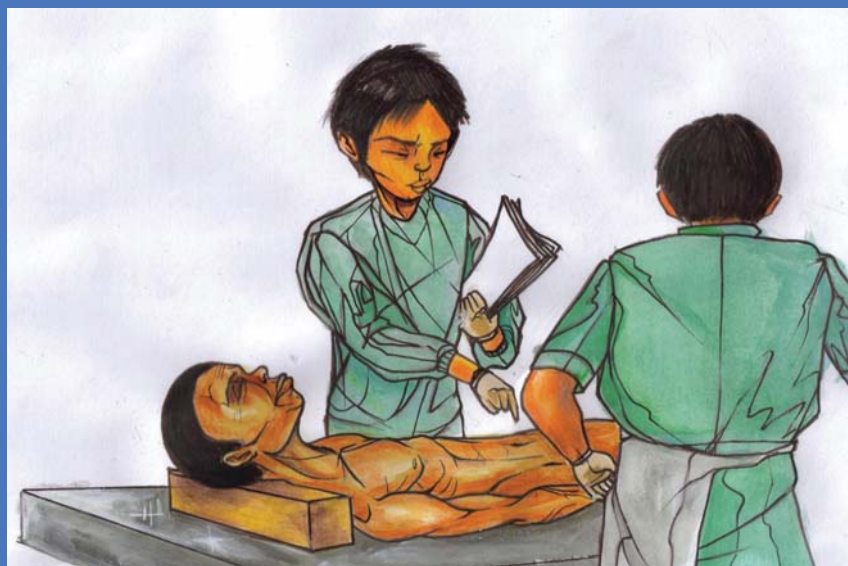


# Practical Manual for the Forensic Investigation of Human Rights Violations





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Chapter I  
Introduction to Forensic  
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# INTRODUCTION

## What is Forensic Science?

Forensic science consists of a large group of scientific disciplines—including pathology, physical anthropology, archaeology, biology, chemistry, ballistics, etc.—that are applied to the study of crimes and the circumstances surrounding them. These disciplines systematically collect and analyze evidence to establish facts that can be presented in legal proceedings.

Forensic science may be used to investigate criminal acts in violation of domestic law—like burglary, arson or murder—as well as those cases that involve violations of international law.

Though this manual focuses on two special types of crimes, extrajudicial executions and forced disappearances, the basic forensic principles detailed in these pages can be applied to any forensic investigation.



# INTERNATIONAL HUMANITARIAN LAW & HUMAN RIGHTS LAW

International human rights law (IHRL) and international humanitarian law (IHL) are complementary bodies of law that provide for the protection of human life and dignity in all circumstances, both during times of peace and war. For its part, international human rights law establishes the minimum rights protections that all people enjoy by virtue of being human. Though states may suspend certain human rights during war or emergency situations, a core set of inalienable rights—including the right to life, freedom from torture and degrading treatment, and the right to recognition before the law—can never be infringed upon.

International humanitarian law, on the other hand, governs hostilities during times of armed conflict. As a result, it can never be suspended due to war or states of emergency arising from armed conflict, since it was specifically designed for those situations. IHL imposes rules on warfare to keep conflicts from getting to a point where reconciliation between the warring parties becomes impossible. It does this by providing for the protection of non-combatants and by restricting methods of warfare that cause unnecessary suffering and destruction.

## International Human Rights Law

Provides minimum rights protections

Inherent to every human

Permits governments to limit certain rights in conflict situations

## International Humanitarian Law

Applies specifically to armed conflicts

Protects non-combatants and restricts methods of warfare

No deviations are permitted since it was created for conflict situations

# WHAT IS AN EXTRAJUDICIAL EXECUTION?

An extrajudicial execution is the deliberate and unjustified killing of a person by agents of the state, or by agents supported by the state, acting outside of the legal system.

Extrajudicial executions should not be confused with the death penalty, with homicides committed by state agents acting outside of their official duties, or with cases in which state agents kill someone in self-defense or in a proportional use of force.

Under international humanitarian law, extrajudicial executions also occur in the context of war when combatants kill a person who is not participating directly in the hostilities, such as civilians, wounded or surrendering combatants and prisoners of war.



## WHAT IS A FORCED DISAPPEARANCE?

“Forced disappearance is considered to be the arrest, detention, abduction or any other form of deprivation of liberty by agents of the State or by persons or groups of persons acting with the authorization, support or acquiescence of the State, followed by a refusal to acknowledge the deprivation of liberty or by concealment of the fate or whereabouts of the disappeared person, which place such a person outside the protection of the law.”  
International Convention For The Protection Of All Persons From Enforced Disappearance, Article II

A forced disappearance is the deprivation of liberty by agents of the State, or by agents supported by the State, followed by the concealment of the fate or whereabouts of the victim.

Forced disappearance is understood as a multi-offensive crime since it violates a number of fundamental rights protections, including the right to liberty and security of person, the right to recognition as a person before the law, the right to legal defense and the right not to be subjected to torture or cruel and degrading treatment.



A forced disappearance is not resolved until the victim is set free or his or her body is found. Therefore, it is a crime that has no defined time limits. As a result, forced disappearances not only affect the missing persons but also their relatives who wait for their return. Though the disappeared are presumably dead, their family members often live in a suspended state of uncertainty due to the unknown fate of their loved ones.

# NON-STATE ACTORS, EXTRAJUDICIAL EXECUTIONS AND FORCED DISAPPEARANCES

Under IHRL, States may also be held responsible for killings committed by non-state actors if States do not act with due diligence to prevent, deter and punish perpetrators of those crimes. According to IHRL, States must not only refrain from violating individuals' right to life but they also have a positive obligation to protect the enjoyment of that right. If non-state actors engage in a pattern of killings and the State responds inadequately to stop those killings, a State's responsibility is engaged. Such cases may occur, for example, when States refrain from intervening to stop so-called "honor killings," or killings against vulnerable groups such as homosexuals, ethnic and religious minorities, or labor unions and other professions that may be subject to extortion<sup>1</sup>.

In situations involving internal armed conflicts of a non-international character, proscriptions against extrajudicial executions and forced disappearances under IHL also apply to armed groups and non-state actors that operate under a responsible command and control sufficient territory that enables them to carry out sustained and concerted military operations<sup>2</sup>. Rebels or armed opposition groups that meet this threshold are, therefore, considered responsible for complying with the standards laid out in international humanitarian law, which include prohibitions against violence to the life and well-being of those that take no part, or have ceased to take part, in hostilities.

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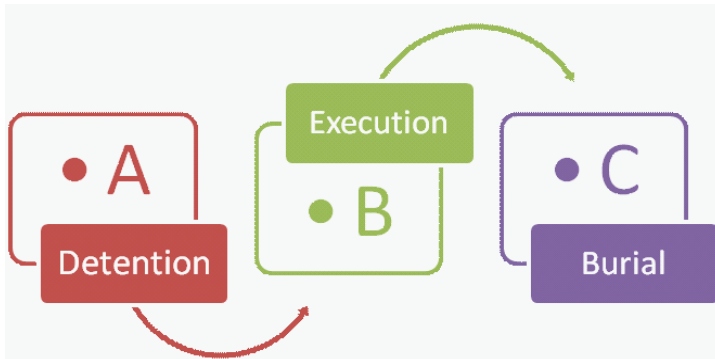
1 "Killings by Non-State Actors and Affirmative State Obligations," UN Special Rapporteur on Extrajudicial Executions Handbook, p. 4, para. 71. Available at <http://www.extrajudicialexecutions.org/application/media/Handbook%20Chapter%203-Responsibility%20of%20states%20for%20non-state%20killings.pdf>

2 Article 1(1), Protocol Additional to the Geneva Conventions of 12 August 1949, and relating to the Protection of Victims of Non-International Armed Conflicts (Protocol II), 8 June 1977.

# PATTERNS IN EXTRAJUDICIAL EXECUTIONS AND FORCED DISAPPEARANCES

In general terms, extrajudicial executions often follow a linear pattern in which the victim is targeted and executed in the same place. Extrajudicial executions are frequently committed in a public manner with little or no effort to conceal the crime, since its purpose is often to send a political message or warning to the victim's cohorts or society at large.

Forced disappearances, on the other hand, are complex crimes in which the victim may be conducted through a circuit of clandestine detention centers in order to deny them access to legal recourse and protection from the law. In many cases, the victim is ultimately executed and disposed of at an undisclosed location. As a result, forced disappearances tend to follow a non-linear pattern. For example, the victim may be detained at Point A, transferred to Point B for interrogation, executed at Point C and then taken to Point D for burial. In more complex cases, the remains may even be disinterred and moved to a second burial site at point E.



The patterns that characterize extrajudicial executions and forced disappearances should be taken into account when formulating strategies for an investigation so that the investigators do not miss any important evidence that could help to clarify the case. Based on

the previous example, what would happen if we tried to conduct an investigation only from point A (detention) or point D (burial)? We would have an incomplete view of what happened, since each point represents only one phase of the crime.

The complex nature of these crimes underline the importance of carrying out complementary, multidisciplinary investigations that can shed light on the crime and the people that we are looking for. Concentrating the investigation on only one facet of the crime (a clandestine gravesite, for example) does not necessarily help to identify the victims who are in the grave or help to explain the reasons that they are buried there. Therefore, it is necessary for investigators to collect all of the available information on a crime and then enlist the help of specialists from different fields in order to develop a better understanding of what took place.

# MULTI-DISCIPLINARY APPROACH TO FORENSIC INVESTIGATIONS

As we have seen, forensic investigations can deal with different kinds of evidence and complex questions. Thus, cooperation is needed between different branches of forensic science to reconstruct the events of a crime.

Different forensic disciplines may contribute specialized knowledge and techniques to a criminal investigation. Forensic pathologists, for example, can determine the cause of death of a recently deceased person, but their knowledge about skeletal remains is limited. If investigators find a highly decomposed body, forensic anthropologists may intervene to estimate the sex and age of the human skeleton, but they must rely on forensic entomologists to identify the stages of insect development on the remains in order to determine the amount of time that has passed since the person's death. Likewise, the analysis of other kinds of evidence found in a crime scene—like bullets and bullet casings, fingerprints or liquids and chemical substances—will require the participation of different experts with specializations in those particular fields.





## OTHER ACTORS INVOLVED IN THE PROCESS

When investigating crimes against IHL and IHRL, we deal with complex scenarios that involve many different actors, such as forensic experts, prosecutors, judges, the relatives of the victims and civil society at large. These investigations are conducted within a larger process that searches not only to solve the crime but also to strengthen the rule of law, restore the victims' dignity and identity, and hold perpetrators accountable for their crimes. The role of the forensic expert, while scientific and objective at all times, is part of the effort to reach these higher goals.

### The Role of the Victim's Family within the Investigative Process

There are three things that we need to keep in mind to understand the role that the victim's family plays in the investigation.

First, due to the intimate knowledge that they possess of the victim, they can contribute valuable information to the investigation about the victim's appearance and physical characteristics, the events leading up to the crime, the victim's whereabouts and possible perpetrators.

Second, as relatives of the victim, they have the right to know what happened to their loved one. Out of respect for this right, investigators have the obligation to keep the victim's family members informed about the investigation's progress throughout the entire process.

And, third, the investigation is a deeply emotional process for the family of the victim and will often require them to recall painful details about their loved one's death or disappearance. Therefore, the investigation must be conducted with utmost care and sensitivity to their psychological and emotional wellbeing. When possible, psychosocial services should be provided to the victim's family so that they can process their grief as the investigation advances. In the end, a forensic investigation helps to solve a criminal case, but

it also responds to a humanitarian need on the part of the family to know what happened to their loved one and to recover their remains. An investigation that fails to keep this in mind can end up harming the victim's family even more than it can help them. Therefore, it is essential that forensic experts keep the victim's family informed and make sure they have realistic expectations for each phase of the investigation. We will elaborate more on these points in the following chapter.



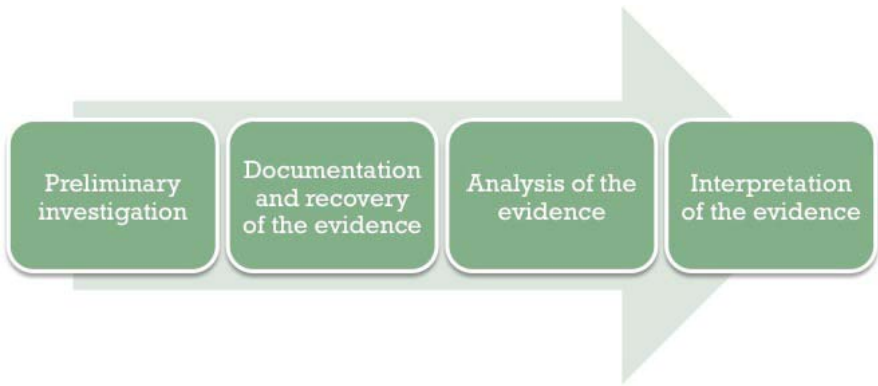
The forensic team explains the investigative process to the families of the victims during the investigation of a massacre.



Family members search through clothing recovered from a mass grave in order to help identify the victims.

# STEPS OF A FORENSIC INVESTIGATION

Now that you are familiar with the types of crimes that this manual will focus on, take a look at the following graphic that shows the steps in a forensic investigation. In the chapters that follow, we will describe each of these steps in greater detail.





## Chapter II

# Preliminary Investigation



# PRELIMINARY INVESTIGATION

At the beginning of a forensic investigation, we must collect all the information we can about the crime in order to better understand what happened, who the victims were and who the perpetrators may have been. This information will then help us to define our strategy for how to approach the investigation.

## Sources of Information

Forensic investigators must look for all possible sources from which they can find relevant information about the crime they are investigating. These sources may be broken down into three general categories:

- **Oral testimonies** collected from the witnesses to the crime, as well as the victim's family and friends.
- **Open sources** to which everyone has access, like print and digital media, television news coverage, reports from human rights organizations, Truth Commission reports, maps and public documents.
- **Closed sources** are classified or restricted documents, such as police reports, military files or court records, that require special permission to view.

The first source of information that should be collected as a part of the investigation is the oral testimony that the victim's family, friends and witnesses to the crime can provide. This information gives us a first impression of what could have happened to the victim and can contribute important details that will allow us to determine the timeframe in which the crime occurred, locate sites associated with the crime, identify other witnesses and search for suspects who may have been involved.

In many cases, the police officers that first arrive at the scene of the crime will collect witness testimony and take statements from the

victim's friends and family. However, forensic investigators should conduct their own interviews of these people in order to corroborate the information in the original reports and deepen their understanding of the circumstances surrounding the crime.



Investigators conduct interviews with victims' family, friends and with witnesses of the crime.

Keep in mind that in conflict or post-conflict societies many people lose confidence in institutions and may be reluctant to share sensitive information about human rights crimes. Therefore, it is essential that investigators make every effort to gain their trust before attempting to take their testimony. It is important to remember, however, that this relationship of trust is not just a tool that investigators use as a means to obtain information. Due to the very real impact that the outcome of the investigation can have on their lives, investigators must assume a commitment to those who are courageous enough to share sensitive information with us. As a part of that commitment, we should be honest with them at all times about what the investigation will require from them and what they can expect from the investigative process.

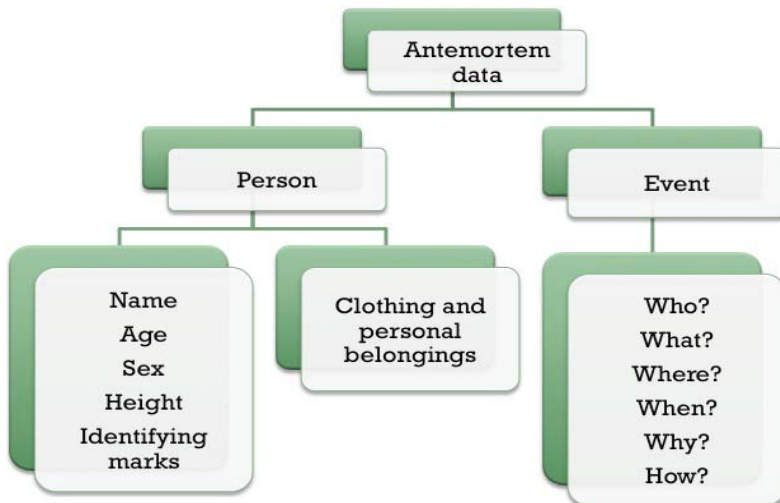


# COLLECTION OF ANTEMORTEM DATA

In cases of forced disappearance, we are looking for people who are missing. To get a better picture of the people we are searching for, we need to collect detailed descriptions of who they were, what they looked like and what they may have been wearing at the time of their disappearance. The best way to do this is by interviewing the people who knew the victims best: their friends, family and anyone who may have seen them before they disappeared.

The information we collect through these interviews is called **antemortem data** since it provides specific details about the victim prior to their death or disappearance. Once we have conducted a forensic investigation of a gravesite that we suspect contains the victim's remains, we can compare this antemortem data to the postmortem analysis of the remains we recovered. If the antemortem data and the postmortem data match, we can make a possible identification of the victim.

