



A Simplified Guide To Bloodstain Pattern Analysis

Introduction

Because blood behaves according to certain scientific principles, trained bloodstain pattern analysts can examine the blood evidence left behind and draw conclusions as to how the blood may have been shed. From what may appear to be a random distribution of bloodstains at a crime scene, analysts can categorize the stains by gathering information from spatter patterns, transfers, voids and other marks that assist investigators in recreating the sequence of events that occurred after bloodshed. This form of physical evidence requires the analyst to recognize and interpret patterns to determine how those patterns were created.



(Courtesy of NFSTC)

Bloodstain pattern analysis (BPA) is the interpretation of bloodstains at a crime scene in order to recreate the actions that caused the bloodshed. Analysts examine the size, shape, distribution and location of the bloodstains to form opinions about what did or did not happen.

BPA uses principles of biology (behavior of blood), physics (cohesion, capillary action and velocity) and mathematics (geometry, distance, and angle) to assist investigators in answering questions such as:

- Where did the blood come from?
- What caused the wounds?
- From what direction was the victim wounded?
- How were the victim(s) and perpetrator(s) positioned?
- What movements were made after the bloodshed?
- How many potential perpetrators were present?
- Does the bloodstain evidence support or refute witness statements?

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BPA provides information not only about what happened, but just as importantly, what could not have happened. This information can assist the investigator in reconstructing the crime, corroborating statements from witnesses, and including or excluding potential perpetrators from the investigation.

Principles of Bloodstain Pattern Analysis

To understand how analysts interpret bloodstains, one must first understand the basic properties of blood. Blood contains both liquid (plasma and serum) and solids (red blood cells, white blood cells, platelets and proteins). Blood is in a liquid state when inside the body, and when it exits the body, it does so as a liquid. But as anyone who has had a cut or a scrape knows, it doesn't remain a liquid for long. Except for people with hemophilia, blood will begin to clot within a few minutes, forming a dark, shiny gel-like substance that grows more solid as time progresses. The presence of blood clots in bloodstains can indicate that the attack was prolonged, or that the victim was bleeding for some time after the injury occurred.

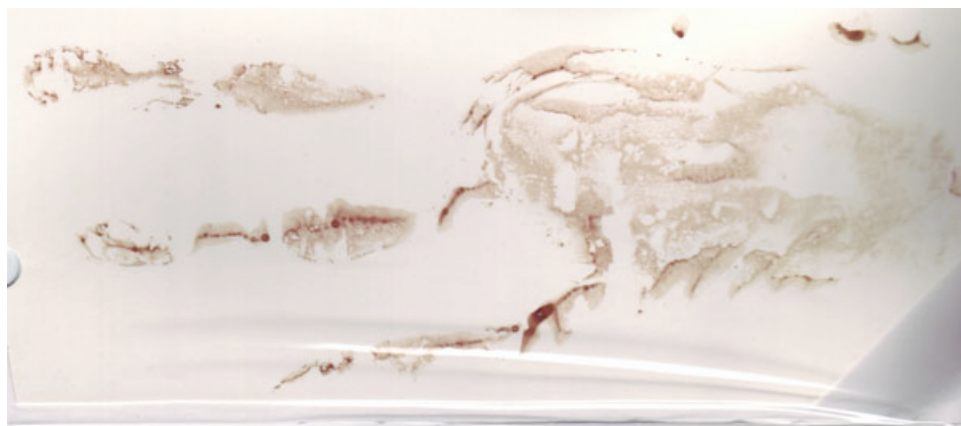
Blood can leave the body in many different ways, depending on the type of injury inflicted. It can flow, drip, spray, spurt, gush or just ooze from wounds.

Types of Stains

Bloodstains are classified into three basic types: passive stains, transfer stains and projected or impact stains. Passive stains include drops, flows and pools, and typically result from gravity acting on an injured body. Transfer stains result from objects coming into contact with existing bloodstains and leaving wipes, swipes or pattern transfers behind such as a bloody shoe print or a smear from a body being dragged. Impact stains result from blood projecting through the air and are usually seen as spatter, but may also include gushes, splashes and arterial spurts.



