Forensic Toxicology: Analyzing Biologics and Fluids

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Introduction to Forensic Toxicology

In the early 1700s, convicting someone with the charge of poisoning was solely based on circumstantial, rather than actual, evidence concerning the actual poisoning of said victim (Hodgson, 2004). In 1781, Joseph Plenic stated the only way to find any signs of a poisoning was to look in the deceased's organs. Later, in 1813, Mathias Orfila, thought to be the father of toxicology, wrote the first completed works on the subject of poisons and legal medicine. James Marsh further developed a test to find the existence of arsenic in tissue and in 1839, Orfila effectively used Marsh's test to actually identify arsenic taken from human tissue. The first Medical Examiner's Office and Toxicology Laboratory was established in New York in 1918. The chief forensic toxicologist was Alexander O. Gettler, and considered the father of American toxicology (Hodgson, 2004).

Forensic toxicology can be divided into two categories: post-mortem, and human performance. With the postmortem, the medical examiner will take tissue and blood samples to be tested in the lab for any metals, poisons, drugs, both prescription and illegal, and anything else the crime scene technician thinks may need to be tested. The samples will be taken prior to embalming, otherwise the embalming fluid will ruin any samples taken, and with alcohol in the embalming fluid could give a false reading on the deceased's sobriety. There are nine different samples to be collected, from the brain to the urine and stomach contents (Girard, 2011).

With the testing and analysis of human tissue, there are acceptable levels of prescription drugs, such as the dose given by a doctor. Elevated levels of drugs could show an overdose, whether it was accidental or on purpose. The tests will also show any type of heavy metals poisoning, elevated carbon monoxide levels in the blood, etc. The lab can test a person's hair to check for poison and will be able to see the concentration level in the hair. Toxicologists have found the blood left in the heart to be the best source of drug concentration once a person dies, and as the time of death lengthens, the concentration is greater (Girard, 2011).

In order to understand forensic toxicology, one must be able to know the definition of toxicology. Experts say it is the science that tests the source, characteristics, and properties of poisons (Grippo, 2001). Forensic Chemistry and Toxicology is relevant to the discovery and classification of poisons or toxins showing signs of adverse physiological effects on an individual. The technique used in a lab for toxicological analysis cover a extensive assortment and the testing of toxins can be done by using material tests, crystal tests, chemical spot tests, spectrophotometric tests, and chromatographic tests.

With toxicology being the study of materials harmful to humans, those in the world of toxicology have the duty of finding and recognizing the existence of drugs and poisons in a person's biological fluids, organ and tissue samples. A toxicologist's experience is not just required in crime laboratories or in medical examiner's rooms. This experience would also be required in hospital lab identifying an overdose of a certain toxin or drug would mean the change between a victim living, or dying from the effects of the poison (Grippo, 2001). The job of a toxicologist can usually be put into three categories. The technician routinely tests for alcohol or drugs in someone's urine or blood; the technician would test for illegal drugs such as heroin, cocaine, THC, etc., and the identification of said drugs in one's system. Currently, identifying modern drugs is getting to be very difficult, due to the extensive list of drugs, and their hybrids increasing greatly, and new ones hitting the streets often. The drug in question will be put through thorough tests and there will be no margin for error. To date., there is a vast series of tests for the finding of certain substances, but in order to conduct all of these tests to determine the identity of the substance it would be extremely time consuming, so presumptive testing is done (Grippo, 2001). This type of test does not always identify the substance, but it does narrow it down enough to eliminate thousands of possibilities so that a more specific test can be done later.

Using color tests are generally the first test used to narrow down the options for the kind of drug at hand. When the drug is placed in a container and it makes contact with with a specific chemical reagent, the reagent will change color. There is a guide sheet that tells each specific color and what that color represents as far as the testing of the drug in question. After the color test has been completed the technician can then conduct a crystal, or microcrystalline, test on the drug that was just tested with the reagent. The substance in question put onto a microscope slide, a drop of a chemical agent is placed on the slide with the drug, and the two will have a chemical reaction that will produce a crystalline reaction. The crystalline configuration is specific for each drug and can be seen through the microscope. Crystal testing is more exact than color testing, and there are a number of individual crystal tests available (Grippo, 2001).