As illustrated in the following graph, antemortem data can help investigators collect information on the victim, but it can also provide important information on the events related to the crime:



# The Antemortem Interview

Investigators collect antemortem data on victims of forced disappearance through antemortem interviews with the family and friends who knew them best. Investigators use the questions on an **Antemortem Form** to give structure to the interview. An Antemortem Form is a tool for forensic investigation that includes a group of very specific questions about the victim and the crime. It is designed as a guide for the interview, though investigators are by no means limited to recording information that strictly corresponds to the questions on the form. Rather, investigators allow the interviewees to take their time and elaborate on each question as much as they see fit. Often, details that do not seem relevant to the case can trigger important memories about either the victim or the events leading up to the crime. Any important information provided by the interviewee that does not coincide with the questions on the form should be noted in the margins.



A forensic expert conducts an antemortem interview prior to the investigation of a burial site.

As mentioned above, the investigators need to establish a relationship of trust with the interviewee before beginning the antemortem interview. As a result, it is important to conduct the interview in a place

where the interviewee feels safe and secure. The interview should also be conducted in the interviewee's native language to facilitate communication and create a more relaxed environment. Therefore, it is essential that the investigator conducting the interview be capable of fluid, effective communication in the interviewee's language. This means understanding the cultural context of the language and possessing the ability to transmit questions in a clear way and register the answers in full detail.

The interviewees, who are usually close friends and relatives of the victims, are often acutely affected by revisiting painful memories related to their loved one's death or disappearance. To make this process less painful, it is important to clearly explain to them the purpose of the antemortem interview, the types of questions that will arise during the interview and how the information they provide will be used in the investigation. Throughout the interview, the investigator must also treat the interviewee with respect and allow them time to process their memories and tell their story. Many people who come forward with information on the disappeared often do so with the need to tell their story in order to make sure that the memory of their loved one is not forgotten. An antemortem interview, therefore, can be understood as an intersection between the things that the investigator needs to know for the investigation and the things that the interviewee needs to tell.

The antemortem interview can last well over an hour, in which case it is important to take a break if either the interviewee or investigator feels tired or overwhelmed with emotion.

Keep in mind that the interviewee's memory of the disappeared person becomes increasingly distant as time passes. The interviewee may have also repressed certain details of the crime as a mechanism for dealing with the pain that recalling those memories can generate. In order to help them remember those details, investigators will need to reframe certain questions in a way that may trigger the interviewee's memory. For example, consider the following scenario: An interviewee

describes her son as an accomplished athlete that participated competitively in sports up until the time of his disappearance. However, when the investigator asks if her son ever experienced any injuries, the interviewee says ‘no’ without giving it much thought. Instead of recording this response on the antemortem form, the investigator decides to reframe the question. “Do you ever remember a time when your son may have had to sit out of a game or a tournament due to injury?” Now that the investigator has related the question to actual events in her son’s life, the interviewee gives the question more consideration and, indeed, recalls that her son missed an entire season of basketball due an injury he suffered while riding a horse. This example highlights the importance of listening carefully to the interviewee’s stories. Even those details that seem irrelevant to the investigation—like the fact that this particular victim was an accomplished athlete—may be helpful in constructing a more complete profile of the victim and the crime.



### **Processing the emotions that arise from the antemortem interview**

Just as the antemortem interview can be emotionally difficult for the family and friends of the victim, it can also take a heavy toll on the investigator who conducts the interviews. Through the antemortem data collection process, it is likely that the investigator will be emotionally impacted by the events discussed and may even develop defense mechanisms that gradually lead him or her to become desensitized to the pain of others. As a result, it is important that interviewers have regular access to psychosocial support so that they

can process these emotions with the help of a trained professional. Of course, it is also important to provide similar services to the interviewee. Psychosocial accompaniment is an important source of support for the family and friends of the victim that collaborate with the investigation and should be included in every step of the process. While it is not in the investigators' direct responsibility, the inclusion of professionals in this area should be contemplated as part of the strategy for each investigation.

### **What information does an Antemortem Form contain?**

The Antemortem Form contains a set of highly detailed questions about the disappeared person, which are tailored to the specific social, political and cultural context of the country or region where the crime occurred. Since the details that can help to identify a person or describe the events of a crime vary greatly between regions, the Antemortem Form must reflect local terms for articles of clothing, traditional dress, political institutions and geographic references to name a few. In the Peruvian highlands, for example, the landscape, climate, language, culture and clothing of the people that inhabit the area is completely different to those who live in the tropical rainforests of the country's Amazon river basin. If we developed a single Antemortem Form to use in both regions, we would run the risk of losing out on valuable, context-specific information that could be important to identifying victims or reconstructing the events of the crime. For that reason, it is always important to design an Antemortem Form for the specific context in which it will be used.

The following details should be included in an Antemortem Form:

1. Information related to the interviewee, such as the person's name, contact information, relation to the victim and details about the last time the interviewee saw the victim before they disappeared.
2. General information about the victim, such as the victim's name, sex and age at the moment of the disappearance. This information is important for identification since the analysis of the victim's remains

can corroborate the individual characteristics of the victim that were recorded on the form. It is important to keep in mind that, for some people and cultures, the victim's age may not be registered on a calendar but rather gauged based on other markers of time. For example, a mother may report that her daughter was born during the rainy season right before the death of a popular political leader. In order to estimate the victim's approximate age, the investigator will need to find information that corroborates the year in which the political leader died and then find out during which months the rainy season occurs in that particular region. Other information, such as the victim's marital status, profession, address, place of work or school can help to determine where more information may be found about the victim.

3. Information about the victim's relatives—their names, kinship and contact information—can be useful in locating other people that can give testimony about the missing person. This information can also help to establish genealogies in the case that DNA analysis might be required to identify the victim. For this reason, investigators will need to confirm whether the kinship information that the interviewee provides is based on biological relationships, since in many cultures words like father, mother, uncle, aunt, brother and sister are used to reflect social relationships as well.

4. Information about the circumstances of the disappearance. This entails creating a detailed story of the events leading up to the disappearance of the victim and asking specific questions regarding the date, time, and place of the crime, along with possible burial sites where the victim's remains may be found.

In an interview of an actual witness to the detention or kidnapping of the victim, it is important to record whether the victim suffered any type of physical abuse during, or prior to, the abduction (including details of wounds, injuries or broken bones); who abducted the victim and how it happened; if the abductors were associated with a group and whether they had any recognizable features, clothing, weapons, or insignia; the names and contact information of other potential

witnesses; and any other information that might be relevant to the investigation.

In the case that the interviewee has seen or heard of the victim after his or her abduction, it is important to record the last time that the interviewee saw or knew about the victim; when and where the witness saw the victim; and if there are any other witnesses that may be able to provide more details about the victim's whereabouts.

If the interviewee knows, or suspects he knows, where the victim is buried, the burial site should be record with precision, clearly indicating if other victims are buried in the site and who they might be.

It is also important to register the steps that the interviewee has taken to search for the missing person. For example, whether anyone has searched for the victim in local morgues, police stations or army bases; if anyone has filed a legal complaint; if that person was harassed after submitting the complaint; if the interviewee believes that the victim could still be alive; and where he or she could be found.

5. Detailed descriptions of the clothes and personal effects that the victim was wearing at the time of his or her disappearance. Instead of simply recording that the victim wore a "red shirt", the interviewee should be encouraged to remember more specific details like, "He wore a short-sleeved red shirt with embroidered blue flowers on the neck and a patch of the same material sewn by hand on the back." Detailed descriptions like these increase the likelihood of making a positive identification of the victim's remains.



6. The physical features of the missing person, such as height, weight, handedness (right-handed, left-handed or ambidextrous), hair color and any unique features on the skin (including scars, tattoos, moles and birthmarks). This information should also include descriptions of any accidents and illnesses that the victim may have suffered during his or her lifetime. Recording this information is important since accidents and illnesses often leave marks on the bones that forensic anthropologists can detect during the analysis of the victim's remains. Sometimes an interviewee may not be able to recall the specific name of the illness that the victim suffered from, in which case the investigator should ask the interviewee to describe the symptoms of the disease.

7. The dental features of the missing person. The victim's teeth provide some of the most important information for identification, since their condition will continue to be preserved for many years after death. These details include: the size, color and wear of the teeth; the presence of lost or broken teeth; and any special dental features, such as twisted, crowded or gapped teeth. Since the interviewee may have trouble remembering these details, some of the questions on the Antemortem Form seek to establish possible features of the victim's teeth by other means. For example, the form asks interviewees if the victim used to complain of a toothache, since this information could indicate a possible dental infection. Another question asks if the victim was a habitual smoker, since this might indicate that the victim had discolored teeth.





## **Limitations of memory and its impact on antemortem data collection**

Investigators should be aware that interviewees have a natural tendency to idealize the victim in their memory. As a result, investigators may get a somewhat distorted picture of the victim's physical features. For example, the mother of a disappeared person may remember that her son was much taller and muscular than he actually was in real life. Others may remember that the victim had a perfect set of teeth and a spotless medical record, when in truth the victim may have had several cavities and made more than a few trips to the local hospital for scrapes, bruises and broken bones. Despite the undeniable importance of this information for the identification of the victim, it is important to remember that these details depend on the interviewee's memory and, in the absence of corroborating medical records, they must not be taken as irrefutable fact. This also holds true for the testimony of witnesses to the crime. Sometimes, due to the chaotic way in which they experienced the events of the crime, there may be significant holes in their memory or contradictions that may only become apparent when compared to the testimony of others.

Due to the limitations of memory, these mistakes are common. However, they do not necessarily invalidate the entire testimony. It is best to think of data from antemortem interviews as information that helps to construct a picture of the disappeared person and the circumstances of the crime. Whenever possible, it is important to complete that picture with information from other sources, including interviews with other relatives or witnesses, photographs of the victim and the victim's dental and medical records. The more information you gather, the more complete your understanding of the case will be.

## An Antemortem Database

The search for the disappeared requires strategies that go beyond a case-by-case approach. Though every case is different, testimonies, victims and burial sites can be related in ways that are not always visible at first sight. For this reason, it is important that antemortem information is included in a database that allows investigators to cross-reference data and establish patterns between crimes.

An antemortem database that is used to assist in identifying victims should include searchable categories for specific injuries, physical traits and details about the victim's clothing and personal effects. Details regarding the perpetrators and the crime itself should also be included, since they can help to identify common patterns indicative of systematic crimes. We must keep in mind, however, that databases do have their limitations. For example, even if we have a complete set of information on a victim and the crime, a simple search in the database will never be able to solve the case and make a positive identification of the victim. Rather, the antemortem database must be seen as one more tool that can assist the experts in finding the information they need to draw their own conclusions.

## SITE ASSESSMENT

For cases of forced disappearances involving clandestine gravesites, the site assessment is another important part of the preliminary investigation. Before beginning the recovery of evidence and human remains from a gravesite, an investigator visits the suspected burial site to conduct a survey of the area, corroborate information from the



Forensic experts assess a possible gravesite.

antemortem interviews and witness testimony, and determine the logistical requirements for the investigation. As a part of this process, the investigator takes detailed notes on the size of the area, access routes to the site, characteristics of the terrain, weather conditions, the suspected gravesite and all possible surface evidence.

During the survey of the area, investigators will look for indicators of any suspected gravesites, including: areas with differing soil consistencies; areas where soil has been removed and mixed together; cracks in the soil; abnormal or uneven surfaces in the terrain; changes in vegetation; and areas containing exposed human remains, fragments of clothing and firearm shells.

In order to carry out an adequate inspection, investigators record all relevant observations about the site in their field notebook and photograph the site to document exactly how it was when the investigator arrived on the scene. If there are other sites related to the crime scene, the investigator must also include them in the site assessment. Remember that each site that might include information on the crime should be incorporated in the investigation.

Finally, the site assessment can also help to gather new information for the investigation. For example, investigators can use the site assessment as an opportunity to identify new witnesses in the area, re-interview previous witnesses and relatives of the victim, record places of interest to the investigation and collect new documents that may have emerged since the crime occurred. This information, supported by the visual inspection during the site assessment, can help to create a more complete understanding of the events of the crime and allow investigators to better organize their strategy for the investigation.



Aerial photographs, maps and easy access tools like Google Earth can also be helpful in locating the site of the potential crime scene.

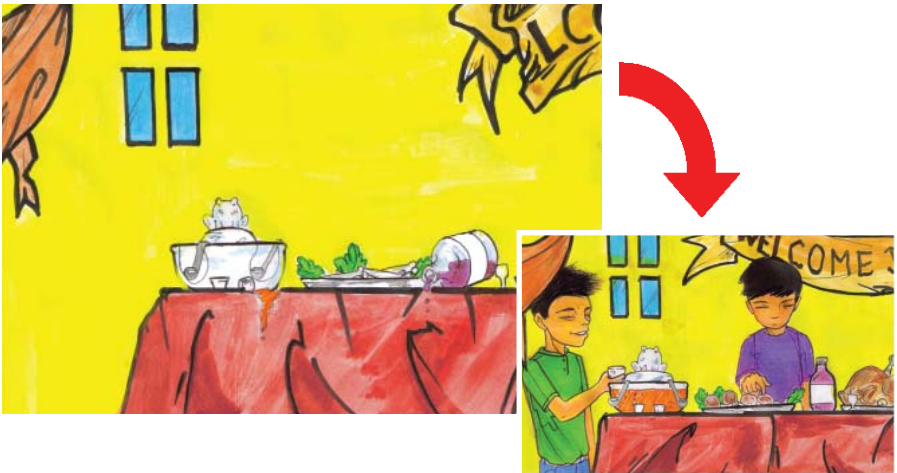
Chapter III  
Documentation and  
Recovery of Evidence



# MATERIAL EVIDENCE

## What is material evidence?

Almost all human activity produces associated material evidence that characterizes it. This “material evidence” appears in the form of objects or modifications in the environment. A careful analysis of material evidence can help to reconstruct the activities that produced it. For example, imagine a room full of empty beverage containers, dirty dishes, streamers and a central table with a cake on it. What does this material evidence tell you about the type of activity that happened in that room? From the material evidence, we can infer that some type of celebration took place. The number of plates and glasses can help us to estimate how many people were present, and their position can give us a sense of the distribution of people within the room.



Material evidence of a crime could be, for example, the gun used in a murder or a piece of cloth that was worn by the killer. However, objects are not the only things that should be considered as material evidence. The marks left by the machine that dug a mass grave, imprints of vehicle tires or shoeprints, and the traces of gunshots on a wall are also examples of material evidence that can be found in the crime scene.

Material evidence is not just “stuff.” Rather, it is fossilized human behavior. The goal of a forensic investigation is to reconstruct and interpret that behavior through the patterns found in the evidence. Often seemingly random occurrences may be found repeatedly throughout a number of crime scenes. By thoroughly documenting these recurrences, investigators can establish that the evidence actually reflects a pattern of intentional behavior. These types of observations can help the investigator to better reconstruct the events of the crime and link suspects or victims to the crime scene.

In order to correctly interpret the events of the crime, it is necessary to carefully and rigorously recover and document the evidence within the crime scene. This does not mean that absolutely everything within the crime scene should be recovered. Rather, investigators must rely on the information they collected during the preliminary investigation to determine what evidence is relevant to the investigation.

To encourage a systematic recovery of the evidence in a way that is consistent from one investigation to the next, it is important that investigators follow a protocol that lays out a set of guidelines, procedures and minimal requirements for the investigative process. This manual—much of which is based on the protocols outlined in the United Nations Manual on the Effective Prevention and Investigation of Extra-Legal, Arbitrary and Summary Executions—has been designed for you to use as a model protocol to direct forensic investigations into violations of IHL and IHRL. Though the focus in these pages is on those particular types of crime, it is important to note once again that the basic procedures for documenting, recovering, analyzing and interpreting evidence presented here can be applied to the investigation of any crime or forensic context.



# DOCUMENTING EVIDENCE IN A CRIME SCENE

Investigators must document evidence throughout every step of the investigation; however, it is particularly important during the recovery of the evidence. If investigators find that they have omitted information from their preliminary investigation, they can often go back to the source of that information and conduct a new interview. If the laboratory analysis of a piece of evidence does not produce results, forensic scientists can run the analysis again. However, once a crime scene has been altered and the evidence recovered, the only way we can go back and revisit the scene is through the documentation we took during the recovery process. As a result, every step of the recovery process should be recorded in as much detail as possible, including written notes, forms, photographs and hand-drawn sketches.

## **Assigning codes to the investigation**

Before intervening in the crime scene, investigators must first assign a case code to the investigation. This code will link the crime scene with all the evidence collected from it. Frequently, these codes will contain acronyms that indicate the specific geographic location of the crime scene. In Peru, for example, the case code **AY-VH-AC-01** refers to a crime scene from the region of Ayacucho (AY), in the province of Vilcashuamán (VH), belonging to the district of Accomarca (AC). The number 01 at the end of the case code establishes that it was the first crime scene investigated in that area. Subsequent investigations of other crimes in that area will preserve the same geographical code, only the number at the end of the code will change to reflect the order in which the investigations occurred: AY-VH-AC-02, AY-VH-AC-03, AY-VH-AC-04, etc.

This case code must appear in all of the documentation that investigators take of the crime scene, including forms, documents, maps and photographs. Doing so, allows investigators to identify all of the evidence and documentation from a particular crime scene and keep it separate from those that belong to other investigations.