Passive bloodstain on a wooden floorboard. (Courtesy of John Black, Ron Smith & Associates)



Transfer pattern made by a bloody hand. (Courtesy of John Black, Ron Smith & Associates)

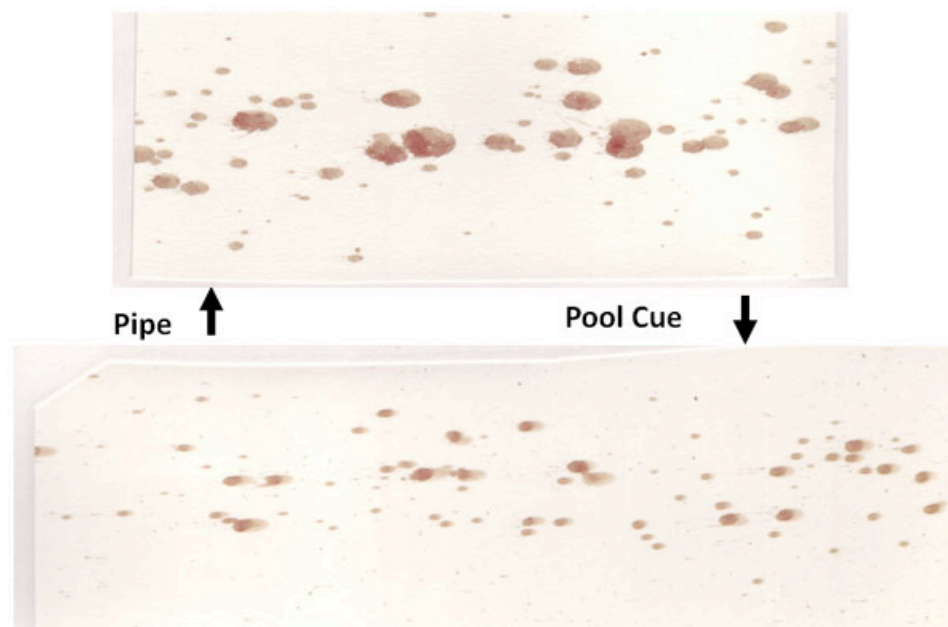
Blood spatter is categorized as impact spatter (created when a force is applied to a liquid blood source) or projection spatter (caused by arterial spurting, expired spray or spatter cast off an object). The characteristics of blood spatter depend on the speed at which the blood leaves the body and the type of force applied to the blood source.

Gunshot spatter - includes both forward spatter from the exit wound and back spatter from the entrance wound. Gunshot spatter will vary depending on the caliber of the gun, where the victim is struck, whether the bullet exits the body, distance between the victim and the gun and location of the victim relative to walls, floors and objects. Typically, forward spatter is a fine mist and back spatter is larger and fewer drops.



Back spatter from a gunshot wound on a steering wheel. (Courtesy of John Black, Ron Smith & Associates)

Cast-off - results when an object swung in an arc flings blood onto nearby surfaces. This occurs when an assailant swings the bloodstained object back before inflicting another blow. Analysts can tell the direction of the impacting object by the shape of the spatter (tails point in the direction of motion). Counting the arcs can also show the minimum number of blows delivered.



Cast-off spatter patterns from a pipe and a pool cue. (Courtesy of Brian Dew, Ron Smith & Associates)

Arterial spray - refers to the spurt of blood released when a major artery is severed. The blood is propelled out of the breached blood vessel by the

pumping of the heart and often forms an arcing pattern consisting of large, individual stains, with a new pattern created for each time the heart pumps.

Expirated spatter - is usually caused by blood from an internal injury mixing with air from the lungs being expelled through the nose, mouth or an injury to the airways or lungs. Expirated spatter tends to form a very fine mist due to the pressure exerted by the lungs moving air out of the body. Small air bubbles in the drops of blood are typically found in this type of spatter.

Some bloodstains are latent, meaning they cannot be seen with the naked eye. Investigators can use chemical reagents such as Luminol to find and photograph latent bloodstains. When sprayed on blood, Luminol creates a bright blue luminescent glow by reacting with iron in the blood's hemoglobin.



Luminol reveals latent bloodstains left on a sink. (Courtesy of John Black, Ron Smith & Associates)

Bloodshed Events

A crime scene where bodily injury has occurred is likely to have some amount of bloodstain evidence present; however, the amount will vary depending on the circumstances of the crime. The type of injury inflicted and the amount of force used will determine the volume and pattern of bloodstains:

Sharp force injuries (stabbing) - these injuries are caused by an object with a relatively small surface area, such as an ice pick or a knife. Less blood is deposited on the instrument, resulting in a smaller, more linear pattern of stains.

