CRIME-SCENE INVESTIGATION AND EXAMINATION

Contents

Collection and Chain of Evidence

T M Palmbach, University of New Haven, West Haven, CT, USA

Introduction

Crime-scene investigation is an integral component of many aspects of more general investigations. It can provide investigative leads, aid in the identification of suspect(s) or victim(s), prove or disprove alibis, identify a *modus operandi*, establish the *corpus delicti*, and create linkages and associations among the victim, suspect, scene, and evidence. Evidence may consist of transient, conditional, pattern, transfer, or a diverse variety of physical evidence.

If the full potential of physical evidence is to be achieved there are certain safeguards and standards that must be met. Evidence must be collected in a manner that will preserve the integrity and evidentiary value. In addition, each piece of evidence must be collected and maintained in such a manner that it can be authenticated and proven to be in the substantially same condition as when initially collected. This so-called chain of custody must be established from the moment evidence is first in custody until the conclusion of analysis and legal proceedings.

Physical Evidence

The role and value of physical evidence to an investigation can be best expressed by the four-way linkage theory (Figure 1). This theory postulates that there are four key components in an investigation: (1) suspect; (2) victim; (3) scene; and (4) evidence, and that a reliable and objective means of solving a case is to establish linkages between these components. The more linkages established, the greater the probability of resolving an investigation. No one component necessarily bears any more weight than another. Ideally, the suspect, victim, scene, and relevant evidence will be identified and associations between them established. However, it is possible to solve a case without locating the primary scene, the actual body of the victim, the exact identity of the offender, or several pieces of key evidence. For example, the trial may proceed without the recovery of the victim's body and only a circumstantial case that established homicide has occurred and an identification of the victim through analysis of partial remains, such as DNA analysis of a blood stain. Moreover, forensic examinations may identify a common perpetrator in a series of cases through methods such as fingerprint, bite mark, or DNA analysis and yet the true identity of the offender remains unknown. Modern mass media exposure and public interest in crime scenes, forensic science, and investigations have created jury pools that hunger for each of the primary four components, and most particularly physical evidence.

What constitutes physical evidence in a particular case will often vary and be difficult to determine. However, recognition that a particular object is to be a piece of physical evidence is only the first step in a sequential process that must be undertaken with each piece of evidence (Figure 2). Recognition of an

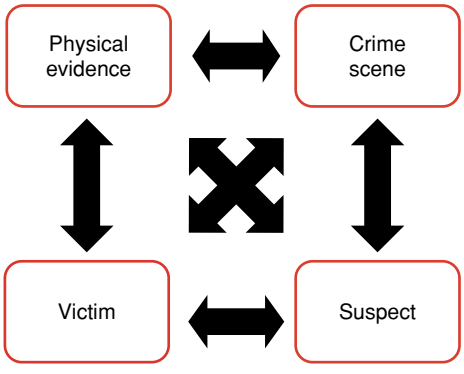


Figure 1 Four-way linkage theory.

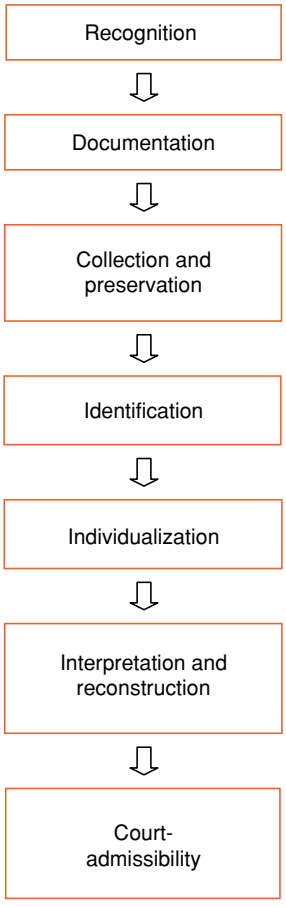


Figure 2 Sequential schematic processing of evidence.

object as potentially possessing evidentiary value is dependent upon the case particulars and the experience and training of the crime-scene investigator. After recognition and before the evidence is touched or altered in any way, the evidence must be thoroughly documented. Documentation includes a variety of functions, such as note-taking, photographs, videotaping, and sketch preparation. After documentation is complete the evidence may be properly collected and preserved. The nature and method of collection and preservation will depend on the nature of the evidence, such as whether it is chemical, biological, or physical in nature. After documentation the identification of the evidence is the next logical step. This step may or may not require sophisticated laboratory analysis. Once the item is identified an examination scheme can be implemented to develop further class characteristics and proceed toward an individualizing methodology. Individualization of an object will require comparisons of the object to known standards or the source. For example, a paint chip located on the clothing of a hit-and-run victim may be compared to either known automobile paint databases or to samples of paint obtained from the suspect's car. Once the examination process is complete scientists will need to evaluate and interpret the results in a scientifically reliable and objective manner.

In many instances, such as the example above, true individualization may not be possible. Rather, the correct conclusion is that the known and unknown samples were similar in all observed characteristics. This information can then be collated with other available information in a reconstruction process.

Documentation

Documentation of physical evidence is best accomplished through a variety of means. The item should be photographed and videotaped in place, showing both overall perspectives and close-up photographs, some taken with scales or rulers in the photograph. In addition, the exact location where the item was located must be recorded. Usually, obtaining fixed measurements for each item of evidence and incorporating those measurements in a crime-scene sketch is the method of choice. Finally, notes should be maintained articulating every aspect of the process from discovery until the examination of the evidence is complete. Documentation functions should occur before, during, and after collection of the evidence. For a given piece of evidence there may be numerous photographs or documentations, some obtained at the crime scene and others during the examination process at the medical examiner's office or forensic science laboratory.

Proper documentation is required for many purposes – to document the crime scene for reconstruction or investigative purposes, to serve as demonstrative aids for legal proceedings, or to help establish and maintain a chain of custody for that particular piece of evidence.

Collection

General Considerations

The proper collection of evidence is determined by the nature of the evidence and potential uses or examination schemes to be employed. As a general proposition, evidence should be handled and packaged in a manner that minimizes the possibility of contamination, destruction, or spoilage. In addition, packaging and labeling must be sufficient to establish the authenticity and chain of custody in future proceedings.

The size and amount of sample to be collected will vary, but it is better to collect more samples than an amount so small that full analysis cannot be conducted. In addition to unknown or questioned samples it is important to collect known standards for

comparison, such as a carpet sample from the room where the assault allegedly occurred. In addition, control samples may be beneficial for analysis and interpretation of the laboratory results. For example, in a suspected arson scene samples of the oak flooring apart from the suspected point of origin should be obtained. Known standards, such as blood, hair, and fingerprints, should be taken from the victim at autopsy or during medical evaluation and treatment.

Biological Evidence

Biological evidence or items of evidence containing trace amounts of biological material requires special handling and packaging. Commonly encountered biological samples contain blood, semen, saliva, urine, feces, vomit, tissue, bone, and teeth. General precautions must be taken to preserve the biological evidence, preventing spoilage or bacterial growth that can negatively impact on subsequent testing.

Thus, items with biological stains must be air-dried before packaging and should be placed in nonairtight containers such as paper bags or envelopes. In addition, care must be used to avoid contaminating the samples either by the individual who is collecting or handling the samples or from cross-contamination between samples. Cross-contamination can occur if collection tools such as forceps or scalpels are not properly cleaned between each sample. Alternatively, disposable tweezers, pipettes, or other collection devices can be used. Contamination has always been an issue, but now more than ever it is a concern due to the increased sensitivity of DNA-typing methods. Mitochondrial DNA testing is particularly sensitive, thus even minute amounts of contamination will likely appear in the analysis. Minor components detected in case samples can be very problematic in interpretation and may subject one to claims of insufficient evidence-handling and preservation. Finally, by their very nature, biological materials may contain a wide variety of pathogens or harmful agents; therefore, anyone exposed to the evidence must employ universal precautions. Minimally this means handling the evidence with gloved hands, but may also require the examiner to don full protective wear, including a face mask and hairnet.

Blood

Liquid blood can be collected on a sterilized cotton swab and allowed to air-dry. With large amounts of liquid blood the sample can be pipetted, placed in a purple-topped (with ethylenediaminetetraacetic acid) Vacutainer test-tube, and refrigerated. With dried blood stains there are a few options. First, if possible, the entire item with the dried blood stain can be collected or the area containing the blood may be cut and collected. Alternatively, the dried blood stain can be collected on a sterile swab moistened with saline solution or distilled water (Figure 3). Other less desirable options include scraping the stain or lifting the stain with adhesive lifters.

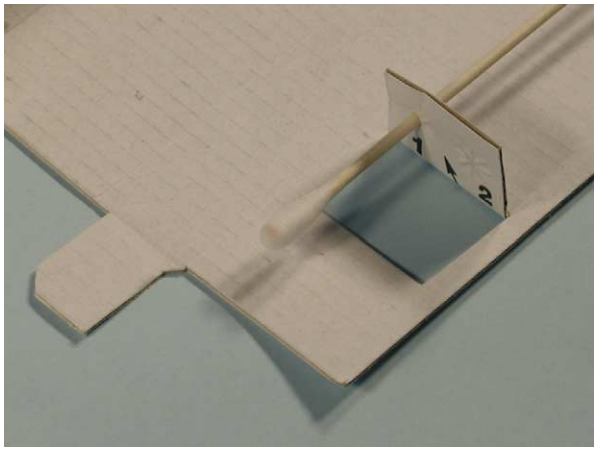


Figure 3 Sterile swab.

Trace Evidence

A wide variety of trace evidence may be encountered at the crime scene, autopsy, or during the investigation. Trace evidence is essentially a small amount of material that may be either biological or chemical in nature. Many times this evidence is so small that it is not detected through macroscopic examination. Thus, evidence must be properly handled and preserved so as to maintain the possibility of locating trace evidence during subsequent microscopic or instrumental examination. Commonly encountered trace evidence includes hair, fibers, soil, glass particles, paint, gunshot residue, vegetative debris, organic and inorganic materials, and blood or other biological materials.

Collection methods will vary, but there are essentially three primary options.

1. Collect the item containing or believed to contain trace evidence and package it in a manner so as to prevent loss of trace material.
2. Macroscopically or microscopically examine the item and individually remove trace components, such as removing a hair from clothing with forceps. Once removed, place the trace item into a druggist fold, and place that druggist fold in a sealed envelope (Figure 4).
3. Utilize a collection method that will remove a majority of trace material from a surface, such as by vacuum methods, tape lifts, or scraping the item down over a piece of clean butcher paper.

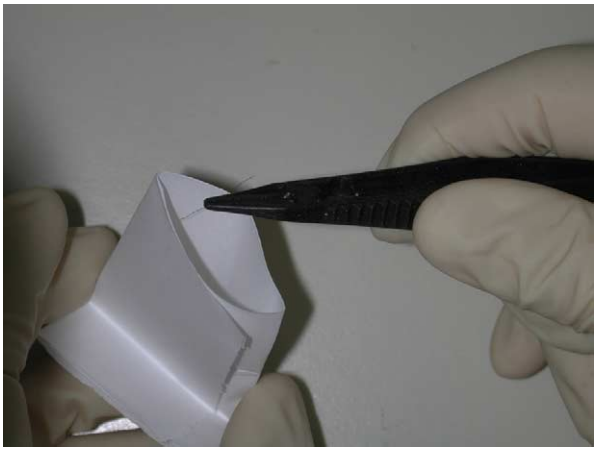


Figure 4 Placing of trace item in a druggist fold.

Hazardous Materials/Weapons of Mass Destruction

Evidence collection personnel, medical personnel, and laboratory examiners always need to be aware of potentially hazardous substances of a chemical, biological, radioactive, or explosive nature. However, with the possibility of exposure to weapons of mass destruction, individual precautions and refined procedures need to be developed and implemented. Only properly trained personnel, wearing the appropriate level of protection, should handle these types of hazardous materials. In addition, these materials should not be transported to a "normal" laboratory or facility unless they are conclusively determined to be a nonhazard, rendered safe, or brought to a facility that is designed to handle and store such materials safely. A potential dilemma is the need to conduct traditional forensic testing on an object that may be contaminated with a hazardous substance, such as anthrax (Figure 5). For example, it would be important to process a potentially tainted letter for trace evidence and latent fingerprints, and perform a questioned document examination on the written or printed material. These examinations will normally be done at a forensic laboratory that is not designed to handle pathogens safely. Therefore, the letter must be rendered or determined to be pathogen-free, or the forensic scientists will need to go to a facility where they can conduct their examinations safely.

Electronic and Computer Evidence

In the present highly technological era it is common to encounter some form of electronic- or computer-based evidence at a crime scene or during the investigation. This type of evidence has unique challenges.

Since destruction or alteration of data or information can easily occur, it is highly recommended that only properly trained personnel collect and package this type of evidence. Preferably, a forensic data examiner or similar specialist will need to respond to a crime scene with computers or electronic evidence and assist in the system shutdown, dismantling, collection, and packaging. A "traditional" crime-scene technician, laboratory scientist, medical examiner, or investigator simply needs to be aware of the possibility of this type of evidence and the special handling techniques.

Figure 5 (A) Testing of a hazardous substance. (B) Traditional forensic testing.

Chain of Custody

General Information

Regardless of how effectively a crime-scene search was conducted, resulting in the location and collection of relevant physical evidence, or the quality and breadth of laboratory testing, physical evidence is only as valuable as its ultimate use, such as admissibility in court. Rules of evidence dictate how evidence will or will not be used during the trial, but it is a fundamental rule that a general requirement for the chain of custody needs to be established, before that evidence may be admitted in the trial.

Underlying chain-of-custody rules are a necessity to identify the item of evidence being offered as the same

evidence seized from the scene and ultimately presented in court, and to establish that the evidence is substantially unchanged. The process by which the identification and lack of spoilage are documented and substantiated is commonly referred to as the chain of custody.

A chain of custody begins once an item of evidence comes into the custody of government personnel or their agents. There is no requirement that a chain be established prior to the government seizure, regardless of how long the item of evidence has been in existence. Generally, once the item of evidence is presented in court, the stringent chain of custody is no longer required. However, depending upon the nature of the evidence and for what purpose it is being offered in trial, the relevant chain may terminate before trial. In several instances the critical chain is concluded once the item has been analyzed in a laboratory. For example, a package of white powder seized from the accused's clothing, subsequently tested at a reliable laboratory, and conclusively determined to be heroin, may require a stringent chain of custody only until the laboratory examination is complete. In contrast, consider a case where a stolen firearm will be admitted into trial as the tangible property upon which the offense is based. In this case a full chain of custody will need to be established all the way until the gun is offered into trial, and proven to be the same gun that law enforcement originally seized. Each of the links in this chain represents a period of time along the chain, and articulates specifically who was in custody of that item during that period of time. Each person, or link, may be called upon to establish that the item of evidence, while in his/her possession, was properly secured and preserved such as to assure its identity and prevent spoilage or alteration. It is not necessary to identify every individual that could potentially have access to that item, so long as each custodian or link can establish that he/she followed accepted protocols, ensuring the safe keeping and integrity of that evidence.

How to Establish and Maintain an Effective Chain

Ultimately, a court must be convinced that the item of evidence being offered is in fact the same item originally seized during the crime-scene search, autopsy, or investigation. The goal is to make the item readily identifiable as the original item seized. Some items by their very nature are inherently identifiable, such as an original Claude Monet painting. These relatively identifiable pieces of evidence will require only a minimal chain of custody, generally limited to showing that the item is substantially unchanged. Other items are quite fungible, such as one of dozens of dried blood stains swabbed from a crime scene. With fungible evidence the necessity for a detailed and strong chain of custody is even more essential.

One method for identifying fungible items at a later point is by uniquely marking the actual item. The practice of actually marking an item, often with the initials of the seizing individual, is effective, but may be detrimental to the evidence. Markings placed on the item of evidence may alter or destroy critical components or characteristics of the evidence that may be needed for laboratory analysis or comparison. Therefore, if an item of evidence is to be marked, extreme caution must be employed to place the markings in an area where they will not alter the evidentiary value. For example, a bullet recovered during autopsy should never be marked anywhere other than the base of the bullet, and only then when a preliminary macroscopic examination of the base reveals no signs or trace, transfer, or impression evidence in that area. With an item of clothing the markings should be placed in an area free of all stains, transfers, patterns, or defects in the material.

