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Volume II
Research Analysis of the Phoenix Homicide Clearance Project

Final Report

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List of Exhibits

Chapter 1

Introduction

Research Approach

This volume provides the results of analysis on several other aspects of homicides that occurred in Phoenix over the two-year period of July 1, 2003 – June 30, 2005. An important difference between this analysis and the evaluation in the first volume is that we include cases that occurred during July and August 2004, the training period for the four crime scene specialists assigned to the homicide unit. For the evaluation, these cases were not included. However, ILJ staff coded the 42 cases (43 victims) for these two months in anticipation of the analysis for this volume. As with the evaluation, we did not include police shootings. The result is that we have data on all 404 homicide cases (435 victims) that occurred during the two-year period. As of the cutoff date for data collection, the clearance rate for the 435 victims was 43.0 percent (187 clearances).

Exhibit 1-1 on the following page provides basic information for the 435 victims. The exhibit shows that victims are predominantly males (86.4 percent), their race is predominantly white (83.9 percent), and the majority of victims are Hispanic (60.7 percent). The average age of victims is 31.3 years (average age for males was 30.5 years and average age for females was 36.5 years). Firearms (primarily handguns and rifles) accounted for 79.5 percent of the weapons in homicides and the majority of victims were found outdoors (65.5 percent). The primary circumstances underlying the homicides were arguments (58.4 percent), drug-related homicides (19.1 percent), robbery (14.7 percent), domestic violence (12.6 percent, which includes child victims), and retaliation (10.1 percent). About 40 percent of the victims had more than one circumstance involved in the incident.

Exhibit 1- 1: Victim Characteristics

Characteristic	Number	Percent
Sex		
Male	376	86.4
Female	59	13.6
Race		
White	365	83.9
African-American	54	12.4
Other	16	3.7
Ethnicity		
Hispanic	264	60.7
Non-Hispanic	171	39.3
Weapon		
Firearm	346	79.5
Other weapon	89	20.5
Location		
Indoors	150	34.5
Outdoors	285	65.5
Circumstances		
Arguments	254	58.4
Drug-related	83	19.1
Robbery	64	14.7
Domestic violence	55	12.6
Retaliation	44	10.1
Gang-related	33	7.6
Immigration-related	25	5.7
Other motives	65	14.9
Circumstances		
Instrumental	169	38.9
Expressive	266	61.1
Victim Transported		
Yes	147	33.8
No	288	66.2
	Average	**Standard Deviation**
Age (years)	31.3	13.1

Homicides can also be classified as either predominantly *expressive* or *instrumental* incidents. In general, we coded expressive homicides as those involving domestic violence, gangs, fights, and arguments. The dominant quality of expressive homicides is the motivation for violence itself. Instrumental homicides included those involving robberies, drugs, immigration, and prostitution. We reviewed the supplemental reports for each homicide to determine the most appropriate category. About 39 percent of the homicides were classified as instrumental and 61 percent as expressive homicides.

Overview of the Report

This report covers the following topics:

Chapter 2: Analysis of Open and Closed Cases

This chapter provides several types of analysis on factors that affect case clearances. It includes comparisons with two previous research reports on clearances, an event history analysis, and a multinomial analysis on the three categories of arrests.

Chapter 3: Comparative Analysis

Comparisons are made in this chapter between ILJ's study and two previous studies on homicides. The first comparison is with a study entitled *Changing patterns of homicide and social policy in Philadelphia, Phoenix, and St. Louis, 1980-1994* (Zahn, 1999), and the second comparison is with *An analysis of variables affecting the clearance of homicides: A multistate study* (Wellford and Cronin, 1999). The comparisons provide insight into how homicides have changed over a 25-year period.

Chapter 4: Types of Clearances

This chapter on homicide clearances is a qualitative review of closed cases. It divides clearances by arrest into three categories—*self-solving cases*, *quick action cases*, and *whodunits*. A self-solving case is one in which a suspect is immediately identified at the homicide scene. A quick action case is one in which investigators acted quickly to arrest a suspect (usually within a few days of the incident). A whodunit is a case that requires considerable effort on the part of investigators to identify and arrest suspects. Examples of the different types of cases are provided in the chapter along with investigative approaches for each.

Chapter 5: Evidence from Homicide Scenes

This chapter describes the types of evidence collected at homicide scenes. It includes evidence collected at the primary scene, defined as the scene where the victim was found, and secondary scenes, which are all other scenes associated with a homicide (vehicles, residences, businesses, hospitals, and others).

Chapter 6: Analysis of Forensic Evidence

This chapter summarizes the analysis performed by the department's crime lab on forensic evidence collected at the scenes. It includes examples of successful case outcomes related to lab analysis.

Chapter 2

Analysis of Open and Closed Cases

Introduction

This chapter gives the results of statistical analysis in four areas:

- Basic characteristics of open and closed cases (bivariate analysis)
- Factors affecting open and closed cases (binary logistic regression)
- Time to clearance (Cox regression)
- Comparison of types of clearances to open cases (multinomial regression)

These approaches give different statistical views of the cases based on the dependent variable of interest. For each dependent variable, the analysis determines the influence of a variety of independent variables (victim characteristics, incident characteristics, and police response). Differences in the importance of the independent variables are reflected in the analysis.

Basic Characteristics of Open and Closed Cases

Exhibit 2-1 compares open and closed cases by providing descriptive statistics on several key variables. Several differences emerge from the exhibit. For example, the clearance rate for non-Hispanic victims (56.7 percent closed) is significantly higher than Hispanic victims (34.1 percent). With regard to circumstances, domestic violence cases have the highest clearance rate (80.0 percent), while immigration-related cases have the lowest clearance rate (20 percent). At a more general level, expressive homicides have a significantly higher clearance rate (49.6 percent) than instrumental homicides (32.5 percent).

Significant differences also emerge with variables on location, weapon, and transport of the victim to a hospital. Incidents with victims found indoors have a higher clearance rate (53.3 percent) than those in which victims are found outdoors (37.5 percent); incidents involving firearms have lower clearance rates (39.3 percent) than incidents with other weapons (57.3 percent); and incidents with victims transported to a hospital have a higher clearance rate (49.7

percent) than incidents in which victims were pronounced dead at the primary scene (39.6 percent).

The analysis of forensic evidence shows a significant positive impact for biological evidence. Cases with biological evidence have a higher clearance rate (49.1 percent) than cases without biological evidence (36.2 percent). The number of investigators, patrol officers, and witnesses at the primary scene has a positive impact on closures. Closed cases averaged 5.4 investigators, 7.8 patrol officers, and 5.1 witnesses at the primary scene, while open cases had significantly lower averages of 4.6 investigators, 6.0 patrol officers, and 3.5 witnesses.

Exhibit 2- 1: Characteristics of Open and Closed Cases

Characteristic (n=435)		Open Cases		Closed Cases		
Sex		**Number**	**Percent**	**Number**	**Percent**	χ^2
Male		219	58.2	157	41.8	1.37
Female		29	49.2	30	50.8	
Ethnicity* **						
Hispanic		174	65.9	90	34.1	20.78
Non-Hispanic		74	43.3	97	56.7	
		Average	**S.D.**	**Average**	**S.D.**	**t-value**
Victim's Age		30.7	11.4	32.1	15.1	1.11
Weapon* **		**Number**	**Percent**	**Number**	**Percent**	χ^2
Firearms		210	60.7	136	39.3	8.64
Other weapons		38	42.7	51	57.3	
Location* **						
Indoors		70	46.7	80	53.3	9.36
Outdoors		178	62.5	107	37.5	
Circumstances						
Argument	Yes	136	53.5	118	46.5	2.67
	No	112	61.9	69	38.1	
Drug-related	Yes	52	62.7	31	37.3	1.06
	No	196	55.7	156	44.3	
Robbery	Yes	38	59.4	26	40.6	0.08
	No	210	56.6	161	43.4	
Domestic violence***	Yes	11	20.0	44	80.0	33.48
	No	237	62.4	143	37.6	
Retaliation*	Yes	19	43.2	25	56.8	3.22
	No	229	58.6	162	41.4	
Gang-related	Yes	20	60.6	13	39.4	0.06
	No	228	56.7	174	43.3	
Immigration-related**	Yes	20	80.0	5	20.0	6.23
	No	228	55.6	182	44.4	
Other circumstances*	Yes	44	67.7	21	32.3	3.06
	No	204	55.1	166	44.9	
Circumstances* **						
Instrumental		114	67.5	55	32.5	11.61
Expressive		134	50.4	132	49.6	
Victim Transported*						
No transport to hospital		174	60.4	114	39.6	3.63
Transport to hospital		74	50.3	73	49.7	

Exhibit 2-1: Characteristics of Open and Closed Cases (Cont.)

Characteristic		Open Cases		Closed Cases		
Forensic Evidence		**Number**	**Percent**	**Number**	**Percent**	χ^2
Biological (DNA)***	Yes	116	50.9	112	49.1	6.84
	No	132	63.8	75	36.2	
Weapons	Yes	186	56.5	143	43.5	0.06
	No	62	58.5	44	41.5	
Trace	Yes	69	52.3	63	47.7	1.73
	No	179	59.1	124	40.9	
Latent prints	Yes	95	61.7	59	38.3	2.14
	No	153	54.4	128	45.6	
Impressions	Yes	51	58.0	37	42.0	0.01
	No	197	56.8	150	43.2	
Drug	Yes	57	52.3	52	47.7	1.08
	No	191	58.6	135	41.4	
On-scene Circumstances		**Average**	**S.D.**	**Average**	**S.D.**	**t-value**
Number of investigators***		4.6	1.9	5.4	2.4	3.73
Number of patrol officers***		6.0	3.9	7.8	6.0	3.81
Number of witnesses***		3.5	3.3	5.1	4.7	4.22

NOTE: * Significant at the .10 level
** Significant at the .05 level
*** Significant at the .01 level

Factors Affecting Open and Closed Cases

The variables in Exhibit 2-1 served as the basis for a binary logistic regression with the open/closed variable as the outcome variable. Exhibit 2-2 on the following page provides the results from the regression. The regression determined several variables significantly related to case outcome. For example, in cases where the victim was Hispanic versus non-Hispanic, the odds of clearance were significantly less at 0.42; that is, Hispanic victim cases had a 42 percent less likelihood of clearance than non-Hispanic cases.

Expressive homicides are more likely to be cleared than instrumental homicides. The odds are 1.86 for clearing expressive homicides over instrumental homicides. Similarly, the odds of clearing cases where the victim is found indoors are higher at 1.69 than cases where victims are outdoors. Cases involving weapons (firearms and knives) are less likely to be solved. The odds are 0.51 for clearing a case with firearms, which makes these cases less likely to be solved that those with other weapons. The results in Exhibit 2-2 indicate that the number of investigators and the number of witnesses at the primary scene have a significant and positive influence on whether cases are closed. As the numbers of investigators and witnesses increase, the odds of closing a case also increase.

Equally important are the variables not found to be statistically significant in the regression—gender, age, victim transported, and forensic evidence. The regression indicates that the clearance odds for these variables are about the same after other variables are taken into consideration. No biases are seen on the odds of clearance in regard to gender or age. While victim transport to a hospital was significant at the univariate level, it is not statistically significant in the multivariate regression due to the influence of other variables. Of particular interest is that none of the different types of forensic evidence appears as significant in the regression. This result may be due to the fact that many homicides are cleared within a few weeks after the homicide incident, and analysis of forensic evidence generally has not occurred within that time period.

Exhibit 2- 2: Binary Logistic Regression for Open and Closed Cases

Variable	Coefficient	Odds Ratio	Wald Statistic
Male	0.05	1.05	0.02
Hispanic* **	-0.86	0.42	13.55
Age	0.01	1.00	0.04
Expressive Homicide**	0.62	1.86	6.61
Indoors**	0.52	1.69	4.73
Weapon**	-0.67	0.51	3.95
Victim transported	0.32	1.37	1.82
Forensic Evidence			
Biological Evidence	0.21	1.24	0.85
Weapons Evidence	0.34	1.41	1.19
Trace Evidence	-0.06	0.95	0.05
Latent Print Evidence	-0.12	0.89	0.20
Impressions Evidence	-0.06	0.94	0.04
Drug Evidence	0.10	1.10	0.14
On-scene characteristics			
Number of investigators**	0.12	1.13	4.19
Number of patrol officers	0.03	1.03	1.35
Number of witnesses*	0.07	1.07	3.56
Constant**	-1.43	0.24	4.53

NOTE: * Significant at the .10 level
** Significant at the .05 level
*** Significant at the .01 level

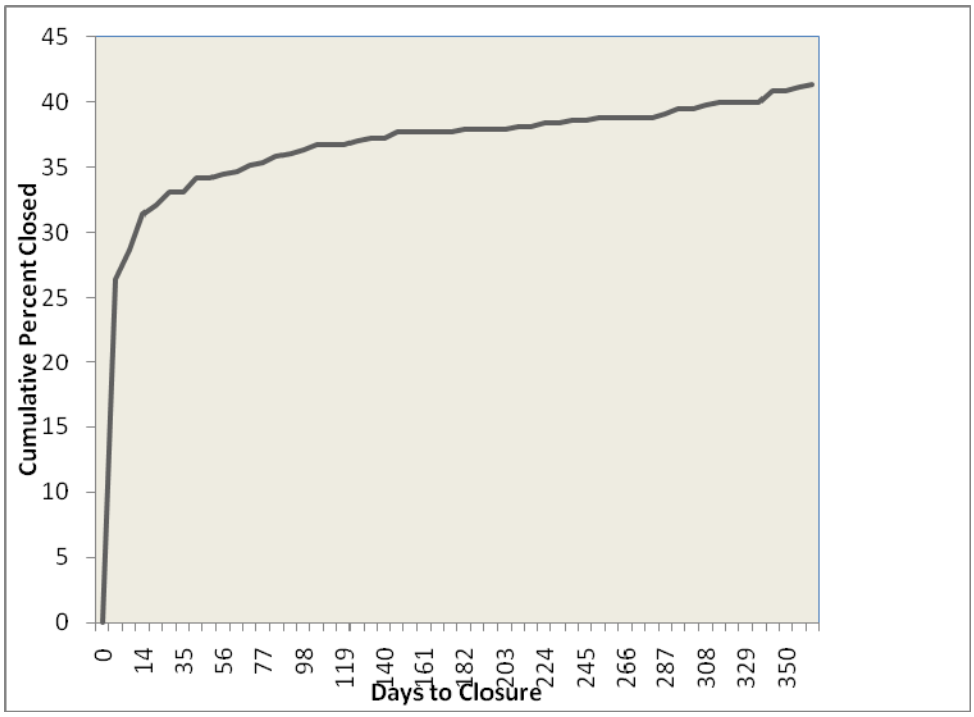
Time to Clearance

As described in previous chapters, suspects may be arrested in a short period (such as the majority of immediate arrest cases) or it may take weeks, months, or even years before investigators identify and arrest a suspect. The analysis in this section is based on continuous-time event history analysis, sometimes called survival analysis, instead of the logistic regression approach described in the previous section. The difference between the two approaches is that logistic regression treats the dependent variable as having only two values—zero if the case remains open and one if the case is closed. Consequently, logistic regression does not take into account the length of time to closure. Incidents taking several months to clear are treated the same as incidents cleared within a few hours.

The dependent variable in an event history analysis is length of time to clearance. In this study, clearance time is from the date and time that the investigation started (usually the time of the first call to the department's communication center about the homicide) to the date and time of a suspect's arrest. With multiple arrests for the same homicide, we used clearance time for the first arrest. Cases still open at the cutoff date of November 30, 2006, are explicitly part of an event history analysis. These censored cases have elapsed times measured between the start of the investigation and the cutoff date. Elapsed times for censored cases varied between 18 and 42 months.

To illustrate the ideas behind event history analysis, Exhibit 2-3 summarizes the time to clearance for the cases during the two-year period under study. It shows the cumulative percent of cases closed within one year after start of investigation. About 25 percent of the cases are cleared within two days of investigation. These short periods of time reflect the relatively high number of immediate arrest and quick action cases (see Chapter 4). Thirty-one percent are cleared within 14 days and 38 percent with six months. In summary, the curve in Exhibit 2-3 starts at a steep angle and flattens quickly over time.

Exhibit 2- 3: Investigative Time to Clearance



Cox regression was used as the statistical approach for modeling the elapsed time to closure with open cases handled as censored cases. The regression processes the open (censored) cases correctly, and provides estimated coefficients for each of the independent variables, thereby allowing for the assessment of the impact of variables introduced into the model. The independent variables for the Cox regression were the same as for the previously discussed logistic regression analysis.

Cox regression models calculate a hazard ratio rather than the odds ratio in a logistic regression. The hazard ratio is the effect of an independent variable on the hazard or risk of an event. Hazard ratios indicate that the independent variable is positively related to the risk; in our application, risk is closure during the specified time period.

Exhibit 2-4 gives the results (coefficients, hazard ratio, and Wald statistic) from the Cox regression model. The victim's ethnicity (Hispanic vs. non-Hispanic) had a significant impact on the hazard rate for homicide clearance. According to the model, cases involving Hispanic victims are 56 percent less likely to be solved than cases with non-Hispanic victims. The

coefficient for expressive versus instrumental homicides is also statistically significant with the interpretation that expressive homicides are more (71 percent) likely to be cleared than instrumental homicides. Similarly, homicides with victims found indoors were more (49 percent) likely to be cleared than those where victims were found outdoors, and homicides involving weapons (firearms and knives) were less (59 percent) likely to be solved than those with other weapons. Finally, a positive relationship exists between the number of investigators at the primary scene and case closure.

A comparison between the logistic regression and Cox regression shows one difference on significant variables. In the logistic regression, the number of witnesses at the primary scene was statistically significant, while in the Cox regression, this variable is not significant. Other independent variables—gender, age, victim transport, and forensic evidence—were not significant in the logistic or Cox regression.

