this approach, this guarantees that they will not be used for purposes other than those for which they were initially carried out.

The many social, ethical and political (less so economic) concerns and issues pertaining to forensic DNA profiling and data-basing are situated at the intersection of civil rights, science and governance. Such concerns include, but are not limited to, privacy; (non) standardization of jurisdictional databases; surveillance; ideological and scientific interpretation of DNA evidence; scientific reliability of DNA testing; potential misuse and abuse of databases; sample collection and analysis, security and/or contamination; database implementation and expansion; function creep; public trust and participation; and mass testing or DNA dragnets.

In this study, we focused on the current situation around the world regarding the forensic DNA profiling and legislation as well as its ethical and social concerns. We also provided the status of Pakistan with respect to DNA forensics. This study can be helpful for the understanding the issues for establishment of regulatory affairs of the
forensic DNA database in Pakistan. It also highlights the social, ethical and legal concerns faced by other countries that Pakistan has to face and deal with in developing its database.
CHAPTER 2

REVIEW OF LITERATURE

Science of DNA profiling:

Deoxyribonucleic acid (DNA) is the genetic material found in all cells of an organism except red blood cells (RBCs) (Fig.1.). Each nucleated cell contains chromosomes that are basically combination of various segments of DNA. Each DNA molecule in turn is composed of nucleotides. Nucleotide is formed by the combination of three components, viz., a pentose sugar, a phosphate group, and a nitrogenous base. The four types of nitrogenous bases (adenine, cytosine, guanine and thymine) make each nucleotide distinct. The complement nature of these bases (adenine with thymine and cytosine with guanine) is the reason for the double-helix structure of DNA as was proposed by Watson and Crick (Watson, 1968). It is worth mentioning to note that only 3% of DNA codes for various activities of life and the other 97% is referred as “junk DNA”. Interestingly, this junk DNA is used in forensic DNA profiling (Van Camp and Dierickx, 2007).

![Fig.1. DNA inside the cell](image)

Dr. Alec Jeffreys is the pioneer for introducing DNA profiling (referred as “DNA fingerprinting”) in forensic cases by the discovery of mini-satellites and restriction fragment length polymorphism (RFLP) (Jeffreys et al., 1985). Later on, the discovery of polymerase chain reaction (PCR) leads to analyze the forensic samples containing
small amount of DNA (Mullis, 1986). By mid-nineties DNA fingerprinting was substituted by short tandem repeats (STRs) that are short repeated sequences of DNA (Jobling and Gill, 2004). STRs are unique to every individual and therefore serve a key role in DNA, however, need large amount of DNA sample in order to carry out the analysis. In cases where DNA is degraded mitochondrial DNA (mtDNA) analysis is carried out (Varsha, 2006). However, mtDNA can not differentiate between individuals born from the same mother as it is inherited solely from mother. Despite the various limitations both STRs and mtDNA is being used in forensic DNA analysis.

The overall goal of forensic DNA analysis is to compare the DNA samples obtained from the crime with the prime suspects. The probability of two persons having the same DNA profile is very small. The Federal Bureau of Investigation (FBI) has standardized the use of 13 different loci (singular: “locus, meaning position of gene on chromosome”), which reduces the chance of two persons having the same DNA profile to one in trillion (Budowle et al., 2000).

All the above mentioned technological breakthroughs have lead DNA to be generally accepted in the court rooms and legislations around the globe.

**Forensic Databases:**

A forensic DNA database is a digital repository that contains DNA profiles which are used for criminal investigation purposes. A forensic DNA database typically holds DNA profiles of unidentified crime scene stains, crime suspects, convicted offenders and sometimes also of missing persons (Fig.2.).

![Fig.2. Type of DNA samples in a forensic database](image)

A forensic database is utilized to solve crime investigation by examining the DNA profile of the question sample to the samples stored in the database. The first
execution of an individual identified through a DNA database search occurred in Virginia in April 2002 when James Earl Patterson was put to death by lethal injection (Anon, 2002). While imprisoned for another matter, Patterson’s DNA sample “hit” samples associated with the 1987 rape and murder of 56-year-old Joyce Alridge in 1999. Following the DNA match, Patterson confessed and pled guilty to the allegations.

