

# Comparative Role of Serology and DNA Profiling in Forensics

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## Abstract

**Background:** Forensic serology and DNA profiling are extremely important branches of forensic science. Forensic serology has been a major area of forensic science biology for many decades. Forensic serology is traditionally been concerned with the identification and individualization of biological evidence. The use of DNA technology in forensic science evidence examination is the most beneficial and an important part as compared to the forensic serology division

**Main body of the abstract:** The biology branch of the forensic science laboratory performs serological and DNA analysis of physiological fluids for identification and individualization. Forensic techniques for DNA profiling which being developing around 1985 have replaced the classical or traditional genetic system previously used such that forensic serology. DNA typing can help to bring home the guilt, acquit the innocent those wrongly convicted.

**Conclusion:** In this article we'll review two techniques of forensic science which are the basis of forensic serology and DNA typing as important forensic evidence. Apart from all available techniques DNA profiling for evidence easily give the result. Forensic DNA profiling is used to bring major benefits to society by helping to convict serious criminals.

**Keywords:** Depressive disorders • Seropositivity • Patients

**Abbreviations :** DNA: Deoxyribonucleic acid; SOP: Standard Operating Procedure; IO: Investigation Officer; STR: Short Tandem Repeats; SNP: Single Nucleotide Polymorphism

## Introduction

In the forensic science, many forensic scientists deal with the main two major divisions that is serology and DNA division because each division is related to forensic biology. Forensic biology described the all-body enzymes, body fluids etc. In most of the crime scene biological fluids related evidences are mainly found. Now days in the forensic community, serology and DNA analyses are closely related because of the better performance and result. In many forensic laboratories, they are considered within the same division. Serology analysis means screening of evidence for bodily fluids such as saliva, serum, blood, urine, semen, vomit etc, these types of body fluids are frequently generated during the occurrence of violent crimes such as homicides, rape, sexual violence/assaults etc, whereas "DNA analysis" refers to the efforts to individualize bodily fluids to a specific person. In most cases, bodily fluid identifications performed on evidentiary items before DNA analysis is attempted. Depending on the qualifications of laboratory personnel, analysts can be trained to perform either serology or DNA analysis or can be trained in both techniques of biology division.

Serology procedures is one of the most oldest techniques have essentially remained unchanged, DNA has emerged in the forensic area recently two decades back and its applications and technology are constantly emerging and changing. In serology, Examination is done by old methodology, instruments and technique but in DNA profiling examination is done by new methods and newer technologies.

DNA is the basic unit of life in the cell. Cells are micro-factories in which raw materials such as amino acid, carbohydrates, simple lipids and trace elements are received and new substances like proteins, nucleic acids, carbohydrates are produced and wastes are removed. In other words we can say that, DNA is our genetic blueprint because it stores the necessary information for passing down genetic attributes to coming generations

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residing in every cell of our body. The use of DNA technology in forensic science evidence examination is the most beneficial and an important part as compared to the forensic serology division [1-4].

## Background

### Evidence at the scene of crime: Serological/DNA

The correct identification of criminals and other individuals has always been one of the most important part in criminal and civil investigations, that's why for the purpose of solving any crime cases, forensic experts as well as Investigation Officers (IO) search the biological evidence at the scene of crime. The investigation officers should be collected all evidences on the bases Standard Operating Procedures (SOP). Those evidence on which bodily fluids are thought to be found at the crime scene, the investigation officers collected that exhibits for submitted to forensic science laboratories in forensic serology and DNA division for further analysis. Basically, a large majority of serology and DNA cases involve in murder, rape, and sexual assaults etc. Exhibits from these types of cases commonly include the following items i.e., sexual assault kits, complainant clothing, bedding, and sometimes suspect clothing etc and the other common case where the forensic serology and DNA division related evidences are found for that submissions include the most valuable potential blood evidence from homicides, aggravated assaults, and robberies etc.