Exhibit 2- 4: Cox Regression for Time to Clearance

Variable	Coefficient	Hazard Ratio	Wald Statistic
Male	0.02	1.02	0.01
Hispanic* **	-0.58	0.56	12.71
Age	0.01	1.00	0.09
Expressive Homicide* **	0.54	1.71	9.27
Indoors **	0.40	1.49	5.96
Weapon **	-0.54	0.58	5.73
Victim transported	0.23	1.26	1.94
Forensic Evidence			
Biological	0.15	1.16	0.84
Weapons	0.31	1.37	1.98
Trace	0.02	1.02	0.01
Latent prints	-0.15	0.86	0.63
Impressions	-0.17	0.85	0.64
Drugs	0.05	1.05	0.08
On-scene characteristics			
Number of investigators**	0.10	1.10	5.43
Number of patrol officers	0.03	1.03	2.59
Number of witnesses	0.03	1.03	1.69

NOTE: * Significant at the .10 level
** Significant at the .05 level
*** Significant at the .01 level

Comparison of Types of Clearances

This section takes a quantitative look at immediate arrests, quick action arrests, and whodunits as compared with open cases. Multinomial logistic regression serves as the basis for the comparisons. A multinomial logistic regression is more general than a binary logistic regression because the dependent variable is not restricted to two categories. In this application, there are four categories (open cases and three types of closed cases), with the open cases serving as the reference category. A multinomial regression breaks the regression into a series of binary regressions comparing each group against the baseline group.

In preparation for the regression, Exhibit 2-5 compares the basic characteristics for open cases and the three types of closed cases. Significant differences exist for most variables based on chi-square and t-tests across the four categories. Variables showing no significant differences were gender, age, and three types of forensic evidence (ballistics, trace, and drug evidence).

With regard to significant differences, several trends are present in the exhibit:

- Hispanic victims were over-represented in open cases (70.2 percent), compared with their representation in immediate arrest cases (40.0 percent), quick action cases (57.1 percent) and whodunits (48.9 percent).
- Expressive homicides comprised 54 percent of the open cases, 90.0 percent of immediate arrest cases, 73.5 percent of quick action cases, and 46.8 percent of the whodunits.
- With open cases, 28.2 percent of the victims were found indoors, compared with 56.7 percent of victims in the immediate arrest cases, 34.7 percent in quick action cases, and 29.8 percent in whodunits.
- Weapons (primarily handguns) were the weapon in 84.7 percent of the open cases, 55.0 percent of the immediate arrest cases, 75.5 percent of the quick action cases, and 85.1 percent of the whodunits.
- Victims were transported to a hospital in 29.8 percent of the open cases, compared with 50.0 percent of the immediate arrest cases, 40.8 percent of the quick action cases, and 25.5 percent of the whodunits.
- Crime scene specialists obtained biological evidence at the primary scene in a smaller percentage of open cases (46.8 percent), compared with finding biological evidence at immediate arrest cases (55.0 percent), quick action cases (67.3 percent), and whodunits (66.0 percent).

Exhibit 2- 5: Victim Characteristics for Types of Arrests and Open Cases

Characteristic	Open Cases		Immediate Arrests		Quick Action Arrests		Whodunits		
Gender	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**	χ^2
Male	219	88.3	48	80.0	43	87.8	43	91.5	3.88
Female	29	11.7	12	20.0	6	12.2	4	8.5	
Ethnicity* **									
Hispanic	174	70.2	24	40.0	28	57.1	23	48.9	23.12
Non-Hispanic	74	29.8	36	60.0	21	42.9	24	51.1	
Age	**Average**	**S.D.**	**Average**	**S.D.**	**Average**	**S.D.**	**Average**	**S.D.**	**F-value**
Victim's age	30.7	11.4	32.2	19.2	30.3	12.7	32.4	12.1	0.44
Circumstances* **	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**	χ^2
Instrumental	114	46.0	6	10.0	13	26.5	25	53.2	33.42
Expressive	134	54.0	54	90.0	36	73.5	22	46.8	
Location* **									
Indoors	70	28.2	34	56.7	17	34.7	14	29.8	17.90
Outdoors	178	71.8	26	43.3	32	65.3	33	70.2	
Weapon* **									
Firearm / knife	210	84.7	33	55.0	37	75.5	40	85.1	27.26
Other weapon	38	15.3	27	45.0	12	24.5	7	14.9	

Exhibit 2-5: Characteristics for Types of Arrests and Open Cases (Cont.)

Characteristic		Open Cases		Immediate Arrests		Quick Action Arrests		Whodunits		
Victim Transported* **		**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**	χ^2
No transport to hospital		174	70.2	30	50.0	29	59.2	35	74.5	11.31
Transport to hospital		74	29.8	30	50.0	20	40.8	12	25.5	
Forensic Evidence										
Biological***	Yes	116	46.8	33	55.0	33	67.3	31	66.0	11.33
	No	132	53.2	27	45.0	16	32.7	16	34.0	
Weapons*	Yes	186	75.0	39	65.0	42	85.7	35	74.5	6.15
	No	62	25.0	21	35.0	7	14.3	12	25.5	
Trace*	Yes	69	27.8	15	25.0	19	38.8	21	44.7	7.70
	No	179	72.2	45	75.0	30	61.2	26	55.3	
Latent prints***	Yes	95	38.3	4	6.7	23	46.9	24	51.1	30.10
	No	153	61.7	56	93.3	26	51.0	23	48.9	
Impressions**	Yes	51	20.6	5	8.3	12	24.5	14	29.8	8.50
	No	197	79.4	55	91.7	37	75.5	33	70.2	
Drug	Yes	57	23.0	14	23.3	16	32.7	12	25.5	2.14
	No	191	77.0	46	76.7	33	67.3	35	74.5	
On-scene Characteristics		**Average**	**S.D.**	**Average**	**S.D.**	**Average**	**S.D.**	**Average**	**S.D.**	**F-Value**
Number of investigators***		4.6	1.9	5.2	2.4	6.3	2.6	5.2	2.1	9.39
Number of patrol officers***		6.0	3.9	8.3	6.9	10.0	6.4	5.5	3.7	12.76
Number of witnesses***		3.5	3.3	5.4	6.9	5.9	3.4	4.4	3.3	7.36

NOTE: * Significant at the .10 level
** Significant at the .05 level
*** Significant at the .01 level

- Existence of latent prints varied considerably across the four categories: open cases (38.3 percent), immediate arrest cases (6.7 percent), quick action cases (46.9 percent), and whodunits (51.1 percent).
- Variations were also found with existence of other impressions from the primary scene: open cases (20.6 percent), immediate arrests (8.3 percent), quick action cases (24.5 percent), and whodunits (29.8 percent).
- Open cases averaged fewer investigators and witnesses at the primary scenes than closed cases. For open cases, the average number of investigators was 4.6 at the primary scenes of open cases, compared with 5.2 investigators at immediate arrest scenes, 6.3 at quick action scenes, and 5.2 at whodunits. The average number of witnesses was 3.5 at the primary scenes of open cases, compared with 5.4 witnesses at immediate arrest scenes, 5.9 at quick action cases, and 4.4 at whodunits.
- Open cases averaged fewer patrol officers (6.0 officers) than at immediate arrest scenes (8.3 officers) and quick action arrest scenes (10.0 officers), but more than whodunits (5.5 officers).

With this information as background, Exhibit 2-6 provides the results from the multinomial logistic regression. The exhibit has three sections giving the coefficients, odds ratios, and Wald statistics. Information is provided in each section for the closed case categories—immediate arrests, quick action arrests, and whodunits.

Exhibit 2-6 gives the results of the multinomial regression. The exhibit is divided into three sections. The first section gives the coefficients for the variables in the model, the second gives the odds ratios, and the third gives Wald statistics. Open cases serve as the reference category.

Results in Exhibit 2-6 show differences across the three categories in comparison with open cases. Each type of closed case has coefficients with significant values, but the variables are not the same across the three categories. The odds ratios in the middle section show the contribution of each variable to the ratio. As an example, the regression indicates that increases in the number of investigators is especially important for quick action and whodunit cases, but not for immediate arrest cases. The result makes sense from a practical viewpoint because immediate arrest cases are usually on-scene arrests in which a suspect is immediately identified and arrested.

Exhibit 2- 6: Multinomial Logistic Regression for Types of Clearances

	Coefficients			Odds Ratios			Wald Statistics		
Variable	Immediate Arrest	Quick Action	Whodunit	Immediate Arrest	Quick Action	Whodunit	Immediate Arrest	Quick Action	Whodunit
Male	0.10	0.52	0.86	1.11	1.68	2.37	0.04	0.80	1.93
Hispanic	-0.87**	-0.61	-0.86**	0.42	0.54	0.42	5.35	2.48	5.22
Age	0.01	-0.01	0.01	1.01	0.99	1.01	0.39	0.14	0.27
Expressive Homicide	1.68***	0.98**	0.12	5.34	2.66	1.13	11.10	5.83	0.10
Indoors	1.19***	0.14	-0.26	3.29	1.15	0.78	10.05	0.12	0.39
Weapon	-1.68***	-1.74***	0.45	0.19	0.18	1.56	10.26	9.49	0.43
Victim transported	0.62*	0.81**	-0.26	1.87	2.49	0.77	2.74	4.30	0.41
Forensic Evidence									
Biological	-0.14	0.21	0.69**	0.86	1.23	2.00	0.15	0.27	3.40
Weapons	0.24	1.28*	-0.02	1.27	4.59	0.98	0.22	4.59	0.01
Trace	-0.20	-0.13	0.35	0.82	0.88	1.41	0.22	0.10	0.86
Latent prints	-1.49**	0.75*	0.28	0.23	2.12	1.33	5.81	3.43	0.54
Impressions	-0.94	0.18	0.40	0.39	1.20	1.49	2.15	0.15	0.86
Drug	0.24	0.04	-0.15	1.27	1.04	0.86	0.31	0.01	0.14
On-scene Characteristics									
Number of investigators	0.09	0.27***	0.23**	1.10	1.31	1.26	0.73	8.13	5.79
Number of patrol officers	0.12**	0.10**	-0.13**	1.12	1.11	0.88	6.27	6.01	5.13
Number of witnesses	0.08	0.02	0.09*	1.08	1.02	1.09	2.38	0.15	2.60
Intercept	-4.29***	-1.38	-3.33**	—	—	—	9.12	1.09	6.33

NOTE: * Significant at the .10 level
** Significant at the .05 level
*** Significant at the .01 level

Other results from the multinomial regression are as follows for each of the three types of arrests:

- Immediate arrest cases (compared with open cases) are:
  - Less likely to involve Hispanic victims
  - More likely to be expressive homicides
  - More likely to occur indoors
  - Less likely to involve weapons (firearms or knives)
  - More likely to have the victim transported to a hospital
  - Less likely to have latent prints obtained at the primary scene
  - Likely to have more patrol officers at the scene.
- Quick action cases (compared with open cases) are:
  - More likely to be expressive homicides
  - Less likely to involve weapons
  - More likely to have the victim transported to a hospital
  - More likely to have weapons evidence and latent print evidence collected at the primary scene.
  - Likely to have more investigators and patrol officers at the primary scene.
- Whodunit cases (compared with open cases) are:
  - Less likely to involve Hispanic victims
  - More likely to have biological evidence collected at the primary scene
  - Likely to have more investigators, fewer patrol officers, and more witnesses at the primary scene.

In summary, the multinomial regression shows clear differences across the three types of closures as compared with the characteristics of open cases. Of particular note is that biological evidence is statistically significant for whodunit cases, but not for immediate arrest and quick action. Latent prints are significant in the opposite direction from what was expected in immediate arrest cases and are not significant for quick action and whodunit cases.

Conclusions

For the analysis presented in this chapter, we were able to combine victim, incident, and police response characteristics to provide a more complete picture of influences on case clearances than have been found in other studies. Victim characteristics include age, sex, and

ethnicity; incident characteristics were measured by type of homicide (expressive/instrumental), location where victim was found (indoors/outdoors), whether the victim was transported to a hospital, and number of witnesses. Police response variables included the number of investigators and patrol officers at the primary scene, and the types of forensic evidence collected at the primary scene.

With regard to ethnicity, the analysis in this chapter indicates that cases with non-Hispanic victims are more likely to be solved and in less time than those with Hispanic victims. An exception to this finding is with quick action cases in which no significant difference was found. This finding may reflect the difficulties in solving cases with Hispanic victims. As discussed elsewhere in this report, these cases may be more difficult to solve for a variety of factors, including lack of cooperation from witnesses, fear of the police, concerns about retaliation, and language barriers between police and witnesses. The other victim characteristics of age and sex did not show significant differences, indicating that the likelihood of clearance for male and female victims did not differ substantially, and did not vary with age.

Expressive homicides (e.g., domestic violence incidents, fights, and arguments) are more likely to be solved and in less time than instrumental homicides, with the exception of whodunit cases. We can conjecture that a reason for this finding is that the offending person either may still be at the scene or easily identified by witnesses. With instrumental homicides (e.g., robberies, drug-related, and immigration-related homicides), there may be a greater likelihood that the parties involved did not know each other. As a result, these cases take longer and are more difficult to solve.

Results for the variables of location (indoors/outdoors) and firearms are consistent with other studies. With regard to firearms, the analysis shows that these incidents are also less likely to be solved and require more time than incidents with other weapons. Similarly, incidents in which the victim is found indoors are more likely to be solved and in less time than those where the victim is found outdoors. Exceptions for both variables were found with the types of clearances. The firearms variable was significant with immediate arrest and quick action cases, but not whodunits; location was significant with immediate arrest cases, but not with the other two types of cases. These exceptions show the importance of analyzing different types of clearances, rather than considering all cases as a group.

A similar finding occurs with the variable on whether the victim was transported to a hospital. This variable was not statistically significant in regard to whether a case was closed and time to clearance. However, the multinomial logistic regression found it to be statistically significant for immediate arrest and quick action cases, as compared with open cases. This result may be due to the fact that investigators are able to talk with injured victims at the hospital and to friends and family who arrive at the hospital. Information obtained from these interviews may lead to a faster arrest.

The analysis also found a greater likelihood of clearance when more witnesses are available at the scene, although this variable was not significant in regard to the time to clearance. Interestingly, the number of witnesses was significant for whodunit cases, but not for the other two types of cases. The number of investigators at the primary scene was also found to be significant for case clearance, time to clearance, quick action cases, and whodunits, but was not significant for immediate arrest cases. However, the number of patrol officers at the scene was found to be statistically significant for immediate arrest and quick action cases.

None of the forensic evidence variables was found to be significant for overall case clearance and time to clearance. However, the presence of biological evidence was significant for whodunit cases. A surprising finding was with latent prints, which showed statistical significance, but not in the expected direction.

Chapter 3

Comparative Analysis

Introduction

At the request of NIJ, we developed comparisons between our study and two past studies on homicide:

- Zahn, M.A. (1999). *Changing patterns of homicide and social policy in Philadelphia, Phoenix, and St. Louis, 1980-1994*.
- Wellford, C. and Cronin, J. (1999). *An analysis of variables affecting the clearance of homicides: A multistate study*. Grant project awarded to the Justice Research and Statistics Association (JRSA).

Results of the comparison, as described in this chapter, provide insight into the changes in the characteristics of homicides and the possible impact of these changes on homicide clearances.

The Zahn study collected data on all homicides occurring in their three study sites for the 15-year period, 1980-1994. For Phoenix, they coded cases on a total of 1,851 victims. The dataset for the Zahn study was available through ICPSR and we were able to download the dataset and merge it with our files to make comparisons. Some recoding was necessary in order to make direct comparisons. We were then able to perform statistical tests, primarily chi-square tests, to determine significance of changes as reflected in the two datasets.

We were less successful in making comparisons with the Wellford and Cronin study for two reasons. First, the dataset for the Wellford and Cronin study was not available at ICPSR. We contacted the principal investigators of the study and the executive director of JRSA, and determined that they did not keep a copy of the data after submitting the final report and dataset to NIJ. Representatives at NIJ were not able to locate the dataset and apparently, it was never submitted to ICPSR. A second difficulty was that the Wellford and Cronin study included many variables that were not captured in our study. In fact, they collected over 200 variables for the 798 cases in their study. Many of their variables did not match easily with our study. Because of these problems, our comparisons with the Wellford and Cronin study were limited to a few comparisons based on tables from their final report.

By way of background, Exhibit 3-1 shows how the number of homicides and clearance rates have changed in Phoenix over the 27-year period, 1980-2006. In the 1980s, homicides were relatively constant with an average of just over 100 homicides each year. There was a steady increase in homicides starting in 1990 and continuing to a high of 241 homicides in 1994. Homicides then showed an overall decrease to a low of 152 homicides in 2000, but since 2000, the number of homicides has increased dramatically to 234 homicides in 2006.

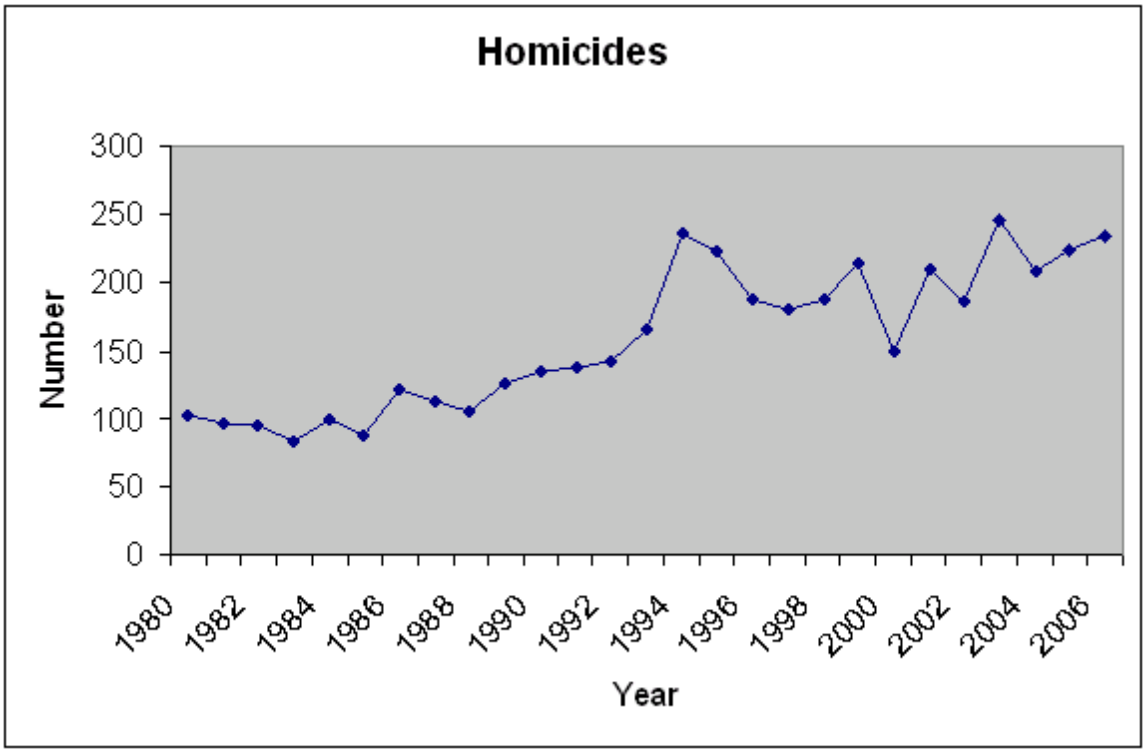
The bottom portion shows a steadily decreasing trend in clearance rates. In the 1980s, the clearance rates were high, usually over 70 percent. Decreases in annual clearance rates started around 1990. In 2000, the clearance rate was 53.3 percent and by 2006, the rate had decreased to 40.2 percent. Possible influences on the decrease in clearance rates are provided in this chapter.

