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# The influence of forensic evidence on the case outcomes of homicide incidents ☆,☆☆

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A B S T R A C T

*Objective:* In spite of the growth of forensic science services little published research exists related to the impact of forensic evidence on criminal case outcomes. The present study focused on the influence of forensic evidence on the case processing of homicide incidents.
*Materials and Methods:* The study utilized a prospective analysis of official record data that followed homicide cases in five jurisdictions from the time of police incident report to final criminal disposition.
*Results:* The results showed that most homicides went unsolved (34.5% conviction rate). Only 55.5% of the 400 homicide incidents resulted in arrest of which 77% were referred to the district attorney. On the other hand, 94% of cases referred to the district attorney were charged. Cases were more likely to have arrests, referrals, and charges when witnesses provided information to the police. Suspects who knew their victims were more likely to be arrested and referred to the district attorney. Homicides committed with firearms were less likely to be cleared. The most noteworthy finding was that none of the forensic evidence variables significantly influenced criminal justice outcomes.
*Conclusions:* The study results suggest that forensic evidence is auxiliary and non-determinative for homicide cases.



## Introduction

Over the past twenty years, advances in forensic science have resulted in, among other things, an increased use of DNA typing, an expansion in physical evidence databases, and the development of more specialized instrumentation. It also has led to an increase in the public's awareness of the potential for forensic science to solve serious crimes. Television programs such as CSI, Forensic Files, NCIS, Bones, along with other shows, have large viewing audiences who have come to expect the presence of forensic evidence in criminal cases (Baskin & Sommers, 2010). Every day, people are exposed to newspapers and television news shows that report on well-publicized trials (e.g., O.J. Simpson, Robert Blake, Scott Peterson, Phil Spector) where the use (or absence) of forensic evidence is a focal point. Awareness of the achievements of the Innocence Project in utilizing forensic evidence to gain death row exonerations has expanded to larger segments of the populace and blogs dedicated to forensic issues have exploded onto the internet. With all of this attention being paid to the use of forensic evidence in the processing of criminal cases, its probative value and utility have taken on the status of truisms.

The present study examines the validity of these truisms and provides a detailed examination of the impact of forensic evidence on homicide case processing. Here, a distinction is made between tangible evidence, which is a physical item that, without scientific analysis, is of evidentiary value to the case (e.g., stolen property, driver's license) and forensic evidence. In terms of forensic evidence, the study focuses specifically on the impact of biological, latent print, pattern evidence, firearms/weapons, materials, generic objects, electronic/printed data, trace, and drug evidence on arrest, referral to the district attorney, issuance of a charge, and conviction.

## Literature review

### *Forensic evidence impact studies*

Despite both the lure and concern over the use of forensic evidence across many domains of society and within the criminal justice system, very little published research exists that explores its impact on the various stages of the criminal justice process. Looking back to Parker's survey of forensic laboratories conducted in 1963, it was observed that in only 1% of all crimes was scientific evidence used despite being present in almost 90% of cases (Parker & Peterson, 1972). Similarly, a study conducted by the Rand Corporation supported the finding that forensic evidence played an insignificant role in criminal case outcomes, and again, notwithstanding its availability in the majority of

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cases (Greenwood, Chaiken, Petersilia, & Prusoff, 1975). And, Feeney (1983) found that non-scientific evidence, specifically, eyewitness identification of the suspect, best predicted conviction. Comparable results regarding the negligible and oftentimes non-existent role of scientific evidence were also found in studies of charging (Peterson et al., 1987) plea bargaining (Heumann, 1977; Peterson et al., 1987; Rosett & Cressey, 1976) and in bringing about convictions (Lassers, 1968; Peterson et al., 1987) except in cases of strong DNA evidence (Briody, 2004).

Only a few studies focused explicitly on the impact of forensic evidence on the case processing of homicide incidents. One study considered whether the collection of weapons, bullets, fingerprints, and clothing at the crime scene influenced clearance by arrest (Wellford & Cronin, 2000). The results indicated that the variables most likely to produce an arrest were not those of forensic evidence but were related to law enforcement practices, such as the speed with which officers responded to the scene and with the identification and interviewing of witnesses, neighbors, and friends. Non-drug cases were also more likely to result in an arrest than those incidents that involved drug evidence. The use of criminal information databases for checks on weapons, victims, and suspects was also found to affect clearance by arrest. Therefore, homicide cases in which police resources were sufficient and quickly utilized increased the probability of arrest as did the use of computerized databases.

Keel, Jarvis, and Muirhead (2009) also explored the clearance of homicides through arrest and much like Wellford and Cronin (2000) found that police investigative techniques were more powerful predictors of arrest than forensic evidence. For instance, formally trained homicide detectives improved clearance rates. As for scientific evidence, the study included voice stress analysis, statement analysis, blood splatter, and a vaguely labeled category called "criminal investigative analysis." These variables affected clearance rates but only marginally. In neither of these studies were extralegal variables, such as victim and offender characteristics, significant in predicting clearance.

Perhaps the most relevant study concerning forensic evidence and homicide case outcomes was conducted by Briody (2004). Briody examined the effects of DNA evidence on the progression of homicide cases through the criminal justice process. The study involved a sample of 150 completed cases referred by the police for prosecution in the State of Queensland. Half of these cases had DNA evidence that linked the accused to the crime, while the other half acted as a comparison group and did not include DNA evidence. Cases with DNA evidence were much more likely to reach court than those without. Additionally, incriminating DNA evidence had a positive effect on jurors' decisions to convict but no effect on securing guilty pleas from defendants. Unfortunately, the study used a highly underspecified model for analysis that was limited by a very short list of evidentiary and contextual variables. For instance, tangible evidence was not included nor were forensic variables apart from DNA and fingerprint evidence. No data were collected on whether an arrest was made based on forensic analysis or on police observation of the incident. Thus, it is difficult to discern the impact of DNA evidence when other variables known to influence case processing were absent.