## Forensic photography

The Forensic Photographer documents the entire crime scene using photography. Forensic photographers are responsible for making sure that each one of their photographs includes a north-facing arrow, metric scale, case code and evidence number. Each photograph must then be documented in the **Photographic Record Form** so that a careful registry is maintained of all the photographs taken during the investigation. Photographs should be taken in a sequence from general photographs that show the entire scene, mid-range shots that show related pieces of evidence and detailed shots of individual pieces of evidence. The following series of photographs demonstrate this progression:



General photograph



Mid-range photograph



Detailed photograph

Before investigators intervene in the crime scene, panoramic photos of the area under investigation should be taken in order to document exactly what the crime scene looked like as the investigators found it. These photos should be taken with and without case codes, metric scales and north-facing arrows so that we have twin photographs: one clean photograph of the unaltered scene and one version with all of the information corresponding to the investigation.

When photographing a crime scene, it is important to capture the context in which the evidence is found. Therefore, forensic photographs should attempt to not only show where evidence is placed within the scene but also how different pieces of evidence may be associated with each other. For example, if a gun and two bullet casings were discovered in the crime scene, investigators would determine that these pieces of evidence share an obvious association. Therefore, the forensic photographer would want to capture all three of these objects in a single photograph in order to show how they relate spatially within the scene. Once this spatial relationship has been recorded, the forensic photographer will proceed to take detailed shots of each of the separate pieces of evidence with the corresponding case code, evidence number, north-facing arrow and metric scale.

Similarly, when photographing the impact of gunshots or other munitions, photographs should be taken that visually represent the likely trajectory, including:

1. Photographs taken from the shooter's likely position facing toward the point of impact.
2. Photographs taken from the point of impact looking back at the shooter's likely position.

When pieces of evidence—like bullet casings or the outline of a gravesite—are not clearly visible within the scene, colored flags may be used to show their location in the photographs. When photographing bodies within a mass grave, a photograph should be taken of each individual body before it is removed. To individualize the bodies of each victim in the photograph, forensic photographers outline the bodies using metric rulers, rope or string.

The photographs constitute the photographic testimony of the case, which is presented in the final report. As a result, the forensic photographer must provide a catalogue of all of the photographs taken during the investigation, along with corresponding photograph numbers and descriptions. If the photographs are taken on a digital camera, the catalogue must include a CD containing the photographs along with a sworn affidavit verifying that the images have not been altered. In this way, the disk can be considered an unadulterated negative of the images from the crime scene.

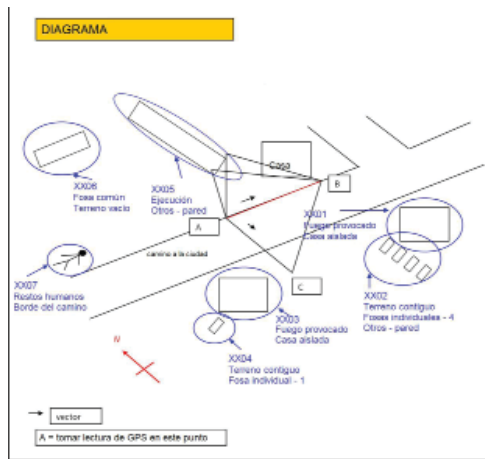
If professional cameras and other accessories—like lenses, lighting and filters—used in forensic photography are not available, they can be replaced with less costly materials. For example:

- Disposable cameras or cell phone cameras can be used in place of professional cameras, as long as they capture images in color, since important details may be lost in black and white photography.
- Ballpoint pens or trowels can be used in place of a north-facing directional arrow.
- Case codes and evidence codes can be written on pieces of paper.
- Colored tape, rope or string can be used to outline the bodies in a crime scene.
- A simple ruler can be used as a metric scale.

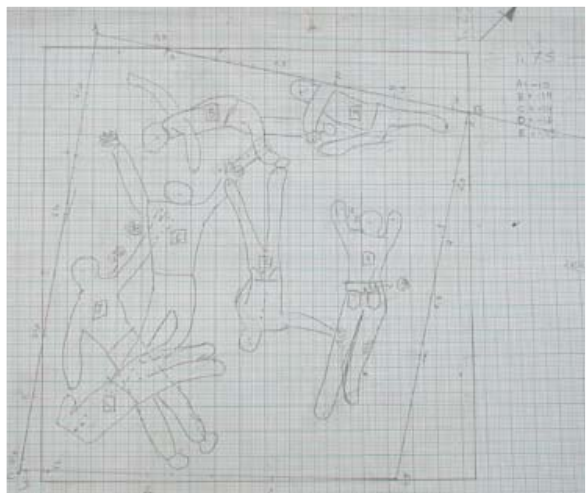
## **Graphic record of the crime scene**

Investigators make scale drawings, or maps, of a crime scene to accurately represent the location of all evidence within the scene. In order to draw their maps to scale, investigators take reference measurements that pinpoint the precise location of the evidence. To do this, they lay down a tape measurer along the length of the crime scene. They then measure the location of each piece of evidence along the length of the tape measurement and record the distance of the piece of evidence away from the measurement tape at a 90-degree angle. The investigator can then plot these two measurements on a piece of graphing paper to represent the exact location of the evidence within the scene. Once all of the evidence is plotted, investigators will have a reliable map of the crime scene that allows them to have a

bird's eye view of the distribution of evidence within the crime scene. This is important because it eliminates problems of perspective that may often distort the spatial relationships between pieces of evidence in the photographic record.



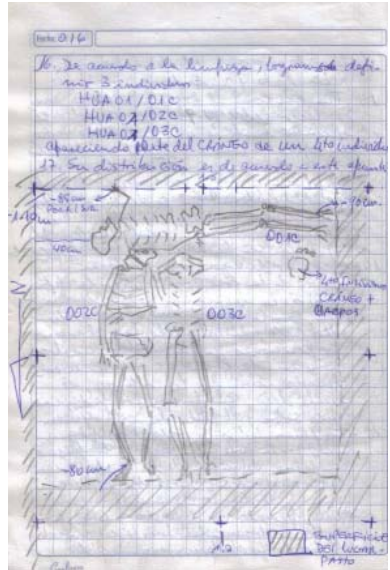
Simple sketch of a crime scene.



Hand-drawn sketch showing measurements taken in the field.

## Field notes during the investigation

The lead investigator must take written documentation of all the tasks performed during the investigation in a **field notebook**. The field notebook includes notes on important details that are relevant to the investigation, as well as detailed descriptions of any problems that arise during work in the field. The information collected in the field notebook will later serve as the documentary basis for the crime scene report and may be read by other investigators at later stages of the investigation to get a better understanding of how the investigation was conducted. For this reason, it is important that the field notes are written in clear, understandable language and recorded in legible handwriting.



Sample page from a field notebook.

The notes collected in the field notebook, along with all of the other types of documentation produced during the investigation, help the investigators to interpret the evidence and reconstruct the events of the crime.

# RECOVERING EVIDENCE FROM A CRIME SCENE

Once investigators have thoroughly documented the evidence within the crime scene, they may proceed to recover it. The way in which they do so will depend largely on the size and type of material they need to collect. In the following section, we will discuss some of the different types of materials that investigators encounter in a crime scene and provide guidelines for how they should be collected. Before beginning with this discussion, however, it is important to understand the foundational principle that guides the recovery of all evidence from a crime scene: the chain of custody.

## Chain of custody

The chain of custody is the written record that details everything that happens with the physical evidence from the moment it is recovered from the crime scene until the moment it is presented before a court of law. Investigators must maintain the chain of custody in order to preserve the admissibility of the evidence before the court, since this is the only way to assure that the evidence that reaches the court is the exact evidence that the investigators recovered from the crime scene.

The chain of custody begins at the crime scene when each piece of evidence is recovered and placed in an individual bag. Each bag is then marked in indelible ink with the case code, evidence number and date of recovery for each particular piece of evidence. Investigators then seal the evidence bags with tape, sign across the seal and register the collected evidence on a **Case Sequence Form**, which corresponds exactly to the information written on the evidence bags.

From then on, every time the evidence is transferred to another person or investigative team, new information is added to the record. This information should include the date and time of the transfer, the name of the person responsible for the evidence and the reason

for the transfer. Each time the container is opened to analyze the evidence, another record should be made to include the name of the responsible person, the reason for opening the container, details of the type of analysis performed on the evidence and any alterations that may have been made to it as a result. Once the analysis has finished, the container should be re-sealed for transfer and storage.

Investigators use the Case Sequence Form to record all of the evidence collected during the investigation in the exact order in which it was recovered. The form requires that investigators provide specific information on each piece of evidence, including: its case code and evidence number; a description of the object; its corresponding photograph number from the Photographic Record; and the name of the person responsible for the recovery. Documenting all of this information with precision is essential to maintaining the chain of custody and preserving the admissibility of the evidence in a court of law.



Packaging and transportation of evidence in the field. All containers are marked with the case code and date, so that the evidence can be traced back to the crime scene. (The case codes have been blacked out in these photographs since they are part of an ongoing investigation.)





## Assigning evidence numbers to each piece of evidence

As mentioned above, investigators assign every piece of recovered evidence a unique evidence number that identifies and distinguishes it from every other piece of evidence collected during the investigation. To determine the **evidence number**, investigators assign letters to each piece of evidence—depending on whether it is an artifact (**A**), a body (**B**) or a body part (**BP**)—followed by a number that indicates the order in which the evidence was recovered. For example, investigators may collect a machete (**A1**) from a crime scene, followed by the body of a victim (**B2**) and, finally, a severed arm (**BP3**) from a third victim whose body is not found within the scene. If the next piece of evidence the investigators collect from the scene is a bloodstained shirt, what evidence number would they assign it? The bloodstained shirt would be recorded as **A4**, indicating that it is an artifact and the fourth piece of evidence recovered during the investigation. To link the evidence to the crime scene they were recovered from, investigators write the evidence numbers at the end of the case code for that particular investigation. If we use the aforementioned case code from Peru, each piece of collected evidence would be represented in the following way:

AY-VH-AC-01/**A1** = Machete  
AY-VH-AC-01/**B3** = Body of the victim  
AY-VH-AC-01/**BP2** = Severed arm  
AY-VH-AC-01/**A4** = Bloodstained shirt

The case code and unique evidence number should then be written on the outside of each evidence bag before collecting the corresponding artifact, body or body part from the crime scene.

## General guidelines for collecting evidence

When collecting evidence from a crime scene, investigators must wear latex gloves in order to avoid contaminating the evidence and to protect themselves from any harmful or toxic substances that may be

in the scene. Depending on the type of evidence they are collecting, investigators may also need to wear surgical masks as discussed in more detail below.

As a general rule, investigators may recover non-organic materials in plastic bags and containers. Organic materials, on the other hand, should be collected in paper bags and cardboard boxes, since they allow air to pass through and will prevent the accumulation of moisture that can cause the evidence to mold or mildew.

If investigators recover associated evidence from a crime scene, each piece of evidence should be collected in a separate sealed bag and registered on the **Case Sequence Form** with a unique evidence number. The bags containing the associated evidence should then be packed into a common cardboard box, which is labeled and sealed before being transferred from the crime scene. Doing so, will allow investigators to keep those commonly associated pieces of evidence together in storage.

### **Collecting gunpowder residues**

Gunpowder residues remain on the hands of *living* subjects for short periods of time and easily wear off by intentional or unintentional washing, wiping and rubbing of the hands against other surfaces. As a result, some laboratories will not accept samples removed from a suspect more than 6 hours after a weapon has been fired. In cases involving *dead* subjects (suicide victims or those killed in a shoot out, for example), gunpowder residue can be identified at a much higher rate if they are collected before the body is moved from the crime scene, or if investigators cover the subject's hands with paper bags for more careful collection of the residue in the morgue.

Follow these steps to collect gunpowder residues from a suspected shooter's hand:

1. Hold the shooter's wrist with one hand and use your free hand to remove the residue from a shooter's trigger finger, thumb web and back of the hand using adhesive tape.

2. When collecting the sample, avoid making contact with any blood that may be on the subject's hand, since it will neutralize the adhesive properties of the tape.
3. Press the tape gently against a white note card in order to preserve the residue on the adhesive side of the tape.
4. Place the tape in a "druggist fold" envelope, seal and sign it and then document it on the Case Sequence Form.

A "druggist fold" envelope can be easily made from a clean white sheet of paper. Begin by folding one edge of the paper over one-third of the page. Then fold the opposite edge in the same way so that the two sides overlap. Repeat this process for the two remain edges and tuck them into each other so that no trace evidence can escape.

## **Collecting hairs and fibers**

Hair and fibers from clothing, carpets and other fabrics can easily transfer from one subject to another, particularly in situations involving struggle or forcible contact. Hair and fiber transfer evidence can then be used to link a suspect to a crime scene, a residence, a vehicle or a victim.

The collection of hair and fiber evidence is a meticulous undertaking that is best done in a laboratory environment and not at the crime scene. Whenever possible, crime scene investigators should identify potential transfer areas (clothing, sheets, rugs, etc.), carefully fold those items so that fiber evidence is not lost and package them for analysis in the laboratory. If fiber evidence is precariously adhering to an object and may be lost in transit to the laboratory, investigators may then carefully collect the fiber. Precise documentation must be made on where the object was recovered from and its location in the crime scene.

Investigators should follow these steps to search for fibers that may be helpful in connecting a perpetrator to a crime scene:

1. Concentrate a flashlight beam on a surface at a 20 to 45 degree angle. Fibers that may not be visible under normal light conditions will cast a shadow or illuminate under the flashlight.
2. Shine a black light on a surface to see fibers that may not otherwise be visible under normal light conditions.
3. Once you have identified the fibers you would like to collect, photograph them and document their location on the material to which they are attached.
4. Whenever possible, carefully fold the material containing the fiber and package it for transfer to the lab. Just as with any other piece of evidence, the material must be documented, collected in a signed and sealed bag or container and then recorded on the Case Sequence Form.
5. If it appears that the fiber may be lost in transfer to the lab, use a pair of disposable tweezers or fingers from a gloved hand to remove the fiber. Place the fiber in a “druggist fold” envelope, seal and sign it and then document it on the Case Sequence Form.

### **Collecting liquids and bodily fluids**

When handling liquids and bodily fluids, there are two principle concerns: 1) minimizing the risk of infection to the investigator and 2) avoiding contamination of the sample. Therefore, crime scene investigators should always wear protective gloves to keep the investigator from making direct contact with the fluid and a mask over the mouth and nose to avoid contaminating the sample. If surgical gloves and masks are unavailable, plastic bags over the hands and a bandana or piece of fabric can be used to avoid directly breathing on the sample.

Investigators should follow these steps to collect liquids and bodily fluids from a crime scene:

1. Take a photograph of the liquid within the crime scene and register the photograph on the Photographic Record.
2. Cover hands with surgical gloves or a plastic bag as a bio-safety precaution and cover your mouth and nose with a surgical mask in order to avoid contaminating the sample. If surgical masks are unavailable, you can use a bandana or simply pull your shirt over your nose and mouth to avoid breathing directly on the sample.
3. Absorb some of the fluid on the top of a new cotton swab.
4. Air-dry the swab until it is **completely dry**. Never blow on a sample to dry it. Blowing on the sample will expose it to contamination that may corrupt the analysis in the laboratory.
5. Store the dry swab in a “druggist fold” envelope. Note that organic materials should not be stored in plastic bags since they trap humidity and encourage the growth of bacteria.

### **Obtaining control samples**

The examination of evidence in the laboratory often requires comparison with a known control sample in order to positively identify them as belonging to the suspect, victim or another source. For example, if investigators recover hairs from the clothing of the victim that they suspect belong to the perpetrator, the laboratory will need a sample of the perpetrator’s hair to compare with the sample collected from the victim in order to confirm the match. Though the suspected perpetrator may still be at large, investigators should look for other sources—such as the suspect’s hairbrush, the headrest of the suspect’s car or the suspect’s pillow—where they can get samples of the suspect’s hair.

## Storing the evidence

As a general rule, all collected evidence should be stored in a cool, dry environment to keep it safe from mold and mildew. The storage space should also be secure so that its access can be strictly restricted to those individuals who have authorization to be there. Additionally, each piece of evidence should be catalogued and indexed according to its case code and evidence number so that those responsible for the storage space know the exact location and contents of all recorded evidence. A lack of these types of controls can lead to breaches in the chain of custody that can render the evidence inadmissible in a court of law. For that reason, it is of utmost importance that evidence is stored in a tidy, organized environment with security measures in place to guard against both the contamination and tampering of evidence.

## DOCUMENTATION AND RECOVERY OF THE DECEASED IN THE CRIME SCENE

When approaching a crime scene that includes the body of a dead victim, investigators should follow these steps to document and recovery both the victim's body and any associated evidence:

1. Secure the crime scene with yellow security tape and immediately close off access to all unauthorized personnel. In order to preserve the evidence in the crime scene, only investigators and their staff should be allowed entry into the area.

2. Take photographs of the scene and of any of the physical evidence within it. Also, take photographs from outside of the scene to demonstrate its location relative to other buildings or visible landmarks. Photographs should then be taken of the principal entry and exit points to document the way in which perpetrators may have gained access to the scene.



3. Make a sketch of the crime scene to scale showing all of the relevant details of the crime, such as the location of weapons, furniture, vehicles and surrounding terrain. The sketch should accurately represent the position, height and width of items, and their relationship to each other. If you do not have time to draw the sketch to scale, make sure you take reference measurements for all the relevant details in the scene, since a proper sketch to scale can be prepared later from these measurements.