Comparisons with Zahn Study

The Zahn (1999) study aimed at determining the reasons for increases in homicides during the 1980s, as compared with the previous decade. The Phoenix Police Department participated in the study along with the police departments in Philadelphia and St. Louis. In Phoenix, researchers reviewed all homicide case files for the 15-year period, 1980-1994, a total of 1,851 victims. Data were collected on victim demographics and a limited number of case characteristics.

The clearance rate (cleared by arrest and exceptional clearances) for the 15-year period in the Zahn study was 74.0 percent, compared with a clearance rate of 43.0 percent for our two-year study. The comparison is somewhat misleading because cases from the earlier period could have been solved years after the homicide (for example, a 1980 case solved in 1990), while less than two years was the follow-up period for most of the cases in our study. On the other hand, the chances of solving a case decrease substantially over time and it is highly unlikely that the clearance rates for our cohort will eventually reach the level of 74 percent.

Exhibit 3- I: Homicides and Clearances in Phoenix, 1980-2006



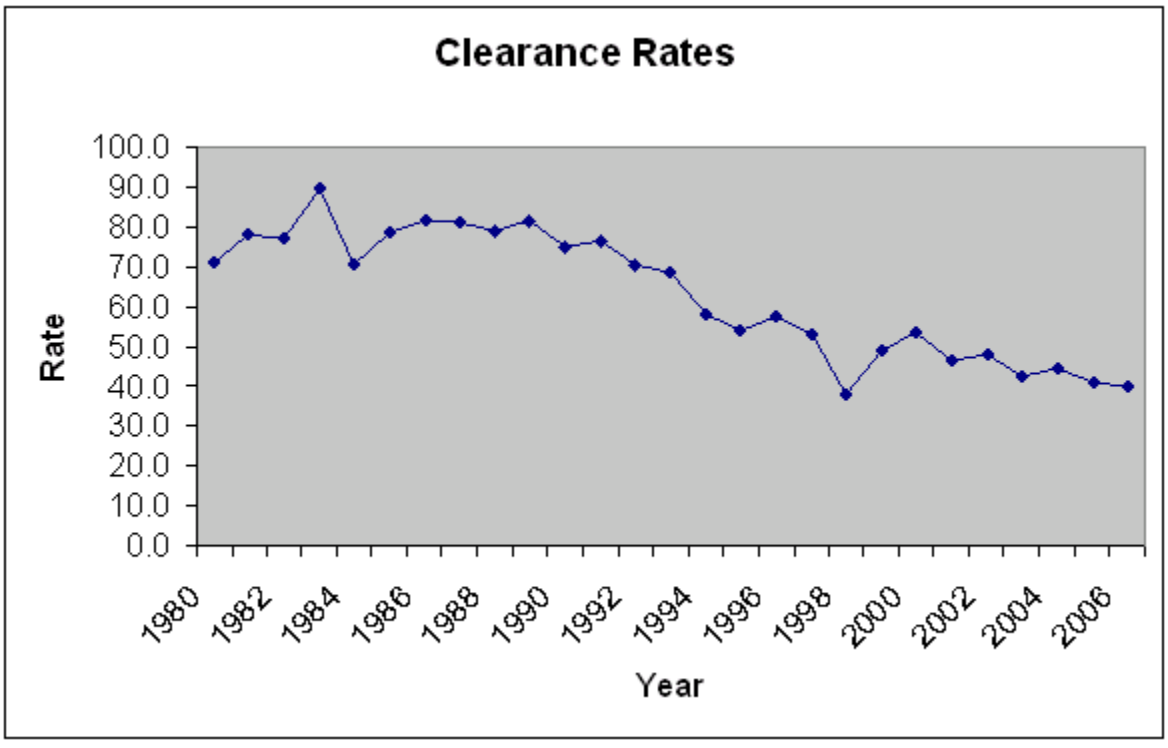


Exhibit 3-2 on the following page shows significant differences between the victims of the two studies in every characteristic available for comparison. Compared with the Zahn study, the victims in our study have:

- A higher percent of male victims—86.4 percent compared with 77.7 percent.
- A higher percent of Hispanic victims—60.7 percent compared with 32.0 percent.
- A lower percent of victims under 18 years old (6.7 percent compared with 13.0 percent), a higher percent of victims between 18 and 34 years old (59.8 compared with 52.8), and a lower percent of victims 50 years or older (9.2 percent compared with 12.2 percent).
- A higher percent of instrumental homicides—38.9 percent compared with 23.1 percent.
- A lower percent of victims found indoors—34.5 percent compared with 51.8 percent.
- A higher percent of victims killed by firearms—79.5 percent compared with 64.8 percent.

In addition to developing the variable on expressive/instrumental circumstances, a few comparisons were possible with specific types of circumstances. In both studies, arguments and felony crimes were the leading circumstances for the incidents. One difference was that drugs were involved with 19.1 percent of the victims in our study, while the Zahn study recorded about five percent drug involvement.

Incidents involving illegal immigration from Mexico were another difference between the studies. The Zahn earlier study did not have any such incidents and personal communication with the principal investigator indicated that illegal immigration was not a problem during the years of her study. Our review identified 25 victims (5.7 percent) in which illegal immigration played a role. From interviews with investigators, the most common reason for these homicides is that the person is unable to pay for having been brought into the country.[1] Other circumstances leading to homicides are arguments between coyotes and immigrants over the amount to be paid, conflicts between coyotes, and conflicts between coyotes and others they hire to assist in getting immigrants into the country or guarding immigrants at safe house.

[1] The immigrant usually does not carry the payment money with him while being brought into the United States. Instead, payment is made by having relatives or friends in Mexico wire the payment money (usually $1,500-$2,500) to the coyote and while waiting for payment, the immigrant is kept in a safe house.

Exhibit 3- 1: Comparison of Characteristics with Zahn Study

Characteristic	Zahn Study 1980-1994		ILJ Study July 2003 – June 2005		
Gender* **	**Number**	**Percent**	**Number**	**Percent**	**χ^2**
Male	1,439	77.7	376	86.4	16.3
Female	412	22.3	59	13.6	
Ethnicity* **					
Hispanic	592	32.0	264	60.7	123.6
Non-Hispanic	1,257	68.0	171	39.3	
Age* **					
Less than 18 years old	239	13.0	29	6.7	20.2
18-24 years old	441	23.9	129	29.7	
25-34 years old	532	28.9	131	30.1	
35-50 years old	407	22.1	106	22.4	
More than 50 years old	224	12.2	40	9.2	
Circumstances* **					
Instrumental	356	23.1	169	38.9	49.9
Expressive	1,183	76.9	266	61.1	
Location* **					
Indoors	937	51.8	150	34.5	42.2
Outdoors	871	48.2	285	65.5	
Weapon* **					
Firearms	1,194	64.8	346	79.5	35.0
Other weapons	649	35.2	89	20.5	
Case Status* **					
Open	480	26.0	248	57.0	155.2
Closed	1,363	74.0	187	43.0	

Finally, a related explanation for the decrease in clearance rates, mentioned by many homicide investigators, is that the number of investigators has not kept pace with increased caseloads. During the time of our study, the homicide unit had an average of about 24 investigators for case assignment plus three investigators in the cold case unit. According to the commander of the unit, during the 1990s, the unit had about 28 investigators for case assignment plus five investigators for cold cases. Thus, there has been a 20 percent decrease in the number of investigators available for case assignment.

In addition, the higher percentage of Hispanic victims means that more bilingual investigators are needed. During the Homicide Clearance Project, about 25 percent of the homicide investigators were bilingual. Bilingual investigators were sometimes called in to conduct interviews at the primary scene or later at headquarters.

The staffing picture is complicated by the fact that investigators could be assigned as either case agents or scene agents (except for the experimental squad during the test period). Some investigators are excellent in collecting evidence and tend to be selected as scene agents, while others have excellent reputations as investigators and therefore are assigned regularly as case agents. The result is a large variation in the caseloads of investigators. As an example, during the 24 months from July 2003 through 2005, one investigator was assigned as scene agent for 43 cases but was not assigned as a case agent on any case. Another was scene agent for 33 cases and was assigned as case agent in seven cases. Conversely, one investigator received 27 new cases as case agent and handled only six cases as scene agent. Heavier dependence on some investigators as case agents is seen further by the fact that six investigators were assigned as case agents to 160 new cases during the 24-month period and as scene agents in only 34 cases.

Comparisons with Wellford and Cronin Study

The Wellford and Cronin study examined 798 homicides that occurred in four large cities during 1994 and 1995. The cities were not randomly selected but instead were selected to "maximize variation on homicide and total index crime clearance rates as measured from 1980 through 1993." (Executive Summary, p. i). City A's police department had consistently high rates of clearances for homicides and total crimes relative to other departments; City B had an overall low clearance rate for crimes; City C had a high rate of clearance for total crimes and a low homicide clearance rate, and City D had a high homicide clearance rate but a low total crime clearance rate. The research team for this study collected data for 200 homicide cases from cities A, B, and D, and 198 cases from City C. The cities were not identified in the study.

Of the 798 cases, a total of 589 (73.8 percent) were solved at the time of data collection and 209 (26.2 percent) were still open cases. By comparison, the case clearance rate for our study was 42.3 percent (171 closed cases out of 404 total cases).

As stated in the introduction, we depended on results from their final report for comparisons because we were unable to obtain their dataset. Exhibit 3-3 provides a comparison of victim characteristics between the two studies. Interestingly, there was no significant difference with regard to gender. In both studies, about 86 percent of the victims were male and 14 percent were female. However, there was a large difference on ethnicity. In the Wellford and Cronin study, 15.8 percent of the victims were Hispanic, as compared with 60.7 percent in our study. While we do not know the names of the cities in the Wellford and Cronin study, it seems apparent that none of the cities had a large Hispanic population. In addition to ethnicity, the distribution of ages in the two studies showed differences. The main difference is for victims in the 45 to 64 year old category. In the Wellford and Cronin study, seven percent of the victims were in this age category, while in our study, 13.8 percent were in this category.

As seen in Exhibit 3-3, there were significant differences between the two studies in witnesses located at the primary scene, use of firearms as the weapon, and whether drugs were found at the scene. In the Wellford and Cronin study, firearms were used with 75.2 percent of the victims, compared with a slightly higher percentage of 79.5 percent in our study. Witnesses were found at 61.5 percent of the scenes in the Wellford and Cronin study, compared with 87.1

Exhibit 3- 2: Comparison of Characteristics with Wellford and Cronin Study

Characteristic	Wellford/Cronin Study 1994-1995		ILJ Study July 2003 – June 2005		
Gender	**Number**	**Percent**	**Number**	**Percent**	χ^2
Male	686	86.0	376	86.4	0.1
Female	112	14.0	59	13.6	
Ethnicity* **					
Hispanic	126	15.8	264	60.7	262.5
Non-Hispanic	672	84.2	171	39.3	
Age* **					
Less than 14 years old	33	4.1	12	2.8	15.9
14-24 years old	285	35.7	146	33.6	
25-34 years old	237	29.7	131	30.1	
35-44 years old	145	18.2	77	17.7	
45-64 years old	56	7.0	60	13.8	
65 years or older	22	2.8	9	2.1	
Missing	20	2.5	0	0.0	
Weapon*					
Firearms	600	75.2	346	79.5	3.0
Other weapons	198	24.8	89	20.5	
Witness Found at Scene* **					
Yes	491	61.5	352	87.1	83.9
No	307	38.5	52	12.9	
Drugs Found at Scene* **					
Yes	129	16.2	100	24.8	12.8
No	669	83.8	304	75.2	
Case Status* **					
Open	209	26.2	248	57.0	114.6
Closed	589	73.8	187	43.0	

Source for Wellford and Cronin Study: Table 6 (Victim Characteristics), p. 18.

Note: For their table, Wellford and Cronin apparently selected one victim from incidents with multiple victims.

percent in our study. Finally, drugs were found at 16.2 percent of the scenes in the Wellford and Cronin study compared with 24.8 percent in our study.

In their Executive Summary (p. iii), Wellford and Cronin listed results from several bivariate analyses they conducted with the data from their four cities. We were able to make comparisons against three of their conclusions:

- Cases in which the victim was killed by the use of a rifle, knife, or personal weapon (hands or feet) were more likely to be solved than cases in which the victim was killed with a handgun.
- Cases in which drugs were a circumstance were less likely to be solved.
- The number of detectives assigned to a case, and their actions, had a significant effect on closing the case. A case was more likely to be solved if 3, 4, or 11 detectives were assigned to the case, compared with cases where only one detective is assigned.

The actual statistics underlying these conclusions are not provided in their report. However, analysis of our dataset is in agreement with two or their conclusions. We found that with handguns, the victim clearance rate was 39.0 percent (124 clearances out of 318 victims killed with handguns), while with other firearms, knives, or personal weapons, the rate was 53.8 percent (63 clearances out of 117 victims killed). The chi-square value associated with this difference is 8.1, which is significant at the .01 level.

With drug-related incidents, we did not find a significant difference. The victim clearance rate for drug-related incidents was 37.3 percent (31 clearances out of 83 killed victims), while the clearance rate was 44.3 percent (156 victim clearances out of 352 killed victims) for incidents that were not drug related. While the clearance rate for the other incidents is higher, it is not a statistically significant difference (chi-square value of 1.3, which is not significant at the .10 level).

The Wellford and Cronin conclusion on the number of detectives is basically indicating that more detective assigned to a case increases the likelihood of solving the offense. Their comparison is against cases in which only one detective is assigned to the follow-up investigation. In Phoenix, the operational procedure is that at least two detectives are almost always assigned for follow-up investigation. We did not record the actual number of investigators assigned to each case. However, we did record the number of investigators who conducted investigative activities at each primary scene, and an analysis of that information

provides results that parallel the Wellford and Cronin study. In our study, when either two or three investigators were at the primary scene, the clearance rate was 34.3 percent (35 clearances out of 102 cases). When there were four or five detectives at the primary scene, the clearance rate was 41.6 percent (77 clearances out of 185 cases), and when there were six or more detectives, the clearance rate was 50.4 percent (59 clearances out of 117 cases). Thus, our conclusions are in line with the Wellford and Cronin study.

Chapter 4

Types of Clearances

Introduction

This chapter presents a qualitative look at the 143 cases cleared by arrest during the project period. The cases are divided into three groups—immediate arrest cases, quick action cases, and whodunits. The groups are an extension of the research by Innes (2003), Puckett & Lundman (2003), and others in their attempts to classify cases into investigative types. In this chapter, an *immediate arrest* is a case in which arrest of a suspect is made at the scene either by responding patrol officers or by an investigator after a preliminary investigation. A *quick action* case is one in which a suspect is not immediately known, but quick action on the part of officers and investigators results in the identification and arrest of a suspect in a relatively short period of time. Finally, a *whodunit* case is one that requires a considerable amount of investigative effort before an arrest is made.

The cases cleared by arrest during the project were reviewed and found to subdivide into 57 immediate arrest cases (60 victims), 44 quick action cases (49 victims), and 42 whodunits (47 victims). Each group is discussed with an emphasis on three investigative areas: scene activities, investigative activities, and prosecution. A fourth section on exceptional clearances is included because of their special designation as cases that are cleared without the arrest of the suspect. Exceptional clearance cases cut across the three types of cases.

The descriptions of cases in this chapter do not attempt to include all aspects of the investigative process that went into their clearances. Indeed, many investigations are complicated, requiring extensive amounts of time and effort from investigators. It would not be possible to describe the full extent of twists and turns that an investigation might take before a suspect is arrested.

Immediate Arrest Cases

Immediate Arrest Case Examples

The following narrative is an example of a case in which the suspect was detained at the scene by witnesses and arrested by responding patrol officers. The suspect eventually pled guilty to one count of murder in the second degree and one count of aggravated assault. As of the cutoff date of this report, the court had not ruled on his prison term.

The incident took place on a November morning around 2 a.m. at a birthday party where several people were present. A knock was heard at the door and a young man entered looking for his fiancée, who was attending the party and had said that she would be home by midnight. The young man had a large kitchen knife in his waistband when he entered the apartment. As he entered, Victim 1 approached him and said that he did not have to bang so loudly on the door. Accounts by witnesses in the apartment were that the young man immediately drew out his kitchen knife and began stabbing Victim 1. Victim 2 was stabbed as he tried to stop the altercation. Both victims were transported to a nearby hospital where Victim 1 died and Victim 2 recovered from his wounds. Witnesses at the apartment detained the young man and called police.

The department's communications center received a 9-1-1 call from the apartment at 2:09 a.m. and the first responding officer was inside the apartment six minutes later at 2:15 a.m. The officer's account about the arrest is as follows:

> I had several people in the apartment screaming and yelling in Spanish and some English that the male that was being held down stabbed the victim. I then placed cuffs on the male. At this time I noticed that one of the other males who was holding the suspect down was bleeding and appeared to have a couple of knife wounds also. At this time, two other officers arrived on scene and escorted the suspect out of the apartment. Another witness gave me a knife approximately 6" long and stated that this was the knife that was used in the fight. At this time, another officer arrived on scene. I gave this officer the knife, who secured it as evidence.