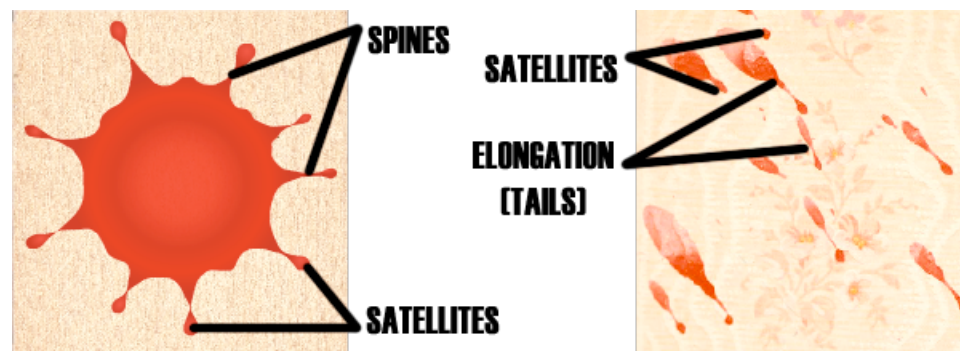
Blunt force injuries (hitting or beating) - objects inflicting this type of injury are usually larger, such as a bat or hammer. If the object impacts liquid blood, the larger surface area will collect more blood, producing drops of varying sizes.

Gunshot injuries - mist-like spatter caused by bullets entering and exiting the body.

Interpreting the Patterns

When blood is impacted, droplets are dispersed through the air. When these droplets strike a surface, the shape of the stain changes depending on the angle of impact, velocity, distance travelled and type of surface impacted. Generally, the stain shape will vary from circular to elliptical, with tails or spines extending in the direction of travel. Smaller satellite stains may also break away from the initial drop. By measuring the width and length of the stain, the angle of impact can be calculated, helping investigators determine the actions that may have taken place at the scene.

As the angle of impact changes, so does the appearance of the resulting stain. A blood drop striking a smooth surface at a 90° angle will result in an almost circular stain; there is little elongation, and the spines and satellites are fairly evenly distributed around the outside of the drop. Below 75°, spines begin to become more prominent on the side of the spatter opposite the angle of impact. As the angle of impact decreases, the spatter stain elongates, becoming more elliptical, and the spines, etc., become more predominant opposite the angle of impact. At very low (acute) angles, a single satellite may break off to form a second stain; this is the distinctive “exclamation point” stain.



Void Patterns

A void occurs when a person or object blocks the path of the blood. They are important because voids can show investigators if objects are missing from the scene, where a person or persons were at the time of the incident, and if a body was moved. An object that leaves a void in a bloodstain pattern will have a matching bloodstain pattern on its surface, allowing analysts to

replace it in the scene if found. Void patterns are most useful for establishing the position of the victim(s) and assailant(s) within the scene.

Why and when is bloodstain pattern analysis used?

Bloodstain evidence is most often associated with violent acts such as assault, homicide, abduction, suicide or even vehicular accidents. Analyzing the size, shape, distribution, overall appearance and location of bloodstains at a crime scene helps investigators by answering basic questions including:

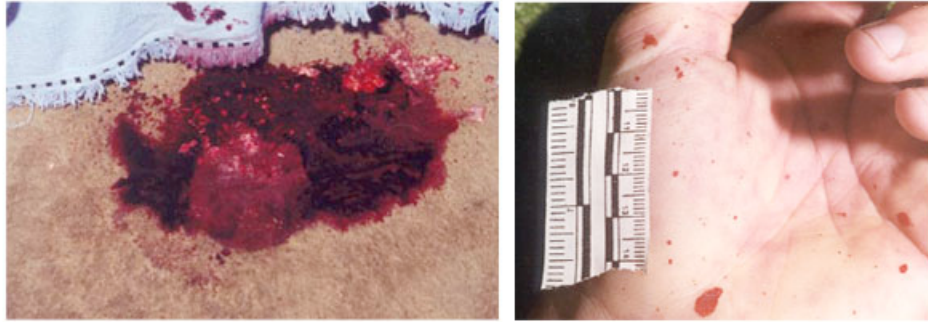
- What occurred?
- Where did the events occur?
- Approximately when and in what sequence?
- Who was there? Where were they in relation to each other?
- What did not occur?

One of the most important functions of bloodstain pattern analysis is to support or corroborate witness statements and laboratory and post-mortem findings. For example, if the medical examiner determines the cause of death is blunt force trauma to the victim's head, the pattern and volume of blood spatter should be consistent with a blunt instrument striking the victim one or more times on the head. Conversely, if the spatter resembles that seen in expired blood spray, the analyst will check the medical examiner or pathologist reports for injuries that can cause the presence of blood in the nose, throat or respiratory system of the victim. If blood is not reported in these locations, the analyst may be able to exclude expiration as the possible cause of that spatter pattern.