4. Photograph the body both as it is found and then after it has been recovered to document what is underneath it. As always when

photographing a crime scene, color photographs of the victim should be taken as these, in comparison with black and white photographs, may reveal in more detail the nature and circumstances of the victim's death.

5. Take notes recording the position and condition of the victim's body and clothing, including notes on:

- Temperature of the body (warm, cool, cold).
- Location and degree of fixation of lividity (see the following chapter for a detailed description of lividity).
- Rigidity of the body (see the following chapter for a detailed description of rigidity).
- Stage of the body's decomposition.
- Record any visible injuries.
- Whether the victim appears to have been sexually assaulted.
- Document any visible scars and artificial marks such as tattoos.

6. Take note of the ambient temperature at the scene, since this information, when compared to the temperature of the body, can help determine the rate in which the body has cooled. This information is important for estimating the time since death. For bodies in more advanced stages of decomposition, collect any insects present on the body for forensic entomological study, which can also to help establish the time since death.

7. Cover the deceased's hands with paper bags to preserve fingerprints and possible evidence, such as gunpowder residue, skin, blood or fibers under the fingernails.

8. Examine the scene for blood and other trace evidence. Any samples of blood, hair, fibers and threads should be photographed, collected and preserved.

9. Record the identities of all persons at the scene, including their complete names, addresses and telephone numbers. Obtain information from witnesses at the scene, including any person that may have last seen the deceased alive. Record when, where and



under what circumstances the victim was last seen. Interview any emergency medical personnel who may have had contact with the body.

10. Search for any evidence that may help establish the victims identity. If no such evidence exists, obtain all pertinent information from friends or relatives who have reported a missing person to try to make a potential match that could confirm the victim's identity. Once the victim's identity is determined, obtain the deceased's medical history from his or her physician, including hospital charts, records of previous surgeries, alcohol or drug use, suicide attempts and habits that may have affected his or her health.

11. Using a tag, label the body with the case number, victim's name (if known) and date and time of death (if known). Then place the body in a body bag, or wrap it in a clean white sheet. The body should be removed to a secure location where an external examination can be performed.

12. Make a record of any vehicles found in the area. Record each vehicle's make, model and color. Take note of each vehicle's license plate numbers.

13. Take photographs of any pry marks, tire or shoe impressions, and any marks left by weapons in the scene. Castings should be made and preserved when possible.

14. Document and recover any evidence of weapons, such as guns, projectiles, bullets and cartridge cases. When applicable, have the weapons analyzed for the presence of gunshot residue and trace metals.

15. Locate, document and recover any fingerprints left in the scene (see the following section for a detailed description of how to collect fingerprints).

16. Recover any relevant papers, records or documents from the scene that may illuminate the circumstances surrounding the crime.

# CRIMINALISTICS TECHNIQUES

Criminalistics techniques are used in a crime scene to analyze evidence and help to either reconstruct the events of the crime or link a suspect, or a suspect's weapon, to the scene. Some of these techniques are complex and require the intervention of specialized investigators called criminalists. In the following section, we will provide you with a basic introduction to two useful techniques that can help you to interpret what you find within the crime scene: fingerprint and blood spatter analysis.

## Fingerprint analysis

Fingerprints are reproductions of skin friction ridges on the fingers and thumb. These ridges discharge perspiration and collect oils from other part of the body. Perspiration and oils on the fingers deposit fingerprint patterns on touched surfaces.

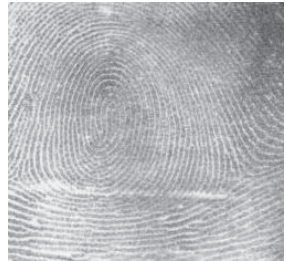
Fingerprints—consisting of loop, arc and whorl patterns—will remain unchanged during a person's life. Importantly for the purpose of forensic investigations, fingerprints are unique characteristics of each human being. No two fingerprints have ever been found to be identical. As a result, a suspect's fingerprints can be carefully studied under a microscope to determine if they match the fingerprints collected from the scene of the crime.



Fingerprint arch



Fingerprint loop



Fingerprint whorl

Keep in mind, however, that fingerprint identification can only be made by comparing one fingerprint to another. Therefore, we need to compare the fingerprints we collect in the scene with fingerprints from a suspect in order to make a match.

## **Procedures for collecting fingerprints**

If the size of the object allows for it, evidence containing fingerprints should be recovered and transported to the laboratory for analysis. To protect the prints from being altered during transportation, follow these steps:

1. Dust the area containing the fingerprints with a fine powder, such as ash or cocoa powder, to make the prints visible.
2. Photograph the dusted fingerprints and document their location within the crime scene.
3. Carefully wrap the object in cellophane in order to preserve the fingerprints for analysis in the laboratory.
4. Place the object in an evidence bag, seal and sign it, and the document it on the Case Sequence Form.

If fingerprints appear on an object too large to collect—such as a wall, a glass door or a table—the prints will need to be lifted by following these steps:

1. Dust the area with a fine powder to make the fingerprints visible.
2. Carefully lay a piece of clear adhesive tape over the dusted prints. When you remove it, the dusted prints should be preserved on the adhesive side of the tape.
3. Press the tape against a note card so that the dark-colored dust contrasts with the white background of the card.

4. Place the note card tape with the lifted fingerprints in an evidence bag, seal and sign it, and then document it on the Case Sequence Form.

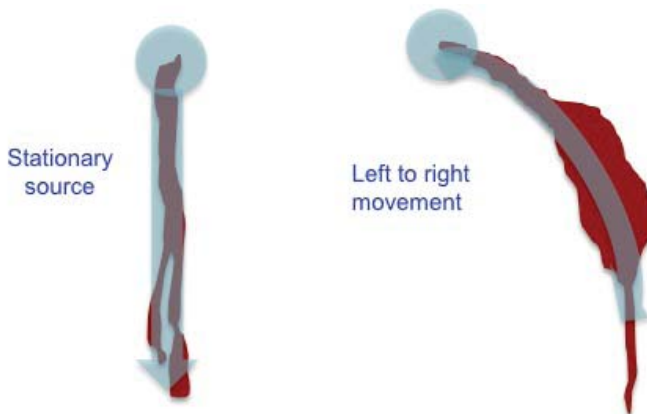
Do not forget to register the exact location where you found the fingerprint both in written notes and photographs.

## Blood spatter analysis

If blood spatters are left on the crime scene, their location, appearance and distribution should be photographed and mapped, since they can show patterns that help us to reconstruct the event that caused them. The analysis of these patterns is complex. However, there are a few simple techniques we can use to draw useful conclusions from blood spatters present in a crime scene in order to determine movement, directionality of the blood spatter and the impact area of a heavy blow.

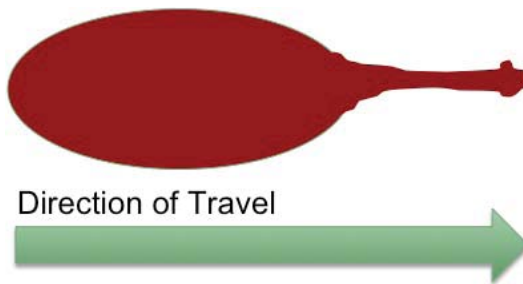
### **Movement**

Bloodstain patterns can be interpreted to suggest the movement of their source. As shown in the examples below, a vertical bloodstain on a wall indicates that the blood flowed from a wound on stationary source. In the second example, the arc shaped bloodstain suggests the source moved from left to right across the surface of the wall.



## Directionality

When analyzing bloodspots, we can also look at their shape to determine the direction they were traveling when they made impact with a wall or horizontal surface, since the pointed end of a bloodspot always indicates the direction of travel. This information is important in determining the directionality of the source of the blow or gunshot that produced it. Based on the shape of the blood spot represented below, investigators could easily determine that it was traveling from left to right when it made contact with the surface. Additionally, a blood spatter analyst can calculate the impact angle of the blood spot by measuring the degree of elongation present in the bloodstain. The more elongated the bloodstain, the narrower the impact angle. For example, a blood spot produced from a gunshot at a perpendicular angle ( $90^\circ$ ) will leave rounded bloodstains on the wall behind the victim, while a gunshot at a  $10^\circ$  angle (almost parallel to the surface of the wall behind the victim) will produce a long stain. By determining the directionality of the bloodstain and its impact angle, investigators can determine the approximate point from which the gunshot or impact originated.

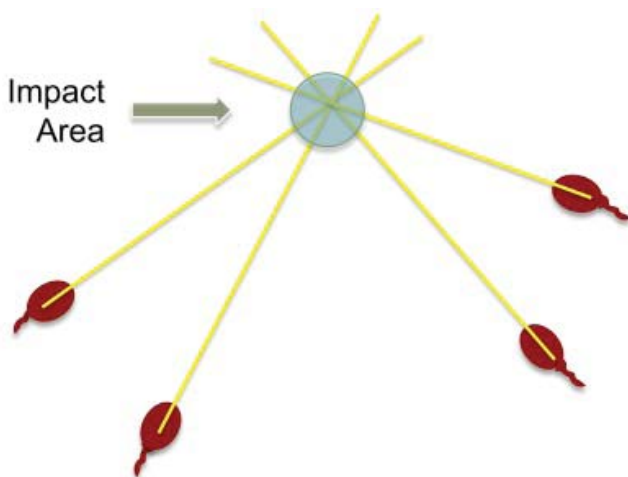


## Impact area

Blood spatters can also be used to determine the impact area of the blow that produced it. When a victim is hit with a blunt object, droplets of blood disperse from the point of impact and make contact with an adjacent wall. By drawing a line through the center axis of each blood spot left on the wall, it is possible to determine the height of the

point of impact. As seen in the example below, the lines will converge around the impact area. When compared to the wounds observed on the victim, this information can allow investigators to determine the position of the victim when the blows that produced the blood spatter were delivered.

By analyzing blood spatters for directionality, movement and impact areas, investigators can make important inferences that help them to recreate the events that took place within the scene of crime.



# INVESTIGATING MASS GRAVESITES: AN INTRODUCTION TO FORENSIC ARCHAEOLOGY

When investigating cases of forced disappearances involving mass gravesites, forensic archaeologists apply their specialized skills to the recovery of human remains and associated evidence. Through this process, they meticulously document the location and position of evidence within the grave for clues that can help reconstruct the circumstances of the crime. Forensic archaeologists interpret the evidence they recover according to the principles of **superposition**, **association** and **recurrence**.

**Superposition** states that the elements found at a crime scene are deposited according to a certain order. In a forensic archaeological investigation, for example, the first objects to be found during the excavation, from top to bottom, were the last to be deposited.



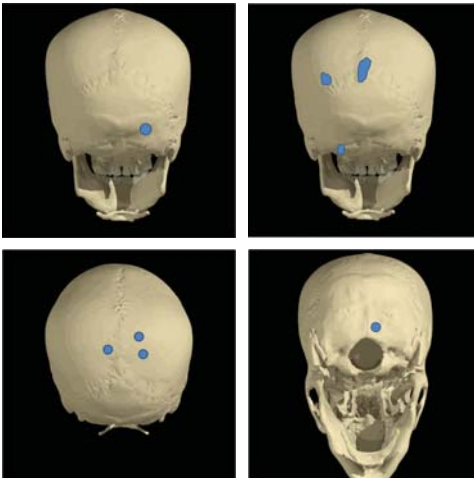
Burial site where the bodies were deposited in three separate layers. According to the principle of superposition, we can tell that the bodies in the bottom layer were the first to be deposited, followed by the middle layer and then the top.

**Association** states that there are relationships between evidence that can indicate the activities that took place in the crime scene. Recording these associations can help to better interpret the scene.



The presence of bullet shells next to a mass grave allows investigators to determine that the victims were executed in the scene.

**Recurrence** states that any event or artifact that is found repeatedly in a crime scene, or across various crime scenes, probably does not reflect random behavior.



The recurrence of certain injuries can tell us a lot about the crime. For example, if we find that all the victims in a gravesite sustain gunshot wounds in the back of the head, we can be confident that we are dealing with intentional executions instead of accidental killings.



# STAGES IN A FORENSIC ARCHAEOLOGICAL INTERVENTION

## Visual inspection

As described in Chapter 2, a forensic archaeological investigation starts with the assessment of the suspected burial site during the preliminary investigation. The observations collected during the site assessment help the forensic archaeologists to build their strategy for the investigation, develop a list of required materials and make logistical preparations for their intervention.

Once the preliminary investigation is complete and antemortem data has been collected on the possible victims and the events related to the crime, forensic archaeologists return to the site to conduct the investigation. Before getting started, they conduct a visual inspection of the area and register the condition of the scene as they have found it. They look for signs that indicate if the gravesite has been tampered with, or altered, by human activity, scavenging animals or natural erosion. The investigators then record all of their observations about the site in the field notebook, take photographs of the site and register them in the Photographic Record.

Forensic archaeologists also register the exact coordinates of the site using a global positioning system (GPS). A GPS is a satellite-based navigational system that is capable of providing location coordinates and altitude readings for any place on Earth. A handheld GPS has a margin of error of 15 meters and, consequently, may be used to locate the site, but not to record the precise location of each piece of evidence. National Geographic maps, aerial photos, and satellite images available from Google Earth can also be used to locate the site in case a GPS is not available (see <http://earth.google.com/>).

If superficial evidence is found during the visual inspection, it is assigned an evidence number, registered in the Case Sequence Form and photographed before being recovered according to the principles described in the previous section.



Superficial evidence found near a mass grave.

## Survey the area to identify a possible gravesite

Sometimes, due to different factors—including the size of the area, the conditions of the terrain and the presence of overgrown vegetation—the exact location of the gravesite is not always immediately apparent. In such circumstances, forensic archaeologists conduct a survey of the area to verify the existence of possible gravesites. Once they believe that they have identified a possible gravesite, they excavate a 1x1 meter test pit in the middle of the suspected area in order to confirm whether or not it contains human remains and other associated evidence.

### **Securing and protecting the site**

Once the gravesite has been identified, the crime scene is delimited and marked off with thick yellow crime scene tape. The tape clearly defines the perimeter of the site and delineates the area to which only authorized people should have access. Securing the perimeter of the investigation site preserves the legal integrity of the crime scene and keeps it from being altered by humans or animals.

## Exhumation

The initial excavation of a burial site allows us to clearly and objectively define the borders, structure, form and size of the grave. If only a part of the grave can be seen, the excavation of the original test pit is extended in order to more precisely define the spatial distribution of the borders and the characteristics of the area under forensic investigation.

Before starting the excavation, forensic archaeologists establish a control point, known as the **datum point**, from which all depth measurements are recorded for the evidence within the gravesite. Forensic archaeologists place the datum point at the highest point around the grave border and mark it with a large nail, or wooden stake, so that it is easily recognizable to all those who are involved in the investigation.

Keep in mind that every step in the investigation, from the identification of the gravesite and delimitation of the scene until the recovery of the last piece of evidence from the grave, should be documented in the field notes and photographed according to the principles expressed in the previous sections of this chapter. Detailed sketches should also be made to indicate the location of superficial evidence within the crime scene, and a separate sketch should document the position of evidence within the excavated gravesite. As in any forensic investigation, a detailed record of all collected evidence should be carefully registered on the Case Sequence Form in order to maintain the chain of custody.

Next, forensic archaeologists lay down string to define a rectangular perimeter along the borders of the grave. Nails, or wooden stakes, are then placed 1 meter apart along this perimeter in order to establish a uniform grid pattern across the gravesite. This grid helps to make a two-dimensional sketch to scale of all the evidence within the grave. By extending a level string from the datum point out over the grave and measuring down to mark the depth of the different pieces of

evidence within it, a three-dimensional record can be constructed of all of the contents within the grave.



A grid built on the clean surface of a gravesite. The yellow flags indicate the presence of superficial evidence.

Forensic archaeologists carefully remove the dirt that covers the gravesite layer by layer in order to expose the bodies and associated evidence. As always, any evidence that is exposed during the removal of these layers should be photographed and mapped to show its exact location within the grave. Pick axes, flat and spoon-shaped shovels, pails and wheelbarrows are used for removing the bulk of the earthen



material covering the grave, while trowels, brushes, spoons, pails and smaller tools are used for the more delicate tasks of removing the soil and vegetation that lies directly on top of the human remains and associated evidence.

A sieve is then used to carefully filter the earth that is removed during the excavation. This allows for investigators to recover any bone fragments, small bones, teeth and tiny artifacts that may have been mixed in with the dirt when it was removed during the excavation.

When the remains are finally revealed, each body is assigned an evidence number and all of the information related to the body and its position within the grave is record on an **Exhumation Form**. Each body is then individualized with string or colored tape and photographed before being recovered from the grave. Since decomposition can make it difficult to differentiate one body from another, it is important that experts familiar with the human anatomy conduct the investigation.



Once the body and any associated evidence has been thoroughly documented, photographed and mapped within the grave, forensic archaeologists carefully collect the bones from each of the following body parts and place them in separate paper bags: the skull, jaw, left hand, right hand, left arm, right arm, left leg, right leg, left ribs, right ribs, left foot, right foot, left shoulder and collarbone, right shoulder and collarbone, sternum, all of the vertebrae and hipbones.

