DNA Primer and Considerations for the Professional Investigator

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The role of forensics in the investigative profession has increased dramatically in the past 10 years. When someone hears 'forensics' they immediately think of DNA – the results that impact the investigative process. Its much more than that, and for investigators rarely is DNA directly involved (i.e. analysis), it is an evidentiary byproduct of the investigation; but that's another article. What is seen of DNA is often related to exoneration of persons wrongfully convicted. The question for investigators is – 'what do I need to know about DNA?' Chances are you will not be testing for and analyzing DNA – unless you are a scientist. Investigators may be directed to collect DNA and assist with finding a lab for the testing. At other times, such as with wrongful convictions, there may be testing of original DNA evidence from a years old crime or event. What should be, or should have been, collected and how? DNA is deoxyribonucleic acid – sounds complicated, with a thankfully relatively simple understanding. It is our genetic makeup with characteristics unique to each individual, with only identical twins sharing the same DNA (but different fingerprints). DNA is used in civil cases – such as paternity or determining who the driver of a vehicle was, and the obvious criminal cases. The following are the areas of typical concern to the investigator:

- What is DNA Evidence?
- Examples of DNA Testing.
- Evidence Theories and DNA History.
- DNA Collection and Storage.
- DNA Fingerprinting.
- Precautions.

The first question is: Where is DNA found? It is found in the nucleus of the cell. The next question is: Where are these cells found? They are found in white blood cells, as red bloods cells do not have a nucleus. This is important as it tells the investigator what can be collected, which includes: hair, saliva, blood, semen, bone, tissue, fingerprint residue, sweat, and skin – if it has been touched, there may be DNA left behind. There is no guarantee that DNA has been left behind. It may seem a bit odd, but it does happen and will depend on the circumstances. What is important is to consider the DNA that has been left behind. First, is to consider the DNA testing process – the basics of what can be done and what to expect. In the course of investigative work, the following are some of the most common purposes of collecting and analyzing DNA.

- To determine Paternity and other ancestry.
- Evidence.
- Decedent identification.
- Missing person/child identification.
- Suspect inclusion/exclusion.
- To determine who was driving a vehicle or occupying a given space under specific circumstances.

The testing process often begins with determining the likelihood of where the DNA would be. This may include any sexual contact, where a driver would contact vehicle components, where a suspect was hiding prior to a crime, clothing that is suspected to have been worn, etc. Next is to extract the DNA from the evidence, which is then followed by the DNA profiling and analysis for comparison. Scientists are not 'matching' DNA to a person; they are more typically excluding a person. This exclusion is based on probability – not certainty. This probability of inclusion is so infinitesimally small that an exclusion is made. It is when the person is 'included' in the probability of being the donor of the DNA that it is often referred to as a 'match'

The first case of DNA fingerprinting occurred in 1986 in England. Between 1983 and 1986 two schoolgirls were murdered in a village near Leicestershire, England. The only clue left at the respective crime scenes was semen, and a suspect had already been arrested. However, police asked a scientist to help them positively identify whether the DNA profiles from both crime scenes matched that of the suspect. The scientist showed that although the DNA profiles from both crime scenes matched, they did not match that of the suspect [exclusion]. The suspect was released, and police then obtained a blood sample from every adult male in the area of the village. A local bakery worker, who had initially paid another coworker to provide his DNA sample, was eventually arrested and forced to provide a blood sample. His DNA sample matched the samples from the crime scene, and the worker confessed to the murders.

So how did investigative, particularly scientific investigative principles, advance from using fingerprints for identification to DNA? First, as with fingerprints and other evidence, how did the DNA end up where it was found? This is important to the nexus of the person to the event; or not as the case may be.

- What is Locard's Principal?
- Where is DNA found?
- How is DNA collected?
- How is DNA packaged?
- Locard's Exchange Principal - Every Contact Leaves a Trace

Professor Edmund Locard (1877–1966) was the director of the very first crime laboratory located in Lyon, France. Locard's Exchange Principle states that, "With contact between two items, there will be an exchange."

> *"Wherever he steps, whatever he touches, whatever he leaves, even unconsciously, will serve as a silent witness against him. Not only his fingerprints or his footprints, but his hair, the fibers from his clothes, the glass he breaks, the tool mark he leaves, the paint he scratches, the blood or semen he deposits or collects. All of these and more, bear mute witness against him. This is evidence that does not forget. It is not confused by the excitement of the moment. It is not absent because human witnesses are. It is factual evidence. Physical evidence cannot be wrong, it cannot perjure itself, it cannot be wholly absent. Only human failure to find it, study and understand it, can diminish its value."* - Dr. Edmond Locard [date of quote unknown].