### *Homicide clearance studies*

Overall, few studies have explored the role of forensic evidence in criminal case processing and even fewer assessed the impact of physical evidence for homicide cases. Instead, most studies examined the influence of extralegal and situational factors. Given the present study's interest in assessing the influence of forensic evidence *relative* to other factors already identified as predictive, looking at some of these other studies can be instructive.

By and large, the available literature on homicide clearance by arrest, failed to support the role of victim and offender characteristics, except when cases involved parties known to each other (Alderden, 2009; Lee, 2005; Marché, 1994; Roberts, 2007). One possible explanation for this finding is that these homicides were more likely perpetrated by individuals known to the victims, thereby providing the police with a more readily available list of suspects. Other factors that increased the likelihood of identifying suspects for the police were the testimonies of witnesses and of victims premortem (Lee, 2005; Marché, 1994; Roberts, 2007). Thus, despite arguments to the contrary (Paternoster, 1984; Peterson & Hagan, 1984), the influence of victim and/or suspect race, age, gender, or economic class on police decisions to make arrest appears to be minimized in the investigation of homicide incidents (Bynum, Cordner, & Greene, 1982).

Research on the clearance of homicide incidents also found that the availability of evidence that brings the victim and offender into close physical contact, such as knives, blunt objects, hands, were of greater value in generating arrests than such forms of evidence as firearms, where contact between parties tended to be nonexistent, or minimal at best (Addington, 2006; Alderden & Lavery, 2007; Litwin, 2004; Puckett & Lundman, 2003; Roberts, 2007).

An additional situational characteristic, that is events that are expressive rather than instrumental, were more likely to produce an arrest (Alderden & Lavery, 2007). This may be due to the greater likelihood that such events involve persons known to each other, again increasing the ability to identify potential suspects. However, contrary to research on arrests, studies on the prosecution of homicides suggested the very opposite. Cases involving parties known to each other were *less* likely to be prosecuted and victim and offender characteristics were important predictors of charging. For instance, Riedel and Boulahanis (2007) used homicide data from Chicago from 1988 through 1995 to explore cases in which the offender was detained by police but later released because the prosecution refused to issue a charge. Disproportionately, these cases tended to involve domestic homicides. Additionally, they found that White offenders were less likely to be charged when compared to African Americans, as were homicides involving male victims and male offenders.

By and large, research on homicide case processing, from arrest to conviction, is limited. However, a review of the literature suggests that in order to assess the role of forensic evidence in bringing cases to justice, research needs to parse out the influences of extralegal, situational, law enforcement, and a wider range of physical evidence factors on specific stages of the criminal justice process. The present study moves the field in this direction by using a more fully specified model that evaluates the relative roles of each of these factors as homicide cases move through the justice system.

## Research methodology

Data for this study came from a larger project sponsored by the National Institute of Justice (NIJ) that: (1) estimated the percentage of crime scenes from which one or more types of forensic evidence were collected; (2) described and catalogued the kinds of forensic evidence collected at crime scenes; (3) tracked the use and attrition of forensic evidence in the criminal justice system from crime scenes through laboratory analysis, and then through subsequent criminal justice processes; and (4) assessed the impact of forensic evidence on case processing outcomes.

The present study utilized a prospective analysis of official record data that followed homicide cases in five jurisdictions (Los Angeles County; Indianapolis, IN; Evansville, IN; Fort Wayne, IN; and South Bend, IN) from the time of police incident report to final criminal disposition.

### *Sample design*

Data were derived from the records of 400 reported homicide incidents for the year 2003 in Los Angeles County (N = 245);

Indianapolis, IN (N = 71); Evansville, IN (N = 14); Fort Wayne, IN (N = 38); and South Bend, IN (N = 32). The year 2003 was selected as it represented the greatest likelihood of having most cases at their completion and therefore provided the richest dataset. Cases in which an investigation determined that the incident was not a homicide but resulted from natural causes, an accident, or suicide, were excluded. Additionally, juvenile offender cases were eliminated due to the lack of access to juvenile prosecution records. Thus, study analyses were based on adult offender homicide incidents.

### *Variables & measures*

Various forensic variables were used for both descriptive and outcome analyses. These included: presence of crime scene evidence, laboratory submitted and laboratory examined evidence (i.e. biological, latent prints, pattern evidence, firearms, natural and synthetic materials, generic objects, drugs); and evidence that linked a suspect to the crime scene and/or victim. The types and quantities of physical evidence at crime scenes were derived from police reports and through a review of autopsy reports. No attempt to assess, independently, whether there was physical evidence at crime scenes that was present, but not collected or why autopsies were not performed in almost 30% of the cases. The specific study variables are indicated in Table 1.