**Countries using forensic databases:**

By 1995 the U.K. had a legally established national DNA profile database based on a platform of STR technology (Werret, 1997). This model was followed shortly afterwards by New Zealand (Harbison et al., 2001; Werret, 1997). National DNA databases were introduced into Holland and Austria in 1997; Germany (1998); Finland and Norway (1999); (Martin et al., 2001) Switzerland, Belgium, Denmark, France, South Africa, and Hong Kong (2001), Botswana (2002), Peru, Venezuela, Thailand, Jordan, Qatar, Syria, Tunisia, Croatia, Cyprus, Czech Republic, Italy, Cyprus, Greece, Iceland, the Ukraine, and many others (Hitchin and Schuller, 2002). A parallel process has occurred in Canada (Frégeau et al., 2003; Walsh, 1988) and the U.S. (Hoyle, 1998), where standardization was based on 13 STR loci known as the Combined DNA Index System (CODIS). Australian states and territories are operating DNA databases that are planned to be combined under the federally administered CrimTrac program (Mobbs, 2001) (Fig.3.). Databases are planned in countries including Lesotho, Mauritius, Tanzania, Zimbabwe, Argentina, Bahamas, Chile, Columbia, Cuba, Uruguay, Malaysia, Macao, Bahrain, Lebanon, Libya, and Oman. Local, as opposed to national, databases exist in China, India, Uzbekistan, and many other countries (Hitchin and Schuller, 2002). Furthermore, the criteria to include a DNA profile in to a database vary among countries (Table.1.).
In Pakistan, the National Forensic Science Agency (NFSA) has a DNA laboratory that helps the police/law enforcement agencies. NFSA was established by the cooperation of China in 2006 and was further upgraded by the National Police Improvement Agency, Government of UK (National Forensic Science Agency, 2011). However, NFSA cannot be regarded as an established database repository. The Punjab Forensic...
Science Agency (PFSA) established in 2007 is looking forward to have a CODIS facility that can be used to share the data regarding crimes and criminals nationwide. The database planned by PFSA includes the following areas:

<table>
<thead>
<tr>
<th>Toxicology</th>
<th>Forensic Photography</th>
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<tr>
<td>Narcotics</td>
<td>Trace Chemistry</td>
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<tr>
<td>DNA&amp; Serology</td>
<td>Crime Scene Specialist</td>
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<td>Fire Arms &amp; Tool - marks</td>
<td>Death Scene Investigation</td>
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<td>Questioned Documents</td>
<td>Computer Forensic</td>
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<td>Latent Fingerprints</td>
<td>Polygraph</td>
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<tr>
<td>Pathology</td>
<td>Audiovisual</td>
</tr>
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</table>

Table.2. Disciplines of proposed CODIS facility by PFSA (Punjab Forensic Science Agency, 2011)

**Functional aspects of forensic database:**

Typically, DNA intelligence databases consist of two separate collections of profiles:

1. A database of the profiles of individuals who have either volunteered or been compelled to submit samples, and,

2. A database of profiles obtained from samples from crime scenes, or exhibits associated with an alleged offense.

Often the operator of a database has a program that can compare crime samples to other crime samples, crime samples to individuals, and individuals to individuals.
Corresponding profiles revealed through the above comparisons could each be termed a “hit,” but each has a very different meaning. Obviously, crime-to-crime hits may suggest that the same person was at both scenes. Crime-to-individual hits may suggest that this particular individual was at this particular scene and may lead investigators to others who were involved.

**Administration of forensic database:**

As the technology that forms the basis for DNA intelligence databases is specialized, the operational components have remained the responsibility of forensic biology laboratories. In general, the database and its products are the property of law enforcement agencies, with the analytical and matching processes administered on their behalf by forensic institutions. All aspects of the process, whether handled by police or scientists, are subject to governing legislation. Often this legislation contains clauses that facilitate external review of operations by delegated parliamentary authorities. This is highly desirable.

From a forensic scientist’s perspective, the legal basis for the administration of DNA databases represents an additional level of legislative governance over their work. Almost ubiquitously, DNA laws contain sections that prescribe the appropriate conditions under which a DNA sample can be collected, analyzed and stored, and the criminal sanctions that are enforceable for individuals in breach of these requirements. The offense categories generally include intentionally or recklessly supplying forensic
material for analysis, improperly accessing or disseminating information stored on the DNA database, and matching profiles on the database unlawfully. Penalties can include fines and/or prison sentences. Some legal commentators feel that they are too lenient and do not provide sufficient deterrence to prevent a rogue scientist acting to pervert the course of justice through inappropriate use of a DNA database (Meagher, 2000).

