Forensic DNA Collection at Death Scenes

A Pictorial Guide

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Foreword

Early on in my role as chief medical examiner at the Harris County Institute for Forensic Sciences (HCIFS), I recognized the importance of the collection of trace evidence from a decedent at the scene of death. The significance of this practice has escalated in recent years in step with advances in DNA and other forensic sciences. Biological and trace evidence that is properly documented and safeguarded by medical examiners, forensic investigators, scientists, and healthcare professionals is vital for the proper functioning of the criminal justice system. Evidence collected from a victim or crime scene is often essential to ensure, in equal measure, that the guilty are conclusively identified and convicted and that the innocent are protected from unwarranted prosecution.

Forensic DNA Collection at Death Scenes: A Pictorial Guide is the first atlas of its kind—a handbook devoted to trace evidence and DNA collection at the death scene rather than in the autopsy suite. Our hope is that this atlas will help minimize the considerable risk of altering or losing trace evidence during transportation of the body. The procedures outlined herein provide a practical approach with emphasis on the identification, documentation, and preservation of evidence. A wide range of cases investigated at the HCIFS, and the lessons learned by our Trace DNA Evidence Collection Team (TECT) over the past ten years, are laid out and examined to provide a road map to best practices in the field.

We recognize that the variable resources and organizational infrastructures among federal, state, and local agencies often do not permit the operation of an independent, multidisciplinary forensic facility such as HCIFS. Therefore, the full TECT approach applied in this office (utilizing scientists from the Forensic Genetics Laboratory) is impractical for some jurisdictions. Nonetheless, many of the concepts and procedures presented in this guide are designed for implementation by any medicolegal death investigation system.

While the scientific methodology in this field has become state of the art, this atlas makes clear that best practices may still be achieved with basic "low tech" collection and preservation procedures, matched with resourceful cognitive output—a combination of knowledge, perception, and judgment.

This atlas will be of benefit not only to medical examiners, healthcare professionals, forensic investigators, serologists and DNA analysts, but also to crime scene technicians, law enforcement, prosecutors, defense attorneys, judges, and forensic educators, as well as all others who are committed to sound scientific evidence and impartiality in the pursuit of criminal justice.

There is no doubt that the increasing applications of evidence-based medicine and forensic science to criminal justice and civil litigation demand that crime scene investigations be more scientific, better organized, and multidisciplinary. This atlas responds by providing a step-by-step guide to effective, uncompromising evidence collection. The

development of the Trace DNA Evidence Team as an integral part of the medicolegal investigation is indeed a specialty whose time has come!

Luis A. Sanchez, MD
Executive Director & Chief Medical Examiner
Harris County Institute of Forensic Sciences
Houston, Texas

Preface

> Wherever he steps, whatever he touches, whatever he leaves, even unconsciously, will serve as a silent witness against him. Not even his fingerprints or his footprints, but his hair, the fibres from his clothes, the glass he breaks, the tool marks he leaves, the paint he scratches, the blood or semen he deposits or collects—all of these bear mute witness against him. This is evidence that does not forget. It is not confused by the excitement of the moment. It is not absent because human witnesses are. It is factual evidence. Physical evidence cannot be wrong; it cannot perjure itself; it cannot be wholly absent—only its interpretation can err. Only human failure to find it, study and understand it can diminish its value.
>
> **—P.L. Kirk (1953)**

Looking at the same thing from differing points of view can be interesting. A forensic pathologist examining bruises on the neck of a murder victim might consider whether the pattern is consistent with strangulation. A forensic DNA analyst looking at the same bruises might see an opportunity to find DNA linking a known suspect or identifying a new suspect with a DNA database. A multidisciplinary case approach is common in crime labs but not always so in medicolegal death investigations. In a crime lab, a latent print examiner, a trace evidence analyst, and a forensic DNA expert will meet beforehand when evidence needs to be tested in multiple ways. This ensures the work of one does not impede the work of another. A bloody fingerprint must be a fingerprint first and a DNA sample second.