**Table 1**
Key study variables

| Variables | Measures |
|---|---|
| *Forensic* | |
| crime scene location(s) | specific locations (e.g., bar, car, park, house) |
| types of evidence & substrates collected at crime scene | each type coded 1 = yes 0 = no |
| types of evidence submitted to lab | each type coded 1 = yes 0 = no |
| types of evidence examined by lab | each type coded 1 = yes 0 = no |
| database entry | CODIS, NIBIN, AFIS |
| database hit | 1 = yes 0 = no |
| link suspect to crime (i.e., places suspect at crime scene, indicates suspect on victim or on weapon) | 1 = yes 0 = no |
| tangible evidence (i.e., a physical item of evidence that, without scientific analysis, is of evidentiary value to the case) (e.g., stolen property, driver's license) | 1 = yes 0 = no |
| *Criminal Offense* | |
| date of crime | date |
| date incident reported to police | date |
| date of arrest | date |
| time from incident to report | total # days/hours |
| time from incident to arrest | total # days |
| victim sex | 1 = male 0-female |
| victim age | 1 = <20 2 = 20-29 3 = 30+ |
| victim race/ethnicity | 1 = White 2 = Black 3 = Latino 4 = Asian 5 = other |
| suspect/offender sex | 1 = male 0-female |
| suspect/offender age | 1 = <20 2 = 20-29 3 = 30+ |
| suspect/offender race/ethnicity | 1 = White 2 = Black 3 = Latino 4 = Asian |
| number of eyewitness(es) | 1 = 0 2 = 1 3 = 2+ |
| victim reports to police | 1 = yes 0 = no |
| witness reports to police | 1 = yes 0 = no |
| victim/suspect relationship | dummy coded (1,0) intimate/family, friend/acquaintance, stranger |
| victim receipt of medical treatment | 1 = yes 0 = no |
| *Crime Dispositions* | |
| suspect arrest | 1 = yes 0 = no |
| referral to District Attorney | 1 = yes 0 = no |
| case charged | 1 = yes 0 = no |
| case conviction | 1 = yes 0 = no |
| attorney type | 1 = private counsel 0 = public defender |
| plea bargain | 1 = plea 0 = trial |
| *Arrest Characteristics* | |
| suspect apprehended within 10 minutes of the crime | 1 = yes 0 = no |
| type of arrest technique | 1 = direct (i.e., suspect surrender, suspect apprehended, suspect arrested in another case, police observation, suspect named, traffic stop, recovered property) 0 = descriptive (i.e., vehicle description, citizen observation, photo ID, suspect description, line-up) |
| *Suspect Crime History* | |
| # prior convictions | total number |

### *Analytical strategy*

The metaphor of the funnel is particularly appropriate for understanding criminal case processing. It captures the perception that few suspected criminals are ultimately convicted, while the majority is diverted from the criminal justice system. Such mortality of cases at each stage of criminal case processing can impact research by affecting the ability to detect true statistical differences, that is, it can result in the loss of power. Consequently, all analyses for the present study were based on pooled data across the five sites. It is important to note that case outcomes existed within varying site-specific organizational structures. Factors such as sentencing guidelines, police culture, prosecutorial attitudes toward various crimes, and other dynamics varied across sites but not within a site. Unfortunately, sufficient data on the jurisdictional contexts that might have conditioned variation in dispositional outcomes were limited. Consequently, the analyses were only able to include three dummy coded variables for the sites (i.e., Los Angeles, Indianapolis and the combined outcomes for the three smaller Indiana sites-Evansville, Fort Wayne and South Bend).

The study explored the effect of forensic evidence on four different case outcomes: (1) whether a reported crime incident resulted in an arrest, (2) whether an arrested case was referred to the prosecutor, (3) whether the district attorney formally charged the suspect(s), and (4) whether a prosecuted defendant was convicted. Since each of the four outcomes is binary, the models used logistic regression analysis to assess the respective case outcomes.

### *The correction of selection bias: The heckman estimator*

Criminal justice case processing can be thought of as a multi-stage procedure, involving first a decision to arrest a suspect, second, if arrest is selected, a decision to refer the case to the prosecutor, next the decision to charge the case, and if charged, the conviction decisions. However, there are three problems with simply treating these decision points as separate occurrences: (1) the phases of the case process are left disconnected, while in practice they are not; (2) the separate results make it difficult to reach summary judgments about the overall influence of explanatory variables; and (3) the parameter estimates for the separate analysis of each decision point will be biased (Berk, 1983; Heckman, 1979; Peterson & Hagan, 1984).

For example, the decision to refer a case to the district attorney results in a selected pool of offenders who have exceeded a threshold on the criteria that determine the choice of case referral. When such selection occurs, the decision to charge a case will be a function not only of the linear combination of regressors ordinarily considered, but also of what Heckman (1979) terms the "hazard rate," or risk of not being selected into the referral population, i.e., the risk of exceeding or not exceeding the threshold. Estimation procedures which fail to take into account the "hazard rate" will yield biased and inconsistent estimates of the structural coefficients (Berk, 1983).

To avoid these problems, a procedure is required that provides information about the two decisions, referral and charging, but that also allows us to combine this information in a meaningful way. One type of correction for selection bias involves calculating the likelihood of reaching a particular stage of case processing (using a probit model), and then entering this likelihood as a control variable in the model predicting an outcome at the next possible stage of case processing (Heckman, 1979). In the present study, this two-stage procedure was followed by first estimating probit models predicting district attorney case referral (for all arrested suspects), formally filed charges (for all case referrals), prosecution (for defendants with formal charges), convictions (for fully prosecuted defendants), and sentence length (for convicted defendants), and then entering the likelihoods (i.e., inverse Mills ratio) calculated from these equations into the appropriate models.

The inverse Mills ratio represents the hazard rate, or the probability of exclusion for each observation conditional on being at risk and is a function not only of observed or measured variables that are included in the selection equation, but also of unobserved or unmeasured variables. These are captured through the error term or residual in the selection equation, and included through the non-linear function used to estimate the inverse Mills ratio. As a result, adding the inverse Mills ratio into the outcome equation introduces a term that attempts to capture both observed and unobserved variables that affect selection.

A common error in the Heckman approach, however, is a failure to properly correct for misestimated standard errors (Bushway, Johnson, and Slocum, 2007). Because the data are censored, the variance estimates obtained tend to be smaller than the true population variance. This, in turn, produces underestimated standard errors in the second stage of the Heckman two-step model. Underestimated standard errors can lead to overstated statistical significance. As a result, researchers need to correct these standard errors using a consistent errors estimator, referred to as robust standard errors. In the current study, robust standard errors were used in all stage-two (i.e., outcome model) estimates.