The testing fluids, organs, and tissues will be carried out in such instances as a sudden death such as homicide or suicide, or a suspected poisoning. The post-mortem is done by a pathologist or medical examiner who will then send the samples taken of the individual's tissue and fluid samples to the lab for examination. There are many ways in which to test the samples including chromatography, scanning electron microscopes, emission spectrographs, and atomic absorption interments for the detection of heavy metals such as mercury and lead, which is common in poisoning cases. Currently, one of the most significant and precise devices used to test tissue and blood is the mass spectrometer (Grippo, 2001).

Forensic toxicology can be dated back to 1500 BC, with an Egyptian papyrus which is said to be the earliest surviving medical work of Hippocrates, Aristotle, and Theophrastus (Hodgson, 1997). This papyrus was tested to show it was published during the time frame of 400-250 BC and talked about poisons, and the therapeutic and medicinal effects that it can have on in individual, both medically and psychologically.

The use of toxins to treat illnesses is said to be the oldest practical sciences, but most humans and animals needed to stay clear of certain ones, because it can be poisonous if taken incorrectly, but could use others could be safe. Take for instance, the plant Bella Donna. Everyone knows that taken in small doses, can have great healing benefits on the patient. But, given in a large dose, it will act as a poison.

The field of forensic toxicology has grown a great deal in the past years, both with the number of scientists becoming interested in the field, and the amount of knowledge and modern equipment used to test the evidence. Every day, more and more knowledge is gained by scientists, and it is easier to share that knowledge with access to the internet, both nationally and globally. Scientists from around the world share information obtained from cases, and are more than willing to work with other scientists in a cause for the greater good. To date, there is not much that cannot be tested through a mass spectrometer or under a microscope. Should a situation come up with unknown biologics or non-biologics, the information will be passed around until someone either recognizes the signature of the sample, or they in turn will pass it to someone that had seen it.

When a scientist is working in a lab, the scientist is able to effectively test those samples brought in by those investigating a crime scene. Those that choose a profession in this field must have extreme patience, the ability to process minute particles of sand, or soil, or blood that will tie a victim to a suspect, or even prove accidental death at the hands of the victim. The scientist must also be able to understand the diligence behind maintaining the proper chain of custody, and must understand the ramifications behind breaking that chain, and what will happen to the suspect, if the case does not stand up in court. These scientists must understand that just about the entire case rests on the proper testing and documenting of evidence, as if one little mistake is made, the suspect could go free.

This field of forensic toxicology has evolved to a profession of not only testing items brought in from a crime scene, but also includes testing for various professional positions. These scientists are able to not only test human samples, but animal samples as well for those in the profession of wildlife criminal investigations, and test victims for date rape or other and performance-enhancing drugs. The forensic scientists are also involved in on cases tied to any type of environmental contaminations, to find out and establish the impact of chemical spills on nearby neighborhoods and cities (Hodgson, 1997). Those in the investigative positions must be able to count on forensic toxicologist to make consistent deductions concerning the effect a certain amount of any type of poison or toxin would have on a particular individual. More often than not, this will require the scientist to give an educated guess, based on the specific science and experience. After testing these biological and non-biological samples, the scientist may be asked to testify in court. When asked to testify in court, the scientist must be able to give a good enough testimony as to what poisoned a person, how much, how it was tested to determine what poison or toxin was ingested, etc. the scientist must be able to put it in layman’s terms that the jury can understand.

Testing Biological Samples

When it comes to investigators processing a crime scene, what the investigator is looking for is something that will tie the suspect to the victim. The investigator collects everything deemed important and relevant to the case, and fluids, both biologic and non-biologic, are very important; nothing should be overlooked. When biologics are found at a crime scene, the fluids are specific to the individuals tied to that scene. It is also important to limit the amount of foot traffic at a scene, and any fingerprints left at the scene should have all those involved in the collection and processing of the scene be accounted for, that way the investigator can tell which are the victim's and which could be a possible suspect.

Fluids found at the scene need to be tested as a possible match the victim, and any unmatched fluids could belong to the suspect. Fluids that could be found at the scene would include blood, saliva, semen, and non-fluid biologics will include skin, hair, fingernails, etc. When someone is a victim of a sexual assault, there is a kit that is collected for various fluid and non-fluid samples to match a suspect to that victim (Girard, 2011). If any of those samples are put into a national database, the investigators could find the suspect quickly. If the samples are not in the database, then it would be put in for future reference. The samples collected in the kit would include blood, hair, vaginal swabs, fingernail scrapings, and the victim's clothing. Also any marks sustained during the assault would be tested and photographed. Fluids are not just tested at crime scenes. The police also have a need to have fluids tested, for routine purposes, such as with human performance testing. Human performance testing involves some of the same type of tests, except the person in question is not deceased, so most of the samples will not be taken, only blood and urine (Girard, 2011). And, because the person in question is not dead, cause of death does not need to be determined. The police use blood and urine samples to test drug levels and alcohol levels, and to determine a person's ability to operate a motor vehicle or other equipment. Drivers in some states have the right to submit to a breathalyzer, in which their blood alcohol is tested through the breath, or the driver can submit to a blood or urine test. Fluids can also be tested to determine paternity or relationship to a victim or suspect.