Forensic pathologists, focusing on the cause and manner of death in the morgue, might miss the chance to identify an assailant from DNA left on the decedent's skin. At the crime scene, no one is likely to look for an assailant's DNA on the decedent. Death investigators focus on documenting the scene and preparing to transport the body to the morgue. Crime scene personnel are usually kept from the decedent and only collect evidence away from the body.

It is easy to miss evidence that cannot be seen. DNA left on a body, clothing, or bindings might not be as apparent as a blood or semen stain. Even close inspection of the decedent might not reveal its presence. Most of the DNA links described in the pages that follow are from touch DNA, small amounts of DNA transferred from the assailant to the decedent by touch. It is collected from the bodies using routine collection methods and it is tested with the same DNA test that most forensic DNA labs use. We have been surprised that samples collected from decedents at crime scenes frequently contain foreign DNA and in many cases the DNA links an assailant to the crime. We are pleased to share the lessons we have learned collecting DNA from bodies at hundreds of crime scenes.

Note: The photos in this book are from actual crime scenes; they may be offensive to some viewers and should be viewed with caution. Because the photos are from crime scenes, photo quality varies.

Acknowledgments

This book is dedicated to the families of the victims of homicides in Harris County (Houston), Texas. We would like to recognize the Trace DNA Evidence Collection Team analysts, past and present, for their dedication and hard work. We also thank HCIFS Deputy Chief Medical Examiner Dwayne A. Wolf, MD, PhD, for his clear vision, his helpful guidance, and his vigorous support of the team. We also thank him for invaluable comments and suggestions for this book. We also thank Kathy Haden-Pinneri, MD, and Pramod Gumpeni, MD, directors of the HCIFS Investigation Division, for their leadership in integrating the trace team into the death investigation process. Both are awakened frequently during the night to assess and approve trace team callouts. Their seemingly limitless energy is greatly appreciated. And last, we thank the Harris County Institute of Forensic Sciences Executive Director and Chief Medical Examiner Luis A. Sanchez, MD, for inspiring and supporting the Trace DNA Evidence Collection Team to ever-growing success.

About the Authors

Rhonda C. Williams, PhD, earned her doctorate in biochemistry/molecular biology from the University of Oklahoma Health Sciences Center in 2006. Dr. Williams joined the Harris County Institute of Forensic Sciences Forensic Genetics Laboratory in May 2006 as a DNA analyst. She was appointed to the DNA Trace Evidence Collection Team in February 2007 and currently serves as the team's lead. In addition, Dr. Williams serves on the Mass Fatality Committee for the Institute. Dr. Williams is a member of the Association of Forensic DNA Analysts and Administrators, the American Society of Biochemistry and Molecular Biology, and is certified as a Molecular Biology Fellow by the American Board of Criminalistics.

Dr. Roger Kahn holds a PhD in human genetics from Yale University in New Haven, Connecticut. He joined the Miami-Dade Police Department in the late 1980s to establish one of the first forensic DNA laboratories in the United States. He later served the Ohio Bureau of Criminal Identification and Investigation for nearly a decade as director of the state's three crime laboratories. Currently, he is crime laboratory director of the Harris County Institute of Forensic Sciences in Houston, Texas. Dr. Kahn is a past president of the American Society of Crime Laboratory Directors and is certified as a Fellow in Molecular Biology by the American Board of Criminalistics.

Introduction 1

Introduction and History

The Harris County (Houston, Texas) Institute of Forensic Sciences began to send, on occasion, a trace evidence analyst to homicide scenes in the early 2000s. Crime lab analysts from the trace evidence section collected trace tape lifts from the decedent in search of foreign hairs, fibers, and other trace evidence that might link a perpetrator to the crime. It soon became apparent that traditional trace evidence rarely contributed to investigations. Even when a suspect was known, trace evidence seldom linked the individual to the crime. In the best of circumstances, comparisons led to matching class characteristics. Occasional associations, but not identifications, resulted. What is more, investigators only occasionally submitted the trace tape lifts for analysis. Lab officials began to question the value of the trace evidence collection project and whether the benefit was worth the cost. Over time the focus changed to DNA collection, primarily touch DNA. There were several reasons for this. On a couple of occasions, a pathologist's swab of a bruise or a very light stain on a homicide victim's skin revealed foreign DNA that helped link a suspect to the crime. These cases alerted the medical examiner staff to the potential power of touch DNA.