DNA is most commonly known to be found in hair, saliva, blood, semen, sweat and tissue. Advances have expanded where DNA can be collected and extracted from, to include urine, skin cells, teeth, and bone. Initially requiring large samples – such as blood that would cover a dime, further advances now allow testing from what would seemingly be the most unlikely of samples – such as flakes of skin and sweat from undergarment waistbands – similar to having left a fingerprint. In looking to collect DNA, or determine if DNA were collected from likely and/or appropriate places, consider the following:

- A recovered bullet from a patient or decedent may have traces of DNA evidence.
- Trace evidence from clothing, blankets, furniture, car seats, airbags, etc.
- Eye glasses, hair brushes, tooth brushes, etc.
- Cigarettes, glasses, utensils, tools, fingernails.
- *ANYTHING that a person has been in contact with COULD have DNA and SHOULD be tested.*

Circumstantially, where the DNA is located may determine a person's involvement. If a suspect's DNA is found inside the waistband of the victim's pants, he must have touched that area. This is direct evidence. The circumstantial evidence – when he could, or could not, have touched that area of the pants is what may contribute to determining, or eliminating a person's involvement. It is not practical to simply look 'everywhere' for DNA – it must be focused on the particulars of the case at hand.

Knowing where DNA can be found, and knowing the proper method of collection is important, as both the investigator of a case involving DNA collection and as a person that may be asked to collect DNA evidence. Before getting started, as part of your toolbox, be cognizant of identification and chain of custody. Identify, and confirm, the collection point of the DNA. If it is a person check their government issued identification; if it is a vehicle document the VIN and location; if it is a weapon or item note any serial or identification number – at least a description. Include photographs and written acknowledgements. You will then need the following items and guidelines:

- Sterile swab
  - One swab per surface area (handgun – grip, cylinder, trigger, casings)
- Sterile saline (for dry evidence); saline is not necessary for liquid items.
  - Commonly dried items include areas having blood, saliva, semen. This is also used to collect off of dry surfaces, such as metal, wood, fabric and skin. Saline can be purchased in bulk respiratory treatment 'single dose' containers from medical suppliers.
- Sterile container
  - DNA can now be isolated – but do not cross-contaminate. One envelope per swab – DO NOT lick to seal [it does happen], only fold.
  - Recommend placing air dried swab in a paper bindle and then in the envelope.
- As with all biological evidence, non-organ DNA is best stored in paper, as plastic will retain moisture and damage the DNA and evidentiary value.

Now that all the preparations are taken care of, just how is DNA collected from a person (suspects, victims & decedents)?

- Hair – pulled (including the roots) and combed (for contributing DNA).
- Fingernails – pulled or clipped (to collect contributing DNA – Locard's theory).
- Oral, vaginal, penile, and anal – use sterile swab (no saline – except dry penis).
- Any organ or muscle tissue is suitable.
- Blood (i.e. Paternity) – a special DNA card to swab multiple 1cm spots of DNA.

During the collection process, or when investigating the collection process during the review of criminal discovery and civil disclosures, look for proactive measures in preventing contamination. The same theory of how the DNA was left holds true for cross-contamination – Locard's Exchange Principle. Cautionary measures include:

- Always wear gloves and a mask, and change as needed.
  - This should include changing for each item.
  - DO NOT touch other items and evidence.
- Use one (disposable) tool for collection per item.
- Avoid touching or grasping an item in the same manner as the person leaving the DNA.
- DO NOT touch your hair, clothes, face or that of another person.
- Carefully photograph, document, and label all collections and procedures.

When reviewing criminal discovery and civil disclosures, look for lapses in these appropriate measures, and other contributors of potential cross examination. Many scenes can be contaminated by persons that do not belong in the scene. Be sure that you do not violate the precautions, and look for these common blunders:

- The 'brass' just checking on things
- Attendants not needed
- Untrained personnel (interns & volunteers)
- Family members and witnesses that are not promptly escorted away

A sign, bearing the following warning, should be at every incident scene or at least considered as part of the collection, retention and testing policy:

> *"All persons entering this scene must log in, be searched, and their belongings collected and logged. You must submit to full DNA collection to eliminate your DNA from future tests. This may include: buccal swabs, pulled and combed head and pubic hair, anal swabs, penile swabs, and vaginal swabs. NO EXCEPTIONS."*