Subsequent activities by investigators illustrate the investigative procedures that are necessary with immediate arrest incidents. In total, the team assembled at the scene consisted of an investigative sergeant, two patrol sergeants, eight investigators, six patrol officers, and two crime scene specialists. Responding patrol officers made the apprehension, separated the

witnesses, and secured the scene. By standard procedure, one investigator was designated as the case agent and another as the scene agent. The scene agent obtained the kitchen knife and swabs of blood from the apartment. An investigator was dispatched to the hospital for follow-up activities with the victims and interviews with hospital personnel. Another investigator prepared a search warrant for the suspect's residence, and after a judge's approval of the search warrant, investigators entered the suspect's residence and retrieved a knife set from the kitchen that contained knives similar to what the suspect brought to the scene (the set had one empty slot). Within the first few hours after the incident, investigators had conducted 10 interviews of witnesses to obtain statements on what had occurred at the party, and a crime scene specialist had photographed the apartment scene.

After arrest, follow-up investigative activities proceeded for many months along three interrelated paths: additional interviews, analysis of forensic evidence, and prosecution. With immediate arrest cases, additional interviews are conducted to obtain more information from witnesses, rather than to develop leads and identify suspects. Analysis of forensic evidence collected at scenes assists in preparing a case for prosecution and establishing with greater certainty that the suspect is indeed the offending party. Obviously, prosecution is the next step in the criminal justice process.

In this case, the case agent made three requests for forensic analysis. The first was for an analysis of residue from a pipe found in the suspect's pocket at time of the arrest. The laboratory found no marijuana residue in the pipe. That was followed by a request to compare latent prints found on the kitchen knife with fingerprints of the suspect and both victims. Results from the examination of the latent prints illustrate the difficulties that can occur in comparative analysis of prints. Three latents were obtained from the kitchen knife. One was determined to be of no comparative value, which meant that it did not have enough detail and quality for a valid comparison. The other two latents could not be positively identified as matching either the suspect or the two victims. On the third, the lab technician indicated that the latent may have been from the palm of a hand and only prints from the fingers were available for comparison. Because the suspect's guilty plea took place soon after this analysis, the case agent did not try to obtain a full palm print for comparison.

The third request was to compare a DNA profile from blood on the knife to the DNA profiles of the suspect and both victims. An interesting feature of the request was that the case agent had to obtain a court order to obtain a saliva sample from the suspect for determining his DNA profile. Court orders are standard procedure when a DNA profile needs to be developed from an arrested suspect. The DNA analysis required about five months from the time of the request until the lab report was available through PACE. This length of time is not unusual because of the lab's process for development of the DNA profiles, comparisons between profiles, preparation of the laboratory report, and reviews by a laboratory supervisor. Lab technicians frequently call the case agent with the results prior to official release of the lab's report into PACE. In this case, a mixed DNA profile was obtained from the knife blade, with the major component matching the profile from the second victim. No conclusions could be drawn about the minor component.

In the meantime, court proceedings had taken place. At the arraignment hearing held three weeks after the incident, the suspect entered a plea of "not guilty." Over the next few weeks, several other court actions took place including court approval for a Spanish-speaking court interpreter to assist witnesses during interviews and trial testimony (granted), court order for a saliva sample from the defendant (granted), request for a hearing on admissibility of statements by the defendant to investigators (denied), and a request for a competency screening evaluation on the defendant (granted). The competency screening evaluation was completed in May 2005 and the court found the defendant competent to stand trial, with trial set for August 29, 2005. Delays in the court process caused the trial to be reset to mid-October. Ten days before trial, the defendant pled guilty to murder in the second degree (Class 1 Dangerous Felony) and aggravated assault (Class 3 Dangerous Felony). Sentencing was scheduled for December 2, but was changed to December 16, 2005. On that date, lawyers for the defendant requested an extension to prepare a motion requesting withdrawal from the plea agreement. The hearing on the motion to withdraw took place on Feb. 24, 2006, and the motion was denied. Sentencing was reset for March 16, 2006, at which time lawyers for the defendant requested a diagnostic and mental health evaluation of the defendant, which was approved by the court, to assist in decisions on sentencing. The case eventually was transferred to the Rule 11 Commissioner's Court for overseeing the evaluation. Because of extensions in time to complete the mental health

evaluation, the final report had not been completed as of the cutoff date (November 2006) of this report.

This case illustrates the effort required in immediate arrest investigations and how the different investigative activities relate to each other. It shows that even though a suspect is quickly identified, considerable effort is needed after arrest to prepare the case for prosecution. A team of investigators interviewed several eyewitnesses from the apartment, and these interviews needed to take place as soon after the incident as possible. Witnesses had to be separated and interviewed separately so that they did not have an opportunity to compare notes. Even though the suspect confessed to police, forensic analysis was requested to link the suspect to the murder weapon. The fingerprint analysis was inconclusive in providing a link, but the DNA profile from Victim 2 matched the DNA profile from blood on the kitchen knife held by the suspect.

The case also illustrates the complexities that can occur in the judicial system. Most homicide cases take many months, even years, for complete adjudication, and this case was no exception. The case was plea bargained nine months after indictment. Sentencing had not taken place 16 months after acceptance of the plea because the mental health evaluation had not been completed.

Two other categories of immediate arrest cases are accidental shootings and child victims (under five years of age). Accidental shootings usually occur when a person is handling a pistol, sometimes for the first time, and it discharges and kills someone in the room. These cases can be especially tragic when the victim is a close relative or friend. The person who handled the gun may display considerable remorse about what has taken place. In these cases, police actions are straightforward. Patrol officers secure the room, allowing no one to enter and separating any witnesses to the incident. Evidence collected by the scene agent is minimal, usually consisting of the weapon and related items. The case agent takes the shooter into headquarters for interview, followed by arrest and booking. The case agent will prepare and submit a report to the county attorney's office for determining whether the case will be accepted for prosecution. With most accidental shootings, forensic analysis is not needed with the possible exception of a ballistics test to verify that a pistol from the scene is the offending weapon. The usual

disposition for these cases is that the county attorney decides not to prosecute or to move forward with a manslaughter charge.

With a child victim, the caretakers (child's mother, father, or other relative) of the victim are immediate suspects. Cases with two caretakers may pose particular challenges to investigators in determining whether one or both caretakers should be charged. Interviews and forensic analysis may be important in making this determination. In addition, an outside medical expert may be brought in to assist; such experts are sometimes difficult to enlist.

Characteristics of Immediate Arrest Cases

In summary, immediate arrest cases have the following investigative characteristics:

Scene activities: Responding patrol officers usually apprehend suspects at the scene or identify suspects quickly through interviews with witnesses. With some immediate arrest cases, the suspect made called the police stating that he or she had shot someone and asking for assistance for the victim. At the time of the call, the victim may still be alive. Because immediate arrest cases include accidental shooting and child victims, the callers may be emotional about what has occurred at the scene. Many immediately describe the incident to responding officers.

Responsibilities of patrol officers include placing the suspect under arrest, separating witnesses at the scene, and securing the scene. After gathering relevant information, they avoid extensive conversation with a suspect pending the arrival of homicide investigators. Their involvement generally ends when the investigative team arrives and the scene is turned over for investigation.

Investigative activities: In immediate arrest cases, investigators must interview suspects as quickly as possible. The aim is to have a suspect describe what happened in as much detail as possible or provide an explanation that may be refuted after further investigation. Several investigators may be assigned to interview witnesses at the scene. Additional investigative effort is needed to interview surviving victims at the hospital along with relatives, friends, and hospital staff.

Suspects will sometimes not immediately admit any involvement in the homicide. In one case, for example, the victim was found in a dumpster at an apartment complex. Her boyfriend

stated that they had argued in his apartment the night before but that she was unharmed when she left. Neighbors at the scene told police that they saw him taking items to the dumpster. After questioning, he admitted to the homicide and gave a complete accounting.

Prosecution: Immediate arrest cases can require a considerable amount of follow-up by investigators even when a suspect admits to a homicide. After talking to a defense attorney, a suspect may decide to plead not guilty—especially after hearing the likelihood of a prison term. Investigators almost always made immediate requests for forensic analysis to build the case against a suspect. During the months of adjudicatory process, prosecutors may request forensic analysis in preparation for plea bargaining and jury trial. In most immediate arrest cases, the suspect eventually pleads guilty as charged or agrees to a plea bargain negotiated between defense lawyers and the district attorney.

Quick Action Cases

Quick Action Case Examples

Quick action cases differ from immediate arrest cases in that suspects are not immediately apparent to responding patrol officers and investigators. Witnesses may be able to provide descriptions of suspects and vehicles, along with details on what preceded the fatal incident. They may also be able to provide nicknames and other information about suspects and their associates. However, the suspects are nowhere in sight when police arrive. In some cases the victim and suspect may be friends or acquaintances (for example, a dealer/customer relationship with drug sales), but witnesses may not know the suspect. In other cases, the victim and suspect may not know each other (for example, an argument between two people at a bar that escalates to violence). Regardless of the circumstance, investigators are able to piece together bits and pieces of information at the scene and their actions then lead to the apprehension of suspects in a relatively short period of time.

In our first example case, the apprehended suspect eventually pled guilty to one count of manslaughter resulting in a prison term of 18 years. Accounts differed among witnesses, and, after arrest, the suspect proclaimed his innocence and implicated another person in the shooting. The following description is the most likely scenario on what happened based on police

investigation. The differences in accounts are then presented along with a discussion on the follow-up investigation.

This incident took place around 10 p.m. at a swap meet dance in a lumberyard. Victim 1 (passenger), Victim 2 (driver), and a third person (backseat passenger) were driving around the parking lot in a pick-up truck. An off-duty deputy from the Maricopa County Sheriff's Office providing security at the swap meet asked them either to park their truck or leave. As they were driving down an aisle to leave, a Dodge Neon with Suspect 1 (driver) and a passenger cut in front of them. Words were exchanged between the occupants of the two vehicles. Victim 1 exited the truck and approached the passenger side of the Neon where the argument continued. The suspect shot Victim 1 in the face as he was approaching. Victim 2 got to the car and began to grab and hit the passenger. He fought with the passenger until he saw the gun held by the suspect. He then started running away from the vehicle. The suspect shot Victim 2 twice in the back. The third passenger in the pick-up truck had trouble exiting the back seat. He saw the incident from a distance and took cover to avoid being shot. He later told investigators that the passenger in the Neon exited and ran from the scene. The passenger was never located.

The suspect started driving his Neon away from the lumberyard. He drove by a second county deputy who was providing security at the event. At the time, the deputy was in a golf cart that was used to patrol the area. He took chase after the Neon. The suspect drove a short distance, exited the vehicle, jumped a fence into the lumberyard, and kept running. The deputy observed that the suspect had a gun in his hand as he jumped the fence. The case agent at the scene requested a canine officer with his dog to search the entire area. Around 1:50 a.m., the dog located Suspect 1 hiding in the lumberyard. He was taken into custody for questioning. Victim 1 was pronounced dead at the scene and Victim 2 recovered from his wounds in a local hospital.

The suspect told investigators that he was the passenger in his Neon and that his friend had been driving. He further stated that his friend fired the shots and then exited the vehicle, handing the pistol and car keys to him with instructions to hide the pistol. The suspect's reason for letting his friend drive his car was because his friend knew where to park at the swap meet. The suspect did not know the name of his friend, whom he had come across at a gas station. His friend had asked for a ride to the swap meet. The suspect stated there was a third person in the back seat of the Neon who got out of the vehicle and fled immediately after the shooting. In this

case, a plea agreement with the suspect was reached nine months after the incident. He entered a plea of guilty to one count of manslaughter (Class 2 felony) and received a sentence of 18 years in prison.

Difficulties in moving this case forward after arrest stemmed from the fact that the suspect gave a different account of what occurred. Victim 2 was an important witness because of his involvement in the incident. The third passenger in the pick-up truck did not see any of the shots as they were fired and could only describe his actions after coming to the two victims.

An investigative team assembled at the scene consisted of two investigative sergeants, one patrol sergeant, seven investigators (including case agent and scene agent), 12 patrol officers, and a crime scene specialist. Activities of the patrol officers included the search for the suspect with a K9 dog, interviews of witnesses at the scene, recording of license number of vehicles in the immediate area, and securing the scene. One investigator accompanied by a crime scene specialist was dispatched to the hospital to interview, photograph, and take fingerprints of the second victim. Several of the investigators, including night detectives, searched the area for evidence; one of the investigators found the pistol that had been dropped by the suspect. The next day, an investigator and a crime scene specialist processed the Dodge Neon at the department's impound lot, obtaining evidence and taking photographs.

Forensic analysis can play an important role when eyewitnesses are either not available or their accounts can be challenged. In this case, the case agent made several requests for forensic analysis over a six-month period after the arrest of the suspect. The requests and subsequent analyses were:

GSR Kit on Victim 2: A GSR kit was administered on Victim 2 on the day of the shooting while he was at the hospital. The lab report states that several particles known to be indicative of gunshot residue were detected on the GSR collection from both hands.

GSR Kit on suspect: A GSR kit was administered on the suspect at the scene after his apprehension. The lab report states that several particles known to be indicative of gunshot residue were detected on the GSR collection from both hands.

Examination of pistol: This first examination of the pistol found at the scene included test firing the weapon, entering the samples into the NIBIN system, swabbing the pistol for possible future DNA analysis, and swabbing blood from the revolver for possible DNA analysis.

Drug analysis: Contents of a plastic bag found in the Neon were determined to be cocaine.

Latent Print analysis: No useable latent prints were developed from the pistol, the suspect's shoes, and two beer cans found at the scene. Useable latents were developed from a Powerade bottle found at the scene and from latents taken on the Dodge Neon.

Ballistics: A bullet jacket found at the scene was identified as having been fired from the pistol. Two metal fragments from the scene were determined to be a bullet jacket fragment and bullet core, but were unsuitable for comparison to the weapon.

Muzzle-to-target distance analysis: The case agent requested an estimate of the muzzle-to-target distance based on results from the autopsy and test firing of the pistol. The lab reported a distance of approximately six to 24 inches.

Shoe examination: The right shoe from the suspect was determined by lab personnel to be comparable in dimensions, outsole design, and a point of comparison to the partial right shoe impression on a piece of drywall from the scene (the suspect had stepped on the drywall as the scaled over a fence).

DNA analysis:

- DNA profiles from three samples of blood found on the suspect's shirt and jeans matched the DNA profile of the suspect.
- No results or inconclusive results were obtained from attempts to obtain a DNA profile from a bullet jacket.
- A DNA profile from a swab of dried blood near Victim 2 was found to match the DNA profile of the victim.
- A DNA profile of blood on the pistol was found to match the DNA profile of the suspect.
- A mixed DNA profile was obtained from a swab of the pistol with the major component matching the DNA profile from the suspect at nine loci.

In addition to the forensic analyses, the case agent, with assistance from other investigators, reconstructed the shooting at the lumber yard. The reason for the reconstruction was to develop assurances that the driver of the Neon was the only person who could have fired the shots. The reconstruction was videotaped.

The plea agreement with the suspect was reached nine months after the incident. At the time of the agreement, the DNA analyses were in process but had not yet been completed. Because of the agreement, the case agent made no further requests for forensic analysis and withdrew other requests he had submitted. In short, investigation stopped when the plea agreement was accepted.

Summaries of two other examples of quick action cases are the following:

Gang shooting: Upon arrival at the scene at 3:30 a.m., officers found Victim 1 and Victim 2 suffering from shotgun wounds. Victim 1 had been shot in the neck and Victim 2 had been shot in the back. Both were transported to a hospital. At the time of the shooting, they were playing basketball with others on a neighborhood court. Victim 1 subsequently died of his wounds and Victim 2 recovered. Witnesses on scene had seen a gray Lincoln town car drive up slowly prior to the shooting. A shotgun was seen pointing out the left rear window as it was fired at the victims. One of the witnesses called 9-1-1 with the suspect vehicle information. A few minutes later, officers spotted the suspect vehicle and stopped it. Eight people and a shotgun were in the vehicle. Investigation revealed that the group had been at a party and decided to drive to the area of a rival gang to "cause trouble." Suspect 1 stated during his interview that he wanted to become a member of the gang that others in the vehicle belonged to. Suspect 2, driver of the vehicle, drove to the neighborhood with the intent of shooting a gang member. Suspect 1 pled guilty to 1st degree murder resulting in a life sentence and aggravated assault with a concurrent sentence of 15 years. Suspect 2 pled guilty to 2nd degree murder resulting in a sentence of 22 years and aggravated assault with a concurrent sentence of 15 years.

Automobile Shooting: On April 2, 2005, around 10:15 p.m., a shooting began in the area of Pinchot Avenue and Earl Drive. A white Ford Taurus with six occupants was struck several times by gunshots believed to be from the occupants of a white Mercedes that was later recovered. Victim 1, riding in the backseat of the Taurus behind the driver's seat, was struck by two gunshots to the back of his head. He was taken to a hospital where he died. Victim 2 was seated on the opposite end of the back seat of the Taurus. She was struck by a gunshot to the middle of her back and was taken to the hospital. She recovered from her gunshot but was paralyzed from the waist down. The other four occupants of the vehicle received non-life threatening injuries. Many people in the neighborhood called 9-1-1 when the shooting started. As a result, a description of the suspect vehicle was broadcast to patrol officers in the area. Officers saw the white Mercedes cut across a parking lot and head south. They pursued the Mercedes and eventually the police helicopter joined the pursuit. The helicopter followed the Mercedes to the neighborhood at 85th Drive and Lewis, where they saw three or four people quickly exit the car. The Mercedes continued about two more blocks, where the driver was seen leaving the Mercedes. Officers searched the area and detained Suspect 1 who had been hiding

under a parked vehicle in the area of 85th and Lewis. Other arrests were also made. The case had not been adjudicated as of this evaluation report.

One of the characteristics of many quick action cases is the ambiguity on what actually occurred and who is responsible for the incident. In the extended example from the incident at the lumberyard, the suspect gave an alternative explanation about what had taken place and stated that another person had fired the pistol. A considerable amount of follow-up investigation was needed to try to establish the truth about what happened. In the other two examples, eyewitnesses who could positively identify suspects were not readily available. With a large number of suspects, as in the gang shooting, investigators may be able to bargain with some suspects to testify against others in exchange for dropping or reducing charges.

Scene activities: The scene activities at quick action cases are vitally important because they may lead to the apprehension of a suspect. As highlighted above, patrol officers and their supervisors take actions that result in arrests sometimes even before homicide investigators have been notified to report to the scene. With most quick action cases, however, patrol officers and supervisors can only relay to investigators what they have learned about the participating incident. That information includes names of witnesses and possibly names of suspects.