Around the same time, in 2007, the Harris County Forensic Genetics Laboratory began to encourage the submission of evidence from property crimes. Most crime laboratories will test DNA evidence from property crimes if success is nearly certain. Bloodstains, cigarette butts, and ski masks, for example, almost always yield complete DNA results, and most labs will test these items whether they are from crimes against persons or from property crimes. Complete, or nearly complete, DNA results are needed for entry into the FBI's national DNA database, known as CODIS. The database compares the DNA of millions of previously convicted offenders to the DNA from crime scenes. A match can strongly link a previously unidentified offender to a crime.

Few labs will test property crime evidence that was merely touched by the perpetrator as the odds of obtaining a useful DNA profile are much lower. Nonetheless, in 2007 the HCIFS Forensic Genetics Laboratory began in earnest to test large numbers of touch DNA samples from property crimes. To our surprise, touched objects often provided full or nearly full DNA profiles that matched an offender in CODIS. Investigators responded by submitting increasing numbers of touch DNA property crime DNA cases and since that time nearly half of HCIFS DNA cases from property crimes are solely touch DNA evidence. As a result, the HCIFS lab leads all Texas crime laboratories in the total number of CODIS offender matches and total number of matches from property crimes. While this was taking place, the trace evidence collection team was in transition and eventually the entire team as well as the team lead were forensic genetics analysts who had firsthand experience with touch DNA. They began to swab bindings and bruises on decedents in

addition to collecting trace tape lifts and they began to see surprising numbers of successes from the foreign DNA they recovered.

The Program Matures

Today, the Trace DNA Evidence Collection Team, the TECT, is an accredited component of the HCIFS Crime Lab. In 2013, ASCLD/LAB accredited the TECT in the crime scene discipline of specifically for Trace/DNA Evidence Collection. The TECT has grown to ten forensic DNA analysts who view scenes with a keen appreciation for touch DNA. These analysts focus on collecting samples from areas where the assailant may have touched the decedent during a struggle or while moving the body. They also comprehensively sample bindings and wrappings in a search for foreign DNA.

The DNA analysts of the TECT are volunteers who work week-long, 24-hour call rotations in addition to their duties in the DNA lab. The call-out criteria is formalized in order to reduce the number of unnecessary scene responses. TECT staff members are called only to suspected homicides that meet at least one of these criteria [Figure 1.1].

1. The decedent has been found in a place other than the original crime scene; i.e., the body was transferred from one location to another.
2. The decedent was found bound or wrapped by, e.g., with duct tape, handcuffs, zip ties, belts, or a comforter.
3. The decedent was killed by means that required sustained close contact, e.g., sharp force trauma, strangulation, or blunt force trauma; or the investigation suggests that such close contact occurred prior to or contemporaneous with the death regardless of the cause of death.

When a crime scene is identified for potential TECT activity, a team member accompanies an HCIFS investigator day or night, in any weather.

TECT scenes are a small subset of the deaths to which the HCIFS responds. Harris County, including the City of Houston, has a population of 4.1 million people according to the 2012 U.S. Census Bureau, making it the third most populous in the United States while Houston is the fifth most populous metro area in the United States. The county spans more than 1700 square miles. The HCIFS includes the medical examiner service and a full-service crime laboratory. The medical examiner is responsible for responding to and investigating unexplained deaths throughout the county. Deaths that must be reported to the HCIFS are specified by state law (CCP, Article 49.25) and include deaths that are suspected to have resulted from physical or chemical injury, sudden and unexpected deaths, deaths under unknown circumstances, suspected suicides and homicides, and deaths of children.