The above mention following cases exhibits commonly submitted for blood testing include swabbing's from crime scenes, clothing, weapons and any number of other exhibits that may contain bloodstains patterns. If at the crime scene, the small size of evidences is found, at that time, the evidence can be submitted to the laboratory in its totality and for larger size of evidences, the investigation officers collected the stains on to a sterile cotton swab or a cutting from the exhibits can be taken for submission for further analysis.

If the investigative officers must be following the Standard Operating Procedures (SOP), it is also possible to collect exhibits that have been in contact with an individual's mouth, e.g., lipsticks, glass, cigarette butts, drinking cans, cups, bottles, gum, candy, toothbrushes etc also the following these exhibits usually provide enough DNA examination for a profile to be established an offender or criminal. In some of the cases , objects that have been touched i.e. a steering wheel, weapon, phone, or even a fingerprint may also contain biological evidence that can be collected for analysis for that particular case but may not always produce a DNA profile, because all these types of pieces of evidence don't contain a that much required amount

of biological material and are processed for DNA without going through any type of serological screening to maximize the amount of sample available for DNA testing [5].

DNA examination is successfully done when the proper sample are available, for that region blood or saliva is collected from a living individual to serve as a reference sample or standard sample. Blood is collected from the vein and properly stored in a purple or lavender top blood tube, which contains an additive to prevent DNA from becoming degraded. After the collection of blood it's placed onto a filter paper card, dried, and stored and blood samples dried in this manner are stable for many years even at room temperature. The most important evidence in DNA examination that is saliva and it can be collected either by chewing sterile gauze, by depositing saliva on to a collection card, or by swabbing the inside of a person's cheeks (buccal swabs) to collect epithelial cells. In some crime scene traces evidence are found for examination of DNA analysis which is hair. Hairs can also be used as a reference sample or standard sample. Reference samples or standard samples can also be collected from deceased individuals in the form of blood, tissue samples, or bone samples depending on the state of decomposition of the remains and analysis is done quite easy.

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## Examination of Biological Evidence: Current Prospective of DNA Profiling

Forensic science is a multidisciplinary science which helps in criminal investigation. To link a suspect to a crime, DNA analysis has been playing a vital role. If any crime is occurred, the suspect always leaves a trace, and then the forensic investigator identifies the crime scene. After collection of all evidences, investigation officers referred to the exhibit in the forensic science laboratory. Then the forensic expert continues working on that particular evidence on the basis of investigation officers requested. The real task in evidence screening is determining that which items of evidence should be processed and the most effective way in which to process them.

In general, probative samples are those in which a transfer of bodily fluids, and therefore DNA, has occurred. A suspect's bodily fluid on a complainant's body or clothing, or a complainant's bodily fluid present on clothing or items belonging to a suspect are the objects that hold the most evidentiary, or probative, value. The most common types of case such as murder, rape, sexual assault etc. In this type of cases, the most important biological evidence is semen. In some sexual assault cases, the identification of semen is central to supporting evidence of a claim of sexual assault. Semen is found on clothing or bedding because, along with demonstrating the presence of semen of the complainant, semen can only survive inside a victim for a finite amount of time whereas the semen evidence of stains on clothing can present a much longer duration time depending on whether the evidence is washed. In the following cases, a determination can be readily made for the type of testing to perform and for the most efficient order in which to process the items. Other cases are less apparent.

Generally, all biological evidence first goes through serology division for screening. However, traces amount of DNA evidence found in many cases that do not benefit from serology screening. DNA analysis can be performed on the concept and the alleged father to establish or disprove parentage (paternity testing). It is not necessary to have a reference sample from the mother or complainant for paternity testing, having the DNA profiles of the off spring and both parents facilitate DNA interpretation [6-8].

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## Evidence Examination

Evidence examination, analysis and identification are the most crucial part of forensic science. As we know, forensic serology methods are relatively simple and straight forward. Forensic serology experts are not to be confused with conventional serology, which deals with serum and its

properties. Forensic serology involves the different types of bodily fluids for identification.