How It's Done

Bloodstain Patterns that May be Found

Bloodstains range in both amount of blood and type of pattern—from pools of blood around a body to obvious spatter patterns on the walls to microscopic drops on a suspect's clothing. The shape of the bloodstain pattern will depend greatly on the force used to propel the blood as well as the surface it lands on. Forward spatter from a gunshot wound will typically form smaller droplets spread over a wide area, while impact spatter will form larger drops and be more concentrated in the areas directly adjacent to the action.



Left: large volume blood stain. Right: impact spatter pattern.



Left: passive bloodstains. Right: bloody shoe print transfer pattern.



Left: void patterns. Right: projected blood stains. (Courtesy of John Black, Ron Smith & Associates)

Because blood demonstrates surface tension, or cohesive forces that act like an outer skin, a drop of blood dropped at a 90° angle forms a near-perfect spherical shape. A smooth surface, such as tile or linoleum, will cause little distortion of this spherical shaped drop, whereas a rougher surface, such as

carpet or concrete, disrupts the surface tension and causes the drops to break apart.

The number and location of stains, as well as the volume of blood influence how much useful information can be gathered. Large amounts of blood, such as if the person bled to death or was so severely injured that the resulting blood spatter was extensive, can often yield less information than several well-defined spatter patterns. Too much blood can disguise spatter or make stain patterns unrecognizable. Conversely, too little blood, just one or two drops, will likely yield little or no useable information.

Stains that overlap or come from multiple sources present challenges to analysts, but often reveal valuable details about the crime. Overlapping stains may obscure pattern details, but can provide information on the force, timing and instrument used. In the case of multiple victims, analysts will often use DNA profiling to determine whose blood is included in a given pattern, helping to estimate the locations of the victims in relation to each other and the perpetrator(s).

How Bloodstain Evidence is Collected

Bloodstain samples can be collected for BPA by cutting away stained surfaces or materials, photographing the stains, and drying and packaging stained objects. The tools for collecting bloodstain evidence usually include high-quality cameras (still and video), sketching materials, cutting instruments and evidence packaging.

Documentation of Bloodstain Evidence

The most frequently used method of capturing bloodstains is high-resolution photography. A scale or ruler is placed next to the bloodstain to provide accurate measurement and photos are taken from every angle. Video and sketches of the scene and the blood stains is often used to provide perspective and further documentation. This is commonly done even if stained materials or objects are collected intact.



A crime scene photographer documenting blood spatter evidence on a wall. (Courtesy of NFSTC)

Sampling Bloodstains For DNA Profiling

Analysts or investigators will typically soak up pooled blood, or swab small samples of dried blood in order to determine if it is human blood and then develop a DNA profile. This becomes critical when there are multiple victims. DNA profiling may also indicate whether the perpetrator was injured during the attack, as in the case of two DNA profiles found at a scene with only one known victim.



Collecting a blood sample with a swab. (Courtesy of NFSTC)

Whenever possible, analysts or crime scene investigators try to collect the evidence intact. This may require removing a section of a wall or carpeting, furniture, or other large objects from the crime scene and sending them to the laboratory for analysis. Items that cannot be removed, such as a section of concrete flooring, will be thoroughly photographed and documented.

Who Conducts the Analysis

Bloodstain pattern analysts can be found at all levels of crime scene investigation: from law enforcement to laboratory staff. Analysts investigate and study patterns at the scene and often screen and profile the blood in the laboratory as well. It has become more common for bloodstain pattern analysts to have a degree in math or a physical science, such as biology, chemistry or physics. This helps the analyst to corroborate findings from other scientific disciplines including pathology, toxicology and serology/DNA. Analysts are typically required to undergo formal training in blood pattern analysis, accompanied by competency testing and periodic continuing education. Certification is offered by International Association for Identification (IAI) (<http://www.theiai.org/>) but is usually not required.

The FBI's Scientific Working Group on Bloodstain Pattern Analysis (SWGSTAIN) maintains guidelines (http://www.fbi.gov/about-us/lab/forensic-science-communications/fsc/jan2008/standards/2008_01_standards01.htm/) for minimum education and training for bloodstain pattern analysts.

How and Where the Analysis is Performed

Bloodstain analysts use established scientific methods to examine bloodstain evidence at a crime scene including information gathering, observation, documentation, analysis, evaluation, conclusion and technical (or peer) review. All tests and experiments should be able to be reproduced by independent analysts to ensure accuracy and quality.