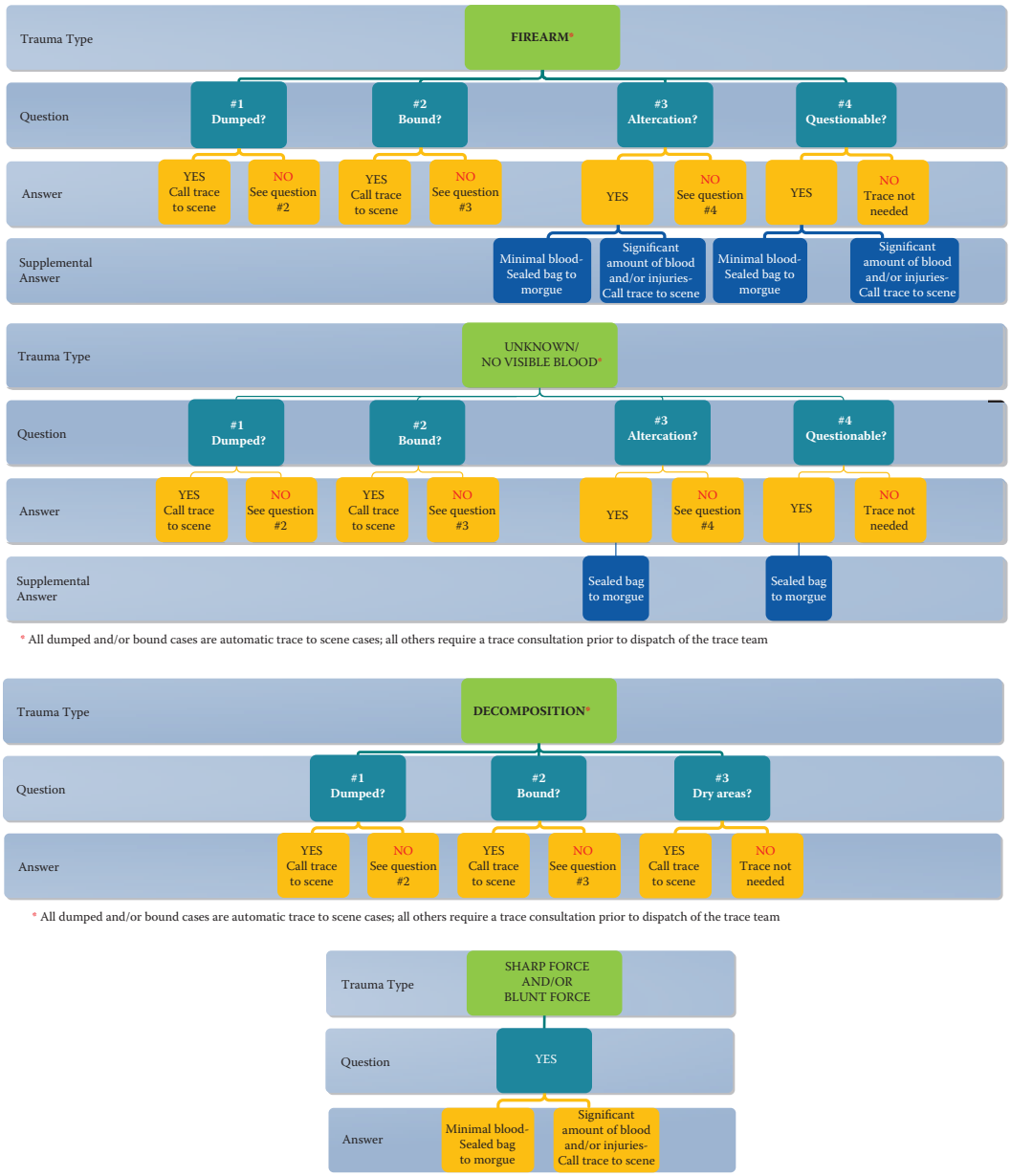

Figure 1.1 The flowchart used by investigations personnel to determine if trace collections should be performed. Depending on the questions and responses from on-scene law enforcement, the flowchart will direct the investigator toward calling the trace analyst for a collection at the scene or in the morgue.

Training 2

According to Locard's principle of exchange, whenever two objects come into contact, materials are exchanged between them (Locard, 1920). Team members are trained to search for and collect material transferred to the decedent, to the decedent's clothing, or to bindings on the decedent. To be eligible for training, a volunteer must be fully trained as a forensic DNA analyst. Once selected for training, volunteers participate in an in-depth training beginning with literature readings on trace collection theory and practice and a thorough review of TECT standard operating procedures. Hands-on training starts with a mock collection instructed by the team lead. Once the mock collection has been performed and all readings are completed, the trainee must pass two quizzes. Photos illustrating a variety of scenarios from prior scenes are reviewed with the trainee during this time. These are the photos presented in this atlas.