Investigative activities: The initial activities for investigators at the scene depend on whether a suspect has been identified by witnesses. Investigators have to be concerned at this point that the suspect will flee the area before police can make an apprehension. Indeed, in some cases, suspects who were immediately named at the scene could not be located—with the result that the case remains open. When a suspect cannot be located, investigators send out bulletins and establish surveillance of locations where the suspect might appear. The bulletins are sent within the department and to surrounding departments to be on the lookout for the suspect. The bulletins provide as much descriptive information as possible about the suspect and information on the suspect's vehicle when available. These bulletins proved useful in several cases where the suspect has been stopped by patrol officers and then transported to headquarters for interviews by investigators.

Locations for surveillance include the suspect's residence, a friend's residence, and areas the subject is known to visit. Within the police department, the Special Assignment Unit has been especially effective in conducting surveillances and apprehending suspects. Investigators

from the homicide unit work closely with this unit and frequently participate in the surveillances. Surveillance can be as short as a few hours or as long as several days depending on the reliability of the information and results from other investigative activities.

Prosecution: As with immediate arrest cases, prosecution of quick action cases requires a considerable amount of time from investigators. Quick action cases generally have witnesses who can testify on what they saw or heard at the scene. Witness statements are therefore an important component of the prosecution, as is forensic analysis. When a suspect is apprehended within the first few hours or days of an investigation, there is a greater chance that investigators will locate incriminating forensic evidence, such as the firearm used in the incident or DNA material on the suspect's clothing. Analysis linking the suspect to the scene can be strong evidence for prosecutors.

Whodunits

Whodunit Case Examples

A whodunit case is one in which a suspect is not immediately identified and investigators have to devote a considerable amount of time and effort to solve the case. Weeks and months may go by before a suspect is arrested, and, after arrest, more investigative efforts and forensic analysis are needed to prepare the case for prosecution. The following are examples of whodunit cases from Phoenix during the time frame of our study.

Pawn Shop Shooting: Around 5:30 p.m. on the day of this incident, a couple entered a pawn shop to buy jewelry. They saw no one behind the counter, and called "hello" to the back of the store and waved to a video surveillance thinking that someone might be monitoring the camera. As no one came forwarded, they started looking at merchandise and then spotted the legs of a person lying on the floor behind the counter. After determining that the person was dead, they immediately called police. Responding officers determined that the person was the owner of the pawn shop and had been shot twice in the chest. This case typifies the starting point of whodunit cases. There were no eyewitnesses to the shooting. The incident could have occurred several hours before the couple entered the pawn shop. A canvass of the neighborhood resulted in two people reporting they heard shots but no one who saw what occurred.

In this case, the investigators received a lucky break because the video surveillance camera recorded the entire incident. An alert patrol officer arriving at the scene turned the camera off so that the videotape did not loop around and record over itself. The tape showed the suspect entering the pawn shop and immediately firing a handgun several times. He was holding the handgun with his right hand inside a blue plastic shopping bag as he fired the gun at the victim. He dropped the bag on the floor as he exited after stealing two handguns. With the availability of a videotape showing the entire incident, it would seem that a quick arrest should be possible. However, a showing of the video on local news the next day did not result in anyone coming forward with identification of the suspect.

The video assisted investigators in making requests for forensic analysis of evidence collected at the scene. Unfortunately, the analysis did not identify the suspect. No useable latents were obtained from a wooden drawer that the suspect had opened. A latent from the front door was matched through AFIS to a known offender who was clearly not the person in the video. Over 20 other latents from the scene did not result in a hit through AFIS. The plastic bag dropped at the scene was swabbed for DNA material; however, investigators did not request that analysis for a DNA profile from the material for entry into CODIS.

The break in this case came six months after the shooting when the videotape was shown on a nationally syndicated television show that occasionally highlighted high profile crimes. As it turned out, the suspect had an accomplice, a female passenger to whom he gave a necklace to pawn prior to the shooting. She went into the pawn shop alone but was not successful in making the transaction because she did not carry identification. When she returned to the car, the suspect questioned her to determine that only one person was in the pawn shop. They then drove around for a few minutes returning to the pawn shop at which time Suspect 1 entered the shop, shot the owner, and left with two handguns. He told his female passenger not to tell anyone about what she had seen or heard. He subsequently fled to Charlotte, North Carolina.

A few months later, the female accomplice and her sister decided to fly to Charlotte to collect money that the suspect owed her. At the airport, she told her sister what had happened at the pawn shop, and her sister informed their mother. Her mother had seen the videotape of the incident on the national show and had thought that she recognized her daughter's friend in it. She contacted investigators in the Charlotte Police Department, who then arrested the suspect.

Three investigators from Phoenix flew to Charlotte to interview the suspect and the two sisters. Upon questioning, the suspect confessed to investigators that he had shot the pawn shop owner and stolen two guns, which he later sold for $150. He stated further that the handgun found on him at the time of arrest was the murder weapon. He told investigators that he had been in the pawn shop several months earlier and observed that the owner carried a handgun and stored a handgun in a drawer. His motive was that he was in debt and needed money.

The court outcome in this case had not been decided at the end of our data collection period. Forensic analysis provided two results greatly strengthening the prosecutorial case. First, the DNA profile from swabs off the plastic bag matched the suspect. Second, six cartridge cases from the scene were identified as having been fired from the handgun recovered from the suspect upon his arrest in Charlotte.

Serial Shooter: Two cases during our study are the earliest known victims of what became labeled by police as the Serial Shooter cases. Victim 1 was killed on May 17, 2005, around 11 p.m., as he was riding his bicycle on an east Phoenix street, and Victim 2 was killed on May 24, 2005 near midnight, while sitting on a bus stop bench. No witnesses were identified in either shooting and no motives were established during the preliminary investigations. A third homicide occurred on June 29, 2005, at about 3:32 a.m., at the border of Phoenix and the town of Tolleson. It was determined that the shooting took place in the city of Tolleson and investigators from that police department assumed the investigation. The common features of these three homicides were that they occurred within the same time period of the day (11 p.m. – 5 a.m.) and .22 caliber projectiles were recovered from the three victims.

Over the next few months, other shootings, including those of dogs and horses, were reported to police in the metropolitan area, with the same common features on time of occurrence and caliber projectiles. Within the Phoenix Police Department, the cases came to be known as the “Serial Shooter” cases, a phrase picked up by the media as they reported on the progress of the investigations. In July 2006, a multi-agency task force was established involving the police departments of Phoenix, Mesa, Scottsdale, Tolleson, and Avondale, along with the Bureau of Alcohol, Tobacco, and Firearms (ATF), and the Federal Bureau of Investigation

(FBI). The Phoenix Police Department would eventually have over 200 police officers and investigators working with the task force and would process over 6,000 tips from citizens.[2]

On July 31, 2006, two men were identified as key suspects through tips from citizens and an informant who told police that one of the suspects has asked him if he knew what it was like to kill someone. Suspects A and B were arrested on August 3 at their apartment in Mesa, Arizona. One of the suspects subsequently called their activities "random recreational violence."

As of this report, Suspect 1 has been charged with five counts of first-degree murder, two counts of attempted first-degree murder, 1 count of aggravated assault, eight counts of drive-by shootings, two counts of discharge of a firearm at a structure, and 10 counts of cruelty to animals. They have both been charged with one count of conspiracy to commit first-degree murder, one count of attempted first-degree murder, two counts of drive-by shootings, two counts of arson of an occupied structure, and one count of aggravated assault.

Cold Case: The Phoenix Police Department formed a "cold case" unit in 1992 with the assignment of two investigators. By 1998, the unit had grown to five investigators who reviewed old cases with the aim of determining whether fresh investigation and forensic analysis might lead to arrests. Within the context of our study, no cold cases exist because our analysis comprises homicides over a two-year period starting in mid-2003. However, we can briefly highlight one case that was prosecuted during our time frame to illustrate a typical cold case. Victim 1 was killed on August 24, 1984, in a church located five miles from his home. He had gone to the church around 9 p.m. to turn on a cooler so that the church would be comfortable for services the following morning. He apparently interrupted a burglar stealing money from the poor box and was stabbed to death. Investigators worked on the case for over two years with no results. In 2002, the department connected to IAFIS, the FBI's system that links AFIS information across states. An investigator from the cold case squad submitted a latent print from the church to IAFIS and it produced a match with Suspect 1, who had his fingerprints on file in New Jersey as a result of an arrest for possession of marijuana in 1987. He was subsequently

[2] Another serial case was ongoing at this time called the "Baseline Killer" case. That case involved a series of homicides, sexual assaults, and robberies that were linked because of common characteristics. The earliest homicide attributed to the Baseline Killer took place in August 2005, which was after the completion of this project's experimental period. A person suspected to be the Baseline Killer was arrested on September 6, 2006.

arrested and returned to Phoenix to face prosecution. In April 2004, he pled guilty to one count of second degree murder and was sentenced to 18 years in prison.

At the time of our study, only two investigators and a crime analyst were assigned to the cold case unit. The unit had been depleted over the years because of increases in homicides and the priority given to current cases. However, at the recommendation of a sergeant from the homicide unit, the cold case unit implemented an investigative approach in 2003 that has produced good results. An investigator from the homicide unit was teamed with an investigator and analyst from the Adult Sex Crimes Unit to review sexual assaults and homicides with common characteristics. As of August 2006, the combined unit had solved over 48 sexual assaults, resulting in eight suspects incarcerated and 13 pending arrest warrants. Fourteen sexual assault/homicide related reports have been cleared, resulting in eight suspects incarcerated.

Cold cases are the quintessential whodunits. They have few if any witnesses and all leads have been exhausted. However, they may have DNA evidence and fingerprints that predate CODIS and AFIS/IAFIS systems. Cold cases may be solved by submitting DNA profiles to CODIS and latent prints to AFIS/IAFIS.

Magic Phone Call: Whodunit cases may be solved by what one investigative sergeant terms the "magic phone call" in which an investigator receives a call from someone with key information about a case. The call may be from a confidential informant, an acquaintance of a suspect, an accomplice to the incident, or an arrestee wanting to trade information for reduced charges. As an example, around midnight on an August evening in 2004, Victim 1 was shot and killed in his taxi. A witness heard shots and saw three men running from the taxi. The witness said he would not be able to identify any of the men who fled from the scene. In November 2004, two informants called and then met with the case agent and provided the name of the shooter. Both stated that the motive was robbery and both gave supporting information on what had occurred. Suspect 1 was arrested three weeks later with a handgun in his possession that proved to be the murder weapon.

This case illustrates another characteristic of homicide investigations—leads can quickly dissipate. For example, three persons matching the descriptions of the suspects were stopped near the scene but were soon released based on their answers to questions from the officers. Another lead was developed through the cooperation of a cell phone communications company

that provided the name of the person who called the taxi company. The caller was never located and the case agent received information that he had moved to Colorado. A final possibility was through an analysis of 38 latent prints taken from the taxi. However, only one hit was made through AFIS and that person provided an alibi for his whereabouts at the time of the incident.

Characteristics of Whodunit Cases

Several comments can be made in regard to the investigation of whodunits:

Scene activities: Patrol officers responding to a whodunit must first secure the scene. A characteristic of whodunits is that there are usually few witnesses at the scene to interview. In the pawn shop case, the only witnesses were the couple who found the body and a third customer who arrived soon after the couple called the police. None of the three had ever been inside the pawn shop in the past and could contribute no information toward solving the case. There were no eyewitnesses to the two Serial Shooter cases discussed above, and most cold cases have no eyewitnesses to the incident. When a whodunit takes place in a residential area, patrol officers and investigators will canvass a neighborhood to determine if anyone heard or saw anything related to the incident. The usual result is that witnesses may be identified who heard shots fired, people arguing, or saw suspects running from the scene. These witnesses rarely indicate that they can make positive identifications of anyone they observed. Another characteristic of whodunits is that time has expired between the precipitating incident and the first call to police. Responding patrol officers and investigators are therefore limited in what they can do immediately, such as having a police helicopter scan the area. There are no "quick actions" that can be taken.

Investigative activities: As indicated by the above examples, the investigative effort for whodunits can be extensive. The Serial Shooter case is an extreme example of the effort that may be expended in finding and arresting suspects. As described, a multi-agency task force was developed because the suspects were operating in several different jurisdictions. The Phoenix Police Department had over 200 sworn personnel with assignments on the case including special patrols, follow-up interviews, responding to tip-line calls, and pursuing a variety of different leads. The role of the media is of particular note in many whodunit cases. For example, cold cases may be the subject of television specials, and surveillance videos may be shown on newscasts in an effort to identify suspects. The Serial Shooter case received considerable media

attention after the task force was established with daily commentary on the progress of the investigation. The Serial Shooter and Baseline Killer cases were designated the top two news stories in the state for 2006. The Phoenix Police Department has a media spokesperson with responsibility for providing information to newspaper and television reporters about ongoing investigations.

The first few weeks of a whodunit case are key to whether the case will be solved. Case agents will employ different approaches depending on the circumstances of the case. With stranger-to-stranger crimes, the case agent may distribute flyers in the area asking for information or coordinate with patrol officers about their knowledge of people in the area who might be contacted. A robbery in which the victim was killed is an example of a case in which these approaches may be employed. In other circumstances, the case agent will interview family and friends to obtain information about the victim's lifestyle, which may in turn lead to the identification of suspects.

In our review of whodunits, we did not find that forensic analysis played a significant role in the identification of suspects. Most whodunits are solved by other means—determined efforts by an investigator, a lucky break (such as a tip from an anonymous caller), effective use of the media (video showing), or formation of a task force for serial offenses.

Chapter 6 provides a detailed review of forensic analysis that was conducted on the cases occurring during this project. One result is that forensic analysis can take weeks to complete because of backlogs in the crime lab and the need for careful administrative and technical reviews of test results. During the time lag, investigators will likely be assigned other cases. When lab results are returned on an older case, investigators may not be able to return immediately to the investigation. Moreover, the time delay provides an opportunity for suspects to flee the area.

Cold cases are significant exceptions to the value of forensic analysis. With cold cases, forensic analysis usually is crucial to the successful identification of suspects. In the example from this chapter, latent prints from the scene resulted in a match that led to the arrest of a suspect who eventually pled guilty to the homicide. The prints from the suspect were not in the national database until years after the homicide in Phoenix. Identification of suspects through the CODIS system with DNA profiles from evidence is proving increasingly valuable in

Phoenix. As DNA profiles of more offenders are entered into the state and national databases, the CODIS system will increase in value for investigators.

Forensic analysis may be especially important in whodunit cases. As indicated by the summary of the cold case, latent prints were the key to the apprehension the suspect who subsequently pled guilty to the homicide. As an investigation proceeds, investigators may request forensic analysis on evidence that has been collected at the primary scene. These requests are especially prevalent when leads in an investigation have not resulted in an arrest. Investigators then turn to forensic analysis to determine whether additional leads can be developed.

Prosecution: Prosecution is more difficult in whodunits for several reasons. Generally, there are fewer witnesses to whodunits than in other cleared cases, and when witnesses exist, investigators are challenged to keep track of their whereabouts over the long duration of an investigation and prosecution. Witnesses may move to other locations in the city or surrounding area, or they may move to another state; in some instances, they may move back to their home countries. Prosecution is weakened when witnesses are unavailable.

Exceptional Clearances

The Phoenix Police Department adheres to the guidelines of the FBI's Uniform Crime Report system for determination of whether a case can be exceptionally cleared. The guidelines (Federal Bureau of Investigation) state that a department can clear an offense exceptionally if all of the following questions can be answered in the affirmative:

1. Has the investigation definitely established the identity of the offender?
2. Is there enough information to support an arrest, charge, and turning over to the court for prosecution?
3. Is the exact location of the offender known so that the subject could be taken into custody now?
4. Is there some reason outside law enforcement control that precludes arresting, charging, and prosecuting the offender?

In Phoenix, an exceptionally cleared case will not receive any additional investigative effort. A total of 28 cases in our study were determined to be exceptionally cleared:

Murder-suicide (7 cases): Six suspects committed suicide immediately after killing their victims, and one suspect committed suicide a few days afterwards. Domestic and interpersonal problems were the underlying circumstance in all seven cases.

Suspect killed (5 cases): In three cases, the victim killed the suspect as a result of a home invasion by the suspect intent on robbery or burglary. In another case, two combatants shot and killed each other, and in the final case, the suspect was killed months later in an unrelated gun battle over illegal drugs.

Suspect in prison (1 case): In one case, the suspect was already serving a long prison term on charges from an unrelated case.

Prosecution declined (8 cases): In six cases, the district attorney's office declined to prosecute because the victim and offender were in mutual physical combat. In another case, three suspects were involved in a drug shootout in which they killed two others, and in the final case, the suspect killed mistakenly killed a person whom the suspect believed had planned to kill him. With all eight cases, the district attorney's office believed there was probable cause for arrest but a small likelihood of conviction.

Cases in which the suspect commits suicide or is killed by the victim are classified in our typology as immediate arrest cases because they do not require an extensive amount of investigative time. With suicide cases, for example, evidence and circumstances at the scene usually indicate what has occurred. On the other hand, cases in which the prosecutor declines to prosecute may have been solved quickly by investigators or may have required a considerable amount of investigative effort. In mutual combat cases, a fight has occurred resulting in the death of the victim either by a severe beating or gunshot injury. These cases are usually easy to solve because the suspect is still at the scene when police arrive or is quickly apprehended. Prosecutors are reluctant to take these cases forward because they anticipate a self-defense strategy on the suspect's part, a strategy that is difficult to overcome when no witnesses saw what occurred.

In one such case, the suspect was a member of a gang and bragged to gang members that he mistakenly shot the victim in a white truck. He thought the white truck was occupied by another person who owned the same make and style of truck, and he believed that person was trying to kill him over an unpaid debt. The case agent received tips from informants all of whom

insisted on remaining anonymous for fear that the subject would retaliate on them. None of the informants was comfortable with testifying at a trial. There were no witnesses to the shooting and no forensic evidence could connect the suspect to the victim. The case agent submitted the case to the district attorney's office for review. The district attorney's office declined to file because there was no reasonable likelihood of conviction without forensic evidence and witnesses willing to testify.

Conclusions

The three types of case clearances discussed in this chapter were immediate arrest cases, quick action cases, and whodunits. *Immediate arrests* were defined as cases in which arrest of a suspect was made at the scene either by responding patrol officers or by an investigator after a preliminary investigation. These include cases where the suspect readily admits the murder to the police (sometimes to the call taker at the department's communication center), cases in which witnesses hold the suspect until police arrive, and cases in which the suspect commits suicide as part of the incident.