Biological samples that are not fluids are found with skin, fingernails, hair, etc. Anything taken from a crime scene that is biological in nature will be tested to tie suspect to victim. Sometimes there are cases in which the investigator may never get a suspect; the evidence collected at the crime scene may not be a match to anyone in the database, and the case may sit cold until that individual commits another crime, and the biological samples match to the other case (Girard, 2011). When it comes to cases being prepared to be taken to trial, there are certain ways in which to ensure the evidence will be accepted into the trial, the forensic scientist and prosecutor need to present evidence before the judge so the judge will accept it into court.

Biological fluids and samples are not the only items found at a crime scene. There are a great many things that can be categorized as trace evidence on a victim. Any item collected at a crime scene is evidence, to include fibers, soil, fingerprints, shell casings,

bullets, etc. All samples are tested, both biologics and non-biologics (Girard, 2011). Soil samples taken at the scene can be tested to check for primary and secondary crime scenes; fibers can be tested to check for where the cloth or carpets may have originated from, whether it is a special weave or commonplace with manufacturers that produce mass quantities of each item, which will be harder to place. The importance of testing every piece of evidence collected at the scene is that it will help tell the forensic technician and lead investigator the story of what happened, hopefully from beginning to the end. Every piece of evidence tells a story, perhaps not now, but things do fall into place, like a puzzle.

Evidence must be carefully handled, the chain of custody with evidence must not be broken or compromised, otherwise the evidence can be perceived as inadmissible, as is the powers of the judges and justices, who can decide what will be allowed or not allowed (Girard, 2011). A forensic technician must be very careful when documenting and testing evidence as everything must be accounted for, written down, so that if the technician is called to testify, they are able to explain what the evidence is, how they identified it as what it is, how they tested it to tie it to the victim or the suspect, etc. If the technician has everything document and precise, most evidence will be allowed in a trial. When the technician is shaky, and cannot explain what is needed before the judge, the judge has every right to disallow the evidence as it stands if the judge doesn't like it. There are several Supreme Court rulings in such cases where the evidence was not collected properly, i.e., without a proper search warrant in place, where the evidence was mishandled, the chain of custody compromised, or a suspect's interrogation mishandled in that the Miranda Warning was not given properly. One must not be in such a hurry to make a case that things are not handled as they should be. If people start getting sloppy about handling evidence or collecting evidence, the job starts getting sloppy, and those suspects will get off on technicalities.

There are several Supreme Court rulings that came about in the past that help define those evidentiary issues that had come up. Once a ruling has been made, it will take another ruling to change it back, but very seldom comes into question. These rulings were made after much research and discussion, and these decisions were made with the best course of action.

Supreme Court Cases - Mincey v Arizona, 1978

When investigators are investigating a case, the lead investigator needs to make sure all the legal paperwork is in the proper place prior to searching, seizing, or interrogating a suspect, the proper search warrants must be in place, Miranda warnings have to be given to those individual that are suspect, etc. In Mincey v Arizona, the investigators in charge of the case raided Rufus Mincey's home on the suspicion of drug dealing (Girard, 2011). The homicide investigators that took over the case searched the house with no search warrant in place, interrogated Mincey while semi-conscious, and charged Mincey with crimes of homicide and drug dealing. Mincey's attorney's were able to later get the homicide and assault charges reversed in the Arizona Supreme Court, but not

the narcotics charges. Rufus Mincey's attorney's stated that the majority of the evidence collected was done without a proper warrant, and Mincey's statements were inadmissible due to his medical condition (Girard, 2011).

Brinegar v United States, 1949

People in the United States have an expected right to privacy, based on the Fourth Amendment. Police officers and others involved in law enforcement must have the necessary warrants in place in order to search and seize a suspect's possessions. To obtain a warrant, those needing the warrant must find a neutral magistrate that will sign off on the fact that the lead investigator and prove there is probable cause to obtain evidence in order to affect an arrest. In order for the defense to disallow evidence, the defense must be able to prove to the judge that the police did not in fact have probable cause, and the warrant was ill-gotten.