In many cases the item may be properly marked for future identification by sealing the item of evidence in an appropriate evidence container and placing markings on the packaging. This labeling should include the date and time of seizure, the location from where the item was seized, a description of the item, an investigative or case number, and the name of the seizing individual. In addition, the seizing officer should place his/her initials on this package, and any interior packaging such as a druggist fold. The sealing process will vary depending upon the packaging container. With paper bags, envelopes, and boxes, the container should be closed and any access point sealed with tamper-resistant tape. If tamper-resistant tape is not available, ordinary tape may be used and the seizing officer may inscribe his/her initials across the tape. It is preferable to use tape that will adhere to the packaging surface for an extended period of time, and also that can withstand extreme temperatures if the item needs to be refrigerated or frozen. Heat-sealed plastic bags are excellent for securing evidence. However, plastic or airtight bags are not appropriate for a variety of materials like those containing biological stains, such as blood or semen.

In addition to the label or information listed above, a bar-coded label may be adhered to the package. This barcode can be used to track and identify the item, thus establishing the requisite chain of custody. Barcodes can be purchased as commercially available generic products, or can be custom-designed and printed individually by the agency. Custom labels are advantageous in that additional information can

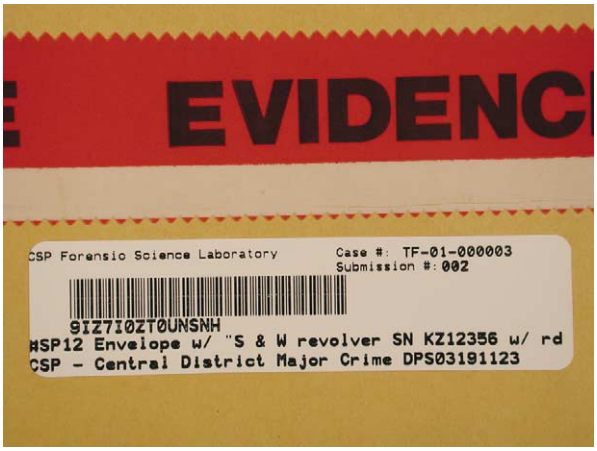


Figure 6 Custom bar code label for physical evidence received at a forensic science laboratory.

be generated and printed on the actual barcode, such as case number, item, and brief description (Figure 6). However, this type of label cannot be prepared in advance, making it a difficult, though not impossible, option for field or crime-scene use.

Even with generic labels there are numerous evidence management programs that can capture the barcode and associate it with a particular case, or with an additional barcode printed back at the agency facility or forensic laboratory.

The chain of custody must be documented either in a written log or in an electronic medium that captures and maintains relevant data, or a combination of both the options. Chain-of-custody logs come in many varieties, but should minimally contain case or control number, individual exhibit number, brief description, location where originally seized, name of seizing individual, date and time of original seizure, and a series of entries for each and every occurrence if there was a change in custody. These transfers should include date and time of transfer, name of person to whom custody of the evidence is being given, and the new location where the evidence will be stored. These transfers should be verified by obtaining a signature from both the individual releasing the evidence and the individual receiving the evidence. Maintaining a chain of custody requires that an examination of the log will show where that evidence was stored for every moment since its original seizure, and who was responsible for that evidence during each of those time intervals.

These logs or forms may be separate forms, one for each piece of evidence, or a logbook that lists adequate chains for numerous pieces of evidence. In addition, some packaging material, such as a sex crimes evidence collection kit, may have a chain of custody form on the box itself. While the use of the form on the packaging material is acceptable, it is recommended that an additional log be maintained and kept with the case file in case the packaging material is damaged, or the item or sections of the item are repackaged. If bar coding is utilized, then the evidence transfers can be recorded electronically with barcode readers and an appropriate database. However, these types of transfer can be unsecured transactions, thus leaving the integrity of the transfer in question. That is, it may be possible for anyone with access to the database to transfer any item of evidence under any individual's name, even without the listed individual authorizing the transfer. This problem can be alleviated by requiring secret PIN entries in conjunction with the transfer, or by incorporating an electronic signature.

One common dilemma is the situation where one piece of evidence is eventually segregated in several subitems. This separation process may occur at the laboratory once the examination process is commenced. When practical, items should be packaged separately such as to minimize this potential confusion. In order to achieve an effective chain of custody for the item of evidence in its entirety, each subitem must be properly logged and secured, and clearly associated with the piece of evidence upon which it was derived. For example, consider a loaded handgun that was recovered from an untimely death scene – all the potential evidence that may be derived from that one item, and all the potential necessary transfers for each of those subitems (Figure 7).

Legal Requirements

The general legal requirements associated with a chain of custody are codified by Federal Rules of Evidence Rule 901(a): "The requirement of authentication or identification as a condition precedent to admissibility is satisfied by evidence sufficient to support a finding the matter in question is what its proponent claims." The burden of proof regarding this requirement rests on the party offering the item into evidence. Generally, the offering party only needs to make a *prima facie* showing of authenticity to gain admissibility. The offering party need not eliminate every possibility of substitution, alteration, or tampering, but rather show that there is a reasonable probability regarding the identity and substantially unchanged condition of the evidence. Once this burden of proof is established, evidence presented generally is admitted and any discrepancies or minor breaks in the chain of custody will go to the weight to be accorded by the jury. Since there are no "black-and-white" rules as to what constitutes a "minor" break in the chain going to the weight rather than

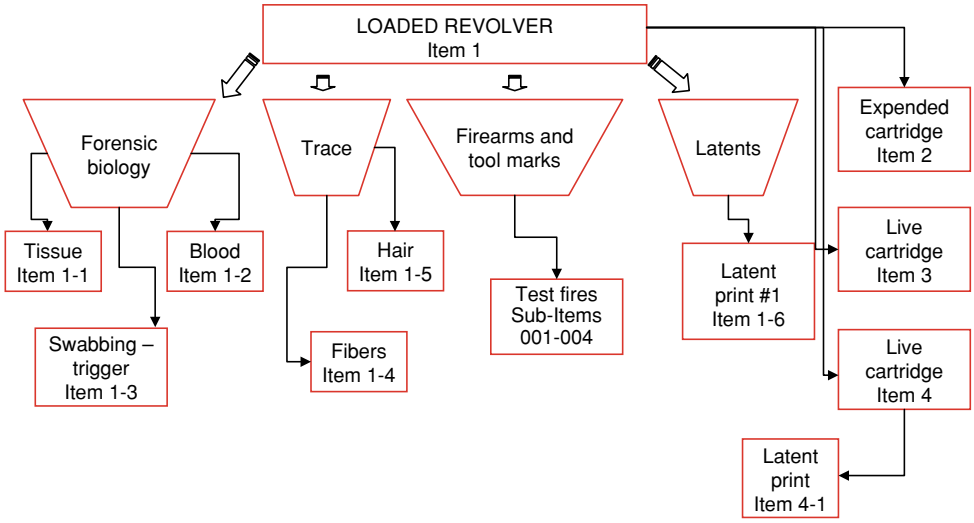


Figure 7 Schematic segregation of evidence into sub-items.

admissibility of that piece of evidence, due diligence should be exercised to maintain an infallible chain.

Generally, the integrity of evidence is presumed to be preserved unless there is a showing of bad faith, ill will, or proof that the evidence has been tampered with. Even clerical errors relating to the chain are not necessarily fatal to the case so long as they occurred in good faith. Moreover, several courts have found that there is a presumption of regularity in the handling of evidence by officers, and that they presumably exercise due care in handling their duties. The state is only required to demonstrate that it took reasonable protective measures to maintain the evidence. However, these presumptions are predicated on an adequate foundation that reasonable evidence-handling procedures were in place and were followed. Yet, the standard may be elevated for fungible items of evidence where the identification of the item is not readily apparent.

The bottom line regarding chain of custody is that every effort should be made to handle and preserve a piece of evidence properly so that there is no doubt as to the authenticity or condition of that item from the time it is first collected until all potential uses are exhausted.

See Also

Computer Crime and Digital Evidence; **Crime-scene Investigation and Examination:** Major Incident Scene Management; Recovery of Human Remains; Suspicious Deaths; **Evidence, Rules of**

Further Reading

Federal Rules of Evidence, Article IX. Rule 901, Authentication and Identification.

Giannelli PC, Imwinkelried EJ (1993) *Scientific Evidence*, 2nd edn., pp. 193–214. Charlottesville, VA: Michie.

Lee HC, Harris HA (2000) *Physical Evidence in Forensic Science*. Tucson, AZ: Lawyer's and Judges Publishing.

Lee HC, Palmbach TM, Miller M (2001) *Henry Lee's Crime Scene Handbook*. London: Academic Press.

Moenssens AA, Inbau FE (1978) *Scientific Evidence in Criminal Cases*, 2nd edn. Mineola, NY: Foundation Press.

Troxell v. *State of Indiana* (2002) 778 N.E.2d 811, nd. Lexis 888.

United States v. *Briley* (2003) 319 F.3d 360, US App. Lexis 2713.

United States v. *Cardenas* (1989) 864 F.2d 1528, 491 US 909, 109 S. Ct. 3197.

United States v. *Gorman* (2002) 312 F.3d 1159, US App. Lexis 24485.

Death-scene Investigation, United States of America

M F Ernst, St. Louis University School of Medicine, St. Louis, MO, USA

Introduction

US death scene investigations were first mentioned by the Maryland Historical Society in the *Archives of Maryland* as early as 1635, when a coroner's inquest was held to determine the cause of death of an American colonist who died as a result of bodily weakness from fasting and cold. The US system originated from the English coroner system that had been brought to the New World by American

colonists. Because the USA is composed of many states, each independently establishing its own type of medicolegal system (coroner or medical examiner) and reporting laws, training, resources, and personnel background prerequisites; the quality of death scene investigations varies greatly from state to state, and from county to county. In 1997, the US Department of Justice published the *Research Report: National Guidelines for Death Investigation*. These guidelines provide a structured, step-by-step process whereby investigators can achieve a thorough, scientific death scene investigation – every scene, every time.

US Death Investigation Systems

The USA is composed of 50 states, the District of Columbia and four major territories (Puerto Rico, Guam, American Samoa, and the Virgin Islands). The estimated population is 290.3 million; life expectancy is 77.14 years and the annual death rate is 8.44 deaths/1000. Approximately 500 000 deaths are reported annually to medical examiner or coroner offices in 3137 counties, with 2185 death investigation jurisdictions. Ten states have coroner systems, 18 have statewide medical examiner systems, and 22 states have mixed systems. As a result, 48% of the US population is served by a medical examiner system, and 52% by a coroner system.

Death-Reporting Systems

Without impinging on federal laws, each state and territory determines its own laws, system type (medical examiner or coroner), organizational structure (statewide or county-based), and the types of death reportable to the system. Commonly violent, suspicious, sudden, and unexpected deaths, death when no physician or practitioner treated recently, inmates in public institutions, in custody of law enforcement, during or immediately following therapeutic or diagnostic procedures, or deaths due to neglect are reportable to a medicolegal system. The medicolegal jurisdiction (medical examiner or coroner) is charged with determining the cause and manner of death of individuals whose demise is investigated.

Military, Offshore, and Indian Jurisdiction

On military installations, the death investigation authority is determined by jurisdiction – exclusive federal, concurrent with state, partial, or mixed. On a military facility, such as an air force base, the armed forces medical examiner, the commanding officer, or the judge advocate may have authority to investigate a death. The county of first landfall has jurisdiction over offshore death scenes, such as airplane explosions over water. Native American Indians have jurisdiction to investigate deaths in Indian country, utilizing tribal coroners and tribal police, such as the Navajo nation in New Mexico. Smaller tribes, who do not have their own law enforcement agencies, often rely upon the Bureau of Indian Affairs to conduct their death investigations. Serious criminal matters, such as homicides, are under the jurisdiction of the Federal Bureau of Investigation.

National Guidelines for Death Investigation

In 1997, the first *National Guidelines for Death Investigation* were established through a grant from the National Institutes of Justice, Office of Justice Programs, and the Centers for Disease Control and Prevention. The guidelines detail the 29 procedures that should be considered in every death investigation (every scene, every time) to achieve a thorough, scientific death inquiry. Although the guidelines are voluntary, they are slowly being implemented in most larger, heavily populated communities.

First Responders

Personnel from emergency medical or law enforcement agencies are commonly the first responders, who determine that a death has occurred. An authorized individual, determined by state statute, then pronounces the person dead. State laws require that the medical examiner or coroner's office be immediately notified of the death. Death scene investigations are usually conducted on violent, suspicious, and unexpected deaths when the dead person has not been removed from the scene to a medical facility. All deaths of children involve a death scene investigation, even if the child is removed from the scene to a medical facility for evaluation. Based on an office's standard operating procedure (SOP) that will be determined by its resources, a medicolegal death investigator or a forensic pathologist responds to the death scene. Because of the severe shortage of forensic pathologists in the USA, few jurisdictions send forensic pathologists to death scenes. In jurisdictions with limited personnel or financial resources, no representative from the medicolegal office may be available to perform a death scene investigation. The scene investigation will then be conducted solely by the jurisdiction's law enforcement agency. This presents serious problems when a potential conflict of interest exists with the investigating agency, such as in a police shooting or a death occurring while in police custody.

Multidisciplinary Team Approach

The US *National Guidelines for Death Investigation* state that a multidisciplinary team composed of

representatives of the medical examiner/coroner office, law enforcement, and crime laboratory should respond to the death scene. The law enforcement agency has authority over the scene itself. The medical examiner/coroner has authority over the dead individual. Depending on the type of death, additional forensic scientists may respond to the death scene, that is, an anthropologist if skeletal remains are present, and an archeologist if a grave is suspected. Crime laboratory personnel are responsible for photographing and documenting the death scene, recognizing, and seizing evidence that is not adhering to the dead person, and transporting the evidence to the crime laboratory for analysis. Specialized federal and state investigative units respond to death scenes under their jurisdiction; for example, the National Transportation Safety Board (NTSB) will respond to deaths that occur as a result of a commercial airplane crash.

Evidence

Trace evidence that is found at the scene and not attached to the decedent is photographed, documented, and collected by the crime laboratory investigator and conveyed to the crime laboratory for evaluation. Evidence that is on or attached to the deceased's body is documented, photographed, and retained on the victim who is conveyed to the morgue facility for examination.

Scene Safety, Briefing, and Walk-Through

Upon arrival at the scene, first responders may call additional experts to evaluate the area to ensure a safe working environment for investigators. Scene boundaries are cordoned off by use of scene perimeter tape to restrict unauthorized persons from entry. Unofficial persons, such as family members, are immediately removed from the scene.

The scene commander, usually a member of law enforcement in nonmass casualty incidents, conducts a scene briefing and walk-through. Previously determined information and location of identified evidence are shared among investigators to avoid any damage or loss of items. Responsibilities and activities of each agency are defined, that is, law enforcement will interview witnesses and notify next of kin. The crime laboratory personnel will photographically document the scene. The medicolegal death investigator will identify and document marks or trauma, and evaluate time of death signs found on deceased. A scene walk-through is conducted to provide investigators with an overview of the scene, including the decedent, evidence, and other scene information.

Chain of Custody

Following federal, state, and local laws, the chain of custody of evidence must be maintained to ensure that it is properly collected, packaged, transported, and transferred to the analyzing facility. Fragile and trace body evidence is identified by the medicolegal death investigator at the scene. The trace evidence on the decedent remains in place and is carefully protected from contamination or loss by enclosure in a clean, white sheet. Additional protection to hands and feet can be achieved by placing the body part into clean, unused paper bags. The dead person is then placed into a clean, sturdy body bag that is marked with identifying information on the outside for conveyance to the morgue facility. Fragile evidence found on the decedent is photographically documented, removed from its unsecured position, collected, and placed in an appropriate container for transfer with the deceased to the morgue.

Scene Documentation

The death scene provides a wealth of information to investigators. A neat, clean, bedroom may suggest that a self-inflicted injury occurred instead of a homicidal gunshot wound to the victim's head. The death scene is photographically documented before anyone enters the area. If first responders have changed the death scene by moving the decedent or have left behind resuscitation items, the photographs should be taken as found. Investigators should not attempt to replace moved items. The death report should note what items first responders moved. The scene photographs provide a detailed picture that should include the decedent, evidence, and location references. Overall scene pictures, specific scene areas, full-body, and identification photographs should be taken from different angles. Items of interest, that is, weapons, notes, and ligatures, should also be photographed to corroborate investigative and medical findings of manner of death. Measurements should be taken of distances between the body and scene landmarks and weapons. Bloodspatter patterns should be photographed and measurements taken to develop data regarding points of convergence and size of spatter. A photographic record and written documentation of all information gathered at the scene should be made.