Quick action cases are those in which a suspect is not immediately known, but actions on the part of officers and investigators result in the identification and arrest of a suspect in a relatively short period of time. Examples are cases in which interviews result in the naming of a suspect who is arrested within the next few hours or days; cases in which other resources in the department (such as helicopters, canines, and other special units) are deployed to locate suspects; and cases in which patrol officers locate a suspect by canvassing an area near the incident. They differ from immediate arrest cases because the suspect is not readily identified and could have fled the area without the quick actions by police.

Whodunit cases significant investigative activities. They are the true mysteries in which suspects cannot be identified in the first few days of the investigation. They may require weeks, months, or even years of investigation before suspects are identified and arrested. Serial offenders are included in this category as an example in which large task forces may be formed as the core of the investigation.

Chapter 5

Evidence from Homicide Scenes

Introduction

The analysis provided in this chapter is based on information from investigative supplemental reports prepared by case agents and scene agents (including crime scene specialists) and entered into the PACE system. As described in Volume I, the PACE system includes an evidence screen for itemizing each item of evidence collected at a scene during the preparation of a scene report. As a result, a detailed list of evidence is automatically provided by printing the report.

Primary and Secondary Scenes

We define the *primary scene* as the location where the victim was found and *secondary* scenes as all other locations where collection of forensic evidence took place. An example shows how primary and secondary scenes are related. In one case from Phoenix, an eyewitness saw the suspect and victim arguing in the hallway of the victim's residence. The suspect shot the victim and fled from the residence. Scene agents collected evidence from the victim's residence, the primary scene in this case. A few days later, the case agent obtained a search warrant for the suspect's home. Upon executing the search warrant, they collected evidence from the residence including a towel with bloodstains and handwritten papers. The suspect's residence is a secondary scene in this case.

Our definitions differ from Lee, et. al. (2004) in which they define the primary scene as the location where the crime occurred, and secondary scenes as all other scenes where evidence is collected. With their definitions, the location where a victim has been taken (e.g., the victim is shot at one location and dumped in a remote area in the desert) is a secondary scene, and the primary scene may never be determined. Our definition for primary scene focuses on the location where the victim was found because that location is the starting point of the investigation.

The rule of thumb followed by scene agents in the Phoenix Police Department is to err on the side of collecting too many items at primary and secondary scenes rather than taking the risk of leaving an important item of evidence. Interviews with crime scene specialists gave two reasons for this approach. First, an item left behind at a scene may in fact turn out to be the key piece of evidence for identifying a suspect or linking a suspect to the scene. During evidence collection at the primary scene, investigators may not have enough information about the incident to determine whether an item is important. Second, a defense attorney may point to items not collected as evidence that could prove the innocence of their client. Jurors could find a defendant not guilty because doubt has been placed in their minds on the value of items not collected at the scene.

As will become evident in this chapter, a large number of items of evidence can accumulate during a homicide investigation. It is not unusual, for example, for crime scene specialists to collect dozens of beer bottles, soda cans, cigarettes, and articles of clothing at a scene. Each is theoretically subject to forensic analysis, although investigators rarely request analysis of all items. In the next chapter, we summarize the types of forensic analysis conducted on the homicide cases from Phoenix.

Types of Forensic Evidence

Several forensic experts (Fisher;Gardner;Lee, Palmbach, and Miller;Ragle) have developed typologies for forensic evidence. These typologies cover the variety of forensic evidence collected at crime scenes: fingerprints, impression evidence, hair, fiber, firearms, biological evidence, drug evidence, and entomological evidence. Our typology, based on Fisher (2004) and Lee, Palmbach, & Miller (2004), is as follows:

- **Fingerprint Evidence**: Fingerprint evidence is divided into complete *10-prints* (fingerprints are available for both hands and palms as in the case of fingerprinting a victim or suspect) and *latent prints* (only partial prints of one or more fingers are available, usually through a powdering technique on physical evidence such as a weapon or vehicle).
- **Biological Evidence**: The two most common types of biological evidence are *blood* and *saliva*. Blood evidence comes in the form of *wet blood* (e.g., a tube of blood from an autopsy) or *swabs* of bloodstains collected at crime scenes. Buccal swabs are the most common way of collecting biological evidence, usually from a victim or suspect. Other types of biological evidence include *seminal stains*,

urine, and *perspiration*. In each case, the aim is to provide sufficient samples of biological evidence to allow DNA profiling.

- **Firearms Evidence**: Firearms evidence consists of *firearms* (handguns, rifles, assault weapons, etc.), *ammunition* (e.g., spent casings, fired projectiles, bullet fragments, and unfired bullets), and *gunshot residue (GSR)* tests. The purpose of a GSR kit is to determine whether an individual was close to a firearm at time of discharge.
- **Drug Evidence**: Drug evidence includes *drugs* (e.g., marijuana, cocaine, methamphetamine, and others), and *drug paraphernalia* (pipes, spoons, etc.) found at a scene.
- **Trace Evidence**: Trace evidence is a generic term for small, sometimes microscopic, material. It covers a wide variety of evidence, including fibers, hair, building materials (asbestos, paint, etc.), cigarettes, tobacco, glass, and others.
- **Other Evidence**: Other evidence is a catchall category for evidence that does not fit any of the above categories. Typical examples are clothing, beer bottles, cell phones, blankets, questioned documents, and flammable liquids.

Evidence Collected at Primary Scenes

In coding evidence from primary scenes, we found it beneficial to separate evidence collected from the general area of the scene and evidence collected from vehicles at the scene. We found differences in both the types and quantities of evidence found between these two categories of primary scenes.

Homicide Scenes

Exhibit 5-1 summarizes the evidence found at the homicide scenes (other than vehicles, as discussed in the next section). The 10-print cards are sets of fingerprints taken of suspects and witnesses who were present at the scenes. As shown in the exhibit, there were 27 scenes at which 10-print cards were taken (average of 1.2 cards per scene). Scene agents took latent lift cards at 68 scenes, with an average of 9.1 cards per scene. Biological evidence consisted of DNA evidence swabs at 195 scenes (5.9 swabs per scene) and buccal swabs of suspects and witnesses at 12 scenes (1.4 persons per scene).

Exhibit 5- 1: Evidence Collected at Homicide Scenes

Type of Evidence (n=404)	Number of Scenes	Average Per Scene	Type of Evidence	Number of Scenes	Percent Of Scenes
Fingerprint Evidence			**Impressions Evidence**		
10-print cards	27	1.2	Shoeprints	63	15.6
Latent lifts	68	9.1	Tire tracks	7	1.7
			EDPL impressions	21	5.2
Biological Evidence			Other impressions	3	0.7
DNA swabs	195	5.9			
Buccal swabs of persons	12	1.4	**Trace Evidence**		
			Cigarettes/cigars	84	20.8
Weapons Evidence			Tape	7	1.7
Handguns	91	1.5	Fibers	4	1.0
Other firearms	32	1.5	Hair	20	5.0
Knives	45	1.7	Paint	5	1.2
Shell casings	217	6.9			
Spent projectiles	105	2.8	**Other Evidence**		
Live cartridges	119	12.0	Clothing	261	64.6
GSR	39	1.5	Documents	77	19.1
Bullet fragments	67	16.6 % (of scenes)	Tools	9	2.2
			Other items	308	76.2
Drugs					
Suspected illegal drugs	75	18.6 %			
Drug paraphernalia	51	12.6 %			

Scene agents obtained firearms (handguns and other firearms) at 123 scenes with an average of 1.5 firearms per scene. They obtained shell casings from 217 scenes (6.9 casings per scene), spent projectiles at 105 scenes (2.8 projectiles per scene), and live cartridges at 119 scenes (12.0 cartridges per scene). Bullet fragments were obtained at 67 scenes and GSR test kits were administered (usually to suspects and witnesses) at 39 scenes (1.5 kits per scene). Scene agents found knives at 45 scenes (1.7 knives per scene). Suspected illegal drugs were found at 75 scenes (18.6 percent) and drug paraphernalia at 51 scenes (12.6 percent).

Impressions evidence consisted of shoeprints at 63 scenes (mostly comparison shoeprints from police and fire personnel), tire tracks at seven scenes, EDPL impressions at 21 scenes, and other impressions from three scenes. Trace evidence was primarily cigarettes and cigars (84 scenes) and hair (20 scenes).

Other evidence included clothing (usually the victim's clothes) from 261 scenes and documents from 77 scenes.[3] The list of "other items" is extensive, and examples from three cases give an indication of the range of evidence that falls into this miscellaneous category:

- Case 1: Styrofoam cup; paper bag; 10 peanut shells; wrapper; plastic straw; wrapper; band-aid; AA batteries; blanket; beer can.
- Case 2: Small 'C' cell flashlight with blood stains on ground east of victim's apartment; video camera found on sidewalk; white metal hoop; deadbolt lock; bloodstained bed spread; white pillow with blood stains; small scale; door jamb strike plate; small zip lock bag; interior door knob with bloody latent prints.
- Case 3: 25 rocks with reddish colored substance that is believed to be blood; cereal box; plastic dish; pieces of cardboard with reddish substance; napkins; silk roses; detergent box; lamp box; tree branches with reddish substance; blanket; fence post with black tape. Virtually all the items had reddish substance on them indicative of blood.

Crime scene specialists took digital photographs at all scenes. Larger, more complicated scenes required two or more crime scene specialists for complete coverage, and sometimes shift changes would result in a second crime scene specialist completing the photographs. Overall, crime scene specialists took an average of 264 photographs per scene.

As a general comment applicable throughout this chapter, Exhibit 5-1 illustrates the fact that not every type of evidence is found at every scene. Casings, clothing, and other items were obtained as evidence at the majority of scenes. The predominance of casings is a reflection of the high number of homicides in which weapons were fired. Casings are usually analyzed in an attempt to determine the caliber and type of weapon fired. As seen in the next chapter, only a fraction of the clothing and other items become objects of forensic analysis. Most often, clothing obtained at the scene is from the victim and usually does not add any probative value to a case. The other items may have probative value, especially fingerprint, biological, and trace evidence.

An unusual circumstance was that investigators collected no forensic evidence in six cases because a primary scene could not be located. The typical situation for this phenomena was that time had elapsed between the incident and the time that the victim died. For example, in one case, the victim was a transient who walked into the hospital complaining of head pain because of a beating received three days earlier. He had been home since the assault. The victim

[3] The documents included in this category are those with handwriting for which it would be theoretically possible for forensic scientists to compare against a sample provided by someone during the course of an investigation.

told investigators he had been drinking alcohol prior to the assault, did not know the names of his assailants, and could not remember the location of the assault. He underwent surgery four days after admission but never recovered from his injuries and died in the hospital. It was only after surgery that the hospital contacted the police department. Police investigators were unable to determine the location of the assault and the case was never closed.

In other cases with no evidence, unknown persons transported the victim to a hospital and left without talking to any hospital personnel. A variety of reasons could be hypothesized on why they did not remain at the hospital—reluctance to talk to the police, fear of retaliation by the offenders, or their own involvement in the incident.

Vehicle Scenes

Scene agents collected evidence from 94 vehicles at homicide scenes that were associated with the victim (e.g., victim's vehicle, relative's or friend's vehicle, taxi). In fact, 22 victims (in 20 vehicles, with two double homicides) were killed in vehicles, while the remaining 72 victims were killed in incidents not involving the vehicle. All vehicles were towed to the police department's lot for storage. Scene agents collected evidence from the vehicles while at the homicide scene, and in many instances performed follow-up processing at the impound lot later in the investigation.

Scene agents obtained latents from 61 vehicles (12.4 cards per vehicle) and swabs from 21 vehicles (6.5 swabs per vehicle). Firearms were found in three vehicles (two handguns and an assault weapon), and knives were found in five vehicles. Nine vehicles had casings or shells (four per vehicle) in them and 21 had spent projectiles (2.3 per vehicle). Scene agents located fragments in 14 vehicles and live cartridges in seven vehicles. GSR tests were taken on three vehicles to determine whether a firearm may have been fired near the vehicle. Suspected illegal drugs were found in six vehicles and drug paraphernalia in five vehicles. Trace evidence included cigarettes (four vehicles), hair (four vehicles), and fibers (one vehicle). Other evidence included documents (14 vehicles) and clothing (26 vehicles). Finally, crime scene specialists took an average of 98 photographs of each vehicle.

Photographs, car titles, magazines, and other documents without handwriting were not counted in this category.

In addition to evidence obtained from vehicles associated with victims, scene agents collected evidence from 20 vehicles associated with suspects. They obtained latent prints from 12 vehicles (average of 7.3 lift cards per vehicle) and swabs from five vehicles. Scene agents found six handguns in four vehicles, casings in three vehicles, and live ammunition in seven vehicles. Crime scene specialists took an average of 122 photographs of vehicles associated with suspects.

Typology of Evidence from Primary Scenes

Exhibit 5-2 summarizes forensic evidence by major categories (excluding the "Other" category). It shows that weapons evidence is the most frequent type of evidence found at primary scenes (74.3 percent), followed by biological evidence (51.2 percent), fingerprint evidence (34.2 percent), trace evidence (29.7 percent), drug evidence (24.8 percent), and impressions evidence (18.8 percent). Of course, more than one type of evidence might be obtained, and in fact, scene agents collected two or more types of evidence at 67 percent of the scenes.

Exhibit 5- 2: Types of Evidence at Primary Scenes

Type of Evidence	Number of Cases (n=404)	Percent of Cases
Weapons evidence	300	74.3
Biological evidence	207	51.2
Fingerprint evidence	138	34.2
Trace evidence	120	29.7
Drug evidence	100	24.8
Impressions evidence	76	18.8

Selected Examples

Two examples from cases handled by experimental squads during the test period illustrate the variety of evidence found at homicide scenes by crime scene specialists. In the first example, the victim was found in his home by a friend. Burglary appeared to be the motive as several items—including cash, laptops, and cell phone—were missing from the house. The

crime scene specialist assigned to process the scene found two bullet casings, one live round, and recovered a bullet from the wall. She located several ziplock baggies containing substances that appeared to be illegal drugs, along with glass pipes for inhaling illegal drugs. Six latent lift cards were taken from several places in the residence, and the crime scene specialist took a total of 273 photographs. Arrests were made several weeks later after the investigator determined that calls were still being made from the stolen cell phone. Investigators were able to trace the general location of the cell phone and arrested three suspects. As of the cutoff date of this report, they were awaiting trial and efforts were ongoing by the crime laboratory to link evidence from the suspects to the scene.

In the second example, the victim was shot while sitting in his car with a friend at a parking lot. The shooting was precipitated by an earlier argument between the victim and another individual. The victim's friend stated that the individual walked toward the vehicle and started firing his handgun. A few hours after the shooting, officers and investigators arrested this individual in an apartment complex. The victim's friend identified the person as having fired the shots. The crime scene specialist assigned to the scene collected five spent cartridges from the parking lot and obtained swabs of possible saliva from the hood of the vehicle. Two days later, the crime scene specialist did additional processing of the victim's vehicle at the impound lot and found a copper jacketed bullet inside the back seat. He obtained GSR samples from the exterior and interior of the vehicle and took 82 photographs.

Evidence from Secondary Scenes

In addition to collecting forensic evidence at primary scenes, case agents and scene agents obtain forensic evidence at other scenes during the course of an investigation. These secondary scenes include hospitals, residences, suspects' vehicles, businesses, headquarters (fingerprints and buccal swabs from suspects), and others. The following sections summarize forensic evidence collected at these secondary scenes for the cases in our database.

Forensic Science Center

The Medical Examiner's Office in Maricopa County is responsible for conducting autopsies for all suspicious deaths occurring within the boundaries of the county. In October 2002, the office moved into a new, state-of-the-art facility known as the Forensic Science Center,

located just blocks from the police department. The Medical Examiner's Office conducts autopsies of homicide victims in a timely manner, usually within two or three days after the discovery of the victim. In most instances, the case agent attends the autopsy; however, during the test period of the experiment, crime scene specialists assigned to the experimental squad attended 22 autopsies. Medical examiners provide the attending case agent or crime scene specialist with any forensic evidence found during the course of an autopsy.

The case agent or crime scene specialist documents the evidence from an autopsy in a supplemental report for PACE and submits the evidence to the property room for storage. The medical examiner performing the autopsy prepares a report and provides a copy to the case agent along with photographs taken during the autopsy. The medical examiner will be called to testify at trials on the cause of death. The PACE supplemental reports are the source for the summary in this section on the forensic evidence obtained during the autopsies. ILJ staff did not request copies of the autopsy reports because our focus was on evidence collected rather than details on the cause of death.

Medical examiners performed autopsies on all 435 victims of homicide over the two-year period. Standard procedure calls for the medical examiner to obtain a vial of blood, and in most cases, to cut the tips of fingernails. The police department's crime lab may analyze the fingernails if case agents believe the victim was in an altercation prior to the incident. In addition, a sample of hair was obtained from 37 victims and swabs from different parts of the body were obtained from 10 victims (average of three swabs each). Tests with sexual assault kits were conducted on 11 victims.

Medical examiners recovered spent projectiles from 209 victims with an average of 1.8 projectiles per victim (range from one to nine projectiles). Gunshot fragments were recovered from 79 victims and GSR kits were administered to 140 victims (for indications that the victim was near a firearm when it was discharged). Clothing from 172 victims was obtained after the medical examiner had completed autopsies. Suspected illegal drugs were taken from the clothing of 14 victims and drug paraphernalia (usually glass pipes) were obtained from the clothing of 13 victims. Duct tape for binding was removed from five victims and trace evidence from 17 victims.

In addition to the autopsy, the Phoenix Police Department has a standing policy to obtain fingerprints from homicide victims. Crime scene specialists go to the Forensic Science Center for this purpose prior to the autopsy. In several cases, the fingerprints aided the police department in identifying victims, usually from matches against the department's AFIS system.

Vehicles

Case and scene agents obtained evidence from 67 vehicles associated with suspects in 59 cases. Exhibit 5-3 provides statistics on the types of evidence obtained from these vehicles. The most frequent evidence was latent prints, obtained in 31 cases (average of 16.5 lift cards). Swabs of possible bloodstains were obtained in 20 cases (average of 5.1 swabs each). Ballistics evidence included handguns in 10 cases, other firearms in four cases, knives in three cases, casings in four cases, spent projectiles in two cases, live cartridges in 14 cases (average of 30.0 cartridges), and bullet fragments from vehicles in two cases. GSR kits were administered in three cases to determine if a firearm was fired in the vicinity of a vehicle. Suspected illegal drugs were obtained in five cases and drug paraphernalia in three cases.