To emphasize more on the administrative level of a forensic database let us take an example of the FBI database, named CODIS, which links all 50 states in the U.S. with the capability to search criminal DNA profiles. The structure of CODIS reflects the sociopolitical organization of the U.S. in that it has local (LDIS), state (SDIS), and national (NDIS) levels of operation. A laboratory can load and compare samples within their own database at the local level. Forensic DNA records originating at the local level can be uploaded to the state database that is housed at a central laboratory. This laboratory manages the collation of information at the state level and uploads to the national database that is maintained by the FBI. In order for a state to have DNA profiles included on the NDIS, it must first sign a memorandum of understanding whereby the state agrees to adhere to the FBI-issued quality assurance standards. The complexities of the U.S. model are paralleled in other jurisdictions, such as Australia, where state or provincial laws that govern database operations must be combined and compared at a national level. In the U.S., only complete convicted offender profiles are able to be loaded to the NDIS (13 STR loci or 4 RFLP loci). For casework samples, ten of the STR loci are required or a minimum of three RFLP loci (Butler, 2001).

PFSA is looking forward a similar sort of CODIS facility in Pakistan as mentioned earlier (Punjab Forensic Science Agency, 2011; Table.2).
Legislation of a forensic database:

The development of DNA intelligence databases has almost always been preceded by the alteration of existing legislation, or the creation of entirely new laws that codify, and often extend, the rights of the police to obtain and store DNA samples. In general, such legislation covers the grounds under which DNA samples can be obtained from suspects and convicted offenders, and provides for the creation and administration of a DNA database. Many differences exist between jurisdictions. Usually these surround the focus and extent of post-conviction sampling and the grounds for requesting a DNA sample from a suspect. In general however, a clear trend has been shown for governments to embrace the concept of DNA databases and enact legislation accordingly.

Internationally, there are several countries in which a regime of court authorized compulsory sampling exists. In Canada, the Criminal Code (DNA Search Warrant, 1995) allows for the taking of bodily samples for DNA typing from suspects in serious, violent offenses (Walsh, 1988). In Netherlands, legislation allows the investigating judge to force a non-consenting defendant to provide a sample for DNA testing, following an application by the Crown, provided the DNA analysis will assist in proving the case (Kloosterman and Janssen, 1997). U.K. has an aggressive version of DNA laws in comparison with other international jurisdictions. Any person convicted of, charged with, or suspected to have had involvement in the pursuance of a “recordable offense,” may be required to provide a DNA sample (Asplen and Lane, 2003).

The U.S. provides another interesting example of the willingness to clear a legislative path for the use of DNA evidence and the construction of DNA databases. The states of U.S. began to consider laws covering the compulsory acquisition of DNA samples from convicted offenders (usually sex offenders) as early as 1988. By 1994, 29 states had passed some form of DNA legislation, and by 1998 all states had done so, the last being Rhode Island (Jost, 1999). In 1994 Congress introduced the DNA Identification Act, specifically authorizing the FBI to create an index of DNA profiles collected from all persons convicted of crimes, evidence recovered from crime scenes, and missing persons.
Due to the concern about misuse of DNA samples, some jurisdictions require the compulsory destruction of samples as a component of their DNA laws. This occurs in New Zealand, where under the Criminal Investigations (Blood Samples) Act 1995 only the computerized record of the DNA profile is retained. The original biological sample and all other products of DNA analysis are destroyed within three months of receipt at the forensic laboratory. Similarly, forensic agencies in Germany, The Netherlands, Norway, and Belgium must destroy a sample once the DNA profile has been obtained, precluding reanalysis for the purpose of confirmation or updating DNA profile data (Martin, 2001).

In Pakistan, forensic evidence relies under the Article 59 of the Qanun-e-Shahadat Order, 1984 (The Punjab Forensic Science Agency Act, 2007). Legislation regarding DNA database in Pakistan is still a matter to be resolved.

**Social and ethical considerations:**

There are worrying aspects to the present and future uses of forensic DNA profiling for some members of the international criminal justice community (Kirby, 2001; Redmayne, 1998). The formidable expansion in the use of DNA, catalyzed largely through the introduction of forensic DNA databases, has increased the relevance of socio-legal and ethical perspectives in strategies for applying forensic DNA techniques. Considerable debate has accompanied the use and development of forensic DNA profiling (Walsh et al., 2004).