Warden v Hayden, 1967

Obtaining a warrant for search and seizure of property is not the only thing they are used for anymore. In the case of Warden v Hayden, the decision was made by the Supreme Court that warrants could also be obtained for fluids, DNA, skin samples, hair samples, fingerprints, etc (Girard, 2011). Whatever the judge decides can be admissible as evidence in which to rule out a suspect. However, there are limitation to these warrants in what the police may obtain and it is up to the judge to keep things fair.

Coppolino v State, 1968

This Supreme Court ruling helps make binding the prudence and fluidity the judge has when it comes to evidence admissibility (Girard, 2011). In this ruling, the evidence collected to be presented to the judge for admissibility for the case came under scrutiny because the toxicology was run with a new test that was not proven. This ruling is referred to the Coppolino standard, in which the judge is able to accept evidence into trial is that judge agrees with the test and can verify its validly and proven effectiveness. If enough paperwork is produced to the judge to prove the test if trustworthy, the judge can allow that evidence into trial.

Frye v United States, 1923

Evidence collected for a case is given better credibility when the forensic technician can explain in layman's term to a jury how the evidence was tested and the results were of the test. The process by which the labs test the evidence collected from the scene must not only be based on those scientific principles already accepted by the courts, but must also satisfy the rules by which the evidence will be accepted by the courts (Girard, 2011). The guidelines that are used for determining what scientific information is admissible, is overseen by the Frye Standard, in which the judge decides whether the

technique used by the technician to examine the evidence will be allowed. Such general acceptance tests must also be accepted by the scientific community, in order to prove validity. To date, the Frye standard has caused arguments about its inability to deal with new and innovative scientific tests that may not be generally accepted.

Daubert v Merrell Dow Pharmaceuticals, Inc, 1993

The Daubert standard dictates the judge is the “gatekeeper” in ruling on the admissibility of evidence into a trial (Girard, 2011). The Daubert standard states the judge can use guidelines in which to decide whether to use evidence in a case or not. Although the Daubert standard was considered overly strict, but this standard was given affirmation in 1999 during Kumho Tire Co v Carmichael (1999) in which those in authority stated that this decision not only applied to the testimony based on scientific knowledge, but also testimony based on technical and other specialized knowledge (Girard, 2011). The Daubert standard also states that the guidelines by which they govern their decision do not necessarily pertain to all experts, or every case. .

United States v Byron Mitchell, 1999

Some defense attorney’s will try to dispute the make less the evidence provided by the prosecution in a case. The defense will try to make the evidence circumstantial, and make it appear as if the evidence could point to any potential suspect. In United States v Byron Mitchell, the defense tried to say the fingerprints found on the gearshift belonged to the accused, and could not be proven using the Daubert guidelines. The situation with the fingerprints was brought before the U.S. District Court for eastern Pennsylvania, and the decision to allow the evidence was upheld. The decision by the judge was the all fingerprints were unique to each individual, and could not be confused to be someone else’s (Girard, 2011).

Testing Non-biologic Samples

Not everything collected at a crime scene is a biologic. There are samples that are not blood, skin, or hair. There are various items that will be considered evidence, even transfer, depending on whether the scene being worked on is the primary, and not the secondary. While biologics are also susceptible to the elements, so are non-biologics. Fibers, oil, even duct tape can become degraded over time. A scientist can tell if an oil stain left on the floor of a garage is recent, or if it has been there a while. The same with the glue on tape; left to the elements it will become degraded and perhaps give a timeline of how long it has been at the scene, and whether it is part of the crime scene.

The testing of the non-biological evidence will come in the form of a ballistics test, taking a mold of a shoe print at the scene, retrieving a show print from a floor via electrostatic means. The crime lab today is very different from crime labs twenty years ago. Twenty years ago, DNA testing was not available, and scientists have come such a long way

since then. Cold cases are being reopened, to test various evidence that came back as inconclusive, and perhaps free an individual that was wrongly incarcerated. Any drugs left at the scene can be tested to see not only what type of drug it is, but what other properties are included in that drug samples, as almost all drugs are cut with another element, and is not in pure form.