Additionally, when the same predictors are used to model the selection process and substantive outcome, there will often be substantial correlation between the correction term and the included variables. The presence of serious multicollinearity is a common theme in papers that use the Heckman method, but one that is seldom addressed, effectively. In the present study, the concern is with the collinearity between one particular regressor (the inverse Mills ratio) and the other predictor variables. As explained by Belsley, Kuh, & Welsch (1980), a sufficient condition for the presence of collinearity for any particular regressor is a high value of its variance inflation factor (VIF). The VIF provides an index that measures how much the variance of an estimated regression coefficient (the square of the estimate's standard deviation) is increased because of collinearity. There is no formal VIF value for determining presence of multicollinearity. Kutner (2004) suggests that VIF's that exceed 10 should be regarded as indicating multicollinearity but in weaker models, which is often the case in logistic regression, values above 2.5 may be a cause for concern (see Allison, 1999). The present study calculated the VIF's for each model. In each case, the VIF value between the correction factor and the respective predictor variables did not exceed 2.5.

Finally, since the dependent variables in the second stages are binary, a standard Heckman model would be inconsistent and biased. Therefore, the study used a modified Heckman selection model. As in the original approach, it consisted of two stages. While the original Heckman selection model employs a probit estimator in the selection equation and an ordinary least squares estimator in the second stage, the present study ran a probit estimator in stage one and logistic regression in stage two incorporating Lee's (1983) transformation technique.

*Analytical models*

As discussed above, the Heckman two-stage correction estimate was used to analyze criminal justice outcomes. The first step employed probit analyses to estimate selection into the respective processing stage (i.e., the selection models). Likelihood estimates (inverse Mills ratio) were subsequently used in the stage two logistic regression models (the substantive or outcome models) to correct for selection bias. The predictors used in the selection models (stage 1 probit models) are outlined below.

Predictors for the selection models:

| Arrest | Referral | Charged |
|---|---|---|
| Witness reports | Witness reports | Witness reports |
| Victim reports | Victim reports | Victim reports |
| Intimate/family | Intimate/family | Intimate/family |
| Friend/acquaintance | Friend/acquaintance | Friend/acquaintance |
| Crime scene evidence | Crime scene evidence | Crime scene evidence |
| Time incident to report | Time incident to arrest | Time incident to arrest |
| Victim male | Victim male | Victim male |
| Suspect male | Suspect male | Suspect male |
| Victim teen | Victim teen | Victim teen |
| Victim young adult | Victim young adult | Victim young adult |
| Victim black | Victim black | Victim young adult |
| Victim Latino | Victim Latino | Victim Latino |
| Suspect Black | Suspect Black | Suspect Black |
| Suspect Latino | Suspect Latino | Suspect Latino |

## Results

The study database included 400 homicides, with most of them (245 or 61.3%) committed in Los Angeles (Table 2). The victims were typically male (69%) as were the suspects (86%). Victims and suspects were predominantly Black or Latino, and less than 30 years old. The majority (72%) of cases involved strangers. Sixty-three percent of homicide victims received medical treatment for their injuries. Seventy-six percent of homicides had at least one witness and most (67%) of the witnesses provided reports to the police. As expected, few (15.8%) victims gave eyewitness descriptions to the police. On average, incidents were reported to the police within 12 hours and the average time from incident to arrest was approximately 36 days.

*Physical evidence collected, submitted, & examined*

An extremely high percentage of homicides (97%) had physical evidence collected from the crime scenes (Table 3). The data indicated that firearms/weapons and natural/synthetic materials were the categories of evidence collected most frequently. Police gathered a wide array of guns, bullets, shell casings, and cartridges. Materials evidence primarily factored in as a substrate upon which other evidence might have been found. Clothing was the predominant type of materials evidence collected. Biological (38%), latent print (28.5%) and trace (32.5%) evidence were collected fairly frequently. Suspected blood evidence was the primary form of biological evidence. DNA evidence was collected in 4.5% of the cases. Autopsies were performed in 71.8% of homicide incidents. Autopsy examinations not only revealed the cause and manner of death but also involved the collection of other forensic evidence, including trace (e.g., hair and fibers), clothing, and bullets removed from the victims' bodies.

Police agencies submitted evidence from homicide scenes for laboratory analysis in a very high percentage (88.5%) of cases. Firearms evidence was the most consistently submitted category; a collected gun, bullet, or shell casing was almost always submitted as evidence. Once submitted, a high percentage (81%) of cases had evidence that was examined by crime laboratories, most frequently, firearms, latent prints, and biological evidence. The volume of physical evidence going into and examined by the Los Angeles County crime

**Table 2**
Descriptive characteristics of homicide incidents

| | (N = 400) |
|---|---|
| *Victim*: | |
| % male | 85.5 |
| %<20 | 25.1 |
| % 20-29 | 36.8 |
| % 30+ | 38.1 |
| % White | 14.1 |
| % Black | 49.9 |
| % Latino | 32.1 |
| % Asian | 2.9 |
| % Other | 1.0 |
| *Suspect*: | |
| % male | 94.8 |
| %<20 | 20.8 |
| % 20-29 | 47.7 |
| % 30+ | 31.5 |
| % White | 15.4 |
| % Black | 54.2 |
| % Latino | 28.8 |
| % Asian | 1.6 |
| *Victim/Suspect Relationship*: | |
| % intimate/family | 12.2 |
| % friend/acquaintance | 15.8 |
| % stranger | 72.0 |
| *% victim received medical treatment* | 62.8 |
| *Crime Location*: | |
| % car | 7.5 |
| % bar | 1.3 |
| % park | .5 |
| % retail store | 1.3 |
| % house/apt. | 29.5 |
| % street | 45.5 |
| % indoors (other than house/apt.) | 7.5 |
| % other (e.g., hotel/motel, restaurant, hospital) | 6.9 |
| *# of Witnesses*: | |
| % 0 | 24.0 |
| % 1 | 62.2 |
| % 2+ | 13.8 |
| *% witness report to police* | 67.0 |
| *% victim report to police* | 15.8 |
| *Case Outcomes* | |
| % arrests | 55.5 |
| % referral to District Attorney | 42.5 |
| % charged | 40.0 |
| % convictions | 34.5 |
| *% arrested within 10 minutes of incident* | 14.8 |
| *time from incident to police report (mean hours)* | 12 |
| *time from incident to arrest (mean days)* | 35.56 |

laboratory was far greater than that of the other laboratories. It often exceeding the number of cases in *all* the other sites combined. For latent prints, pattern evidence, firearms/weapons, and materials evidence, the quantity of Los Angeles cases exceeded those in the other jurisdictions combined by a factor of three or more.