Many of these ethical complexities hinge around individual conduct and integrity. However, they are also influenced by the adversarial climate where forensic evidence is gathered and presented. Lucas described a scientists ‘‘sphere of conduct’’ as being bounded by scientific ethics and individual morality, with pressures to expand the sphere of conduct considered ethical potentially arising from involvement with law enforcement and the adversary system (Lucas, 1989). He observes how for a forensic scientist operating under the direct control of the police, particularly if they are also sworn officers, the sometimes conflicting ethics of science and law enforcement can present major dilemmas. As Lucas states:
“The police, quite properly, are a partisan unit in the criminal justice system. This being so, should forensic scientists whose credibility depends in large part on their impartiality, be part of that unit? The question seems to answer itself” (Lucas, 1989).

In legal literature forensic science has been distinguished from academic sciences on the basis that it does not seek to “find truth through the scientific method” as our academic counterparts do, but rather it seeks “to provide a service to a client by answering specific questions about evidence” (Thompson, 1997).

The ability of a forensic scientist to cope with the pressures of the adversarial system can have a profound bearing on their evidence and possibly on the outcomes of the criminal trial. Once in the witness box scientists must learn, or at least accept, that the judicial process is not a search for truth in the scientific sense, but rather a search for truth as defined by one or other of the advocates. Scientists tend to resolve disputes or clarify ambiguities by a process of open disclosure where findings are objectively evaluated by their peers. One of the ethical issues associated with the pursuit of science under the adversarial system is that scientific findings are passed to the “clients” of the forensic institutions (usually police investigators or prosecutors) who subsequently exert some control over their disclosure. This may not present an ethical problem for the police, prosecutor or attorney, but it may be for the scientist involved (Lucas, 1989).

The contemporary context within which a forensic biologist works now tends to include DNA-specific legislative models. In themselves, these have been the subjects of considerable ethical and socio-legal debate. When considering issues in this debate, a forensic scientist must subjugate to some degree their operational mindset. As Redmayne explains:

“(DNA database technology) . . . provides substantial benefits: the ability to link offenders to the crimes which they have committed, in the process protecting the innocent from suspicion. These benefits should not, however, blind us to the problematic issues that accompany the technology” (Redmayne, 1998).

Forensic DNA laws aim to strike a balance between the crime investigation needs of the State and the privacy rights of its citizens. How effectively this balance is
constructed is a pivotal issue. An example of a sound regime is sometimes explained as one beneath which the innocent have nothing to fear. There is a problematic dichotomy in this reassurance. It is true that an innocent person should be favored by the use of DNA, as the results should exculpate them from the case at hand. However, the regime also serves to bring more and more such people into the system, thereby minimizing their protection against State intrusion into their lives (their right to privacy). Moreover, some attest that once a person is brought in contact with the system, there are more protections in place (on paper at least) to prevent intrusions into property than there are guarding against bodily searches (Walker and Cram, 1990).

It should be noted that for a variety of historical and political reasons civil rights and human dignity issues relating to DNA forensics are viewed separately in different countries (Martin et al., 2001). The 1995 Criminal Justice Act in UK allows police to take non-intimate samples for DNA analysis from anyone suspected of committing a recordable offence. If the person is found guilty, the DNA profile can stay on the database forever and furthermore should new technology become available sample can be re-examined using new technique. If a person is acquitted, the result must be removed from the database. In other European countries more restrictive legislation is practiced, which only allows DNA profile of those persons who have convicted serious offence. In France, only profiles of sex offenders could be hold. In Germany, DNA samples remain anonymous to the forensic scientists, whereas the profile obtained by laboratory is entered in to the police database. In the Netherlands, DNA profile of sexual offenders admitting their crime is not held. Furthermore, in Germany, The Netherlands, Norway and Belgium it is not possible to retain a blood or saliva sample from the offenders. The samples in these countries are destroyed after the DNA profile has been obtained. Thus, it is not possible to reanalyze a suspect’s sample before a database match is being reported to the police, or to update the database records to extend the existing DNA records. This protocol has been laid down in order to prevent the use of samples besides the forensic identification. In contrast, reference samples are being stored routinely in Austria, Finland, UK and Switzerland. All of these were debated at a European meeting in Germany in 1996 (Schneider, 1998), where it was generally agreed by scientists that the use of
comprehensive databases can be extremely effective in linking scenes of crime and identifying the perpetrators of a wide spectrum of cases.