Outside consultants are used frequently depending on whether there are any trained analysts in the jurisdiction. The location of the analysis will also depend on the complexity of the case and whether expertise beyond that of the local analyst is required.

Bloodstain pattern analysis is performed in two phases: pattern analysis and reconstruction.

1. Pattern Analysis looks at the physical characteristics of the stain patterns including size, shape, distribution, overall appearance, location and surface texture where the stains are found. Analysts interpret what pattern types are present and what mechanisms may have caused them.

2. Reconstruction uses the analysis data to put contextual explanations to the stain patterns: What type of crime has occurred? Where is the person bleeding from? Did the stain patterns come from the victim or someone else? Are there other scene factors (e.g. emergency medical intervention, first responder activities) that affected the stain patterns?

To help reconstruct events that caused bloodshed, analysts use the direction and angle of the spatter to establish the areas of convergence (the starting point of the bloodshed) and origin (the estimation of where the victim and suspect were in relation to each other when bloodshed occurred).

To find the area of convergence, investigators typically use string to create straight lines through the long axis of individual drops, following the angle of impact along a flat plane, for instance the floor or wall where the drops are found. Following the lines to where they intersect shows investigators where the victim was located when the drops were created.

To find the area of origin, investigators use a similar method but also include the height calculations. This creates a 3-D estimate of the victim's location when the drops occurred. For example, if the area of origin is determined to be only two feet above the area of convergence on the floor, the analyst may presume the victim was either lying or sitting on the floor. If it is five feet above the convergence, the victim may have been standing. This analysis can be done using strings and a protractor, mathematical calculations or computer models.

Tools used to determine area of convergence and area of origin include:

- Elastic strings and protractors
- Mathematical equations - (tangent trigonometric function)
- Computer software programs such as BackTrack™ or Hemospat
- Limiting angles method, which examines the physical evidence to exclude angles from analysis (e.g. if blood is found on the underside of a desk or table, analysts know that at least a portion of the spatter-producing event took place below the height of the desk or table.)

BPA can range from investigation and analysis of bloodstain patterns at the crime scene to bench work in the laboratory analyzing and DNA profiling the blood. Limited analysis can also be done using only photographs of the scene.

FAQs

What kind of results can be expected from bloodstain pattern analysis?

The results will generally take the form of a technical report that outlines the findings of the analyst. BPA results will generally include, in the opinion of the analyst, the following information for each stain or pattern found at the scene:

- How the bloodstains were formed (type of instrument and action that caused the stains)
- Number of victims (confirms case information)
- When possible, the approximate number of perpetrators
- The approximate position of the victim(s) (standing, sitting, lying on the floor, etc.) using area of convergence and origin
- When possible, the relative position(s) of the victim(s) to the perpetrator(s)
- Photographs and diagrams may accompany the report to provide additional details about the scene.

What are the limitations of the analysis?

Limitations of the BPA include the fact that it cannot recreate the entire scenario, as there are unknown variables that analysts cannot account for using scientific methods. For example, the analyst cannot tell if a perpetrator was older or younger, if an attack was planned or spontaneous, or if drugs or alcohol influenced the perpetrator (unless their blood was left behind). BPA recreates the actions of specific blood shedding events with reasonable certainty based on measurements and understanding of the scientifically understood behavior of blood, not supposition or inference. The results of bloodstain pattern analysis are often used to support or confirm the findings of other forensic disciplines used in the case.

How is quality control and quality assurance performed?

To ensure the most accurate analysis of evidence, the management of forensic laboratories puts in place policies and procedures that govern facilities and equipment, methods and procedures, and analyst qualifications and training. Depending on the state in which it operates, a crime laboratory may be required to achieve accreditation to verify that it meets quality standards. There are two internationally recognized accrediting programs in the U.S. focused on forensic laboratories: The American Society of Crime Laboratory Directors Laboratory Accreditation Board (<http://www.ascl-d-lab.org/>) and ANSI-ASQ National Accreditation Board / FQS (<http://fqsforensics.org/>).

In bloodstain pattern analysis, quality control is achieved through proper training and competency testing for analysts, as well as technical review and verification of conclusions. Technical review and verification involves an expert or peer who reviews the data, methodology and results to validate or refute the outcome. This review encompasses the analysis and observations, laboratory work, tests and experiments, bench notes and written reports. The percentage of cases that undergo verification may vary depending on the experience of the analyst. In addition, defense attorneys may hire

independent BPA analysts to review and reexamine questioned evidence to ensure accuracy of the findings.