Interview Witnesses

At least two people have valuable information as to the decedent's death: the person who last saw the deceased alive and the person who discovered him/her dead. The last person to see the decedent alive can describe whether the decedent had any medical problems, his/her mental state, topic of conversation, and

upcoming plans. The person who discovered the decedent dead should be able to provide information as to the exact location of the body. The discoverer should also explain what set of circumstances caused him/her to discover the deceased. For example, the discoverer is the decedent's brother who telephoned earlier today and received no answer, so the brother came to the decedent's residence to check on his welfare. It is valuable to interview first responders at the scene. They can describe any movement of the deceased or scene items required to assess life signs.

Actualization of Decedent

The decedent's body is the most important piece of physical evidence at a death scene. It can explain who the individual is, how long he/she has been at the scene, what or who caused death, where the decedent had been, and when the injury occurred. Documentation of the decedent's race, sex, approximate age, height, weight, and any unique features should be noted. Methodical evaluation of the deceased and his/her clothing can assist in determining the person's identification, time, cause, and manner of death. Following a preset pattern of evaluation, each body area should be closely inspected for injuries, color changes, or marks. Routinely beginning the actualization at the top of the body (head) and working downward (feet) will compel the investigator to assess all body parts and clothing thoroughly.

The position of the decedent when found should fit the scene precisely. The deceased's rigor and livor mortis should be congruent with the death scene environment. If it is not, suspicions that the decedent has been moved after death should be considered.

The scene environment temperature and the microenvironment of the decedent's body should be documented. Investigators should be suspicious if witness and scene information does not correlate with the decedent's postmortem indicators or state of decomposition. Dead people (and their bodies) have no reason to lie, but witnesses may.

Photographs and written documentation should be made of information collected during the actualization.

Evidence on the Decedent

Trace evidence that is adhering to, attached to, or embedded in the dead person is the responsibility of the medicolegal death investigator. That evidence should be photographed, documented, preserved, and conveyed with the decedent to the morgue facility. If fragile evidence, such as a tiny rug fiber that may be lost, contaminated, or changed if not collected at the scene, is identified on the deceased, it should be photographed, documented, collected, packaged, and conveyed with the decedent for evaluation at time of examination and later analysis.

Postmortem Changes

The decedent's body should be evaluated for signs of postmortem change. Gathering information regarding rigor mortis (stiffening of the body), livor mortis (settling of the blood in dependent body areas), algor mortis (body temperature), state of decomposition, insect activity, and scene time references (i.e., clocks, sales receipts) can allow the medicolegal death investigator to approximate the length of the postmortem interval. Inconsistencies between witness statements and postmortem changes should be recognized at the scene and discussed by investigators.

Decedent's Clothing and Valuables

The victim's clothing and personal effects may assist the investigator to determine what the decedent had planned to do that day when he/she dressed. All clothing and personal effects should be photographed and described in report documentation as to item, size, color, and identifying characteristics. Clothing evaluation may help determine the subject's identification and actions before death. Personal effects may provide information that leads to the positive identification of the subject and identity of the next of kin. Clothing and personal effects are cataloged and safeguarded at the scene and at the receiving facility to ensure that all will be returned to the decedent's next of kin at the appropriate time.

Identification of Deceased

Personal papers, jewelry, and personal effects found on the subject or at the scene can assist investigators to determine the subject's identity. Scientific identification is the best method of establishing the individual's identification. The decedent's fingerprints or DNA may be found at the scene. Samples can be collected from the scene to be used for analytical comparison. Identification of infants dying in the 1995 Oklahoma City bombing of the Murrah Federal Building was made by fingerprints and DNA samples taken from their residences. Teeth, dentures, and other orthodontic devices found at a death scene may be useful to odontologists in establishing the decedent's identification. Visual identification of a person who has died recently and whose body has not deteriorated is an acceptable form of identification if the person making the identification is trustworthy. Scientific identification is always preferred to visual identification or use of circumstantial evidence or personal property.

Removal of Deceased from Death Scene

If it is determined that further examination is required, the deceased is placed in a clean body bag and conveyed to the morgue facility for radiographic and medical examination by a forensic pathologist. An identification tag is placed on the subject inside the body bag and on the body bag itself. The bag is secured so that the decedent, clothing, and physical evidence are safeguarded against contamination and/or loss.

Scene Debriefing

After all scene investigative procedures have been completed (photography, collection of evidence, removal of decedent to morgue), investigators share information that they developed. This allows all parties to discuss issues and agree to postscene responsibilities such as notification of next of kin and follow-up interviews.

Notification of Next of Kin

Next of kin may be present at the death scene or respond to the scene when notified of the death. If the identification and location of the next of kin have not occurred while at the death scene, a concerted effort between law enforcement and medical examiner/coroner office must begin to accomplish this task. Thorough and time-sensitive report documentation should include all notification efforts attempted by law enforcement and medicolegal personnel.

Documentation of Medical, Psychological, Work, and Social History

The decedent's medical history is extremely important in determining if death was due to natural or other causes. Medical, psychological, and social history information can be found in scene documents, such as electronic day timers, medical bills, check registers, and notes as well as prescription and over-the-counter medications found at the scene. Documents can help determine the decedent's current and past health problems, medications, hospitalizations, and treating physicians. Tobacco products, alcoholic containers, and drug paraphernalia found at the scene can assist in developing the subject's health profile. Occupation-related materials found at the scene can assist the investigator to determine the subject's workplace or vocation.

The most important thing for investigators to remember when conducting a death scene investigation is that the scene is the final chapter in the decedent's book of life. If the decedent is aware that death is imminent, he/she may leave clues behind to assist investigators in determining what was happening at the time of death. A thorough death scene evaluation will provide investigators with the opportunity to identify those clues.

American Board of Medicolegal Death Investigators

The American Board of Medicolegal Death Investigators (ABMDI) is a not-for-profit, independent, professional certification board that was established in 1998 to promote the highest standards of practice for medicolegal death investigators. The ABMDI was created, designed, and developed by veteran practicing medicolegal death investigators who were involved in the development of the *National Guidelines for Death Investigation*. More than 700 individuals have been awarded basic (registered medicolegal death investigator) certification and 40 people have been awarded advanced (board-certified medicolegal death investigator) certification.

The ABMDI certifies individuals who have the proven knowledge and skills necessary to perform medicolegal death investigations, as set forth in the publication *Death Investigation: A Guide for the Scene Investigator*, renamed and published in 1999 by the National Institutes of Justice. This is a voluntary certification program.

The purpose of the ABMDI is to:

- encourage adherence to the high standards of professional practice and ethical conduct when performing medicolegal death investigations
- recognize qualified individuals who have voluntarily applied for professional basic and advanced levels of professional certification
- grant and issue certificates to individuals who have demonstrated their mastery of investigational techniques and who have successfully completed rigorous examination of their knowledge and skills in the field of medicolegal death investigation, and to maintain a listing of individuals granted certification
- recertify individuals every 5 years according to established recertification criteria, including examination and continuing education requirements.

Further Reading

Bevel T (1997) Documenting the reconstruction of a crime. In: Geberth VC (ed.) *Bloodstain Pattern Analysis,* pp. 197–229. Boca Raton, FL: CRC Press LLC.

Clark S (1996) *Medicolegal Death Investigator – A Systematic Training Program for the Professional Death Investigator.* Big Rapids, MI: Occupational Research and Assessment.

Dirkmaat D (1997) The role of archaeology in the recovery and interpretation of human remains from an outdoor forensic setting. In: Haglund WD, Sorg MH (eds.) *Forensic Taphonomy – The Postmortem Fate of Human Remains,* pp. 39–64. Boca Raton, FL: CRC Press LLC.

Ernst MF (1999) The death scene. In: Caplan YH, Frank RS (eds.) *Medicolegal Death Investigation, Treatises in the*

Forensic Sciences, 2nd edn., pp. 7–104. Colorado Springs, CO: Forensic Science Foundation Press.

Ernst MF (2003) Medicolegal death investigation and forensic procedures. In: Froede R (ed.) *Handbook of Forensic Pathology,* 2nd edn., pp. 1–10. Northfield, IL: College of American Pathologists.

Fisher BA (2000) Trace evidence and miscellaneous material. In: Fisher BAJ (ed.) *Techniques of Crime Scene Investigation,* 6th edn., pp. 161–215. Boca Raton, FL: CRC Press LLC.

Hochrein MJ and US Department of Justice (2003) A Bibliography Related to Crime Scene Interpretation with Emphasis in Forensic Geotaphonomic and Forensic Archaeological Field Techniques. In: *Federal Bureau of Investigation St. Louis MO Division.* Washington, DC: FBI Print Shop.

Humphry D (1991) *Final Exit – The Practicalities of Self-Deliverance and Assisted Suicide for the Dying.* Eugene, OR: Hemlock Society.

Institutes of Medicine of the National Academies (2003) *Medicolegal Death Investigation System: Workshop Summary,* pp. 7–29. Washington, DC: National Academies Press.

Jentzen J (1998) Developing medicolegal death investigator systems in forensic pathology. In: Clauser G (ed.) *Clinics in Laboratory Medicine,* pp. 279–322. Forensic Pathology II, 18. Philadelphia, PA: W.B. Saunders Company.

Miller M (2003) Crime scene investigation. In: James SH, Nordby JJ (eds.) *Forensic Science – An Introduction to Scientific and Investigative Techniques,* pp. 115–135. Boca Raton, FL: CRC Press LLC.

Saferstein R (2003) DNA and fingerprints. In: Mortimer K Jr. (ed.) *Criminalistics – An Introduction to Forensic Science,* 8th edn., pp. 361–426. Saddle River, New Jersey: Pearson Prentice Hall.

Shemonsky N (1993) Jurisdiction on military installations. *American Journal of Forensic Medicine and Pathology* 14: 39–42.

US Department of Justice (1997) *Research Report: National Guidelines for Death Investigation.* NCJ167568 Washington, DC: National Institutes of Justice.

Major Incident Scene Management

J Horswell, Forensic Executives, Upper Mt. Gravatt, QLD, Australia

Major Incident or Crime-Scene Investigation

The undertaking of a major incident or crime-scene investigation is no different from that of a minor crime-scene investigation. The same technical recording and recovery of potential evidentiary material must take place, as does an interpretation of what has occurred. The size and seriousness of the offense are of no consequence to the investigation sequence. What is of consequence in a comparison between the two is the size and type of incident being investigated and the application of resources to undertake the technical work and interpretation of the overall scene or scenes. The old adage "many hands make light work" applies when there is a large scene and the nature of the case will dictate the requirement for the presence or absence of other specialists, who may be required to attend the scene for their "expert" advice. For example, a break-and-enter into a dwelling with stealing can easily be undertaken by a crime-scene investigator carrying out the investigation on his/her own, whereas a major bombing scene with casualties and a wide distribution of building debris and bomb fragments will require several crime-scene investigators with a crime-scene manager (CSM). Depending upon the nature of the casualties and the recovery of explosive residues, other specialists may need to be involved. There is nothing prescriptive regarding the allocation of resources. Allocation of resources is a matter for the most senior crime-scene investigator such as the CSM or in relation to primary and secondary scenes, a crime-scene coordinator (CSC) to negotiate their application with the senior investigating officer (SIO).

It is the responsibility of the SIO to ensure that the crime scene is investigated by appropriately skilled and qualified crime-scene investigators and it is the responsibility of the relevant crime-scene unit head to ensure that he/she provides the appropriate resources. Resources should be based on the complexity and seriousness of the alleged incident and competence in their allocation in this regard only comes with considerable experience. It is invariably useful for the police to have a major incident response plan, which recognizes the crime scene as the principal responsibility of the forensic support group. It is vitally important that the crime-scene unit has a response plan that includes staff profiles with relevant backgrounds recorded so that appropriate crime-scene investigators can be dispatched to a particular or specialized crime scene when an incident occurs.

What is a Crime Scene?

Crime-scene investigation is practiced differently in different jurisdictions worldwide, and the responsibility for crime-scene investigation may include a

combination of the following types of incidents and examinations:

- accidental deaths, which include a multitude of circumstances, including misadventure
- suicidal deaths, which include a multitude of circumstances
- homicidal deaths, which include a multitude of circumstances
- sudden deaths, with or without suspicious circumstances
- forced entry on to premises, including houses, factories, shops, shopping malls, garages, and garden sheds
- forced entry into money containers, including safes and automatic teller machines
- theft, including the placement of thief traps
- fraud, including the scientific examination of documents but excluding handwriting identification
- sexual assault, which includes touching, penetration, and ejaculation, with or without violence
- assault with a weapon, such as a hammer, screwdriver, axe, knife, firearm, or piece of timber
- difficult victim identification, which includes mummification and putrefaction
- disaster victim identification dealing with multiple casualties
- fire-scene investigation
- explosion-scene investigation, which could include multiple casualties
- drug investigations, such as the importation of drugs, plantations, and clandestine laboratories
- firearms-scene examinations
- physical comparisons, including mechanical fit, footwear, tiretrack, and toolmark impression identification
- identification and recovery of micro- and macrophysical evidence, including the location, visualization, and recovery of fingerprints and other latent marks
- vehicle accidents, including car, bicycle, motorcycle, boat, or aircraft
- vehicle identification, including number falsification and restoration, vehicle parts identification, as well as headlight examination in vehicular accidents
- chemical and biological agents employed to kill numerous individuals.

The location or "locus" of an "incident" is usually called the crime scene. A crime scene could be anywhere, and it is usually a place where a crime or an incident that may end in legal proceedings has occurred.

In some "incidents," it may be readily apparent that a crime has indeed been committed and it is a "crime scene." However, in many situations one of the initial and primary tasks of the crime-scene investigator is to determine whether a crime has been committed. An obvious example is that of a deceased person. In many instances it will be obvious that death was not due to natural causes. In other instances it may be far from obvious; hence, the primary role of the crime-scene investigator is that of a key player in the overall forensic investigation.

Australian Jurisdictional Differences in Crime-Scene Investigation

In the state and Northern Territory jurisdictions of Australia, relevant state and territory police have the responsibility for crime-scene investigation, which is usually confined to that jurisdiction or to other jurisdictions where suspects have traveled to avoid apprehension. In the federal jurisdiction there are no boundaries. This was recently seen with the Bali terrorist incident and less well-known crime-scene responses to Fiji, New Guinea, and Vanuatu. The skill and competency, education and training qualifications, and experiences vary considerably in Australia. Much has been done in the education and training arena to rectify this; however, there are still variations in approach, with some commonality. The differences are mainly structural and do not relate to the actual technical recording and recovery of potential evidential material.

Primary Crime Scene

The primary crime scene is an area, place, or thing where the incident occurred or where the majority or a high concentration of physical evidence will be found, for example, where there has been a sudden suspicious death.

Secondary Crime Scene(s)

Secondary crime scene(s) are areas, places, or things where physical evidence relating to the incident may be found. The potential physical evidence will usually be transported away from the primary crime scene. Some examples include:

- the deceased
- the get-away vehicle in crimes of armed robbery
- the suspect
- the suspect's environment
- the suspect's vehicle
- the weapon used in the crime.

Approaches to Crime-Scene Investigation

The examination of a crime scene and subsequent collection of potential evidential material requires

special skill, knowledge, aptitude, and attitude. The manner in which a crime-scene investigation is conducted may be a critical factor in determining the success of an investigation. The thorough examination of a crime scene requires a disciplined and systematic approach to recording the various observations made and collection of potential evidential material. This must be combined with the analysis of various observations and the interrelationship of potential evidentiary material with the dynamics of the crime. In order to undertake these investigations, the crime-scene investigator must have a well-developed understanding of the application of forensic science and how it can be applied to what is being observed, visualized, and recovered at the scene.

Examining a crime scene is often a demanding task, and in many instances, requires physical and mental stamina as well as team-member and team-leadership skills.

Forensic science has become a powerful aid to criminal investigation, with courts placing much emphasis on the results. Accordingly, the manner in which evidence is located, recorded, and collected, along with the observations and comparisons made, is vigorously examined by the courts in any subsequent proceedings.

Therefore, a systematic approach to crime-scene investigation will ensure:

- good coordination between investigation and crime-scene examination teams
- an efficient, effective, and thorough examination
- less fatigue
- orderly recording and collection of potential evidence
- correct observations and deductions.

Crime-Scene Investigation Management

Crime-scene investigation management is a subject that encompasses:

- the management and coordination of human and physical resources
- the technical aspects of recording and recovery of potential evidentiary material
- the interpretation of what has occurred in the recent past as a recent archeological search, recovery, and interpretation.

The principles of professional investigation management apply equally to the overall investigation or to any part of the investigation, such as the forensic investigation, regardless of the enormity or political sensitivity of a particular major incident or crime scene. The principles are:

- Management decisions must focus on achieving specific outcomes.
- Forensic investigation, like any investigation, is subject to the realities of resource allocations.
- The investigation process must be open to administrative, operational, and judicial review.