Pakistan’s perspective:

The 2008 survey of INTERPOL showed that there is no specific legislation regarding forensic database (INTERPOL, 2008). Thus in Pakistan, there is a great demand to come up with specific DNA-legislation in order to establish a reliable forensic database. Both NFSA and PFSA can play vital role in this regard. Further elaboration on this topic is provided in the discussion of this thesis.
CHAPTER 3

MATERIAL AND METHODS

Research design:

This study is solely based on the qualitative model designed to gather information that can be utilized to establish forensic DNA database at Pakistan.

Literature search:

A wide spectrum literature search is conducted, by all the members of the group to avoid bias, using GOOGLE and PUBMED search engines. The key words included to carry out the search were as follows:

1. Forensic database.

2. “Forensic DNA database” AND “Ethical concerns”.

3. “DNA forensics” AND “Social and ethical concerns”.

The inclusion criteria for the related literature were based on the relatedness of the subject matter that is concerned with the social, ethical, and legal aspects of forensic database.

We also searched for the current legal perspective of DNA forensics at Pakistan. For that we searched for the legislation that is held at present for the purpose of DNA profiling and its use in the domain of the legal system.

Survey:
Once the general aims of the work had been specified and the tasks to be performed had been planned, the following steps were taken: production of an opinion questionnaire (Appendix-I) and the selection of a homogeneous group of interviewers; selection of a random, cross-sectional sample; purging of non-random errors that do not concern the survey; and analysis and statistical summarization of the data obtained.

The questionnaire form was chosen to collect the data. This is comfortable for interviewees and is an easy, efficient way of obtaining a great amount of data to be coded and purged. Ten questions were analyzed. These were of standard levels of comprehension and, in order to form a homogeneous group of interviewers, the latter were chosen on the basis of a suitable level of education. The sample was chosen using random criteria and by trying to find a cross-section nature in the different sexes and age groups. A stratified survey of the Pakistani population was carried out, and 200 questionnaires were completed (Table.3.).

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>NUMBER OF PERSONS</th>
<th>PERCENTAGE</th>
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</thead>
<tbody>
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<td>Students</td>
<td>67</td>
<td>33.5%</td>
</tr>
<tr>
<td>Teachers</td>
<td>29</td>
<td>14.5%</td>
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<tr>
<td>Forensic Scientists</td>
<td>31</td>
<td>15.5%</td>
</tr>
<tr>
<td>Policemen</td>
<td>30</td>
<td>15%</td>
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<tr>
<td>Lawyers</td>
<td>33</td>
<td>16.5%</td>
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<tr>
<td>Administrators</td>
<td>10</td>
<td>5%</td>
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<tr>
<td>Total</td>
<td>200</td>
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Table.3. Number of persons in each category of study population
CHAPTER 4
RESULTS

Literature search:

Our search for the relevant literature returned 246 hits on PUBMED. Relevant articles were selected based on inclusion criteria mentioned in the material and methods. The related articles were further cross matched with GOOGLE.

One of the most important find of the literature search was the survey conducted by the INTERPOL in the year 2008. According to this survey 120 countries around the world are known to use DNA profiling in their criminal investigations (Fig.5). 54 countries were found to have established DNA databases. 28 out of these 54 countries had specific DNA legislation.

Fig.5. Global geographical distribution of countries performing DNA profiling (Orange)
Fig. 6. Global geographical distribution of countries with a national DNA database (Purple)

<table>
<thead>
<tr>
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<th>Year of DB introduction</th>
<th>Member country</th>
<th>Year of DB introduction</th>
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<td>Ukraine</td>
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<td>United Kingdom</td>
<td>1995</td>
</tr>
<tr>
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<td>2002</td>
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<td></td>
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<td>1999</td>
<td>Bahrain</td>
<td>2001</td>
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<td>France</td>
<td>2001</td>
<td>Tunisia</td>
<td>2000</td>
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<tr>
<td>FYR Macedonia</td>
<td>2008</td>
<td>United Arab Emirates</td>
<td>2002</td>
</tr>
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</table>
Table 4. Regional breakdown of member countries with a current national DNA database

**Survey:**

The results of the survey questionnaire are summarized as follows. The response for each of the ten questions is quantified in terms of percentage and the response chosen most for each question is highlighted (Table 5).