SWGSTAIN publishes Guidelines for a Quality Assurance Program in Bloodstain Pattern Analysis (http://www.fbi.gov/about-us/lab/forensic-science-communications/fsc/jan2008/standards/2008_01_standards02.htm/) on their website.

What information does the report include and how are the results interpreted?

Reports will vary from jurisdiction to jurisdiction; however, SWGSTAIN maintains recommended standard operating procedures for final reports. According to these guidelines (<http://www.swgstain.org/resources>), reports should ideally contain:

Items of evidence or materials evaluated (usually photographs or diagrams and other reports)

- Observations and results of the analysis
- Conclusions and opinions of the analyst
- Definitions of terminology used in the report
- Brief summary of the case
- Description and results of any experiments conducted

Conclusions and opinions of the analyst typically include information about how the stains were formed and the approximate position of the victim (standing, sitting, lying on the floor, etc.). Photographs and diagrams included in the report serve to illustrate the location and pattern of the stains and, where known, the relative positions of the victim and perpetrator.

In most cases, the analyst will be prepared to testify in court regarding the results.

Are there any misconceptions or anything else about bloodstain pattern analysis that would be important to the non-scientist?

Bloodstain pattern analysis is not a recent field of study; it has been around since the late 1800s. In 1895, Dr. Eduard Piotrowski of the Institute of Forensic Medicine in Krakow, Poland, published a paper on bloodstain pattern analysis titled **CONCERNING ORIGIN, SHAPE, DIRECTION AND DISTRIBUTION OF BLOODSTAINS FOLLOWING HEAD WOUNDS CAUSED BY BLOWS**. Dr. Piotrowski performed experiments using live rabbits, white

paper and a variety of instruments including rocks, hammers and hatchets to better understand how bloodstains are created and what information could be gleaned from their study.

Misconception: Blood spatter tells the whole story

Television crime dramas paint bloodstain analysts as being able to tell investigators everything that occurred at a crime scene based solely on a few blood splashes or spatters. This is far from the truth. As discussed earlier, BPA cannot produce a playback of the entire crime. Bloodstains tell analysts, with reasonable certainty, what happened at specific moments in time corresponding to each useable stain. In some cases, the bloodstains are too few or the volume of blood is too great for analysts to reasonably render any opinion on the causes of the stains.

Common Terms

Blood pattern analysts use a number of terms to describe bloodstains, how they behave and the methodology of examining a scene for blood evidence. The glossary terms below are from the Scientific Working Group on Bloodstain Pattern Analysis (SWGSTAIN) (<http://www.swgstain.org/>).

Angle of Impact - The angle at which a blood drop strikes a surface.

Area of Convergence - The area containing the intersections generated by lines drawn through the long axes of individual stains that indicates in two dimensions the location of the blood source.

Area of Origin - The three-dimensional location from which blood spatter originated.

Backspatter Pattern - A bloodstain pattern resulting from blood drops that traveled in the opposite direction of the external force applied; associated with an entrance wound created by a projectile.

Blood Clot - A gelatinous mass formed by a complex mechanism involving red blood cells, fibrinogen, platelets, and other clotting factors.

Bloodstain - A deposit of blood on a surface.

Bloodstain Pattern - A grouping or distribution of bloodstains that indicates through regular or repetitive form, order, or arrangement the manner in which the pattern was deposited.

Bubble Ring - An outline within a bloodstain resulting from air in the blood.

Cast-off Pattern - A bloodstain pattern resulting from blood drops released from an object due to its motion.

Cessation Cast-off Pattern - A bloodstain pattern resulting from blood drops released from an object due to its rapid deceleration.

Drip Pattern - A bloodstain pattern resulting from a liquid that dripped into another liquid, at least one of which was blood.

Drip Stain - A bloodstain resulting from a falling drop that formed due to gravity.

Drip Trail - A bloodstain pattern resulting from the movement of a source of drip stains between two points.

Edge Characteristic - A physical feature of the periphery of a bloodstain.

Expiration Pattern - A bloodstain pattern resulting from blood forced by airflow out of the nose, mouth, or a wound.

Flow Pattern - A bloodstain pattern resulting from the movement of a volume of blood on a surface due to gravity or movement of the target.

Forward Spatter Pattern - A bloodstain pattern resulting from blood drops that traveled in the same direction as the impact force.

Impact Pattern - A bloodstain pattern resulting from an object striking liquid blood.

Luminol ($C_8H_7N_3O_2$) - is a versatile chemical that exhibits chemiluminescence, with a striking blue glow, when mixed with an appropriate oxidizing agent. Luminol is used by forensic investigators to detect trace amounts of blood left at crime scenes as it reacts with iron found in hemoglobin.