Next, the trainee begins to attend actual crime scenes under the supervision of a qualified TECT analyst (Figures 2.1 and 2.2). After observing two to three scenes, the trainee is permitted to process two to three scenes under supervision (Figures 2.3 and 2.4). After passing an oral exam administered by the team lead, the trainee is approved to begin independent trace collections at crime scenes.

All qualified TECT analysts participate in a proficiency testing cycle; TECT-specific proficiency tests are administered once per calendar year. The test is prepared in-house by the Harris County Institute of Forensic Sciences Quality Management section using a latex mannequin to simulate a variety of crime scene scenarios (Figure 2.5). Each TECT analyst is given one of a variety of scenarios and asked to perform a trace collection as he or she would at an actual crime scene. Scenarios include bound, stabbed, and strangled decedents. In order to complete the test successfully, the analyst must be properly gowned at the scene, complete documentation properly, use correct collection techniques for the scenario, and retrieve key items of evidence. The test is observed by the trace team lead who evaluates the work and provides a written critique to the analyst. The TECT analyst must successfully complete the test to continue performing trace collections. An unsuccessful test would result in retraining and a requalifying exam using a different case scenario.

For continuing education, the team meets quarterly to discuss case information and to gather ideas and approaches that contribute to best practices. Current literature is reviewed and discussions are held on topics relevant to trace collection practices, such as bloodstain pattern analysis and crime scene collection techniques. We review situations and consider lessons learned. Most of all, we strengthen the camaraderie that makes this team work so well.

Additionally, representatives from the team meet regularly with an advisory "board" comprised of HCIFS forensic pathologists, the crime laboratory director, and the directors of the HCIFS Investigations Division. Specific scenes are reviewed and results are presented, with an eye toward identifying which types of scenes are the most fruitful for obtaining foreign DNA, the specific techniques that proved successful, the logistics of scene

Figure 2.1 The training process is crucial to developing a competent TECT analyst. The trainee must learn all the aspects of the trace collection process and be able to perform under various scene conditions. Collecting trace evidence from the decedent is different in every case.

response, and even manpower issues. The integration of pathology, laboratory expertise, and investigations with the experience of the TECT is one of the most unique features of this team and allows for continual strengthening of the scientific aspects of DNA collection from decedents.

Scene Interactions

TECT analysts collect evidence on scene to identify and protect it before the body is moved (Figure 2.6). During transportation, blood patterns and fluid stains may change or be obscured, and touch DNA may be mixed with contaminating bodily fluids, making it much more difficult to identify the source of foreign DNA (Figure 2.7).

TECT analysts limit collection to the decedent and to objects, such as clothing and bindings, in contact with the decedent. Crime scene personnel from the investigating law enforcement may not participate in collection from the body, and in turn, TECT analysts are not authorized to collect evidence that is not associated with the decedent.

The TECT goal is to assist the law enforcement agency investigating the homicide. Accordingly, the TECT works closely with homicide investigators, sharing information along the way. Although supervised on scene by an HCIFS investigator, their activities are always guided by scientific principles, based on circumstances and scene observations.

Figure 2.2 The observation process is a critical component of the training process. The trainer must ensure that key elements of a collection are conveyed properly to the trainees, so they may apply their knowledge in future cases.

Once the trace evidence is collected, packaged, and labeled, all collected material is transferred to the investigating agency for submission to a crime laboratory for analysis.

In some instances, TECT analysts work with additional HCIFS specialists, including pathologists, anthropologists, and entomologists (Figure 2.8), to assist in determining the cause and manner of death, time of death, and the approximate age and sex of the victim.

Supplies

Below is a list of supplies and materials that are used at the crime scene and found in the TECT crime scene cart that is brought to the scene (Figures 2.9 and 2.10). Different materials are used depending on the crime scene scenario, which will be discussed in detail in the following chapters.