The forensic scientists will also test any type of fiber found at the scene, on the victim, that will perhaps tie the victim to another place, maybe someone's car trunk if transported, or living room. Just because the victim was found on a carpet, does not mean that other carpet fibers found on the victim could not be tested as well. It could lead to another source, perhaps another suspect. Crime labs, both state, federal, and private, are usually able to tie into each other's databases for examples of various samples and should be able to match fibers found at a scene. If not, it could be a carpet specially made for that particular room, and can be traced to manufacturer and buyer. Tool marks left at the scene of a break-in can also be tested for typical striations that hammers and crowbars leave behind. Every tool leaves behind a specific mark, and no two are the same. Even sand and soil samples are indigenous to a certain location, and if found at a scene where it is not common, it could link that scene to another, perhaps the original or the suspect carried the sample on their clothing, and transferred it to the victim.

However, because a crime scene can contain so many types of evidence, it is necessary to rule out those are not tied to the scene, exclude them from the case, and take what is relevant to trial. Those investigators involved in collecting the evidence needs to be familiar with the identification of pertinent evidence, so as not to leave out what could be important. Collect what must be collected, and it can be sorted at the lab. Those scientists working in the lab that test the evidence must be able to logically include or exclude what evidence that is not relevant to the case, and keep what is. Based on those tests from the lab, the prosecutor can decide what evidence will be entered into the case and what will not (Girard, 2011). The scientist's job is to test the evidence; not to make the decision of what will go to trial and what will not. The evidence is defined by the Federal Rules of Evidence, and once the prosecution brings for the case and the evidence at hand, the judge will determine what will be allowed and what will not.

Arson

Another fascinating field of forensics is the one involving arson. Usually those that investigate arson cases will have taken some classes concerning fire science. It helps to know how a fire works in order to investigation the scene properly as those types need to know how to search and document a crime scene concerning arson. The investigator can tell, when entering the scene, where the fire started, how fast or how slow it burned, whether or not it was arson or accidental. The crime scene investigator will collect all samples that are found, in hopes of finding the accelerant that was used to start the fire (Girard, 2011). There is a list of flash points for frequently used accelerants that the scientist should be familiar with that will tell the investigator what was used, and how much to cause the burn patterns and the speed of the fire. The

crime scene investigators will collect everything and place in metal containers, in case of unknown residues and other liquids so not to damage anything around it (Girard, 2011). The gas chromatographer is used to test what accelerant was used in the fire and how much was used. Some accelerants burn off quickly and some will leave some trace behind. Testing these samples and causes of fire also falls under the heading of non-biologics, as blood very seldom has a place at the scene of a fire, unless someone was killed prior to the fire being set, and some traces of blood is found at the scene. Other items to be tested at a fire could be a heat lamp, a tanning bed, a space heater, anything that would be used to warm a space, especially in the winter-time. The bad thing about trying to collect evidence at the scene of a fire, is that once the fire team is done hosing everything down to put the fire out, just about all the evidence has been washed away.

The first thing the arson investigator does when arriving on scene is to interview any witnesses available. The investigator needs to find out who called the fire department, who saw the fire, did anyone see anything out of the ordinary, etc. The person that called the fire department may have seen someone leave the building, who may have in fact started that fire. As soon as the fire has cooled enough, and the Fire Marshall states it is safe to enter the building, the investigator is able to do so (Steck-Flynn, 2009). The investigators will also interview those individuals on the fire department, to determine what was seen as soon as the fire fighters entered the building.

The investigator will also need a copy of the report, to determine the color of smoke, what was found during overhaul, etc. The investigator will also need to determine if the building was up to code, with sprinklers and/or smoke alarms in the proper places. The investigator will also work closely with the forensic lab to determine if an accelerant was used, or was the fire accidental (Steck-Flynn, 2009).

Cyber Crimes

Computers and other digital mediums have become commonplace in society. Just about everything can be accessed online now, from shopping to banking to video conferences. However, once a channel has been opened to allow an outsider in to view our most secretive data, it allows anyone to get in that same way. Today, modern forensic scientists must know and understand how a computer works, and how to process a crime scene where computers are involved. Cybercops, forensic scientists that specialize in computer sciences, has become a specialty within the criminal justice world, and certainly have the job security to go with it.

Since the 1990s computer knowledge and equipment has become highly developed and with that, certain crimes from fraud to stealing personal information to drug financing. With regards to a criminal investigation, those forensic technicians tasked with cyber crimes are able to find, safeguard, and analyze that data which will be used as evidence of wrongdoing in an electronic and digital sense (Girard, 2011). The Fourth Amendment protects law enforcement from taking a person’s computer and processing

the information on it without warrant. However, the Supreme Court ruled that a search of electronic equipment does not violate a person's right to expected privacy, if a copy of what is on the computer is copied to a CD or taken in to a computer repair ship. In the case of United States v Hall (1998) the individual that owned the computer took it to a shop for repair and the technician saw illegal activity on it, and in turn reported that person to the police (Girard, 2011).