By far, firearms/weapons evidence generated most of the laboratory findings for homicides. This was followed by biological evidence and then latent prints. The laboratories also routinely submitted fingerprints, firearms-related evidence, and DNA profiles to different computerized databases in hopes of identifying otherwise unknown offenders or in an attempt to link suspects to the victim, crime scene, and/or weapon. The hits for latent prints were 18.8% (9/48), for NIBIN/IBIS 8.6% (7/82), and for CODIS, no hits were produced (0 of 3).

**Table 3**
Crime scene evidence for homicide cases

| Evidence Type | N | Collected | | Submitted | | Examined | |
|---|---|---|---|---|---|---|---|
| | | n | % | n | % | n | % |
| Total | 400 | 388 | 97.0% | 354 | 88.5% | 324 | 81.0% |
| Biological (blood, DNA, saliva, tissue, bone, sexual assault kit) | | 153 | 38.3% | 129 | 32.3% | 102 | 25.5% |
| Fingerprints | | 114 | 28.5% | 177 | 44.3% | 167 | 41.8% |
| Pattern Evidence (blood pattern, footprint, shoeprint, tire print tool marks) | | 98 | 24.5% | 44 | 11.0% | 29 | 7.3% |
| Firearms/Weapons (gun, bullet, casing, cartridge, GSR) | | 332 | 83.0% | 300 | 75.0% | 272 | 68.0% |
| Natural/Synthetic Materials (clothes, bath and bedding, carpet, bindings) | | 252 | 63.0% | 132 | 33.0% | 101 | 25.3% |
| Generic Objects (vehicle, container, door, walls, furniture) | | 137 | 34.3% | 54 | 13.5% | 52 | 13.0% |
| Electronic/Printed Data (documents, computer, computer) | | 44 | 11.0% | 18 | 4.5% | 15 | 3.8% |
| Trace (hair, paper, glass, cigarette butt, plastic, metal, soil, fire debris) | | 130 | 32.5% | 75 | 18.8% | 51 | 12.8% |
| Drugs | | 43 | 10.8% | 27 | 6.8% | 19 | 4.8% |

### *Tracking cases through the justice process*

Fig. 1 tracks the movement of the 400 homicides through the justice process. The data in the flowchart reveal a major difference with respect to the presence of collected physical evidence: only 12 of 400 (3%) cases had no physical evidence collected. Yet, only 55.7% of homicide offenses with forensic evidence and half of the cases without forensic evidence produced an arrest. This resulted in an overall clearance rate of 55% for all homicide cases. This percent is below the national average of 62.4% for the same year (FBI, 2003).

As stated above, only 12 of the 400 (3%) homicide cases lacked physical evidence collected at the crime scene. Ten of these cases were in Los Angeles and the other two were from Indianapolis. A review of the 10 Los Angeles cases revealed that 8 were gang-related and between strangers. Although evidence was not collected at the scene, 6 of the 10

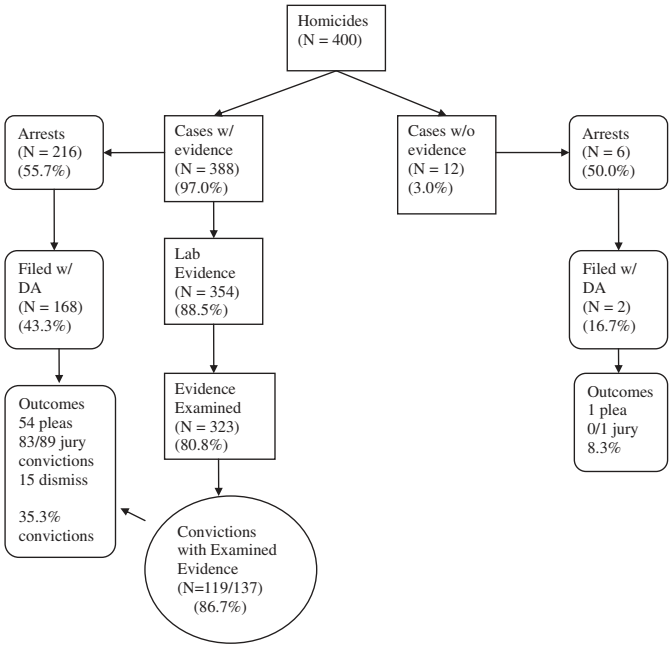


**Fig. 1.** Flowchart of forensic evidence and criminal justice outcomes for homicide incidents.

homicide victims were examined in the coroner's office. Overall, these 10 homicides resulted in four arrests and one referral to the district attorney which then ended in a plea conviction. This one case, despite being a gang-related stranger homicide, was distinguished from the others in that it had eyewitness reports. The percentage of homicide offenses with physical evidence that ended in a conviction (35.3%) was almost four times higher than for those cases without physical evidence (8.3%). The overall conviction rate across the five sites was 34.5%.