Mist Pattern - A bloodstain pattern resulting from blood reduced to a spray of micro-drops as a result of the force applied.

Parent Stain - A bloodstain from which a satellite stain originated.

Perimeter Stain - An altered stain that consists of the peripheral characteristics of the original stain.

Plasma - The clear, yellowish fluid portion of blood.

Platelet - An irregularly shaped cell-like particle in the blood that is an important part of blood clotting. Platelets are activated when an injury causes a blood vessel to break. They change shape from round to spiny, "sticking" to the broken vessel wall and to each other to begin the clotting process.

Pool - A bloodstain resulting from an accumulation of liquid blood on a surface.

Projected Pattern - A bloodstain pattern resulting from the ejection of a volume of blood under pressure, such as a spurt or spray.

Satellite Stain - A smaller bloodstain that originated during the formation of the parent stain as a result of blood impacting a surface.

Saturation Stain - A bloodstain resulting from the accumulation of liquid blood in an absorbent material.

Serum Stain - The stain resulting from the liquid portion of blood (serum) that separates during coagulation.

Spatter Stain - A bloodstain resulting from a blood drop dispersed through the air due to an external force applied to a source of liquid blood.

Spines - A bloodstain feature resembling spokes or rays emanating out from the edge of a blood drop; they result from the drop contacting a non-smooth surface.

Splash Pattern - A bloodstain pattern resulting from a volume of liquid blood that falls or spills onto a surface.

Swipe Pattern - A bloodstain pattern resulting from the transfer of blood from a blood-bearing surface onto another surface, with characteristics that indicate relative motion between the two surfaces.

Transfer Stain - A bloodstain resulting from contact between a blood-bearing surface and another surface.

Void - An absence of blood in an otherwise continuous bloodstain or bloodstain pattern.

Wipe Pattern - An altered bloodstain pattern resulting from an object moving through a preexisting wet bloodstain.

Resources & References

You can learn more about this topic at the websites and publications listed below.

Resources

Scientific Working Group on Bloodstain Pattern Analysis (SWGSTAIN)
(<http://www.swgstain.org/>)

International Association of Bloodstain Pattern Analysts (IABPA)
(<http://iabpa.org/>)

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Acknowledgments

The authors wish to thank the following for their invaluable contributions to this forensic guide:

Paul E. Kish, *Owner*, Forensic Consultant and Associates

Alistair Ross, *Director*, National Institute of Forensic Science at Australia
New Zealand Policing Advisory Agency

Edmund (Ted) Sileniaks, *Evidence Recovery Coordinator*, Forensic Science
South Australia

John P. Black, **CLPE**, **CFWE**, **CSCSA**, *Senior Consultant*, Ron Smith and
Associates

Brian Dew, **CLPE**, *Consultant*, Ron Smith and Associates

Forensic Evidence Admissibility and Expert Witnesses

How or why some scientific evidence or expert witnesses are allowed to be presented in court and some are not can be confusing to the casual observer or a layperson reading about a case in the media. However, there is significant precedent that guides the way these decisions are made. Our discussion here will briefly outline the three major sources that currently guide evidence and testimony admissibility.

The *Frye* Standard – Scientific Evidence and the Principle of General Acceptance

In 1923, in *Frye v. United States*^[1], the District of Columbia Court rejected the scientific validity of the lie detector (polygraph) because the technology did not have significant general acceptance at that time. The court gave a guideline for determining the admissibility of scientific examinations:

*Just when a scientific principle or discovery crosses the line between the experimental and demonstrable stages is difficult to define. Somewhere in this twilight zone the evidential force of the principle must be recognized, and while the courts will go a long way in admitting experimental testimony deduced from a well-recognized scientific principle or discovery, the thing from which the deduction is made must be **sufficiently established to have gained general acceptance** in the particular field in which it belongs.*

Essentially, to apply the “*Frye* Standard” a court had to decide if the procedure, technique or principles in question were generally accepted by a meaningful proportion of the relevant scientific community. This standard prevailed in the federal courts and some states for many years.

Federal Rules of Evidence, Rule 702

In 1975, more than a half-century after *Frye* was decided, the Federal Rules of Evidence were adopted for litigation in federal courts. They included rules on expert testimony. Their alternative to the *Frye* Standard came to be used more broadly because it did not strictly require general acceptance and was seen to be more flexible.