Cybercriminals is a term used to describe those criminals that try to damage or destroy computer networks, obtain money through fraudulent means, disrupt daily business by hacking their way into a network, generally causing havoc. Computer crimes have gone beyond simple hacking to identify theft to funding criminal activity by means of wire transfers of money to off-shore accounts that those criminals have access to (Girard, 2011). The FBI and other agencies are now able to obtain search warrants for computers involved in suspected criminal activity and forensic technicians obtain the data contained on the hard drive and in turn, can process the electronic evidence needed for trial. But, because computer activity is so fast and can reach globally, it is very hard to catch criminal in the act; these criminals are usually caught after months or years of careful and detailed surveillance by those law enforcement agencies, and all this work usually involves more than one agency.

The science of cyber forensics is the method by which a forensic technician, schooled in the art of computer science, recovers evidence from digital medias such as computers, video tapes, and audio tapes. As with all other means of evidence collection, computer forensics involves the safeguarding, recognition, withdrawal and documentation of computer evidence accumulated in the means of magnetically encoded information data (Raut, 2010). Some experts would even say that computer forensics is an art, and includes the science of applying computer science to help the prosecution or defense in their case. As with every crime scene, computers confiscated at a crime scene will contain evidence, and because of Locard's Principle, this principle can be applied to computer forensics, as such that all actions on computers will leave a trace (Raut, 2010). As with every other evidence collection, those testifying as to the validity of what is found on the computer, how it was tested, how it was found to be from another source, must be explained in detail in such a way that the jury and all those concerned will understand. As with all other evidence, the evidence taken from the computer must be maintained in a way that preserves its evidentiary value (Raut, 2010)

Conclusion

Forensic toxicology is a fascinating field. It involves testing biologics, non-biologics, finding out how someone died, how a fire started, anything and everything that will connect a victim to a suspect. But forensic technicians do not just test items for homicides. These scientists also test for suicides, accidental deaths, robberies not involving fatalities, etc. Forensic technicians also conduct tests on employees that require a certain security clearance, and certain jobs that are zero tolerance on drug use. At crime scenes, technicians test everything the investigators bring to the lab

labeled as evidence. Technicians must be able to recognize what is being tested, how to test it, be able to read the results, and testify in court, if necessary. Technicians must be able to tell the jury what the findings are in regards to the evidence tested for the case. If the technician cannot, the case may be lost.

As part of the investigating team, the technicians will work closely with the crime scene investigators, and must be able to coordinate with other law enforcement agencies on the results of evidence tested in the lab. Being a forensic scientist requires the individual be precise, methodical, have great patience, and be able to test any item brought to the lab. When an autopsy is performed on an individual, the morgue will bring samples of tissue and brain, and stomach contents to the lab to determine cause of death, of not already known. Forensic toxicology was first used to determine poisonings in certain individuals, and it grew from there. The toxicologist, on occasion, may be asked to test other items, from fingerprints to hair to even analyzing a computer hard drive, depending on the size of the lab and the amount of staffing available.

The Supreme Court has ruled on several cases regarding certain forensic cases in which the evidence at hand came into question. As seen in this research, all cases were expertly handed by the judges, the ruling was fair and impartial, and it served as a precedence for future cases in which should the evidence come into question again, these cases that already have a ruling can be cited as resolved. The Daubert Standard, Coppolino, and Frye have all been established in which the judge is the gatekeeper when it comes to evidence submission within a court case, and it is at the judge's discretion as to what is accepted, and what is not. The technician must be able to answer any and all questions when testifying in court, and make the jury understand what is at stake when testing evidence important enough to make it to trial.

Forensic testing of toxins have come a long way with helping save lives, knowing what toxins poison someone, what the antidote is, and with modern technology, there isn't much that cannot be tested. Along with national and global databases, anything tested in the lab is put into the database for others to use. Fingerprints, DNA, toxins, even the poisons obtained from snakes, spiders, and other venomous creatures. These scientists can also test anything found at an arson scene, and help the arson investigator determine exactly how a fire was started, if an accelerant was used, and how much. They can also tell if the fire was accidental or if it were set on purpose. Perhaps if research were advanced enough, one can even tell from lab testing what gene causes cancer and how it can be eradicated.

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