There are three critical operational stages of a criminal investigation:

1. the control and coordination of the overall criminal investigation
2. the tracing, locating, and interviewing of witnesses and suspects
3. the forensic investigation.

Any investigation is dual, involving individuals and material items. Normally, the coordination of a major criminal investigation is delegated to an SIO. A senior investigator (SI) should also be appointed to coordinate the gathering of all oral evidence from witnesses and suspects (individuals). Likewise, a senior forensic investigator should be appointed to lead and coordinate the overall forensic investigation (material items), and this person should have the authority commensurate with the role as the CSC.

Scene Control and Coordination

In relation to the management of major incidents or crime scenes, the two terms – CSM and CSC – can be interpreted as follows.

Crime-Scene Manager

CSM is a term that applies to a senior crime-scene investigator who has been given the role of managing a large and complex single crime scene.

Crime-Scene Coordinator

CSC is a term that applies to a senior crime-scene investigator who has been given the role of coordinating several single simple and/or complex scenes, all interlinked and interrelated, and who takes on the role of chairing case management committee meetings when both forensic personnel and senior investigating police come together for case management meetings.

The CSM must surround him/herself with competent, skilled, and qualified forensic investigators to carry out the task of conducting the crime-scene investigation.

In order to manage major incidents or crime scenes and multisited crime scenes successfully, both the SIO and the CSC must have a thorough knowledge and understanding of forensic science and criminal investigation.

Scene Security and Control

The first officers attending the scene will make an initial assessment of the crime scene. They will secure the scene to an extent based on the information available at the time. This may include a perimeter cordon, which takes in areas not concerned with the primary crime scene, and then a further cordon closer to the primary crime scene. This enables crowd and press control and provides a buffer zone, which is useful in the identification of crime-scene tourists, which could include those members of the police service who do not have business at the crime scene.

The CSM, who will normally be a senior member of the crime-scene investigation staff, should attend the scene at the earliest possible opportunity to take charge of the management of the crime scene. A crime-scene investigator or a team of crime-scene investigators who will undertake the crime-scene investigation will normally accompany him/her. The size of the crime scene(s) will dictate the amount of resources allocated to the particular incident. It is imperative that the CSM has the authority to allocate the amount of resources required.

Once the crime scene is handed over to the CSM, a reassessment of the scene security should be made to ensure the scene security is adequate. A formal protocol should be used for the handing-over of a crime scene. This ensures control and the maintenance of the scene's chain of custody.

It is an essential element of any prosecution where forensic evidence is involved to prove the security of the scene and that it was maintained throughout the subsequent examination/investigation. Therefore, the objective of securing the crime scene is to:

- prevent evidence being destroyed or contaminated
- ensure security of information – generally only a media liaison officer or the SIO releases information to the media
- ensure that chain of custody of the scene is maintained, as is necessary with any item of potential evidence
- remove from the scene all unnecessary persons, including police officers and the media. It must be remembered that the more people present, the greater the potential for contamination and destruction of evidence. Large numbers of persons present will also inhibit the proper processing of a crime scene
- ensure that all evidence has been recorded and recovered. This may include securing the scene until the results of the postmortem or scientific analysis are to hand.

There are a variety of methods for securing the crime scene, including:

- posting guards
- rope or printed tape cordons
- the strategic placing of vehicles
- the use of markers, flags, and signs
- locking rooms or areas within buildings or using the external walls of a building as the barrier
- establishing safe walk areas (common-approach path with tape or purpose-built raised stepping plates).

The lack of appropriate control and coordination at the crime scene may lead to vital information not reaching the crime-scene investigator. This may render his/her efforts aimless and uncovered leads may never be passed on to investigators for follow-up action. This is most important when the crime scene is large and there are several crime-scene investigators present processing the scene or where there are secondary scenes away from the primary scene. There must be a flow of information back and forth between investigator and crime-scene investigator. This is one of the functions of the CSM.

Management of Occupational Health and Safety Issues

The well-being of the crime-scene investigators is the primary responsibility of the CSM. He/she must be aware of fatigue and must cater for their comfort. Appropriate protective clothing and equipment should be made available. Breaks should be organized for the forensic investigators and refreshments should be on hand during those breaks. Scene guards should also be part of the crime-scene operation, regardless of the area they originate from. There should be a designated area where food and drink can be taken, equipment can be stored, and rubbish can be accumulated.

All personnel on site should be briefed regarding safety hazards, smoking and eating, the location of critical areas, and the use of telephones and toilets.

In relation to the investigation of fires, suitable safety equipment must be provided, including: hard hats fitted with battery torchlights, nonslip steel-plated boots, overalls, leather gloves, face shields, and gas and/or dust masks.

One of the most hazardous crime scenes that requires the adoption of specific crime-scene protective safety techniques, and one that is an emerging issue for the management of crime scenes in the twenty-first century, is the use of chemical, biological, and/or radiological materials. This has been experienced in recent years by the Japanese police in the sarin attack on the Tokyo underground and the experimentation that took place in outback Australia prior to these attacks, which were investigated by the Australian federal police. The recent anthrax and white-powder scares that were experienced by a number of police agencies in North America and Australia were indicators of the emerging protection required for crime-scene investigators in the current climate of terrorism.

Chemical, biological, and radiological crime-scene investigations require a specialist response with their own individual health and safety considerations, a subject in its own right to be dealt with separately.

Management of Contamination Issues

In general terms, the greater the number of personnel present at a crime scene, the more likely it is that the scene and its evidence will be contaminated. As with any other personnel, crime-scene investigators who are required to be in attendance at the crime scene can deposit hairs, skin cells, and sweat, in addition to other trace evidence, such as fibers, or leave their own trace marks, such as shoemarks and fingerprints.

In light of recent advances in DNA technology and its sensitivity, there are increased risks of contamination. The addition of the crime-scene investigator's own DNA and/or the alteration of DNA recovered from the crime scene are issues for those who process crime scenes.

Crime-scene investigators and other specialists present at the scene should be equipped with the following protective clothing and adhere to their use: disposable overalls with hood, masks, shoe covers, and gloves.

These items should be changed as necessary and must be changed when dealing with secondary crime scenes, victims, and/or suspects. Gloves should automatically be changed when moving within a scene from one discrete area to another, particularly when dealing with different areas of body fluids, which can potentially come from a variety of sources.

The level of contamination risk to be expected is relative to the type of crime scene and the number of personnel required to have access to the scene. For example, the victim and the police officer taking the crime report may be the only individuals present at a burglary scene; therefore, the contamination risk is low. In contrast, at least the first responding police officer, ambulance officer(s), investigator(s), crime-scene investigator(s), and forensic pathologist would usually attend a typical suspicious death scene. In addition, the witness who discovered the deceased, family, friends and/or neighbors of the victim may also have visited or also be present at the crime scene. These individuals increase the potential for contamination.

Environmental conditions may also play a major role in the contamination of crime scenes and any potential evidence. Wind, sun, rain, snow, and temperature can play a key role in the contamination and degradation of potential evidence at a crime scene.

Protection measures should be considered and recovery of potential evidentiary material at risk should take priority over the recovery of any other potential evidence. The CSM or CSC should consider crime-scene protection tents, tarpaulins, and corrugated iron. These items can be used as covers to protect important evidence from any detrimental environmental conditions prevailing during the crime-scene search and potential evidence recovery stages.

Appropriate packaging and transportation have been discussed elsewhere in this encyclopedia.

Management of Records

In order to conduct a thorough systematic crime-scene investigation, protocols should be developed for each activity. Each jurisdiction will have such protocols, with their own subtle differences. There should be pre-prepared forms, which will provide the crime-scene investigator with comprehensive notes taken during the examination, and these pro-forma records should be available for:

- crime-scene log – activities undertaken at the scene, including movements, who was at the scene on arrival, who arrived and who left the scene, and a summary of their activities whilst on-site
- formal "handover" and "takeover" of the crime scene from the first police at the scene to the crime-scene investigator to arrive or the CSM
- environmental conditions at the crime scene
- description of conditions within the premises and the surrounding area
- activities and observations at the crime scene
- exhibit list
- rough sketch of the crime scene
- photographs taken at the scene
- specialists attending the scene, with entry and exit times and detail of examinations undertaken

- initial findings from the crime-scene investigation and from all specialists attending the scene.

Management of Quality Management Systems Records

Record management and the control of documents are integral parts of third-party quality management systems forensic science accreditation. Crime-scene investigation now forms part of both the American Society of Crime Laboratory Directors Laboratory Accreditation Board (ASCLD-LAB) and the National Association of Testing Authorities, Australia (NATA) and is likely to spread through the mutual recognition agreements (MRAs) with other international accreditation bodies. It is, therefore, desirable that crime-scene facilities have both "systems" and "technical" accreditation of their system conforming to the international standard ISO/IEC 17025.

The use of a computerized program to manage record management within a quality management system is the only systematic and comprehensive way to manage and control the quality management system documentation and thus control the quality system.

Ongoing Case Management

Once the scene work is completed, the emphasis changes to the coordination of further examinations and the communication and flow of information and results from forensic analysis or examinations to investigating officers from forensic examiners, and from investigating officers to forensic examiners. If it is not practical for the CSC to chair further case management meetings, then another senior crime-scene investigator, who is already involved in the case, may be nominated to maintain that contact and coordinate the ongoing case management and chair case management meetings.

Computerization of Case Management

There is only one effective way to manage all the information gathered at the crime scene and to ensure accountability and chain of custody of items using a specific case management system, which has either been developed in-house or is commercially available. There are several commercially available forensic laboratory information management systems. These will be employed to cater for the crime-scene investigation aspect of a forensic investigation after the key stakeholders come to the realization that the most critical aspect of forensic science is the crime scene and how it is examined. These systems manage the lodgment, tracking, and accounting for items in addition to the information gathered as a result of the crime-scene investigation as well as any subsequent laboratory examinations and/or analyses.

The Future – Field Testing

Forensic science laboratories usually have backlogs of cases and there is usually a need to prioritize casework. This normally does not fit in with the urgent needs of investigators for results and leads to carry their investigation further and to assist in the identification of the suspect(s). Investigatory leads soon grow cold after a crime has been committed. Suspect(s) vanish, witnesses disperse, and potential physical evidence may only persist for a limited time or may be disturbed in some way, even by normal activities.

Although faster processing of potential evidentiary material in the forensic science laboratory is important, in many cases the ability to secure critical information by undertaking field testing at the crime scene could significantly enhance the likelihood of a successful resolution.

Field testing should not, and will not, replace laboratory testing; instead, it may enhance investigations conducted at the crime scene. For example, it could be used to identify the presence and type of flammable or combustible fuel at fire scenes and therefore provide investigators with lines of enquiry. It could also be used to screen potential DNA evidentiary items for those most likely to produce results and, through preliminary analysis conducted at the scene, to assist in developing investigative leads. Of course, confirmatory testing in the controlled laboratory environment should be continued to ensure absolute confidence in the results.

The role of preliminary analysis in the field is therefore elimination, arguably a more important role than incrimination in the early stages of any investigation.

There are many small gas chromatographs currently on the market and these would suffice in the preliminary testing of debris and residues from fire scenes. A portable microchip-based prototype DNA field-testing instrument has also been developed. The instrument, which produces findings within 30 min, is currently being trialed and improved, and will be made available commercially.

The Future – Case Review

It is unfortunate that crime-scene sizes are constantly increasing; the terrorist attack in Bali is a case in point. There are issues that immediately come to mind with this type of major crime scene and they

relate to control and access to the scene. In the early stages of the Bali scene, to an outside observer, it would seem that far too many people were allowed to move throughout the scene. Those in charge of such scenes are faced with gaining control and limiting access. It should be realized that in practice these are very challenging tasks.

The issue for the future with such large scenes with so much information and so many items with so many subsamples is to have everything that it is possible to have from such a scene. This is where a case review, which is an extension of case management, will play a more prominent role in crime-scene investigation in the future.

What is a Review?

The *Australian Macquarie Dictionary* (1988), second revision, defines a review as follows:

- critical article or report
- critique
- a viewing again
- a second or repeated view of something
- an inspection, or examining by viewing
- a viewing of past events, circumstances, or facts.

Types of Review

There are essentially three types of reviews:

1. constant informal reviews
2. independent formal reviews
3. quality assurance reviews.

Constant informal review A constant informal review is the process that occurs in discussion with colleagues during an investigation and at case management meetings.

Independent formal reviews conducted in-house This is a formal procedure instituted in-house where nominated colleague(s) who are not involved in the case review and scrutinize the forensic investigation to ensure that nothing has been overlooked.

Independent formal review This formal procedure is instituted as a means of scrutinizing a forensic investigation by another forensic science expertise provider. Although not the norm in Australia, this does happen in circumstances where second opinions are desired or where there are particular analyses required, as the primary investigating forensic science facility does not have the ability to conduct the examinations/analyses itself.

The primary reason for commissioning such reviews is to assist in achieving successful outcomes and ensuring that everything that needs to have been done has been done.

It is important to ensure, in an independent formal review, that:

- best practice in forensic science is being applied
- all reasonable avenues of examination and/or analysis are being considered and applied
- sufficient resources are available to complete the examinations/analysis
- the resources are being applied efficiently and effectively
- any health and safety issues arising from the forensic investigation requiring attention are dealt with
- lessons learned are shared with colleagues
- training, retraining, and/or remedial action that may be required
- an investigation carried out well is rewarded.

An independent formal review:

- should be conducted as soon as possible
- should appreciate the complexity and sensitivity of a forensic investigation
- should ensure the likelihood of reaching a conclusion in the near future
- should have adequate resources devoted to the forensic investigation
- should have benefits to be obtained from it.

Terms of reference of an independent formal review include:

- it must be written
- it must be clear and concise
- it must specify a timeframe
- it must specify the available resources
- it must include other relevant factors.

Conduct of an independent formal review consists of:

- detailed briefing
- review to minimize disruption and/or interference to the examinations and/or analyses being conducted
- review to add value to the forensic investigation
- prioritization of examinations and analyses.

Other types of independent formal review These types of reviews are outside the control of the forensic expertise provider. If appropriate examinations and analyses have been conducted, covering all aspects of the case, then the likelihood of a case coming under the scrutiny and review of the following organiza-

tions is slim. Forensic practitioners, however, should be aware that every step they take could at some time in the future be subjected to the closest scrutiny by these organizations:

- the parent organization internal investigations department
- the ombudsman
- the defense council and their relevant specialists
- royal commissions
- commissions of inquiry
- parliamentary enquiries.

Quality assurance reviews The work carried out by crime scene investigators, and for that matter laboratory examiners and analysts from a forensic science service, that has in place a quality management system, ensures, through regular reviews, or what are known as audits, that the examinations are conducted by appropriately educated and trained practitioners who are competent and proficient, the relevance of the methodology used in the examinations and/or analysis, and the equipment used is regularly maintained and calibrated. This is what is known as a quality management system which, when in place, underpins professional practice.

The Future – Practitioners

Quality outcomes and systems in crime-scene investigation are dealt with elsewhere. The move by crime-scene investigation providers toward ensuring a quality product through embracing quality management systems should be applauded. One of the most significant issues in crime-scene investigation in the past has been the lack of formal externally assessed and validated standards. This is changing, as many crime-scene investigation organizations move to join their laboratory colleagues in putting in place an externally assessed forensic science quality management system by a third-party quality systems accreditation provider. This is not an issue for the fully integrated forensic science laboratory, as when laboratory services put in place a quality management system, it also includes the crime-scene investigation service.

Robertson put it succinctly when he stated "Strong leadership and management by the forensic science community will be required if appropriate standards are to be developed and maintained. It would help if more crime scene investigators had the confidence to view themselves as forensic scientists and if laboratory scientists would also recognise this self-evident fact."

Education and training of crime-scene investigators has come a long way since the 1980s. Historically, crime-scene investigators have been sworn police and only some have had the opportunity of a science education. During the early 1980s, programs were introduced to educate sworn police crime-scene investigators to raise their level of understanding and appreciation of the application of the "scientific method" so that their forensic investigations could be more objective. As history has shown, there has been a mixed degree of success. The author is now a proponent of science graduate recruitment into this unique field. Not all science graduates will be suitable for this type of career; however; many will be, and the present and future rest on having the appropriate selection processes in place and the appropriate professional training, which should be a recognized university qualification at an appropriate postgraduate level.