<table>
<thead>
<tr>
<th>Question Number</th>
<th>Poor</th>
<th>Fair</th>
<th>Good</th>
<th>Very Good</th>
<th>Excellent</th>
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<td>32</td>
<td>29.5</td>
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</tbody>
</table>

Table 5. Percentage responses for the choices avail in the survey
CHAPTER 5

DISCUSSION

The useful information that genetic information has provided and continues to provide for identification purposes cannot be ignored. The analysis of the polymorphisms of decoded DNA has been found relevant in departments of justice. Such analysis could concern civil trials, as in paternity testing, or criminal trials, where there may be biological traces of the perpetrator of the criminal offence found at the scene of a crime or on the instrument used in a crime. However, the development of this type of test has been significantly influenced by differences between established legal systems (Schneider and Martin, 2001).

Regardless of the efficiency of the identification mentioned above, this type of test may present problems or raise questions that must be dealt with the appropriate respect for basic rights, as well as sufficient technical and legal guarantees. These problems and questions include the following:

a) the extent to which DNA analysis should be obligatory for an individual accused of an offence, when this involves the breach of some of their basic rights;

b) society’s perception of the reliability of the techniques and analyses used, as well as the way they are assessed legally;

c) Storage of the biological samples of both offenders and victims, the samples obtained in the place of the incident or crime and also the results of the analyses of such samples, thereby creating a database of biological samples, together with DNA profiles (Guillén et al., 2000; Pardo, 1995).

It is necessary to examine and define the conflicting social and individual interests in order to provide clear legislation that would regulate the inclusion of the DNA profiles in national databases in Pakistan and also the biological samples from which these profiles are obtained, given the enormous quantity of information that they can reveal. Any future laws must necessarily be drawn up in accordance with the attitude of society towards this subject, no doubt influenced by the prevailing ethical
tendencies, the law, social conceptions and the existing scientific knowledge of this area of science (Gamero et al., 2004; Guillén et al., 2000). Many authors have expressed themselves in similar terms (Begleveld, 1997; Carracedo et al., 1997; D’Aloja, 1997; Olaisen, 1997; Scheithauser, 1997; Schmitter and Schneider, 1997).

Survey:

As Pakistan is also looking forward to establish its own DNA database, it is of utmost importance that the view point of its society regarding it be known. For that reason we carried out the survey mentioned in appendix-I. We now turn to each of the question of the questionnaire, explaining the significance of each query and then analyzing the response to each of the questions. It is also worth mentioning to note that our sample included only the literate class of the population comprising of 156 post-graduates and 44 graduates.

**QUESTION#1: How would you grade your general understanding about DNA?**

We asked this question in order to evaluate the understanding of the general public about DNA. According to the scale we set forth, the understanding of the subjects is found to be “good” (34.5%) on the scale. In fact, 90% of the subjects showed that their understanding about the DNA is good, very good or excellent.

**QUESTION#2: Have you taken any formal course or training regarding DNA test?**

The highest response to this question on the scale is “good” (30.5%), that is in accordance with the question#1. Approximately 72% subjects were observed to undergo training about DNA test. This percentage mainly included forensic scientists, lawyers and policemen. This shows that a pattern is being set to bring forensic scientists and law enforcement agencies on common grounds.

**QUESTION#3: According to your understanding, is DNA test authentic?**

97% of the subjects vividly agree with the authenticity of DNA test. All the categories of the subjects marked the “excellent” (65.5%) choice to this question.

**QUESTION#4: Do you know about any DNA database?**

Most of the subjects (94%), who also agreed with the authenticity of the DNA test, also showed that they know at least one database. Such awareness is an indication
about the concern the individuals may possess when establishing DNA database in Pakistan.

**QUESTION#5: DNA database helps in solving crimes?**

On the scale the answer to this question lies at either “good (11.5%)”, “very good (21.5%)” or “excellent (66.5%)”, making a total of 99.5%. Almost all the subjects consider that DNA database is a valuable tool in criminal investigations. This shows that at least the literate class of the Pakistani population recognizes the vitality of forensic database.

**QUESTION#6: All convicts should have their DNA profile in the database?**

49% of the subjects mark this question on the highest scale (“excellent”). This percentage overlaps the percentage of forensic scientists, policemen and lawyers that make up 47% of the subjects. Thus, it can be speculated that all the personnel mainly involved in forensic investigations consider that DNA profile of the convicts need to be maintained at the database.