For those that are in the scene, and/or collection area – of any evidence – proper personal protective devices are a must. As with all evidence, this should also be noted in the review of criminal discovery and civil disclosures, look for proactive measures in preventing contamination. In the cases of contact with biological hazards, this will protect the user. It will also prevent them from contributing DNA (hair, sweat, fibers, saliva, etc.) and other trace evidence (dirt, footwear patterns). From head to toe, consider the following:

- Hair net
- Latex (or similar) gloves

- Eye protection
- Nose and mouth protection
- Clothing cover – Tyvek
- Booties and hoods

Each scene is different, from the testing laboratory or the morgue, to a detention center booking station (where some states permit felony arrest DNA collection) the protocols vary – sometimes all this protective gear is not necessary. For large and intrusive scenes, it is standard protocol to cover areas coming in contact with the scene to be protected. The next consideration is what can damage DNA and how it should be initially stored for safe transport to the evidence room or laboratory.

- Sunlight can damage DNA and other evidence.
  - Store in cool dry places. It is acceptable for temporary storage/transportation to be in an air conditioned vehicle.
- Paper bindles and envelopes are best – a barrier should exist between the DNA sample and the containing envelope.
- Transfer to the lab as soon as possible as DNA can be contaminated by environmental factors, particularly heat and sun.

The chain of custody and transfer of all evidence is paramount – in both the investigator's processes, and that of analyzing the processes of the opposing party in the criminal discovery or civil disclosure review. An example of discovered inappropriate handling of evidence can be seen in the famous (or infamous) OJ Simpson investigation as brought out in the trial. It was learned that an experienced crime scene technician collected blood evidence and then transported the same in the trunk of his hot vehicle, including an extended transport not directly to the crime lab or evidence facility. Evidence may not be harmed, as it was in this case, but that does not excuse improper handling or documentation of evidence.

The use of DNA in investigative forensics is most often used to include or exclude a person(s) from being a participate in an incident. This uses DNA 'fingerprinting' from known persons or their personal effects, and that of the person of interest. The known exemplar must be witnessed as collected from the person or known belongings of the person (i.e. toothbrush). Known persons include victims, missing persons, identified suspects, paternity, etc. This is not really a 'fingerprint' – it is a unique profile. DNA bank testing is a sample profile matched against recorded profiles of known profiles. In the United States this system is known as Combined DNA Index System (CODIS). To continue the fingerprint analogy, this is similar to Automated Fingerprint Identification System (AFIS) and works very similarly. They both use key points of the profile submitted for comparison and confirmed by the analyst – and protocol requires a second confirming comparison. The possible results (with the purpose) are:

- Knowns against Knowns (identification and link cases)
- Knowns against Unknowns (identification)
- Unknowns against Knowns (identification)
- Unknowns against Unknowns (links cases)

The protocol of comparison greatly depends on the collected sample, comparative exemplar, and storage facility:

- DNA evidence has been used many years after collection (i.e. Timothy Masters and Innocence Project Cases).
- Autopsy samples as evidence and paternity or identification.

- Private laboratories offer DNA testing of material, just as second testing of toxicology and pathology.
- Appropriate chain of custody.
- Confirm methodology and protocol of the lab.

- Check the credentials and protocol of the testing laboratory.
- Check the credentials of the scientist.
- Check the chain of custody logs and testing logs.
- Verify the reports of the condition of the test samples and exemplars.

Investigators may not be scientists, however investigators are fact finders – and investigators apply a form of the scientific process to our factual investigations. Understanding DNA, including the process of locating, documenting and the basic laboratory processes, is important to maintaining an edge in the growing investigative field. In a world of uncertainty there is DNA, which can, with a certainty, determine by exclusion if a person is connected to an incident or crime scene. It will not determine what took place or when, or even how or why – but it is an advanced tool in determining who.

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Dean has been a legal investigator since 1987 and operates his agency with his wife, Karen. He is currently the VP of Membership for the Professional Private Investigators Association of Colorado, and is also a member of the National Association of Legal Investigators, from which he has been conferred the coveted Certified Legal Investigator and is also a regularly contributing author to 'The Legal Investigator'; other memberships include the National Council of Investigation and Security Services, Co-Chair of Membership / Investigations, World Association of Detectives, National Association of Medical Examiners, and International Association for Identification. He has been a topic speaker and seminar instructor, authored multiple articles, peer reviewed white papers, and provided expert testimony on the protocols of private investigations. He has self-published 'Professional Locate Investigations' and recently completed 'Practical Methods for Legal Investigations: Concepts and Protocols in Civil and Criminal Cases' that will be available through CRC Press in January 2011.

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