The outside of each bag is marked with the corresponding case code, evidence number, date of recovery, part of the body and the side of the body to which it belongs (the victim's right or left). If the remains are clothed, investigators recover the clothes with the bones inside and place them in a paper bag. Investigators never attempt to remove the bones from the clothes in the field, since bones may get lost in the process. All of the bags belonging to an individual body are then

placed in a separate cardboard box for transport from the crime scene. Larger, stronger bones are always placed on the bottom of the box, while thinner, more fragile bones go on top. The skull, in particular, should always be placed on top of the other bones since it has many fragile features that can easily be broken. Though each part of the body is collected in a separate bag, all of the skeletal remains from the same body share the same evidence number. To avoid confusion, investigators need to clearly label which part of the body is in which bag before packing them together and sealing them in a cardboard box.

When everything has been recovered from the grave, a final search is conducted to make sure that no evidence remains. Then, the empty grave is photographed and refilled with dirt.

Through the exhumation process, investigators make observations regarding the distribution and position of the bodies within the grave that can help to reconstruct the crime. If there are artifacts associated with the skeletal remains that have dates registered on them—such as coins, identification cards and other or a bullet casing stamped with the year of its manufacture—investigators can also determine an approximate time in which the crime was committed. As a result, the person that directs the forensic archaeological investigation should possess an adequate level of expertise to guarantee both an ordered, scientific recovery of the evidence and a rigorous recording of all the elements related to the investigation. The inferences and explanations about the way in which the crime was committed will ultimately depend on the way in which the forensic archaeological investigation was carried out.

## PRESENCE OF OTHER ACTORS DURING THE INVESTIGATION

Cases involving human rights violations require the contribution of more than just the forensic team that conducts the investigation. The police, lawyers, prosecutors, relatives of the victims and witness to the crime all have important roles to play and, as a result, may wish to be present during the field investigation. While it is important to recognize and respect their legitimate role in the investigative process, only authorized members of the forensic team, along with competent legal authorities, should be granted access to enter the crime scene while it is under investigation. Keep in mind that allowing unauthorized individuals into the crime scene can result in the accidental, or intentional, alteration of evidence, rendering it invalid in a judicial process.

Though the families of the victims will not play an active role in the actual recovery of evidence, their presence during the investigation is important to lend transparency to the process. As mentioned in the previous chapter, investigators should respect the victims' families



Forensic experts inform the prosecutors, the families of the victims and their lawyers about the advancements in the recovery of the evidence.

right to know what happened to their loved ones by keeping them informed about the progress of the investigation. This does not imply that the investigators can provide them with classified information. Rather, they should explain to them the procedures involved in the investigation and answer their questions regarding the investigative process. Keep in mind that the exhumation of the victims remains is likely to be the most difficult stage of the investigation for the victims' family members. It is, therefore, an important time to provide them with psychosocial accompaniment in order to process the difficult emotions that they will be forced to deal with.

Investigations into human rights crimes may also tend to attract a significant amount of curiosity from the general public and attention from local, national or international press. Due to the sensitive nature of the investigation, the authorities in charge of the investigation must first clear any statements or declarations made to the media. No member of the forensic team should ever divulge information about the investigation to the press without prior authorization. Doing so could jeopardize the impartiality of the investigation and call into question the integrity of the collected evidence.



# Chapter IV

## Analysis of the Evidence



Once evidence has been recovered from the crime scene, investigators send it to a forensic laboratory that can analyze the evidence to collect even more information from it. There are different types of analysis that can be performed in a forensic laboratory depending on the nature of the evidence and the information that we need to obtain from it. Perhaps the most important in cases of forced disappearance and extrajudicial killing is the analysis of human remains, which provides useful information that can help to both identify the victim and determine the most probable cause and manner of death. Other common types of analysis conducted in a forensic laboratory include DNA, fingerprint, ballistic and chemical analysis. For the purpose of this manual, we will focus on three of these: human remains analysis, ballistic analysis and DNA analysis.



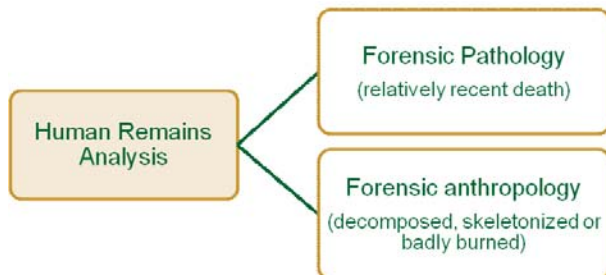
# HUMAN REMAINS ANALYSIS

## Cause and manner of death

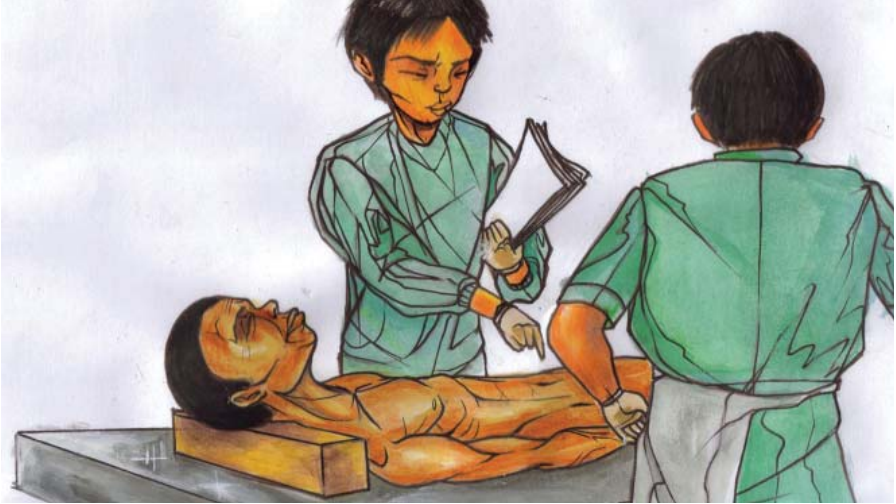
In forensic science, cause of death refers to the factors that prompt the heartbeat and breathing to stop. Causes of death include disease, malnutrition, old age and accidental or intentional trauma. Manner of death, on the other hand, refers to whether a person died a natural death (due to natural processes like old age or disease) or a non-natural death (due to an accident, suicide or homicide).

In many investigations, forensic pathologists can establish cause and manner of death by performing an autopsy. In cases involving skeletal or highly decomposed remains, forensic anthropologists examine the bones to understand the mechanism that altered them and, based on their findings, determine “the most probable cause of death”. In cases involving trauma, fractures to the hand bones may indicate violence at the time of death but are unlikely to be fatal. A gunshot wound to the head or chest, on the other hand, is often classified as the most probable cause of death since it represents a fatal injury that affects vital organs of the body. A gunshot wound to the abdomen, upper arm or upper leg can also be classified as fatal if untreated due to blood loss and infection.

On the basis of the most probable cause of death, forensic pathologists and anthropologists can then determine the most probable manner of death (i.e. whether the person suffered a natural or non-natural death).



# FORENSIC PATHOLOGY



**Forensic pathology** is a branch of medicine that involves the investigation of sudden, unnatural, unexplained or violent deaths. In cases involving recently deceased bodies that contain soft tissue and organs, forensic pathologists conduct a thorough autopsy of the victim's body. Through the autopsy, a forensic pathologist is interested in answering four basic questions:

1. Who is the victim?
2. How much time has passed since the victim's death?
3. What injuries are present?
4. Why and how were the injuries produced?

Based on the answers to these questions, the pathologist can then make a conclusion as to the cause and manner of death.

In the following sections, we will discuss different methods that pathologists use to determine time since death and will provide you with a basic model protocol for how an autopsy should be conducted. Keep in mind that this information is not sufficient to allow you to conduct an autopsy on your own. Rather, the purpose of this section is to give you enough of an understanding about the process so that you can knowledgeably evaluate an autopsy report and its findings.

## Determining time since death

In order to determine the time since death of a victim, forensic pathologists look for signs of post-mortem changes in the victim's body. Three conditions, known as **algor mortis**, **livor mortis** and **rigor mortis**, start simultaneously in the first two to four hours after death and continue until approximately 48 hours after death.

**Algor mortis** is the phase in which the body loses heat as the body's core temperature of 37°C (98.6°F) adjusts to the surrounding environmental temperature. Although there are factors that affect algor mortis, theoretically the body loses approximately 0.83°C (1.5°F) per hour (note that in hot environments the core temperature may actually rise). Therefore, a comparison between living core temperature, the core temperature of the body when found, and the environmental temperature can be used to estimate the time since death.

**Livor Mortis** (also called lividity) is a condition where a pattern of bruising and blanching appears as a result of the pooling and clotting of blood within the body. Due to the pull of gravity, blood settles in the parts of the body closest to the ground and forms distinctive dark-colored clots. If there is pressure on any particular part of the body, blood will not settle in those tissues, resulting in the lighter, or blanched, color that can be observed in the image below. Livor mortis usually is evident at least two hours after death and becomes fixed in four to six hours after death. Fixed livor mortis means that the blood has fully pooled and clotted and that the pattern will not change even if the body is moved. Livor mortis is not only useful to calculate time since death, but can also be used to determine the position of the body at the time of death. For example, a body found lying facedown that has evidence of clotting on its back could help investigators to determine that the body had been moved from its original



Livor mortis.

position in the crime scene, since a facedown body should demonstrate clotting on its front.

**Rigor Mortis** is the rigidity that appears throughout the body as a consequence of chemical changes in the muscles. Small muscles, such as those in the face and hands, are the first to be affected within two to four hours after death. Within a 24-hour period, the larger muscles harden as well. The body stays in this

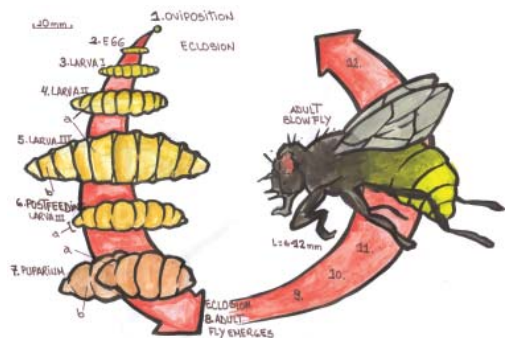


Rigor mortis.

rigor stage for at least 24 to 48 hours. After that, breakdown of the tissues occurs, rigor mortis dissipates and the body becomes flaccid again. The timing of rigor mortis is affected by many factors, including ambient temperature, core temperature and age. In hot environments and in very young or old individuals, rigor mortis appears and disappears faster.

## Forensic Entomology

Time of death can also be estimated by observing the presence of carrion insects on the body. Carrion insects, which are attracted by the smell of putrefaction, feed on the remains of the deceased, affecting the rate and process of decay. The most common types of insects in a crime scene are blowflies and flesh flies,



Redrawn from Haskell et al, 1997.

but the particular species and variety of carrion insects varies by geographical region and time of year. In hotter environments, carrion insect activity can even start before death, while in extremely cold regions there may not be any insect activity at all.

Forensic entomologists are specialists that collect and interpret samples of insects and their eggs from the crime scene and the body of the victim. The insects have a predictable pattern of feeding and reproduction, and various species usually arrive in a predictable order. By analyzing these patterns, forensic entomologists can determine approximately when the infestation began and correlate it to the time of the person's death.

## Model protocol for the autopsy of victim's remains<sup>1</sup>

Before beginning an autopsy, forensic pathologists and their assistants thoroughly wash their hands and put on protective clothing and gloves. No eating, drinking or smoking is permitted in the examination area. The area where the autopsy is conducted should be well ventilated, and all instruments and surfaces should be cleaned and disinfected before and after use. Once the area is prepared and the forensic pathologists are ready to begin the autopsy, the examination of the body proceeds according to the following general guidelines:

1. Review the available information including medical records, witness statements and/or circumstantial information and reports about the death.
2. Record the date, starting and finishing times, and place of the examination. Verify the case number and that the body and evidence all belong to the correct case.

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<sup>1</sup> Adapted from the "Model Autopsy Protocol" in the United Nations Manual on the Effective Prevention and Investigation of Extra-Legal, Arbitrary and Summary Executions, available at <http://www.theadvocatesforhumanrights.org/4jun20046.html> Adapted from the "Model Autopsy Protocol" in the United Nations Manual on the Effective Prevention and Investigation of Extra-Legal, Arbitrary and Summary Executions, available at <http://www.theadvocatesforhumanrights.org/4jun20046.html>



3. Record the name and signature of all persons present during the examination.
4. Adequate photographs are crucial for thorough documentation:
  - a. Photographs should be in color, in focus and adequately illuminated. Each photograph should contain a metric reference scale and an identifying case number. The name and signature of the person taking the photographs must be recorded.
  - b. Supplement close-up photographs with general and/or mid-range photographs to permit orientation and identification of the close-up photographs.
  - c. Photographs should be comprehensive and document the presence of all signs of injury or disease.
  - d. Identifying facial features should be photographed after washing and cleaning the face. Photographs of the face from the front, left and right profiles should be taken with the hair in the normal position and with the hair retracted to reveal the ears.
5. Examine the body and the clothing. Photograph the clothed body. Record and photograph any jewelry present on the body.
6. If possible, the clothing should be carefully removed over a clean sheet. Let the clothing dry if it is bloody or wet. Describe the clothing that is removed and label it in a permanent fashion. Either place the clothes in the custody of a responsible person or keep them, as they may be useful as evidence or for identification.
7. Conduct the external examination of the body. The search for, and identification of, external evidence of injury is, in most cases, the most important part of an autopsy.
8. Describe and document the means used to identify the victim. Examine the body and record the deceased's apparent age; the length of the body; sex; hairstyle and length of hair; nutritional status; muscular development; and color of skin, eyes and hair.

9. Record the degree, location and fixation of rigor and livor mortis.
10. Note body warmth or coolness and its state of preservation. Take note of any decomposition changes, such as skin slippage. Evaluate the general condition of the body and note the presence of maggots, eggs or anything else that suggests the time or place of death.
11. Record the size, shape, pattern, location (related to obvious anatomic landmarks), color, course, direction, and structure of all injuries. In the description of projectile wounds, note the presence or absence of soot, gunpowder or singeing. If gunshot residue is present, document it photographically, remove it and save it in a “druggist fold” envelope for analysis. Attempt to determine whether the gunshot wound is an entry or exit wound. Tape together the edges of knife wounds to assess the blade size and characteristics.
12. Photograph all injuries. Include a case code and scale in every photograph.
13. Examine the skin. Note and photograph any scars, tattoos, prominent moles, areas of increased or decreased pigmentation and anything distinctive or unique, such as birthmarks. Note any bruises, injection sites, abrasions or puncture wounds. Note any bite marks and photograph them to record the dental pattern. Note any burn marks and attempt to determine the cause (i.e., burning rubber, a cigarette, electricity, a blowtorch, acid, hot oil, etc.).
14. Identify and label any foreign object that is recovered, including its relation to specific injuries. Do not scratch the sides or tip of any projectiles. Photograph each projectile and large projectile fragment with an identifying number. Then place each projectile in a sealed, labeled container in order to maintain the chain of custody.
15. Examine the head and external scalp, bearing in mind that injuries may be hidden by the hair.
16. Examine the teeth and note their condition. Make a record of any absent, loose or damaged teeth. Record all evidence of dental work, including restorations, crowns, fillings and any other procedures that

may have been performed. Photograph dentures, if any, and save them if the deceased's identity is unknown. Check the inside of the mouth and note any evidence of trauma, injection sites, needle marks or biting of the lips, cheeks or tongue. Note any articles or substances that are inside the mouth. In cases of suspected sexual assault, save oral fluid or take a swab for analysis. Air dry the swabs and preserve them in a "druggist fold" envelope. Sign and seal the envelope and record it on the Case Sequence Form.

17. Examine the face, nose, ears and neck and note any evidence of trauma, hemorrhage or other abnormalities.

18. Examine all surfaces of the extremities and describe any injuries on the arms, forearms, wrists, hands, legs and feet. Note any "defense" wounds on the extremities, which are caused when victims try to protect themselves from oncoming blows. Note any bruises about the wrists or ankles that may suggest the deceased's hands and feet were restrained or suspended.

19. Note any broken or missing fingernails. Take note of any gunpowder residue on the hands, document it photographically and collect it for analysis. Take fingerprints from the deceased in all cases. Cut and save fingernail clippings. Scrape under the fingernails and save the scrapings in a "druggist fold" envelope for analysis. Carefully examine the soles of the feet, noting any evidence of beating. Examine the palms and knees, looking especially for glass shards or lacerations.

20. Examine the external genitalia and note the presence of any foreign material or semen. Note the size, location and number of any abrasions or contusions. Note any injury to the inner thighs or perianal area. Look for peri-anal burns.

21. In cases of suspected sexual assault, examine all potentially involved orifices. Collect foreign hair by combing the pubic hair. Pull and save at least 20 of the deceased's own pubic hairs, including roots. Take swabs from the same areas for seminal fluid typing. Air dry the swabs and preserve them in a "druggist fold" envelope. Sign and seal the envelope and record it on the Case Sequence Form.

# Clothing

Clothing is important evidence and should never be cut from the body of a victim. Just like any piece of evidence, it should be thoroughly documented and photographed:

1. Before being removed from the body.
2. When it has been removed from the body but before being cleaned.
3. After it has been cleaned.



A forensic investigator cleans the clothing in a field laboratory.

Clothing is an important tool in determining the identity of the victim. In cases where the victim's identity is unknown, certain types of cloth or clothing styles may indicate group affiliation or the region, or town, where the person was from. Family members, friends and other witnesses may also be able to describe or recognize the victim's clothing or personal belongings.