The identification of biological fluids during serology analysis is accomplished through presumptive and confirmatory testing, where Presumptive or preliminary testing refers to testing that is sensitive, fairly specific to the bodily fluid in question, and can be performed quickly and the Confirmatory testing is still sensitive, but the time required for the testing can be much longer than that required for presumptive testing.

In some of the cases, DNA analysis examination can be considered a type of confirmatory test because it's reliability of results, species, although not bodily fluid, specific for human DNA [9, 10]. Here we mention the biological evidence examination with the help of steps of DNA profiling:

- DNA Extraction Method
- Differential DNA Extraction
- DNA Quantification
- Human-Specific DNA Quantification
- Real-Time Polymerase Chain Reaction Quantification
- STR Analysis
- Mitochondrial DNA sequencing
- Y-Chromosome STR Analysis
- SNP Analysis
- CODIS Database

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## Conclusion

The recent technologies and scientific development in the field of forensic DNA are certainly stamping a huge impact in capturing and most convicting the criminals without any doubt. Forensic DNA profiling is the use of DNA which means deoxyribonucleic acid in the criminal justice system. DNA analysis is the most effective way to solve any case easily. When any crime is occurring, people can leave evidence at the crime scene or scene of the crime and they leave a trace such as biological materials that contain DNA.

DNA recovered from stains of saliva, blood, semen, hair, bone and skin can be matched to the DNA of a suspect also DNA can be recovered from the fingerprints. Thus, all forensic science laboratories nowadays use DNA technique to easily solve the crime. Today, the general public is familiar with the fact that newer DNA techniques like touch DNA are being used. However, newer technologies are regularly introduced and validated by experts to expand the capabilities of laboratories working because of easy to recover DNA results with improved sensitivity and reliability. As compose to serology and biology examination of all body fluids and other relative evidence examination are tough because of the evidence isolation and preserved but in DNA profiling, all preserving integrity of DNA for a long period and storage of DNA becomes easy. Apart from all available techniques DNA profiling for evidence easily give the result. Forensic DNA profiling is used to bring major benefits to society by helping to convict serious criminals.

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## Declaration

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## References

1. Jolicoeur, Christine, Gouvernement du Québec, and Edifice Wilfrid-Derome. "Body Fluid Identification and DNA Typing in Forensic Biology." *Int Forensic Sci Manag Symposium*, 526 (2013): 821.
2. Young, Brian, Tom Faris, and Luigi Armogida. "A Nomenclature for Sequence-Based Forensic DNA Analysis." *Forensic Sci Int Genet* 42 (2019): 14-20.
3. Kobus, Hilton J, Edmund Silenieks, and Jordana Scharnberg. "Improving the Effectiveness of Fluorescence for the Detection of Semen Stains on Fabrics." *J Forensic Sci* 47 (2002): 1-5.
4. Williamson, Angela L. "Touch DNA: Forensic Collection and Application to Investigations." *J Assoc Crime Scene Reconstr* 18 (2012): 1-5.
5. Peschel O, Kunz SN, Rothschild MA, and Mutzel E. "Blood Stain Pattern Analysis." *Forensic Sci Med Pathol* 7(2011): 257-270.
6. Saferstein R. *Criminalistics: An Introduction to Forensic Science*. Pearson Education, Upper Saddle River, New Jersey, USA (2015).
7. Karger, BS Rand, T Fracasso, and H Pfeiffer. "Bloodstain Pattern Analysis—Casework Experience." *Forensic Sci Int* 181(2008): 15-20.
8. Butler, John M. "Fundamentals of forensic DNA Typing." Academic press, 2009.
9. Butler, John M. *Advanced Topics in Forensic DNA Typing: Methodology*. Academic press, 2011.
10. Sessa, Francesco, Monica Salerno, Giuseppe Bertozzi, and Giovanni Messina, et al. "Touch DNA: Impact of Handling Time on Touch Deposit and Evaluation of Different Recovery Techniques: An Experimental Study." *Sci Rep* 9 (2019): 1-9.

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