The forensic science community can ill afford to fall into the trap of a two-tier system of "volume" crime-scene investigators and "major" crime-scene investigators, as evidence will be lost through inexperience and we will return to the old days, with review of forensic science practice by royal commissioners again being a frequent occurrence. Crime-scene investigators need a cross-section of "crime types" and a considerable number of crime-scene attendances in order to maintain their expertise. As every crime scene is different, the challenges faced by the crime-scene investigator will also be different.

Robertson again put it succinctly when he stated: "Crime scene investigation is real science, and at least the more complex and major incidents demand a scientific approach requiring personnel with appropriate basic science and specialist training. It would be a tragedy for the future if this was to be lost in short-term 'fix it' solutions to deal with the challenges posed by volume crime."

Summary

The management of major incidents and crime scenes, no matter what the size or seriousness of the crime, is a matter of gaining control of the crime scene and then managing the coordination and application of resources. What follows must be a systematic and thorough approach to processing the scene. Serious and major crime scenes will vary in size and complexity, some requiring many crime-scene investigators; others, which are smaller and less complicated, will require only one or two crime-scene investigators.

Overall scene management and the maintenance of a two-way flow of information and communication are the essential ingredients to successful crime-scene management. Regular case management meetings must be held to keep all stakeholders abreast of the latest available information. These should be recorded in the case notes as minutes of the meeting,

as a record of what transpired and who is responsible for any ongoing action items.

Underpinning the crime-scene investigation facility should be quality systems that are technically assessed to conform to the international standard ISO/IEC 17025-1999, general requirements for the competence of testing and calibration laboratories.

The future is indeed bright for crime-scene investigation if the current trend of a willingness to be open and to review is applied at the early stages of a forensic investigation, rather than waiting until it is forced on practitioners by a royal commission.

See Also

Accreditation: Crime Scene Investigators; **Crime-scene Investigation and Examination:** Collection and Chain of Evidence; Recovery of Human Remains; Suspicious Deaths

Further Reading

Belgrader P, *et al.* (1998) Rapid PCR for identity testing using battery-powered miniature thermal cycler. *Journal of Forensic Sciences* 43: 315–319.

Fisher BAJ (2000) *Techniques of Crime Scene Investigation,* 6th edn. Boca Raton, FL: Chemical Rubber.

Gael Quality (2002) *Marketing Material for Q-PULSE™ Version 4.2*, Gael. East Kilbride, UK: Gael Quality.

Horswell J (2000) Major incident scene management. In: Siegal JA, Saukko PJ, Knupfer GC, *et al.* (eds.) *Encyclopaedia of Forensic Sciences,* pp. 428–432. London: Academic Press.

Horswell J (2004) Management of crime scene investigation. In: Horswell J (ed.) *The Practice of Crime Scene Investigation,* pp. 83–95. Boca Raton, FL: Chemical Rubber.

Horswell J, Edwards M (1997) Development of quality systems accreditation for crime scene investigators in Australia. *Science and Justice* 37: 3–8.

Ibrahim MS, *et al.* (1998) Real-time microchip PCR for detecting single differences in viral and human DNA. *Analytical Chemistry* 70: 2013–2017.

Kirk PL (1953) *Crime Investigation.* New York: Wiley.

Management Systems Designers (2003) *Marketing Material for FORENSIC LIMS™*. http://filmsmsdinc.com.

NATA, ISO/IEC 17025 (2000) *Application Document, Supplementary Requirements for Accreditation in the Field of Forensic Science*, Version 1. Sydney, Australia: National Association of Testing Authorities.

Robertson J (2004) Crime scene investigation: key issues for the future. In: Horswell J (ed.) *The Practice of Crime Scene Investigation,* pp. 399–406. Boca Raton, FL: Chemical Rubber.

Van Oorschot RAH, Jones MK (1997) DNA fingerprints from fingerprints. *Nature* 387: 767.

Underwater Crime Scene

R F Becker, Chaminade University of Honolulu, Honolulu, HI, USA

Introduction

More than 70% of the earth's surface is covered with water. Since earliest time human beings have worked, played, and committed crimes on, around, and in the water. It is not until recently that a new investigative specialty has evolved, that of the "underwater investigator."

Whenever a crime or disaster involves submerged material someone is charged with its retrieval. Historically attention was focused on locating and retrieving it. Little thought was given to the possibility of submerged items having evidentiary value. Most agencies today recognize that a crime scene may be inside, outside, or underwater. Once the police community was made aware of the potential of forensic evidence on submerged items it was not long before protocols were devised to preserve that potential forensic evidence.

Underwater Crime Scenes

As waterway recreation and transportation expands so do crimes committed on those waterways. The first step in any underwater investigation is to locate the underwater crime scene. It is helpful to think of the recovery of underwater evidence as an extension of the overall investigation. By perceiving the recovery operation as an integral part of the overall investigation it is but one short step to viewing the underwater operation as the processing of a crime scene with depth as commuting time. If the offense suspected is such that it would precipitate a crime scene analysis then the underwater counterpart of that investigation should be conducted as meticulously.

Reconstructing a crime scene is accomplished by recording each piece of evidence in relation to other permanent nonevidentiary items at the scene. That reconstruction is the same regardless of the location of the crime scene. Indoor or outdoor evidence must be recovered with some record of its relationship to the environment from which it was removed. The inability to demonstrate that relationship at the time of trial may result in that evidence not being admitted. The underwater investigation begins with determining what is to be searched and where it is to be searched.

The Underwater Search

The nature and scope of the search will be determined by the offense, existing current, tidal conditions, water depth, visibility, wind direction, and known bottom structure. It is the recovery team leader's responsibility to determine, based on the relevant variables, which search pattern to employ. Search patterns vary and have different attributes enabling them to address different search requirements but all search patterns should have certain basic attributes:

1. The pattern is to begin at a predetermined point and have predetermined midpoints and changes of direction, ending at a predetermined location or upon discovery of the item sought.
2. It includes communication from surface personnel to searchers through line signals or voice communication.
3. The pattern of search allows the searcher to deploy buoys to mark points of interest or evidence.
4. It is simple.
5. It effectively uses divers and resources.
6. It allows for safe support of the diver or divers.

Most searches involve a surface component (line tender) and a diver or divers. As a team the diver provides the labor and the tender provides the direction and support. The tender is the diver's eyes, ears, and lifeline.

Temporal and Geographical Location of Evidence

After the team has located the evidence the usual procedure is to retrieve it. It is important to remember that the officer recovering the evidence will be responsible for testifying as to the method used in locating, marking, sketching, measuring, photographing, bagging, tagging, and maintaining the chain of custody.

All details pertaining to the dive site must be recorded prior to the recovery of any evidence. Failure to mark properly and record the location of the recovery site may result in the following:

1. losing it, in the event that more than one dive is necessary
2. inability to orient parts of a dismembered or dismantled auto, vessel, airplane, or body. In airline crashes body limbs, arms, hands, legs, and feet may be strewn over the site. Reconstruction of the bodies may require anthropological assistance. Often the fastest way to associate severed body parts with the torso is by recording the location of the body parts relative to each other or to the seat or seats to which the parts were closest. By referring to the seating chart body parts can be readily associated with the passenger who had been occupying the seat nearest to where the body parts were found
3. considerable expense in time and effort in relocating the site and the evidence at the site
4. having the evidence rendered inadmissible at the time of trial.

The most effective method of preserving a record is photography. Where visibility allows, the camera should be the first piece of equipment on the site.

Photographing the Underwater Crime Scene

The method whereby the underwater crime scene is first recorded is through photographs and/or videograph. The video recorder is becoming a popular tool in recording the underwater crime scene. The film makes a permanent historical record of how the scene appeared when the film was exposed.

Establishing a Reference Point

When evidence is recovered from a crime scene in a conventional crime, measurement is generally not a problem. There are fixed landmarks from which measurements can be taken. However, there may not be a readily available landmark for an underwater investigator to anchor measurements. After plotting the recovery area on the site chart it is generally necessary to establish a point of reference from which measurements can be made.

Crime-Scene Measurements

Interior crime scenes utilize one of three basic measurement techniques: (1) rectangularization; (2) triangulation; and (3) baseline construction. Both triangulation and baseline construction work especially well outdoors where permanent landmarks are at a distance from the item to be measured, but none of these methods works very well when processing an underwater crime scene where measurement of items in the water to permanent objects on land is hampered by limited or zero visibility. Trilateration is a method of measurement in which the underwater investigator need not rely on sight for accuracy (Figure 1). Objects in the water are measured from two known locations on the shore. The end of the tape to be read is on shore at the prelocated position and the diver moves the tape to a point on the object being measured. The shore-based end of the tape is then moved from one known position to the other. It is important to note that this measurement will only give you the location of the object being measured, not the orientation. To orient the object two more measurements must be taken from a different point on the submerged item (Figures 2 and 3).

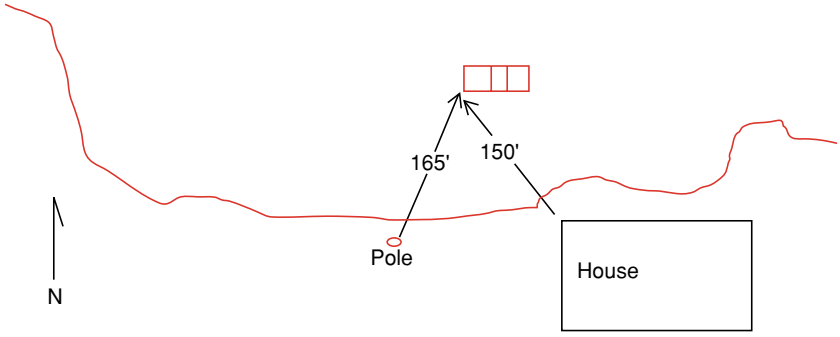


Figure 1 Trilateration. Measurements are read and recorded by the dive tender and on-scene intelligence officer. This measurement does not orient the vehicle, it could be anywhere 360 degrees around the established point.

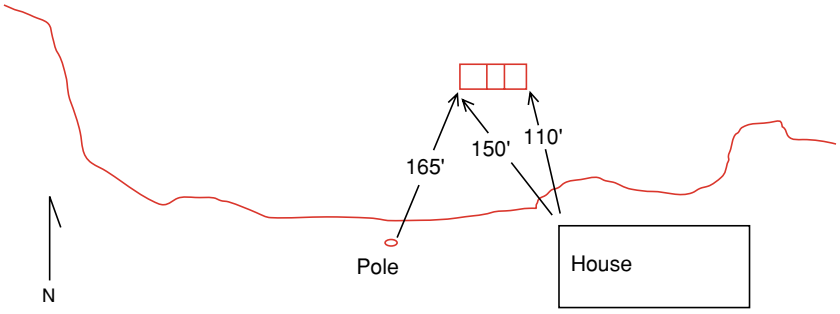


Figure 2 Trilateration (orientation). A third measurement is required to orient (lock in space) the vehicle.

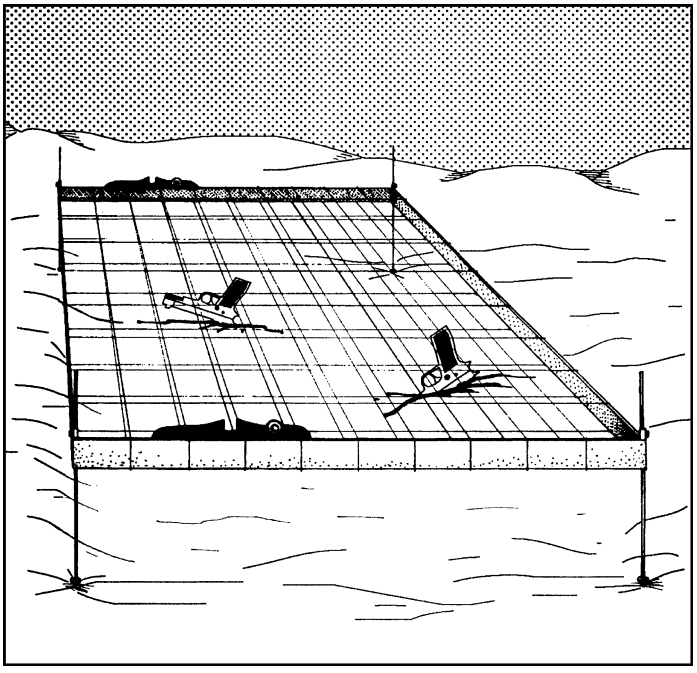


Figure 3 Small grid orientation: in recoveries where small items are to be measured, it may be best to use an ''orientation grid,'' first locating and orienting the grid then the objects within it.

The Underwater Crime-Scene Sketch

The data upon which the underwater crime scene sketch is based are gathered after the scene has been completely processed and photographed but before evidentiary items have been bagged, tagged, and transported. The sketch is a measured drawing showing the location of all important items, landmarks, permanent fixtures, and physical evidence.

Handling Evidence

Physical evidence is usually handled according to a predetermined protocol. That protocol includes recording field information about all evidence discovered. That information may include but is not limited to:

1. identifying evidence by description in field notes and evidence tags
2. the location within the underwater crime scene at which the evidence was obtained
3. the name of the person who found the evidence
4. time and date of the finding of the evidence
5. a description of any special characteristics unique to a piece of evidence
6. the names of all participants in the search process.

Firearms

Historically firearms have been treated in a cavalier way in recovery operations. It was understood that a firearm could not possess any important forensic information once submerged. A new perspective is being transmitted between agencies and jurisdictions. It is now recognized that water does not necessarily destroy forensic evidence and in some instances may even preserve it.

Weapons used in homicides may potentially contain a plethora of trace evidence. If a semiautomatic handgun was used to inflict a contact wound, a phenomenon known as "barrel blowback" creates a vacuum effect at the barrel of the pistol once the projectile has left. It may pull in fiber, tissue, and blood from the body of the victim. If that firearm is placed in a pocket, fibers may be ensnared by sights, clip, and safety releases. If the firearm is removed from the pocket of the assailant and placed under the seat of an automobile for transportation to a disposal location, again fiber evidence may be lodged in the metallic protuberances. Additionally, there are certain parts of the firearm that may retain a fingerprint, including the ammunition that was pushed into the clip by the suspect's thumb. The weapon is then transported to a waterway and thrown some distance where water enters the barrel creating, in effect, a water-block, trapping any materials within the barrel against the breach face. That equilibrium remains until a diver grabs the weapon by the barrel and carries it to the surface, emptying the barrel's contents as it clears the water's surface.

In an effort to preserve any prospective forensic information on the firearm it should be packaged in the water and in a watertight container (once photographed and measured). It should not be unloaded or handled unnecessarily. It should be presumed loaded, charged, and cocked, and handled accordingly.

Automobiles

The traditional method of recovering autos was to wrap a chain around an axle and drag the vehicle to the surface. Although highly effective in removing the vehicle it may also destroy any forensic information on, around, or in the vehicle. Once the vehicle exits the water the pressure that was once equalized inside and outside the vehicle is drastically changed and the water now carries significant weight as the auto continues to clear the water. If the windshield had been shattered and the windows have not been rolled down, there is a good possibility that the windshield will be burst outward by the water pressure, flushing the contents of the interior through the front window. Most vehicles recovered by towing are damaged externally in the process. It is impossible to determine upon retrieval whether the damage occurred before the vehicle was submerged, during submersion, or as a result of the salvage operation.

Although most vehicle recovery is done by tow truck, floating (lifting) vehicles with airbags is a method that reduces internal disturbance, exterior damage, and unnecessary damage to the undercarriage.

If a vehicle has been stolen and used in the commission of a crime, fruits or instrumentalities of the crime may be lost during recovery. The license plate number and the vehicle identification number, if retrievable, may allow a computer check to determine the status of the vehicle. In water of limited visibility, license plate numbers and vehicle identification number (VIN) numbers can be read through a "water bath," which is a plastic bag filled with clear water. When pressed against a license plate, the water bath allows a diver to place his/her facemask against the bag and view the plate through clear water. Some stolen vehicles are not immediately reported, nor are some crimes that were committed with a stolen auto. The best policy is to treat each vehicle to be recovered as a possible tool in the commission of an offense and as a possible source of trace evidence.

If a vehicle has been involved in a vehicular accident or a hit and run, the investigating officers will probably subject it to a vigorous examination. If there are dents, scratches, fabric, or paint on the exterior that may have been transferred by another vehicle or body, all scuba and salvage equipment will have to be eliminated before any trace evidence can be considered use-

ful. Therefore, the salvage operation should be done with the least adverse impact upon the vehicle, and all scuba and salvage equipment should be logged and specifically described to allow for exclusion of possible contamination by the dive and recovery team.