As we will see in the next section, clothing can also give important clues to the types of trauma the victim may have suffered in cases where the victim's body is highly decomposed and injuries can no longer be detected in the soft tissue. For example, the victim's clothing may contain holes indicating the entry and exit wounds of gunshots or rips and cuts from sharp force trauma. These indicators are important pieces of evidence that can help to establish the most probable cause of death and should, therefore, be thoroughly photographed and documented in the laboratory.



Holes in two layers of clothing associated to an injury in the ribs.

# FORENSIC ANTHROPOLOGY



As mentioned in Chapter I, when human remains are decomposed, skeletonized or badly burned, forensic pathologists work together with forensic anthropologists to determine the most probable cause and manner of death.

Forensic anthropology is the analysis and interpretation of human skeletal remains in a legal context.

Skeletal remains are considered material evidence that can provide significant information about the victim's identity, the crime and the cause of the victim's death.

When beginning an analysis of human skeletal remains, the forensic anthropologist must first establish the forensic nature of the remains.

To do so, the forensic anthropologist must answer three main questions:

1. Are the remains bones?
2. If so, are they human or animal bones?
3. If they are human, are they contemporary (i.e. related to a forensic context) or archaeological (i.e. from the ancient past)?

If the remains are fairly intact, an expert can easily answer the first two questions using the naked eye, since human bones have distinctive shapes and forms that distinguish them from animal bones. If only small fragments of skeletal remains are available, the forensic anthropologist will need to analyze them under the microscope, since the microscopic structure of the human and animal bones are different.

Some important clues can also indicate if a skeleton is contemporary or not. The most direct proof is offered by the clothes and personal belongings associated with the body. The mint date on coins and bills found on the victim's body, for example, can help to limit the timeframe in which the person's death could have occurred, since it could not have happened before the date that appears on the money.

Sometimes, however, forensic anthropologists encounter skeletons without any associated artifacts or clothing. In such cases, skeletal observations can also help to determine if the remains are recent or if they belong to the archaeological past. For example, the cultural modification of the skull, known as cranial deformation, was typical of some ancient cultures but is no longer practiced in modern times. Observations of teeth can also determine if the remains are contemporary, particularly if modern dental treatments can be detected. Similarly, modern prosthetic implants, such as hip replacement or surgical plates found on the bone, can help to establish that the remains are contemporary.



Staples from open heart surgery

Once the forensic nature of the remains is established, other questions must be answered:

1. Do the remains represent one or more individuals? (Remains exhumed from a mass grave may have been mixed together in such a complex pattern that it is difficult to know exactly how many victims are present.)
2. What is the age, sex and stature of the victim?
3. Does the skeleton show significant antemortem features (deformations, signs of disease or healed fractures) that can help to identify the victim?
4. Can the cause and manner of death be determined?

## Determining the Minimum Number of Individuals

To determine if the remains represent one or more individuals, forensic anthropologists count the number of unique bones present within the remains. For example, if the forensic anthropologists count 7 right femurs, that would represent a minimum number of individuals (MNI) of 7 people, since each person can only have one right leg. It is still possible that more than 7 individuals could be present, but the MNI in this case establishes that there can be no less than 7 individuals.

When counting non-single bones to determine the MNI, we divide the number of total bones counted by the maximum number of those particular bones that occur in a normal body. For example, the presence of 15 right ribs would represent an MNI of 2 individuals, since there are 12 right ribs in a single body.

MNI can be further refined by combining information about the sex and age of the victims. For example, 2 adult ribs could represent only one person, but the rib of an adult and the rib of a child would represent an MNI of 2 individuals.

Forensic anthropologists can assign the victim's biological identity (age, sex and stature) depending on the state of preservation of the remains.



These three sacra, or tailbones, represent an MNI of three individuals, since each person has only one sacrum.

## Sex estimation

Physiological differences between the male and female body are present on the human skeleton. When indicators of sex are no longer visible in the soft tissues due to advanced states of decomposition, forensic anthropologists analyze these differences in order to determine the sex of individuals. Since the female body is adapted for childbearing, the most notable difference between the male and female skeleton can be found in the hips, or pelvic bones. The female pelvis, for example, tends to be wider and more rounded than the male pelvis. Females also tend to have more graceful (gracile) skulls while the male skull is more robust and has thicker brow bones. However, these characteristics vary between different populations and are not always reliable.

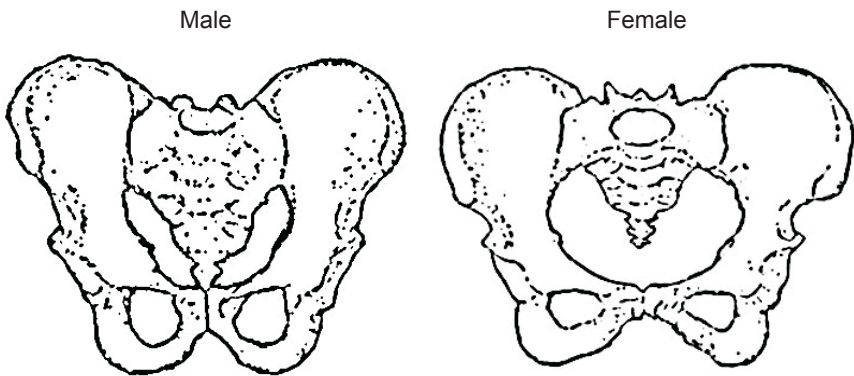
Reliability of sex estimation ranges from about 80%, where only the skull is present, to about 96% when the entire skeleton is analyzed.



As a result, out of every 100 skeletons analyzed, approximately four will show such indefinite sexual characteristics that making a sex determination is impossible.

There are no reliable sex determination methods for children and teenagers, since their sexual features are still developing.

There are no reliable sex determination methods for children and teenagers since their sexual features are still developing.



Sex characteristics of the pelvis. Note the wider angle and broader shape in the female pelvis.

## Age estimation

As we grow older, our skeleton changes. Many of these changes have been studied to develop standards that indicate when a specific change occurs in a specific population. By observing which changes have taken place and which have yet to take place, forensic anthropologists can estimate the age of the skeleton at the time of death. Still, even though there are standards, not everybody grows at the same rate. For example, children generally tend to lose their baby teeth between 6 to 8 years old, though this process varies from child to child. As a result, forensic anthropologists must rely on a combination of different methods to make age estimates of skeletal remains. Due to the inexact nature of age indicators, however, they are limited to

expressing age estimates in ranges—such as 1-2 years old, 19-23 years old, 30-45 years old and so forth.

It is important to note that the ranges become wider as the age of the individual increases. This is due to the fact that children and adolescents' bodies develop quickly over a relatively short period of time, and the growth indicators in their skeletal remains allow forensic anthropologists to make a more narrow estimate of their age. Once we reach maturity, however, changes in the body occur more gradually and age estimates become less precise.

### **Age estimation in children and adolescents**

Dental development is the most reliable and precise method for estimating age in children and adolescents. It can be used from the intrauterine phase to approximately 21-25 years of age, though variations exist depending on the sex of the individual and the population he or she comes from.

6 months – 1 year



7 – 9 years



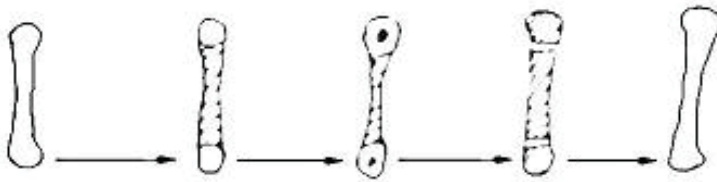
To estimate the age of children and adolescents, forensic anthropologists also measure the length of the long bones in the arms and legs and observe the state of ossification and fusion of

the bones. When we are born, some of our bones are split in parts separated by cartilage. As we grow, the cartilage is gradually replaced by osseous material and the parts fuse to form a solid bone. Since different bones reach maturity at different times, the presence of fusion lines on the bones can be used to determine the age of individuals approximately between 12 and 28 years old.



Femurs from different aged children, younger to older (left to right).

Bone ossification can be illustrated using a long bone:



This picture shows the unfused tibia of a child.

## Age estimation in adults

As we grow older, our bones deteriorate. Forensic anthropologists look at different parts of the skeleton to compare the stage of deterioration with known standards in order to make an age estimation. For adults between 18 and 60 years old, forensic anthropologists observe the border between the pelvic bones and the border of the ribs with the sternum to make age estimates for adults between 18 and 60 years old.



Younger Older

For individuals between 40 and 60 years old, forensic anthropologists can also measure the specific characteristics of the incisor and canine teeth in order to reach an approximate age estimate.

Keep in mind, however, that in some cases the estimated age may not match the victim's real age, since bone deterioration can be affected by things not related to age, like degenerative diseases and malnutrition.

## Ancestry

Ancestry can sometimes be estimated by observing skull characteristics. In general terms, East Asian and Native American people tend to have round eye orbits, rounded nasal aperture and forward projected cheeks. People of European, Nordic and East Indian origin tend to have sloped orbits, a narrow nasal apertures and receding cheeks. People of African ancestry, on the other hand, tend to have wide orbits, flared nasal apertures and receding cheeks. However, it should be noted that not everyone shows strong enough cranial characteristics to make a correct estimation of a person's ancestry. Additionally, cranial characteristics such as these are not likely to be useful in cases that involve victims from the same community or population.

# Height

Height can be estimated by measuring the long bones in the legs and then making a mathematical projection of the individual's stature. The results are then expressed in ranges and means. For example, the range might be a height of 1.59-1.66 meters with a mean of 1.62. This means that the height of the individual could be between 1.59 and 1.66 meters, with a greater possibility of being 1.62 meters tall.

Height is not always helpful in the identification of victims' remains, however, since the broad range provided by the formula tends to include, more than exclude, a large part of the population under study.



Measurement of a femur with an osteometric board.

# TRAUMA

In order to determine the cause and manner of death, forensic pathologists and anthropologists look for evidence of injuries or changes to the normal functions of the human body. In cases of human rights violations, they are particularly interested in documenting trauma related to violence.

In their reports, forensic pathologists and anthropologists describe each wound that they documented during the analysis of the victim's remains, including information on:

1. The type of trauma and force that produced it.
2. The tissues and bones affected by trauma.
3. The minimum number and sequence of wounds.
4. The wound size and direction.
5. The amount of displacement of tissues caused by trauma.
6. The presence and type of fracture lines on the victim's bones.

In the following section, we will explore these points in more depth by providing a detailed description of the principal types of trauma that can be detected on the human body.

## Antemortem, perimortem and postmortem trauma

To determine cause and manner of death in cases involving skeletal or highly decomposed remains, forensic anthropologists must determine if the injuries present on the victim's bones occurred during the victim's lifetime, at the time of the victim's death or after the victim's death. These three general categories are referred to as antemortem, perimortem and postmortem trauma.

**Antemortem trauma** is the type of trauma that occurs during a person's lifetime. It can be easily recognized because these injuries have had time to heal. As shown in the image below, any significant trauma will leave a permanent imprint on the bone. For this reason,

antemortem trauma is often useful for the identification of victims, since injuries observed on the bones may coincide with antemortem data about the injuries that the victims suffered during his or her lifetime.



In this picture, we can compare the callous left by a healed fracture in a tibia and fibula (bottom) with the smooth lines of a healthy tibia and fibula above.

**Perimortem trauma** is the type of trauma that occurs at or near the time of death. This information is helpful because it allows us to determine the most probable cause of the victim's death. In contrast to antemortem trauma, perimortem trauma—as seen in the images below—shows no sign of healing, since it occurred very near to the time that the victim died.



**Postmortem trauma** is damage that occurs to bones after a person's death. Bones become dry and brittle after death and, as a result, they may get broken or crushed. Since dry bone breaks differently from fresh bone, postmortem trauma can be easily identified by the shape and color of the injury. As shown in the images below, the border of postmortem fractures tend to have a lighter color than that of the surrounding bone. Also, postmortem trauma tends to demonstrate irregular fracture patterns that are not typical in perimortem injuries. Other postmortem changes to the bone may also result from scrapes left by tools, machinery or tooth marks from scavenging animals.



In addition to identifying when an injury occurred, forensic pathologists and anthropologists also need to determine how the injury was produced. In the following section, we will discuss the 3 types of traumatic injuries that affect the human body: blunt force trauma , sharp force trauma, and gunshot wounds.



# BLUNT FORCE TRAUMA

**Blunt force trauma** is produced when a blunt object impacts the body with force. It can result from intentional violence, such as attacks with bats, clubs, maces, pipes or stones, or with high impact accidents, such as falls or car crashes. Typical injuries include abrasions, bruises, lacerations and bone fractures. The location, size and shape of these injuries then permit forensic anthropologists and pathologists to make inferences about what caused them.

**Abrasions** are superficial injuries that occur when the skin is scraped, pressed or impacted resulting in the removal of its outer layer. Examples include fingernail scratches, “rope burns” from strangulation or binding of the hands and feet, and “rug burns” caused by dragging an individual over coarse surfaces.



**Bruises**, or contusions, occur when blood vessels are damaged by a forceful impact to the body, causing blood to pool beneath the skin. The affected area and amount of bleeding into the skin may be small (petechiae) or large (hematoma).

**Lacerations** occur when the skin is torn or split due to the application of force. In contrast to incisions that are produced by bladed objects, the edges of lacerations tend to display an irregular pattern, often with bridges of intact skin connecting the two sides of the injury.



When analyzing an injury, pathologists and forensic anthropologists attempt to establish the characteristics of the instrument that caused it. Artifact characteristics are usually described using relative categories, such as short or long and heavy or light. In general terms, short and light objects cause less damage than long and heavy ones. Depending on the object that causes the injury, blunt trauma can be described as “focal” or “diffused.” In general terms, focal injuries occur in a localized area, while diffused injuries occur over more widespread areas. For example, a hammer impact to the skull would produce a focal injury, while the impact of a windshield on the skull during a car crash would result in a diffuse injury.

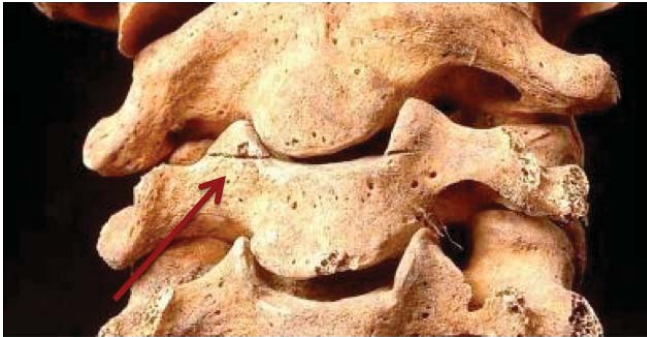
Keep in mind that any injury to soft tissue may also be accompanied by fractures to the underlying bones. On the long bones, a direct, forceful impact may create a special type of fracture, known as a “butterfly fracture,” which produces two opposing triangular fractures. The point in the middle where those two triangular fractures meet represents the point of impact. These types of fractures can also be reported in certain firearm injuries.



# SHARP FORCE TRAUMA

**Sharp force trauma** is produced when a sharp or pointed object impacts the body with force. Typical injuries include incisions, punctures and chop wounds produced by bladed instruments, such as knives, axes, machetes and ice picks.

**Incisions** result from being cut, or sliced, with a bladed instrument, such as a knife. Incisions tend to be characterized by straight, clean-edged wounds that are longer than they are deep.



**Punctures** result when a pointed object, such as an ice pick or a knife point, is applied with force to the body at a vertical, or near vertical, angle. This creates a stab wound in which the entry, and sometimes the exit, orifice can be observed. In contrast to incisions, a puncture wound is deeper than it is long.

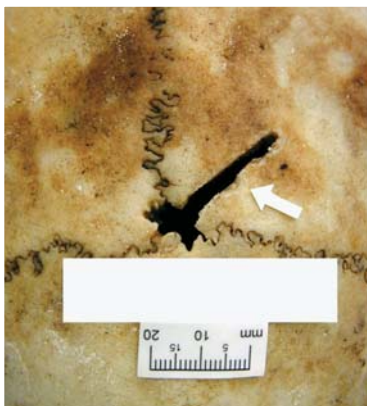


**Chops** result when a large bladed instrument, such as an ax or a machete, makes a forceful impact against the body. Due to the force of the injury, the edges around the wound may contain abrasions. In addition, the underlying bone is often damaged by the injury, resulting in the loss of bone fragments, known as “wastage,” from the affected area.



Forensic pathologists and anthropologists analyze these wounds to determine the type and size of instruments that caused them. For example, pathologists can analyze incisions to determine if the blade of the instrument was smooth or serrated. They can measure the width, length and depth of a puncture wound to determine the dimensions of the blade. And, they can analyze the length and width of chop wounds to determine the size of the blade and measure the depth of the wound to determine the magnitude of the force with which it was applied.

Keep in mind that while sharp force trauma leaves visible injuries on the exterior of the body, it may also cause damage to the bones underneath. As a result, forensic anthropologists can often identify incisions, punctures and chop wounds on skeletal remains, as well.



# GUNSHOT WOUNDS

Projectiles that are fired with a high degree of force can penetrate both soft tissue and bone. Bullets are the most common type of projectiles that cause these types of injuries. However, there are other weapons, such as arrows and shrapnel, which can cause similar wounds, although generally at much lower velocity.