A variety of trace evidence was obtained from suspects' vehicles, including cigarettes or cigars in six cases, fibers in four cases, tape in two cases, hair in one case, and paint in one case. Clothing was obtained from vehicles in 22 cases and documents in 17 cases. Finally, crime scene specialists took an average of 72 photographs of each vehicle.

Other objects were obtained as evidence in 33 cases, of which the following are two typical examples:

- Case 1: CDs, beer cans, bottle caps, sunflower seed wrappers, candy wrappers, sections of fabric and foam from seats
- Case 2: Cigarette lighter; water bottle; CDs; CD cases; hair brush; beer bottle caps; beer can; toothbrush

Exhibit 5- 3: Evidence from Suspects' Vehicles

Evidence from Suspects' Vehicles (n=59 cases)

Type of Evidence	Number of Cases	Average Per Case	Type of Evidence	Number of Vehicles	Percent Of Vehicles
Fingerprint Evidence			**Drugs**		
Latent lifts	31	16.5	Suspected drugs	5	8.5
			Drug paraphernalia	3	5.1
Biological Evidence					
DNA Evidence Swabs	20	5.1	**Trace Evidence**		
			Cigarettes/cigars	6	10.2
Weapons Evidence			Tape	2	3.4
Handguns	10	1.0	Fibers	4	6.8
Other firearms	4	1.0	Hair	1	1.7
Knives	3	1.0	Paint	1	1.7
Bullet fragments	2	3.8			
Casings/shells	4	2.5	**Other Evidence**		
Spent projectiles	2	2.5	Clothing	22	37.3
Live cartridges	14	30.0	Documents	17	28.8
GSR	3	5.0			

Case agents and crime scene specialists obtained evidence from 27 other vehicles (19 cases) that were involved in the incident or near it. These vehicles were not associated with the victim or suspect. Latent prints were obtained from 10 vehicles (10.8 lift cards on average) and swabs of possible bloodstains in three cases. Handguns were found in four vehicles along with casings in two vehicles and spent projectiles in four vehicles. Bullet fragments were retrieved from one vehicle; suspected illegal drugs were found in three vehicles. Clothing was obtained from two vehicles, documents from one vehicle, and cigarettes from one vehicle.

Victims at Hospitals

EMS personnel from the Phoenix Fire Department transported 161 victims (139 males and 22 females) from homicide scenes to local hospitals. A total of 123 victims had received injuries from firearms, 12 from stabbings, and 22 from blunt force trauma. Attending medical personnel at the hospitals collected evidence from these victims and turned the evidence over to police for storage and analysis. Weapons evidence included one handgun, four knives, bullet fragments from five victims, shell casings on three victims, and spent projectiles from 16 victims. Buccal swabs were obtained from seven victims and GSR kits were administered to five

victims. Suspected illegal drugs were found on nine victims and drug paraphernalia on three victims. Hospital personnel turned over clothing from 111 victims to police personnel. Crime scene specialists went to hospitals to photograph the injuries of 43 victims (average of 35 photos per victim) and 20 victims were fingerprinted while in the hospital (usually for identification purposes).

Residences and Businesses

Scene agents collected evidence from 135 residences (106 cases) during the course of investigations. Standard investigative procedure is that a judge approves a search warrant in order for investigators to enter the residence. While most searches occurred with 24 hours of the incident, some took place days or weeks after the incident, depending on the course of the investigation. The majority of searches were at the residences of victims and suspects. As an example, the victim may have been found in the front yard of his or her residence, and investigators needed to search the residence for evidence.

Exhibit 5- 4: Evidence Collected at Residences

Type of Type of Evidence	Number of Cases (n=106)	Average Per Case	Type of Evidence	Number of Cases (n=106)	Percent Of Cases
Fingerprint Evidence			**Drugs**		
Latent lifts	9	6.7	Suspected drugs	23	21.7
			Drug paraphernalia	18	17.0
Biological Evidence					
DNA evidence swabs	7	4.7	**Trace Evidence**		
Buccal swabs of persons	8	1.3	Cigarettes/cigars	4	3.8
			Tape	2	1.9
Weapons Evidence			Hair	5	4.7
Handguns	19	1.3	Paint	1	0.9
Other firearms	12	1.3			
Knives	5	2.2	**Other Evidence**		
Casings/shells	9	2.7	Tools	1	0.9
Live cartridges	36	15.0	Clothing	36	34.0
GSR	2	1.0	Documents	35	33.0

As seen in Exhibit 5-4, scene agents obtained a variety of different types of evidence from residences. Latent lifts were obtained from nine residences, with an average of 6.7 lift cards per residence. Biological evidence included swabs from seven residences and buccal swabs from occupants at eight residences. Handguns were found in 19 residences and other

firearms in 12 residences, knives (from give residences), and casings from nine residences. Live cartridges were taken as evidence from 36 residences, with an average of 15.0 cartridges per residence. Suspected drugs were found in 23 residences and drug paraphernalia in 18 residences. Trace evidence consisted of clothing (usually the clothing of a suspect or victim with apparent bloodstains) from 36 residences and documents from 35 residences (handwritten notes, signatures, etc.). Crime scene specialists took an average of 125 photographs at these residences during the course of the evidence collection.

Scene agents collected evidence from 18 businesses. In one case, the scene agent obtained evidence from four business locations during a long investigation: trash dumpster, pawn shop, large retail store, and rented storage unit. In general, evidence from businesses were swabs of possible biological evidence (in some cases, the business was the location of the incident even though the victim was discovered elsewhere). Crime scene specialists took photographs at five locations (average of 37 photos each).

Police Headquarters

Evidence was obtained at police headquarters from 342 individuals (suspects, victim's relatives, witnesses, etc.) in 193 cases. The most frequent type of evidence were buccal swabs (from 238 individuals). Swabs of possible bloodstains (e.g., on a suspect's clothing or body) were obtained from 10 individuals. Firearms were taken from six individuals and knives from three others. Suspected drugs were found on six persons and drug paraphernalia on eight others. Clothing (usually from suspects upon arrest after interviews) was obtained from 73 individuals, and handwritten documents from 16 persons. Crime scene specialists took photographs of 124 individuals with an average of 43 photos per case.

Jails and Prisons

Evidence was obtained from 42 suspects who were in jail or prison at the time of the evidence collection. All evidence collected in this manner resulted from court orders at the request of the case agent. Buccal swabs were obtained from 35 suspects and vials of blood were drawn from two suspects (in these cases, the buccal swabs and blood sample were not taken at the time of arrest and a court order was required to obtain the evidence). In three cases, handwriting samples were obtained for comparison.

Other Scenes

During the course of investigation in 43 cases, evidence was collected from sources not previously mentioned: other police departments (in conjunction with arrests of suspects turned over to the Phoenix Police Department), canals, street scenes, pawn shops, casinos, telephone booth, and several others). The evidence included swabs of possible bloodstains at four scenes, buccal swabs at six scenes, handguns from ten locations, other firearms from three locations, latent lifts (3 scenes with 9.7 lift cards per case), cigarettes at one scene, tools at one scene, clothing from five scenes, handwritten documents from seven scenes, suspected drugs at three scenes, and drug paraphernalia at one scene.

Conclusions

A major conclusion from this analysis is that a considerable amount of forensic evidence can accumulate during the court of a homicide investigation, starting with the primary scene and continuing to a variety of secondary scenes. We found it beneficial to separate forensic evidence obtained at primary scenes from evidence collected at subsequent scenes. The evidence from primary scenes sets the stage for crime lab analysis that will be performed and can frame how a homicide investigation is conducted.

As presented in this chapter, ballistics evidence is the most frequent type of evidence found at primary scenes. Scene agents obtain ballistics evidence in almost three-quarters of primary scenes, followed by biological evidence at 53 percent of primary scenes. Fingerprint evidence is obtained at 38 percent of primary scenes.

The amount of evidence obtained at secondary scenes is substantial. Secondary scenes include autopsies, hospitals, residences, businesses, and many others. As discussed in subsequent chapters, evidence from second scenes is important in identifying suspects (and sometimes victims), linking suspects to the primary scenes, and preparing cases against suspects for trials.

Chapter 6

Analysis of Forensic Evidence

Introduction

This chapter extends the discussion from collection of evidence to analysis of evidence. The Phoenix Police Department provided ILJ with copies of the lab analysis on all evidence analyzed on the cases during the two-year period. The lab reports provided considerable information on what types of tests were performed and the analytical results. As seen in this chapter, the three most frequent types of analyses are latent print examinations, DNA analysis, and ballistics tests. Drug analysis and trace analysis may also be performed but occurs much less frequently.

Statistics on lab processing time are included in this chapter. The amount of time from request to completion of lab report can be weeks or months depending on the type of request and the backlog in the crime lab. Moreover, many requests for lab tests are made after arrest of a suspect, sometimes by the case agent and sometimes by a prosecutor.

Latent Prints

Latent prints can be obtained in two ways. Crime scene specialists can "lift" latent prints from surfaces at crime scenes (such as lifting prints from an automobile) or latent print examiners can locate latent prints on evidence (such as beer cans) from scenes. In the latter case, the case agent or scene agent will ask the crime lab to analyze specific items of evidence to determine whether latent prints exist. These requests are necessary because the volume of evidence precludes latent print examiners from examining every item. The agent may also ask the lab to determine whether the items contain any biological material for DNA analysis.

Latent prints can be used in two ways during an investigation. First, latent print examiners can submit a latent print to the Arizona Automated Fingerprint Identification System (AZAFIS) to see if it matches someone in the system. Latent print examiners are responsible for deciding whether a latent print is "AZAFIS quality" for submission and whether a match exists.

Second, latent print examiners may compare a latent print against the fingerprints of a known person, such as a suspect who has been arrested.

The following section provides more information on the efforts by latent print examiners to obtain latent prints from items of evidence. Results from submissions of latent prints to AZAFIS and comparative analyses are then presented.

Evidence Processing

The Evidence Processing section of the crime lab is responsible for obtaining latent prints from items of evidence, employing a variety of techniques. The task of finding and photographing latents from evidence is time consuming and requires considerable experience.

Case and scene investigators make requests to the Evidence Processing section for checking specific items of evidence from scenes for latent prints, and they generally take care in selecting items that are most likely to have beneficial latent prints. In total, case and scene agents made 237 requests in 135 cases and the lab analyzed 1,001 items of evidence for latent prints. Of the total items, 96 items were found not suitable for analysis (the majority of these were shell casings). Of the remaining 905 items, 375 (37.5 percent) were determined to have useable latent prints. The lab has a broad definition of "useable" latent prints; it does not mean, for example, that the print has enough detail for submission to AZAFIS or enough detail for comparative analysis. What it means is that the latent prints may possibly have benefit in subsequent analysis.

The top portion of Exhibit 6-1 gives the types of evidence processed for latent prints. Beer and soda cans/bottles top the list with 280 requests for analysis (30.9 percent). Firearms, firearm magazines, and shell casings/bullets collectively accounted for 149 items analyzed (16.5 percent). These were followed by glass/plastic items (10.3 percent), paper items (7.3 percent), plastic bags (6.4 percent), and knives (1.0 percent). The miscellaneous items (19.6 percent) included cell phones, hair brushes, flashlights, cigarette lighters, furniture, cameras, and other items.

Exhibit 6- 1: Evidence Processing for Determination of Latent Prints

Type of Evidence	Number	Percent	Type of Evidence	Number	Percent
Beer/soda cans/bottles	280	30.9	Tape	44	4.9
Glass or plastic items	93	10.3	Cigarettes/cig. containers	29	3.2
Paper items	66	7.3	Magazines for firearms	20	2.2
Firearms	66	7.3	Knives	9	1.0
Shell casings/ bullets	63	7.0	Other misc. items	177	19.6
Plastic bags	58	6.4			

Type of Evidence	Number	Useable Latents	Percent
Beer/soda cans/bottles	280	156	55.7 %
Glass or plastic items	93	42	45.2 %
Paper items	66	28	42.4 %
Firearms	66	25	37.9 %
Shell casings/ bullets	63	6	9.5 %
Plastic bags	58	25	43.1 %
Tape	44	8	18.2 %
Cigarettes/cig. containers	29	7	24.1 %
Magazines from firearms	20	12	60.0 %
Knives	9	3	33.3 %
Other misc. items	177	63	35.6 %
Total	905	375	41.4 %

The bottom portion of Exhibit 6-1 gives information on the success of finding latent prints on the various types of evidence. Magazines from firearms had the highest percentage for types of evidence from which useable latents were obtained (60.0 percent). Next were beer and soda cans/bottles (55.7 percent), glass or plastic items (45.2 percent), paper items (42.4 percent), and firearms (37.9 percent). Shell casings and bullets were the least productive in locating useable latents (9.5 percent).

In summary, the experience in Phoenix is that about 41 percent of the items requested for analysis resulted in useable latent prints. The most likely sources for useable latents were magazines from firearms, cans/bottles, glass/plastic items, and paper items.

Arizona Automated Fingerprint Identification System

The Arizona Department of Public Safety has responsibility for the Arizona Automated Fingerprint Identification System (AZAFIS). Authorized users throughout the state can access AZAFIS to remotely initiate fingerprint searches against the centralized database. After AZAFIS has been searched, the prints are forwarded to the Federal Bureau of Investigation's Integrated Automated Fingerprint Identification System (IAFIS) for searching against the national fingerprint database. AZAFIS currently has approximately three million fingerprint cards in the database.

In making requests for AZAFIS checks, case agents are attempting to identify an unknown person through latent prints collected at the scene or obtained by latent print examiners through evidence processing. For the cases in the project period, case agents made 318 requests for AZAFIS checks from 157 cases. Seventy-three of the 318 requests resulted in an AZAFIS match for a rate of 23.0 percent. The 73 matches identified 61 different individuals due to multiple matches. A further breakdown of the 61 individuals showed that 11 were victims in the cases, five were suspects, and the remaining 45 may have been witnesses or had other involvement with the precipitating incident. More discussion on the AZAFIS matches is provided later in this chapter through case summaries.

Comparative Analysis

Forensic scientists in the crime lab will do comparative analysis to determine whether a group of latents match the fingerprints of a known person. A case agent may request, for example, that a latent print collected at a scene be checked against a suspect who has just been arrested. The comparison may determine that the suspect was at the scene where the latent was collected and that information may be beneficial to the case agent's theory of the case. In one case, the case agent requested that comparisons be made between six suspects against two sets of latents obtained at the primary scene. In total, case agents made requests for comparative analysis from 70 cases during the project period, which resulted in 469 comparisons by forensic scientists.

Unlike AZAFIS submissions, comparative analyses can result in four different results, summarized as follows:

- Successful comparison: A latent matches a fingerprint from a known individual.
- Latent has no comparative value: A latent is not clear enough to make comparisons against a set of fingerprints.
- Better fingerprint impressions needed: The set of fingerprints from the known individual are deficient because, for example, palm prints are needed or some prints are not clear enough for comparison.
- No identifications were effected: A latent (or set of latents) do not match any of the fingerprints from the known individual.

When several latents are checked, combinations of the above results can occur within the same comparison. For example, in one case, 51 digital photographs of latents were compared against a suspect. The results were that four latents were found to be of no comparative value, better impressions were needed from the suspects to compare against 13 latents, no identifications were effected on 28 latents, and six latents matched the suspect.

Exhibit 6-2 provides information on the number of matches obtained from the 469 comparison tests. In this exhibit, the No Match column means that no identifications were effected, and the results were a combination of the other three possible outcomes. The exhibit shows that 53 matches were made for a comparison match rate of 11.3 percent. An interesting feature of the exhibit is that lab evidence processing and latent lifts from scenes produced similar results.

Exhibit 6- 2: Source of Latent Prints and Comparison Matches

	Comparison—Matches		Comparison—No Matches	
Source	Number	Percent	Number	Percent
Lab evidence processing	27	11.6	205	88.4
Latent lifts from scenes	26	11.0	211	89.0
Total	53	11.3	416	88.7

The 53 matches were from 42 different individuals, with multiple matches made in some comparisons. Of the 42 individuals, 11 individuals were the victims, 15 were suspects who had been arrested, and 16 individuals were others who might have been involved in the incident.

DNA Analysis

DNA analysis of biological material has received considerable attention in the last few years. The distinct advantage of DNA analysis is that it has a scientific foundation for interpretation of results. The science of DNA has been developed to the extent that the probability associated with a DNA match can be expressed as "1 in 100 quadrillion Southwestern Hispanics," or "1 in 85 quadrillion African Americans."[4] Reporting these kinds of statistics make the match virtually unique and can be powerful evidence in an investigation and at trial. On the other hand, DNA analysis may conclude that there is no match between a piece of biological evidence found at a scene and a suspect. These results are simply reported as saying that someone has been "excluded" as a possible source of the DNA from the item of evidence.

Screening for Biological Material

There are several sources of material for DNA analysis. For example, a vial of blood is always obtained as part of the autopsy of a victim. The vial will be preserved by crime lab personnel for comparison with other DNA evidence accumulated during the course of an investigation. Buccal swabs of suspects are another primary source of DNA evidence for comparisons.

[4] 1 quadrillion = 1,000,000,000,000,000.

Crime laboratory analysis of evidence obtained at a scene can also yield biological material for DNA analysis. The Forensic Biological Screening unit within the department's crime lab determines whether biological material is present on a piece of evidence and that it is in sufficient quantity for development of a DNA profile. The procedure in the Phoenix Police Department is that a homicide investigator submits a request through the PACE system for the crime lab to check one or more items of evidence for DNA material. Typical requests may read follows:

- "Swab sunglasses for DNA."
- "Examine clothing for blood. If located, preserve for future comparison."
- "Examine listed evidence (11 items) for DNA."

Forensic scientists from the screening unit will conduct the analysis as requested and report the results back to the investigator though the PACE system (the results will also be entered into the lab's information system). If biological material has been located, the investigator may request that a DNA profile be developed and compared with profiles from other evidence.