A considerable amount of information can be obtained from a submerged vehicle before efforts are made to raise it. If access into the vehicle is practicable and can be accomplished safely, an examination of the glove compartment can be made. All items in the glove compartment should be removed and placed in plastic bags, leaving water in the bags with the contents. The floors of the vehicle can be examined, photographed, and if anything is discovered, tagged and bagged. The most innocuous of items may prove to be useful. Inflatable and wooden toys may have been used to block the accelerator pedal.

Whenever practicable, occupant recovery should be conducted in the water. Much evidentiary information will be lost if the occupants are left in the vehicle during the recovery operation. Postmortem injuries to the body resulting from the contact with the interior of the vehicle during recovery will complicate the autopsy.

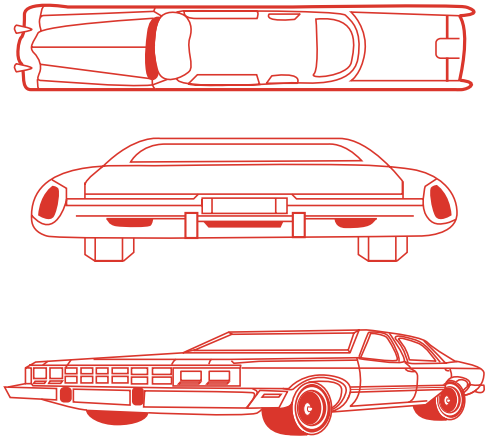
Items recovered in the water should be immersed in the medium from which they were retrieved, not just kept damp. Turning the items over to the lab wet transfers the responsibility for drying and preserving the items to the laboratory technicians.

An exterior examination of the vehicle should be performed that is similar to the preflight "walk-around" conducted by pilots of small aircraft.

During the swim-around, the diver, if s/he has an underwater slate, can record gross anomalies of the exterior of the vehicle (Figure 4). In black water where the diver cannot visually examine the exterior of the vehicle, s/he can conduct a tactile examination of a portion of the vehicle, surface, and verbally recount the findings to the tender and submerge and continue the swim-around. Many dive teams are investing in underwater communication systems that would allow a dive tender to direct and guide the diver in his/her tactile examination of the entire exterior of the vehicle by word of mouth.

It would also prove helpful to the investigation to know whether the lights were intact prior to recovery, because they too are often a casualty of the salvaging operation. If the light lenses are intact prior to raising the vehicle, no false assumptions will be drawn as to how the lenses were broken if they are broken during the salvaging of the auto. If the lenses are not intact prior to raising the auto, a bit of evidentiary information has been obtained. If there are pieces of the lens still in place, they will probably not be in place following the typical recovery. The pieces therefore, should be photographed, bagged, and tagged prior to lifting the vehicle.

The fact that the light switch is on or off is not always indicative of whether the lights were on or off at the time the vehicle entered the water. In salvage operations, the light switch will likely be struck by debris or bodies thrown forward as the vehicle is raised by its rear axle.



Auto swim around

License plate number

VIN number

Windows lowered

yes no

Occupants

Left front Middle Right front

Left rear Middle Right rear

Windows intact

Windshield yes no

Left front yes no

Left rear yes no

Right front yes no

Left front yes no

Rear yes no

Windows open

Left front yes no

Left rear yes no

Right front yes no

Right rear yes no

Doors openable

Left front yes no

Left rear yes no

Right front yes no

Right rear yes no

Keys in ignition

yes no

Glove compartment bagged

yes no

Reported stolen

yes no

Headlights intact

right left

Tail-lights intact

right left

Crime vehicle

yes no

Accelerator blocked

yes no

Figure 4 Automobile swim-around checklist.

The light bulbs can often reveal whether the lights were "on" when the vehicle entered the water. A retrieval of the bulbs may prove to be useful as the investigation progresses.

Burning light filaments break in a characteristic fashion upon impact (their breakage differs from that of filaments that break when not lighted or after they have burnt out). It is important not to remove the bulbs from their housings when bulb comparisons may be necessary but instead to remove the entire light assembly so that damage to the bulbs and filaments will be kept to a minimum. The direction of an external impact can often be determined by the direction in which the hot filament was bent.

Bodies

Once a body has been located and measurements recorded, it must be raised to the surface. It is during the recovery portion of the operation that evidence can be preserved or irredeemably destroyed or contaminated. All unattended drownings should be presumed homicide until proven otherwise.

All bodies should be bagged in the water. Any efforts to recover the body prior to bagging may result in the loss of transient evidence, such as hair, fiber, accelerants, residue, dirt, and glass. Hands should also be bagged to preserve any tissue, broken fingernails, or gunpowder that may be retrieved from the hands and fingers. Hands may also suffer postmortem damage during the recovery; if bagged, the nature of such damage is revealed in the damage to the material in which the hands are bagged.

Feet and shoes should be bagged while still on the body to preserve any trace evidence in the shoe soles. Footwear is often dislodged during traditional recovery procedures and along with it any trace evidence lodged in the soles of shoes may also be lost. Footwear evidence is especially important in recovery operations involving an unidentified body or body parts. All bags placed on hands and feet must be placed with due regard to the possibility of leaving postmortem ligature marks. The shod foot resists burning, decomposition, marine animal depredations, and water damage more consistently than do hands and especially fingers.

Personal effects, clothing, and gross anatomical features are the first items available for examination in attempting to determine the identification of a submerged body. In mass disasters (air crashes), descriptions of clothing and personal effects are provided by next of kin. Billfolds contain driver's licenses, credit cards, and personal papers. Jewelry is often unique and engraved. Keys are often distinctive in design and can be recognized as door keys, auto keys, briefcase keys, and suitcase keys. A successful unlocking provides a tentative identification.

Postmortem Changes

After death physicochemical changes occur in submerged bodies just as they do in bodies on land; however postmortem intervals may be more difficult to determine based on salinity, bacteria, temperature, and depth. One of the first postmortem changes involves the eye. A thin corneal film may begin to develop within minutes of death. Corneal cloudiness develops within 3 h of death. If the eyes are closed, the appearance of corneal filming and clouding may be seriously delayed. Often a deceased has what is known as the "lazy eyelid," where the lack of muscle rigidity allows the eyelid to fall half over the eye. An examination of the eye will reveal that the lower exposed half has developed corneal filming while the upper half, still damp and protected from the air, has not. As the result of water immersion, the corneal filming that ordinarily occurs on dry land should not be evident in recent drowning victims and the existence of corneal filming in a drowning victim calls for an explanation.

Once the heart no longer circulates blood through the body, gravity causes blood to pool in the lower parts. The pooled blood imparts a purple color to the lower body parts and paleness to the upper body. This discoloration is known as postmortem lividity. In deaths that occur on land the location of lividity may reveal the body has been moved after death. Bodies in water should show little evidence of lividity because of the water's buoyancy. If lividity is prominent, death before submersion should be suspected. Lividity can be manufactured in fast-moving water where the current creates a gravitational pull independent of the earth's gravity on a stationary body, usually made stationary as a product of entanglement or entrapment. Lividity in those circumstances should appear in the downstream parts of the body.

Marine life feeds on the soft part of the victim's face. Often postmortem injuries to the eyelids, lips, nose, and ears are mistaken for traumatic antemortem injuries. A variety of algae may cover the exposed parts of the body, giving a green or black hue to those areas. A body may be so covered with algae that to make a determination of gender or race would be difficult.

Most police believe that all unencumbered submerged bodies float as a result of decomposition gases. The flotation of a submerged body is dependent upon the production of gases as decomposition progresses. Carbon dioxide, methane, sulfur dioxide, ammonium sulfide, and hydrogen sulfide make up

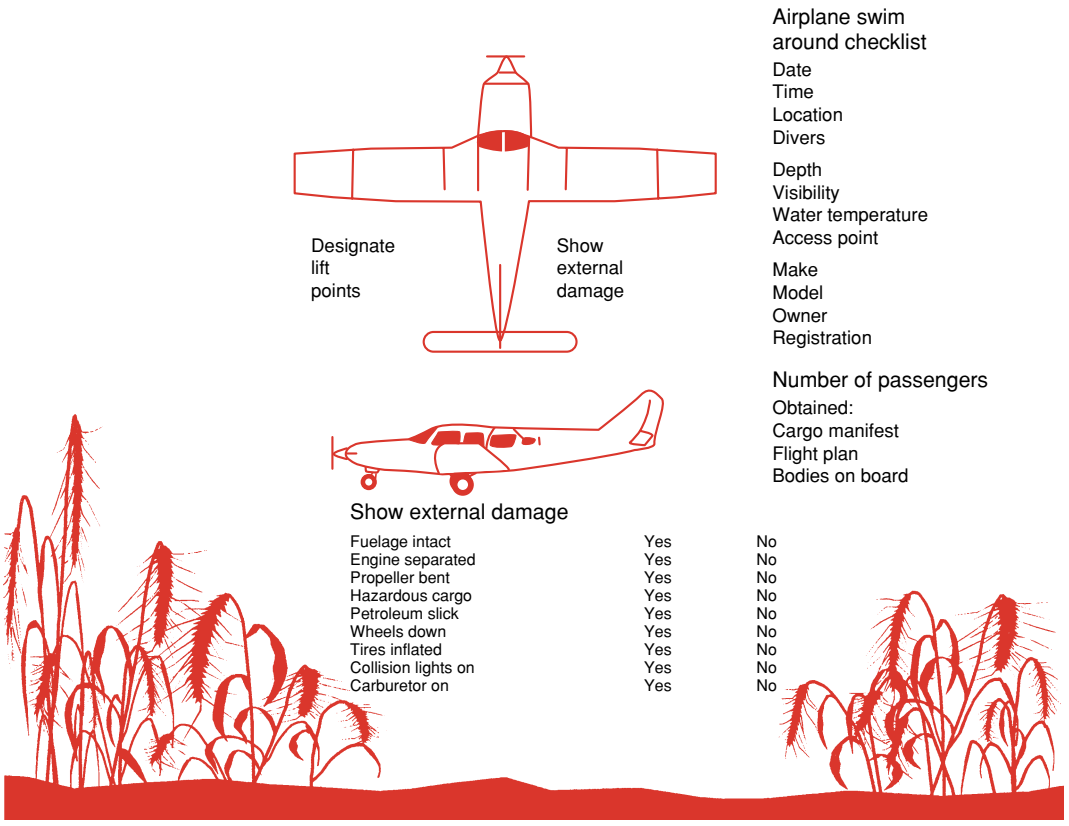


Figure 5 Small aircraft swim-around checklist.

the bulk of these gases, and they all have two characteristics that militate against postmortem flotation: they are water-soluble and easily compressed (water pressure increases 6.6 kg (14.7 lb) every 9.9 m (33 ft) of depth). At greater depths, where the water exceeds 33m (100 ft) and the water temperature is less than 38 °F (3.33 °C), the body may never float. The depth impedes the production of decomposition gases sufficiently to let those that are created dissolve into the surrounding medium.

Passenger Aircraft Crashes

Large Aircraft

Aircraft crashes are especially visible because of the attention accorded them by the media, the great number of airports, the great number of aircraft, and the potential for large numbers of injured and dead. The primary objectives in an aircraft crash recovery operation are to:

1. recover the bodies
2. identify the bodies
3. reconstruct the events leading to the crash.

The recovery and identification of the passengers is generally the most time-consuming part of an air crash investigation, especially if that investigation is taking place underwater. Identification can be positive or presumptive. Positive identification is based on pre- and postmortem comparisons of dental records, fingerprints, palm prints, and footprints or DNA profiling. A positive identification is identification beyond reasonable doubt. A presumptive identification is an identification that is less than certain. A presumptive identification requires several points of inconclusive comparisons that cumulatively establish the legal identity of the body.

In all crashes, the specter of a human-caused explosion hovers. All clothing, personal effects, and body parts should be handled in the same fashion as for a known bombing. Any searches should include detonator components among the items sought. Aircraft parts should be recovered and documented, like any other evidence. Even in a crash where there is confirmation of accidental causes, those causes will be best discovered and corroborated by treating the recovery operation as a criminal investigation.

Small Aircraft

The crash of a small aircraft poses a different challenge to underwater investigations. Such aircraft are often intact. In the investigation of this type of

crash, a preliminary swim-around should be conducted to ascertain gross features of the aircraft, passengers, and cargo. Occupants may still be strapped in their seats. In many instances, the entire aircraft and occupants can be lifted intact to the surface without disturbing the interior of the craft or destroying evidence (Figure 5).

Conclusion

People flock to recreational waterways in vast numbers. As the number of people using such waterways increases, so too do the number of accidents, drownings, violent crimes, and homicides. Criminals often seek a watery repository for weapons and other evidence of wrongdoing. It has become an integral part of the police function to provide resources that can be deployed to retrieve this evidence. It is also becoming more common to find agencies with large bodies of water within their jurisdiction having underwater investigators with the specialized equipment and training necessary to process an underwater crime scene.

See Also

Crime-scene Investigation and Examination: Collection and Chain of Evidence; Major Incident Scene Management; Recovery of Human Remains; Suspicious Deaths; **Odontology:** Overview

Further Reading

Becker RF (1994) *Processing the Underwater Crime Scene*. Springfield, IL: Charles Thomas.

Becker RF (2001) *Criminal Investigation*. Gaithersburg: Aspen.

Fierro MF (1994) Identification of human remains. In: Spitz WU (ed.) *Medicolegal Investigation of Death*, 3rd edn., pp. 71–117. Springfield, IL: Charles Thomas.

Hendrick W, Zaferes A (2000) *Public Safety Diving*. Saddlebrook: PennWell.

Horton M (2001) *Public Safety Diver*. Miami Shores, FL: International Association of Nitrox and Technical Divers.

Perper JA (1994) Time of death and changes after death: anatomical considerations. In: Spitz WU (ed.) *Medicolegal Investigation of Death*, 3rd edn., pp. 14–49. Springfield, IL: Charles Thomas.

Spitz WU (1994) Drowning. In: Spitz WU (ed.) *Medicolegal Investigation of Death*, 3rd edn., pp. 498–515. Springfield, IL: Charles Thomas.

Teather RG (1983) *The Underwater Investigator*. Fort Collins: Concept Systems.

Teather RG (1994) *Encyclopedia of Underwater Investigations*. Best: Flagstaff.

Recovery of Human Remains

H B Baldwin, Forensic Enterprises, Inc., Orland Park, IL, USA
C P May, Criminal Justice Institute, Little Rock, AR, USA

Back to Basics

For the purpose of this article, the recovery of human remains is defined as the actual recovery of human remains from all crime scenes. This article focuses on the procedures that should be accomplished when removing human remains from death scenes and the safe deposition of these remains within a secure mortuary storage. Regardless of the type of death investigation, certain basic procedures should be followed. Most crime scenes are secured prior to the arrival of the medical examiner/coroner official. The official will need to have proper identification so that he/she can identify him/herself to others at the crime scene. This will go a long way in allowing easy access to the crime scenes since most crime scenes are well secured by police officers. Once at the scene, the official will need to identify the lead investigator and other essential officials at the scene. The lead investigator will need to provide the official with all pertinent information about the case, essentially the who, what, where and when of the case.

Before the official enters the scene he/she must exercise good safety procedures. Hazards at crime scenes may include crowd control, building structure collapse, poisonous gases, and traffic. Environmental and physical threats must be removed in order to conduct a death investigation safely.

The lead investigator should conduct a walk-through with the official to provide an overview of the entire scene. This walk-through will help the official to understand the parameters of the scene and the dynamics of the scene. Potential evidence should be identified so that it is not destroyed or contaminated upon removal of the deceased.

The crime scene is the responsibility of the investigating law enforcement agency. The scene needs to be well documented by notes, photography, and sketching. Physical evidence at the crime scene must be protected from destruction and the scene must be protected from contamination. The official needs to work closely with the investigating agency to provide additional knowledge and support to the investigative process. Death investigations are a team effort.

The medical examiner/coroner is a critical part of that team.

In any death investigation, all law enforcement officials involved have specific responsibilities; attempts to meet these responsibilities often impact the efforts of others. A crime scene can be handled in numerous ways and each case may dictate a different approach.

In processing a "normal" death scene the primary and secondary area of the scene must be identified. The primary represents that area where the body is located. The secondary area is the area leading to the primary death scene. For example, if a body is in the middle of a room, the primary area of the death scene is the room and is well defined by the walls, floors, and ceiling. The secondary area will represent all avenues to the room, including the outside yard. How did the suspect enter and leave the scene? Did he/she drive to the scene? These are all secondary areas of the crime scene.

A recommended protocol to be used by law enforcement to process a crime scene is as follows:

1. interview: gather and verify information
2. examine: examine and evaluate the crime scene
3. photograph: photograph the crime scene
4. sketch: sketch the crime scene
5. process: process the crime scene.