The first version of Federal Rule of Evidence 702 provided that a witness who is qualified as an expert by knowledge, skill, experience, training, or education may testify in the form of an opinion or otherwise if:

[1] 293 Fed. 1013 (1923)

- a. the expert's scientific, technical, or other specialized knowledge will help the trier of fact to understand the evidence or to determine a fact in issue;
- b. the testimony is based on sufficient facts or data;
- c. the testimony is the product of reliable principles and methods; and
- d. the expert has reliably applied the principles and methods to the facts of the case.

While the states are allowed to adopt their own rules, most have adopted or modified the Federal rules, including those covering expert testimony.

In a 1993 case, *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, the United States Supreme Court held that the Federal Rules of Evidence, and in particular Fed. R. Evid. 702, superseded *Frye's* "general acceptance" test.

The *Daubert* Standard – Court Acceptance of Expert Testimony

In *Daubert* and later cases^[2], the Court explained that the federal standard includes general acceptance, but also looks at the science and its application. Trial judges are the final arbiter or "gatekeeper" on admissibility of evidence and acceptance of a witness as an expert within their own courtrooms.

In deciding if the science and the expert in question should be permitted, the judge should consider:

- What is the basic theory and has it been tested?
- Are there standards controlling the technique?
- Has the theory or technique been subjected to peer review and publication?
- What is the known or potential error rate?
- Is there general acceptance of the theory?
- Has the expert adequately accounted for alternative explanations?
- Has the expert unjustifiably extrapolated from an accepted premise to an unfounded conclusion?

The *Daubert* Court also observed that concerns over shaky evidence could be handled through vigorous cross-examination, presentation of contrary evidence and careful instruction on the burden of proof.

In many states, scientific expert testimony is now subject to this *Daubert* standard. But some states still use a modification of the *Frye* standard.

[2] The "Daubert Trilogy" of cases is: **DAUBERT V. MERRELL DOW PHARMACEUTICALS, GENERAL ELECTRIC CO. V. JOINER** and **KUMHO TIRE CO. V. CARMICHAEL**.

Who can serve as an expert forensic science witness at court?

Over the years, evidence presented at trial has grown increasingly difficult for the average juror to understand. By calling on an expert witness who can discuss complex evidence or testing in an easy-to-understand manner, trial lawyers can better present their cases and jurors can be better equipped to weigh the evidence. But this brings up additional difficult questions. How does the court define whether a person is an expert? What qualifications must they meet to provide their opinion in a court of law?

These questions, too, are addressed in **Fed. R. Evid. 702**. It only allows experts “qualified ... by knowledge, skill, experience, training, or education.” To be considered a true expert in any field generally requires a significant level of training and experience. The various forensic disciplines follow different training plans, but most include in-house training, assessments and practical exams, and continuing education. Oral presentation practice, including moot court experience (simulated courtroom proceeding), is very helpful in preparing examiners for questioning in a trial.

Normally, the individual that issued the laboratory report would serve as the expert at court. By issuing a report, that individual takes responsibility for the analysis. This person could be a supervisor or technical leader, but doesn't necessarily need to be the one who did the analysis. The opposition may also call in experts to refute this testimony, and both witnesses are subject to the standard in use by that court (*Frye, Daubert*, Fed. R. Evid 702) regarding their expertise.

Each court can accept any person as an expert, and there have been instances where individuals who lack proper training and background have been declared experts. When necessary, the opponent can question potential witnesses in an attempt to show that they do not have applicable expertise and are not qualified to testify on the topic. The admissibility decision is left to the judge.

Additional Resources

Publications:

Saferstein, Richard. **CRIMINALISTICS: AN INTRODUCTION TO FORENSIC SCIENCE**, Pearson Education, Inc., Upper Saddle River, NJ (2007).

McClure, David. Report: Focus Group on Scientific and Forensic Evidence in the Courtroom (online), 2007,

<https://www.ncjrs.gov/pdffiles1/nij/grants/220692.pdf> (accessed July 19, 2012)

Acknowledgements

The authors wish to thank the following for their invaluable contributions to this guide:

Robin Whitley, *Chief Deputy*, Appellate Division, Denver District Attorney's Office, Second Judicial District

Debra Figarelli, *DNA Technical Manager*, National Forensic Science Technology Center, Inc.

About This Project

This project was developed and designed by the National Forensic Science Technology Center (NFSTC) under a cooperative agreement from the Bureau of Justice Assistance (BJA), award #2009-D1-BX-K028. Neither the U.S. Department of Justice nor any of its components operate, control, are responsible for, or necessarily endorse, the contents herein.

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