### *Predictors of criminal justice outcomes*

#### *Arrest*

The data in Table 4 indicate that homicides among non-strangers and cases with witness reports were significantly more likely to result in arrest. Forensic evidence was not a significant factor and this finding initially appeared to be the result of a lack of variation in cases with and without evidence. However, further analyses (not shown) in which individual types of evidence (e.g., biological, latent prints, firearms) were entered separately into the arrest model (thereby allowing for variation) confirmed that forensic evidence was not a significant predictor of arrest. In terms of extralegal variables, the interaction of race/ethnicity and gender were important predictors. Cases with White victims (both male and female) and Black suspects (both male and female) were more likely to cleared by arrest. Unfortunately, due to the reliance on official records, the present study was unable to collect data that would provide a more nuanced understanding of the police investigation process.

**Table 4**
Likelihood of arrest and DA referral for homicide incidents

| | ARREST | | REFERRAL | |
|---|---|---|---|---|
| | Estimate | Odds Ratio | Estimate | Odds Ratio |
| Witness Reports to Police | .639 (.325) | 1.90* | 1.15 (.471) | 3.15* |
| Victim Reports to Police | -.579 (.350) | .561 | -.403 (.552) | .668 |
| Intimate/Family | .895 (.418) | 2.45* | .944 (.557) | 2.57 |
| Friend/Acquaintance | 2.78 (.643) | 16.16*** | 3.46 (.728) | 31.80*** |
| # of victims | .349 (.166) | 1.42* | .116 (.242) | 1.12 |
| Gun-related incident | -1.03 (.424) | .357* | -.951 (.595) | .386 |
| Crime Scene Evidence | 1.24 (.761) | 3.45 | 2.98 (1.09) | 19.73** |
| Lab Examined Evidence | .650 (.352) | 1.92 | .687 (.496) | 1.99 |
| Los Angeles | -.581 (.357) | .599 | -1.34 (.526) | .261* |
| Indianapolis | .434 (.545) | 1.54 | -.157 (.685) | .855 |
| Victim teen | .156 (.329) | 1.17 | -.143 (.464) | .867 |
| Victim adult ( 20-29) | -.426 (.305) | .653 | -.756 (.464) | .470 |
| Victim black male | -1.08 (.399) | .340* | -1.62 (.632) | .199* |
| Victim black female | -.416 (.566) | .660 | -2.13 (.777) | .119** |
| Victim Latino | -.556 (.395) | .574 | -1.48 (.622) | .229* |
| Victim Latina | -1.31 (.797) | .269 | .467 (1.61) | 1.60 |
| Suspect Black male | 1.32 (.351) | 3.75*** | 1.61 (.571) | 5.02** |
| Suspect Black female | 2.66 (1.17) | 14.39 | 3.20 (1.14) | 24.41** |
| Suspect Latino | .892 (.375) | 2.44* | .891 (.609) | 2.44 |
| Suspect Latina | .350 (.968) | 1.00 | .795 (5.31) | 1.00 |
| Victim Medical Treatment | | | .180 (.398) | 1.20 |
| Arrest within 10 Minutes of Crime Incident | | | -.440 (.446) | .644 |
| Direct Arrest | | | .251 (.426) | 1.29 |
| Likelihood of arrest | | | 3.64 (.575) | 37.89*** |

*Note.* Correction (selection) variables control for the time from the incident to arrest, victim and suspect age, race/ethnicity and sex. All evidence categories were entered individually into each model. Robust Standard Errors are in parentheses. Stranger is the reference category for victim/suspect relationship. Pooled small Indiana sites (Evansville, Fort Wayne, South Bend) is the reference site category. * $p<.05$ ** $p<.01$ *** $p=.000$.

#### *Referral*

The data in Table 4 show that the odds of referral to the district attorney increased significantly for cases that had witness reports (odds ratio = 2.15) and for those in which the victim and suspect had a friendship or acquaintance relationship (odds ratio = 9.44). Differences were noted, as well, in the likelihood of referral by site with arrests more likely in the small Indiana locales than in Los Angeles County.

#### *Charges*

A number of variables were significant predictors of charging (Table 5). Again, the impact of forensic evidence on case processing was not significant nor was the forensic evidence "link" variable that would have connected the suspect to the crime scene and/or victim. Instead, friend/acquaintance and victim/suspect relationships were more likely to be charged than stranger homicides (odds ratio = 12.00) as were cases in which the suspect was arrested within 10 minutes of the incident (odds ratio = 6.31). Additionally, cases from the smaller Indiana sites were more likely result in a charge than those from Los Angeles County. And, cases involving a White male victim significantly predicted the issuance of a charge. Forensic evidence variables were not significant predictors of charging.

#### *Convictions*

The logistic regression results indicate that neither the types of forensic evidence nor evidence linking suspect with victim and/or crime scene significantly predicted conviction. For that matter, despite the quantity and diversity of evidence collected across the five sites, it is surprising that only a limited amount of physical evidence associated the suspect with the crime scene and/or victim. There were 54 cases with linking evidence, representing 13.5% of the 400 homicides reviewed. Overall, 46.3% of these cases resulted in a conviction, which is only a slightly higher conviction rate when compared to all other cases in the sample (32.7%).

Although cases with known relationships between victim and suspect were more likely to be charged, they were significantly less likely to result in convictions (Table 5). Similarly, suspects arrested within 10 minutes of the crime incident were less likely to be convicted. As previously stated and consistent with the regression model for charging, none of the forensic variables were significant predictors of conviction. A number of extralegal variables, however, significantly increased the likelihood of conviction. Cases with White female victims were more likely to produce a conviction than those in which the victim was a Black female. Also, cases in which the defendant was a White male were more likely to result in conviction as compared to those in which the defendants were minority males (Black or Latino).