**QUESTION#7: All citizens should have their DNA profile in the database?**

Although the highest score to this question on the scale was “excellent” (31%) but this there is also a great variation of response to this question. In fact 26.5% of the subjects marked this question as “poor” on the scale. The response to this question is quite similar to the countries that already have developed their databases. Maintaining database record of innocent citizens raises concerns because it is generally thought that such an act may pose a threat of manipulation of the record thereby an innocent can be render as guilty.

**QUESTION#8: Do you think information regarding DNA can be manipulated?**

This question was formulated in series with question#7. Again a great deal of variation is present in a response to this question that is consistent with the choices avail to question#7. It seems that although great majority of the subjects do consider the validity and significance of a DNA database but still there is a great lack of trust in such a database.
**QUESTION#9: Are you willing to provide your sample of DNA to the database?**

The response to this question is also varying as to the previous ones (question#7 and question#8). The choice “excellent” received 34.5% response that is very near to the similar choice of question#8 (32.5%). It is obvious that the percentage of individuals whose consideration is that DNA database cannot be manipulated is willing to give their DNA sample for the database. On the other hand the doubted ones are reluctant to provide their DNA sample for such a database.

**QUESTION#10: Do you think DNA database at Pakistan will maintain your confidentiality?**

95% of the subjects think that DNA database at Pakistan will maintain the confidentiality of the profiles. This response contradicts with the response to other previous questions about the manipulation of the profiles. One reason for this could be that subjects are sure about the structural integrity of the system of database but are not confident about the administration of the database.

In general our survey suggests that the literate class of Pakistani population consider the worth of a DNA database. There are however certain doubts, the most prominent is the “manipulation of forensic database”, which need to be settled down. It also has not escaped our observation that police, lawyers and forensic workers are on the same terms in order to establish a forensic database. It is further needed that combined workshops and training sessions must be carried out to bring the scientists and law enforcement agencies together so that they can devise a way to establish Pakistani DNA database that is consistent with its ethical, social and legal parameters. In general, the role of each of the player can be as follows:

1. Forensic scientists may deal with the technical issues.
2. Police should be concerned that the confidential chain of custody of DNA samples must be maintained.
3. Judiciary must set up the legal parameters that secure the legal rights, whether convict or innocent, of every individual whose DNA profile is maintained.
A lot of ethical and social concerns can be dealt by taking in to account the following:

**Custody of database:**

An important issue that has resulted in disagreement in many countries is the kind of institution that should have custody of the biological samples collected and the DNA profiles generated. This is of great importance since transparency and accountability of DNA databases are essential for maintaining public confidence in them. In an opinion poll carried out in Spain, the citizens were asked to choose, for the safekeeping of the national DNA database, between (a) the State Security Agencies (police laboratories), (b) an independent laboratory on a national level and (c) an independent organization. The majority of those questioned considered that the custody of their national database should remain in the hands of a judicially backed, autonomous public institution (Gamero et al., 2008). Such an opinion poll has to be carried out in Pakistan, prior to DNA legislation.

**Inclusion criteria of database:**

There is a wide range of views about whose DNA profile should be held on the forensic DNA database and for how long. The question is how to balance the need to prevent crime with the need to protect people's privacy and other rights and freedoms.

Does the DNA database should be expanded to include the whole Pakistani population, or only the convicts’ data should be included. Different issues arise in relation to people who have been convicted of a crime; people who have been acquitted or whose charges have been dropped; and people who volunteer to help with investigations. These issues are discussed below:

**People who have been convicted of a crime:**

Many commentators have concluded that the DNA database should be restricted to being a criminal justice database by containing only the DNA profiles of people who have been convicted of a crime. It is generally agreed that people lose some of their right to privacy as soon as they have been found 'guilty'. It is also argued that innocent people should not have to pay any penalty to the state, no matter how small that penalty is (Reilly, 2001).
Keeping records permanently on the database, particularly in the case of juvenile offenders, can also be seen as a problem because it undermines the long-standing principle of rehabilitation (Kimmelman, 2000).