For the 404 cases in this project, one or more requests for locating biological evidence were made in 133 (32.9 percent) cases. A total of 282 requests were made because of multiple requests on some cases at different stages of an investigation. Within a request, an investigator may ask for several items to be examined. For the 133 cases, the average number of items examined by forensic scientists in the screening unit was about 6.5 items, and on average, 3.7 items were found to have biological material for DNA analysis.

DNA Comparative Analysis

Requests for DNA comparative analysis are sometimes made early in the investigation based on evidence known to produce a DNA profile (e.g., vial of blood, buccal swab, etc.). A request could be made based on earlier lab reports that an item of evidence did, in fact, have biological material that could produce a DNA profile. Investigators would then ask for comparisons between DNA profiles from one or more items of evidence against the DNA profile of a person who may have been involved in the homicide. As described later in this section, comparisons against the DNA profiles of victims and suspects are the main analyses conducted

by the lab. Results from the comparisons may assist an investigator in advancing an investigation.

In total, investigators asked for 575 comparisons in 105 cases during the two-year period. With 50 of these requests, the lab reported that the DNA profile from an item of evidence was from an "unidentified source," which meant that it did not match any of the victims or suspects. These DNA profiles are entered into the CODIS system for possible matches.

Exhibit 6-3 shows the results of the remaining 525 comparisons. It shows a total of 307 matches: 190 matches to a victim, 111 matches to a suspect, and six matches to other individuals (witnesses, investigative leads, etc.). Ninety-four comparisons resulted in exclusions, with 41 comparisons showing that the evidence did not match the DNA profile of a victim, 37 did not match a suspect, and 16 did not match some other individual. The next two columns are results from mixed profiles, meaning that the DNA analysis shows that the biological sample was from two or more sources. With a mixed profile, it may still be possible to determine whether the major component of the profile can be applied to match or exclude a source. As seen in the exhibit, 98 mixed profiles resulted in the major component matching victims (42 profiles), suspects (53 profiles), or other individuals (three profiles). Exclusions were made with 17 mixed profiles, with 13 excluding victims, two excluding suspects, and two excluding other individuals. The column for other results in the exhibit is most comparisons in which no conclusions could be made.

Exhibit 6- 3: DNA Comparison Results

	Comparison Matches		Comparison Excludes		Mixed Profile/ Major Component Matches		Mixed Profile/ Major Component Excludes		Other Results	
Source for Comparison	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**
Victim	190	61.9	41	43.6	42	42.9	13	76.5	2	22.2
Suspect	111	36.2	37	39.4	53	54.1	2	11.8	5	55.6
Other	6	2.0	16	17.0	3	3.1	2	11.8	2	22.2
Total	307	100.0	94	100.0	98	100.0	17	100.0	9	100.0

Ballistics

The Firearms Section within the Laboratory Services Bureau is responsible for examining firearms, ammunition, and related ballistics evidence. Analyses might include identification of the types of weapons from which bullets or jackets were recovered, determination of whether bullets and spent jackets from a scene were fired from a recovered weapon, tests for gunshot residue to determine whether an individual was close to a weapon when it was fired, determination of whether a firearm is operational, and estimates of muzzle-to-target distance. Because of the predominance of firearms in homicides, investigators frequently make requests for analysis by the Firearms Section. These different tests are discussed in the following sections.

Gunshot Residue Tests

Gunshot residue (GSR) from a fired weapon can contaminate a shooter or someone nearby because the excessive back pressure of gases and associated debris escapes through openings other than the muzzle. The amount of GSR contamination depends on the design and condition of the weapon, type of ammunition, and length of the barrel (for more information, see (Ragle)). Investigators and crime scene specialists frequently administer GSR collection kits to an individual's hands to collect any residue that may have accumulated. Forensic scientists then conduct tests to determine whether the collected samples contain any gunshot particles.

For the cases in this project, a total of 163 GSR tests were conducted from 99 cases. Final results were that GSR particles were found in 123 tests (75.5 percent) and no particles in 40 tests (24.5 percent). The findings are recorded in the lab's information system and a PACE report. For positive results, forensic scientists are careful not to say that the person from whom the sample was collected actually fired a weapon. The positive result may be due to a person's close proximity to the shooter. A typical report reads as follows:

> "Several particles highly specific to Gunshot Residue (GSR) and numerous particles containing one or more components known to be indicative of GSR were detected on the GSR collection kit sample from the right hand. The samples are consistent with the individual having either discharged a firearm, having been in the vicinity of a firearm when it was discharged, or having contacted an item with GSR on it."

Most homicide investigators in the Phoenix Police Department find GSR results to be of limited value. As implied by the above summary, the test merely indicates that an individual may have been close to a firearm when it was discharged. However, the results may be able to confirm or refute the testimony of a witness or suspect.

Firearms Identifications and Matching

One of the most frequent requests to the Firearms Section is to analyze bullets and spent projectiles to determine the types of weapons from which they could have been fired. For the project cases, 212 requests from 90 cases were made and forensic scientists were able to make identifications in 170 requests (80.2 percent). They are usually able to determine the type of firearm from which the ammunition may have come and specific manufacturers that produce the firearm. As many as a dozen types of firearms may be listed to include all the possibilities.

The Firearms Section also analyzes firearms that have been obtained from crime scenes. A total of 123 weapons were analyzed from the project cases: all except three were found to be operational. The majority of firearms are fired for test purposes and the results entered into the National Integrated Ballistic Information Network (NIBIN) operated by the Bureau of Alcohol, Tobacco, Firearms, and Explosives.[5]

One of the most important responsibilities of the Firearms Section is to compare bullets and spent projectiles against specific firearms to determine whether they may have been fired from the weapon. The comparison is a manual effort by a forensic scientist and results are not definitive. For the cases in this project, 257 comparative tests were made of which 79 tests (30.7 percent) resulted in a "match" between the firearm and projectiles and 37 (14.4 percent) resulted in an "exclusion," which meant that the projectile was not fired from the firearm. The forensic scientist determined that the projectile was "comparable" to projectiles usually fired from the firearm in 52 tests (20.2 percent) and that the projectile could not be "identified or excluded" as having been fired from the firearm in 89 tests (34.6 percent). Results from these examinations

[5] ATF provides Integrated Ballistic Identification System (IBIS) equipment to Federal, state, and local law enforcement agencies for their use in imaging and comparing gun crime evidence. The equipment allows firearms technicians to acquire digital images of the markings made by a firearm on bullets and cartridge casings. The images are then entered into NIBIN for matching purposes. A total of 182 agencies participate in the program (see www.nibin.gov for more information).

may confirm or exclude an investigator's theory about what occurred at a scene and who was responsible.

Other Analysis

Evidence subject to drug analysis includes rolled cigarettes with possible marijuana, plastic bags with suspected drugs, glass pipes, and drug paraphernalia. Data collected on the project cases indicate that drug analysis is not performed as frequently as other types of analyses. Within the project cases, a total of 114 drug tests were conducted from 48 cases. The results were that marijuana (or residue) was found in 48 tests (42.1 percent), methamphetamine in 34 tests (29.8 percent), cocaine in 19 tests (16.7 percent), other drugs in five tests (4.4 percent), and no drugs found in eight tests (7.0 percent).

Finally, other types of analyses were performed in some of the cases. These included handwriting comparisons (10 cases), detection of gasoline in arson-related homicides (3 cases), detection of alcohol in blood/urine sample (25 cases), and other types of trace analyses (26 cases).

Lab Processing Time

Exhibit 6-4 shows time required for crime lab processing and the breakdown of requests for lab processing by open and closed cases. The exhibit makes several important points about the role of forensic evidence analysis in the investigation of cases and prosecution of arrested suspects.

As described in previous sections, investigators and crime scene specialists request forensic analysis to be done by crime lab personnel. These requests may be done at the start of an investigation and may continue through the entire duration of a case. Two time durations are shown in Exhibit 6-4. The first time duration is between the start of an investigation and a request for some type of lab analysis, and the second is the duration from the request to the completion of a lab report in PACE.

As an example, the exhibit shows that the median time for an AFIS request is 11 days from the start of the investigation. Other requests, such as GSR tests and firearms identifications from bullets and spent projectiles, have shorter average time periods. The reason for the shorter

durations is that the evidence is readily available at the start of the investigation and the requests can be easily made with specific instructions. The largest duration is 103.5 days for comparative analysis of latent prints. While this result appears to be an anomaly, it is easily explained by the fact that 61.7 percent of these requests are after arrest. That is, an investigation has proceeded to the point that a physical arrest has been made, and on the basis of having a suspect in custody, a request is made to check the suspect's fingerprints against latent prints from a scene.

Exhibit 6- 4: Crime Lab Processing Time

Lab Test	Start of Investigation To Request (median days)	Crime Lab Processing Time (median days)	Requests Open Cases	Closed Cases: Requests Before Arrest	Closed Cases: Requests After Arrest
Latent Prints					
AFIS	11.0	13.0	46.3 %	26.4 %	27.2 %
Comparative Analysis	103.5	32.5	24.3 %	14.0 %	61.7 %
DNA					
Biological Screening	6.0	57.0	27.1 %	19.0 %	53.9 %
Comparative Analysis	8.0	164.0	27.3 %	15.9 %	56.8 %
Ballistics					
Gunshot Residue Tests	4.0	34.0	45.6 %	13.6 %	40.8 %
Firearm Identifications	4.0	54.0	56.5 %	19.4 %	24.2 %
Comparative Analysis	17.0	42.0	35.7 %	16.7 %	47.6 %
Drugs					
Drug Identification	5.0	28.0	27.7 %	23.1 %	49.2 %

Crime lab processing times in the exhibit are calculated from the date of the request to the date of the LIMS report providing the results. These average (median) times vary considerably from 13 days for AFIS checks to 164 days for DNA comparative analysis. The larger average time for DNA comparative analysis is due to two factors. First, the Forensic Biology Section within the crime lab handles a large workload for the number of forensic scientists in the unit. The workload includes analysis of evidence from all types of violent crimes and some property crimes, and a backlog exists. Second, the process of developing DNA profiles, making comparisons, and reviewing lab reports is lengthy. Reports on DNA comparative analysis require both a technical and administrative review. The reviews require time on the part of other forensic scientists and supervisory personnel.

Exhibit 6-4 shows fairly long periods of time in the crime lab for other types of analyses. Comparative analysis for latent prints takes an average of 32.5 days: ballistics comparisons (usually between spent projectiles and specific weapons) require 42 days; and drug identifications take 28 days. With open cases, the investigator may be waiting for the results before proceeding with an investigation or before making a physical arrest.

The information in the right portion of Exhibit 6-4 gives a breakdown of requests by open or closed cases. With the exception of firearm identifications, the majority of supplemental requests are for closed cases. For example, 46.3 percent of the AFIS requests were from open cases with the remaining 54.5 percent from closed cases. Moreover, the last column in the exhibit shows that with many tests, the requests were made after arrest. These included latent print comparative analysis (61.7 percent after arrest), DNA biological screening (53.9 percent), DNA comparative analysis (56.8 percent), and ballistics comparative analysis (47.6 percent). These requests may be made immediately after arrest. For example, a request may call for DNA comparative analysis between the arrested subject's DNA profile and a DNA profile from evidence collected at a scene. Prosecutors may also request lab analysis for plea negotiations or in preparation for trial.

Case Examples

As with other topics in this report, it is instructive to summarize cases in which evidence played a role. Three examples are provided, emphasizing the evidence analyzed during the course of the investigation.

Immediate Arrest Homicide: This first example illustrates that a considerable amount of forensic evidence analysis can take place even with immediate arrest homicides. The suspect in this case called the police to report that he had just shot and killed the victim in a family dispute. Patrol officers arriving at the scene immediately arrested the suspect. Evidence collected at the scene included a handgun, rifle, sword, several shell casings, bullet fragments, and other miscellaneous items. GSR kits were administered on the hands of both the suspect and the victim. The case agent requested the following laboratory analysis based on the evidence: (1) GSR test on the two kits, (2) processing of the handgun and sword for latent prints and, if found, comparisons against the suspect and victim, (3) processing of the handgun for biological material

and, if found, comparisons against the DNA profiles of the suspect and victim. Key results from the lab's analysis were:

- Particles specific to gunshot residue were found on the collection kit sample from the suspect's hands (analysis requested the day of the arrest with lab report dated 11 days later).
- Particles specific to gunshot residue were found on the collection kit sample from the victim's hands (analysis requested two days after arrest with lab report dated 24 days later).
- Five casings found at the scene were determined to have been fired from the handgun at the scene; two others were "entirely consistent" with having been fired from the handgun; bullet fragments were "consistent" with having been fired from the handgun (analysis requested three days after arrest with lab report dated 34 days later).
- Bullet fragments from the victim were "entirely consistent" with having been fired from the handgun (analysis requested six days after arrest with lab report dated 30 days later).
- A latent print photographed from the handgun could not be compared with the suspect's inked palm impression because the impression was not of sufficient quality (analysis requested one day after photographing the latent print with lab test report 53 days later).
- The DNA profile from a swab of the magazine of the handgun matched the DNA profile of the suspect; other DNA profile comparisons were included in the report. (Analysis requested six days after arrest with lab report dated 130 days later).

As indicated by these results, there was a substantial amount of evidence showing that the suspect did the shooting. Ten months after arrest, he pled guilty to 2nd degree murder and was sentenced to 19 years in prison.

Stranger-to-Stranger Homicide: The victim in this incident had called for a taxi from her residence to another location. As she was entering the taxi, her boyfriend drove his van in front of the taxi, bumping and blocking the taxi from proceeding forward. The suspect then got out of his van and pointed a handgun toward the taxi. The taxi driver exited his taxi and was then shot several times by the suspect. The suspect fled from the scene but was arrested the following day by police. Subsequent investigation revealed that he was upset over arguments during the day with his girlfriend.

The handgun used in the incident was found in the suspect's van and was the main item of evidence against the suspect. Six casings recovered at the scene were identified as having

been fired from the handgun. Two projectiles recovered at autopsy were also identified as having been fired from the handgun. Finally, a latent print from the handgun's magazine was identified as the fingerprint of the suspect's thumb.

The suspect pled guilty to a reduced charge of 2nd degree murder and received a sentence of 16 years in prison.

Double Homicide: In this case, the suspect shot and killed Victim 1 and Victim 2 while the three were driving through a neighborhood around 1 a.m. The shooting was over a dispute about money owed by the suspect to Victim 1. Two weeks earlier, the suspect had purchased a shotgun from Victim 1 for $250. He had paid Victim 1 $200 of the purchase price at that time and stated that he had paid the remaining $50 just before the three had gotten into the car. During the drive, the suspect stated that Victim 1 began to accuse him of cheating by paying only $30, rather than $50. The suspect believed that he was about to be assaulted. He then shot Victim 1 and Victim 2 with a shotgun that he had carried with him into the car. The vehicle eventually crashed into a telephone pole. The suspect jumped from the vehicle just prior to the accident and fled the scene. Due to quick investigative efforts by the case agent and other investigators, the suspect was identified and his shotgun was found at his residence. He was arrested two days later by members of the department's Special Assignment Unit. He was subsequently tried by jury and found guilty on two counts of 1st degree murder.

Evidence included shotgun shells from the vehicle, several latent prints from the vehicle, recovery of the shotgun at the suspect's residence, and swabs of blood from the suspect's shoes. Key results from the analysis of evidence were:

- Shotgun shells recovered from the vehicle were identified as having been fired from the shotgun found at the suspect's residence (analysis requested nine months after the incident with lab test report 33 days later).
- DNA profiles from swabs of blood from the suspect's shoes (at time of arrest), a blood stain on a pillow case from his residence, and swabs of blood from his bathroom sink matched the DNA profile of the suspect (analysis requested seven days after arrest with lab test report four months later.
- The major component of a mixed DNA profile obtained from a swab from the suspect's shoe matched the DNA profile from Victim 1.

It should be noted that other forensic analysis was not beneficial in establishing relationships between the suspect and victims. Several latent prints taken off the vehicle

matched the two victims, but none matched the suspect. Similarly, latent prints taken at the suspect's residence matched the suspect.

Conclusion

One of the conclusions from this chapter is that only a fraction of evidence collected actually gets analyzed by crime lab personnel. Several reasons can be given on why more evidence is not analyzed. While ILJ did not conduct a staffing study of the crime lab, it is clear from our review of project cases that more forensic scientists are needed in the crime lab, especially for DNA analysis. Crime lab personnel have competing demands on their time. They receive requests for analysis from all types of cases, not just homicides, and priorities must be established on which analyses should receive immediate attention. During the course of the Homicide Clearance Project, weekly meetings were held with supervisors from the crime lab and homicide unit to discuss the status of cases and evidence that needed analysis as soon as possible. These meetings have proved beneficial in prioritizing analyses.

In general, case agents were specific in their requests for analysis. They usually stated the specific item of evidence and the type of analysis needed (e.g., "Check the bottle for latent prints and if found, enter into AZAFIS."). In some cases, it is obvious which item needed to be checked but in other cases, the selection of specific items of evidence for analysis was not straightforward. For example, a dozen bottles may be collected from a scene and rather than requesting that all bottles be checked, the case agent may select the most likely candidates for analysis. To an extent, the selection of only a few items is a realization on the part of case agents that the crime lab is understaffed.

One type of request was not being made by case agents during the course of this project. On open cases, case agents were not requesting that a DNA profile be obtained from an item of evidence for the sole purpose of entering the profile into CODIS for a possible match. Instead, requests were only for comparative analysis between a DNA profile from an item of evidence against the DNA profile of a known individual. Since the completion of the project, it is our understanding that DNA profiles of evidence are entered into CODIS and that matches are starting to occur. The CODIS system is a strong tool for a department in solving violent crimes in which material for DNA profiles is available.

Results in this chapter shed light on the role of forensic analysis in homicide cases. The conclusion is that the majority of crime lab analysis is after arrest with the aim of building a case against an arrested suspect. Put another way, forensic analysis in Phoenix rarely identifies a suspect who has not already been identified through efforts by investigators. A partial reason is that many homicides are solved within a few days and most lab analysis requires weeks to complete. Arrest of a suspect provides opportunities for more lab analysis. For example, it was noted in this chapter that the majority of requests for comparative analysis of latent prints, DNA, and ballistics were after arrest of a subject.

It seems obvious from these conclusions that more forensic analysis by crime lab personnel will result in more clearances. Case agents should be making greater utility of the three systems that other departments are finding beneficial in investigations: AFIS, CODIS, and NIBIN. This will only be possible with increases in staffing levels in the department's crime lab.

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