Some differences were discerned in comparisons between those cases resolved by trials versus those that were plead. Overall, there were 90 homicide trials that produced a 92.2% conviction rate. Additionally, there were 55 plea dispositions across the study sites. The percentage of cases that had laboratory examined evidence was

**Table 5**
Likelihood of charges and convictions for homicide incidents

| | CHARGES | | CONVICTIONS | |
|---|---|---|---|---|
| | Estimate | Odds Ratio | Estimate | Odds Ratio |
| Witness Reports to Police | 1.49 (1.31) | 4.44 | -6.52 (3.35) | .001* |
| Victim Reports to Police | -1.06 (1.47) | .346 | 5.18 (3.09) | 178.28 |
| Intimate/Family | 3.71 (2.78) | 41.00 | -3.81 (2.12) | .022 |
| Friend/Acquaintance | 3.94 (1.52) | 51.40** | -12.95 (5.32) | .000* |
| # of victims | -.246 (.663) | .782 | .413 (.592) | 1.51 |
| Gun-related incident | -1.57 (1.64) | .209 | 2.23 (1.61) | 9.30 |
| Crime Scene Evidence | 4.29 (3.65) | 73.28 | 4.10 (3.53) | 60.29 |
| Lab Examined Evidence | 2.72 (1.87) | 15.24 | 1.31 (1.29) | 3.71 |
| Victim Medical Treatment | 1.60 (1.22) | 4.96 | -2.62 (1.45) | .073 |
| Arrest within 10 Minutes of Crime Incident | 2.26 (1.17) | 9.60* | -9.11 (3.52) | .000* |
| Direct Arrest | .157 (.916) | 1.17 | -.097 (1.16) | .908 |
| Private attorney | -1.08 (1.84) | .340 | -.819 (1.03) | .441 |
| # Prior Convictions | .343 (.243) | 1.41 | .087 (.175) | 1.09 |
| Los Angeles | -14.06 (6.70) | .000* | 6.74 (3.19) | 842.68* |
| Indianapolis | -8.57 (6.07) | .000 | -.198 (1.48) | .820 |
| Victim teen | -.458 (1.24) | .632 | -1.76 (1.47) | .171 |
| Victim adult ( 20-29) | -1.60 (1.20) | .201 | -.186 (1.64) | .830 |
| Victim black male | 1.72 (1.84) | 5.57 | 1.72 (2.22) | 5.58 |
| Victim black female | 4.68 (3.63) | 107.29 | -4.44 (2.30) | .012* |
| Victim Latino | -.899 (1.83) | .407 | 22.56 (21.87) | 1.00 |
| Victim Latina | 18.17 (6.94) | 1.00 | 20.83 (10.53) | 1.00 |
| Suspect Black male | 1.51 (1.37) | 4.52 | -5.76 (1.27) | .003* |
| Suspect Black female | -5.44 (3.66) | .004 | -7.94 (2.46) | .103 |
| Suspect Latino | .698 (1.44) | 2.01 | -6.88 (3.55) | .001* |
| Suspect Latina | 16.81 (8.24) | 1.00 | -5.04 (4.82) | .006 |
| Probability of Referral | 8.35 (2.35) | 4211.95*** | | |
| Probability of Charges | | | -26.11 (10.71) | .000* |

*Note.* Correction (selection) variables control for the time from the incident to arrest, victim and suspect age, race/ethnicity and sex. All evidence categories were entered individually into each model. Robust Standard Errors are in parentheses. Stranger is the reference category for victim/suspect relationship. Pooled small Indiana sites (Evansville, Fort Wayne, South Bend) is the reference site category. * $p<.05$ ** $p<.01$ *** $p=.000$.

similar for trials (77.8%) and for pleas (74.5%). However, cases resolved through trial tended to have a higher percentage of laboratory examined biological (45.6% vs. 36.6%), latent print (43.3% vs. 38.2%) and firearm (65.6% vs. 52.7%) evidence than did plea negotiated cases. Logistic regression results (not shown) indicate that gun-related homicides as well as cases with multiple victims and victim reports were less likely to be resolved through plea bargaining as were cases in which the victim was a Black male.

## Discussion

The study results show that most homicides went unsolved (34.5% conviction rate). Case flow data reveal that the overall low conviction rate was primarily a result of limited success in making arrests. Only half of the 400 homicide incidents were cleared by arrest. However, of these cases, approximately three-quarters were referred to the district attorney and most (94%) resulted in charges being filed and in convictions (86%). Thus, the principal locus of homicide case mortality resided in the steps prior to arrest. Here, despite an abundance of physical evidence, it was the lack of witnesses and of a victim-suspect relationship that determined the outcome. Whereas in the past, homicide was understood primarily as a crime of passion involving family members or close acquaintances, recent years have witnessed a dramatic increase in stranger homicides (Alderden & Lavery, 2007; Wellford & Cronin, 2000). This may be due, in part, to the rise in gang and drug-market related homicides.

Nonetheless, regardless of the underlying reasons for the qualitative change in homicides, it has had significant implications for clearance by arrest as the identification of suspects has become more difficult. Therefore, the type of homicide, that is one that occurs between strangers, has erected a barrier to clearance by arrest as it affects the availability and cooperation of potential witnesses and informants. Research suggests that witnesses of stranger-to-stranger homicides often fear retribution and feel that law enforcement is uninterested in their participation or is indifferent to the case altogether (Natapoff, 2009).

The findings in the present study support the above perspective and are consistent with prior research (Lee, 2005; Marché, 1994; Roberts, 2007). Suspects who knew their victims were more likely to be arrested and referred to the district attorney than in those cases involving strangers. Also, similar to the findings of Wellford and Cronin (2000), Addington (2006), Litwin (2004), and Roberts (2007), the current study found that homicides committed with firearms were less likely to be cleared by arrest. However, unlike these studies, findings from the current research do not support the explanation that there was insufficient physical evidence in firearm homicides due to the lack of proximity between the victim and suspect. Data demonstrated no differences between the volume and types of evidence collected in firearm versus other weapon homicides. Instead, the findings consistently pointed to the difficulties of processing homicide incidents when the victim and suspect were strangers.