**People who have been acquitted or whose charges have been dropped:**

While it is clear that the police need the powers to collect DNA samples from suspects so that they can investigate a crime, it is less obvious why they need to keep people on the database once they have been acquitted or charges have been dropped. Keeping them on the database means they remain “suspects” for any future crime. This raises the concern that a record of arrest, rather than of any criminal conviction, will be used to restrict people's rights and freedoms.

**People who volunteer to help with an investigation:**

People may volunteer to help with a police investigation if their sample is needed to interpret the evidence from a crime scene, for example to eliminate the DNA profile of the partner of a woman who has been raped; or to help narrow down the list of suspects in the case of a mass screening.

**When should samples be destroyed?**

The retention of suspects’ samples poses a bigger threat to privacy than the storage of data on the DNA database, because these samples could provide unlimited amounts of genetic information about known individuals. In the case of samples from convicted criminals, overriding the individual's right to privacy may sometimes be justified in terms of the wider interests of society. However, even in these cases the usefulness of retaining samples after a DNA profile has been obtained is questionable. When a person is found to be innocent, there does not seem to be any compelling reason why their rights should be denied.

The importance of protecting human rights in the collection and use of samples and genetic information has been recognized by UNESCO in its International Declaration on Human Genetic Data (UNESCO, 2003). Article 21 specifically relates to the retention of forensic DNA samples. In an early draft of the declaration, this Article states:
“….samples should be destroyed if the person investigated is either not charged with an offence or is found not guilty of the offence”.

Who decides how the forensic DNA database should be used?

Some of the ethical considerations around the use of the DNA database do not seem to be adequately addressed by the current oversight mechanisms. These include:

*Carrying out familial searches:*

Familial searches can be justified in some circumstances, for example if they provide the only means of tracking down a violent criminal. However, they risk revealing very personal information, such as non-paternity, to people who may be unaware of the truth. It is therefore essential that the seriousness of the crime can justify the invasion of family privacy. As yet there are no published guidelines as to when such an approach can be considered ethical and what the implications might be for data protection. This situation is clearly inadequate and open to abuse.

*Using the DNA database for research:*

The matter that using the DNA database for research is not clear in Pakistan. Researchers may not seek consent from participants or the approval of independent ethics committee to carry out their research. Some of the research could be highly controversial, for example research on ethnicity and race or research on “genes for criminality”.

Getting independent ethical approval is an important safeguard to ensure that research is morally and socially acceptable. Seeking informed consent protects the freedoms, rights and dignity of the people who take part. Current procedures remove people's right to opt out of potentially controversial studies. Even people in prison are asked to give their consent before taking part in any scientific study. Consent should have to be obtained from the individuals on the database before genetic research is allowed to go ahead.
CHAPTER 6:

CONCLUSION

DNA profiling plays an important role in tackling crime. The police rightly have the powers to collect DNA samples during criminal investigations and use this evidence in court. However, there are important questions about the extent to which DNA samples and profiles should be kept indefinitely as part of the forensic DNA database.

At Pakistan, there is a great need to bring balance between the rights of the individual and the interests of the public. While there is no doubt that society does have an interest in the detection and prevention of crime, this cannot be used to justify every infringement of the individual's right to privacy and the loss of our civil liberties. This is especially true for people who are not found guilty of any crime.

Questionable practices:

The following upcoming practices raise serious concerns regarding establishment of forensic DNA database in Pakistan:

1. Retaining people's records permanently on the DNA database regardless of the nature of their offence;
2. Including people permanently on the DNA database who have been arrested but not charged, or who have been acquitted;
3. Retaining DNA samples, rather than just the DNA profiles and personal data;
4. Using the database for genetic research without consent.

The need for public debate:

In Pakistan the legislative changes to date have been introduced too rapidly in the absence of any meaningful public debate (Punjab Forensic Science Agency, 2011). We believe that further deliberation is needed to find out what the public think is a
reasonable balance between protecting the right to privacy and protecting citizens from crime. The questions that need to be addressed include:

1. When should samples be destroyed?

2. Whose profiles need to be on the database to ensure the most efficient prevention and detection of crime?

3. Does the DNA database reinforce existing inequalities in the criminal justice system?

4. Is expanding the forensic DNA database the most cost-effective way of detecting and preventing crime when compared to other measures, for example increasing the number of police officers?

5. When should convicted criminals be allowed to reopen their case to seek exoneration via DNA profiling?

6. When should the police be allowed to access other DNA databases, set up for health or research purposes?
REFERENCES


APPENDIX: I

SURVEY FORM