Before removing the deceased from the scene, several things must have already occurred. The scene must be both secured and safe for all those present. The scene needs to be well documented and evidence collected and secured properly. The documentation of the position of the body will play an important role when reconstructing or interpreting the scene. Blood stain patterns on the body or clothing are critical and need to be documented and protected for the pathologist. Other evidence associated with the body will also be important. This includes but is not limited to trace evidence such as hair and fibers, bodily fluid, including blood and seminal fluid, and impression evidence on the victim's skin or latent fingerprints on the skin. It will need to be determined at the scene what processing will need to be done before the body is removed. The potential for evidence is most critical in and around the body. Each death investigation is different and must be handled on an individual case basis. Only once these procedures have been accomplished should the body be removed from the scene.

Outdoor death scenes present unique situations because there are no physical barriers that tell us the size of the crime scene. The dimensions of the scene as well as the primary and secondary scenes need to be defined and secured. The potential for physical evidence in the outdoor scene is the same as indoor, with the additional potential of impression evidence such as footwear, tire impression, and possibly ridge detail on the ground or vegetation from the suspect. The medical examiner/coroner must be cognizant of this potential for evidence. The removal of the deceased could easily destroy or contaminate the evidence and crime scene.

Contamination of crime scenes is usually eliminated by the use of personal protective equipment (PPE). The PPE usually consists of a mask, jump suit, gloves, booties, and possible head cover. All of these items are disposable. Often the evidence unit may be seen wearing only booties, mask, and gloves in addition to their normal clothes. This is for their protection rather than a contamination issue.

Death investigations are normally classified as homicides, suicides, accidental, or natural. The potential exists that some deaths are not what they appear. That is the reason why all death investigations should be handled using the same procedures and methodologies. All deaths should be considered as potential homicides until proven otherwise.

Additional Duties of the Medical Examiner/Coroner

At a death scene where law enforcement is present, the medical examiner/coroner's duties are limited to just the body. However, in deaths determined to be natural or accidental, law enforcement may not need to be present. Additional duties will need to be performed by the medical examiner/coroner in these situations. He/she will not have the luxury of having the "check and balance system" to work with; he/she will have to do the documentation, collection, and processing that law enforcement would normally do in these situations. This includes establishing a chain of custody for the evidence collected.

In all situations where a body is moved for transportation to a mortuary, the body should be properly recovered and transported. If the deceased is not handled properly, crucial evidence could be lost or destroyed. Documentation should further include observations such as fluid on the body as froth, purge, and bleeding from orifices. Additional considerations for evidence potential may include the fragile evidence of latent prints on the deceased's skin. The suspect may have touched, moved, or carried the deceased. This action leads to the potential of latent prints from the suspect left on the victim's skin or other clothing such as shoes.

Postmortem changes also need to be identified and documented. Some of these changes include livor, rigor, degree of decomposition, insect activity, scene

temperature, and body temperature. This information will assist in establishing the time of death, corroborate witness statements, and indicate if the body has been moved after death. Complete photography and written documentation is required to document accurately the condition of the body when found and the condition of the scene.

Thoroughly securing the scene will prevent contamination and destruction of evidence. A command post concept should be used to have essential personnel, equipment, and communications limited to aspecific area. A log listing the names, agency, and time entered/left of all individuals documents the personnel arriving and leaving the scene. An additional secured area should be identified and used to decontaminate those entering or leaving the scene to prevent additional cross-contamination of the scene or prevent the scene from cross-contaminating others and their equipment. Most death investigations have some form of biological fluids present and consequently create biohazard issues. Any potential biohazard must be decontaminated and detained within the secured area of the scene.

Every death investigation scene is different. No two are identical. This requires the medical examiner/coroner to think carefully about how the body is to be handled and moved without destroying evidence and contaminating the scene or body. The deceased body should be considered as a piece of evidence. Consequently, the body will need to be packaged and sealed, just like any piece of physical evidence. This can be accomplished by placing the body in a disposable body bag and then sealing and marking the bag, as with any evidence container. The date, incident number, and officer's initials should be included. A seal should be placed over the zipper of the bag to ensure the evidence bag is not tampered with between the scene and mortuary. However, before placing the body in a bag and sealing, the body should be laid on a white sheet. The sheet is then folded over the body and placed in the body bag. A backer board can be placed under the sheet to provide a rigid surface for easier removal and keeping the body in the same position as it was found. Wrapping the body in a white sheet and placing it in a body bag ensures that all trace evidence on the body is kept packaged within the white sheet. The medical examiner/coroner must maintain jurisdiction over the body. This action protects the chain of custody as the body is moved from the scene for an autopsy, specimen collection, or storage. Following packaging, the body should be transported directly to a mortuary where it is placed in a secured facility until the autopsy or specimen collection is completed.

Environmental conditions (i.e., rain, snow, wind, sun) can complicate the removal of a body from an outdoor scene. Geographic location and terrain should also be taken into consideration. Evidence potential is the same at outdoor and indoor scenes. However, latent prints and footwear impressions may be developed on the vegetation around the body in an outdoor scene.

If the death scene is a vehicle, additional complications may result because of the limited space for investigators to maneuver. Additional problems that may be encountered include the environmental conditions and any hazards. Vehicles present a unique problem in evidence recovery because of the different textures and surfaces present. The use of the backer board as described above will greatly assist in the removal process.

When removing a body from water or a fire, the same procedure as previously described should be followed. The body is wrapped in a sheet, then placed in a body bag, sealed, and transported. Documentation of the scene is the same. A sample of the water from which the body was found should be collected and analyzed for possible contaminates.

Search Techniques for Human Remains

Because of the potential for scattering of the bones or hidden evidence, surface recovery of skeletal remains or the recovery of a buried body is different than most other scenes. The primary event in the recovery of the remains in these types of circumstances is finding the body. Most remains are found by accident. In the Midwest states of the USA a majority of the remains are found in the fall or spring by hunters, farmers, or others such as hikers in the woods and construction workers performing excavations at job sites. Once the remains are found the primary area of recovery is now defined. However, the secondary area of the scene should not be forgotten.

Remains can also be found incident to searching an area specified by investigative leads or informants. Before starting a search, the information received from informants or the result of investigative leads must be verified. Once the search area is defined and the information is verified, an evaluation, with respect to staffing levels and equipment needs should be conducted and a recovery team established. The team should consist of a team leader and searchers as well as crime-scene personnel for photography, sketching, collection of evidence, and the recovery of the remains. A detailed map of the area in question and aerial photos to show the layout of the search scene may be useful. Securing the assistance of someone who is familiar with the area can provide insight

concerning the terrain and any unforeseen issues such as changes made to the area which have not been documented.

The team leader must also take comfort conditions into account. This might include weather conditions, food for the workers, bathroom facilities, plenty of liquids for drinking and water for cleaning up.

Once the area has been evaluated and a team is established, the team should be informed of the object of the search and how to look for it. Do not assume that they know what to do. Have a meeting before the search to explain in detail the objective of the search.

Search methods that can be useful for all outdoor crime scenes are circle, grid, strip, and zone. The method selected will depend entirely on the terrain to be searched and the amount of staff available. Always have the area searched twice, but not by the same person. Another person may find what the first person missed.

When using any of the search techniques, if one of the searchers finds an item the whole team stops until the item found can be photographed, its location sketched, then collected and marked for further examination later. After the item is marked or collected the searchers continue until another item is located. This process is continued until the entire area to be searched is covered.

Another search method to be considered is use of trained canines. Some dogs are trained specifically for recovering items of evidence in fields, while others are trained specifically for finding deceased bodies. If canines are to be used, they must be specifically trained for the search and recovery of human remains. Canines cross-trained for drugs, arsons, bombs, and other items of evidence are not as productive as canines specifically trained for recovery of human remains.

If you are looking for buried remains, use the same search methods as for surface recoveries but look for different search indicators, such as disturbances in vegetation, compacted soil, evidence of animal activity, and changes in soil coloration that may reflect a disturbance of the soil. In this type of search it is imperative that the searchers are educated in the different types of burial indicator that may be observed. Because of time of the year and weather elements, burial indicators may be difficult to find. These indicators will vary based on the type of terrain being searched. Remember, you may be looking for pieces of a body, which could mean multiple burial sites, rather than one large burial site.

Some special problem areas for visual indicators are sandy beaches, desert areas, and cultivated land. The visual indicators discussed above will not be useful in these areas. Locating a burial site in these areas requires a different approach to the problem. Several nondestructive methods, including infrared photography, methane detectors, and aerial photography, should be considered before using methods such as probing or large equipment such as a bulldozer, which may damage valuable evidence along with the body.

Surface Recovery

Once the search is completed and the body is located on the surface, the recovery site should be defined. Keep in mind that there may be extreme scattering of the bones or body parts by animals. The area encompassing the scattered bones may be less than 1 m or several meters. Some of the bones may never be found because of vast scattering or consumption by animals. Vegetation, dead leaves, or fallen trees or branches may cover the bones. This covering of the deceased may be intentional by the suspect to camouflage the body.

Following the location of the remains and defining the recovery area, proceed as with any other crime scene. The area should be secured, examined, evaluated, photographed, sketched, and processed. An evidence-free access area to and from the site should also be established. An outer-perimeter search must be completed to locate other body parts or physical evidence. A command post should be set up, preferably away from the recovery site. A checkpoint should also be set up to check personnel and limit the number of people who are entering the site, just as would be done with any other crime scene. One way of limiting the difficulties caused by other people entering the scene is to take Polaroid or digital pictures of the site and leave them at the command post for viewing. Do not permit anyone to rush you. These scenes should be done right the first time. There are no second chances.

After photographing and sketching the scene, the primary area should be cleared of all vegetation and debris. This must be completed without disturbing the remains or any of the physical evidence that is present. Again, photos should be taken of the new "clean" site. A metal detector should be used prior to any further processing. Any items located with the detector should be marked with a wood or plastic stake for future reference. Using rope or string, a grid should be established for the purpose of locating the items by measurements and for ease in placing the items on a sketch. The grid should be measured so that the sides are square to each other. Plot all evidence and remains on the sketch. Close-up photographs should be taken of all evidence prior to re-

moval. Of course the photographs should be taken with a scale to show the size of the item.

All evidence collected should be packaged separately. As a rule of thumb, each item of evidence should be packaged in a paper product unless it is liquid, in which case it should be placed in a glass vial. Paper product means paper fold, paper bag, or cardboard box. The remains of the deceased should be packaged separately if that is the way they were found. If the body is intact, use a wooden backer board, white sheet, and body bag.

Once the surface of the site has been cleared of all remains and evidence, recheck the area with a metal detector. If there are no further readings with the detector, then examine and excavate the top 15 cm (6 in.) of soil for any additional evidence or remains/bones. In some instances the remains have gone through a self-burial. Any object placed on the surface of the ground can work its way into the ground to some extent, depending on weight, ground density, and weather conditions. This will of course depend on the terrain of the area, the amount of time that has elapsed, and the weather conditions.

In removing the top centimeters of soil we have found that the best method is to cut the area into strips of about 15 cm (6 in.) wide and then to remove the soil from the strips a section at a time. This material should then be sifted with a fine sifter/screen. A sifter of 0.5 (1/4 in.) or 1 cm (1/8 in.) mesh should be used so that projectiles or teeth are not missed. Once this is completed one can be assured that the maximum amount of evidence and remains from this site have been collected. The one tooth that may be missed may be the tooth needed to make a positive identification of the deceased.

The possibility of contaminants in the soil beneath the remains should be considered. A sample of the soil should be collected for further analysis at a laboratory along with a standard of the soil from the general area.

Finally, all other evidence or body parts in the area outside the recovery site should be recovered. This recovery should be handled and processed as thoroughly as any other crime scene.

The length of time spent from the initial search to locating the remains to the completion of the processing of the site may be several days or weeks. Because of this time element, one must take into account the weather conditions and plan accordingly.

Excavation Techniques

The same basic procedures that apply to surface recoveries also apply to excavations. The difference is that most of the evidence and the remains are below ground level.

Once the burial site is located and defined, an excavation method should be chosen. There are basically three methods of excavating the ground around the body: hole, trench, and table.

Because of the ease and comfort it provides personnel while removing the remains and evidence, many investigators prefer the table method. However, the time-consuming nature of some soils may make using this method time- and cost-prohibitive.

Regardless of the method chosen, the position of the body under the ground should be estimated before initiating the excavation. This is not as difficult as it sounds. Some portion of the body should already be visible because it has been determined that there is a body there. Based on what is seen, one can overestimate the position and dig around it.

As with any of these methods, the soil should be removed in strips approximately 30 cm (12 in.) wide and 15 cm (6 in.) in depth. The soil should be hand-checked and sifted as the different layers/strips are removed. To accomplish these tasks it will be necessary to have one qualified person in the pit and at least four other people using the sifters.

What are you looking for in the soil? Anything that is not soil could be evidence or bones! Coins from victims' and/or suspects' pockets, wine bottle caps that can be physically matched to a wine bottle found in the suspect's vehicle, skin tissue with ridge detail that can identify the victim, soy beans and corn stalks that can provide a time element of the burial, magazines that can also provide a time element, and a whole host of other unusual items, not excluding weapons and projectiles, can be and have been found. Expect the unexpected and remember that any and all forms of evidence can be found in a gravesite.

The least cumbersome method of removing the body is to wrap it in a white sheet and place it on to a wooden backer board (all fire departments use them) before removing it from the grave. This will keep the body intact and make transportation easier. Once the body is removed, do not forget to check the ground under it for the suspect's footwear impressions in the soil. The soil beneath the body must also be removed for several centimeters and sifted again to locate evidence, bones, projectiles, and teeth.

Unfortunately, cases where the buried body is literally yanked out of the ground and taken away from the scene with no thought to evidence either in the grave or on the body are not uncommon. Just because a body is buried does not mean it cannot tell a story or point a finger at the murderer. If this was a fresh homicide scene and the body was in a parking lot, wouldn't one use everything available and do every-

thing possible to process the scene? Then why is it that when a body is buried investigators often have a different attitude? Probably because it is something with which they are unfamiliar. One needs to take time in the recovery of the remains and try to plan for the welfare of coworkers, the changing weather conditions, equipment needs, and 24-h security at the scene.

See Also

Crime-scene Investigation and Examination: Collection and Chain of Evidence; Major Incident Scene Management; Suspicious Deaths; **Crime-scene Management, Systems:** Continental Europe; United Kingdom; United States of America

Further Reading

Crime Scene Investigation: A Guide for Law Enforcement (2000) Washington, DC: US Department of Justice.
Fisher BAJ (2004) *Techniques of Crime Scene Investigation,* 7th edn. New York: Elsevier Science.
Geberth VJ (2000) *Practical Homicide Investigation,* 3rd edn. New York: Elsevier Science.
Hawthorne MR (1999) *First Unit Responder.* Boca Raton, FL: CRC Press.
Medicolegal Death Investigation Guidelines (2001) Washington, DC: US Department of Justice.
Sansone SJ (1998) *Police Photography,* 4th edn. Cincinnati, OH: Anderson.
Siegel JA, Saukko PJ, Knupfer GC (2000) *Encyclopedia of Forensic Sciences.* Academic Press.
Spitz WV, Fisher RS (1993) *Medicolegal Investigation of Death,* 2nd edn. Springfield, IL: Charles C. Thomas.
Svenson A, Wendel O, Fisher BAJ (1993) *Techniques of Crime Scene Investigation,* 5th edn. New York: Elsevier Science.

Suspicious Deaths

J Horswell, Forensic Executives, Upper Mt. Gravatt, QLD, Australia

Background

To understand suspicious death investigation, police officers and specialist forensic scientists tasked with this type of investigation should understand the various mechanisms involved in suspicious deaths.

This would be second nature to a forensic pathologist; however, others who attend scenes of crime, such as senior investigating officers (SIOs), crime-scene investigators, and other more specialist forensic practitioners, should also be conversant with forensic medicine and forensic pathology. This is now certainly the case for crime-scene investigators; however it has not always been the case. With wider cross-training in these various forensic specialties, those specialists tasked with a suspicious death investigation where all participants will know where each other's specialist function begins and ends.

Kirk's view that any criminal investigation is a dual investigation, involving individuals and material items, is as true today as it was when he discussed these issues. Normally the coordination of a major criminal investigation involving a suspicious death scene certainly is a dual investigation, and it is normally delegated to a senior investigating office (SIO). A senior investigator (SI) should also be appointed to coordinate the gathering of all oral evidence from witnesses and suspects (individuals). Likewise, a senior forensic investigator (SFI) should coordinate the overall forensic investigation, gathering information and potential evidentiary material.