Based on a careful analysis of gunshot wounds present in the body, forensic pathologists and anthropologists can often determine the type of firearm that caused the wounds, the characteristics of the projectiles that entered the body, the distance of the weapon from the victim when it was fired and the most probable sequence in which multiple injuries occurred.

## Basic notions of firearms and munitions

Before discussing the types of injuries gunshots produce on the body, we first need to review the different types of firearms and the properties they possess. To begin with, firearms are divided into three basic categories: handguns, rifles and shotguns. Each one of these can then be further classified according to its velocity, size and the ammunition it fires.

**Velocity** refers to the speed at which the projectile hits its target and has a great effect on the type of wound, or damage, produced. Weapons are classified as low, medium or high velocity. In general, handguns and shotguns are medium velocity weapons and rifles are high velocity. Since a higher velocity carries more kinetic energy, weapons of a higher velocity cause greater damage.

**Size** refers to the diameter of a projectile or the barrel of the weapon that shoots it. The size is given in terms of caliber, gauge or number. The term “caliber,” which is used for handguns and rifles is given in

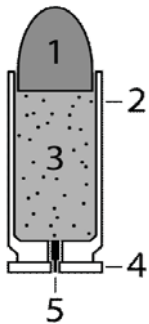
hundredths of inches or millimeters. Sometimes, however, the actual diameter of a bullet may differ from that indicated by the manufacturer.

In contrast to handguns and rifles, shotgun barrel diameters are measured according to their gauge, which represents the maximum weight of a lead ball that can fit into the barrel of the weapon. Shotgun ammunition is then given a numerical code that indicates the size and number of pellets it contains.

**Ammunition** can consist of single projectiles, in the case of bullets, or multiple projectiles, in the case of a shotgun cartridge loaded with pellets. There are many different types of ammunition, and they produce different effects based on their design. Here, we present some general characteristics.

### Handgun and rifle ammunition

A modern cartridge consists of the following:



1. The bullet itself, which serves as the projectile.
2. The case, which holds all parts of the bullet together.
3. The propellant, for example gunpowder or cordite.
4. The rim, part of the casing used for loading.
5. The primer that ignites the propellant.

Most bullets have one of three profiles: round nose, flat nose, or hollow-point (also known as soft point). Hollow-point bullets can be easily identified because they have an indentation in the tip that allows them to expand or deform upon impact.

The majority of bullets are solid lead, although some may contain a rod or core of a hard metal, such as steel. These bullets include armor piercing bullets and hollow-point bullets.

Finally, bullets may be encased in a **jacket** to increase the bullet strength and to prevent the lead bullet from damaging the inside of the gun barrel. The jacket refers to a thin metal sheet on the outside of the bullet usually made of an alloy of copper and zinc that strengthens the lead bullet, allowing it to be used in higher velocity weapons. A **full-metal jacket** bullet means that the jacket covers the entire lead bullet. This allows for it to be shot at greater velocity while preventing the soft lead interior of the bullet from accumulating on the inside of the gun barrel. In semi-jacketed bullets, which are typically associated with hollow-points, the jacket only covers the base and sides of the bullets to allow the tip to deform upon contact.

The Hague Convention of 1899 prohibits military use of ammunition that flattens or expands upon entering the body, including hollow-point bullets, since they are designed to cause maximum damage to body tissues and internal organs.

## Shotgun ammunition

Shotgun ammunition consists primarily of a shell containing either lead pellets (also known as shot) or a shotgun slug. Shotgun shells are generally made out of a plastic case with a brass base at the bottom. Inside the shell, a plastic or felt wad separates the projectile from the gunpowder. The pellets generally consist of either lead or steel and can range from about 2 mm to 9mm in diameter. A slug is a single lead projectile that allows the shotgun to be used like a rifle, though the projectile is fired at medium velocity.



Shotgun pellets and slugs.

## Entrance and exit wounds

Identifying the entrance and exit wounds can help to determine the path of the bullet as it passed through the body. In general terms, the hole produced when the projectile enters the body is smaller than the hole produced when it exits the body.

The relationship between the entrance and exit wounds provides important information about the relative position of the weapon to the victim when it was fired. To identify the path, or trajectory, that the bullet travelled, forensic pathologists and anthropologists often insert a wooden guide, or a “probe,” through the entrance wound and the exit wound. Using the probe as an indicator, they can then better visualize the direction from which the projectile impacted the body. For example, if a victim received a gunshot wound that entered in the top of the head and exited from underneath the chin, forensic pathologists and anthropologists can easily infer that the killer must have fired the shot from a position above the victim. In such a case, it is possible that the killer could have fired the shot down on the victim from an elevated area, or the perpetrator could have been standing over the victim as he or she was seated or kneeling below.



Entrance wound.



Exit wound.



## Estimating the distance of the shooter to the victim

In cases involving wounds produced from handguns and rifles, forensic pathologists and anthropologist look for soot and burn patterns on the victim's body and clothing to determine the distance that a shooter stood from the victim when the weapon was fired. In cases involving shotgun wounds, they measure the space between pellet wounds on the victim's body to estimate the shooter's distance from the victim.

**Contact wounds** are produced when the gun muzzle is pressed against the skin of the victim. When the weapon is fired, the hot gases liberated from the barrel of the gun leave either a ring of black soot around the entrance wound or tear the skin in a star-shaped pattern, known as a stellate wound. Stellate patterns can easily be distinguished from exit wounds by the smoke-colored mark around the edges of the injury. These smoke-colored marks, which appear on of the outer portion of the entry wound, can also be seen on the bone.



Ring of black soot around a contact wound.

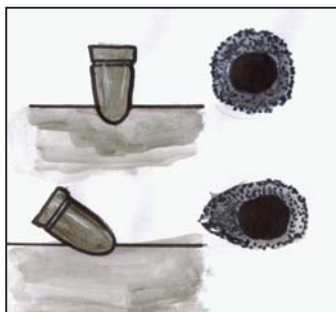


Stellate wound.



A **near contact wound**, or intermediate distance wound, is produced when the weapon is fired with the muzzle held at a short distance from the body. Near contact wounds typically leave a distinctive powder tattooing pattern on the skin around the wound.

The angle at which the bullet enters can leave specific defects as in the following image. In contact wounds, the angle of the muzzle maybe determined by the pattern left on the skin.



Redrawn from DiMaio y Dana, 2007.

Shotguns are medium velocity weapons and cause most damage at close ranges. The pellets that a shotgun expels travel in a cone shape and spread out as they travel through the air away from the firearm. By measuring the space between pellet wounds on a victim's body, forensic pathologists and anthropologists can estimate the distance that the shooter was standing from the victim when he or she pulled the trigger.



Contact wound produced by a shotgun. The entrance wound on the side of the body is marked with a ring of soot. The exit wounds show the dispersion of the pellets inside the body.

## Gunshot wounds in bone

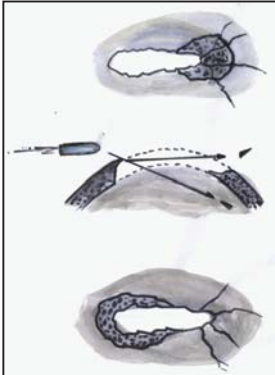
When a projectile penetrates a bone, it creates a funnel-shaped hole. The small hole on the narrow side of the funnel represents the place where the bullet entered the bone, while the large hole on the wider side of the funnel represents the place where the bullet exited the bone. The phenomena that creates these funnel-shaped holes is called “beveling,” and forensic anthropologists use it to determine the path, or trajectory, of the projectile as it moved through the body.



An exit wound showing beveling on the outer part of the skull.

The size of the entrance wound can also provide important information regarding the caliber of the bullet that caused it. To do this, forensic anthropologists measure the diameter of the entrance wound and, based on that measurement, categorize the caliber as either large or small.

**Wound shape:** Wounds in bone can be round, oval, irregular or keyhole-shaped. The shape of the wound depends on many factors, including the type of bullet used, the angle of trajectory and whether it is an entry or exit wound.



**Keyhole wounds** have the shape of an old-fashioned keyhole (circular at one end and triangular at the other). They are usually produced when a bullet grazes the surface of the bone with shallow penetration, creating a combined entrance and exit wound pattern that resembles a keyhole. As illustrated in the following graphic, keyhole wounds are composed of a round entrance hole with inward beveling joined to a fairly triangular exit wound with outward beveling.

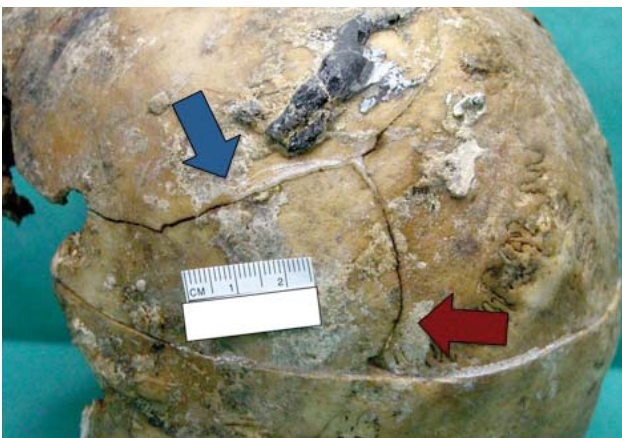
Redrawn from DiMaio and Dana, 2007.

## Gunshot patterns in the skull

In the same way that a ball does when it is thrown against a windowpane, a gunshot impact to the skull creates two types of fractures: radiating fractures and circular fractures.

**Radiating fractures** originate from the bullet's point of impact and move away from it, as if they were rays "radiating" from the sun.

**Concentric fractures**, on the other hand, circle the bullet's point of impact and spread between the radiating fractures.



In this photo, the line indicated with a red arrow is a concentric fracture and the line indicated with a blue arrow is a radiating fracture.

## Shotgun injuries

Shotguns are more effective at shorter distances, since pellets lose velocity and spread out through the air. As a result, they may enter into bone but do not normally pass all the way through it. Depending on the amount of tissue surrounding the point of injury and the proximity of the shooter, however, the pellets may cause lethal injuries. The individual injuries that shotgun pellets leave on bone demonstrate the same internal and external beveling as the injuries that bullets create.



Shotgun wounds.

## Determining the sequence of gunshot wounds

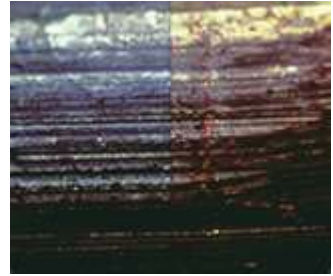
Postmortem analysis can also provide us with important information regarding the sequence of gunshot wounds. As we've discussed, a gunshot wound to the skull creates a series of fractures. When a second gunshot impacts the skull, it will create fractures that stop at the existing fractures from the first gunshot wound. By analyzing these patterns, we can determine

which injury happened first and which came second. Use this criteria to analyze the picture to the left. Given what you now know about skull fractures, can you tell which gunshot wound was delivered first? The gunshot wound on the bottom occurred first, since the fracture from the wound above stops at its radiating fracture.



## Fundamental principles of ballistic analysis

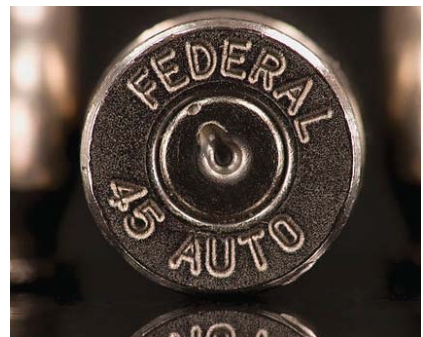
Gun manufacturers cut spiral grooves into the barrels of handguns and rifles to make the bullets spin rapidly and improve the accuracy of the weapon. These grooves leave individual markings, called striations, on the sides of the bullet as it travels through the barrel. These unique markings can be identified under a microscope in order to match a bullet recovered from a crime scene with a test-bullet fired from



Bullet striations

a suspect's gun. For this reason, when recovering a bullet from a crime scene, investigators should make every effort not to damage or alter the side of the discharged bullet. If the bullet is lodged in a wall, for example, they should carefully chip away the surrounding wall material to free the bullet. If the bullet needs to be marked to identify it, it is best to mark it on the top or bottom of the bullet so as not to obstruct the unique markings on the side.

The impact of a gun's firing pin on the back of a casing ignites the powder that expels the bullet. Similar to the markings left on a bullet as it travels through the barrel of a gun, the firing pin also contains tiny imperfections that will leave unique marks on the back of a casing. If the bullet casing needs to be marked to identify it, the mark should be made on the side of the casing so as to avoid obstructing the unique markings on its base.



Firing pin, photo by kcadsTM  
([http://commons.wikimedia.org/wiki/File:Federal\\_45\\_ACP\\_primer\\_cap.jpg?uselang=es](http://commons.wikimedia.org/wiki/File:Federal_45_ACP_primer_cap.jpg?uselang=es))

Just as with fingerprints, the spiral grooves and firing pins from different firearms are unique and individual. Therefore, no two firearms will leave marks that look exactly the same.

## DNA ANALYSIS

DNA analysis can be an important tool for identifying the remains of unknown victims or for connecting perpetrators to a crime scene based on the biological material that they may inadvertently leave behind. However, as we saw with other types of laboratory analysis in Chapter 3, making an identification with DNA requires a control, or reference, sample against which the sample from the crime scene can be compared. In other words, the DNA analysis of biological material that is recovered in a crime scene will not provide you with information about a person's identity unless you have a control sample from a suspect that you can compare it with. We will discuss how this process works in more detail later in this section. For now, it is only important that you understand that DNA analysis is not a magic substitute for the type of good, traditional investigative work that can narrow down possible perpetrators to a list of likely suspects or develop a theory as to the possible identity of an unknown victim. Rather, DNA analysis becomes helpful precisely when investigators have narrowed the list of suspected persons through the information they collected during the preliminary investigation, the recovery of evidence from the crime scene and the laboratory analysis of victims' remains.

### What is DNA?

DNA is a code that contains the instructions for how our bodies are built. This code can be read and translated into something called a "genetic profile." We inherit half of the DNA in our genetic profile from our mothers and the other half from our fathers. Each half carries information regarding the same types of traits that exist in the human body, such as eye color, hair color and blood type. These traits are found on everyone's DNA at the same location, or **locus** (plural **loci**). The individual genes that each person receives from their parents determine the exact characteristics that those traits will express, such as blue eyes, brown hair or AB blood type. These characteristics, which make each individual unique, are called **alleles**. For every locus, there are two alleles: one inherited from our mothers and one inherited from our fathers.



Inherited from the mother



Inherited from the father

A genetic profile is the report of the alleles that a person has in a specific set of loci. Alleles are expressed as numbers according to their particular length. For example, an allele represented with the number 12 means that it is 12 repetitions long; an allele with the number 13 is 13 repetitions long and so forth. Therefore, a genetic profile looks as follows:

<b>Locus</b>	<b>(Allele 1,Allele 2)</b>
D8S1179	(11,12)
D21S11	(12,12)
D3S1368	(13,15)
D7S820	(11,14)
D3S135B	(10,12)

There are two ways of using a genetic profile to identify a person: one, through a direct match or, two, by kinship comparison. We will look at these two methods in more detail in the following section.



## Direct Match

It is often possible to find biological samples in a crime scene. A biological sample can be composed of blood, saliva, hair, semen, bones, teeth and other tissues or fluids from the body. The genetic profile of the sample will be the same as the genetic profile of the person it belongs to. Therefore, it is possible to determine the identity of the person that left the biological sample in the crime scene, if we have a reference sample from a suspect to compare it with. If the genetic profiles of both samples coincide, we can establish the identity of the person through a direct match.

For the following illustration, imagine that forensic investigators have collected blood samples from a crime scene that they believe were left by the perpetrator. Due to their thorough investigation of the case, they have now narrowed down their list of possible perpetrators to one primary suspect. After getting a court order to collect a buccal swab of the suspect's saliva, the DNA laboratory runs an analysis on the blood sample from the crime scene and the reference sample from the suspect. As you can see below, the alleles at each locus are identical between the crime scene sample and the reference sample, resulting in a direct match.



D8S1179 (11,12)  
D21S11 (12,12)  
D3S1368 (13,15)  
D7S820 (11,14)  
D3S135B (10,12)

D8S1179 (11,12)  
D21S11 (12,12)  
D3S1368 (13,15)  
D7S820 (11,14)  
D3S135B (10,12)

## Kinship

Identification can also be made by comparing a person's genetic profile with the genetic profiles of their closest relatives.

The easiest relationships to establish are maternity and paternity. Since we inherit half of our DNA from each parent, one of our alleles must always come from our mother and the other from our father.



The following example shows the DNA for a mother, father and daughter at locus D3S1358.

Locus D3S1358:  
Mother (14, 13), Father (15, 16), Daughter (13, 16)

As you can see, the daughter inherited allele 13 from her mother and allele 16 from her father. If we extended the genetic profiles to include an entire set of loci, we would see this pattern repeated, making it easy to determine that the daughter belongs to this particular set of parents.

Not all relationships are as easy to establish as paternity or maternity, however. Brothers and sisters, as well as other close relatives, share

a great amount of genetic information, but the correlation is not as direct as the one between a mother and father and their child. In these cases, kinship analysis compares different genetic profiles to establish the probability that two people are related. The basic idea is that the probability of kinship increases with the number of alleles that two people share across a specific set of loci. In order to arrive at an even higher probability of identification, particularly in cases where a victim's identity is unknown, DNA analysts may increase the number of loci that they analyze on the genetic profiles of a victim and a potential relative, or collect more samples from other close relatives.