- Forms:
  - Evidence submission forms (Figure 2.11)
  - Trace collection forms (Figure 2.12)
- Personal protective equipment:
  - Tyvek® suit (Figure 2.13)
  - Face masks

Figure 2.3 Once the trainee has completed all required written and oral training exercises, he or she will begin attending crime scenes. The trainee will observe a qualified TECT analyst, and when ready, he or she will begin collecting under supervision. Once the trainee and TECT lead are certain the trainee is ready, a final oral exam involving many different case scenario photographs will be administered. Once all training is complete, the analyst will begin independent TECT collections.

  - Hair nets
  - Shoe covers
  - Gloves (Figure 2.14)
  - Sweatbands (Figure 2.15)
  - Sweat glove liners (Figure 2.16)
  - Lab coats
  - Aprons (Figure 2.17)
  - Goggles (Figure 2.18)
  - Headlamps (Figure 2.19)
- Collection equipment:
  - Evidence pouches
  - Evidence bags
  - Paper envelopes (Figure 2.20)
  - Evidence tape (Figure 2.21)
  - Distilled water (Figure 2.22)
  - Tweezers
  - Swabs (Figure 2.23)
  - Swab boxes (Figure 2.24)
  - Tape lifts (Figure 2.25)

Figure 2.4 Once the trainee has completed all required written and oral training exercises, he or she will begin attending crime scenes. The trainee will observe a qualified TECT analyst, and when ready, he or she will begin collecting under supervision. Once the trainee and TECT lead are certain the trainee is ready, an oral final exam involving many different case scenario photographs will be administered. Once all training is complete, the analyst will begin independent TECT collections.

- Bench paper
- Measuring tape
- Alternate light source/white light
- Rulers
- Gauze pads
- Scene screen (Figure 2.26)
- Crime scene tent

Documentation

Proper documentation is crucial to successful evidence collection. In addition to documenting what was collected and how it was collected, it is also important to describe interventions that took place before collection began since intervention may be a source of contamination. Interventions should be documented in the worksheet. Examples of intervention are the placement of a sheet over the body to protect it from public view. A sheet can cause loss of evidence or contamination of the body and should be documented. Emergency medical technicians (Figure 2.27) may intervene by placing leads on the body during resuscitation efforts. Leads must be documented on the worksheet. Most emergency personnel wear personal protective equipment, which can help limit contamination, but documentation should note any intervention prior to evidence collection.

Figure 2.5 Proficiency testing is performed on a latex mannequin that is used to simulate a variety of crime scene scenarios.

Collection Techniques

Before any collection begins, the TECT analyst must be fully gowned. Full gowning includes a plastic apron, shoe covers, a hair cover, a mask, and gloves. A Tyvek suit with a mask and gloves is another option for full gowning. Gowning protects the evidence from contamination and protects the analyst from biological hazards.

Many collection techniques can be utilized at a crime scene. Perhaps the simplest technique for a dry area of the body is a tape lift (Figures 2.28 and 2.29). The sticky side of a labeled tape lift is pressed on the surface repeatedly until the tape is no longer sticky enough to collect material. A tape lift will pick up hair, fiber, debris, and cells containing DNA. DNA can be recovered from tape lifts by swabbing with water or one of several solvents (Figure 2.30). Xylene, for example, can be used to remove adhesive and cells from the tape lift prior to DNA extraction (May and Thomson, 2009). Another technique is to cut tape lifts into many small pieces, which are then extracted in a small tube in the usual manner (Kenna et al., 2011).

If the body is wet, tape lifting cannot be utilized. However, the body can be searched for macroscopic evidence with a white light flashlight or headlamp, and evidence can be collected with tweezers (Figures 2.31 to 2.33), a technique referred to as *picking*. Picked macroscopic evidence can be placed on a tape lift for preservation (Figures 2.34 to 2.36). Commonly, hair, fiber, paint chips, glass, and debris may be collected this way and stored

Figure 2.6 Prior to moving a body, body fluids have settled, reducing the possibility of body fluids contaminating foreign DNA that may be present. The skin is still intact, and the body is in the position in which it was discovered. Moving the body can release body fluids.

Figure 2.7 Once the body is transported, body fluids can contaminate areas that may have touch DNA. If the body is slightly decomposed, skin slippage occurs. Trace evidence can move with it.