Death as a Major Crime

In the community, the most serious crime is that of the intentional killing of one person by another and it is therefore necessary that each of these events be thoroughly investigated by a team of specialists, including SIOs, crime-scene investigators, fingerprint officers, a forensic photographer, and a forensic pathologist. In some jurisdictions the crime-scene investigator is also the photographer and a police medical officer may also visit the scene as opposed to a forensic pathologist, who may only become involved in the mortuary. If this is the case, the police medical officer should communicate with the forensic pathologist either before or during the preliminary stages of the postmortem examination.

The crime-scene investigator is the individual who is tasked with recording and processing the crime scene. He is also, in conjunction with his team colleagues, tasked with the interpretation of the crime scene. We often hear of forensic pathologists who attend crime scenes to gather information in relation to the cause and manner of death trying to take over the scene investigation: it is not their responsibility to usurp the legitimate role of the crime-scene investigator. The presence of a crime-scene manager at the scene will prevent this occurring as it will be the crime-scene manager who directs the application of all forensic resources.

and it may be several days before a postmortem takes place. When there are questions that require urgent answers then postmortem examinations should be carried out as soon as possible.

There are now two distinct tasks ahead of the crime-scene investigator. The first is the technical recording and retrieval of potential evidence from the scene. Just as important is the second, the reconstruction in the mind of the crime-scene investigator of the events surrounding the death. The technical issues will be discussed first, followed by the reconstruction issues.

Crime-Scene Security

When a suspicious death is discovered, the death scene should be secured immediately so that no one has the opportunity to change it in any way.

Indoor scenes will be easy to secure and protect. Outdoor scenes present challenges. The more urban the outdoor scene, the more difficult it is to secure and there will be the need for several scene guards. The more remote the scene, the easier it is to secure. The weather and movement of animals through outdoor scenes add a dimension to the processing of a crime scene and the condition in which the deceased may be found.

Observations

The crime-scene investigator should take photographs immediately, before anything is moved. Notes and a sketch should also be made at this time. The deceased's location relative to other objects and structures within the scene is very important. The position of the deceased is plotted: the head and groin of the deceased are good points on the body to use for plotting its position. Accurate measurements should be noted to place the items within the scene in the sketch in the same locations as they appear in the scene.

The deceased is the most valuable piece of potential evidence at any death scene. Hence, a systematic and thorough examination of the deceased should be undertaken at every death scene. Blood spillage or spatter should be noted and will remain after the removal of the body. Weather conditions, location, and poor lighting may mask some faint injuries and trace evidence on the body, therefore the crime-scene investigator should document in writing, by sketch, and by photography all information about the body that can be gathered at the scene. The remainder will have to wait until the postmortem examination, which is the role of the forensic pathologist.

The environment where the body was found will affect the rate of body cooling. The wind conditions, temperature, and the presence of any rain should be noted. The crime-scene investigator will need to develop a general description of the deceased, including gender, race, age, height, and weight.

One of the most important questions that needs answering is: did death occur at this location? The position in which the deceased was discovered is of particular importance as it will provide an indication as to whether the deceased was moved or not before being discovered. The presence or absence of rigor mortis or stiffness of the body, whether absent, minimal, moderate, advanced or complete, will help the crime-scene investigator determine if the person died at that locus in the position as found. Some crime-scene investigators with relevant training and experience may feel they are in a position to evaluate rigor mortis and hypostasis. A pink-purple discoloration is usually present at the lowest point of the body. This is due to the settling of the blood by gravitation and the location and state of fixation should be noted and photographed. For example, unfixed livor blanches white when moderate pressure is applied, as opposed to fixed livor mortis, which remains the same color when pressure is applied. If livor mortis is noted on the deceased in areas not consistent with forming in the lowest parts of the body then the crime-scene investigator should consider the possibility that the deceased was moved after death. However well trained a crime-scene investigator may feel he/she is, these observations should be discussed with the forensic pathologist. If the forensic pathologist was not in a position to attend the crime scene then photographs would assist in such discussions.

The blood flow and spatter patterns should match the position of the body. If the scene is one of apparent violence then the blood flow patterns may indicate the type of weapon and how it was used.

The crime-scene investigator must seek answers to the following questions: is trace evidence at the scene consistent with the death having occurred at this location? Does the body contain any trace evidence that is unusual for this location, for example, mud on soles of shoes, grass, or seed material embedded in or found on the clothing when the deceased was located inside a building? Is the death one that can be attributed to natural causes? Are there any external signs of violence? Is there anything amiss or out of the ordinary regarding the scene? Is there anything about the scene that arouses the crime-scene investigator's suspicions?

The crime-scene investigator should consider several hypotheses and then see if there is any evidence

to disprove or support any of them. The physical evidence present, or absent, along with the known facts, should be sufficient to enable the crime-scene investigator to develop a reasonable hypothesis as to what has happened at the scene, however, this is not always possible. Suspicions may not be aroused until the postmortem reveals something that was not apparent at the scene. The forensic pathologist may, however, provide the investigator with a definitive suspicion of the cause of death. This gives investigators leads to start their lines of enquiry.

Removal of the Deceased

The protocols for moving the deceased should be discussed with the forensic pathologist. Before the deceased is moved from the scene the crime-scene investigator should be available to assist the forensic pathologist in the examination of the deceased, systematically noting and photographing trauma and locating and removing potential trace evidence that may be lost on moving the deceased. Best practice suggests that the deceased's hands, feet, and head should be bagged using paper bags, as the use of plastic and any subsequent refrigeration will cause the bag to sweat. The bags should be large enough to be taped securely around the wrist, ankle, or neck and allow "ballooning" over the area to be protected. The body should then be rolled on to a clean white sheet and placed in a clean new body bag. This will then allow a thorough examination of the area that was previously covered by the deceased.

Information-Gathering and Activities at the Death Scene

Forensic science is an information science and it is imperative to gain as much information from the scene and secondary scenes as possible. Forms should be designed in such a way that nothing is missed. These form the basis of the crime-scene investigator's notes made at the scene and his/her examinations. The following is a list of what should be recorded.

Report to Crime-Scene Investigators: Receipt of Information

- Date and time of report
- Form of report (phone, fax, radio message)
- Crime-scene investigator receiving the report
- Crime-scene investigator(s) tasked with the case
- Summary of what has happened
- Officer at crime scene in charge of scene.

Arrival by Crime-Scene Investigators at the Death Scene

- Time of arrival at scene
- Date of arrival at scene
- Scene address or location
- Weather conditions
- Temperature
- Street lighting if present and whether on, if dark
- Police officer in charge of the scene
- History of the incident as known by first officer
- Name and address of victim
- Names and addresses of relatives
- Determine the scope and ensure that adequate crime-scene protection and security is put in place
- Call for additional police for guard duty if required
- Post guards, barricade, rope or tape off crime-scene area
- Ensure that first officer is recording in a log all those who are there and have visited and all those who may visit the scene whilst the first officer is guarding the scene
- Identify a path that allows entry and exit to the critical area of the scene without disturbing potential evidentiary material
- Set aside an area for equipment and rubbish collection during crime-scene processing
- Ensure all specialists are briefed regarding eating, smoking, touching items, and using toilets
- Ensure briefings occur with SIO at regular intervals.

Initial Death-Scene Assessment

- Location of the victim
- Enter death scene
- Ascertain and verify death – an absolute priority: this is sometimes very obvious and at other times less than obvious
- Note condition of deceased
- Implement procedures to protect any potential evidence and protect the critical areas from damage by weather or exposure or by the movement of specialist personnel in and out of the scene
- Commence death/crime-scene investigation.

Death-Scene Investigation

- Identify the path that may have been used by the suspect to enter and exit the critical area of the scene: it is here that the crime-scene investigator should look for latent and trace evidence
- Allocate specialist resources to undertake a team-based approach to processing the death scene
- The death-scene search should not begin until all the photographs, sketches, measurements, fingerprint search, and narrative have been completed

- Ensure scene guard advises the crime-scene manager of the arrival of specialists
- Ensure records are kept of their names, specialty, and time of arrival and departure
- Record the death scene by photographs (video and stills), narrative, and sketch plan (observe, describe, and record)
- Record any alterations to the death scene that were made as a matter of investigative necessity or during the emergency response
- Record the following:
  - Lights: on or off?
  - Doors: open, closed, locked, or unlocked?
  - Deceased: moved or cut down?
  - Windows: open, closed, locked, or unlocked?
  - Names of all persons who moved the deceased before and during the death scene examination
  - Any furniture moved or anything touched?
  - Gas turned on or off at mains?
  - Gas on or off at appliances?
  - Electricity turned on or off at mains?
  - Electrical appliances on or off? Note televisions, radios, and clocks
  - If there is a vehicle involved, is the engine off or on? Is the motor cold or cool, warm or hot?
  - Ensure that the telephone within the death scene is not used
  - Does the telephone have an answering machine?
  - Check last number rung into the premises
  - Make a recording of any messages or take possession of any tape present
  - Check for mobile phones and/or pages and record messages and last numbers called, both incoming and outgoing
  - Check any computers present for messages or written texts
  - Check any cameras present and develop any film on camera.

Death-Scene Photographs

- The entire location where the death took place should be photographed externally and internally, from the general to the specific
- Critical areas and their relationship to the deceased and other areas
- Close-up views of any observable evidence with ruler
- Date and time photographs were taken
- Use of a form to record views, location, and frame number
- Type of film and camera used
- Number of exposures
- Overall view of premises from all four sides
- Front entrance to the building
- Hallways, if any
- Entrance to the room where the deceased was found
- General view of the deceased
- Facial view of deceased
- Full-length view of deceased
- Views of any visible wounds
- View of any visible evidence
- View of entrance and exit routes considered to be used by the suspect
- View of any signs of forced entry
- Close-up views of any apparent evidence
- Area beneath deceased after removal
- Any additional evidence found.

Death-Scene Sketch

- Make a simple line drawing of the death scene on a sheet of clean paper
- The following information should be included:
  - Measurements and distance
  - A title block consisting of:
    - North
    - Name and title of sketcher
    - Date and time the sketch was made
    - Nature of the incident
    - Relating the death of (victim's name)
    - Location of the sketch
  - A legend, to identify any objects or articles within the scene
  - A scale depicting measurements used.

Death-Scene Search

After surveying the overall crime scene, it should be easy to recognize the sequence in which evidence is to be collected and areas to be searched and in what order. The collection and search should be systematic, ensuring absolutely nothing is overlooked.

Priority in collection should be given to:

- any items that are in danger of being removed or destroyed by wind, rain, vehicles, animals, tides, and the movement of individuals at the scene
- the collection of any evidence which will enable access to the deceased or any critical area of the crime scene, such as along entry and exit paths
- those critical areas of the crime scene which may render the most evidence, or once processed, enable the removal of a body, or the remainder of the examination to be carried out
- areas which may give a quick indication as to the identity of any suspect(s)

- areas which when processed will permit the release of scene guards and other resources
- the general examination of the remainder of the crime scene for potential evidence.

In establishing the manner and sequence of collecting potential evidence, consideration must be given to the possible destruction of evidence and which approach will yield the best result in terms of useful information. Consultation with other specialists such as the forensic pathologist as to the sequence and method of collection may be necessary to ensure the best result; however, at the scene this may not always be possible.

The following sequence provides some examples of the collection sequencing:

- Macroscopic evidence should be collected from an area before it is powdered for fingerprints.
- Blood stains and forensic evidence should be collected from an area before searching for fingerprints.
- Sweepings from the floor need to be collected before adding fingerprint powder to the scene.
- Polished floors need to be examined first with oblique lighting to locate latent shoemarks and/or any bare footprints.
- Visible fibers, hairs, and other trace material should be collected from an area before applying general collection techniques, such as tapelifts, sweeping and vacuuming.
- Tapelift areas of interest before removing deceased persons (for blood seepage), as handling and movement of the body can cause subsequent loss of trace evidence which may not be seen again at the mortuary.
- Larger objects should be examined before smaller objects and all items should be packaged and labeled at the time of collection.
- The last items to be recovered would be the pieces of bedding, such as sheets and blankets, that were on a bed in which the deceased was found.

Methods of searching critical areas include grids that are larger in less critical areas and smaller in critical areas, or searching in a clockwise or counterclockwise direction from a fixed point, or conducting a line strip search. All these form part of conducting a professional systematic search of a death scene.

A systematic approach to the searching of death scenes reduces stress and fatigue and ensures a more comprehensive search and recovery operation, minimizing the chance of losing potentially valuable evidentiary material.

Postmortem Examination

The deceased should then be transported to the mortuary for a full external and three-cavity postmortem examination.

The postmortem examination is usually conducted by an experienced (in most cases) and qualified forensic pathologist. The crime-scene investigator should be present at the postmortem, as should be the investigating officer or delegate. If the scene was attended by a police medical officer, and not a forensic pathologist, then the medical officer should also be present to provide any medical information that is already known and a medical assessment of the crime scene.

Summary

After all the information is to hand from the crime scene and the postmortem examination, those involved should, from the available facts, be able to work out the cause and manner of death. Although modern forensic investigation is advanced, there will be times when the crime scene does not provide information and the postmortem does not reveal a definitive cause of death. These cases are the difficult ones.

See Also

Accreditation: Crime Scene Investigators; **Crime-scene Investigation and Examination:** Collection and Chain of Evidence; Major Incident Scene Management; Recovery of Human Remains

Further Reading

Bevel T, Gardner RM (2002) *Bloodstain Pattern Analysis,* 2nd edn. Boca Raton, FL: Chemical Rubber.

Brooks PR (1996) Foreword. In: *Geberth's Practical Homicide Investigation.* Boca Raton, FL: Chemical Rubber.

Fisher BAJ (2000) *Techniques of Crime Scene Investigation,* 6th edn. Boca Raton, FL: Chemical Rubber.

Geberth VJ (1983) *Practical Homicide Investigation – Tactics, Procedures, and Forensic Techniques.* New York: Elsevier.

Geberth VJ (1996) *Practical Homicide Investigation – Tactics, Procedures, and Forensic Techniques,* 3rd edn. Boca Raton, FL: Chemical Rubber.

Horswell J (2000) Major incident scene management. In: Siegal JA, *et al.* (eds.) *Encyclopaedia of Forensic Sciences,* pp. 428–432. London: Academic Press.

Horswell J (2000) Suspicious deaths. In: Siegal JA, *et al.* (eds.) *Encyclopaedia of Forensic Sciences,* pp. 462–466. London: Academic Press.

and the postmortem does not reveal a definitive cause of death. These cases are the difficult ones.

See Also

Accreditation: Crime Scene Investigators; **Crime-scene Investigation and Examination:** Collection and Chain of Evidence; Major Incident Scene Management; Recovery of Human Remains

Further Reading

Bevel T, Gardner RM (2002) *Bloodstain Pattern Analysis,* 2nd edn. Boca Raton, FL: Chemical Rubber.

Brooks PR (1996) Foreword. In: *Geberth's Practical Homicide Investigation*. Boca Raton, FL: Chemical Rubber.

Fisher BAJ (2000) *Techniques of Crime Scene Investigation,* 6th edn. Boca Raton, FL: Chemical Rubber.

Geberth VJ (1983) *Practical Homicide Investigation – Tactics, Procedures, and Forensic Techniques*. New York: Elsevier.

Geberth VJ (1996) *Practical Homicide Investigation – Tactics, Procedures, and Forensic Techniques,* 3rd edn. Boca Raton, FL: Chemical Rubber.

Horswell J (2000) Major incident scene management. In: Siegal JA, *et al.* (eds.) *Encyclopaedia of Forensic Sciences,* pp. 428–432. London: Academic Press.

Horswell J (2000) Suspicious deaths. In: Siegal JA, *et al.* (eds.) *Encyclopaedia of Forensic Sciences,* pp. 462–466. London: Academic Press.

Hunter J, Roberts C, Martin A (1996) *Studies in Crime: An Introduction to Forensic Archaeology.* BT Batsford.

Kirk PL (1953) Introduction. In: *Crime Investigation.* New York: John Wiley.

Lee H, Palmbach T, Miller MT (2001) *Henry Lee's Crime Scene Handbook*. London: Academic Press.

Lee K (2004) The role of the pathologist at the crime scene. In: Horswell J (ed.) *The Practice of Crime Scene Investigation,* pp. 195–240. Boca Raton, FL: Chemical Rubber.

Robertson J (2004) Crime scene investigation: key issues for the future. In: Horswell J (ed.) *The Practice of Crime Scene Investigation,* pp. 399–406. Boca Raton, FL: Chemical Rubber.