As opposed to a direct match, kinship identification will not produce a result such as “this is Alejandro.” Rather, it will give results like “this is the son of Felix and Maria”, or “this is a member of the Navarro family”.

For identification by kinship at least two samples are required: a sample from the person you are trying to identify and a reference sample from one or more of that person's close relatives. In order to get these reference samples, investigators must first develop a theory about who the person in question is and then locate possible family members whose genetic profiles could confirm the person's identity. This requires investigators to conduct a thorough investigation into the case in order to narrow down the potential identity of the person before any DNA analysis can take place.

## Types of DNA

Three types of DNA are used for the purpose of analysis:

**Nuclear DNA** is most commonly used for identification. Nuclear DNA, like the examples seen above, is inherited from both our fathers and our mothers. It provides results such as “this is the son of George and Laura” or “this is Manny's brother.” It cannot, however, be used to distinguish between siblings. For example, though it can tell you

that “this is the son of George and Laura,” it cannot tell you which of George and Laura’s sons the individual is.

**Mitochondrial DNA** is only inherited from the mother and provides results such as “this person belongs to the Cruz family.” It is widely used in population studies, but does not distinguish between cousins, brothers, parents or children. Therefore, it cannot help in making identification in cases where more than one of the victims may be related.

**Y chromosome DNA** is present only in men and, as a result, it is only passed from a father to a son. As in the case of mitochondrial DNA, it provides results such as “this person belongs to the Castro family” but does not distinguish between cousins, parents or children.

## Limitations

It is important to note that, while DNA identification is precise, it can never identify someone with 100% certainty. Therefore, before requesting DNA analysis, investigators should conduct a thorough preliminary investigation of the case to narrow their list of potential victims. Once the victim’s remains have been recovered and transferred to the forensic laboratory for analysis, forensic pathologists and anthropologists can make important observations about the victim’s age, sex and individual characteristics that may further help to reduce the population of potential victims and increase the probability of a positive identification.

The importance of this process may not be readily apparent in a case where 3 people’s remains are incinerated in a car accident and investigators must determine who is who. In cases of mass violence, however, with dozens of victims or in cases of natural disasters with thousands of victims, narrowing the population of potential victims is absolutely critical.

As mentioned above, one of the main limitations of kinship identification is that it can provide general information about family relationship—“this is the son of George and Laura” or “this person belongs to the

Cruz family”—but it cannot distinguish between siblings and, in some cases, not even between cousins. This is particularly problematic in populations with high rates of intermarriage in which the vast majority of its members are related to one another. For this reason, identification should first try to be established through a medical or anthropological examination of the remains before beginning the process of DNA analysis.

Finally, there are some technical limitations involved with DNA analysis. DNA, like all biological material, degrades over time, and degradation can often lead to an incomplete, or inconclusive, analysis. Though some laboratories have the ability to analyze very difficult samples, not all samples will be good enough to produce conclusive results. Samples can also become contaminated with the DNA of the people who handle them. As a result, the environment in which the DNA samples are taken and handled must be sealed off from unauthorized people, and genetic profiles must be taken for those people who come in contact with the samples in order to control for contamination.

## Collecting Samples

Collecting DNA samples from the living or deceased may meet with understandable resistance for religious and/or personal reasons. Therefore, it is important to clearly explain to the victims’ relatives how the samples will be collected, how and for what reasons they will be used, and what their importance is for the investigation so that they have clear expectations for how their DNA will be used.



DNA samples can be collected in the field and then transported to the laboratory for analysis.



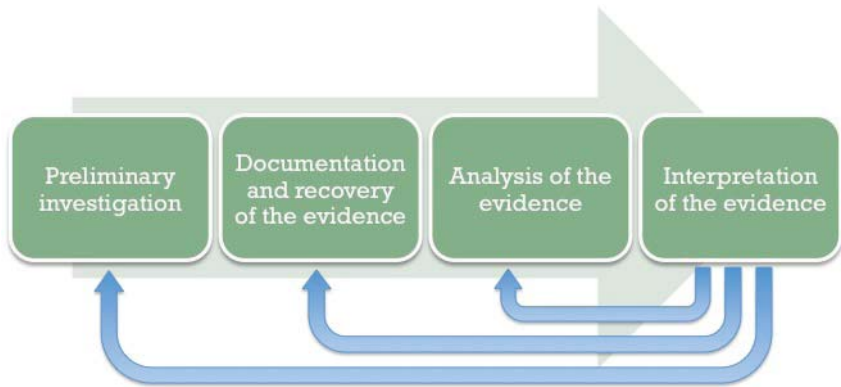
Chapter V  
Interpretation of the Evidence





# INTERPRETATION

This is the stage of the investigation where we put everything that we have observed together in order to draw conclusions from the evidence. In truth, investigators begin interpreting evidence and drawing conclusions about it throughout the entire investigation. Those conclusions may lead the investigators to search for new evidence, seek more analysis, or return to conduct a more thorough preliminary investigation, as represented in the image below.



When interpreting a crime scene, there are two fundamental principles that forensic investigators must adhere to:

1. Every single conclusion must be supported by the evidence. If you cannot provide evidence to support your conclusion, it is speculative and must be excluded from your interpretation. Forensic science, like any other scientific discipline, is empirical and its conclusions must be based on fact.
2. Since forensic investigators generally arrive at the scene after the crime has been committed, they are not direct witnesses to the crime. As a result, they cannot express their interpretations in terms of absolute certainty. Therefore, they must always couch their interpretations in qualifying language that suggests the possibility of other explanations. Instead of saying, “Johnny Castillo died from a gunshot wound to the head,” a forensic pathologist should say, “the

most probable cause of Johnny Castillo's death is a gunshot wound to the head." The second example is more appropriate because it expresses a degree of certainty, yet allows for other possible explanations. Other types of qualifying language that suggest varying degrees of certainty, include words such as "probably" and "possibly." Of the following two examples, which one expresses more certainty: 1) "the remains probably belong to Ms. María García;" or 2) "the remains possibly belong to Ms. María García." If you chose example number 1, you are correct, since probably expresses more certainty than possibly. To explain why, consider the following example: When investigating a murder case, it is possible that aliens came down from outer space to commit the crime, but it is not probable. Keep in mind when formulating your conclusions that, while anything is possible, not everything is probable.

## PATTERNS AND INTERPRETATION

As discussed in Chapter I, forensic experts attempt to identify patterns in the evidence that can help to reconstruct the circumstances surrounding the crime. This is true regardless of the type of case under investigation. In a murder case, for example, investigators would look for patterns in the victim's injuries—their size, depth and shape—in order to determine the nature of the murder weapon that caused them. Based on the type of weapon used and the number of wounds on the body, investigators may be able to make further inferences regarding the perpetrator's access to resources or intention to kill. Evidence of multiple footprint patterns or fingerprints in the crime scene could also indicate whether one or more people participated in the crime. Evidence of forced entry could help to establish if the perpetrator was familiar with the victim or not. As you can see, there are an infinite number of patterns within the evidence that could help to elucidate the crime. The investigator's job, therefore, is to be observant of these patterns and think critically about their implications for the investigation.

In the following section, we will take a look at a number of general patterns that are often present in cases involving violations of IHL and IHRL. Though we have chosen to focus on these particular cases for analysis, it is important to remember that the principles of observation and critical reasoning that underlie the interpretation of evidence are the same regardless of the nature of the crime.

### **Resources employed to carry out the crime**

As mentioned in the example above, material evidence in the crime scene can suggest the types of resources that were needed to carry out the crime. Access to greater resources often distinguishes crimes committed by individual actors from those that may have been committed by corporate groups, such as the armed forces, paramilitary groups or rebel combatants. If activities leave artifacts or modifications in the environment, we can infer what types of resources were necessary to undertake those activities.

Look at the following pictures of two different gravesites. The first picture shows two victims placed within a grave so shallow that the skull of body number 1 protrudes above the surface. The nature of the grave suggests that it may have been created in haste by no more than one or two people digging with a common shovel. The second picture shows a much different scenario. There we see a gravesite with dozens of bodies over a massive area, most likely dug with a mechanical excavator. This suggests that a group of people, with access to significant resources and a high level of organization, worked together to dig the grave and place the bodies inside.



## Proportionality of Force: Intention

The intensity of force used to kill someone can also indicate the intention of the perpetrator. For example, a suspect in a stabbing death may argue that he was acting in self-defense in order to incapacitate his attacker and escape from the scene. Such an explanation may be consistent with one or two stab wounds on the victims body, but would seem less credible if the victim had been stabbed dozens of times in areas containing vital organs. In this second scenario, the pattern of wounds on the body is more consistent with a pattern of injury that indicates an intention to kill.

## Distribution of age and sex of the victims

In traditional armed conflict situations, the majority of the dead and injured tend to be men of fighting age. In violations of IHL and IHRL, however, we often see that the distribution of the victims is more consistent with the demography of civilian populations and includes significant percentages of women, children and the elderly.

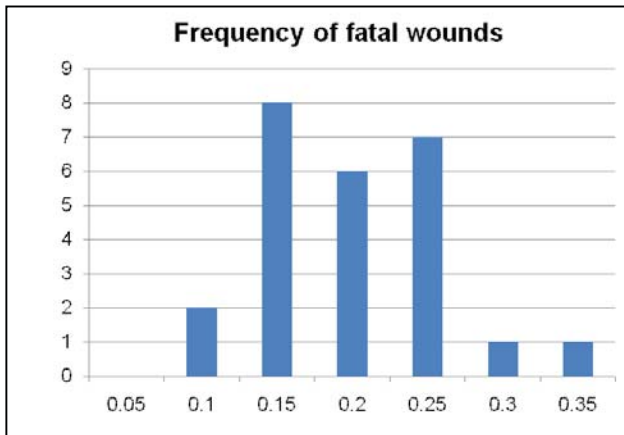
Similarly, if certain ethnic, religious or minority groups turn up in disproportionate numbers among the dead and injured, investigators should question the nature of the violence and the intention of the perpetrators. Remember, as we mentioned in Chapter 1, State responsibility for such killings can be engaged even if State agents are not directly involved in the killings. Under IHRL, States have a positive obligation to protect the enjoyment of the right to life and to intervene to stop the killing of vulnerable groups.



## Proportion of injured vs. dead

The percentage of non-fatal wounds versus the number of fatal wounds in an armed conflict can also indicate violations of IHL and IHRL. In traditional armed conflict, non-fatal wounds typically outweigh the number of fatal wounds by more than 2 to 1. Therefore, if the number of fatal wounds in an armed conflict is higher than one third of the total number of wounds inflicted, an investigation should be initiated.

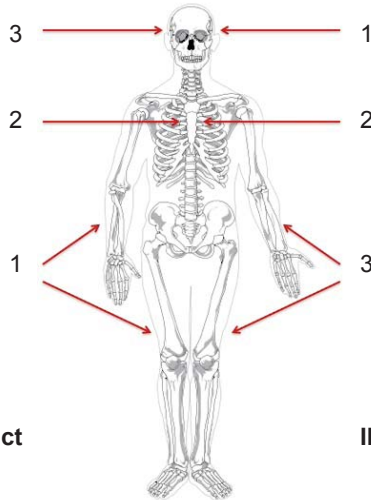
As indicated in the graph below, the frequency of fatal wounds in traditional armed conflicts usually is between 15 and 25 percent of the total number of wounds inflicted.



Distribution of frequencies of fatal wounds in conventional warfare conflicts. (Snow et al. 2008)

## Mechanisms and distribution of injuries

In traditional armed conflict, shrapnel wounds are the primary source of injury, followed by gunshot wounds. Among those injuries, wounds to the arms and legs are most common, followed by injuries to the chest and then to the head. In violations of IHL and IHRL, however, this pattern is reversed: gunshots cause more wounds than shrapnel, and the most common injuries occur to the head, followed by the chest and then the arms and legs.



**Traditional conflict**

**IHL/IHRL violations**

With this in mind, what might you infer from a mass grave where 80% of the wounds are fatal wounds to the head and chest? In such a case, the pattern of injuries would be more consistent with deaths resulting from violations to IHL and IHRL than deaths from armed combat. Furthermore, this evidence would strongly suggest an intention to kill.

With this in mind, what might you infer from a mass grave where 80% of the wounds are fatal wounds to the head and chest? In such a case, the pattern of injuries would be more consistent with deaths resulting from violations to IHL and IHRL than deaths from armed combat and would suggest an intention to kill.

## Torture?

Recent research on human remains from cases involving violations of IHL and IHRL has concluded that there are some patterns of injuries that can be interpreted as signs of torture, particularly those that involve rib and sternum fractures. These injuries typically result from slow loading force associated with stomping, kicking or beatings. Fractures may also occur in other areas, such as the teeth when the victim is made to bite against a hard object, like the muzzle of a gun.

It is important to keep in mind, however, that not all cases of torture result in these type of fractures, and it is entirely possible that a victim may have been tortured without leaving any evidence of abuse on the skeletal remains.



# THE FORENSIC REPORT

The forensic report summarizes the investigation so that its findings and conclusions can be shared with other investigators, prosecutors or judicial authorities that form part of the investigation. When writing a forensic report, therefore, it is important that it be complete, legible and easy to read.

Though there are many different formats for forensic reports, it is important for a forensic team to use a standard format to make sure that every report includes all the necessary information in an organized structure. Standard categories include:

**Date and author of the report:** This information allows you to identify when the report was produced and to whom any questions should be addressed.

**Summary:** A brief summary of the findings and conclusions for those who will not be able to read the entire report.

**Introduction:** The introduction should include information on who commissioned the report, the names of the members from the investigative team and a description of the objectives of the investigation.

**Case background:** The case background includes a brief description of the events under investigation, along with details about any previous investigations that may have been undertaken, who conducted them and a description of their findings.

**Methodology:** Here we include a detailed description of the steps taken during the investigation. If the report covers the documentation and recovery of the evidence, for example, it should include a thorough description of how the crime scene was secured and processed and include supporting photographic evidence. Keep in mind that the descriptions provided in this section need to be as simple as possible,

since they may be shared with prosecutors and judges who are not forensic specialists.

**Findings:** The findings of the case include a clear description of all the evidence discovered throughout the investigation, including bodies, artifacts, evidence of injuries and any important modifications observed in the crime scene. Every piece of evidence listed in this section must be supported by documentation, such as photographs, signed testimonies and laboratory reports. Each of these documents should be included in the annex to the report.

**Conclusions:** This section includes the investigator's interpretation of the evidence presented in the findings. Remember that every interpretation must be supported by evidence and should be stated using appropriate qualifying language that leaves open the possibility of alternative explanations. For example, instead of concluding that "the victim was executed by the military," a forensic report should state that "the most probable cause of death is a gunshot wound to the back of the head" and "official military ammunition was found associated with the crime scene." The conclusion that the military is responsible for the crime is a determination that the competent legal authorities should make and is outside the scope of a forensic investigation. On the other hand, if patterns found in the evidence can be associated with studied behavior, interpretations can be reasonably stated in the following way: "The pattern of the injuries found on the victim's remains is inconsistent with the patterns found in traditional combat."

**Recommendations:** In this section, investigators make a clear statement regarding further steps that need to be taken to complete the investigation, including follow-up analysis, new sites that should be investigated and further witnesses to interview. Any problems encountered during the investigative process and possible solutions for future investigations should also be discussed.

**Annex:** The annex includes all supporting documentation for the investigation, including witness statements, maps, diagrams, forms, laboratory reports and the complete photographic record.

# CONCLUSION

After reading this manual, you now have a basic understanding of how forensic investigations into extrajudicial executions and forced disappearances are conducted, as well as the type of interpretations that forensic investigators can make based on the evidence they find in a crime scene. As you have seen throughout these pages, forensic investigations can provide important information for reconstructing the events of a crime. However, you should also be aware that forensic science has its limitations.

Unlike in the movies and on television, forensic science cannot magically provide investigators with all the answers they need to solve a crime. As you have learned, forensic investigators are limited to making conclusions based on the evidence that they have collected. Many times due to insufficient evidence or inconclusive analyses, these conclusions will not give them all the information they need to completely reconstruct the crime. However, they can help investigators to get a more complete picture of what may have happened. Frequently, the results of forensic investigations will lead them to ask more questions about the crime. Depending on those results, they may decide to go back to their preliminary investigation and collect more information that may lead them to other related crime scenes with more evidence to analyze and interpret.

Given these limitations, it is important that investigators get the most information they can from every investigation they conduct. As a result, it is important to conduct the investigation as carefully and meticulously as possible so that no evidence is missed, lost, damaged or contaminated along the way. Also, keep in mind that forensic investigators will often hand their documentation to other investigators, laboratory analysts, prosecutors or judges, and it is important to keep orderly records that can easily be understood or interpreted by others who may receive them down the line.

Through this manual, we have attempted to provide you with a comprehensive description of the way in which forensic investigations are conducted. We have discussed the forensic investigation proces

as one that follows a simple, logical progression from the preliminary investigation of the case, to the documentation and recovery of the evidence, to the analysis of that evidence and its eventual interpretation in the forensic report. Though we have described this process primarily within the context of investigations into extrajudicial executions and forced disappearances, it is our hope that the basic logical structure presented here will empower you to apply what you have learned to the many different human rights violations that you may be asked to investigate.

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