The importance of witness reports cannot be underestimated. Findings from the present study indicate that they, indeed, increased the likelihood of clearance regardless of whether there was an association between the victim and the suspect. Witnesses from the scene provided information critical to the investigation, including the circumstances of death, possible motives for the homicide, identification of the suspect, identification of the victim, and location of the suspect. In addition to reports from witnesses, a homicide was also more likely to be cleared when a neighborhood canvass produced information from friends and neighbors of the victim, as well as from confidential informants. Police surveillance also meant that a case was more likely to be solved. Thus, extralegal characteristics and police investigative techniques, rather than forensic evidence, played a role in generating an arrest.

The study also examined the effect of victim and suspect characteristics on case outcomes. Interaction effects of victim's race/ethnicity and sex were observed for arrest, referral, and conviction decisions. Homicide incidents with Black male victims were less likely to result in arrests and case referrals to prosecutors as were those incidents involving Black males and females as well as Latino (male) victims. Similarly, cases with Black and Latino (male) suspects were more likely to be arrested than in cases involving their White counterparts. And, cases with both Black male and female suspects were more likely to be referred to the district attorney. These findings

clearly support "conflict" explanations for disparities in the early stages of the criminal justice process (Demuth, 2003; Hagan and Bumiller, 1983) when law enforcement and prosecution determine who will remain in the funnel for further action. Nonetheless, once a case reached its final conclusion, conviction, the viability of the conflict perspective was diminished. White male suspects were more likely to be convicted than their Black or Latino (male) counterparts; and White females were more likely to be convicted than Black women. Thus, the results indicate that predictors exhibit different and sometimes even the opposite effects at distinct decision points.

Perhaps the most noteworthy finding of the present study was that none of the forensic evidence variables had any significant influence on any stage of criminal case processing. In addition, contrary to the finding of Wellford and Cronin (2000) in which a significant relationship was demonstrated between database searches and arrest, the results of the current study indicated that database searches and "hits" were quite limited and not predictive of arrest or any other criminal processing outcome.

Overall, the study results suggest that forensic evidence is auxiliary and non-determinative for homicide cases. Some may argue that the findings of this study are outdated because they are based on cases sampled from 2003 and therefore do not reflect current practices related to DNA analysis. However, national data indicate that homicide arrest rates have *declined* between 2004 and 2008, from 76.5% to 63.5% (FBI, 2004, 2008). Thus, at least for the time being, the increased use of DNA analysis has not improved clearance.

No doubt, DNA typing represents an important tool that has been added to traditional forensic techniques and it may even represent a marked advance over some of them. We have witnessed its potential in well-publicized exonerations. However, it is premature and highly unlikely that DNA analysis will be the cure for what ails criminal investigation and adjudication. For one, it is estimated that only a small percentage of all criminal cases involve biological evidence that could be subjected to DNA testing (see Innocence Project website). In the current study, only 38% of homicide cases had any type of biological evidence and only 4.5% had DNA evidence. Therefore, the potential to solve the overwhelming number of crime incidents most likely will continue to be based on investigative practices and witness reports.

Furthermore, although DNA analysis is singled out as having a more solid scientific foundation than any other forensic discipline (National Academy of Sciences, 2009), its application within criminal justice settings is fraught with potential problems, many of which have already been identified in criticisms of traditional techniques. Some of these issues include weaknesses in the training and education of forensic scientists, inconsistencies in the manner and vocabulary used to report findings from forensic analyses, error rates, alignment with law enforcement culture, and scientific integrity (National Academy of Sciences, 2009; Turvey, 2009). For that matter, various scandals have already besieged DNA typing (Bykowicz & Fenton, 2008; Dolan & Felch, 2008; Mills, 2009; Possley, Mills, & McRoberts, 2004; U.S. Department of Justice, 2004; Willing, 2003), once again suggesting the need to understand the role and impact of forensic evidence within a larger context. This context, however, will probably need to extend beyond the criminal justice system into the cultural practices and stereotypes that permeate our society.

## Conclusions

The National Academy of Sciences' report (2009) highlights the deficiencies of forensic science and calls for the formulation of uniform protocols for analyzing and reporting on evidence. It also recommends the development of standards for forensic science professionals and laboratories as well as the need to provide consistency in the reporting of analytical findings by forensic experts when testifying. Most importantly, the report calls into question many of the forensic techniques, themselves — such as fingerprint, bite mark, and toolmark analyses — concluding that they are not supported by research that establishes their levels of accuracy and reliability. Thus, the National Academy of Science report (2009) raises the fundamental question- is there a scientific basis for forensic scientists' claims? Contributing to the current debate concerning the proper roles and limitations of forensic science, the present study asks equally important questions, such as whether forensic science makes a difference with regard to criminal justice outcomes. It also asks whether the availability of physical evidence improves arrest and conviction rates above traditional investigative practices.

Overall, the jury is still out on both the scientific basis and outcome value of forensic evidence. Future research could move us closer to answering the questions posed by this study if they were to include: (1) qualitative explorations of the decision-making processes for forensic evidence collection, submission, examination, and use by prosecutors in charging and plea decisions; (2) investigations on how unexamined evidence is used in clearing cases (i.e., making arrests); (3) development and evaluations of demonstration projects that improve citizen crime reporting, police response time, and the availability of witnesses; and (4) a special focus on DNA projects that follow reported crimes from incident to final disposition. Data generated from these studies would allow criminal investigators, prosecutors, and criminalists to empirically identify what forms of investigative strategies and which types of evidence have the most probative value. They may also provide an empirical foundation for future policy and planning, replacing some current practices that are only based on assumptions concerning utility.

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